Vrije Universiteit Amsterdam
Faculty of Economics and Business Administration
Department of Spatial Economics, GIS-group
Masters thesis under supervision of
Prof. Dr. Henk J. Scholten and Prof. Dr. Ruud T. Frambach

What About Wireless…?

An Analysis of The Mobile Market and Location-Based Services

July 2001
Machiel Reinders & Jasper Dekkers

vrije Universiteit amsterdam

Executive Summary

The past years, society has experienced an information technology revolution, which meant an enormous change in the way of living. Rapid changes are still taking place. One of these changes is the increasing importance of mobility. The success of the mobile phone has already proven itself. People are now awaiting a complete new breakthrough: the possibility to exchange data with their mobile phone. Stated differently, developments regarding the Mobile Internet are slowly spreading over the world, location-based services (LBS) are expected to become successful within five years from now and enhanced or multimedia messaging is coming.

Generally, two standards are bringing the Internet on mobile devices: WAP and i-Mode. One conclusion that can be drawn with regard to standards is that until now WAP has failed, because it costs too much, user interfaces are too difficult and transmission speed that engines the services is too slow. Beside these reasons, wrong expectations management could be indicated as the major failure. Providers have over-promised WAP, resulting in public mistrust and dissatisfaction. If WAP can be a success in the near future depends on several factors. One of the most important is the arrival of third generation networks, which allow high speed data transmission. Also, a more realistic approach adopted by the suppliers of WAP technology in launching new services can contribute to a higher degree of acceptation among consumers. An advantage of WAP over i-Mode is that WAP is an open standard. However, it remains to be seen if WAP indeed will be a success. The rollout of 3G networks is delayed and i-Mode will probably be introduced in Europe. WAP will definitely not conquer Japan, but will i-Mode conquer Europe?

In this thesis, LBS as an integral part of mobile services are examined in more detail. Therefore, some of the most important positioning technologies are treated and the drivers and characteristics of LBS are described. In conclusion, it is believed that LBS will be among the most used mobile services, and that they will generate a significant part of mobile data revenues within five to ten years. However, there are misplaced and unrealistic expectations about LBS in the short-term. The full potential of LBS will not be disclosed before accurate location determination technology has arrived, network bandwidth will be significant higher and better devices and protocols will be available on the market. Analysts predict this will last between three to five years, so there is still a lot of work to do in this area. Until that time, companies will build location-sensitive services that act independently of location-sensing technology offered by operators.

In analysing the mobile market, the following conclusions can be drawn. Firstly, there are many players involved in the mobile market: network operators, suppliers of mobile devices, service providers, providers of browsers, software and gateways, content providers, etc. Competition is heavy in this dynamic market. It is predicted that this competition will only increase within the next few years. To survive in such a highly competitive and dynamic market, companies are more and more joining forces by signing alliances or other forms of co-operation. Eventually the most powerful player in the mobile market is the customer. He defines if an offered service adds value to his or her way of living. This should be the main focus of the players in this market. Secondly, the last months the number of applications has grown. The kinds of services offered on a mobile device are extended. There are already killer applications in the field of messaging. Future killer applications are expected in the field of LBS, comparison-shopping, streaming media, banking and (personal) information services. Obviously, wireless technology is far from being mature. In conclusion, it can be stated that the developments are going very fast and both suppliers and consumers are learning more about the pro's and cons of mobility and how to benefit from or deal with them.

In this thesis, diffusion theory is examined. It can be concluded that a few factors block consumer acceptation of the Mobile Internet and mobile services. Firstly, mobile services are too much technology-driven instead of customer-oriented. To deliver customer value, the services must fulfil customer needs. Furthermore, a dominant design for wireless devices is not yet identified. It is clear today there is a lack of identifying a design, which best addresses the specific value of wireless services. The amount of applications and services available is the third factor that influences the rate of diffusion. The more different applications and services there are, the more likely customers will step into the wireless world. Network effects play a role in the adoption of mobile services. The adoption of wireless innovations by a small group of innovators and early adopters is very important for the spread of this innovation towards the other part of the social system. Also the degree in which mobile devices are compatible is important. Consumers will accept a new technology faster when it is compatible with other items or with older technologies.

Beside the need for personalisation, the awareness of privacy issues is increasing. At one hand, the Mobile Internet can be helpful for providers to achieve a higher degree of personalisation, on the other hand people think it can threaten their privacy. Customers only want to give personal information when they can define who is going to use the information, for which purposes, and if it pays off. This is a very important starting point when a company is going to offer personalised Mobile Internet services.

Beside the introduction of mobile services, knowledge has become a strategic asset in society. Information technology makes it easier to share information and knowledge. Sharing knowledge and skills is increasing in importance in organisations. There are more possibilities to work together, regardless of location and time. For example, desk research is made easier, because more sources are 'virtually present', and field research is made easier as a consequence of improved mobility through wireless devices and networks. However, restrictions are to be overcome, since not everybody is 'virtually present' yet and networks are not yet that extended. During this project, the authors gained experience in knowledge management by sharing knowledge in the Virtual Office. A lot has been done, but when Oracle Web-DB, which enables participants to update content of the Virtual Office through their browser, can be used, there will be further improvement by adapting the Virtual Office to this technology.

In the thesis, two empirical research projects were presented. Firstly, a consumer survey on mobility was carried out. It has to be mentioned that the results from this survey are only explorative. The most interesting results and preliminary conclusions that could be drawn from this survey, are: Customers prefer mobile communication and information services, the services must be easy to use, networks need to become faster and people want bigger terminal displays and better functionality. Furthermore, privacy and security issues have to be addressed. The results of the survey correspond with existing surveys in the area of mobile services and communication. However, we do not acknowledge any results regarding difference in age in the survey, since the division of age among the respondents is unequal and the group of older people is very small.

Secondly, WAP-sites were reviewed and evaluated The main results of the site reviewing are: Lay-out is almost always consistent, the level of interactivity of the sites is generally very low, all sites generally load within ten seconds, the reviewed sites generally give less information about the organisation and the task of the organisation and relatively few sites contain applications that can be run on-line. It has to be concluded that the evaluation which characteristics of WAP-sites are needed to be successful could not be obtained. This is caused mainly by the fact that, at this moment, WAP-sites do not have much content and are fairly simplistic. It is suspected when faster networks are introduced and screen size of the device improves, the quality of WAP-sites will improve and thereby scores will get higher.

Prologue

This thesis deals with the Mobile Internet and location-based services (LBS) and is written in co-operation with the department of Spatial Economics and the staff of the GIS-group.

Project trajectory

In September 2000, the first plans were made to do a project with regard to the development of WAP and Mobile Services. The first period (until December 2000) was mainly an explorative period, in which some news articles were read and relevant Websites were examined. Furthermore, during this period, a Virtual Office was set up in co-operation with another student of the GIS-group. Together with him, first contact was established with SPSS MR and mobile surveys on a market research conference in Berlin were performed. In this period, talks with two people of SPSS MR resulted in a traineeship contract. Geodan Mobile Solutions and Claritas became also involved in the project. Finally, in December the plan was made to combine traineeship and thesis. This resulted in a project proposal, which was finished just before Christmas.

In January, the real work started by doing literature study. At the end of this month, a meeting was scheduled with SPSS MR and Claritas, during which a very constructive brainstorm session took place in which a lot of ideas for a possible pilot were created, in order to analyse the possibilities on the mobile market for Claritas, Geodan Mobile Solutions and SPSS MR in the form of a partnership. The following months involved writing the theoretical part of the thesis.

In March trainees from abroad became involved in the WAPstad-project, then called LBS-Community. They were all doing research on the new wireless concepts. By the end of March, a conference in Brighton was attended together with a Portuguese student at which surveys with mobile devices for SPSS MR were carried out again. At that time, the plans to set up a pilot project and build a prototype of a mobile service were dropped, because it seemed not realistic to do this within such a short time. The decision was made to only write a detailed proposal for a pilot project. Firstly, this proposal was to be integrated in the thesis. However, mainly due to the fact the intention was to publish the thesis on the Internet and this project plan is somewhat separated from the rest of the thesis, the decision was made to write a separate project plan next to the thesis. The months April, May and June were used to finish the thesis. Beside the rest of the theoretical part, in these months a site reviewing for WAP-sites was done and a consumer survey was published on the Web. Also, in-depth interviews for the project plan were done with executives of SPSS MR, Claritas and Geodan Mobile Solutions. Finally, in July the thesis was finished.

The mobile market has proven to be a very dynamically environment. When the authors started in October, expectations were very optimistic, but after a while, expectations appeared to be set too high and the mobile market collapsed. It was a challenge to write a thesis about such an innovative and dynamic concept. There is not much literature available about the subject yet, so the Internet was an important source of information. There is also much overlap between the different subjects regarding the mobile market. Due to this overlap, it is difficult to set a logical order of chapters.

Acknowledgements

We would like to thank quite a few persons for various reasons. Firstly, there are Prof. Scholten and Prof. Frambach, our first and second tutors. Their helpful advises, participation in the project and moral support helped us to write this thesis. Secondly, we want to express our gratitude to Ton Koster and Leon de Koning from SPSS Market Research. They made our project possible and thanks to them, we were able to visit international conferences and get to know this part of the working process. For these experiences, we are also thankful to Rob van Beek and Wiepke van der Wal of SPSS MR Benelux, Bernhard Witt of SPSS MR Deutschland and Richard Collins, Gary Nelson and the rest of the conference team of SPSS MR England. We really enjoyed working with them at the various conferences!

Then, we are thankful to all the members of the GIS-group within the department of Spatial Economics of the faculty of Economics and Business Administration of the *Vrije* Universiteit: Joost Buurman, for his comments on our writings, Nils de Reus for his participation in the practical parts of our work and for his ideas and support during the initial stages of our project, Erik Koomen, for his comments on the trial version of the consumer survey and for his ideas and support and Margaret Jones for helping us with our English.

Furthermore, we would like to thank Francisco Neves, Eduardo Dias and Sandra Krueger, foreign students who participated in the WAPstad-project, for their stimulating presence during several months of our project; the meetings were great!

We would also like to thank Euro Beinat and Peter ter Haar of Geodan Mobile Solutions and Michiel Zevenbergen of Claritas Europe (now Claritas Spain) for their creative ideas and for sharing their knowledge with us during brainstorm sessions in the practical part of our project.

Also, we would like to thank Hans van der Heijden of Survissimo who gave us good comments on the consumer survey and helped us getting the consumer survey on-line. And Prof. Câmara and Antão Almada of Ideas Interactivas (Portugal), also for their comments on the consumer survey and our project plans in general.

We thank GITA Netherlands for the scholarship, which we received on this project.

And than there are Niels and Tycho Bouwman, with whom we shared an office during the whole project. We would like to thank Niels for bringing us in contact with Hans van der Heijden and Niels and Tycho mostly, just for being there everyday; we really enjoyed working with them at the GIS-lab!

We are very grateful to Judith and Anniek, for their love, patience and moral support whenever needed.

And last but not least, we have enormously enjoyed working together on this thesis and forthcoming projects. It was a challenge to synchronise our thoughts every time ideas came up and to write one thesis while avoiding the danger of our writings not to fit in well with each other.

Amsterdam, July 2001,
Machiel Reinders and Jasper Dekkers

Table of Contents

List of Tables and Figures

Tables

Figures

1 Introduction

1.1 Introduction

The Mobile Internet is one of the most discussed subjects in the field of computer and telecommunications technology at this moment. Although first experiences with the Mobile Internet were still a bit disappointing, companies are convinced it has a bright future ahead.

> "It seems like only yesterday when the Internet hype first grabbed the world's attention. However, today the plain old Internet is almost history, compared with the newest sensation: the Mobile Internet."
> *Bangkok Post, Focus Now Is on M-Commerce, December 15, 2000*

It is interesting to examine the developments in the Mobile Internet market, to see where the technology is today and what the future will bring. Mobility in general and the Mobile Internet in particular affects lives of people all over the world and changes society. What changes have occurred and will occur is another challenging area of exploration.

Mobile services can be location-based and personalised. How do these services work?, What are the main concepts of mobility? and Which mobile services can be thought of? are some good questions that need answering, predictions about mobile services, especially location-based services are very optimistic.

> "Location-based services are projected to rise more than 100-fold in the next four years, making it one of the fastest growing sectors in the mobile field."
> *Euro Beinat, Location-based Services: Market and Business Drivers, 2001*

1.2 Problem formulation and research question

Goal of the thesis
In this thesis, concepts regarding mobility and the Mobile Internet are explored in order to get insight into the market of mobile services and in particular location-based services (LBS). Wireless concepts are investigated, both from a business and a consumer point-of-view.

Problem formulation: research question
The following research question is formulated for the thesis:

> *What does the mobile market look like from a business and a (business) consumer point-of-view, how does the mobile market evolve and what can be the added value of location-based services?*

Sub questions
This research question leads to a number of sub questions that must be addressed. They are:

- What is the Information Revolution?
- What are the main supporting technologies for mobility?
- What is the added value of mobility?
- What are location-based services?
- What does the mobile market look like from a business point-of-view?
- How will the mobile market evolve?
- What are critical success factors for WAP-sites?
- What does the mobile market look like from a (business) consumer point-of-view?
- Which privacy issues are involved?
- How can innovation diffusion and adoption theory be applied to wireless concepts?

1.3 Structure of the thesis

To accomplish the goals set for this thesis, it is roughly separated into three parts. Firstly, the mobile market will be explored. Therefore, mobile services are looked at, all sorts of mobile devices and networks are examined and an effort is made to describe the new mobile market. This part mainly consists of a literature study in which a lot of web-sites are consulted. Secondly, theories like the market model of Porter and the consumer adoption theory of Rogers are applied to the mobile market. Finally, empirical research on the mobile market is done in the form of two cases: a consumer survey and a WAP-site reviewing.

Chapter content
Chapter 2 starts with taking a look at the Information Age and macro-environmental factors that influence mobility.

Chapter 3 includes technological developments starting with the Internet and ending with the Mobile Internet and technologies involved, from the analogue first generation up to technologies like UMTS and EDGE. Mobile standards like WAP and i-Mode are also described in this chapter.

In chapter 4, the changing role of geographical location under the influence of mobility is described. Several positioning technologies are investigated and location-based services are introduced. The drivers and advantages are examined and an outline of the future is given for this kind of services.

In chapter 5, the concept of knowledge management is explained by introducing the WAPstad-project. It is mainly about the Virtual Office of the research-group the authors of this thesis are part of and the sharing of knowledge in general.

Chapter 6 explores the emerging mobile market. Players in the market, recent and future developments and visions on the future from a business point-of-view will be discussed. Finally, the Five Forces-model of Porter is used to analyse the forces that influence the mobile market.

Chapter 7 describes the mobile market from a (business) consumer point-of-view. Collecting consumer data in the mobile age, opportunities and threats of mobility and privacy issues in particular are discussed.

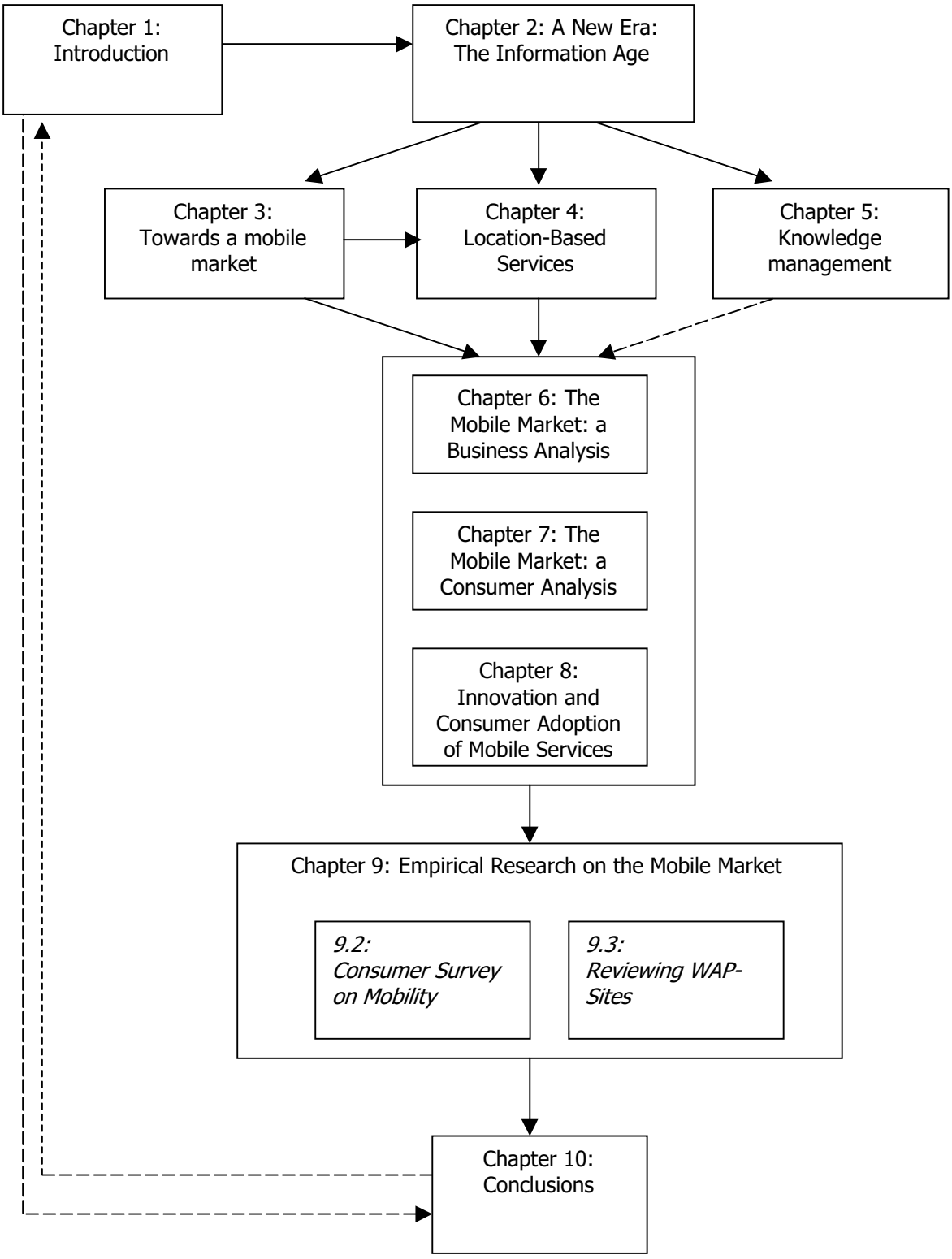
In chapter 8, theory regarding diffusion and adoption of innovations is treated. This theory is applied on the introduction of the Mobile Internet. Based on these theories, criteria for designing wireless services are given.

Chapter 9 contains two cases. The first case is an explorative consumer survey. This survey is set out to obtain insight into the consumer's point-of-view on the mobile market. In the second case, a number of WAP-sites is reviewed to investigate current WAP-applications and –sites and to learn what features are important to implement in WAP-sites.

Chapter 10 gives a summary and presents the conclusions of this thesis. Furthermore, recommendations for further research can be found in this chapter.

Flowchart of the thesis

Below the flowchart of the thesis can be found. This flowchart presents a graphical overview of the report.



2 A New Era: The Information Age

2.1 Introduction

> "In the last quarter of the 20th century, a new form of socio-economic organization has emerged. After the collapse of communism it is certainly a capitalist system. Indeed, for the first time in history the entire planet is capitalist, since even the few remaining command economies are surviving or developing through their linkages to global, capitalist markets. This is a brand of capitalism that is at the same time very old and fundamentally new. It is old because it appeals to relentless competition in the pursuit of profit, and individual satisfaction is its driving engine. But it is fundamentally new because it is tooled by new information and communication technologies that are at the roots of new productivity sources, of new organizational forms, and of the formation of a global economy." (Castells, 1998, p. 3)

In this first theoretical chapter, an outline will be given of the development of our economy into a highly information-based economy, known as the Information Age. The concepts of the Information Revolution as the root facilitator of a changing society and the New Economy forthcoming from this Information Revolution will be introduced. The second part of this chapter is focused on macro-environmental factors, which facilitated or accompanied the whole process of the transformation. The chapter ends with a summary.

2.2 The Information Age

2.2.1 The Information Revolution

Our society is changing rapidly. Two centuries ago, the discovery of the steam engine and electricity caused a major change in daily life, the so-called Industrial Revolution. Today, the world is experiencing the Information Revolution and is on the break of going mobile with information. Information is the key word of this new revolution. The importance of information increases by the day. Information and the underlying technology more and more dictate life. Information is embedded in decisions; information is power. The entire planet is organised around linked networks of computers at the heart of information systems and communication processes.

Information technology (IT) is not the only cause of today's changes we are living through. But it is indeed true that without new information and communication technologies none of today's changes would occur. Revolutionary technological advances provide better, easier and more comfortable devices to give the desired information. This has caused major growth in the generating and spreading of information, perhaps in the near future everywhere, against decreasing costs.

It is not the information or knowledge itself, but rather the change in availability, processing and quality of information that makes this new era so interesting. Or, as Castells (1996, p. 32) states it:

> "What characterizes current technological revolution is not the centrality of knowledge and information, but the application of such knowledge and information to knowledge generation and information processing/ communication devices, in a cumulative feedback loop between innovation and the uses of innovation."

According to C. Freeman in Castells (1996, p. 61), the Information Revolution can be seen as a paradigm-shift:

> "The contemporary change of paradigm may be seen as a shift from a technology based primarily on cheap inputs of energy to one predominantly based on cheap inputs of information derived from advances in microelectronics and telecommunications technology."

Castells offers a framework of the key features that constitute the information technology paradigm. These features are "[…] the material foundation of the information society" (Castells, 1996, p. 61). The key features he lists, refer not to all the influences the new technologies exert upon society, but only to economic factors. Five characteristics define the information technology paradigm (Castells, 1996, p. 61 and 62):

1. In contrast to earlier technological revolutions, today's Information Revolution is about technologies that 'act on information';
2. Since information is part of all human activities, all aspects of life are affected by the new information technologies;
3. Any system or organisation using information technologies is linked to other systems and organisations. These linkages or networks have become more powerful because of improving network computer technology;
4. The paradigm is accordingly based on the flexibility that networks provide. As Castells puts it: "Turning the rules upside down without destroying the organisation has become a possibility, because the material basis of the organisation can be reprogrammed and retooled" (Castells, 1996, p. 62), and
5. The technological convergence of formerly separate technologies into a highly integrated system. Microelectronics, computers and telecommunications are now integrated into information systems.

2.2.2 The 'New Economy'

The increasing importance of information processing technologies not just affects private, social and cultural life, but also economical development. These changes that are taking place in the economic society are pointed out as 'the New Economy' or information economy.

The Information Revolution has transformed the economy into a high-tech, services, and office economy. In a research paper Atkinson and Court (1998, P. 6) describe the New Economy as an economy that

> "[…] refers to a set of qualitative and quantitative changes that, in the last 15 years, have transformed the structure, functioning, and processes of the economy. The New Economy is a knowledge and idea-based economy where the keys to job creation and higher standards of living are innovative ideas and technology embedded in services and manufactured products. It is an economy where risk, uncertainty, and constant change are the rule, rather than the exception."

As mentioned in the definition above the increased importance of knowledge is a defining aspect of the New Economy. What does this mean? As a result of this New Economy, two important types of knowledge industry can be distinguished: Firstly, the industries whose major product is knowledge itself and secondly the industries that manage or use information.

New technologies, new businesses
The first type consists of industries organised around the creation of countless new products and services designed to generate and provide information. One major group are high-tech related, fast growing industries such as software, biotechnology and information technology hardware. Good examples are the garage-born companies Apple and Microsoft. The software industry is still booming business.

Another branch, which has arisen in the past decennium, is the Internet business. New forms of (virtual) companies emerging are directly related to the New Economy. Also telecommunication companies (telco's) are playing an increasingly important role, especially in developments in the area of wireless Internet. These knowledge production firms can be considered as the growth engines of the New Economy.

Industrial changes
The second type of industry is those industries that use information to manage and improve their working process. The existence of completely virtual company environments does not mean the traditionally physical company environment is bound to disappear. There will always be demand for physical products and services. Nevertheless, the Information Revolution has its impacts on these industries. Computer-aided manufacturing requires less people and makes the working process more efficient. Software can be used to support management decisions, to reorganise organisations or work processes and to create new organisational models.

An industrial change is taking place. There is a shift from standardised mass-production to flexible production of goods and services. The New Economy mainly is a high-tech, services and office economy. As a consequence, office and knowledge-based jobs have grown as a share of total employment. A large share of the economy uses information products produced by the industries mentioned above. Examples are industries such as telecommunications, banking, insurance, advertising, law, medicine, and to a lesser extent government and education. In these industries, effective handling and managing of information, rather than breakthrough knowledge generation, are the keys to success (Atkinson & Court, 1998, p.10 and 12).

Next to new high-tech companies and organisational changes among existing companies, other characteristics of the New Economy can be distinguished. They are presented below.

The critical role of the Internet
The Internet, with its high potential to increase efficiency and raise productivity, is one of the most powerful instruments of the New Economy. Companies increasingly offer their products and services using the World Wide Web (WWW) as a complementary marketing channel. Electronic commerce (e-commerce) is no longer a hype but is a structural trend in the New Economy. In the next chapter the role of the Internet will be examined further.

Dynamism and competition become more important
As mentioned above, in the New Economy a shift is signalled towards more flexible production. This means more flexible and dynamic companies, which are better able to target new markets efficiently. In such a dynamic world where changes occur quickly, where an increasing number of firms emerge, where new technology facilitates new-market entries, and where a global marketplace is emerging, competition among companies increases. To deal with this competition, companies are constantly developing new products and services in order to gain new markets and more market share. Innovation is an absolute necessity for survival. The ability of companies to innovate and have a short time-to-market has replaced market share or price leadership as the most important determinant of competitive advantage.

Fierce competition together with a new wave of innovation- and technology-based products and services have shortened the time between market introduction of new products and services and replacement by superior products and services. As a consequence, company engineers must constantly look for new opportunities to make their products better or faster. Ideally, consumers benefit of this highly competitive and innovative market, because their needs are more specifically addressed. However, this requires developers to think customer-oriented instead of technology-oriented.

Globalisation
Inherent to increasing competition is globalisation of business. It is a competitive requirement that businesses make worldwide investments to access markets. Indicators of the trend towards globalisation are the growing value of exports and imports and an increasing amount of foreign direct investments (FDI) (Atkinson & Court, 1998, p. 12). However, globalisation does not mean the whole world can reap the benefits of the Information Revolution. Still, the diffusion of information and communication technology is extremely uneven. For example, most of Africa is technologically separated, and the same can be said for many other regions of the world. This situation is difficult to remedy when one third of the world's population still lives in extreme poverty and misery (Castells, 1998, p. 3).

The network enterprise
Networks are the appropriate organisation for the relentless adaptation and the extreme flexibility that is required by an interconnected, global economy. The increasing importance of networks, partnerships, and joint ventures is strongly connected with an increasing degree of innovation and competition. A network is a set of inter-connected nodes. Networks may have a hierarchy, but they have no centre. One of the main characteristics of a network is that relationships between nodes are all necessary for the functioning of the network (Castells, 1998).

Next to networks in its purest sense, social capital is also important in the New Economy. Social capital (networks, shared norms and trust), as fostered in collaboration and alliances, may be as important as physical capital (plant, equipment and technology), and human capital (intellect, character, education and training) in driving innovation and growth (Atkinson and Court, 1998, p. 15).

2.3 A Macro-Environmental Analysis of The Information Age

2.3.1 The technology push
The driving force behind the Information Revolution and the New Economy is research and development in the information technology area. The first major technological breakthrough in electronics took place during the Second World War, and during its aftermath. The first programmable computer and the transistor were invented in that period. Castells rejected the statement that only in the 1970s the Information Revolution was born, like many authors have stated, because it was in the period after the Second World War that information technology diffused widely and converged into a new paradigm (Castells, 1996, p. 41). Three main technological fields constitute to the Information Revolution: microelectronics, computers and telecommunications.

First of all, the transistor was invented in 1947. This device (also called semi-conductor or chip) made it possible to process electric impulses at a fast pace in a binary mode. The giant leap forward in the diffusion of microelectronics into all machines came with the invention of the microprocessor in 1971 by Intel. The proliferation of semiconductor technology – the combination of integrated circuits (chips) and other discrete components found on circuit boards in everything from desktop computers to phones, cars, kitchen appliances, medical devices, and even roads - is the best testimony of the fact that a mechanised, industrial era has transformed into a new, digital era.

The second landmark is the introduction of the microcomputer. The microprocessor, with the capacity to put a computer on a chip, transformed the market of computers, which consisted mainly of expensive and huge machines like the mainframes and minicomputers. The arrival of the personal computer (PC) in 1981, introduced by IBM, enlarged the computer market from the high tech sector of the economy and the federal government to include all manner of businesses, and even households. The PC carried the world from an analogue to a digital mode of representing ideas (language, numbers, images and sounds). Michael Murphy stated in an article of Norton: "Today, due in large part to that one significant product introduction in 1981, virtually every person, company, and government is a customer for technology products" (Norton, 2000, p. 17).

The third landmark is the revolution with regard to telecommunications. The ability to transfer large amounts of data is largely determined by bandwidth, the carrying capacity of the connections, between the sender and receiver of data. So, the combination of 'node' technologies (electronic switches and routers), new linkages (transmission technologies) and more recently the progression made in opto-electronics (fibre optics and laser transmission) and digital packet transmission technology meant an increase in bandwidth. This boosted transmission capacity, together with more advanced switching and routing architectures, is the basis for one of the largest changes with regard to modern telecommunications: The commercialisation of the Internet in 1994. This has led to instantaneous global communications: the ability to easily send and receive data – varying from email and text documents to video and multimedia - inexpensively. A next step in the telecommunications technology is a different use of the radio spectrum (direct satellite broadcasting, microwaves and digital cellular telephony), which makes communication between mobile users possible everywhere. In the next chapter, this change will be investigated in more detail.

Summarised, it seems that the Information Revolution, that is the emergence of a new technological system in the 1970s, is caused by the autonomous dynamics of technological inventions and diffusion. Synergy effects between various key technologies played a major role in the development of better technologies. For example, advances in telecommunications enabled microcomputers to function in networks, thus increasing their power and flexibility.

2.3.2 Economic growth and social development

Most of western countries experienced a remarkable long period of economic growth during the last decade. There has been and still is much discussion about the statement that this macro-economic growth can be considered to be a result of the New Economy and that technologies create an increase in productivity. Several studies have proven the fact that information technology is the driving force behind productivity growth (Daveri et al. in Bosworth & Triplett, 2000, p. 22). Because this growth is higher than the growth of labour input, it also contributes to a growth in labour productivity by increasing the capital-labour ratio. However, the relationship between information technology capital and labour productivity is not new. What is new is the sharp acceleration of past trends in the last decade: information technology capital is becoming a larger share of total capital, and so is its contribution to labour productivity and to economic growth (Bosworth and Triplett, 2000, p. 14). The Information Revolution per se does not solve social problems, but the availability and use of information and communication technologies are necessary for economic and social development in the world.

The crucial role of information and communication technologies in stimulating development is a two-edged sword (Castells, 1998, p. 4). On the one hand, technology allows countries to accelerate stages of economic growth by being able to modernise their production systems and increase their competitiveness faster than in the past. On the other hand, those economies that are unable to adapt to the new technological system are set back even further. Thus, the Information Revolution has sharpened the contrasts between the developed and less developed countries. Furthermore, the ability to move into the Information Age depends on the educational level of a society and on the ability to assimilate

and process complex information. This starts with the education system, from the primary school to the university, and continues in the overall process of cultural development, including the level of functional literacy, the content of the media, and the diffusion of information within the population as a whole (Castells, 1998, p. 4).

2.3.3 Social-cultural factors

The historical transformation that is taking place is a multidimensional transformation. It changes not only technological and economic aspects of society, but also social, cultural, and political ones. As Castells (1996, p. 52) puts it:

> "The information revolution firstly did not come out of any pre-established necessity: it was technologically induced rather than socially determined. However, once it came into existence as a system, its development and applications, and ultimately its content, were decisively shaped by the historical context where it expanded. Indeed, by the 1980s capitalism did undertake a substantial process of economic and organisational restructuring, in which new information technology played a fundamental role and was decisively shaped by the role it played."

Thus, to some extent, the availability of new technologies, constituted as a system in the 1970s, was a fundamental basis for the process of socio-economic restructuring in the 1980s. And the use of such technologies in the 1980s largely conditioned their use and trajectory in the 1990s. The New Economy cannot be understood without the interaction between these two relatively autonomous trends: development of new technologies and the old society's attempt to retool itself by using the power of technology to serve the technology of power (Castells, 1996, p. 52).

This attempt cannot be seen apart from some other actual concepts, which are of direct influence on the New Economy. These are common, long-lasting developments. Three denominators can be distinguished: modernisation, individualisation and multi-culturalisation. Modernisation deals with a complex of socio-economic and cultural historical changes towards more equality. The social distance between people is decreasing because of better and more education, equal rights and more material prosperity. At the same time technologies are becoming cheaper. This makes modern information technologies more widespread. The danger signalled in economic growth and the Information Revolution can also be applied on the social process of modernisation. Not everybody can catch up with the latest developments, but only people with enough education to reprogram themselves throughout the changing trajectory of their professional lives. Only those people will be able to reap the benefits of the new productivity. The fate of others depends strongly on social organisation, the strategies of firms, and public policies. The only thing that is sure is that the social structure will be more and more polarised, when those groups of people are left to market forces. This development will not only take place between different countries, but also within countries. Lower educated and older people will become a victim of this process of modernisation. Another development is the process of individualisation. There is a different need for freedom among people. Individuals no longer want to be governed by other people. People want to choose their own lifestyle. The last development is an increasing diversity of social-cultural backgrounds in society. This process is strengthened because of a large flow of other cultural and ethnic groups in society. Migrants bring new lifestyles, symbols and (religious) values into society.

2.4 Summary and Conclusions

The Information Revolution is caused by the autonomous dynamics of technological inventions and diffusion. Information technology is transforming businesses and industries. It is increasing efficiency, cutting costs, driving customisation of products and services and increasing the speed of commerce. Whole new industries and products are emerging. Hundreds of thousands of new jobs created by the Internet is a good testimony to this development. The Information Revolution can be seen as a paradigm-shift from a technology based primarily on cheap inputs of energy to one predominantly based on cheap inputs of information.

The Information Revolution has transformed the economy into a high-tech, services, and office economy. As a result of this New Economy, two important types of knowledge industry can be distinguished: Industries whose major product is knowledge itself and industries that manage or use information. In the New Economy, the Internet plays a critical role. Economies are 'globalising' and are becoming more dynamical and competitive. Co-operation is a key word for survival. Modernisation, individualisation and multi-culturalisation are social developments that have influenced the New Economy and still have impact today.

What are the challenges for the new millennium? Some major changes that are already occurring can be distinguished. One of these major changes is an increasing importance of mobility and the rise of mobile devices: from cell phones to handheld or personal digit assistants to Bluetooth-technology. In the next chapter, mobility and mobile devices will be looked at. Also, mobile network technologies and standards will be discussed.

3 Towards a Mobile Market

3.1 Introduction

This chapter includes technological developments starting with Desktop Internet and ending with Mobile Internet and other technologies involved. Firstly, the development of the Desktop Internet is described. Then, mobile telephony is outlined. Here, the developments of mobile communication systems are presented. The next paragraph deals with (new) wireless devices and technologies: a comparison between the Wireless Application protocol (WAP) and i-Mode is being made and other technologies are described. Finally, the issue of mobility versus desktop Internet is discussed, and remarks about technology, legislation and social trends are made.

3.2 The Rising of The Internet

3.2.1 The Internet: a historical overview[1]

The Internet started as an experimental network for the US Department of Defense in 1969. It was set up to test the feasibility of a wide area computer network. Already in 1962 the first efforts were made to set up a globally interconnected set of computers. In 1969 the first host-to-host message was sent from the laboratory of Leonard Kleinrock [2] to the Stanford Research Institute. Then universities joined the network. By the end of 1969, four host computers were connected together into the initial ARPANET, and the 'Internet' was a reality. During the following years, more computers were added rapidly to the ARPANET. Also in December 1970 the initial ARPANET host-to-host protocol, called the Network Control Protocol (NCP) was finished. During 1971-1972 the ARPANET sites completed implementing NCP and a start was made with developing applications. In 1972 one of the most important applications was introduced: electronic mail. From that moment email took off as the largest network application for the next decennia.

The original ARPANET changed into the Internet. Internet was based on the idea that there would be multiple independent networks of different design. The Internet started with the ARPANET as the pioneering packet switching network, but soon included packet satellite networks, ground-based packet radio networks and other networks. As is known today, the Internet embodies an important underlying technical idea, namely that of open architecture networking. In this approach, a meta-level 'Internetworking Architecture' managed the choice of any individual network technology to interact with other networks. Up until than there was only one general method for federating networks. This was the traditional circuit switching method where networks would interconnect at the circuit level, passing individual bits on asynchronous basis along a portion of an end-to-end circuit between a pair of end locations. So, in an open-architecture network, the individual networks may be separately designed and developed and each may have its own unique interface, which it may offer to users and/ or other providers. Each network can be designed in accordance with the specific environment and user requirements of that network (Leiner et al., 2000). Kahn first introduced the idea of an open-architecture network in 1972. Kahn developed a new version of the Network Control Protocol that could meet the needs of an open-architecture network environment. This communications protocol would eventually be called the Transmission Control Protocol/ Internet Protocol (TCP/ IP).

[1] Sources: Turban and Aronson (1998, p. 304), Klein, De and Vos (2000, p. 117) and Leiner et al. (2000)

[2] Leonard Kleinrock worked for the Network Measurement Center at UCLA, which was selected to be the first node.

One of the main concepts of the Internet is that it is not designed for just one application, but as a general infrastructure on which new applications can be developed. By 1985, Internet was already well established as a technology supporting a broad community of researchers and developers, and started to be used by other communities for daily computer communications. Electronic mail was being used broadly across several communities, often with different systems, but interconnection between different mail systems was demonstrating the utility of broad based electronic communications between people (Leiner et al., 2000).

During more than two decades of Internet activity, we have seen a steady evolution of organisational structures designed to support and facilitate an ever-increasing community working collaboratively on Internet issues (Leiner et al., 2000). In addition to universities, research institutes and the various US and international government-funded activities, interest in the commercial sector started to grow. The growth in the commercial sector caused an increased concern regarding the standardisation process itself. Starting in the early 1980's and continuing to this day, the Internet grew beyond its research roots to include both a broad user community and increased commercial activity. Increased attention was paid to making the process open and fair (Leiner et al., 2000). A new coordination organisation was founded, the World Wide Web Consortium (W3C). W3C has taken on the responsibility for evolving various protocols and standards associated with the Web.

When Tim Berners-Lee invented the World Wide Web, it became possible to build a homepage and to include all sorts of graphical objects. The World Wide Web, together with the strongly declining prices of computer hardware and telecommunication services and the accelerated spread and adoption of browsers, caused a breakthrough of the Internet for companies and consumers. It allowed users to have easy access to information linked throughout the globe. This led to a new phase of commercialisation of the Internet in the last decade. Commercial efforts no longer comprised vendors providing the basic networking products or service providers offering the connectivity and other basic Internet services. The Internet became a virtual marketplace that supported mainly other commercial services.

On October 24, 1995, the Federal Networking Council unanimously passed a resolution defining the term Internet. It states: [3]

> "Internet refers to the global information system that – (i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/ follow-ons; (ii) is able to support communications using the Transmission Control Protocol/ Internet Protocol (TCP/IP) suite or its subsequent extensions/ follow-ons, and/ or other IP-compatible protocols; and (iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein."

Basically, the Internet can be defined as different types of computers in different types of organisational nodes, connected to each other by data lines of different speeds.

3.2.2 Fixed- versus mobile networks

The Internet started with only four nodes. In 1996, there were already over 50,000 nodes, and this number is growing rapidly. More and more people have access to 'the web', as the World Wide Web is often called. Even entire continents are connected to the Internet. Recently, a news flash claimed the last capital in Africa was now connected to the Internet with 60 computers only. And there are plans to build a ring of fibre-optic lines around the continent of Africa to ensure all African countries can access the web. This is done to prevent the third world-countries from falling behind in the technological and economical developments of the last and coming years. A mayor of a county in India wanted to invest

[3] Leiner et al. (2000)

heavily in telecommunication and computer hardware in order to connect his villages to the Internet within a year or so. And these villages did not even have water supplies nearby yet! In the vision of this mayor, his country would fall behind in the developments if they would not invest now.

But is it wise to invest so heavily in building a fixed network instead of building a mobile network? It is still more expensive to build a mobile network, but it is the way of the future, or is it not? Wireless technology uses radio waves, a type of electromagnetic radiation. Radio signals have a longer wavelength and a lower frequency than other parts of the spectrum, such as visible light. The higher the radio frequency is, the shorter the range. Mobile phones and wireless data systems use microwaves, which have a higher frequency and thus a shorter range than the waves used for broadcast radio and TV stations (Dornan, 2001, p. 41). Both wired and wireless networks have several advantages and disadvantages:

Fixed networks	**Mobile networks**
+ Cheaper to build	- More expensive to build
- Takes more time to build	+ Build faster
- A lot of cable needed	+ Less cable needed
- Costs a lot of work putting the cables in the ground	+ It is not necessary to put much cables in the ground
	- Uncertainty of radiation danger of radio signals; consumers are worried

Table 3.1 (Dis-)advantages of fixed- and mobile networks

In the next paragraphs, a closer look will be taken at the rise of mobile networks in general and the rise of Mobile Internet in particular.

3.3 The Evolution of Mobile Communication Systems

3.3.1 The First Generation of mobile phones

The first generation of mobile phones was based on a technological concept build by Nordic Mobile Telephone (NMT), a telecom group of the four Scandinavian countries. In 1989, the first handheld phones were introduced in the Netherlands. Before the handheld phones were introduced, there was already a mobile network in the Netherlands. In fact, the introduction of the first handheld phones happened when the existing network was introduced in its third version.

This network was originally introduced in 1980 and was called ATF-1 (AutoTeleFonie in Dutch). Three years later, ATF-2 was opened and in 1989, the ATF-3 NMT network (Klein, De & Vos, 2000, p. 97 and 98). The ATF-3 NMT network was an analogous network, based on a technology, which was called Frequency Division Multiple Access (FDMA). With this technology, every conversation has its own piece of frequency that it can use. When the conversation is finished, the frequency is free for another conversation. [4] The technology can only be used for voice and has highly variable call quality due to interference (Dornan, 2001, p. 3). During this 1980s, these analogue cellular telephone systems were experiencing rapid growth in Europe. The problem was that each country developed its own system, which was incompatible with other systems. This clearly created an undesirable situation, because the mobile equipment was limited only for national use and the market for each type of equipment was very limited, so economies of scale and subsequent savings could not be realised.

[4] http://www.wapworld.nl/gprs/gprs_inleiding/gprs_inleiding.htm , 03-01-2001

3.3.2 The Second Generation: GSM

The Europeans realised the problem of incompatibility of the different cellular phone networks. In 1982 the Conference of European Posts and Telegraphs (CEPT) formed a study group called the Groupe Spécial Mobile (GSM) to study and develop a pan-European public mobile system. In 1989, GSM responsibility was transferred to the European Telecommunication Standards Institute (ETSI) (Scourias, 1997). This service was commercially in use since mid-1991, and by 1993 there were 36 GSM networks in 22 countries. In 1994, KPN introduced GSM, from that moment on standing for the Global System for Mobile communications, in the Netherlands. Nowadays, GSM networks are operational all around the world.

In opposite of the first generation mobile network, the second generation mobile network is a digital network. Speech is digitally encoded and transmitted through the network as a digital stream. The GSM network uses a technology called the Time Division Multiple Access (TDMA). This means several conversations use the same frequency, but they do that separated by time; first, conversation A can speak very shortly, then conversation B can go very shortly, et cetera. Because of the very short time intervals and because this technology only permits eight conversations at the same time on one frequency, the people who are having the conversation do not notice the breaks in their conversation.

GSM uses circuit-switching technology. This means for every conversation a certain amount of network capacity is being reserved. During the conversation, this capacity can only be used for this conversation, whether it is actually being used or not. [5] Through a GSM network, 9.6 Kb per second can be send and received. [6] Through more efficient coding, the speed could be upgraded to a maximum of 14.4 Kb per second, but with new technologies emerging, there is no point in trying to accomplish that. A unique feature of GSM is the Short Messaging Service (SMS). SMS is a bi-directional service for short alphanumeric messages. Messages are sent to another subscriber to the service, and an acknowledgement of receipt is provided to the sender. SMS can also be used in a cell-broadcast mode, for sending messages such as traffic updates or news flashes. Normally, messages can be stored in the SIM card for later retrieval (Scourias, 1997).

3.3.3 The Second-and-a-half Generation: GPRS

Many people in the telecom-industry say the greatest move forward is not the step from GSM to UMTS, but the step from GSM to GPRS. GPRS stands for General Packet Radio Service. The technology is very different from existing technologies. With GPRS, the customer is on-line and logged-on whenever he turns on his device, but the customer only pays when he sends or receives data. This way, people can log-on one time a day and stay on-line. That speeds up communication, because now with mobile data communications, every time a person wants to send or receive data, he has to log-on again, which is a time-consuming process.

GPRS has a maximum bandwidth of, depending on the type of phone and the settings of the network, 115.2 Kb per second. So in theory, it is much faster than the GSM network and even comparable to the speed of the fixed Internet network. In reality, it remains to be seen whether the speed of GPRS will be so much higher than the speed of GSM. One problem, for example, is that with such high data-speeds, the battery temperature of a mobile phone will get very high, perhaps up to the point where the phone can melt. [7] GPRS uses, in opposite of GSM, packet switching technology. This means information is being cut into pieces and transmitted. These kinds of networks resemble the networks we know from the Internet. [8] Ericsson is one of the first companies to deliver GPRS-phones to the market. The phones have arrived, as scheduled, end of March, begin of April: [9]

---

[5] http://www.wapworld.nl/gprs/gprs_inleiding/gprs_inleiding.htm , 03-01-2001

[6] http://www.wapworld.nl/Achtergr.htm , 02-01-2001

[7] *3G Wireless Secrets and Lies*, The Industry Standard, 25-06-2001

[8] http://www.wapworld.nl/gprs/gprs_inleiding/gprs_inleiding.htm , 03-01-2001

[9] *Ericsson Ships First GPRS Phone*, Ybreo , 08-04-2001

> "[…] The R520, Ericsson's first GPRS-telephone, offers 'always-on' connection to the Mobile Internet, as well as a higher data transfer rate than previously. Users will have constant and immediate access to e-mail, WAP sites and the ability to synchronize their mailboxes and calendars with their PCs. In addition to GPRS (General Packet Radio Service), it supports HSCSD (High-Speed Circuit-Switched Data), which means that data transfers are speeded up even in networks where GPRS is not yet available. The phone also features an integrated Bluetooth chip for short-range wireless communication, and works on three GSM frequencies: GSM 900, GSM 1800 and GSM 1900."

Siemens followed Ericsson one week later with the release of their GPRS-phone, the S45: [10]

> "[…] The mobile phone's GPRS facility allows them [demanding business users] […] to surf Internet and WAP sites faster than ever before. Downloading data from the Internet to a PC or laptop via the GPRS S45 also takes about half the time of a conventional GSM mobile phone. […]"

Other telco's are expected to follow soon with the release of their GPRS-phones. One important remark: the telco's have made their GPRS 'publicly available' with this release, but it remains to be seen if the GPRS-phones will become available in large quantities soon. Up until today, no GPRS-phones are for sale in large amounts in stores all over Europe.

3.3.4 Other Second-and-a-half Generation-technologies

There are some other technologies that, like GPRS, can be built into existing GSM networks. One technology is High Speed Circuit Switched Data (HSCSD). This technology uses more connections at the same time, through which a speed of 38.4 Kb per second can be achieved. This speed is comparable to the speed of the fixed Internet network of two years ago. [11] Another technology that increases speed is EDGE. Through a so-called modulation of the mobile signal, speeds up to 384 Kb per second are no exception. [12]

The advantages of technologies like HSCSD, GPRS and EDGE are that they can be built into existing GSM networks. This way, telecom companies do not have to invest in new networks and new licenses; they can just expand the existing networks and use the existing licenses! If these technologies will emerge on a large scale and will be successful, depends for a great deal on the expected time of introduction of UMTS. Some people say in 2003, UMTS will be a reality, others says the introduction will not take place before 2005. If the last statement is true, there is a technological gap to fill between GSM and UMTS and so the technologies mentioned above do have a chance…

3.3.5 The Third Generation: UMTS and beyond

Universal Mobile Telecommunication System (UMTS) opens up the market for all sorts of new services like videoconferencing. The two main reasons for introducing a new network are possible lack of capacity in the near future and necessary increase of speed. The first reason, lack of capacity, is not very urgent in Europe for the next years, but in Japan, there already is capacity shortage. The UMTS network can reach transmission speeds up to 2 MB per second. The speed will be lower when a person is further away from cities and travelling at higher speed (384 Kb per second at 120 Km per hour, 144 Kb per second at 500 km per hour).

---

[10] *Siemens Launches New GPRS Phone*, Ybreo, 11-04-2001

[11] http://www.wapworld.nl/UMTS/umts_inleiding.htm , 03-01-2001

[12] http://www.wapworld.nl/UMTS/umts_inleiding.htm , 03-01-2001

UMTS is the European name for third generation mobile networks. A more international name is IMT-2000.[13] Underlying technologies with UMTS are called Wideband Code Division Multiple Access (W-CDMA) and Wideband Time Division Multiple Access (W-TDMA). With W-CDMA, a special code is assigned to every conversation. All conversations can be transmitted at the same time; the separate conversations are recognizable by their specific codes. An advantage of W-CDMA over NMT and GSM is that, where the first- and second-generation mobile networks divide the available spectrum of frequencies into small bands, W-CDMA does not. It uses the whole spectrum. This is better with regard to bandwidth and sensitivity to disturbances.[14] Large sums of money are being paid all over the world for the licenses of the UMTS frequencies. The investing companies have high expectations. It remains to be seen whether these companies will not be disappointed. As for the customers, the question remains what the price of the new technology is going to be for them.

Research after 4G networks is already taking place, with Ericsson as one of the leading partners in this project.[15] This generation should be able to send and receive 3D-pictures, is going to have even more bandwidth, a higher transmission speed (t he expected data speed is 100Mb per second) and a totally different and more human way of using the terminals. To achieve such an increase in capacity, the networks must be divided up into small cells so that the distance between the terminal and the base station antenna is reduced. The number of base stations in urban areas must increase. For example every lamppost must contain a base station. Hakan Eriksson, CEO at the R&D-department, predicted in the Financial Times of October, 3 of 2000 that the new networks needed for these developments will function as an extension on the existing yet to build UMTS networks and will be operable in 2011.[16] Dornan describes fourth generation technologies in his book as a type of virtual reality, defined as "full stimulation of all senses required to provide the illusion of actually being somewhere else - an illusion that cannot be distinguished from the real thing" (Dornan, 2001. p. 4). Users will no longer have to click through menus but will be able to control their devices using voice commands or hand movements. "You will be able to converse with someone in another place and yet have the feeling that he or she is in the same room," Eriksson says.[17] Still, there are a lot of things uncertain with regard to this network of the future.

> "Nothing about 4G is specifically defined. For example, there is no allocated frequency spectrum, as there was for 3G when research got under way in that area about ten years ago," Eriksson says. "As far as we are concerned, 4G is a matter of open-ended research at Ericsson Research. The research will serve to increase the performance of 3G networks by using WCDMA, as well as being used in the next generation of networks, 4G. It is important to remember, however, that 4G is a further development of 3G."[18]

Table 3.2 gives an overview of the generations of mobile networks (see the next page).

---

[13] http://www.wapworld.nl/UMTS/umts_inleiding.htm , 03-02-2001

[14] http://www.wapworld.nl/UMTS/umts_achtergrond.htm , 03-02-2001

[15] *The next next generation*, On (2000) http://on.magazine.se/technotes/technotes.asp?articleID=464&categoryID=3

[16] *3D-zaktelefoon*, Trouw, 04-10-2000

[17] *The next next generation*, On (2000) http://on.magazine.se/technotes/technotes.asp?articleID=464&categoryID=3

[18] *The next next generation*, On (2000) http://on.magazine.se/technotes/technotes.asp?articleID=464&categoryID=3

Year of introduction	Generation	Network name	Main characteristics
1980	1st Generation	ATM-1	Carphone System, analogous
1983	1st Generation	ATM-2	Carphone System, analogous
1989	1st Generation	ATM-3 NMT	First handhelds, analogous
1994	2nd Generation	GSM	Digital, 9.6 Kb p/s, circuit switching, mainly Europe
----	2nd and a ½ Generation	HSCSD	38.4 Kb p/s, usage of multiple connections, GSM network-compatible
2001	2nd and a ½ Generation	GPRS	115.2 Kb p/s, packet switching, GSM network-compatible
2002?	2nd and a ½ Generation	EDGE	384 Kb p/s, modulation of mobile signal, GSM network-compatible
2003/5?	3rd Generation	UMTS	Max. 2 Mb p/s, new network needed
2011?	4th Generation	3D-pocket phone	Extension on UMTS network, 100 Mb p/s, 3d-pictures

Table 3.2 Generations of mobile networks: an overview

3.4 Developments in The Wireless World

3.4.1 The Japanese standard: i-Mode

i-Mode was introduced by Japans leading telecom company NTT DoCoMo in February 1999. i-Mode offers Internet-like services. It is a huge success, both on demand and supply side. On the demand side, the number of users increased rapidly from 220,000 users on the 23 rd of May 1999, to 1 million users on the 10 th of August 1999, to 2 million users on the 18 th of October 1999. And on the 19 th of March 2000, there were 5.2 million users! On the supply side, in August 2000 591 companies are offering their services and next to that, 18,700 independent I-mode sites can be viewed. [19]

Several reasons explain the success of i-Mode. First of all, the service is cheap: Euro 2.50 for a monthly subscription, 0.0025 Eurocents for each data package (128 Kb). The second reason is the large amount of services available through i-Mode. Among other reasons, the usage of Compact HTML (cHTML, a subset of HTML) is one of the reasons for this large amount of services. With cHTML it is easier to build a mobile site than with WAP (that uses WML: Wireless Markup Language, not a subset of HTML), because WML-based converters are not needed. Thirdly, the simple way of dealing with transactions between demanders and suppliers (namely, billing through the telecom company) is an advantage. And fourthly, of course, is the excellent marketing and market position of NTT DoCoMo. [20]

With i-Mode, the user is always on-line. i-Mode is packet switched and uses PDC-P carrier services, which is a carrier service comparable to GPRS. i-Mode can send information at a speed of 9.6 Kb per second. This is sufficient for small amount of information, but not enough for large amounts, like an MP3-file or a video clip. [21]

3.4.2 The European standard: WAP

WAP looked very promising when it was introduced in 1999. But why did it not live up to the high expectations until now? There are three main reasons: speed, quality and the mobile phones. The first is speed: through a GSM network, only 9.6 Kb per second can be transmitted. This is far less than your ISDN-connection at home, which can transmit 64 Kb per second. The second is quality: It takes a while for a person to log-on and read his email.

[19] http://www.wapworld.nl/imode/imode_inleiding/imode_inleiding.htm , 16-05-2001
[20] http://www.wapworld.nl/imode_inleiding.htm , 03-01-2001
[21] http://www.wapworld.nl/imode_achtergronden.htm , 03-01-2001

During that time, there is a chance of losing the connection. This is very frustrating, since he will have to log-on again etc. This can be a time-consuming process. The third reason is the mobile phones. The screen of a mobile phone is very small, certainly in comparison to the average 15- or 17-inch screen at home. The problem is how to get all the information from a normal website on the screen of a mobile phone. That is simply impossible, so the contents of a website must be filtered to exclude all unnecessary information before converting the website to a Mobile Internet-site. In order to solve these three problems of Mobile Internet, WAP was introduced. WAP increases the speed of connections, automatically restores lost connections and delivers services specially designed for the small screen and keyboard of the mobile phone.

WAP stands for Wireless Application Protocol. It is an open, worldwide supported standard that enables mobile phones to use simple, Internet-like services. A WAP-service consists of a number of screens that you can view through pressing the buttons on the mobile phone. In a WAP-service, a screen is called a 'Card' and a set of screens is called a 'Deck', like a deck of cards that is. WAP uses Internet-like standards. For instance, with WAP HTML is called WML, Wireless Markup Language. The addressing goes the same way: the WAP user agent (the browser) requests an URL (a WAP address) at a WAP Gateway/ proxy and with WAP you can also work with scripts, like JavaScript. [22] The use of open standards is considered to be an advantage for WAP, although the WML standard is not a subset of HTML, so conversion of HTML to WML is needed.

Wapworld has put an overview of the main characteristics of i-Mode and WAP on its Web-site. Symbian composed the overview. [23]

3.4.3 WAP: success or failure?

Several months ago, WAP was a buzzword in the world of wireless technology. Today, the hype about WAP is gone, expectations are not met and WAP is not in the news every day anymore. WAP has neither reached a large user-base, nor has it become the standard of today and the future. Does this mean WAP is a failure, or has it just become another common technology people use? It is still too soon to draw any final conclusions on the success or failure of WAP, but at least the hype has gone, so it is possible to have a look at what WAP is really about and what the future expectations of people about WAP are.

One of the reasons WAP has not had its big breakthrough until now, is because it is slow. The success or failure of WAP is therefore related to the arrival of faster network technology. 2.5G networks are being rolled out already and handsets are scarcely available in the UK, according to BT Cellnet. [24] Managers at Vizzavi, the multi-access Internet portal, acknowledge that it has been disappointed by WAP technology. The company has therefore decided to devote all its efforts to GPRS (General Packet Radio Service) technology, which allows for more rapid access to the net via a mobile handset. The first of these handsets are expected to arrive on the market over the next few months. [25]

The 3G networks are being introduced later than was expected. The last week of April, NTT DoCoMo announced a five-month delay in full-scale rollout of 3G services. [26] A week later, British Telecom decided to postpone the launch of the world's first third generation mobile phone service for at least three months because of malfunctioning handsets. BT said it would now start 3G at the end of summer or early autumn. [27] This is not a positive development for WAP. One source claims (see the next page):

---

[22] http://www.wapworld.nl/achtergr.htm , 02-01-2001

[23] http://www.wapworld.nl/imode/imode_wap/imode_wap.htm , 10-07-2001

[24] *2.5G Phones Go on Sale in UK*, Press Association, 18-05-2001

[25] *Vizzavi Acknowledges Failure of WAP*, FT World Media Abstracts via Comtex, 04-05-2001

[26] *NTT DoCoMo Postpones High-Speed Service Launch*, BridgeNews, 24-04-2001

[27] *British Telecom Delays First 3G Mobile Launch*, Xinhua News Agency, 14-05-2001

> "There could be 1.3 billion subscribers to third-generation (3G) wireless networks in 2010. That's the optimistic case in one market research forecast. Or there could be only 744 million 3G subscribers in 2010. That's the pessimistic view. Or there could be far fewer than that. Third-generation networks haven't been built yet, there are zero subscribers now, and it isn't clear when the 3G market will take off, let alone what it will be like nine years hence." [28]

Paul Mulligan analyses wireless IT forecasts at research aggregator eMarketer Inc. in New York. He says

> "[…] researchers are pulling their numbers out of thin air [in cases like this.] It's one thing to extrapolate growth rates for a technology that has an installed base of users, Mulligan said. But "now we have researchers projecting things that don't even exist yet, like 3G services," he said. "They might as well be telling us how many people will drive wheelless cars in 2007."" [29]

A mass consumer market for wireless data services - which are popular in Japan - seems a long way off in the U.S. A survey of 3,189 wireless device owners by Chicago-based Accenture found that the reasons the vast majority are not using the wireless Web are that they believe that it costs too much, that screens are too difficult to read and that the service is too slow. Phones that use Wireless Application Protocol (WAP) have been a major disappointment in the U.S., analysts agreed. Frank Colletti, director of e-business at Zurich North America, said the only way to cut through the hype is to try it yourself. [30]

Japan has i-Mode, so WAP is not a success there. Also, WAP has not taken off in North America up until now. And in Australia, something has gone wrong too: A survey of Australian Internet users and mobile phone owners, carried out by local on-line research company APT Strategies, found that 42 percent of these customers are not using WAP devices because they are unaware that they are available. Another 39 percent indicated they either were not ready for WAP technology or did not want it. The study, also found that 42 percent of respondents did not know the difference between WAP - which gives mobile devices access to Internet services - and SMS. [31]

Visiongain reports that the mis-labelling of the service is damaging the WAP technology. Providers have over-promised WAP, resulting in public mistrust and dissatisfaction. Ben Thacker, senior-analyst on the Visiongain reports: "WAP isn't the Internet on a phone, or even a version of it. WAP right now is a news and information service than happens to be stored like Web pages […]". [32]

Several enhanced wireless technologies, CDPD in the United States and GPRS in Europe, stand to offer near-term bandwidth relief, with optimal bandwidth over 1 Mbps but typical user bandwidth is in the 28.8 Kbps range. The real future of general m-commerce is said to hinge on third generation technologies, or '3G', promising bandwidth up to 2 Mbps. However, 3G hinges on infrastructure investments by cellular providers that will make it expensive to deploy, and 3G's real-world bandwidth has yet to be established. With 2.5G and 3G data rates on the way, and the WAP 2.0 specification offering a service closer to the successful i-Mode, Visiongain is still confident that WAP will be the wireless data protocol of the future, but argues that poor handsets and the limitations of GSM networks are currently holding it back. "WAP needs to make the jump to packet-based connections. That's how consumers want their data," says Thacker. [33]

---

[28] *Optimistic Forecasts Fuel Wireless Hype*, Computerworld, 07-05-2001

[29] *Optimistic Forecasts Fuel Wireless Hype*, Computerworld, 07-05-2001

[30] *Optimistic Forecasts Fuel Wireless Hype*, Computerworld, 07-05-2001

[31] *Australians Mystified by WAP*, Newsbytes News Network, 07-05-2001

[32] *Report: WAP Has Been Undermined by Service* Providers, M2 Communications, 07-03-2001

[33] *Report: WAP Has Been Undermined by Service Providers*, M2 Communications, 07-03-2001

The Boston Consulting Group (BCG) conducted a study amongst over 1,800 individuals based in Japan, Germany, France, Sweden, Australia and the United States. [34] Consumers were apparently misled by marketing hype into believing that they would enjoy a Web-like experience. The study found that one in four owners of mobile devices stops using m-commerce applications after the first few attempts. David Dean, BCG vice-president and leader of the firm's Technology and Communications Practice says there are three main sources of consumer frustration: slow transmission speeds, difficult user interfaces and high costs. The WAP interface was found to be too limited for consumers. Furthermore, developing WAP content was troublesome for developers, security was questioned, and by-the-minute pricing schemes made using the service an expensive as well as frustrating proposition.

According to research done by META Group 80%-90% of corporate users that purchased WAP phones have abandoned the data capabilities of these phones and are using them for voice communications only. Users are disappointed with WAP in general, with the level of effort required to obtain information exceeding the threshold for perceived value.

> "[…] limited content, slow networks, high latency times, and generally poor user ergonomics have not met the high user expectations and hype that accompanied WAP-enabled devices […]. META Group does not expect a significant uptake in Internet-connected smart phone utilization until these ergonomic issues are fixed. […] Even though Europe and Asia have not quite reached this level yet, up to 65%-75% of their corporate users have stopped using the Internet connectivity of their wireless phones."[35]

Conclusions of this paragraph: research indicates people are very disappointed in WAP and that WAP is not broadly used for several reasons. However, some researchers expect WAP to be a success in the near future, because of a more realistic approach adopted by the suppliers of WAP technology and because of 2.5G and 3G networks will speed up the connections. Furthermore, an advantage of WAP over i-Mode is that it is an open standard. We think it remains to be seen if WAP indeed will be a success. i-Mode will probably be introduced in Europe through its alliance with KPN and from that point, we expect the battle will be between i-Mode and WAP.

3.4.4 The rise of handheld and other hybrid devices

Handheld computers and PDA's are devices, which can be used for Mobile Internet, just like some smartphones. The question is whether phones with extended options will rule the Mobile Internet market or will the PDA's conquer the field? A related question is whether PDA's and mobile phones will be integrated in the future or not? De Klein and Vos (2000, p.138) think because of infrared connections and Bluetooth, integration of phones and PDA's is not necessary. Whether this will happen or not, PDA's and handheld computers cover their own market as well as part of the future Mobile Internet market. How does their own market develop?

Palm and Psion are the biggest PDA-suppliers. There are several operating systems designed for these hybrid devices: Palm has developed PalmOS, Microsoft has developed WindowsCE for the Pocket PC. Next to these closed operating systems, Psion has co-founded Symbian[36] with Ericsson, Nokia and Motorola, in order play an important role in the hybrid market. Symbian uses EPOC, an open operating system. EPOC grants mobile phones PDA-functionalities and vice versa (De Klein and Vos, 2000, p. 139). Symbian also develops applications, which are also suitable for WindowsCE and PalmOS. Handspring is a company founded by to former employees of Palm. They have made the Visor, a Palm-clone with a PalmOS operating system. Microsoft for now has lost the battle with its WindowsCE, but is

---

[34] *Mobile Commerce on A Roll*, NPN, National Petroleum News, 09-05-2001

[35] *Meta Group Sees 'WAP Abandonment' Among Corporate Users*, Business Wire, 23-05-2001

[36] http://www.psionpress.com/qpress/releases/pr129302.asp

fighting back with its partners with the development of Mobile Explorer, which should compete with Symbian (De Klein and Vos, 2000, p. 140). WAP is compatible with all these operating systems.

3.4.5 Bluetooth-technology and infrared

What is Bluetooth exactly? According to the official Bluetooth website [37], Bluetooth

> "[…] will enable users to connect many computer and communication devices to each other in a simple and easy way. It offers the opportunity to set up connections quickly and on an ad-hoc basis, even automatically and unnoticed, between different devices, without the need for external hardware like cables."

An employee of Ericsson invented Bluetooth. The core product in Bluetooth technology is a small chip, which can be built into practically any device. The standard chip enables devices to connect within a distance of 10 metres. There are also more powerful chips, which can connect devices over a distance of 100 metres.

Bluetooth is a de-facto standard for short-distance wireless communication. The standard guarantees point to point and point to multi-point connections (there is a maximum of 7 connections at the same time), over 10 or 100 metres. The maximum data speed of Bluetooth is 721 Kb per second. A 2 Mbps bandwidth is expected to be available in future versions. Early 1998, a group of key players in the telecom- and IT-industries decided to develop Bluetooth as a new standard. These companies, among them Toshiba, Nokia and Ericsson, founded the Special Interest Group (SIG) as a forum for the development of this worldwide standard. Since then, big firms like 3Com, Compaq, Dell, Lucent and Motorola have joined the SIG. [38]

An advantage of Bluetooth is that it uses a frequency (2.4 GHz), which is freely available almost everywhere in the world. Bluetooth is expected to replace infrared as the communications standard for 'personal area networks' with Palm PDA's and laptops, since it does not rely on 'line-of-sight' to work. In addition to m-commerce applications, Bluetooth will link computer peripherals and a future generation of household appliances together in a 'household network.' Given Bluetooth's broad support among computer OEMs, there is little chance it will not be adopted.

The 802.11 lb specification, which also operates at 2.4 GHz, is similar to Bluetooth but is generally designed for wireless Ethernet LANs, which are already installed at various public locations in the United States. This protocol can transmit data at 11 Mbps out to nearly 100 meters. 802.11 lb is already deployed via add-in cards for office LAN applications. Both protocols are incompatible as they are using the same frequency. Bluetooth and 802.11 lb both want to conquer the same market. They are expected to coexist however, though there have been concerns that bandwidth will suffer, perhaps greatly, with many devices suddenly using the 2.4 GHz range in close proximity. [39]

3.4.6 Future developments in applications and technologies

There are several developments in the mobile market, which compete with each other. WAP versus i-Mode are two of these developments. Which is going to win? Some experts in the industry have compared WAP unfavourably to the Japanese i-Mode standard, but Ben Thacker, senior analyst on the Visiongain report on WAP is sceptical of these comparisons. He says one cannot compare WAP as it is now with i-Mode. "[…] i-Mode has packet-based billing and always-on connections, which should arrive for WAP by the end of this year with GPRS. When that happens, we can start making fair comparisons." [40]

---

[37] http://www.bluetooth.com/#

[38] http://www.wapworld.nl/bluetooth/achtergrond/bluetooth_achtergrond.htm , 03-01-2001

[39] *Mobile Commerce on A Roll*, NPN, National Petroleum News, 09-05-2001

[40] *Report: WAP Has Been Undermined by Service* Providers, M2 Communications, 07-03-2001

Next to WAP and i-Mode, m-commerce is a development of which we can ask the question: is it going to break through or not? The likely approach for mobile interaction at a specific retail site will be some form of local communication using a mobile device with a close range wireless transmission protocol. Authorization from the device (dispenser, Point-Of-Sale or vending machine) will still be done through the Internet, preferably using a high-bandwidth connection as with traditional card readers and payment terminals. In an interview[41] with Lucy Sackett, Product Line Manager, Consumer Solutions Marketing, Marconi Commerce Systems, the following question was asked: "How does Marconi see m-commerce developing in the United States?" Sackett:

> "The United States and Europe are very different, and m-commerce in Europe will be different from m-commerce in the United States. M-commerce can facilitate anything from vending goods, shopping at a dispenser, e-cash at the dispenser, banking, advertising, or adding music or video to systems within an automobile - which require varying bandwidths. WAP is more prevalent in Europe, and works nicely for low-bandwidth data communications, but comes up short for some of the high-bandwidth needs. Further, the m-commerce approach based upon next-generation smart-card technology should be well-accepted in Europe, but probably not in the United States. The consumer does not seem to want the technology, and businesses do not want to build an infrastructure to support it."

Rob Randelman, Manager, Marketing and Business Development, VeriFone, a division of Hewlett-Packard, was asked a similar question by NPN: "How do you see m-commerce developing in coming years?" Randelman:

> "M-commerce will come in segments. The first segment will be transaction authentication - log into my account and deduct $15 for this purchase. […] The second segment is using the mobile device to load and store cash value. For this, we're looking at a contactless smart-card built into a cell phone battery with the customer being able to add value from his or her account using the cellular technology. […]"

NPN: "What needs to happen for m-commerce to take off?" Randelman:

> "I think as long as the technology can be used in more than one place, it will take off. I see cell phone providers hooking up with credit processors, and leveraging their m-commerce service to differentiate themselves from the competition. Standardization is required to build confidence with both consumers and businesses […]."

One other question that is asked frequently is: will handheld computers and hybrid devices merge with mobile phones into one device? META Group expects users that are communication-centric to choose one of the next-generation smart phones that offer PDA-like functionality built into the phone. Meanwhile, users that are primarily data-centric will choose somewhat larger and more costly devices for their data processing capabilities, with add-on wireless communications as a secondary benefit. According to META Group, a one-size-fits-all model (also called device convergence) based on a telephone is not expected to meet the needs of all users. Rather, with the emergence of Bluetooth personal-area network technologies, users will choose components (e.g., a Palm and a small form-factor cell phone) that intercommunicate, using the phone as a wireless modem for the data device, and using the PDA to process and interact with complex data sets.

[41] Source of next interviews: *Mobile Commerce on A Roll*, NPN, National Petroleum News, 09-05-2001

> "'With new technologies on the horizon, we should see data access from mobile phones pick up again during the next two to three years -- but only if the ergonomics are substantially improved," said Gold. "We have a catch-22, because most cell phone users want their devices to stay small -- and are demanding the highest levels of portability. Yet the small size prohibits them from being ergonomically correct and data-intensive. That's why a cell phone will never replace a PDA, and a PDA will never replace a phone."'[42]

It will be obvious that it is very hard to draw any direct conclusions from expert opinions on developments that have not taken place yet. Interesting is the difference in adoption of m-commerce in the United States and Europe that Lucy Sackett mentioned.

3.5 Towards The Mobile Internet

3.5.1 Mobile Internet versus the Internet

Major technological differences between a mobile device and a PC can be detected. A user will use his mobile device in other situations, for other purposes, in other places and at other times of day compared to the Internet on a desktop PC. When developing mobile services, attention must be paid to the fundamental difference between services built for a user with a small device on the road and the PC-user at home or at his office. One cannot simply copy and paste the content of a homepage to WAP or another form of the Mobile Internet. In this section the main differences between wired Internet and its wireless version will be examined.

This section will be started with discussing the similarities between the Mobile Internet and the Internet. By the Mobile Internet, WAP-sites are meant because that is the only form of Mobile Internet available in Europe at the time of writing, and by Internet the use of the Internet trough a PC is meant. First of all, the Mobile Internet is like the wired Web on-line connected with a global network. Also, the procedure or handling of the Mobile Internet is much the same as the Internet. For example, WAP-sites can be visited by using Web-addresses (URL's). These URL's can be imported and recorded in your mobile device like a web-browser offers bookmarks to organise your favourite sites. The methodology in surfing the Internet is composed of scrolling and clicking on hyperlinks. This principle can also be applied to the Mobile Internet. Also for your WAP-phone there are a wide variety of good and bad sites. This does not make it easy for users to find good information and for suppliers to reach the user. Portals and search engines may assist you in finding a specific site. This is also the same as the various search engines offering their services at the Internet (Klein, De & Vos, 2000, p. 57).

The most striking differences between a mobile phone and a PC are clear. In short, the next elements can be distinguished (Klein, De & Vos, 2000, p. 58): The mobile phone is much smaller and weights less than a PC. Mobile phones have a smaller screen than a PC, smaller resolution and only black and white display. This is a major disadvantage of the mobile phone. The mobile device falls clearly short with regard to processor capacity and memory. Limited memory and data speed make the device very slow. A PC is equipped with a keyboard and mouse. Many mobile phones only have twelve keys and two function keys. This does not make it easy to import text or data into your mobile device. The handling of a mobile phone is thus more complex.

What can mobile device suppliers do to improve the handling of a mobile phone? Many improvements can be made with regard to device ergonomics. WAP is indeed developed for small screens and twelve keys, but to be successful in the future the displays must get larger, higher resolution and colorised. To capture the problem of the keyboard, keys can be displayed on the screen. These keys can be handled by a so-called touch-screen

[42] *Meta Group Sees 'WAP Abandonment' Among Corporate Users*, Business Wire, 23-05-2001

in combination with a pen. The higher resolution of the new generation screens makes it possible to put more lines of text on a small screen, without a decreasing readability. Also the positive effects of cursors and rollers must not be underestimated. Like with these tools people can scroll quickly through a text, comparative to the mouse on a desktop PC. Hybrid devices, like the Palmtop and Pocket PC, may be a solution for the mentioned disadvantages with regard to ergonomics of a mobile device. Hybrid devices are already treated in paragraph 3.4.4.

Another big difference between WAP and Internet is its relation with voice dialling. Internet and voice dialling is not a common combination until today. A PC is from the users point of view not a device to make a telephone-call with. In contrast with a PC, the primary reason to buy a mobile device is to call with it. Making a call from a WAP-site is not only much easier for the user, but also self-evident. Via the Mobile Internet you can search a certain number, which you can call. Scoot, Gouden Gids and De Telefoongids have already realised WAP-entry to their services.

Another important difference between WAP and the Internet is the number of users plugged in. A mobile phone normally has one single user. Several users share an Internet account, not only at the workplace but also at home. The great advantage of personal entrance to the Internet via a mobile device is a user can indicate the relevant things. This enables personalisation. A user can make up his own menu with his own preferences. The search process will become easier and faster. Because of its personal entrance there also is a greater perception of safety. Paying via a mobile device is much easier, the user possesses his own mobile digital wallet. In the near future, it is expected users will use their mobile phones for ordering and paying products and services.

The Mobile Internet will never replace the Internet. The Mobile Internet is a supplement on the Internet. It will be used for other activities. Compact, actual information like the latest news and e-mail is more relevant than extensive surfing and looking for some nice advertising. Using a WAP-phone or a handheld device takes place in a highly dynamical environment. The user wants to have quick answers to his questions (Klein, De & Vos, 2000, p. 67).

Summarised, a PC is more user-friendly, but falls short with regard to size and weight. A mobile phone is easier to take with you. This mobility makes the adoption of information services to the mobile device very interesting. A mobile phone contains a SIM-card, which can be used in an effective way for transactions and personalisation. Finally, the price of a mobile device is much lower than that of a PC. In the next section a closer look will be taken at the added value of mobility. Two areas can be distinguished: location independency and personalisation.

3.5.2 The added value of mobility

The most important added value of the mobile device is its location independency. Mobile phones offer the possibility to communicate everywhere. Not only domestically, but also more and more globally, because GSM is the dominant standard of mobile telephony. This enlarges the mobile device's usefulness. Many questions, ideas and activities are born spontaneously on an arbitrary place and/ or on an arbitrary time. When people remember they have to make a phone-call, look up some information, place an order, etc. With a mobile device one can directly execute his thought. Applications, which are focused on the location independency of the mobile phone, can therefore fulfil a need. In the next chapter a closer look will be taken at these so-called location-based services.

Closely related to this advantage is the low entry-barrier of the mobile phone. A person can take his mobile phone always with him. Because WAP is always available, a user will use WAP-services on moments he is waiting, bored or seeking distraction.

Localisation and personalisation are the main elements that can give a mobile device added value over wired Internet services. Beinat (2001, p. 6) came to the same conclusion:

> "The value of information to mobile users is proportional to its pertinence to the changing circumstances of use (place, activity, time, mood, profile). Location and personalization are thus becoming key elements to fitting information needs and user desires to information provision."

3.5.3 Privacy concerns and legislation

Encompassing the trend towards more personalisation and the growing importance of the consumer is a distinct trend towards greater consumer awareness of privacy issues. Consumers do not allow companies to fail in protecting privacy. With the rise of mobile devices and mobile services, the privacy concept goes even further. Misuse of location information is condemned heavier because a wireless subscriber can be tracked or located through his or her use of a mobile device. The expanding Internet technology makes it possible to acquire and exploit personal information. The Internet has a unique ability to compile large amounts of information with great efficiency and at low cost. Firms can register our answers to questions about personal preferences, hobbies, occupation, and income bracket etc. This information, and the deductions that may be drawn from it, are vulnerable to marketers interested in personalisation. The information reveals not only individuals' traits, but also, when aggregated, provides insight into broader social trends, preferences, and consumption patterns. The value of on-line personal information is increased due the fact that Internet advertising is relatively inexpensive and can be widely distributed in virtually no time. The very prevalence, ease and relatively low cost of collecting and disseminating this information are also the cause for privacy concerns. At one hand the ability to gather, process, and disseminate information on the Internet provides consumers with a wealth of benefits, on the other hand personal data may be used abusively, as when private information is widely circulated, or when inaccurate information is shared among many firms, or when the information is used to target victims for a scam or children for criminal activity (Valentine, 1998).

The ownership of consumer information is another issue with regard to legislation. Closely related to this issue is what the Forrester report (2001, p. 17) remarks about the ownership of location-based information:

"Heated battles will be fought in Brussels over who owns a consumer's location information: The person who carries a phone or the operators who provision it? To protect themselves, operators will build restrictive clauses into service contracts that assert rights to users' locations. When regulation ensures that consumers will be able to opt out entirely, operators will create costs for doing so in the form of more favourable rates for those who submit to being tracked."

Legislation clearly falls short in defining the ownership of information and the degree in which it can be traded to third parties. European legislation has to be composed in the near future.

Another problem in connection with legislation relates to the use of handheld cell phones while driving. Some people asserted they have the right to use their cell phones while driving as a result of their personal freedom. But, the overall benefit to public safety is a heavier weighted factor than any small discomfort someone may experience as a result of legislation, which forbids the use of handheld phones. On the other hand: cell phones are important devices for reporting emergencies. This is absolutely one of the benefits of a mobile device. But emergency calls can and should be made from stopped vehicles. [43]

[43] *An Education on Common Objections to Cell Phone Legislation*, Geocities.com, 20-02-2001

3.5.4 The Mobile Internet and social trends

In this paragraph the subject will be addressed whether the Mobile Internet is a separate technological development or it is related to other social trends [44] and changes occurring in the society. In other words: are people indeed ready for the Mobile Internet? To be successful, Mobile Internet services has to correspond with the trends in society. However, there are great chances for the Mobile Internet to become an instrument that is clearly connected with our way of life, because of the proven success of the Internet and mobile telephony. In paragraph 2.3.3 social-cultural factors were already discussed in relation to the Information Age. Obviously, there is some overlap with social-cultural factors in relation with the Mobile Internet discussed in this paragraph.

The importance of age is decreasing. Many elderly are unfolding a lot of activities, because of their relative good physical and mental health. The increasing amount of 55-plus people on-line gives an indication the Internet is not only expanding among the younger but broadly among all ages in society. This implies that there is an opportunity to introduce the Mobile Internet among older generations. An accompanying benefit of the Mobile Internet is the possibility to personalise the service, so it can relatively easy be adapted to the preferences of the elderly (Klein, De & Vos, 2000, p. 165/ 166).

There is an increase in freedom of choice in society. For example: having a part-time job, retiring in advance, going back to school or having a sabbatical year are all possibilities that are widely accepted. Time and money are exchangeable. Mobile phones and the Mobile Internet perfectly fit into this perception of freedom.

Another trend is the fact that people are travelling more. A mobile phone can be a helpful device to keep in contact with home. The possibilities to make a phone call wherever you are gives people a comfortable and safe feeling. The Mobile Internet can enlarge this feeling of safety, because travel information or phone numbers can be consulted. The possibility to make on-line reservations is also closely related to this trend.

De Klein and Vos (2000, p. 170 and 171) signal another trend occurring in society, which has influence on the use of the Mobile Internet. They call this trend 'egonomie', the increasing individualisation of society. This individualisation asks for highly personalised products. The Mobile Internet offers all the conditions necessary to accomplish personalisation of services.

Besides the need for personalisation, the awareness of privacy issues is increasing. At one hand the Mobile Internet can be helpful for providers to achieve a higher degree of personalisation, on the other hand people think it can also threaten their privacy. Customers only want to give personal information when they can define who is going to use the information, for which purposes, and if it pays off. This is a very important starting point when a company is going to offer personalised Mobile Internet services.

Finally, the popularity of mobile phones and electronic organizers can be largely explained by the fact that people are getting busier and busier, because they contribute to doing more things in one day and to better scheduling activities. The Mobile Internet can contribute to facilitating the life of occupied people. Making payments and reservations and order products with your mobile phone can save a lot of time.

[44] A trend is a certain lifestyle or attitude which arises slowly, diffuses and holds on for a long period of time

3.6 Summary and Conclusions

In this chapter, the Internet, the Mobile Internet and all sorts of mobile network technologies were discussed. Also, social trends and legal issues related to the Information Age and mobility were highlighted. The most important findings of the chapter are set out below.

Basically, the Internet can be defined as different types of computers in different types of organisational nodes, connected to each other by data lines of different speeds. More and more people have access to 'the web', as the World Wide Web is often called. Even entire continents are connected to the Internet. But is it wise to invest so heavily in building a fixed network instead of building a mobile network? Fixed networks are cheaper, but take more time and cable to build. It is still more expensive to build a mobile network, but it is the way of the future, or is it not?

GSM is the network we use today. GPRS is coming soon, along with other technologies. The advantages of technologies like HSCSD, GPRS and EDGE are that they can be built into existing GSM networks. If these technologies will emerge on a large scale and will be successful, depends for a great deal on the expected time of introduction of UMTS. If there is sufficient delay, there is a technological gap to fill between GSM and UMTS and so the technologies mentioned above do have a chance… The two main reasons for introducing UMTS are possible lack of capacity in the near future and necessary increase of speed.

i-Mode and WAP offer Internet-like services, the first in Japan and the other in Europe. i-Mode is a success because it is cheap, it has a large user-base and a large number of services available. With WAP, it is a different story. WAP is not a success. Three main sources of consumer frustration can be pointed out: slow transmission speeds, difficult user interfaces and high costs. Providers have over-promised WAP, resulting in public mistrust and dissatisfaction. An advantage of WAP is that it uses an open standard, where i-Mode does not. The battle between i-Mode and WAP is not over yet, especially when GPRS is arriving and WAP can also get an 'always on' connection, just like i-Mode.

Bluetooth is a de-facto standard for short-distance wireless communication. Given Bluetooth's broad support among computer OEMs, there is little chance it will not be adopted. The 802.11 lb specification, which also operates at 2.4 GHz, is similar to Bluetooth but is generally designed for wireless Ethernet LANs. Bluetooth and 802.11 lb both want to conquer the same market. They are expected to coexist however.

Will handheld computers and hybrid devices merge with mobile phones into one device? Users that are communication-centric will probably choose one of the next-generation smart phones that offer PDA-like functionality built into the phone. Meanwhile, users that are primarily data-centric will choose somewhat larger and more costly devices for their data processing capabilities, with add-on wireless communications as a secondary benefit. A one-size-fits-all model based on a telephone is not expected to meet the needs of all users.

Major technological differences between a mobile device and a PC can be detected. A user will use his mobile device in other situations, for other purposes, in other places and at other times of day compared to the Internet. There are similarities with a mobile phone and a PC, but there are more differences. The most important differences are that mobile phones have a smaller screen than a PC, smaller resolution and only black and white display and clearly falls short with regard to processor capacity and memory, making the device comparatively slow. Also, the handling of a mobile phone is more complex. Localisation and personalisation are the main elements that can give a mobile device added value over wired Internet services.

At one hand the ability to gather, process, and disseminate information on the Internet provides consumers with a wealth of benefits, on the other hand personal data may be used abusively. Another issue regarding legislation is defining the ownership of information and the degree in which it can be traded to third parties. Legislation clearly falls short in these areas.

To be successful, Mobile Internet services has to correspond with the trends in society. Social trends that correspond with Mobile Internet services are: The importance of age is decreasing and there is an increase in freedom of choice in society. Other trends are the fact that people are travelling more and that individualisation asks for highly personalised products. Also, the awareness of privacy issues is increasing.

In the next chapter, one of the main elements that can give a mobile device added value over wired Internet services will be explored, namely localisation. Personalisation also is discussed, but to a lesser extent.

4 Location-Based Services

4.1 Introduction

Increasingly, people are working on various locations, both inside and outside their offices. A new way of working is introduced: flexworking. Inside the office, that means a lot of people within the company do not have a desk of their own. They just choose a desk that is free when they arrive at the workplace. This requires new, flexible technologies, because people should have the same telephone number, independent from which desk they occupy. People should be able to access their files from everywhere in the building. Outside the office, flexworking means people tend to work at least one day a week at home. They must be able to access their files from their homes and perhaps log in to the companies' intranet.

More often, people are working when they are travelling. For example on the way to the office, they can check their email and plan the day, make some calls etc. In some lines of work, people are on the move all the time. For example sales representatives are out of the office most of their time. When they would be able to access company information, obtain route information and customer addresses on-line real-time from the office without having to go to the office physically, that would save a lot of time and costs. Mobile solutions are almost a necessity for them in order to survive.

This chapter will review location-based services (LBS). Paragraph 4.2 reviews location determination aspects and paragraph 4.3 discusses LBS, its major drivers, its technical background and its added value. Finally, the future and current developments of LBS are explored.

4.2 Location Determination and Positioning Technologies

4.2.1 Extending the fixed networks

This paragraph will be started with a brief overview of the history of telephony. In the beginning all telephony was analogue. A telephone conversation required a pair of copper wires. Both sides of the conversation were carried on a single pair. This worked well for short distances, but the longer the telephone cables the louder you had to speak. Eventually, the distance became too great for shouting and electronic amplification had to be added. This required two pairs of wires since the two speech paths require separate amplification, one for the mouthpiece and one for the earpiece. A signalling system was also required to provide routing information for the call, the dialled number and whether the handset was on or off the hook. The signalling added a further pair of wires. [45] So, the problem with analogue telephone systems is quite clear: there are many wires needed to provide the service.

The telephone companies used a technique called Frequency Division Multiplexing to transmit more information on a single pair of wires. With this technology, a single copper pair can carry more than one speech path if each speech path occupies a different bit of the frequency spectrum. In recent years, telephone network providers have changed from an analogue to digital networks. Digital Telephony transmits information like speech in a binary format. Once speech has been digitised, transmission and switching becomes a lot simpler. Binary systems are relatively reliable, they have enormous capacity and are less expensive than analogue systems. [46]

[45] http://www.wilco-telephony.co.uk/telephony.html , 02-04-2001
[46] http://www.wilco-telephony.co.uk/telephony.html , 02-04-2001

4.2.2 Satellite phones and the Internet expanding

Satellite communication technologies meant a major leap forward. Satellite communications is the only truly commercial space technology, generating billions of dollars in sales of products and services annually. In 1957, the Russians launched the first earth satellite, the Sputnik. In 1965 the Communications Satellite Corporation's (COMSAT) EARLY BIRD was launched, the first commercial communications satellite. This marked the beginning of global satellite communications. In 1964 a new international organisation was born, the International Telecommunications Satellite Organization (INTELSAT), which would control ownership of the satellites and responsibility for management of the global system. From a few hundred telephone circuits in 1965, INTELSAT has currently grown to a system with the capability of providing hundreds of thousands of telephone circuits. [47] In 1976, COMSAT launched a new kind of satellite to provide mobile services to the United States and other maritime customers. In the early 1980s, Europe followed to provide the same services. Today, several companies have committed themselves to providing a version of the mobile telephony system using satellites in low earth orbits.

Beside the developments in satellite technology, which made it possible to communicate even at the most isolated places in the world, the distribution of the Internet throughout the world made it the medium for interaction between individuals through their computers without regard for geographic location. Or, as Leiner et al. (2000) state it: "the Internet has revolutionised the computer and communications world like nothing before."

The Internet has changed much in the three decades since it started as the creation of a small amount of dedicated researchers. It now has grown to be a commercial success with billions of dollars of annual investment. And it is still evolving. It will continue to change and evolve at the speed of the computer industry. New modes of access and new forms of service will spawn new applications, which in turn will drive further evolution of the Net, as the Internet sometimes is called. As a result, the Internet can now provide real time data transport, in order to support for example streaming media (e.g. audio and video). Another application is that of Internet telephony and, perhaps in the near future, Internet television. Originally, the Internet was never designed to carry voice signals. Packet-switched networks like the Internet were typically designed to carry data. Nevertheless, through a Quality of Service mechanism, this packet-switched network is now able to carry real-time traffic such as voice, video and audio. Last but not least, the availability of the Internet along with powerful computing and communications in portable form, like mobile phones and Personal Digital Assistants (PDA's), offers new opportunities. Developments in Mobile Internet were more extensively described in Chapter 3.

As the quote below from Leiner et al. states, how the Internet will develop in the future is a question that is difficult to answer, since more interest groups are involved in the development today and a lot of money is involved for most parties.

> "The most pressing question for the future of the Internet is not how the technology will change, but how the process of change and evolution itself will be managed. The architecture of the Internet has always been driven by a core group of designers, but the form of that group has changed as the number of interested parties has grown. With the success of the Internet has come a proliferation of stakeholders - stakeholders now with an economic as well as an intellectual investment in the network. We now see, in the debates over control of the domain name space and the form of the next generation IP addresses, a struggle to find the next social structure that will guide the Internet in the future. The form of that structure will be harder to find, given the large number of concerned stakeholders. At the same time, the industry struggles to find the economic rationale for the large investment needed for the future growth, for example to upgrade residential access to a more suitable technology. If the Internet stumbles, it will not be because we lack for technology,

[47] Whalen, 27-03-2001

vision, or motivation. It will be because we cannot set a direction and march collectively into the future (Leiner et al., 2000)."

4.2.3 Global Positioning Systems

The Global Positioning System (GPS) is a satellite navigation system that was developed initially by the U.S. Government for military applications. Still, the system is funded and controlled by the U.S. Department of Defense, although there are thousands of civil users of GPS worldwide nowadays. GPS uses radio signals sent from orbiting satellites and receivers on the ground, which collect and convert radio signals into position, velocity, and time information. This way, GPS allows for computing positions anywhere on earth. The position is calculated from distance measurements to satellites. Normally, four GPS satellite signals are used to compute positions in three dimensions and the time offset in the receiver clock (Dana, 2000). The distance to a satellite is determined by measuring how long a radio signal takes to reach its destination from that satellite. See figure 4.1. [48]

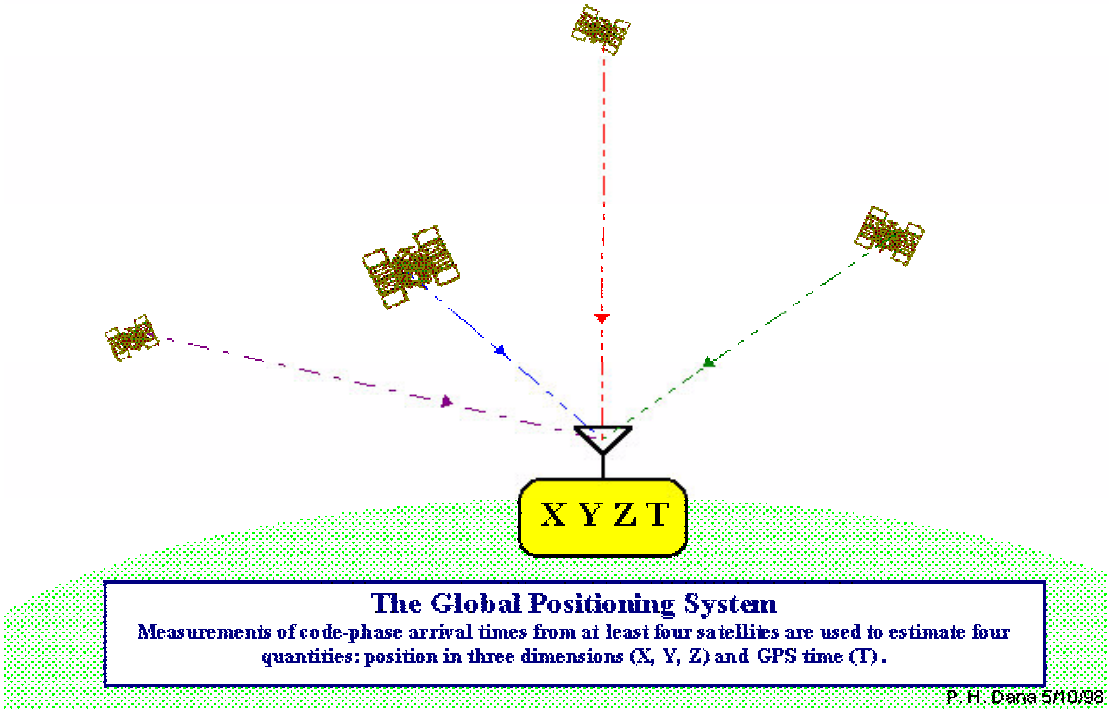


Figure 4.1 The Global Positioning System

A few years ago, GPS had a more accurate version for authorized users (Precise Positioning System, PPS) and a more common version (Standard Positioning System, SPS). This standard version contained an intentional error through which accuracy decreased. This standard error was called selective availability. However, since May 1, 2000, this selective availability is turned off. [49] In theory, it is possible for SPS receivers to match the accuracy of PPS receivers under normal circumstances. To correct the standard error, Differential GPS (D-GPS) was developed. D-GPS is based on the idea that if a GPS receiver is set up on a known location, acting as a static reference point, it can be used to figure out exactly what error the satellite data contains. It can then transmit an error correction message to any other GPS receiver that is in the local area, which can use the error message to correct its position solution. D-GPS is no longer used as error corrector. However, D-GPS is still more accurate, because it uses a fixed ground station. Accuracies up to a few centimetres can be reached. [50] Normal GPS can also be very accurate. The accuracy depends on several factors,

[48] Dana (1999)

[49] http://www.igeb.gov/sa/ , 18-04-2001

[50] http://www.igeb.gov/sa/faq.shtml , 18-04-2001

among others the position of the satellites measured from the point to be located. Formerly, accuracy of better than 100 metres was obtainable at most. The authorised version of GPS had accuracy of better than 25 metres. Now, an accuracy of better than 20 metres can be obtained.[51] A main disadvantage of GPS is the receiver needs to be within reach of satellites. In an urban area with high buildings this can be a problem. Also distortions of TVs or PCs can affect accuracy.

A relatively new development concerning GPS is Internet-based Global Differential GPS (IGDG). IGDG is a software package that provides complete end-to-end system capability for GPS-based real-time positioning and orbit determination. With an accuracy of 10 cm horizontal and 20 cm vertical real time positioning, IGDG is by far the most accurate real time GPS. IGDG collects, edits, and compresses the raw GPS observables at the remote site. It then transmits the packetised data over the open Internet to the processing center. At the processing center, the global data is analysed by IGDG to produce precise GPS orbits and clocks. These are formatted as corrections to the GPS broadcast ephemerides [52], encoded, and are provided over the Internet to authorised users. [53] Accuracy is measured by performing real time positioning (at 1 Hz) of a stationary user, and comparing the estimates with its surveyed location. The position estimates do not assume any knowledge of the user dynamics, and thus are valid for users in motion. [54]

GPS can be combined with a mobile phone by building a GPS-component into the handset. Another way to integrate GPS into the mobile system is to insert the GPS centrally into the network infrastructure. Because of the costs of building the necessary equipment, the combination of GPS and mobile phone is not yet available for the mass market.

4.2.4 Mobile positioning systems

Various forms of mobile positioning systems (MPS) will be highlighted in this paragraph. The name MPS was given to the positioning system, which Ericsson developed. This name has become a group name for a collection of positioning systems.

Microcells

Microcells report when users enter or leave a certain area. Microcells are small base stations designed to cover a fixed area, like an airport or shopping mall, and track when users enter or exit the area (The Forrester Report, 2001, p. 2). Operating a microcell allows retailers to send a welcome message when customers enter the shop. Although this looks very attractive for companies, it is very expensive to place a base station at each site and to connect it to a mobile operator for call completion. Another disadvantage of this positioning method is that users cannot be tracked within a cell, only when they enter and leave it.

Cell Of Origin

GSM-networks are originally not designed to use mobile phones for positioning purposes. Through a GSM-network, the position of a mobile phone can be estimated roughly with a method, which is called the cell-ID or Cell Of Origin (COO) method. COO requires no modification to the mobile phone or networks and therefore is able to be used as the positioning system for existing subscribers. The cell area of the mobile network base station is used as the location of the caller. The position can be traced more exactly when a person is calling. While calling, the location can be determined within a range from 200 metres to 5 kilometres, depending on the size of the cell area. That is the reason why in densely populated areas accuracy is better than in peripheral zones. COO is the only technology that is widely deployed in wireless networks today. [55]

---

[51] http://www.igeb.gov/sa/faq.shtml , 18-04-2001

[52] Ephemerides are essential tools for accurate aiming of communications satellites, especially ones that exhibit significant movement relative to a fixed position on the Earth.
(http://www.its.bldrdoc.gov/projects/t1glossary2000/_ephemeris.html , 10-07-2001)

[53] *Internet-based Global Differential GPS*, GIPSY-OASIS (GOA III), 18-04-2001

[54] *Internet-based Global Differential GPS*, GIPSY-OASIS (GOA III), 18-04-2001

[55] *An Introduction to Mobile Positioning*, http://www.mobileipworld.com/wp/positioning.htm , 18-04-2001

Time of Arrival and (Enhanced-Observed) Time Difference of Arrival
A few other positioning technologies using GSM-signalling are Time of Arrival (TOA), Time Difference of Arrival (TDOA) and Enhanced-Observed Time Difference of Arrival (E-OTD). These are overlay triangulation technologies based on timing or angle of signal transmission and reception at the handset. With TOA systems, the time of arrival of a signal from a base station to a mobile device is measured. The base station must therefore be equipped with receivers. TOA works on every mobile phone, so devices do not have to be modified.

When at least three base stations are measuring the Time of Arrival, the difference in time of arrival of a signal from a mobile device to this base stations can be translated into the difference in distance between the mobile device and the base stations, which makes it possible to calculate the location. The TDOA method is based on this principle. Base stations must be synchronised to make the process possible.

Problems associated with TOA and TDOA systems are that, although accuracy offered is slightly better than that of Cell Of Origin in urban areas, the process of synchronising the base stations causes delay in the positioning process, so the speed of response is slower than the Cell Of Origin method. The cost of synchronising a GSM network is therefore relatively high for little increase in performance offered over the use of Cell Of Origin. One advantage of TOA and TDOA is that no handset modification is required and services can therefore be offered to existing customers, but this is also the case with COO. [56]

E-OTD schemes offer greater positioning accuracy than Cell Of Origin, between 50 and 125 metres, but have a slower speed of response and require software modified handsets, which means that they cannot be used to provide location specific services to existing customers. [57] The quote below explains how E-OTD works.

> "E-OTD systems operate by placing location receivers or reference beacons, overlaid on the cellular network as a location measurement unit at multiple sites geographically dispersed in a wide area. Each of these beacons has an accurate timing source and when a signal from at least three base stations is received by an E-OTD software enabled mobile phone and the location measurement unit, the time differences of arrival of the signal from each base station at the handset and the location measurement unit are calculated. The differences in time stamps are then combined to produce intersecting hyperbolic lines from which the location is estimated."[58]

RadioCamera
Another positioning technology is called the RadioCamera system. "RadioCamera is a high performance network-based geolocation system that pinpoints the location of a wireless telephone subscriber anywhere, anytime, with close precision." [59] The RadioCamera system uses the Location Pattern Matching technology developed by U.S. Wireless Corp. as the location determination technology, and the system supports all the wireless standards. According to the Wireless Technology Inc. website, "cost-effective and flexible, the RadioCamera can locate wireless callers from a single cell site and integrates easily into existing wireless network base stations, without adding any equipment to the user's handset or making major modifications to the network infrastructure." [60]

---

[56] *An Introduction to Mobile Positioning*, http://www.mobileipworld.com/wp/positioning.htm , 18-04-2001
[57] *An Introduction to Mobile Positioning*, http://www.mobileipworld.com/wp/positioning.htm , 18-04-2001
[58] *An Introduction to Mobile Positioning*, http://www.mobileipworld.com/wp/positioning.htm , 18-04-2001
[59] http://www.wti.co.kr/rc.htm , 18-06-2001
[60] http://www.wti.co.kr/rc.htm , 18-06-2001

One of the most unique features of the RadioCamera is its ability to work in all geographical environments, because it is the only positioning system that does not rely on line of sight to multiple points of reference to determine location and it requires only base station to function, so it is very well suited to areas where the number of available base stations may be limited, like mountainous and rural areas. Basically, this technology is based on the fact that radio frequency (RF) signals send out by each wireless phone from a given geographical location has a distinct pattern by the time it reaches the base station antenna of the carrier. Interference caused by natural or man-made objects causes the signal to break up into a number of different paths (multipath). Hence, each location produces a unique RF signature pattern. RadioCamera technology determines the location of a subscriber by measuring this RF pattern, which is compared to a database of previously identified RF signatures and their corresponding geographic locations. Through a pattern matching process, the location of the caller can then be identified.

The picture below gives a short overview of this technology. [61]

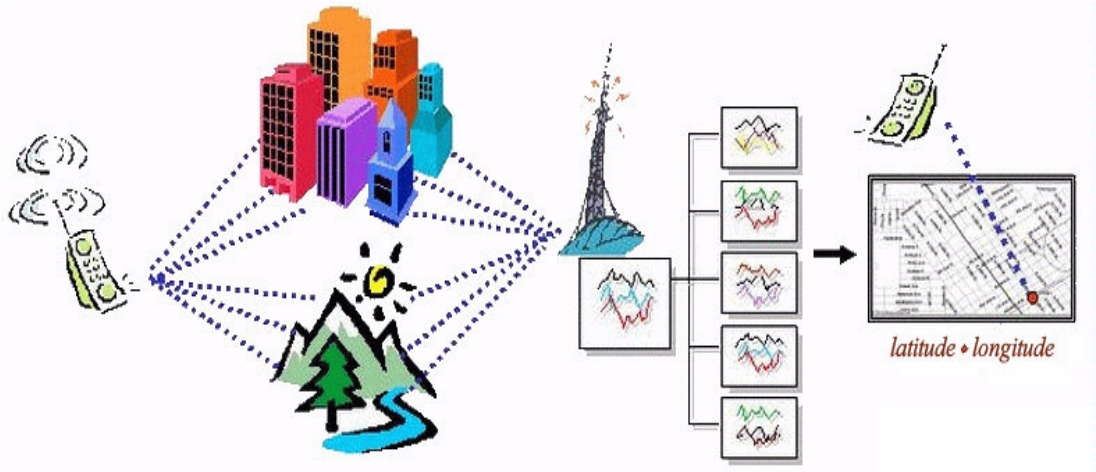


Figure 4.2 RadioCamera technology explained

1. A call placed from a wireless phone emits radio signals.
2. The signals bounce off of buildings and other obstacles, reaching their destination (the base station) via multiple paths.
3. At the base station, the RadioCamera-system analyses the unique characteristics of the signal, including its multipath-pattern, and compiles a signature.
4. The signature pattern is compared to a database of previously identified locations and their corresponding signature patterns, and a match is made.

Ericsson's Mobile Positioning System

Ericsson has developed its own positioning system, called Mobile Positioning System (MPS). MPS requires no specific modifications to standard GSM phones and terminals. The system has been selected as the basis of future European and North American standards. MPS is a server-based solution that allows positioning services to be introduced into any GSM network that has Ericsson switching systems. Via MPS the door will be opened to a whole new range of location-based services.

> "At the heart of the Ericsson MPS is the Mobile Location Centre (MLC), a system that allows user applications to access position information for GSM phones. An Application Programming Interface (API) will be available to allow the development of custom applications. The MLC also handles access security, and protects subscriber privacy by allowing GSM users to choose whether or not their phones and other devices are tracked."[62]

[61] http://www.wti.co.kr/rc.htm, 18-06-2001

[62] *Ericsson's new mobile positioning system uses standard GSM phones*, Ericsson press releases, 05-11-1998

"The European Telecommunications Standards Institute (ETSI) and the American National Standards Institute (ANSI)-accredited T1P1.5 authority have decided to work jointly on a GSM mobile positioning standard based on the Ericsson system." [63]

"Ericsson expects that in addition to deployment for emergency services, fleet management, logistics and stolen vehicle tracking applications, the system will be used to deliver mass-market services to any GSM subscriber. Examples include "Where am I?" guidance, roadside assistance, local news, information and weather reports, and "yellow pages" services." [64]

The different technology types are summarised and compared in the table below. [65]

Technology Scheme	Network or Handset based	Advantages	Disadvantages
COO	Network	No modifications needed to networks or handsets	Relatively low accuracy
E-OTD	Network		Software modified handsets needed
TOA/ TDOA	Network	Uses existing network features	Relatively low accuracy
GPS	Handset/ Network	GPS is free to use	New handsets needed
RadioCamera	Network	No modifications needed to networks or handsets, works in complex geographical environments	
MPS	Network	No modifications needed to networks or handsets	

Table 4.1 (Dis-)advantages of different MPS technologies

Summarised, positioning is a relevant development to support the mobility of the user with specific location-based services. Positioning can bring the user many new applications, which are meant to make life easier. In the next paragraph, a closer look will be taken at this location based services.

4.3 Location-Based Services

4.3.1 Introduction to location-based services

This paragraph discusses location-based services (LBS). It starts by defining LBS and by discussing three major drivers of LBS. Furthermore, technical backgrounds on LBS are presented and the added value of LBS is explored. The paragraph finishes with highlighting developments around LBS today and in the future.

Defining location-based services

Services are usually acquired using a device and/ or an application. Those "applications often need to dynamically obtain information that is relevant to their current location (José and Davies, 1999, p. 2)". José and Davies (1999, p. 2) define a location-based service as "an, otherwise normal, Internet service with a scope that defines its usage in terms of a geographical area."

[63] *Ericsson's new mobile positioning system uses standard GSM phones*, Ericsson press releases, 05-11-1998

[64] *Ericsson's new mobile positioning system uses standard GSM phones*, Ericsson press releases, 05-11-1998

[65] *An Introduction to Mobile Positioning*, http://www.mobileipworld.com/wp/positioning.htm , 18-04-2001, Table 2

Beinat (2001, p. 6) describes location-based services as "services that add value by using the location component". In the same article the author also distinguishes three classes of LBS. Firstly, information services, which provide information about objects close to the user (examples are services which locate the position of the user, which locate the nearest ATM or provide route-information, etc.). Secondly, interaction services can be distinguished. These services are based on the interaction between mobile users and/ or objects. Furthermore, they do not require a 'Mobile Internet' component or content sources. Examples of these services are: "Where are my children?", "Where is my car?" and "Where is the closest emergency car to an accident?" Mobility services form the last class of LBS. They support smart mobility and revolve around navigation capabilities. For example, "How do I get from A to B?" and "What is the quickest reroute to avoid a traffic jam?"

Drivers and inhibitors of location-based services

Beinat (2001, p. 7) distinguishes three major drivers of LBS. The first major driver is the US regulation for wireless emergency services (e911). The Federal Communication Commission (FCC) requires carriers to provide location information automatically to 911 call centres on calls from mobile phones. Another driver of LBS is the distinct relationship between mobility and location. The availability of data communication protocols in all handsets makes it attractive to develop information services for a wide range of devices and users. The third major driver for the developments of LBS is the need for operators to differentiate their offerings and to generate revenues from channels other than voice.

There are also some major inhibitors to the deployment of LBS (Beinat, 2001, p. 9). Operators are only willing to implement LBS in their strategy when market, financial and commercial implications of LBS are clearer. Furthermore, LBS are a new competence area for operators. Location technology and the knowledge required to make the best out of position information is not (yet) a core competence of mobile operators. Another inhibitor of LBS deployment is the technological uncertainty that surrounds the whole mobile industry (networks, protocols and devices are still developing and changing). LBS for consumers will both be an opportunity and an inhibitor. Lack of interoperability of the different devices in combination with a large variety of devices makes it difficult to define a service that fits them all. Beinat believes that stable and reliable device-independent platforms are key to implementing successful location-based services and that interoperability is crucial.

Three elements enabling location-based services

The Forrester Report (2001, p. 2) distinguishes three elements that enable LBS. The first element is the technology for pinpointing mobile users' locations. This technology varies from rough positions with the Cell-ID method to precise coordinates with GPS (see paragraph 4.2). The second element is applications. The Forrester report (2001, p. 5) states:

> "Locating users is only the first step. With X,Y coordinates identified, firms need mapping software to transform coordinates into locations, a mobile platform to deliver services, and geocoded content to feed those services. These applications may be either operated by the company providing the service or hosted by an operator."

LBS applications are highly dependent to location accuracy. The normal structure of an LBS application includes a series of content repositories usually accessed through the Internet; a database platform for spatial and non-spatial information, an LBS platform that performs the main location intelligence tasks, an application software platform that manages content, connection between data sources and LBS modules, and the user interface (Beinat, 2001, p. 9). The table on the next page gives some examples of (location-based) applications related to location accuracy. [66]

[66] Beinat (2001, p. 8) (adapted from Location Based Services requirements Document, Randholph Wohlert, GSM North America, 2000)

Location accuracy	Application
Location independent	Stock prices, news, bank transactions, email, agenda
Regional (> 100 km)	Weather reports, regional news, generic traffic conditions
District (up to 20 km)	Local news, traffic reports
Up to 1 km	Vehicle asset management, fleet management, congestion avoidance
500-1000 m	Emergency services, manpower planning, information services, point of interest search
100-200 m	Urban SOS, localize advertisement, network maintenance, asset tracking, nearest point of interest, people location, wireless ICQ
10-100 m	Asset location, stolen vehicle, turn-by-turn directions
Indoor one-to-one identification (less than 1 meter)	Object identification, shop information

Table 4.2 Location-based applications and accuracy

The third element in the Forrester report (2001, p. 7) is the availability of location information from operators. Some operators use location information only for their own services, giving their mobile portals an advantage over their competitors. Other operators invite selected partners to use the location data in their mobile services only on operators' terms, for example when accessed from the mobile operator's portal. Mobile operators can also sell location information to third parties on a per-request basis.

4.3.2 Technical backgrounds on location-based services

Several systems are designed with the purpose of associating information with location contexts. José and Davies discuss these systems and compare them with their own system design. Their overview will be highlighted here because it is important to understand how the relation between location and information is being set up. [67]

First there is the Service Location Protocol (SLP) [68], which is the standard proposed by the Internet Engineering Task Force (IETF). SLP is a standard for service location with a single administrative domain, designed for local area networks under a single administrative design. This makes it unsuitable for use on wide area level. The second technology is Wide area service location [69], which is designed to overcome the limitations of SLP. The difference with the system design of José and Davies is that this technology is designed to select a service anywhere on the Internet regardless of location, whereas José and Davies use locations as a basis for service selection. Thirdly, there is GPS [70]. This technology aims to integrate the concept of physical location into the design of the Internet. It can be used to support geographical services. This approach differs from the work of José and Davies in its assumption that every node can independently determine its own geographical position. Also, it differs in the concept of proximity: GPS's concept of proximity is based on the absolute physical proximity between the location of clients and servers. Fourthly, Imielinski has done research on Wireless Information Systems [71]. In his exploration of location-dependent information services, he sees the mobile wireless environment as a collection of wireless cells, managed by Mobile Support Stations (MSS). Information pages are accessed from a set of mobile hosts that interact with MSS to obtain the information they need. Each MSS has different pages available, depending on the location of the client. In his work, Imielinski assumes the existence of a homogeneous wireless system. José and Davies drop this assumption in their work. The fifth technology is called the Universal Interaction System

[67] Rui and Davies (1999, p. 3-14)
[68] Guttman et al. (1999)
[69] Rosenberg, Schulzrinne and Suter (1997)
[70] Imielinski and Navas (1996)
[71] Imielinski and Viswanathan (1994)

(UIS) and it is designed by Hodes [72] and is closest to the notion of location-based services in the work of José and Davies. One difference is that the UIS is mainly oriented towards device interaction and interface-adaptation, while José and Davies use an information-centric approach. This difference has consequences for systems design decisions, most notably scale. Another difference is that Hodes' system is closely tied to the network beacons and does not support any form of hierarchy, whereas José and Davies propose a scope model that can model physical space and scale to the Internet level.

Now, the work of José and Davies itself will be discussed. José and Davies claim the existing systems mentioned above are pragmatic in their approaches and are not abstract enough to be applicable to a broad range of scenarios. Also, the existing systems do not handle the issue of proximity in the right way. The systems see proximity as a very abstract concept, which varies in different contexts and for different activities. José and Davies consider it a key requirement that the system is able to support additional layers of proximity on top of the basic notion provided by the underlying technologies. The systems define proximity in the absolute way, whereas José and Davies (1999, p. 4) define it in a relative way in the physical context. The goals of José and Davies (1999, p. 5) in designing the framework are:

- Provide support for multiple views of space and notions of proximity over the same infrastructure. A flexible hierarchy of symbolic locations addresses this requirement;
- Support mechanisms for locating services that are effectively based on physical location. Such mechanisms should allow two collocated devices, attached to different networks, and under different administrative domains to have access to the same service information, and
- Service scopes are represented in terms of physical space. Symbolic locations are used as contexts for service location. Location context is the key component, which indicates the scope of their services for servers and the area where clients want to find services. In this architectural framework, location contexts are organized in a hierarchical way, from town-level to room-level for example. Location contexts may overlap. Each participating network must map to a location context. That way, devices can determine their position through their point of attachment to the network. Multiple networks may be mapped to the same location context. This represents the overlap in coverage areas. Alternative ways of determining location may also be used, either as a substitute or complementary.

The architecture is based on LBS servers. These servers have two main functionalities: Maintain a dynamic repository of service registrations and satisfy requests upon that information, and support the hierarchy of location contexts. The second functionality includes maintaining information about the location contexts and their relationships. Servers can share their service offer spaces, but also work separately. This allows for supporting larger location models.

How does it work in practice? From its point of attachment to the network, and possibly with the collaboration of other locating technologies, a device determines its current location context. Since the name of the location context includes a reference to the respective LBS server, applications on the device (clients or servers) may start to interact with the appropriate server. When a location context is contained within another, then the services registered in the containing location are also available in the contained location, subject only to systems policies. The basic level of proximity that a device may use to find services is the smallest location context in which it may assume to be. Enlarging this proximity range, i.e. searching for services in a wider area, is achieved by changing the scope indicated in the service request to a higher location context. As a result, only the services that have been registered for that wider scope will be returned. The advantage of this approach is supporting a scalable notion of proximity, in which the range of proximate selection may be expanded

[72] Hodes et al. (1997)

without an exponential increase in the number of returned services. The services in smaller locations offer more specific information about events that take place in the respective area, while the service for the town only lists the most important events, i.e. those whose scope surpasses the town area in which they occur.

The use of a location hierarchy supports some interesting options in the association of information with location. For example, town-wide information may easily be associated with the town location context, thus avoiding the need to replicate it on each cell. Clients have the possibility of selecting the most appropriate proximity level for obtaining information.

Open issues and potential difficulties with the architecture are (José and Davies, 1999, p. 12):

- Creating the information space of an application may imply interacting with a large number of servers and may involve many more aspects, such as the characteristics of the services, user preferences in service selection or service content;
- Security requirements must be analysed carefully, and
- Prefetching and caching of service information may also be considered, as a way to optimise performance and support weakly connected operation.

Advantages of the architecture are (José and Davies, 1999, p. 13):

- New sources of information may be added by simply registering new services;
- New types of information may be supported with the creation of new service types;
- Other networks, wireless or not, may be used for accessing the same services, depending only on the existence of a mapping to location contexts, and
- The same information infrastructure may easily be used as the basis for new unpredicted applications.

Several location determination technologies have been discussed in this paragraph. The future will learn which technology will dominate the LBS market. We agree with Beinat (2001, p. 9) in believing that stable and reliable device-independent platforms are key to implementing successful location-based services and that interoperability is crucial. A truly open standard must be developed if LBS is to spread worldwide.

4.3.3 The added value of location-based services

In our opinion, viewing LBS as a sort of Mobile Internet service is not right. People on the move do not have computers with them that have the capacity, speed and large screens of a PC at home. LBS should be designed, taking these differences into account. With the limitations of user devices, designing LBS is the art of excluding unnecessary things. To create added value, benefits must encompass costs.

An example of a location-based service, which has clearly proven its success is P-Info for the Dutch police force. Geodan Mobile Solutions has developed P-Info as a specific configuration of its LBS for mobile police agents. P-Info enables police agents to access information from police databases without intermediaries at any time or place. P-Info offers search functions for incidents, persons and vehicles, location services for mapping, spatial search, route planning and office functions for agenda and contacts, e-mail, SMS and fax. [73] Researchers concluded that a police agent equipped with P-Info could spend 20% more of his time on the streets! This way, the Dutch police force can be present in the streets more frequently without attracting new police agents. A worthwhile investment, so to speak! [74] Because of the successful pilot project, the Dutch ministry of Interior has decided that 2500 police agents must be equipped with a mobile device in the next year!

[73] http://www.geodan.nl/ , 25-06-2001

[74] *Pilot Draadloos Informatie-Systeem Voor De Politie*, Geodan Mobile Solutions (2000) (confidential)

Geodan has built a prototype of a LBS at a conference in Cannes. The customer would be seated in a taxi, driving around in Cannes. On a screen in the back of the cab, the customer could see the taxi on the map of Cannes, real-time, through a GPS-module inside the taxi. On the map locations where marked. The customer could click on these markers to obtain information about that location, for example a discotheque. Also, the customer could reserve dinner places in a restaurant through clicking on a restaurants marker and using the reservation service. The connection was a wireless Internet connection. The map had tree scope levels. At the same time, the taxi central in Cannes has the same application running on a big screen. Some people where given a mobile phone with a special button on it and a GPS-unit built inside. When they pressed the button, the taxi central got a signal that a customer wanted a cab. They could immediately see the customer on the map of Cannes. Also, they could see the taxis driving around. The free taxi closest to the customer was sent to pick up the customer.

According to Scholten[75], LBS can really make a difference and save time and thus costs in lots of situations. For example sales representatives travel a great deal. When they use a route-planner to optimise their route, they can shorten their routes with as much as 18%! This means less fuel is needed, less time is used, which all lead to cost savings. Another example is of the average dispatch time of the Dutch police force. The Dutch law requires police agents to arrive on the scene within 10 minutes after receiving a call. Without LBS, the Police force succeeds in this requirement in 72% of the cases. With LBS however (the P-Info project of Geodan Mobile Solutions), this percentage increases to more than 90%!

Microsoft recognised the importance of LBS already years ago. One of their projects is Auto PC. "The Auto PC platform was designed to enable devices to provide convenient access to information where many people - like today's mobile professionals - spend a lot of time," said Jonathan Roberts, general manager for Windows CE at Microsoft in a news report of December 4, 1998. A goal in designing the platform was to build a system that allows drivers to keep their focus where it should be - on driving. Designers found the answer in the use of voice technology. "Drivers' hands stay where they should be in a car - on the wheel, and their eyes stay on the road," Roberts said. In addition to stereo functions, the Auto PC comes with an address book for storing personal and business contact information; a navigation system called 'Directions' that allows users to map out driving trips; and an infrared port that lets users exchange data with other Windows CE devices, such as the Handheld PC or Palm-size PC. Because Windows CE platforms are designed to be expandable, users can choose from a variety of add-on options to expand the uses of their Auto PC. These options include CD changers, GPS, wireless communications and a cradle that integrates users' cell phones, letting them automatically dial numbers from their Auto PC address book.[76]

4.3.4 The future of location-based services

Predictions of several analysts indicate LBS will be amongst the most used mobile services, and that they will generate a significant part of mobile data revenues. For example, the ARC Group predicts that LBS will be the most used mobile service by 2005 and IDC estimates that almost 50% of European subscribers will use LBS by 2005, underlying a potential user basis close to 150 million users (Beinat, 2001, p. 6 and 7).

However, according to Beinat (2001, p. 9), there are misplaced and unrealistic expectations about LBS in the short-term. The full potential of LBS will not be disclosed before accurate location determination technology is in place, network bandwidth will be significant higher (the advance of technologies like GPRS) and better devices and protocols will be available on the market (e.g. i-Mode)). Beinat predicts that it might take anything between one to three years to remove the obstacles for a full-scale consumer uptake of LBS and that in the short term, LBS growth will only be realised in the professional market. The

[75] Scholten is a Professor at the *Vrije* Universiteit and Director of Geodan CN

[76] http://www.microsoft.com/PressPass/features/1998/12-4autopc.asp , 26-06-2001

Forrester Report (2001, p. 8 and 9) comes to more or less the same conclusion, when it states:

> "[Precise location information in a standardised form from all operators] will take years to materialize. Slow, spotty implementations and operator shortcomings will delay the use of location data by third-party marketers with mobile services […]. Mass-market services will not routinely tap location information for five years."

The Forrester report (2001, p. 9 and 10) distinguishes a few problems underlying the delayed rollout of LBS. The first problem is the difference in speed among mobile operators in which they will deploy location technology. A lot of operators will wait until faster networks, like UMTS, are rolled out. This is strongly related with the fact that loads of debt will cause operators to hesitate in developing new technologies. Revenues of location service initiatives are not clear yet, so operators will slow down the implementation of these services. Also the lack of standards poses a problem, although the Location Interoperability Forum and the Open GIS Consortium are trying to set up some standardisation. Secondly, the value of LBS will rise as availability and precision increases. However, the above-mentioned staggered operator implementations mean location information will not be widely available for years. Cell-ID technology also falls short in providing precise location information. Most operators will not offer better positioning technologies until faster networks are available. Besides this, it will also take some time for prices to drop. At the moment, operators are charging high fees for using location services to generate a premium. The Forrester Report (2001, p. 10) explains:

> "With only a few users, premium pricing makes sense for operators looking to maximize revenue. But as services proliferate and more users become addressable, operators will lower costs to drive volume. This will lead prices to drop […]."

Bridging the gap: location-sensitive services

Because of the fact it will take some years before real-time LBS will be launched, The Forrester report (2001, p. 11) believes that companies will build location-sensitive services that act independently of location-sensing technology offered by operators. The report comes to the following characteristics of location-sensitive services:

- Location-sensitive services treat location as an optional input. This kind of services deliver enhanced value when the location of the user is known but still perform when it is not;
- Location-sensitive services can be implemented today, because they draw on alternative location information reported by the user or inferred from the context, and
- Location-sensitive services will not wait for operators to act but will leverage real-time location information when they do.

Furthermore, the Forrester report (2001, p. 11) states:

> "To deploy location-sensitive services, companies must: 1) build services that don't require X,Y coordinates; 2) obtain alternative location information from many sources; and 3) integrate real-time location information as it becomes available."

Table 4.3 compares location-sensitive and location-based services (see the next page). [77]

[77] *The Forrester Report*, Forrester Research B.V. (2001, p. 12)

	Location-based services	Location-sensitive services
When feasible	2005	Today
Cost of location information	Determined by operator (up to €0.50)	Cheap of free
Key enabler	Location-sensing gear in mobile network	Business logic in mobile platform
Addressable users	Users of selected operators	All mobile users
Nature of service	Rigidly defined	Flexible

Table 4.3 Comparing Location-Sensitive and Location-Based Services

4.4 Summary and Conclusions

The problem with analogue telephone systems is quite clear: there are many wires needed to provide the service and the service does not have much capacity. Binary systems are relatively reliable; they have enormous capacity and are less expensive than analogue systems.

Beside the developments in satellite technology, which made it possible to communicate even at the most isolated places in the world, the distribution of the Internet throughout the world made it the medium for interaction between individuals through their computers without regard for geographic location. How the Internet will develop in the future is a question that is difficult to answer, since more interest groups are involved in the development today and a lot of money is involved for most parties. The availability of the Internet along with powerful computing and communications in portable form, like mobile phones and Personal Digital Assistants (PDA's), offers new opportunities.

GPS allows for computing positions anywhere on earth. GPS can be combined with a mobile phone by building a GPS-component into the handset. Another way to integrate GPS into the mobile system is to insert the GPS centrally into the network infrastructure. GPS is still too expensive to make it on the mass market.

Alternatives for the expensive GPS are mobile positioning systems. Various systems have been developed: COO, TOA, TDOA, E-OTD, RadioCamera and MPS. Most MPS are suitable for existing networks and handsets. The main disadvantage of MPS is they are not very accurate. Positioning is a relevant development to support the mobility of the user with specific location-based services. Positioning can bring the user many new applications, which are meant to make life easier.

LBS are services that add value by using the location component. There are three major drivers of LBS: The US regulation for wireless emergency services (e911), the distinct relationship between mobility and location and the need for operators to differentiate their offerings and to generate revenues from channels other than voice. There are also some major inhibitors to the deployment of LBS: Operators are only willing to implement LBS in their strategy when market, financial and commercial implications of LBS are clearer, location technology is not (yet) a core competence of mobile operators and the technological uncertainty that surrounds the whole mobile industry (networks, protocols and devices are still developing and changing).

Several location technologies are trying to dominate the (future) LBS market. Time will tell which technology will win. Stable and reliable device-independent platforms are key to implementing successful location-based services and that interoperability is crucial. The Location Interoperability Forum and the Open GIS Consortium are trying to set up standardisation. A truly open standard must be developed if LBS is to spread worldwide.

LBS have a lot of added value, as several projects already have proven. Predictions of several analysts indicate LBS will be amongst the most used mobile services, and that they will generate a significant part of mobile data revenues. However, there are misplaced and unrealistic expectations about LBS in the short-term. The full potential of LBS will not be disclosed before accurate location determination technology is in place, network bandwidth will be significant higher (the advance of technologies like GPRS) and better devices and protocols will be available on the market. Mass-market services will not routinely tap location information for five years. Until that time, companies will probably build location-sensitive services that act independently of location-sensing technology offered by operators.

In chapter 6, the mobile market will be analysed from a business point-of-view. However, before going to that analysis, a brief excursion is made into the field of knowledge management. Today's society is becoming mobile and the sharing of information everywhere is increasingly important. Mobile Internet services and LBS will play a significant role in developments in this area. Therefore, in chapter 5, knowledge management is discussed, both in theory and in practice.

5 Knowledge Management

5.1 Introduction

In today's society, knowledge is everything. The saying 'knowledge is power' fits this age more and more. Information has become a necessity of life. Mobility changes the way in which we share our knowledge. People are away from their workstation and on the move more often. The need for knowledge increases at the same time. This knowledge must be available everywhere. How to cope with this need is a question, which will be dealt with in this chapter. This question will be reviewed with regard to modern business in general and with regard to the WAPstad-project – how do we share information within our project group. Paragraph 5.2 will deal with the subject of exchanging knowledge in today's modern business life. Paragraph 5.3 will deal with exchanging knowledge in the WAPstad-project and paragraph 5.4 is about the Virtual Office of WAPstad.

5.2 The Information Revolution and Knowledge Management

5.2.1 The increasing importance of knowledge

In their article 'Information Society: economic and spatial consequences', Van den Hove, Heijs and Van der Linde (1999, p. 93-98) describe the revolution in the Information and Communication Technology (ICT) as "the complex process of increasing knowledge and information usage in our society". They see several strongly correlated factors behind these developments:

1. Internationalisation;
2. Specialisation of labour;
3. Dematerialisation of economic production processes, and
4. A speeding up in economic development;

They claim the effects of increasing knowledge and information usage work for a great part through changes in the economic structure. Increasing importance of information influences the economic structure as follows:

1. An increasing number of interactions and the emergence of knowledge management as a strategic production-factor;
2. Increasing market-transparency and changing market structures, and
3. The birth of network structures, network-innovations and new activities.

Information and knowledge are thus becoming more and more important. ICT makes sharing information and knowledge easier at all levels.

Van den Hove, Heijs and Van der Linde define knowledge management as "the managing of all forms of knowledge and skills, which are needed within an enterprise to innovate processes and products over and over". This definition applies to the management of knowledge with the purpose of innovation. In this chapter, the innovation of products will be disregarded while the definition will be extended to include the everyday work process. In order to let this process run smoothly, a lot of information and knowledge must be managed and shared. Also, enterprises alone are not looked at. Instead, all sorts of organisations are included in the definition. With these changes in mind, the following definition of knowledge management is formulated :

> The management of all forms of (1) knowledge and (2) skills, which are needed within (3) a social system to (4) innovate processes and to function (5) efficiently and (6) effectively

(1) Knowledge
Knowledge is defined as processed information.

(2) Skills
Different members of the social system have different skills. In order to function efficiently and effectively, these skills must be clear and manageable: information and tasks must be divided in the social system so that use of skills is optimised.

(3) Social system
"A social system is defined as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/ or subsystems" (Rogers and Scott, 1997).

(4) Innovation
"An innovation is an idea, practice or object that is perceived as new [by the members of a social system]" (Rogers and Scott, 1997).

(5) Efficiency
A social system functions efficiently when its resources are used optimally (Keuning and Eppink, 1996, p. 103).

(6) Effectivity
A social system functions effectively when its goals are reached according to plan (Keuning and Eppink, 1996, p. 103).

What are the advantages ICT can offer with regard to knowledge management?

- Better access to information causes market imperfections to decrease and reduces transaction costs;
- Specialised knowledge increases in importance, because it gets harder for companies to manage all knowledge themselves. There is simply an over-supply of information. Companies specialise, reduce their time-to-market and reduce the enterprise-risk;
- Innovation is becoming a partnership process of complete production chains, and
- Through co-operation and mutual dependency in the innovation process, ICT creates spill-over effects, which increase the importance of innovation in the ICT-sector for general economic developments.

5.2.2 Impact on mobility and usage of the environment

According to Van den Hove, Heijs and Van der Linde (1999), there are two consequences of the ICT-Revolution. The first is a change in mobility and usage of the environment in the form of replacement of physical transportation (of people) by electronic transportation (of messages). Teleworking is an example of this development. With teleworking, people work at home and 'connect' to their office through the Internet or by phone. In theory, teleworking reduces traffic and the number of employees working at the office, thus saving desk space. In practice, this does not happen on a large scale. Rietveld (1997) comments that the high expectations of the substitution-effects of ICT are unjustified, because there also are generation-effects that are possibly larger than the substitution-effects. A lot of work seems to be 'contact-sensitive'. The technical possibilities to travel cheaper and faster are being used to travel more and further, not to travel the same distance in less time and cheaper. This is called the Brever-law (Van den Hove, Heijs and van der Linde, 1999).

The second consequence of the ICT-Revolution is a change in spatial-economic structure. Death of Distance is one of the changes; geographical distance is becoming less and less important through usage of the Internet, fax and email. But at the same time, geographical location remains important because of existing networks, especially for knowledge-intensive companies. This is because there is a difference between explicit knowledge (codified knowledge), which can be documented and digitally sent over great

distances very easily and cheaply, and implicit knowledge (tacit knowledge), which is incorporated in people. The costs of transporting this form of knowledge are very sensitive to distance and this form of knowledge is best transferred in a face-to-face relation. Some economic activities tend to cluster. So-called localized spillovers often occur in these sorts of local networks.

In general, it can be said become a strategic asset through the ICT-Revolution. The sharing of knowledge and skills is becoming increasingly important in organisations. There are more and more possibilities to work together, regardless of location and time. This way, more work can be done in less time. Of course, there are restrictions that must be overcome: Not everybody has access to the Internet all the time, telephone lines can be busy, computers inadequate for the Internet, servers can be down or very slow due to traffic, etc. Also, tacit knowledge is (still) difficult to transfer electronically.

The ICT-Revolution has also changed the way in which research is being done. The Internet is a great source of knowledge; databases of libraries all over the planet can be accessed from everywhere in the world, white papers on new and still undocumented developments can be downloaded, the latest news can be received by email etc. The next paragraph describes how research is being done at the GIS-group of the Department of Spatial Economics of the *Vrije* Universiteit in Amsterdam, the Netherlands.

5.3 WAPstad: a Knowledge Management Project

5.3.1 What is WAPstad?

WAPstad is a growing group of students and researchers that are all in one way or another participating in research on the subject of LBS. The students come from various countries in Europe and are all connected with the *Vrije* Universiteit. WAPstad is an initiative of the GIS-group, part of the Department of Spatial Economics at the Faculty of Economics and Business Administration of the *Vrije* Universiteit in Amsterdam, the Netherlands. The Professor responsible for this group is Prof. Dr. Henk Scholten. Joost Buurman and Erik Koomen are two Ph.D. students who support the students who are writing their M. Sc. theses. An overview of the participating students and their research projects is presented in table 5.1:

Student	Project
Nils de Reus (NL)	Aqua-WAP - WAP and water recreation
Machiel Reinders and Jasper Dekkers (NL)	What About Wireless…? – An Analysis of The Mobile Market and Location-Based Services
Sandra Kruger (D) and Francisco Neves (P)	Location-Based Services in rural areas - *Providing location-based land-related information on mobile devices*
Francisco Neves (P) and Eduardo Diaz (P)	Flash animation of the Amsterdam-to-Go WAP-site (LBS)
Eduardo Diaz (P)	Environmental Impact Assessment of the construction of a new airport near Lisbon
Eric Koubi (F)	Geodan Web-Mapping Wizard

Table 5.1 Students and projects of WAPstad

Several businesses and government agencies are participating in the research process; these are organisations where the students are doing a traineeship and organisations that are interested in LBS. At the moment, the following businesses and government agencies are participating: Geodan Mobile Solutions, SPSS Market Research, Claritas Europe, the Ministry of Transport, Public Works and Water Management, province of South-Holland, Department Bureau Waterland, the Government Service for Land and Water Management (e.g. in Dutch Dienst Landelijk Gebied (DLG)), Oracle, Hewlett Packard and KPN-GITA. The relations between the students of WAPstad and the other participants are clarified in figure 5.1.

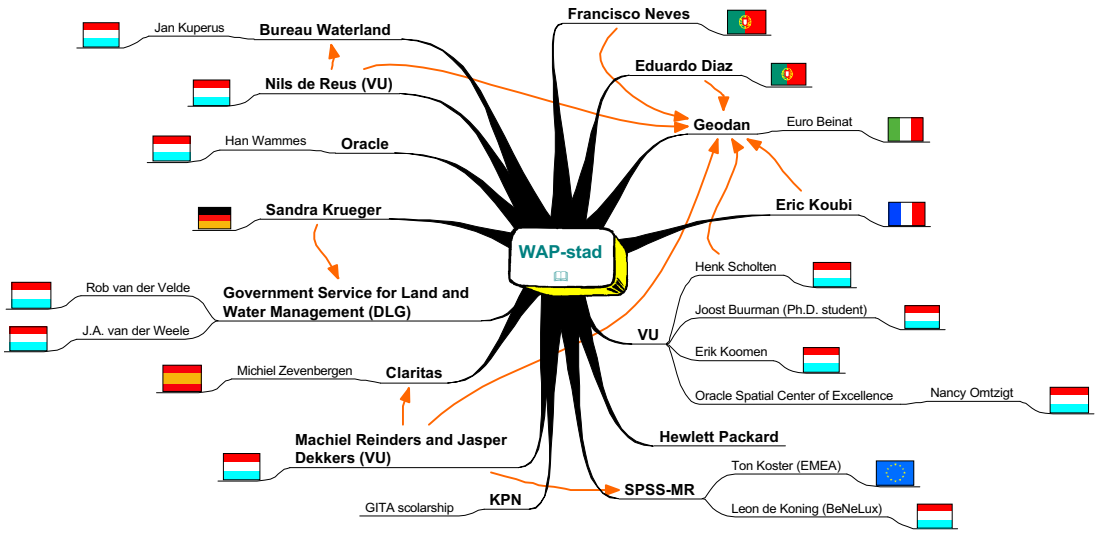


Figure 5.1 Relations between the participants of WAPstad[78]

WAPstad is a European community as can be seen. WAPstad is continuing to grow, as more students, researchers and companies are willing to participate.

5.3.2 Ways of exchanging knowledge everywhere

There are many ways of exchanging knowledge. In the old days, people would transfer knowledge by voice or by handwriting. Then, telephony and telegraphy were introduced, just as typing machines, radio and television. In the 1980's the personal computer was introduced. In the beginning, only affordable for the 'happy few', in the 1990's the PC became a common good. Nowadays, most households have one or more PCs. PCs became connected through the Internet more and more. In the second half of the 1990's, the mobile phone became available for the mass consumer market. Sophisticated technologies enabled people to call from everywhere in the world (although in practice, that is not so easy), and work while travelling on laptop computers. And the new millennium is the age of mobile devices: palmtops, smaller phones, people can use a complete mobile workstation with the aid of several devices! And what will the near future bring us?

Of course, the research sector takes advantage of these developments also and is searching for new ways of doing research. Field research is being made easier through the use of wireless devices and networks. Also, desk research is easier because of the availability of sources on the Internet. WAPstad is using all sorts of technologies to be able to work everywhere and to share knowledge and skills in the most flexible ways. How does it work? In discussing this, the organisation will be explained. Furthermore, what hard- and software is being used will be highlighted.

First of all, we have a physical office, called the GIS-lab; it is a computer laboratory at the *Vrije* Universiteit. All everyday technology is present there: computers, network connections, printers, telephone, and fax. A number of students actually work there most of the time. Other students work at, for example, Geodan or DLG.

Secondly, we have a Virtual Office, which is in fact a network of web-sites. The Virtual Office is used to exchange information through the Internet. The web-sites contain information about the research participants, the latest activities of the research group including agenda's and reports of meetings, project plans are presented on-line, there is a news-section with news items on LBS, wireless telecommunication and related subjects and there are links to related web-sites of research participants (businesses and government agencies), telecommunication companies, computer firms, 'new economy'-companies, news-sites, etc. The Virtual Office is discussed more thoroughly in paragraph 5.4.

[78] This figure is produced in MindManager 4.0

Most students in WAPstad work on laptop computers. That way, they can work everywhere. When there is a phone line or a Local Area Network-connection (LAN) nearby, they can connect to the Internet and share knowledge and skills. In theory, the students can also connect through their mobile phone, but in practice, this is too expensive for them, so they do not use that option. For the research work on LBS, it is important the students can use mobile devices to examine content, interface and technology. Because these devices are expensive and scarce, they mainly use emulators instead, although for some projects they use the real devices supplied by Geodan Mobile Solutions. The emulators work the same way as the real devices and are a fairly good alternative. Sometimes, an application does not run or a WAP-site does not load properly on an emulator, while it does run or load properly on a real device. Also, screen size may differ somewhat. The Ericsson R380-emulator [79], a Palm-emulator[80] and a Pocket PC-emulator are being used for research work. In addition, sometimes on-line Internet-emulators, for example the one at www.yospace.com are used. Also, a Nokia toolkit, including an emulator, is used to build and view WAP-sites.

For the research project around this thesis, the authors are working together intensively on some aspects of LBS with Nils de Reus, a student, and are using an Internet hard disk to share files and work on the same files for that purpose. [81] Also, the two authors write this thesis at the same time. They both write different chapters and paragraphs and put updates of their work on the X-Drive. This way, they can monitor each other's progress and avoid writing about the same things in different chapters. Also, when they have both finished their work on one joint chapter, they can merge the two files into one single file on that particular chapter and put in it another directory on the X-Drive. That way, they can see their progress, prevent the possibility of working in the wrong file and access the chapter's file from anywhere in the world. With the Internet hard disk, the authors kept experiencing technical problems, so for the past few weeks, they have decided to abandon the Internet hard disk and put all their shared files on one of their laptops. Because they both work at the GIS-lab most of the time, they can connect locally through the network and share the files they both use. Next to all the ways of exchanging knowledge mentioned above, the group of students and researchers meets every week face-to-face to update each other, exchange ideas etc. It is our opinion that this form of knowledge management will never disappear completely, because implicit knowledge is (still) difficult to transfer in any other way, and also because people need to have a sense of belonging and they can fulfil that need better by seeing each other once in a while than by only meeting 'virtually'.

5.4 The Virtual Office

5.4.1 The content of the Virtual Office

The Virtual Office is the most important way to manage knowledge and skills in WAPstad. [82] WAPstad is a virtual research city, where researchers can explore concepts like mobility, LBS, wireless etc. WAPstad (i.e. WAPcity) is based on Hewlett Packard's wireless concept called CoolTown[83].

The Virtual Office of WAPstad contains the following categories of information (see the next page):

[79] http://www.ericsson.com/developerszone/ (12-07-2001)
[80] http://www.palmos.com/dev/tech/tools/emulator/ (12-07-2001)
[81] http://www.xdrive.com/index_express.html (12-07-2001)
[82] http://130.37.52.14/gis/research/VIR/LBSCOM/default.htm (12-07-2001)
[83] http://www.cooltown.com (23-04-2001)

Category	Contents
About…	Information about participants, companies, students and university personnel;
Activities	Agenda's and reports of meetings;
Wireless news	News and updates from the 'wireless sector' (telco's, computer firms etc.);
Current projects	Project proposals, plans and updates are presented here;
Background and theory	This category is empty so far. The purpose of this category is to provide links to white papers, sites and books where background information and theory on LBS and closely linked subjects is available;
Research partners	The companies and government agencies who are participating in the research work are highlighted here;
Links	Links to telco's, computer firms, newsgroups, research partners, libraries etc.;
Physical office	Information about the whereabouts of our office, so people know where and how to reach us;
Wild corner	Here we place news items and stories from the 'wireless sector' that are funny, innovative, silly or just fun to read;
Published documents	Articles, theses and white papers written by students and researchers will be made available here;
Emulators	Information on how to get WAP- Palm- and Pocket PC-emulators;
Upload / Download	A link to the Internet hard drive.

Table 5.2 Content of the Virtual Office

Because WAPstad is just starting, the content of the Virtual Office is far from being complete. Not all categories are actually in use at this moment, not all the project plans and updates are there either. One of the main reasons for this is that for several weeks now, we have been expecting the Virtual Office to be updated very soon. The *Vrije* Universiteit has become an Oracle Spatial Center of Excellence. This means students and researchers can use almost all Oracle software, including Oracle Web-DB. This package will enable them to add and change content on the Virtual Office with just their browser. Unfortunately, the developments are not going as fast as they hoped they would go. Web-DB will probably be there somewhere in the summer, by the time this thesis is completed. But as soon as Web-DB is there and the Virtual Office has had its metamorphosis, students and researchers are expected to update their part of the Virtual Office, so everything is up-to-date. When all the information is there, WAPstad can function more efficiently and effectively. In order to improve functionality, a category must be included, perhaps as a sub-category in 'About MJN'. This category must include a description of skills of the students, researchers and participants. This way, the management of skills can be improved and with that co-operation between the members of the community.

In the future, more students will arrive and do research in WAPstad. The number of projects, links and participants will expand. In our opinion, the participants together should manage the content of the Virtual Office, but one person should be made responsible, a sort of Virtual Office Manager that is, in order to guard the update processes, content and to keep the overview of all processes.

5.4.2 Underlying software: Oracle-tools

The Virtual Office will be built with Oracle Web-DB. This is a software package that enables people to build and edit web-sites in a very user-friendly way. The advantage is that with Web-DB, every item that is represented on the web-sites has its source in an underlying database. When an item is edited on one web-site, the item is automatically changed in the underlying database and therefore on all the sites linked to that database. Users can access and edit the web-sites through an Internet browser like Microsoft Internet Explorer [84] or Netscape Navigator[85], if they have editorial rights to edit the web-sites. People often are experienced browser users, so the browser interface and environment is familiar to them. Before getting the Oracle Web-DB software, students and researchers have been using Microsoft FrontPage to edit the Virtual Office. With this program, they can update web-sites manually, but they do not have to have any knowledge about HTML or another Internet programming language. The program programs it for you. An advantage of FrontPage over Web-DB is that it has more possibilities, especially graphically, because a person can do more things manually. This advantage is at the same time a disadvantage, because it takes more time to build a web-site. Another disadvantage of FrontPage is that people cannot edit the web-site from everywhere in the world. For example, when students and researchers used FrontPage to update the Virtual Office, they could only connect to the web-sites when they were connected to the LAN at the *Vrije* Universiteit. With Web-DB, they can update the Virtual Office from anywhere in the world!

5.5 Summary and Conclusions

Increasing knowledge and information usage changes our society. ICT makes sharing information and knowledge easier at all levels. The following definition of knowledge management is used:

> The managing of all forms of knowledge and skills, which are needed within a social system to innovate processes and to function efficiently and effectively.

The effect of teleworking remains unclear. There are both substitution- and generation-effects. Part of the work cannot be done by teleworking, because of the difference between explicit knowledge (codified knowledge) and implicit knowledge (tacit knowledge). Face-to-face contact remains important in many cases. Also, some economic activities tend to cluster in local networks for this reason.

In general, it can be said knowledge has become a strategic asset through the ICT-Revolution. Sharing knowledge and skills is becoming increasingly important in organisations. There are more and more possibilities to work together, regardless of location and time. But there are restrictions to be overcome, since not everybody is 'virtually present' yet and networks are not yet that extended.

Desk research is made easier, because more and more sources are 'virtually present'. Field research is made easier also as a consequence of improved mobility through wireless devices and networks.

WAPstad shares knowledge in its Virtual Office. A lot of information is shared. When Oracle Web-DB, which enables participants to update content of the Virtual Office through their browser, can be used and the Virtual Office has had its metamorphosis, knowledge management will be improved. Recommendations are to improve skills management at the same time and in the future, when WAPstad expands, assign one researcher as Virtual Office Manager in order to keep the overview of content update processes.

---

[84] Downloadable from: http://www.microsoft.com

[85] Downloadable from: http://www.netscape.com

6 The Mobile Market: a Business Analysis

6.1 Introduction

This chapter analyses the Mobile Market from a business point-of-view. Paragraph 6.2 describes the players in the market, market dynamics, devices and applications and expected future developments in this market. Also, possible killer applications are described. Then, paragraph 6.3 contains visions of three well-known companies on the future: Hewlett-Packard with the CoolTown concept, Oracle with OracleMobile and Nokia with Nokia Mobile City. Finally, paragraph 6.4 gives an analysis of the mobile market using the market analysis model of Porter.

6.2 Market Developments

6.2.1 Players in the market

Which players are involved in the mobile market? In this paragraph, a look will be taken at some of the most important players. Roughly, the following players can be distinguished (Klein, De & Vos, 2000, p. 136 and further):

- Suppliers of mobile devices
- Providers of browsers
- Providers of software tools
- Providers of hardware (gateways)
- Mobile operators
- Mobile Internet service providers
- Mobile portals
- Transaction providers
- Content providers
- Merchants
- Advertisers

First of all, the suppliers of mobile devices are important players in the market. Suppliers can create added value, because customers are not only looking for a certain network, but also for a specific type of device. In introducing new services, like the Mobile Internet, suppliers of devices often are a critical factor, because phones are very personal devices. Appearance and features of the device are very important. Beside the common mobile phone suppliers, the role of PDA (Personal Digital Assistant) and handheld computer suppliers is increasing. Because of infrared and Bluetooth technologies, it is not necessary to integrate a mobile phone into a PDA or handheld computer. These technologies enable a PDA to use a mobile phone to connect with the network. The combination of smaller and easier devices with Mobile Internet can be a key for suppliers of PDA's and handheld PCs to access the mass market.

A mobile device needs a browser to get access to the Internet, for example a WAP-browser. Large mobile phone companies installed their own browser in a mobile device, but manufacturers of devices can also use browsers, which are built by software companies.

Software tools to facilitate WAP or other Mobile Internet services are also important. Existing software companies can use their knowledge to develop tools for the Mobile Internet, but new entrants can also enter the market with products specially designed to support mobile applications, like positioning.

A gateway is required to set up a Mobile Internet service. So, providers of those gateways are another important player in the mobile market. Especially the compatibility of gateways with devices and browsers is an important issue. Not every gateway is compatible with every browser.

Mobile operators have a strong starting point in the mobile market, because of their knowledge of mobile networks, their ownership of the SIM-card, their privileged position to select the browser for the devices, their invoice relationship with the customers, their powerful distribution and communication position and finally, their knowledge of the local market. However, in the near future, it is not unlikely that they are going to lose their position as most successful player in the mobile market, because the Mobile Internet requires another kind of customer service, a much higher speed of acting, a strong network of partners and a lot of risk-taking.

Mobile Internet service providers deliver access to the Mobile Internet. A gateway is required to connect to the mobile network. Mobile operators or the normal Internet providers are the most likely candidates to both deliver access to the Mobile Internet and connect to the mobile network.

The providers of mobile portals supply the homepage from which a lot of mobile applications can be consulted, like agenda's, e-mail and relevant information. Member propositions and on-line registration can give the provider a lot of valuable customer information. This data can be used to improve the relationship with the user by offering better customer service. There are a lot of candidates to fulfil the role of mobile portal, for example the mobile operators, the Internet service provider, providers of Internet portals, content providers, mobile phone suppliers or new companies.

Transaction providers arrange the financial transaction, mostly provided by banks or credit card companies. Content providers who offer information services, and merchants, who sell products or services, are other large stakeholders in the mobile market. Two types of content providers can be distinguished; those who want to gain experience in the Mobile Internet and providers who are waiting until a critical mass of their customers is using the Mobile Internet. Content providers who are able to deliver actual information related to the preferences and location of the user can add the highest value.

Finally, advertisers are important in the mobile market. Because of the possibility to communicate one-to-one with a consumer through his mobile phone, advertising can have a lot of impact. Advertising can be made even more specific when positioning is integrated. The other side of the story is that the acceptation level will be very low, when an advertisement is not aimed at the situation of a user; it will give a lot of irritation. An interesting trade-off is one of the possibilities to reduce this irritation, for example by giving the user extra minutes to call.

Because there are so many players involved in the mobile market, in the future a heavy competition between all those players can arise. Maybe the most powerful player in the mobile market is the customer. The consumer has the last word; the customer defines if an offered service adds value to his or her way of living.

Co-operation

To survive in a highly competitive market, companies are joining forces by signing alliances or other forms of co-operation. The liberalisation of the national telephone markets had led to an enormous growth in the number of providers. This has also forced the operators to expand their market abroad. For example, KPN and NTT DoCoMo have decided to co-operate in offering a European version of DoCoMo's i-Mode. The Associated Press of January 18, 2001, stated: "NTT DoCoMo will begin offering a European version of its hit 'i-Mode' wireless Web service in Europe in cooperation with KPN Mobile N.V. of the Netherlands and Telecom

Italia Mobile."[86] In addition to this co-operation, NTT DoCoMo is talking with KPN Telecom N.V. to increase its stake in KPN Mobile. [87] Another example of co-operation between large telecommunication companies (telco's) is the announcement of British Telecom and Deutsche Telekom to construct UMTS-networks together in Great Britain and Germany. They have decided to do this to save costs. [88]

During the nineties a lot of mergers, alliances or other forms of co-operation have established among the telco's. Below, an overview is presented of the large European telco's and their related mobile telephony providers. [89]

Company	Related mobile providers	Other relevant activities
Vodafone, Mannesmann, Airtouch (British/ German/ U.S.)	a.o. Vodafone (United Kingdom), D2 Mannesmann (Germany), Airtouch (U.S.), Libertel (Netherlands), SFR (France), Omnitel (Italy), Airtel (Spain), Telecel (Portugal)	Partnership with Vivendi to deliver mobile portals
France Telecom (French)	a.o. Iternis (France), Orange (U.K.), Dutchtone (Netherlands), Mobistar (Belgium), Wind (Italy), Mobilix (Denmark)	In Holland owner of cable-company Casema and Internet-providers Wanadoo and Euronet.
British Telecom (British)	a.o. Cellnet (U.K.), SFR (France), Viag Interkom (Germany), Blutel (Italy), Airtel (Spain), Telfort (Netherlands)	BT Internet and Genie mobile (SMS) portal
Deutsche Telecom (German)	a.o. D1 (Germany), One2One (U.K.), MaxMobil (Austria), Wind (Italy)	T-on-line, Europe's biggest Internet provider
Telecom Italia (Italian)	a.o. TIM (Italy), Bouygues (France), Amena (Spain), Telekom Austria (Austria)	
KPN Mobile (Dutch)	a.o. KPN Mobile (Netherlands), E-plus (Germany), KPN Orange (Belgium)	Biggest Dutch Internet-provider (Planet Internet, HetNet and XS4all)
Telefónica (Spanish)	a.o. T.Moviles (Spain), Portugal Telekom (Portugal)	Terra Lycos is the leading Internet-provider in Spain and Latin-America
Tele Danmark	a.o. Tele Danmark (Denmark), Belgacom (Belgium), Ben (Netherlands)	Talkline, service provider of Mobile Internet and Internet

Table 6.1 Co-operation between telecommunication companies

6.2.2 Past and recent developments

In this paragraph, an overview will be given of the developments in the mobile market. To do this in a more or less structured way, the developments are ordered in a few categories. Firstly, market dynamics are discussed. Next, developments regarding to technologies and devices are highlighted. Finally, wireless applications are described. The actuality of this paragraph may suffer due to the speed of developments in this market. Therefore, the goal of this paragraph is not to be exhaustive, but to give a global overview of the developments in the wireless market during the last months.

Market dynamics

During the last few months, a lot of firms have introduced WAP or some other wireless technology in their business. According to Director (see the next page):

[86] *NTT DoCoMo to offer i-Mode in Europe later this year*, Associated Press, 18-01-2001

[87] *NTT DoCoMo may increase KPN Mobile stake*, Wireless Internet Daily, 12-02-2001

[88] *BT en Deutsche Telekom leggen samen UMTS aan*, Trouw, 13-06-2001

[89] Klein, De & Vos, 2000, p. 106 and 107

> "More than 200 mobile phone manufacturers, software firms, phone companies and Internet organisations have already signed up for WAP. The initial prime market for WAP is travel-related. Rail tickets, traffic information, hotel reservations, "where's the nearest cash machine?" queries – WAP services for all of these exist now, and more websites are currently coming on-line." [90]

The mobile market is very dynamic. A year ago, expectations were very high and the exchange rates were skyrocketing. Now, the mobile industry is slowing down as Charny and Grice state in their article for CNET News.com, regardless the fact that the mobile market and especially the market for Mobile Internet is still in its infancy. [91] Indices of main telco's of the last three months show this development. To illustrate this, in the figures below the exchange indices of KPN and Libertel are shown. [92]

Figure 6.1 Exchange index of KPN

Figure 6.2 Exchange index of Libertel

Illustrative is also a news item form Ericsson which stated that the company will lay off a part of its employees:

> "LM Ericsson said Friday that it will lay off 4,000 employees in Sweden this year as part of previously announced job reductions aimed at restoring profitability amid an economic slowdown and reduced demand for cell phones." [93]

The following figure of the index of Ericsson LM in Frankfurt of the last year can be illustrative with regard to the problems of Ericsson. [94]

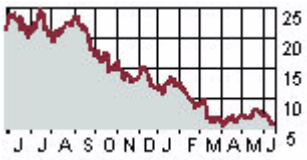


Figure 6.3 Exchange index of Ericsson LM

Nevertheless, there is a lot of confusion in which stage the mobile market is. The same article, which announced a market slowdown, quoted some analysts and industry watchers who stated the industry is still growing. Jupiter Research's Brooks says, for example, that the slowdown of the industry is relative to expectations, but "[…] growth continues at a pretty healthy pace". [95] Charny and Grice stated (see the next page):

---

[90] *WAPs Going On?*, Director, 16-10-2000

[91] *Recent warnings may portend wireless slump*, Ben Charny and Corey Grice for CNET News.com, 12-01-2001

[92] http://www.euronext.com/

[93] *Ericsson to Cut 4,000 Jobs*, Associated Press, 18-05-2001

[94] http://www.financieeldagblad.nl/

[95] *Recent warnings may portend wireless slump*, Ben Charny and Corey Grice for CNET News.com, 12-01-2001

> "Instead of 'slump', analysts use the word 'maturity' a lot these days when referring to the wireless world. They also say that growth will continue, and that the battle won't be for the next new customer, but to keep the existing ones. […] as with the maturing PC industry, analysts expect the market to begin shifting more toward replacement sales, whereby wireless customers trade their older cellular phones in for smaller, lighter new ones with more features and longer battery life." [96]

Chan Komagan came to more or less the same conclusion in his article, as he stated:

> "We are seeing more consolidation in the wireless market than ever before. Consolidation will offer a great advantage to the customer in providing a standard way for accessing the service from anywhere in the world without needing to change services or phones. The Wireless Application Protocol (WAP) and i-Mode technologies will open up a whole new way for the service providers to offer Internet-based services to the customers. Both are open standard technologies that offer wireless telephony services on digital mobile phones and other smart devices." [97]

Technology and devices

Which technologies and devices have already arrived? Better cellular phones are introduced in the market, which are adapted to the Mobile Internet, like the Ericsson R380. "The R380 is approximately the size of a standard cellphone, but a horizontal screen occupies one side of the phone."[98] This larger screen allows incorporating an organizer into the phone and also a better graphical display. Motorola launched a Java-enabled cellphone, which also doubles as a pager.[99] Mobile phones with colour screens are also unveiled. In the first week of April, Sprint PCS has introduced the first full-colour-screen phone in the United States. [100] More and more handheld devices will also be equipped with the possibility to make a wireless connection to the Internet. Wireless modems are added to PDAs, like HP's Jornada:

> "Novatel Wireless, Inc. […] today announced the commercial availability of the Minstrel 540(TM) Wireless Modem for the HP Jornada 540 series Pocket PC. The Minstrel 540 in conjunction with the HP Jornada Pocket PC becomes a virtual office users can take with them anywhere. The Minstrel 540 modem is compatible with the HP Jornada's bundled Pocket Inbox and Pocket Explorer applications, delivering wireless access to email, the Internet, and corporate LANs to users on the go and on the road."[101]

Intel has recently designed what it calls the 'Internet on a chip'. This new chip gives devices like handheld computers "the ability to access the Internet and run applications twice as fast as was previously possible."[102] Intel is not the first one who designed such a chip. Texas Instruments was already developing this technology. [103]

> Also the first GPRS phones have arrived (see the next page):

---

[96] *Recent warnings may portend wireless slump*, Ben Charny and Corey Grice for CNET News.com, 12-01-2001

[97] *The rush to exploit the rich new wireless market is sparking a competitive scrap over who will establish a dominant wireless data transfer standard. But why do we need a standard? What will it achieve ?*, AnyWhereYouGo.com, 12-10-2000

[98] *Wireless 2000: Where's WAP?*, 123Jump, 04-01-2001

[99] *Wireless 2000: Where's WAP?*, 123Jump, 04-01-2001

[100] *Sprint to unveil first full-color cell phone in US*, MobileDataBiz.com, 29-03-2001

[101] *Novatel Wireless ships the Minstrel 540, a wireless modem for the HP Jornada 540 Series Pocket PC* , Business Wire, 09-01-2001

[102] *Intel to unveil its "Internet on chip",* http://news.cnet.com/news/0-1006-200-5952785.html , 18-05-2001

[103] *Intel to unveil its "Internet on chip",* http://news.cnet.com/news/0-1006-200-5952785.html , 18-05-2001

> "The R520, Ericsson's first GPRS-telephone, offers 'always-on' connection to the Mobile Internet, as well as a higher data transfer rate than previously. Users will have constant and immediate access to e-mail, WAP sites and the ability to synchronize their mailboxes and calendars with their PCs." [104]

Three days later, also Siemens declared to launch a GPRS Phone. [105] Who is next?

Beside developments with regard to devices and networks, also other technologies are developing. Bluetooth, which was discussed in Chapter 2, seems to be far from entering the mass market. However, first experiments have been done with this technology. A news article heads: "Bluetooth personal area network (PAN) technology is now starting to take off, even if only at the lower end of the market […]" [106]. The lower end of the market means this technology is only in its research and development stage. Other technologies are also unveiled nowadays, to make everything faster and better. For example,

> "Philips Components […] today unveiled the consumer electronics industry's only in-panel, system-board integrated touch-screen liquid crystal display (LCD) modules -- enabling the world's thinnest, lightest wireless display-centric Internet appliance products."[107]

Applications

The last months, the number of applications has grown rapidly. The kind of services offered on a mobile device is extended. In this section, a few examples will be given of mobile applications to give an indication of the developments that are taking place in the market. Commercial parties are the most obvious initiators of mobile applications. Merchandisers and retailers have extended their service to the Mobile Internet in order to reach the customer in a better way. For example, Bruna, which has already a very extended web-site, has developed a WAP-site on which people can place an order and pay for it. Bruna is the first Dutch on-line-store with a WAP-site, which offers this possibility to order and pay. Owners of a WAP-phone can order and pay a book everywhere and always (Klein, De & Vos, 2000,p. 217).

Making on-line reservations is another application that can be distinguished in the mobile market. In a press item, British Airways is said to be

> " […] the first UK airline to introduce a facility which allows frequent flyers to use their WAP phones to check-in for flights out of the UK, and the first airline in the world to enable passengers to select their seat via a graphical seat map on their handset. In addition, any WAP phone user will be able to look up flight availability and view up-to-the-minute flight arrivals and departures information for any British Airways flight."[108]

Other services, which are unveiling the last months, are wireless shopping malls. For example, the partnership between SNAZ Commerce Solutions and Rogers AT&T Wireless has led to a wireless shopping mall "[…] complete with Canada's most popular retail outlets." [109] Virgin Mobile has done something similar. A press item of February 9 th stated: "Virgin Mobile, a UK wireless virtual network operator, has taken the wraps of what is billed as the world's first secure and interactive Mobile Internet shopping service." [110]

---

[104] *Ericsson ships first GPRS Phone*, Ybreo, 08-04-2001

[105] *Siemens launches new GPRS Phone*, Ybreo, 11-04-2001

[106] *Bluetooth taking off at low end of market*, Newsbytes News Network, 23-01-2001

[107] *Philips components launches thinnest, lightest wireless Internet*, Asia Pulse, 08-01-2001

[108] *British Airways WAPs Away Queues*, M2 Communications, 05-01-2001

[109] *SNAZ, Rogers AT&T Wireless to Launch Canada's First Wireless Shoppin Mall*, Business Wire, 18-05-2001

[110] *Virgin Mobile intros first interactive WAP Shopping Services*, Wireless Internet Daily, 09-02-2001

Other interesting applications, which have been launched, are for example the ability to find new homes via handheld or wireless devices based on criteria such as price, area, and number of bedrooms or bathrooms [111] in the real estate market. The music industry is another important player in the mobile market. Nippon Columbia, for example, has launched a full-scale music distribution service for mobile phones. [112] The first wireless payment services are launched. For example, fast food supplier Mc Donald's, which is "[…] currently testing new wireless payment systems – expected to ensure faster delivery of their fast food." [113] Banks are also looking for opportunities to offer their customers wireless payment services. For example, Wells Fargo & co., a major financial services company in the U.S., launched Wells Wireless, which enables consumers and small business customers to access on-line financial services through wireless devices from anywhere in the U.S. [114]

Next to this, the Mobile Internet offers information services a great opportunity. Scoot and the Gouden Gids have put their service in a mobile format in order to supply their customers anywhere and anytime. According to Scoot, the Mobile Internet is fundamental and leading for the future (De Klein& Vos, 2000, p. 221). Other information service providers who are interested in the possibilities of the Mobile Internet are newspapers. Next to their regular papers, they are offering more short newsflashes by using media like the Mobile Internet. For example, De Telegraaf together with content provider Mobillion has set up WAP-services with up-to-date general news, sport news, actual weather fore castings and financial news (Klein, De & Vos, 2000, p. 211-213).

Another kind of application, which is particular interesting for the mobile market, is location-based services (LBS). For example, MapInfo unveiled PSAP Pro, an enhanced 911 database, to enable "[…] wireless and telecommunications service providers to accurately and efficiently rout E911 calls to the appropriate Public Safety Answering Point (PSAP) to dispatch emergency personnel based on the caller's location." [115] Restaurants also have discovered the possibility to put their location on the mobile map. For example, "T.G.I. Friday's becomes the first global restaurant chain to launch a restaurant locator and its menu via Internet-enabled mobile phones and wireless handheld devices. Weary travellers and frequent guests can easily locate a T.G.I. Friday's restaurant for some serious fun and of course, its famous food and drinks."[116]

6.2.3 Future developments

In this paragraph, future developments will be discussed.

General

Almost every consultancy firm or analyst has optimistic forecasts about the future of wireless data technology. The Computer Daily news heads that the use of wireless data technology is expected to skyrocket:

> "[…] the wireless data market will grow from its current level of 170 million subscribers worldwide to more than 1.3 billion by 2004. As a result, more than 1.5 billion handsets, personal digital assistants and Internet appliances are expected to be equipped with wireless capabilities by the end of 2004 […]." [117]

In addition, Director states on October 16, 2000 (see the next page):

---

[111] *NewHomesDirect.com, Hotpalm.com launch new mobile real estate application*, PR Newswire, 09-02-2001

[112] *Nippon Columbia starts music distribution via mobile phones*, Jiji Press English News Service, 02-01-2001

[113] *McDonald's tests wireless payment technology*, Cosmiverse.com, 10-01-2001

[114] *Wells Fargo first major bank to launch nationwide wireless banking*, Wireless Internet Daily, 08-02-2001

[115] *MapInfo unveils PSAP Pro to accurately locate mobile callers and reduce 911 response time*, GISCafe News, 09-01-2001

[116] *Satama develops wireless restaurant locator for TGI Friday's*, PR Newswire, 26-03-2001

[117] *Wireless data users to reach 1.3 billion,* Computer Dealer News, 05-01-2001

> "Industry experts predict that within 18 months, nearly all the new mobile phones that are on sale will be WAP-enabled and that in four years' time, people will be carrying out some 14 billion m-commerce transactions a year." [118]

123Jump tells us:

> "One forecast estimates that by 2002 mobile data services will outnumber wire line data subscribers. Other analysts expect at least $35 billion to $40 billion in revenues by 2007, representing an annual growth rate of 25% to 30%, along with as much as 100 million subscribers using some form of wireless data." [119]

Predictions about LBS are also positive. PR Newswire states:

> "The global subscriber base for mobile location services is forecast to exceed 680 million users by the end of 2006, which will represent 50% of all mobile subscribers and more than 70% of Mobile Internet users. Analysys forecasts that location services revenues will grow from just over US$ 2 billion at the end of 2002 to more than US$ 18.5 billion by the end of 2006. Forecasts suggest 31% will be generated in Western Europe and 22% in the USA. The consumer market will account for 77% of total revenues."[120]

Regarding the players in the market, more consolidation is expected:

> "The unsustainable burden of astronomically priced third-generation mobile telecom licenses is expected to be the key catalyst for a major wave of consolidation in the European wireless communications market that will leave just five groups serving all mobile users in Europe by 2008, according to a study released Friday by Forrester Research, an independent Internet research firm. Four players – Vodafone Group PLC of the United Kingdom, Deutsche Telecom AG's T-Mobil, France Telecom SA's Orange and BT Cellnet, owned by British Telecommunications PLC – will rank among the certain winners, since they already have a significant presence across the region, the study found. Fighting it out for fifth place will be Royal KPN NV of the Netherlands, Spain's Telefonica SA, Telecom Italia SpA and Japan's NTT DoCoMo Inc." [121]

Technology and devices

Phones and computers are converging, but no one knows exactly what the result will be. Three large companies are vying to produce operating systems for these future devices: software giant Microsoft, 3COM spin-off Palm, and mobile phone consortium Symbian (Dornan, 2001, p. 249). Integration of the devices with GPS receivers is on its way. For example, Garmin Corporation, a leading manufacturer of navigation, communication and information electronics, has unveiled a new GSM cellular telephone for Europe - introducing the NavTalk II GSM. This product combines a European GSM cellular telephone with the proven ability of Garmin's 12 parallel channel GPS receiver. The GPS component of this product will allow users to see their location on a detailed base map. [122] The article says the NavTalk II GSM will be available in the fourth quarter of 2001.

---

[118] *WAPs going on?*, Director, 16-10-2000

[119] *Confusion prevails on the way to 3G*, 123Jump, 02-01-2001

[120] *Mobile location services to generate USD 18.5 billion global revenues by 2006, says Analysys* , PR Newswire, 14-02-2001

[121] *Report: Only five pan-European mobile operators seen surviving past 2007* , BridgeNews, 05-01-2001

[122] *Garmin introduces new GSM cellular phone/ GPS for Europe*, GISCafe News, 22-02-2001

Two-and-a-half generation networks (GPRS) will be launched at the end of this year, followed by third generation networks in the next couple of years. VNUNet.com cites a report from telecommunication consultant Analysys. This report, commissioned by Mobile Internet platform provider 3G Labs, predicts that third-generation (3G) UMTS services will represent about one-third of the total mobile subscriber base in 2006. The number of UMTS handset subscriptions is expected to match that of handsets using general packet radio service (GPRS) technology by 2006. GPRS subscriptions are predicted to decline by 2008. Furthermore, Analysys forecasts that 3G and GPRS will each account for 480 million global subscribers, while existing digital systems will have just 380 million subscribers.

From 2007, GPRS handset sales will enter terminal decline. Second-generation handsets, in decline from 2002, will completely disappear from sale by 2006. UMTS will have strong coverage in Europe, comparable with Japan by 2010, the report says. [123] Japan is ahead regarding to 3G services. For example, NTT DoCoMo will soon deliver videophone-equipped handsets to participants testing its third-generation cellular phone services, which began May 30, 2001. [124]

Although in its infancy, Bluetooth is coming. Newsbytes News network reports: "Bluetooth personal area network (PAN) technology is now starting to take off, even if only at the lower end of the market." This news article mentions a study from Frost & Sullivan (F&S), which says, "While most of the activity on the Bluetooth front is coming from lower parts of the value chain, competition is now growing increasingly fierce among a wide range of semiconductor product developers." Furthermore, "[…] this year will see the arrival of more complex Bluetooth devices, the report said, which will add value to the Bluetooth industry. Wall said that he expects products from Ericsson, Motorola and Nokia in the coming months."[125]

6.2.4 Killer applications

Killer applications are those applications that are expected to be very successful. Dornan (2001, p. 153) describes the most successful wireless businesses as businesses that use the unique advantages of a mobile phone, namely mobility and ubiquity, "[…] while relying less than the Web on high data capacity and having the customer's full attention." Dornan describes six kinds of applications that can be successful in the mobile market. Besides the six categories, messaging can be added as a seventh killer application that has already proven its success.

Comparison shopping

Firstly, comparison-shopping can be a killer application. The amount of mobile shopping malls is also expanding. More m-commerce activities will be employed on the Mobile Internet next years. Customers can access a Mobile Internet terminal to shop around wherever they may be. If a customer sees something he likes in a shop, he can instantly compare the shop's price with that of other stores, which are available on-line. For example, Business Wire brought out the message that

> "[…] SNAZ Commerce Solutions, a global provider of m-commerce solutions, and Rogers AT&T Wireless, Canada's largest wireless communications service provider, have partnered to bring a wireless shopping mall to the hands of the over 2.9 million Rogers AT&T Wireless customer. The SNAZ platform, which will be available in both English and French, provides Rogers AT&T Wireless customers with a wireless shopping mall complete with Canada's most popular retail outlets." [126]

---

123 *UMTS will cover all of Europe by 2010*, VNUNet.com, 15-12-2000

124 *NTT DoCoMo finally deliver 3G videophones*, Asia Pulse, 25-06-2001

125 *Bluetooth taking off at low end of market*, Newsbytes News Network, 23-01-2001

126 *SNAZ, Rogers AT&T Wireless to launch Canada's first wireless shopping mall*, Business Wire, 18-01-2001

Dornan (2001, p. 154) goes even further when he states "[…] some phone companies are even planning data terminals with built-in barcode readers for exactly this purpose. The customer won't even have to fiddle with menus or look at the sites – she will simply scan in the barcode and let an automated shopping agent search the Web for the cheapest price."

Banking

On-line banking is another application that has high potential to become successful one. The idea is to link a mobile phone permanently to a customer's bank account. When mobile phones will get the ability to make transactions in real-time, they can replace cash and credit cards. In the Netherlands, two banks already offer these kinds of services. On-line banking enables shareholders to trade everywhere using their mobile bank account:

> "WAP offers the potential for many more services than simple balance notification, of which share dealing is the one that gets marketers most excited. Their publicity says that people will be able to view real-time quotes and execute bargains while away from their desks, a necessity in a world where many companies are listed on more than one index and exchanges are extending their opening hours (Dornan, 2001, p. 155)."

Location-based advertising

Mobile operators have information about their customers, where they go and with whom they telephone. This information can be very valuable to advertisers, especially when more data services become available. Dornan (2001, p. 156) is very enthusiastic about this kind of application:

> "Mobile operators can already log every customer's exact location, provided that the phone is switched on and within range. By cross-referencing this data with a map, it should be possible to learn when the customer is at home, how she spends her leisure time, or which shops she visits and for how long. One customer's location log could even be checked against another's to learn about friendships and shared interests, though the operator may already know this from phone call records."

Mobile operators believe that advertising will be an important market in the future. For example, when a customer requests the location of the nearest pizza restaurant, he can receive advertising for a restaurant that is not necessarily the closest one but one that will give him a special offer. This kind of service will be even more attractive when the customer is in the driver seat, when he can indicate which kind of advertisements he wants to receive and to offer him an advantage, like a discount on a product or service.

Location-based services

It can be very useful to consumers to pinpoint their own location. With accuracy increasing and higher data rates enabling more useful information to be sent in response to a user's request, more advanced LBS will emerge. The possibilities will increase even further when GPS receivers will be built-in in mobile devices in the future. Mapping will be one of the most obvious and popular LBS. People could ask their mobile phone for a zoomable map complete with position marker. Other LBS, which are also very time dependent are for example: precise weather forecasts, door-to-door directions, up-to-date traffic information, etc. Dornan (2001, p. 157) noted however that LBS could be a Trojan horse for location-based advertising, because customer will object to their exact position being logged by marketers. Hopefully, the services' usefulness will outweigh privacy fears.

The integration of LBS with cars will also take a giant leap forward in the near future. There are already cars, which are equipped with these kinds of information systems. The co-operation between Targa services and Autodesk to deploy wireless LBS under Targa Connect brand that will soon be available in the new Alpha Romeo 147 is an example. The Targa Connect services allow carriers/ operators to send information directly to an in-car information system for selection of preferences and navigation. [127]

Streaming media
Audio and video are examples of streaming media, as are the latest news flashes. These are mobile applications that will be possible with the 3G networks. It will be possible to watch a video clip or listen to radio stations everywhere. Broadcast music or other information is already possible. For example, radio stations use RDS (Radio Data System), with which short chunks of data can be broadcasted along with the radio signal. Information like the name of the radio station, the name of the artist and track playing, weather forecasts and traffic information can be transmitted to car radios, home stereo systems and in the near future mobile phones. Combined with LBS, information can be tailored to the user's precise position (Dornan, 2001, p. 159).

Games
Simple games have been available on mobile phones for some time, but packet-based communications open up the possibility of competing against other players. Portability gives games an advantage, because people who might not usually spend their time and money on games still appreciate the distraction games can provide while standing in line or waiting for a bus (Dornan, 2001, p. 159). Gambling and lottery are other possibilities of multiplayer games, because mobile games can easily be combined with on-line banking.

A nice example of a mobile game that is already successful is Gladiator, a game of JAMDAT Mobile Inc., a leading provider of mobile entertainment and enabling technologies. Gladiator is a multiplayer combat game set in the Colosseum of ancient Rome. Players select character types and weapons for their combatants and then duel against a live opponent in real-time. The more a player utilises a particular gladiator, the more experience and skill that character develops. The article on Gladiator [128] quotes: "The astonishing success of Gladiator demonstrates that U.S. Mobile Internet consumers are hungry for high-quality entertainment", and "We have seen strong evidence from Japan and Korea that entertainment is a major driver of Mobile Internet usage, and our results suggest that the same pattern is developing in the U.S." Games are thus a very promising market.

Messaging
Messaging is already one of the most popular data features of mobile phones. Short Messaging Service (SMS) is, especially among younger people, a very popular method to communicate with each other.

> "Since the initial launch of text services, SMS has steadily grown before experiencing a huge increase during the last year. This pattern has been reflected around the world, as individual markets achieve mass penetration, fuelled by the popularity of GSM pre-paid subscriptions. […] A huge number of SMS information based services like web portals are being launched daily. In addition to basic m-commerce applications, corporate services, sports, financial, news and weather based information services are now available as well as ring-tone downloads and icon messaging. SMS chat rooms are appearing, and it's now possible to participate in auctions, advertise, gamble, or receive jokes via SMS." [129]

---

[127] *Fiat and Autodesk bring location services to mobile individuals*, GISCafe News, 23-01-2001
[128] *M-games Gladiator conquer wireless Web arena*, PR Newswire, 30-01-2001
[129] *Over 200 billion GSM text messages forecast for 2001*, M2 Communications, 12-02-2001

SMS is currently moving towards Enhanced Messaging Service (EMS), which will be widely available in the near future. EMS can be defined as (see the next page)

> "The ability to send and receive SMS which can consist of a combination of simple melodies, pictures, sounds, animations, modified text and standard text as an integrated message for display on an EMS compliant mobile phone. […] There are many different potential combinations of these media. For example, when an exclamation mark appears in the enhanced message, a melody could be played. A simple black and white image could be displayed along with some text and this sound effect."[130]

One step further goes Multimedia Messaging Service (MMS). MMS is a revolutionary way of sending messages, designed and defined as a standard for third generation networks. It is expected to become the preferred messaging method for mobile users, when 3G enabled phones are commonplace. With MMS, messages can be transmitted containing text, graphics, photographic images, audio and even video clips. [131]

6.3 Visions on The Future

6.3.1 Hewlett Packard's CoolTown

CoolTown started as a project of the Internet & Mobile Systems Lab of Hewlett Packard (HP) laboratories. According to HP, CoolTown is

> "A research program, a core set of application software and standards, and a community of developers and partners aimed at creating information appliances, software and services for the coming world of diverse, pervasive networked computing, using the World Wide web as the underlying framework of a fundamentally open solution." [132]

CoolTown is based on five underlying beliefs about the future: [133]

Rampant diversity – there will be pervasive, anytime, anywhere computing, made possible through the use of open, widely available standards.
The future network environment is the Web – the advantages of the web are that it is an open, extensible, heterogeneous, standards-based network infrastructure, known by almost every network and widespread. This will stimulate developments. The omni-presence of the World Wide Web is the main reason why HP chose this technology as a foundation for their wireless world. Another reason is the familiarity of the user-interface and browsing capabilities.
Everything has a web presence – people, places and things from the physical world will be increasingly represented on the Web. Databases and web-sites contain megabytes of information about the physical world, and yet this information is physically dissociated from it.[134] In CoolTown, people, places and things are present on the Web through a dynamic and contextual bridge. This way, access to people, places and things is expanded: the Web is omni-present (although the poorer countries in the world are not that connected…), so every physical entity that is web-present can be contacted from all around the world. Places have a special role as the venue or container for people and things. [135] Sensors can pick up the user

---

[130] http://wwwi.wu-wien.ac.at/Studium/Abschnitt_2/LVA_ss01/se_mc/portal/products/dataservices/ems.htm , 26-06-2001
[131] http://wwwi.wu-wien.ac.at/Studium/Abschnitt_2/LVA_ss01/se_mc/portal/products/dataservices/mms.htm , 26-06-2001
[132] http://www.cooltown.com/ctfaq.htm , 23-04-2001
[133] http://www.cooltown.com/beliefs.htm , 23-04-2001
[134] http://www.cooltown.com/papers/webpres/WebPresence.htm , 23-04-2001
[135] http://www.cooltown.com/papers/webpres/WebPresence.htm , 23-04-2001

when he enters a place and make contact with his PDA to update the location of the user and to inform the PDA of the services available to the user within this place.
Bridging the physical and on-line worlds – this will enable customer relationship management and deep personalisation. CoolTown is about bridging the gap between the virtual and physical worlds and thus creating profitable synergies – both in time and money - and making life simply more enjoyable. Personalisation can bring us enhanced customer service. Technologies like fingerprint and voice recognition are simple examples. It is HPs vision that in the near future, people will encounter devices everywhere he goes. And each device is "[…] a context-aware appliance that identifies his unique characteristics, provides him specific, pre-approved security clearances, and reflects his personal tastes and preferences."[136] The CoolTown web-site shows some nice examples of this. [137] An entity that is web-present is bound to a resource that has a URL and is accessible by the standard HTTP protocol. Special chips and technologies can automatically obtain URLs from physical objects in the users direct surroundings. With infrared, the user can point the infrared port on his PDA at a physical object and exchange information with this object, for example a printer.
Connected ecosystems of service providers – new forms of services will emerge effortlessly. It is very important that the user is in control of the (personal) information released to the outside world. Most people dislike the idea of everybody being able to locate them at all times and perhaps even worse, having their on-line personal information exposed to potential hackers! A government committee in the Netherlands with Prof. Snellen as chairman, advised Minister Van Boxtel, in charge of IT amongst others, to create a 'digi-vault' on the World Wide Web for all Dutch people. This digital vault should contain all personal records: medical and financial records, name, address, social security number etc. An advantage of this idea is that people can control their records and see who uses them in what way. Another advantage is faster availability of information. Electronic identity cards should be introduced to prevent abuse of personal information. The committee expects the system can be set up within the next ten years. [138] Despite the obvious advantages, people fear the introduction of the system. Some people where asked for their opinion on the subject. [139] They all dislike the idea of putting all their personal information together, on-line. They do not believe in a 100% full proof secure system. Every system can be hacked. It is up to HP, its partners and other IT development companies, to overcome these problems and convince people that the benefits of personalised services and information sharing outweigh the potential dangers.

CoolTown is HPs response to Sun Microsystems Inc.'s Jini. With Jini, devices can communicate by using Java technology. Both HP and Sun claim to use open technologies as an infrastructure for their wireless worlds. Which one is better, what are the advantages? James Governor, analyst of Illuminata in Nashua, N.H., believes that HPs CoolTown has the upper hand because its use of the Web makes it truly open technology:

> "One of the things about the approach that HP is taking is it's very pragmatic. Java is actually pretty dogmatic. Sun has this very clear vision of the world which says that anything Java is good, and anything not Java is not good, […] [With Sun,] 'It's open standards, as long as it's our open standards, as long as we've defined a lot of specifications.'"

But Sun insists that Jini is open to everyone: "Jini is publicly available. The licensing for the technology is freely available for anyone on the net. […]". [140]

---

[136] http://www.cooltown.com/vision-cservice.htm , 23-04-2001
[137] http://www.cooltown.com/vision.htm , 23-04-2001
[138] *Digikluis voor elke burger*, Spits, 30-03-2001, p. 4
[139] *Een commissie wil voor elke burger een beveiligde digitale kluis met persoonsgegevens. Gewenst?* , Metro, 30-03-2001, p. 23
[140] http://www.itworldcanada.com/search/DisplayArticle.cfm?V=CW,MAIN,8AFAC6C0-AB81-11D4-AA6600A0CC574E58 , 23-04-2001

6.3.2 OracleMobile

Oracle Technology Network (OTN) is the world's first Developer Service Provider (DSP). OTN membership is free. OracleMobile services are part of OTN. According to the OracleMobile website, "OracleMobile is a leading wireless application service provider (ASP) that creates and hosts wireless sites for all types of companies. Our approach moves content quickly from Web to wireless and allows access from all devices […]." [141] Denise Lahey, CEO of OracleMobile, explains the vision of OracleMobile:

> "The future of software is as a hosted service over the Internet. OracleMobile's hosted approach to wireless delivers the best possible mobile experience, while allowing our customers to stay focused on their core business and maintain complete control of their content and branding." [142]

According to a recent survey of CIOs by Morgan Stanley Dean Witter, 87% of CIOs are already considering or would be willing to consider having their software hosted by an application service provider. At the same time, the wireless Internet market is exploding, with analysts predicting that more than one billion devices will be capable of accessing the Internet by 2003.[143] Merrill Lynch estimates there will be 1.5 billion wireless subscribers by 2003.[144] Based on these figures, OracleMobile can obtain a strong position on the ASP and wireless Internet markets with their strategy. When the second release of Oracle9i Application Server (Oracle9iAS) Wireless Edition was shipped, Unstrung.com talked to Jacob Christfort, CTO of OracleMobile. He said:

> "If you look at today's release, what is in there is the enhanced personalization. People don't want static portals and rigid structure. They want to put personal choices at the top of the menu. […] We are retooling all of our enterprise applications to run through our server and running it through an infrastructure that most people already have which is a database. 90% of companies run our [an Oracle] database."[145]

The benefits of hosting wireless applications versus building and maintaining them in-house include faster time-to-market, reduced complexity associated with application development, and the freedom of keeping your company focused on its core business while wireless experts do the heavy lifting. [146]

OracleMobile On-line Studio is the first service to be delivered by Oracle through OTN.[147] Developers can build, test and debug wireless applications in real-time in this environment. In a recently released Wireless Developer Survey, Evans Data Corp. found that 80 percent of respondents believe that wireless testing and debugging tools are very important, but only 25 percent are satisfied with the current generation of tools on the market. OracleMobile's On-line Studio is positioned as a solution to this problem. [148] The IBM WebSphere software platform is another suite of software product offerings for developing, testing, and deploying e-business applications.

---

[141] http://w2.oraclemobile.com/site/solutions3/index.htm , 02-05-2001
[142] http://w2.oraclemobile.com/site/aboutus/pastpr/20000919wasp.htm , 02-05-2001
[143] http://w2.oraclemobile.com/site/aboutus/pastpr/20000919wasp.htm , 02-05-2001
[144] http://w2.oraclemobile.com/site/aboutus/pastpr/20000919screaming.htm , 02-05-2001
[145] *OracleMobile Renounces Its Past: Announces New Product*, Unstrung.com, 07-02-2001
[146] http://w2.oraclemobile.com/site/solutions3/index.htm , 02-05-2001
[147] http://w2.oraclemobile.com/site/aboutus/pastpr/20001211studiopr.htm , 02-05-2001
[148] *Wireless Developers Need Better Debugging Tools*, PR Newswire, 30-04-2001

6.3.3 Nokia Mobile City – Working together for the mobile future

Nokia has recently presented Mobile City. Their Web-site says:

> "The world's communication and information systems are uniting. As the integration of systems and services increases, so do the opportunities for co-operation between many kinds of companies. Mobile City is the home for companies working together with Nokia for the mobile future. It provides information of some key areas where Nokia is co-operating with different kinds of companies. It demonstrates our vision that working together is essential in building the Mobile Information Society." [149]

With Mobile City, Nokia does not actually present its own vision on the future directly. Mobile City is mainly a platform on key areas were Nokia is working in. In Nokia's vision, working together is the way of the future. For this purpose, they have founded Nokia Mobile City. There are two main subjects in the City: Application avenue and Brand boulevard. The first contains names as Accessory alley and WAP plaza. At every street, plaza alley etc., there is a separate description of the topic. Also, there are links to companies who offer business solutions and other things on the topic. At Brand boulevard, Nokia describes examples of joint projects with other leading brands in various fields of business, offering added value to consumers. [150]

6.3.4 Further remarks about the future

The visions of HP with CoolTown and Oracle with OracleMobile do not exclude each other. In fact, they can be combined fairly easily. That is possible, because CoolTown envisions the future from the application and consumer side, while Oracle Mobile envisions the future from a provider point of view. OracleMobile can provide consumers and businesses with the applications that CoolTown envisions as useful, because OracleMobile is a Wireless Application Service Provider.

Dornan (2001, p. 6-8) gives an outline of the future in the form of a timeline. He based the outlined technology on scientific research. Table 6.2 on the next page shows this timeline.

[149] http://www.nokia.com/mobilecity/index.html , 26-06-2001

[150] http://www.nokia.com/mobilecity/boulevard.html , 26-06-2001

2001: Wireless videophone. Combining a Webcam and a mobile phone with a Palm-type device, this will also allow fast access to the Web.

2002: Voice recognition. The cumbersome twentieth-century method of entering text into phones will be abandoned as phones gain the ability to recognize and understand human commands, even against the background noise of the mobile environment.

2002: Third-generation. Mobile multimedia networks will become commonplace, offering data rates of up to 2 Mbps.

2002: All phones Web-enabled. Every new mobile phone will be equipped with some kind of Internet access technology, from the relatively primitive WAP to new, higher-speed systems.

2003: Virtual retinal displays. These will use tiny projectors mounted in the frames of glasses to shine images directly onto a user's retina, allowing access to information services while walking around or interacting with other people.

2005: Wireless LAN standard on computers. Every new computing device will have a built-in wireless LAN connection of some kind, enabling simple point-and-play networking.

2006: More wireless than fixed-line phones. The difference in cost between wireless and wired telephony will all but disappear, with mobile operators relying on value-added services to make their money. Phone numbers will refer to people, not places. The idea of standing in a fixed spot while making a call might seem rather quaint.

2007: Conversation with a computer. Voice recognition will have improved to such an extent that keyboards will no longer be necessary. Mobile phones will link us to powerful translation computers, fluent in every language.

2008: Internet on Mars. A series of communications satellites will orbit the planet Mars, all based on the same standard protocols as the Internet.

2010: Internet appliances. It will be rare to find new white goods – refrigerators, dishwashers, and the like – that do not have a built-in Internet connection. The Net will be as ubiquitous as microchips became in the 1990s.

2011: Fourth-generation. Broadband mobile systems will appear, offering data rates up to 100 Mbps.

2015: Remote-controlled cars. Roads will be made safer as powerful traffic computers take over driving, preventing accidents and automatically routing every vehicle via the most efficient path.

2020: Holophone. Mobile phones will be able to project three-dimensional moving images of people and other objects.

2025: Mind reading. Thought recognition will become the standard form of input. Primitive mind reading techniques were used by computer games in the 1990s, but this technology will be used on a far greater scale. Machines will act as an extension of the user's body. Making a call in a public place will no longer disturb others.

2030: Full, direct brain link. People will have wireless data devices hardwired into their brains, allowing instant telepathic communication. Learning will become obsolete because high-speed networks will allow people to access the sum total of all human knowledge as easily as they access their own memories. This technology raises all kinds of objectionable possibilities, from *Star Trek*'s Borg to a literal thought police.

Table 6.2 Timeline on the future of wireless communication

6.4 The Five Forces of The Mobile Market

6.4.1 Introduction to the Five Forces Model of Porter

Michael Porter has developed a model for analysing industries. In this model, competition between existing competitors within an industry is influenced by four factors. This so-called Five Forces Model can also be applied by investigating market structures and market segments (Keuning & Eppink, 1996, p. 404). This means the mobile market can also be analysed by using the model of Porter. Figure 6.4 displays this model graphically.

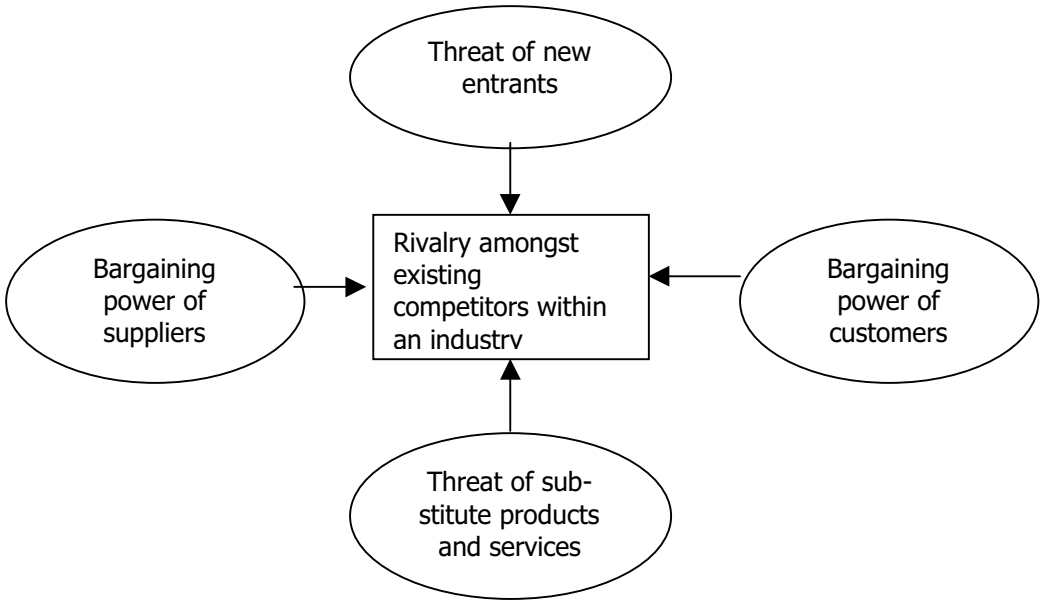


Figure 6.4 The Five Forces Model of Porter

6.4.2 Bargaining power of suppliers

The suppliers to the industry set the prices that have to be paid. A large amount of suppliers will lead to relatively low prices, a small amount of suppliers in comparison with the amount of competitors within an industry will lead to higher prices (Keuning & Eppink, 1996, p. 404). Device manufacturers in the mobile market provide the infrastructure and handsets to create the network, and are represented by a very limited group of companies to supply the high demand of the industry. [151] This enlarges the power of suppliers in the market.

Furthermore, the Mobile Internet can be, like the Internet, an instrument for customers to bypass the traditional sales channels and directly buy products from the supplier. Especially, this is an attractive possibility for suppliers of strong brands, because of the concentration of suppliers taking place and the rise of a global economy. Customers of the formerly retail business can now be approached directly. The necessity of this kind of direct sales is increasing, because of the need of suppliers to adapt to the fast changing consumer preferences (Klein, De & Vos, 2000, p. 209). Also, the Mobile Internet can accomplish virtual presence. This gives suppliers the possibility to be present in countries where local physical presence is not profitable and formerly importers were chartered.

Another feature regarding the increasing bargaining power of suppliers is the business of vending machines. The Mobile Internet offers a lot of opportunities to directly distribute goods through a vending machine instead of using intermediary traders. This machines can be paid by mobile phone, so filling and emptying the machines with cash is no longer necessary. The machine can also give a signal when it needs to be refilled or when there is a breakdown of the machine. Controlling the machine from a distance is possible and the efficiency of use will be increased (Klein, De & Vos, 2000, p. 210).

[151] http://pacificrim.bx.com/telecom/telemarch.html , 20-05-2001

In conclusion, the rise of the Internet and the Mobile Internet has powered the position of suppliers. A small amount of suppliers compared to the demand in the mobile market enlarges the power of suppliers and raises the prices. Besides, intermediaries like retailers and importers are no longer necessary, because suppliers can now directly approach their customers, and mobile entrance to intranets and extranets for the participants of the value chain can strengthen the mutual relations. Also efficiency can be increased, which offers cost reductions. Moreover, because of a more efficient communication between the different participants, knowledge of customers can be enlarged and a shorter time-to-market can be accomplished. This is a two-edging sword, because profits for both customers and suppliers can be yielded (Klein, De & Vos, 2000, p. 210).

6.4.3 Threat of new entrants

New entrants in an industry can make the competition heavier. The supply increases in comparison with demand. Often, it is not easy to predict if totally new companies are going to enter the market or if existing companies are going to extent their product-line and therefore are going to enter the market of the specific product. Barriers to entering the market can be used to scare of new entrants (Keuning & Eppink, 1996, p. 406). However, several forces are present in the Mobile Market that weaken these barriers.

As mentioned before, country borders are becoming less important with the rise of the Internet and the Mobile Internet. Portals, which are focused at a certain group of customers, can extend their activities globally. Companies no longer have to set up a local network of offices, but can offer their services in a virtual form. It is relatively cheap for existing and new competitors to adapt offered services on a web-site or WAP-site to national or even local preferences. This makes the market more unpredictable: new entrants can appear suddenly (Klein, De & Vos, 2000, p. 199).

Another threat is the opportunity companies have with the Mobile Internet to quickly build up a brand in a new market by setting up an innovative and easy service (Klein, De & Vos, 2000, p. 200). A company can relatively easy lose customers to an innovative new entrant, which offers lower prices or better service. However, it needs to be remarked that a good organisation of the back office and a well working logistic and technologic infrastructure is an absolute prerequisite for a successful entrance.

Big companies with a strong brand name pose another threat. When they make the step to the Mobile Internet, they can already rely on a loyal customer base. One of the main causes of brand loyalty is the fact that customers do not want to think about every purchase and show a preference for familiar brands. Besides, big international companies have the means to quickly roll out strong brands locally, even in new markets (Klein, De & Vos, 2000, p. 201).

Knowledge and speed are in most cases stronger barriers of entry than money. Because WAP and the Mobile Internet are part of the New Economy, speed is required for a fast introduction and knowledge of the Internet and mobile communication is necessary to realise a stable architecture of the service. However, an even bigger problem for many companies is the fact they do not know how to define which service to offer to their customers in a mobile environment. Companies with knowledge in this area have opportunities to successfully introduce a new service (Klein, De & Vos, 2000, p. 203 and 204).

However, there are forces, which strengthen barriers of entry instead of weakening them.[152] Firstly, the ownership of a cellular license is a monumental barrier of entry. Secondly, switching costs are high for a current user of a wireless service to switch to another provider. Most cellular service contracts require heavy early cancellation fees. Thirdly, proprietary experience is limited. However, with growing numbers of joint ventures in the

[152] http://pacificrim.bx.com/telecom/telemarch.html , 20-05-2001

wireless industry, talent moves around in a fairly fluid fashion, mitigating the effects of the barrier. And finally, for new entrants, the cost of the license, infrastructure and customer acquisition must be funded well in advance of positive earnings. External funds and supplier credits may be required for up to four years from the start of operations.

6.4.4 Rivalry among existing competitors

The degree of rivalry among existing competitors depends on a number of factors: the amount of competitors, their market shares, their fixed costs, their selling possibilities and the exit-costs (Keuning & Eppink, 1996, p. 406). The Mobile Internet offers several possibilities to get ahead of the existing competition (Klein, De & Vos, 2000, p. 197, 198). One feature for a provider to distinguish himself from his competitors is by offering good service, for example offering the possibility to make on-line reservations or appointments.

The Mobile Internet offers the opportunity to compare a product in a store directly with the price of the same product in the store of a competitor. Because the Mobile Internet is directly available, customers can decide to go to the store of the competitor when it has an attractive discount.

The Mobile Internet can also be an additional communication medium, in addition to local newspapers, advertisings and web-sites. The influence of the Mobile Internet will be especially large in highly trendy and price sensitive branches with much competition and a low loyalty to suppliers. Personal communication and advertising through the Mobile Internet can be a solution in this kind of branches.

Exit costs are also an important factor with regard to the degree of rivalry among existing competitors. The wireless industry has high exit barriers. They are primarily due to the specialised assets employed. Cellular network assets cannot really be used for much else. Base stations, mobile switches, towers and billing software do not lend themselves to easy liquidity. The rapid advance of the technology makes the liquidation of the electronics particularly difficult. [153]

6.4.5 Threat of substitutes

The introduction of substitutes can make the competition within an industry stronger. The Mobile Internet offers various opportunities as a substitute product (Klein, De & Vos, 2000, p. 205 - 208). Firstly, the Mobile Internet can become a substitute for traditional communication and information services because of its low costs and direct and personalised approach. However, it has to be noted that new media like SMS and e-mail have not replaced normal telephone calls. Instead, an increase in the use of such new media appeared to be compared with an increase in the number of phone calls. Obviously, people are communicating more.

The distribution of information services through the Mobile Internet has not replaced the traditional news sources like newspapers. Substitution by the Mobile Internet has not been the case. Mobile Internet is rather an extra information source, which can be used on places and at times where it is not possible to have access to the other forms of media. The desire of people for information and communication seems unlimited.

The Mobile Internet can be an alternative for existing distribution channels. A provider can offer his service or product much easier and cheaper by making use of the Mobile Internet. Customers can be reached directly with a personalised offer. As an instrument of communication and interaction, the Mobile Internet can make stores more attractive by giving additional information.

It is already possible to do payments with the mobile phone, as mentioned earlier in this chapter. Cash will be replaced by paying mechanisms on the mobile phone. Especially this application would be very profitable for vending machines. Retailers will profit from this

[153] http://pacificrim.bx.com/telecom/telemarch.html , 20-05-2001

situation. They do no longer have to purchase hardware, like a teller machine, because customers can pay with their mobile phone. Customers do not need to have credit or cash cards with them anymore. Moreover, it is possible to directly transfer money to others. It must be noted that as a prerequisite the payments must be assured of high security.

6.4.6 Bargaining power of customers

The buying power of customers is also important. A company, which has a large amount of customers buying products for a relatively low price, has a stronger position than a company with only one or two big customers (Keuning & Eppink, 1996, p. 405). The power of customers will increase with the rise of the Mobile Internet because the offered products will become more transparent. The Mobile Internet can provide the customer with better and additional information. For example, it is possible to compare prices with your mobile phone or to gain more insight into the differences between products, conditions that accompany the purchase of a product and availability of a product (Klein, De & Vos, 2000, p. 193).

The Mobile Internet imposes an opportunity for retailers to improve and personalise their service to customers, for example by giving customers access to the stock database or by giving customers the opportunity to make a reservation, put in an order or make an on-line payment. The only reason for customers to go to the store is to pick up his order (if the retailer does not have a delivery service). If they want to, customers can be alerted to some nice offers of a certain store when they are strolling in the shopping area of that store. In this way, the Mobile Internet can help retailers to attract customers to their store (Klein, De & Vos, 2000, p. 194).

Another opportunity for customers is the possibility to paying with their mobile phone and using their mobile phone as a personal identification. In the future it may be possible for customers to track the status of payments with their mobile phone. Services like that can increase customer satisfaction (Klein, De & Vos, 2000, p. 195). Providers of services with limited capacity, like airlines, cinemas or theatres, can efficiently use the Mobile Internet. With the Mobile Internet, reservations can be made and paid in advance, through which the customer can avoid a long queue and the provider can improve its occupation rate (Klein, De & Vos, 2000, p. 196).

6.5 Summary and Conclusions

Many players are involved in the mobile market. In introducing new services, like the Mobile Internet, suppliers of devices often are a critical factor, because phones are very personal devices. Mobile operators have a strong starting point in the mobile market, because of their knowledge of mobile networks, their ownership of the SIM-card, their privileged position to select the browser for the devices, their invoice relationship with the customers, their powerful distribution and communication position and finally, their knowledge of the local market.

Member propositions and on-line registration can give the provider of a mobile portal a lot of valuable customer information. This data can be used to improve the relationship with the user by offering better customer service. There are a lot of candidates to fulfil the role of mobile portal.

Because of the possibility to communicate one-to-one with a (business) consumer through his mobile phone, advertising can have a lot of impact. Advertising can be made even more specific when positioning is integrated. Advertisers will have to offer consumers something in return for the receiving of advertisements however, because customers are likely to get irritated when receiving advertisements on their mobile phones unasked or unwanted.

To survive in a highly competitive market, companies are joining forces by signing alliances or other forms of co-operation. The mobile market is very dynamic. A year ago, expectations were very high and the exchange rates were skyrocketing. Now, the mobile industry is slowing down, regardless the fact that the mobile market is still in its infancy. Instead of 'slowdown', analysts use the word 'maturity' a lot when referring to the wireless world. Growth will continue, and the battle will not be for the next new customer, but to keep the existing ones.

Phones and computers are converging, but no one knows exactly what the result will be. Two-and-a-half generation networks (GPRS) will be launched at the end of this year, followed by third generation networks in the next couple of years. Although in its infancy, Bluetooth is coming. Killer applications are or will be: Comparison shopping, on-line banking, location-based advertising, location-based services, streaming media, games and messaging. Messaging is already one of the most popular data features of mobile phones and will evolve from Short Messaging Services to Enhanced Messaging Services to Multimedia Messaging Services.

CoolTown is a research program of Hewlett Packard aimed at creating information appliances, software and services for the coming world of diverse, pervasive networked computing, using the World Wide web as the underlying framework of a fundamentally open solution. It is based on five underlying beliefs about the future: There will be rampant diversity in computing, the Web will be the future network environment, everything will have a web presence, the physical and on-line worlds will merge and ecosystems of service providers will be connected. OracleMobile, part of the Oracle Technology network is built on the believe that the future of software is as a hosted service over the Internet. The benefits of hosting wireless applications versus building and maintaining them in-house include faster time-to-market, reduced complexity associated with application development, and the freedom of keeping your company focused on its core business while wireless experts do the heavy lifting. Nokia's Mobile City is the home for companies working together with Nokia for the mobile future. They believe, like many other companies, that co-operation is the key word for the future.

A small amount of suppliers compared to the demand in the mobile market enlarges the power of suppliers and raises the prices. The Mobile Internet can be, like the Internet, an instrument for customers to bypass the traditional sales channels and directly buy products from the supplier.

It is relatively cheap for existing and new competitors to adapt offered services on a web-site or WAP-site to national or even local preferences. This makes the market more unpredictable: new entrants can appear suddenly. To avoid that, there are barriers of entry in effect. Knowledge and speed are in most cases stronger barriers of entry than money. Also, the ownership of a cellular license is a monumental barrier of entry. Next to that, switching costs are high for a current user of a wireless service to switch to another provider.

The Mobile Internet offers various opportunities as a substitute product. The Mobi le Internet can become a substitute for traditional communication and information services because of its low costs and direct and personalised approach. However, it is more likely that the Mobile Internet will be an additional communication medium instead of a substitution. Cash will most likely be replaced by paying mechanisms on the mobile phone.

The power of customers will increase with the rise of the Mobile Internet because the offered products will become more transparent. The Mobile Internet can provide the customer with better and additional information. In the end, the customer has a lot of power; he defines if an offered service adds value to his or her way of living.

In this chapter, the mobile market is examined from a business point-of-view. In the next chapter, the mobile market is analysed again, but now from a consumer point-of-view.

7 The Mobile Market: a Consumer Analysis

7.1 Introduction

Paragraph 7.2 starts with discussing possible positive and negative effects of mobility on society. In doing so, it focuses on the user, the (business) consumer: how does mobility affect his life-style? In paragraph 7.3, opportunities and threats of mobility with regard to collecting consumer data are explored and privacy issues regarding LBS are discussed. Furthermore, pull and push services and, related, permission marketing are described here.

7.2 The Effects of Mobility on Consumers

7.2.1 Opportunities and threats of mobility

Mobility affects life. Some changes are evaluated positively, others negatively. People differ in their opinions with regard to mobility and like or dislike the way it is affecting their lives. It is difficult therefore to look at individual consumer level and say anything about mobility. With this in mind, we can nevertheless try to make some remarks about opportunities and threats of mobility. In doing so, we can make a distinction between private and business life, although this is more difficult to do than it was several years ago because of continuous integration of private and business life. Mobility most likely has a role in this phenomenon.

7.2.2 Opportunities

Mobility saves time, both in private and business life. People can make calls, check their e-mail, send a fax and communicate everywhere. They do not have to look for faxing machines or phone booths anymore, or look for a PC to be able to check their e-mail.

Mobility saves money. Because employees save time, they can spend their time doing more useful things and thus generate more money. Of course, companies will have to invest in mobility, thus spending money. How much money is spent and saved regarding mobility in companies is hard to say. But the general belief is that mobility saves money and if not now, it will definitely save money in the future.

Higher efficiency and productivity levels. The time and money saving components of mobility raise efficiency and productivity levels of employees. One can question the truth of this statement, since research states that without having any time to relax, employees will eventually get stressed out, thus costing a lot of money.

Integration of personal and business life. The usage of mobile devices also leads to the integration of personal and business life. According to a study by Pitney Bowes Inc.,

> "Work/life integration is the far more common and productive reality for today's time-crunched households. Nearly half (47 percent) of the employed respondents reported that communication for work has spread beyond regular business hours, and nearly a third (32 percent) reported conducting household business communications while at work. The study reveals that messaging tools, such as cellular phones, personal digital assistants (PDAs) and e-mail, are key to integrating personal, professional and mobile lives because they allow individuals to bridge skills and management techniques learned in the workplace into the home. The study shows that messaging strategies are transforming 21st century households into organized corporate structures, resulting in workers mirroring successful work management techniques at home."[154]

Availability of information. Most information can be stored on-line. An opportunity of mobility is that people can request and get this information through their mobile devices, when authorised of course.

---

[154] *Pitney Bowes Study Reveals That Messaging Tools Help Workers Link And Integrate Personal, Professional And Mobile Lives*, Business Wire, 05-12-2000

Location-based services. If a person is in the south of New York city, he probably would want to get the weather forecast for that specific area that he is in, not the forecast for Chicago. With, mobility and the location technologies that come with it, services can become tailor-made up to a much higher level than ever before.
Quantum leap for third world countries. In most third world countries, the quality of the fixed telephony network is not very high and large parts of these countries lack a fixed network. With mobile networks emerging in countries all over the earth, third world countries can decrease their efforts in building more fixed networks and focus on building wireless telecommunication networks. This way, they can save costs and catch up with the richer countries at the same time.
Increased availability of products and services. Suppliers of products and services can offer their products and services without keeping their stores and offices open longer than they do now. People can visit their stores through their mobile devices, order products and request services twenty-four hours a day.

7.2.3 Threats

Privacy violation. A threat to the success of mobility is the fear of people that privacy can easily be violated. All systems can be hacked and with mobile services becoming more personalised, more personal information is there 'for the take'. A survey carried out by Accenture found that less than 13 percent of users in each of the European countries has privacy concerns, compared to 25 percent in Japan. [155] Based on these figures, one could conclude that privacy concerns are not a big issue. But this survey was of 31,000 users of mobile devices in the UK, US, Finland, Germany and Japan. So it does not include non-users and therefore does not include any privacy concerns of non-users. In our opinion, privacy concerns is one of the greater reasons for non-users not to start using a mobile device.
Costs. The same survey found that "[…] more than half of consumers are put off by the high access charges, slow service and small screen size." So, high access charges is one of the threats of mobility according to this study. And with the high expenses on UMTS licenses, telco's have heavily burdened themselves and are obliged to earn back these high costs through the users. Thus, one can expect high costs for services on the future 3G networks.
Lack of standardisation. "GSM is the predominant wireless interface used outside the United States, while CDMA is the most widely used interface in North America." [156] Next to CDMA in North America, TDMA is another standard.

> "The International Telecommunication Union in 1999 approved CDMA as the foundation for 3G interface standards. CDMA-based technologies were developed to move CDMA and GSM networks to 3G levels, but not for TDMA systems. That left TDMA operators forced to switch to GSM or CDMA to migrate to 3G. […] The TDMA guys have sort of recognized that if they are going to remain competitive in a world that is dominated by GSM, they are going to have to go to GSM," Lee Hamilton, CEO of wireless infrastructure technology vendor AirNet [ANCC], told Wireless Today. […] Once TDMA 850 operators switch to GSM, they probably won't wait long before beginning the migration to higher-data rate service, starting with the 2.5G technologies of general packet radio service (GPRS) and enhanced data rates for global evolution (EDGE) before graduating to the W-CDMA 3G level. "One of the reasons they're going to GSM is to get the higher-speed data capabilities, if not immediately, very quickly," Hamilton said. […] Because TDMA technology is similar to GSM, and quite different from CDMA, infrastructure providers expect TDMA operators to choose the 3G interface for GSM - wideband-CDMA - as their migration path. The largest U.S. TDMA operators, AT&T Wireless [AWE] and Cingular Wireless, already announced plans to change their networks to W-CDMA for 3G. […] Hamilton said it's unlikely any TDMA operator will choose the CDMA 3G- migration path, cdma2000." [157]

---

[155] *High Cost a Turn Off for Mobile Web Users*, VNUNet.com, 25-02-2001
[156] *TDMA 850 Operators Join GSM 3G Party*, Phillips Business Information, 04-05-2001
[157] *TDMA 850 Operators Join GSM 3G Party*, Phillips Business Information, 04-05-2001

A conclusion to draw from the migration path towards higher-speed data capabilities is that various standards are merging and that the dominant position of the GSM standard increases with this merging process. The merging process of standards is a good thing with regard to the threat that lack of standardisation poses. In our opinion, consumers will less be hesitative to buying a phone with one standard because they fear another standard will become *the* standard.

Expectations set too high. There is a general tendency among players in the mobile market and among news agencies to overestimate the possibilities of wireless technologies. In doing so, they create a specific image of the technology towards the customer. Almost every time, the technology cannot live up to the high expectations, consumers get very disappointed and lose their confidence in the technology and in stories about progress being made. When the first mobile devices and services were introduced, the carriers gave the consumers the idea of having the Internet in their hand. That encouraged people to make a comparison between the Internet the Mobile Internet and that is not a fair comparison. Luckily, carriers have recognised this threat and are starting to be more realistic about the technology in their expectations. The carriers now start to avoid the comparison with desktops and emphasise mobility, practicality, usefulness, filling the needs of workers and consumers when they are away from their desktops. Stephen Krom, vice president of marketing for data and Internet services at Cingular Wireless, agrees with this. "People need to realistically set expectations about speed, the size of the screen and the interface for the user […]" he said. AT&T originally launched Internet access via phone in 1998, then re-introduced the feature in May 2000. Tom Trinneer, company vice president for data product development, said - in retrospect - it was a mistake to pitch the wireless Web to consumers as a mobile version of something they already knew. "[…] we won't set up the consumer with the expectations that it is going to be the Internet in your phone. We are trying to describe this as a new medium, and you have to apply it that way." [158]

The Context-Based Research Group is an anthropology group, which undertook a study on wireless usage worldwide. Their report [159] states some interesting conclusions:

1. Wireless companies are failing to market their services effectively because of cultural differences, the difficulty learning to use devices, and not enough emphasis on the social utility of wireless generally.
2. The result of this is a gap between usage and what devices are capable of doing, with many wireless features on people's devices going unnoticed or unused.
3. Carriers and allied companies that address these issues will close the gap between expectations and actual user experiences.

Health issues. One of the main health issues concerning wireless technology is the fear of dangerous radiation levels with the devices and antenna's. This fear seems to affect a great deal of the people, while there is no evidence that radiation levels are in fact dangerous. Everybody knows from the news that mobile phones produce radiation. In the United States, smart businessmen exploit the people's irrational fears, although they claim these fears to be rational. They figure people are willing to pay for a metallic shield to stick over their phone's earpiece to deflect insidious radio frequencies away from the brain. And they prove to have a point. People do not want to take any chances when it comes to their health. Some stores that sell the shields report they sell them with 75% of new phones. Donald Mays, technical director at the Good Housekeeping Institute says next month, they will publish a report on tests that showed the shields do nothing to block or deflect radiation. But people buy the shield anyway, at least for now. [160] The British government also wants to stay on the safe side and wants all stores that sell mobile phones to give buyers a leaflet when they want to buy a phone. This leaflet contains a warning for children not to use the mobile phone too long at one time and warns people in general that the use of mobile phones could mean a health

[158] *Wireless Web Providers Now Avoid Comparisons with Desktops*, New York Times Syndicate, 11-01-2001
[159] *Anthropologists Study Wireless Usage Worldwide*, Newsbytes News Network, 11-01-2001
[160] *Cancer Fears Raise Call for Phone Shields*, Crain, 25-02-2001

risk.[161] As for antenna's, there is a lot of discussion going on on the subject where to place and where not to place them. How high is the radiation level in their direct environment? Can they be placed on houses or in densely populated areas? The Board of Health in the Netherlands was believed to have reported that antenna's are not a threat to the population.[162] Based on this report, the Dutch Ministry of Transport, Public Works and Water Management has released a National Antenna Policy, which states that antennas up until five metres can be placed on high-rise buildings without a permit of the municipality. In the future, people who live in the building can decide whether they want an antenna on their building or not.[163] Another health issue concerns the integration of personal and business life and reachability in general. Uwe Schneidewind, a German researcher, says "being able to check your e-mails or surf the web from anywhere cuts into vital relaxation time for workers. […] Being constantly in touch leads to more stress and fatigue and may affect mental health."[164] He could well prove to have a point here in the future. Repetitive strain injuries are also are health issue with the small mobile devices. Director of the British RSI Association Andrew Chadwick says the process of text-messaging constitutes a perfect recipe for RSI. [165]
Crime communication. Mobility is not only a benefit for mankind. When used for doubtful purposes, mobility can become a threat. Criminals have discovered mobile devices to being very useful for criminal activities. For example, a person leaves his house to walk with the dog. He does not notice the man hanging around in the street. As soon as he is gone, the man reaches for his mobile phone and calls some friends. While the owner is away with the dog, they know they have at least ten minutes to have a look around in his house.

Obviously, wireless technology is far from being mature. The developments are going very fast and carriers, other suppliers and consumers are learning more and more about the advantages and disadvantages of mobility and how to benefit from or deal with them. At this moment, the technology has not developed enough and people do not use mobile devices for a sufficiently long period to draw any real conclusions.

7.3 Issues Concerning Consumer Data

7.3.1 New ways of collecting consumer data

With the widespread diffusion of the Internet into homes of people all over the world, the market research companies were offered another opportunity to interview consumers. They could send people emails, requesting them to go to a certain web-site to participate in a survey. The advantage of doing surveys this way is that the results of the survey can be analysed quickly because they are already entered into the computer. If necessary, the results can be analysed immediately after being received. Because consumers are less willing to participate in a survey, it is important that alternative ways are developed to reach the consumer with a survey. This way, market research companies can contact the consumer the way the consumer prefers to be contacted and so avoid a negative reaction simply because of using the wrong way to contact the customer.

A second step in using digital questionnaires is making the questionnaires ready for mobile use. Already, digital questionnaires can be done mobile, for example when surveyors are using a laptop to question consumers. But with mobile questionnaires here is meant letting consumers participate in a survey by using mobile devices like a mobile phone or a PDA. A mobile questionnaire can be developed for example on a WAP-phone, in WML-format. When doing mobile questionnaires, the mobile device must be connected on-line with the server in order to receive questions and send results. This way, results also can be analysed immediately. Mobile questionnaires can therefore be very useful when an answer is needed

---

[161] *Britse zaktelefoons krijgen waarschuwing tegen* straling,Trouw, 28-11-2000
[162] *UMTS-netwerk hangt op 'antennekwestie'*, Trouw, 09-12-2000
[163] *Gsm-antennes vergunningvrij – Maatregel moet tekort aan zendmasten oplossen* , Trouw, 12-12-2000
[164] *Mobile Revolution May Affect Sanity*, World Entertainment News Network, 28-03-2001
[165] *Text Messaging May Prompt Repetitive Strain Injuries*, World Entertainment News Network, 08-04-2001

immediately, which is the case for example with exit polls. Mobile questionnaires can also be done off-line, but often memory capacity of mobile devices is limited and when doing a questionnaire off-line, the results cannot be analysed immediately.

During the practical period preceding the writing of this thesis, experience was gained in doing mobile surveys at large business conferences. A description of how the mobile surveys were going at the conferences in Berlin and Brighton, UK, can be found in Appendix I.

7.3.2 The privacy issue regarding LBS

With the advance of new kind of mobile services, consumer awareness of privacy issues is increasing. More and more, consumers will rebel against on-line companies that fail to protect privacy. Especially with LBS, the privacy issue is an important concept. Until now, there is no privacy protection for location information derived from the use of mobile information services such as LBS. There is a low barrier for companies to use the location information for marketing or other purposes. The fact that there is minimal legislation with regard to location information and mobile services makes the misuse of this information more attractive.

> "The evidence seems to be that consumers are willing to provide personal information so long as they are truthfully informed about the uses to which the information will be put, have a choice not to participate, and are assured that their personal information will be safeguarded (i.e., the consumer will not be made a victim of identity theft). Indeed, recent surveys have shown that nearly three-quarters of those surveyed appreciate the benefits that are to be gained through personalisation. Thus, the challenge for the budding location commerce industry is to secure consumer trust through the promise of protecting private location information."[166]

> "To foster widespread adoption and acceptance of enhanced location-based mobile services, the wireless industry should take a leadership position on the location privacy issue. Indeed, the wireless industry should consider adopting a set of Fair Location information Practices to assure customers that location information related to their use of any service will be safeguarded and used as disclosed in the company privacy policy."[167]

In the US, the Wireless Communications and Public Safety Act of 1999 (WCPSA) is composed, which states that location information derived from a telecommunications service is Customer Proprietary Network Information (CPNI). This network information may only be used to complete the call but not for marketing without the customer's approval. The WCPSA also states that "Without the express prior authorisation of the customer, a customer shall not be considered to have approved the use or disclosure of or access to location information for any other purpose."[168]

7.3.3 Pull and push services

With regard to the privacy issue, two kinds of services can be distinguished: pull and push services. Both affect privacy considerations. With pull services, the customer requests location sensitive information. This kind of service pose the least privacy concerns, because it is the customer himself who asks for information. The research paper of Airbiquity makes the following remarks with regard to pull services (see the next page): [169]

---

[166] Airbiquity, *No "L-Commerce" without "L-Privacy"; Fair location information practices for mobile commerce*, p. 3

[167] Airbiquity, *No "L-Commerce" without "L-Privacy"; Fair location information practices for mobile commerce*, p. 2

[168] 47 U.S.C. 222 in Airbiquity, *No "L-Commerce" without "L-Privacy"; Fair location information practices for mobile commerce*, p. 6

[169] Airbiquity, *No "L-Commerce" without "L-Privacy"; Fair location information practices for mobile commerce*, p. 13 and 14

"The request may be pursuant to a subscription plan where news and information pertinent to the locale are received on a periodic basis (e.g., the weather in whatever city the customer happens to be in when using the mobile device). Or, the request may be part of an 'on demand' service where the customer dials or signals a location service provider for specific information such as the nearest ATM or traffic conditions. In 'pull' services, the location information seems ephemeral and useful only to complete the requested transaction. The customer's invocation and use of the neighbourhood service implies the requisite consent to be located in relation to the requested information. However, when location information is stored and used to develop a customer profile, greater privacy concerns are implicated. Thus, even "pull" services can present disclosure issues; that is, it may be a challenge for a company providing location services to predict the myriad of uses for location information and therefore to properly inform customers about prospective applications."

Push services are the other kind of services. In this case, the customer receives advertisements or information without request. Location-based 'push' service may include customer receipt of marketing information based on known proximity to a retail store when using the particular wireless service. Receipt of highly personalised advertisements clearly would be more intrusive than a company that merely pushes advertisements to all mobile wireless subscribers in the vicinity of a particular retail store without regard to their personal identification, according to the Airbiquity paper. [170]

7.3.4 Permission Marketing

Another approach to 'pushing' information is permission-based marketing where, for example, the customer 'opts in' to receive advertisements periodically when signing up for the wireless service. In some models, the more advertisements the consumer agrees to receive, the less costly the service plan is. More than half of wireless users that access the Internet or send and receive data with their mobile devices are interested in receiving advertisements via wireless networks, according to results of a survey conducted by Telephia. [171] The table below illustrates the results of this survey. [172]

Willingness to Receive Advertising Without Control or Compensation	Percentage of Respondents
Extremely Willing	6
Very Willing	13
Somewhat Willing	34
Not Very Willing	26
Not At All Willing	21

Table 7.1 Results Telephia survey

In addition, 19 percent of survey respondents that initially opposed accepting ads changed their minds when offered opportunities to receive compensation or to control whether they receive advertisements. Furthermore, the study shows that of the respondents that said they were 'somewhat', 'not very' or 'not at all' willing to accept advertising, 5 percent said they would be 'extremely willing' and 14 percent said they would 'very willing' if they were offered discounts on products or services in exchange for receiving ads. The ability to limit which companies could send discounts would convince 2 percent of those resistant to wireless ads to be 'extremely willing' and 15 percent to be 'very willing', according to Telephia. [173] This makes permission marketing a very interesting concept for companies. Customers are more willing to receive advertisements when they think they are in control by giving companies permission to send them advertisements or information.

[170] Airbiquity, *No "L-Commerce" without "L-Privacy"; Fair location information practices for mobile commerce* , p. 14
[171] *Study: Wireless Ads OK, But Consumers Want Incentives* , Philips Business Information, 07-03-2000
[172] *Study: Wireless Ads OK, But Consumers Want Incentives* , Philips Business Information, 07-03-2000
[173] *Study: Wireless Ads OK, But Consumers Want Incentives* , Philips Business Information, 07-03-2000

7.4 Summary and Conclusions

Mobility affects life. Some changes are evaluated positively, others negatively. In general, the following issues are seen as opportunities of mobility for society: Mobility saves time and money, it causes higher efficiency and productivity levels and supports the integration of personal and business life. Mobility makes more information more widely available and creates an opportunity for location-based services to being introduced, Third World countries can make a quantum leap forward by building mobile networks without first having to build fixed networks. And finally, mobility increases availability of products and services since closing times of shops and physical location become less important.

Threats of mobility that must be mentioned are: Threat of privacy violation, high costs of mobile services and the lack of standardisation in both hard- and software in the mobile market. Next to these threats, expectations have been set too high in the past too often. The players in the mobile market will have to make sure they will be more realistic about developments towards customers. Finally, health issues – mainly possible dangerous radiation levels of mobile phones and antenna's – and mobile phones used during criminal activities are two threats of mobility for society.

Entering the mobile market for market research purposes, market research companies can contact the consumer the way the consumer prefers to be contacted and so avoid a negative reaction simply because of using the wrong way to contact the customer. Mobile questionnaires can be very useful when results are needed immediately because of the possibility to process the answers on-line.

With the advance of new kind of mobile services, consumer awareness of privacy issues is increasing. Until now, there is no privacy protection for location information derived from the use of mobile information services such as LBS. Consumers are willing to provide personal information so long as they are truthfully informed about the uses to which the information will be put, have a choice not to participate, and are assured that their personal information will be safeguarded.

Two kinds of services can be distinguished: pull and push services. Both affect privacy considerations. Pull services pose the least privacy concerns, because it is the customer himself who asks for information. With push services, receipt of highly personalised advertisements clearly would be more intrusive than a company that merely pushes advertisements to all mobile wireless subscribers without regard to personal identification.

Another approach to 'pushing' information is permission marketing: Customers are more willing to receive advertisements when they think they are in control by giving companies permission to send them advertisements or information.

The next chapter will continue the analysis of (business) consumers in the mobile market. This time, the focus will be on, at a market level, diffusion of innovations, and at a more individual level, adoption of innovations with regard to the Mobile Internet.

8 Diffusion and Consumer Adoption of Mobile Services

8.1 Introduction

In the previous chapters, the mobile market was analysed. Firstly, from a business point-of-view and secondly, from a consumer point-of-view. This chapter is also consumer-oriented, but the scope has changed from market level to the individual level. The diffusion and adoption of the Mobile Internet and beyond are analysed in more detail. In paragraph 8.2, the theory of the innovation diffusion model is outlined. The four main aspects of the diffusion of innovations are described: the innovation itself, the communication channels of a certain innovation, the time in which an innovation diffuses and the social system wherein an innovation diffuses. In the second part of this paragraph, the theory of consumer adoption of innovations will be studied more in-depth. The consumer adoption of innovations can be described as the individual's decision to accept or refuse an innovation. In paragraph 8.3, the diffusion of the Mobile Internet is examined. Network effects play an important role in this diffusion, so this subject is addressed separately. The last paragraph of this chapter deals with the consumer's adoption of the Mobile Internet. Several criteria, which are important when setting up mobile services, are discussed. These criteria are mainly based on elements of the adoption theory.

8.2 Diffusion and Adoption of Innovations

8.2.1 Diffusion of innovations

Diffusion theory is of value in explaining the flow of new information, ideas, practices, products and services within and across cultures and subcultures, or markets and market segments (Gatignon and Robertson, 1985). The special focus of this theory is on interpersonal communications within social systems. Diffusion can be defined as the cumulated adoption processes of individuals within a social system. Rogers and Scott (1997) give the following definition of diffusion:

> "Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system."

In this definition, four main elements in diffusion of innovations can be distinguished. These are 1) the innovation, 2) communication channels, 3) time and 4) the social system.

1) The innovation

Rogers and Scott (1997) give the following definition of an innovation:

> "An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption."

Perhaps Van de Ven in article by Shabelnik (2000) gives a better definition of innovation by defining the process of innovation as

> "[…] the development and implementation of new ideas by people who over time engage in transactions with others in an institutional context."

The importance of interpersonal networks needed for innovations in diffusing new ideas is highlighted in this definition. The definition also emphasises the institutional context, in other words, the wider organisational and societal context in which new ideas are born.

Innovations can traditionally be classified into three categories. These categories represent the way in which a given market segment perceives them: continuous, dynamically

continuous and discontinuous. This classification was originally developed by Robertson in 1967 and is based on the impact of the innovation on behaviour in the social structure. [174]

- A continuous innovation is the modification of an existing product rather than the establishment of a totally new one. It has the least disrupting influence on established patterns of behaviour;
- A dynamically continuous innovation may involve the creation of either a new product or the alteration of an existing one, but does not generally alter established patterns of customer buying and product use, and
- A discontinuous innovation involves the introduction of an entirely new product that causes buyers to alter their behaviour patterns significantly.

2) Communication channels

Communication channels is the second element that can be distinguished in the definition of diffusion of innovations. Rogers and Scott (1997) define communication as

> "[…] the process by which participants create and share information with one another in order to reach a mutual understanding."

A communication channel, then, can be defined as

> "[…] the means by which messages get from one individual to another."

A two-step flow exists in which innovations are communicated to the general public. The first step is through mass media networks. Ideas, opinions, and/ or knowledge flow from mass media to opinion leaders. The second step is the flow from opinion leaders to other members of the population in a certain social system through interpersonal contacts. Typically, mass media channels are more effective in creating knowledge of innovations, whereas interpersonal channels are more effective in forming and changing attitudes toward an innovation, and thus in influencing the adoption or rejection of the innovation (Rogers and Scott, 1997).

3) Time

An important element in diffusion of innovations is time. The time dimension is involved in the diffusion process in four ways. Firstly, time is involved in the innovation-decision process. The innovation-decision process is the mental process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, product or service, and to confirmation of this decision (Rogers and Scott, 1997). In every stage of the innovation-decision process, the individual seeks information about the innovation to decrease his uncertainty about it. Secondly, time is involved in the innovativeness of an individual or other unit of adoption. Innovativeness is the degree to which an individual or other unit of adoption is relatively receptive to adopting new ideas compared with other members of a social system (Rogers and Scott, 1997). Researchers have found it useful to divide the adopters of any given innovation into five groups based on their degree of innovativeness. These adopter categories are: [175]

- **Innovators** – this is the very earliest group of adopters. Innovators are venturesome people with higher income, higher education, they are younger and have greater social mobility, a favourable attitude towards risk, greater social participation and higher opinion leadership (Gatignon & Robertson, 1985, p. 861). These people frequently get 'burned' when innovations do not diffuse. It has to be noted that innovators must be identified and characterised on a product category basis, because

[174] McCarthy and Hogg (1997)

[175] Source for the categories: http://www.udel.edu/communication/COMM256/johnc/diffusion.html

the characteristics of an innovator are not generalised across product category or interest domains;

- **Early adopters –** this is a group of people that is more integrated into the mainstream of the social system. Because of their higher degree of integration in the social system, early adopters are frequently opinion leaders: potential adopters look to early adopters for advice and information about the innovation;
- **Early majority** – these are thoughtful people who adopt just before the average member of the system;
- **Late majority** – these are sceptical and cautious people who adopt just after the average member of the system, and
- **Laggards** – this groups consists of traditional people who may be nearly isolated from the social system. Their point of reference is usually the past (the 'good old days'). When they do adopt, a new or better innovation most likely is already widely available.

Beside the innovation-decision process and the innovativeness of members of a social system, a third element in which the time dimension is involved is the diffusion process. The diffusion process is the manner in which the innovation spreads through the market. This process can be characterised in terms of three dimensions: the rate of diffusion, the pattern of diffusion, and the potential penetration level (Gatignon and Robertson, 1985, p. 858). The rate of diffusion reflects the speed at which sales occur over time. The diffusion pattern concerns the shape of the diffusion curve. No matter which innovation is being studied or which social group is involved, the diffusion process frequently seems to follow a similar pattern over time: a period of slow growth, followed by a period of rapid growth followed by a period of slower growth. Typically, an S-shaped curve arises. Finally, the potential penetration level is a separate dimension indicating the size of the potential market, or the maximum cumulative sales (or adoption) over time.

Finally, time is involved in diffusion of innovations in the rate of adoption. The rate of adoption is the relative speed with which members of a social system adopt an innovation. The rate of adoption is usually measured as the number of members of the system that adopt the innovation in a given time period (Rogers and Scott, 1997).

4) The social system

Rogers and Scott (1997) define a social system as "[…] a set of interrelated units that are engaged in joint problem solving to accomplish a common goal". The members of a social system may be individuals, informal groups, organisations, and/ or subsystems. The social system constitutes a boundary within which an innovation diffuses. However, Gatignon and Robertson (1985, p. 857) state that nowadays, where mass media marketing crosses social system boundaries, this assumption is questionable, especially concerning diffusion among consumers.

The influence of the social system on innovations can be characterised along three features (Gatignon and Robertson, 1985, p. 857 and 858). Firstly, the innovation's degree of compatibility with the values and norms of the social system determines the speed of diffusion. Values and norms are the established behaviour patterns for the members of a social system. Normally, values and norms are changing over time. This is the second dimension of the social system. Because values and norms change over time, the social system evolves. This system evolution affects market potential of innovations over time. Thirdly, the degree of heterogeneity of the social system is important. The more homogeneous the social system is, the faster the diffusion rate and the higher the maximum penetration level of the innovation are.

Another important area of research regarding the social system has to do with opinion leadership, the degree to which an individual is able to influence informally other individual's attitudes or overt behaviour in a desired way with relative frequency (Rogers and Scott, 1997).

According to Rogers and Scott (1997), a final important concept of understanding the diffusion process with regard to the social system is the critical mass. The critical mass is the point at which enough individuals have adopted an innovation, so that the innovation's further rate of adoption becomes self-sustaining. Rogers and Scott consider early adopters instrumental in getting an innovation to the point of critical mass, and hence, in the successful diffusion of an innovation.

8.2.2 The diffusion matrix of Henderson

Henderson (1999) provides a framework within which the determinants of diffusion are shown. Generally, a consumer will adopt a new technology when the perceived benefit of doing so exceeds the perceived cost. If adoption is not instantaneous – if diffusion occurs, which is practically almost the case - it must therefore be that potential consumers differ in some fundamental respects and that either costs are falling over time or benefits are increasing. The matrix below shows the framework of Henderson. [176]

Consumers are **The technology**	*All the same*	*Different*
Is always the same	Information transfer determines diffusion: The Epidemics model	Diffusion is driven by: Relative risk preferences Social adoption pressure Development of complementary technologies/ products Price dynamics Competitive dynamics
Evolves over time	Complicated information transmission dynamics	All of the above *plus* reductions in cost and increases in benefits due to technical evolution

Table 8.1 The diffusion matrix of Henderson

In the first quadrant, consumers are fundamentally identical (they differ only in their knowledge of the innovation or their 'closeness' to its point of introduction) and there is no change in the technology. If consumers adopt as soon as they learn about the technology, either through seeing it or using it or by hearing about it from others, diffusion will follow what is known as the Epidemics model. In this model, benefits of adoption are always greater than costs. It is simply that consumers are not well informed, but as soon as they know about the innovation, they adopt.

The second quadrant, where consumers are identical, but technology evolves over time, is a more complex version of the first quadrant. The difference is the fact that there are different periods of information transmission, which follow each other across the target population.

In the third quadrant, the consumers are different. Meanwhile the technology does not evolve. Because the consumers differ, the innovation will merely be adopted by all those consumers for whom benefits are larger than costs, up to the stage at which the 'marginal' consumer adopts the innovation. The marginal consumer is the one for who the cost and benefit of adopting the innovation are approximately equal. Below this breakeven point there will be no further diffusion.

[176] Henderson (1999)

In the fourth quadrant, consumers differ and technology evolves. According to Henderson (1999), "[…] in the simplest case technology diffusion is driven by the fact that as the technology improves it becomes more attractive to more and more consumers for whom the benefit to cost ratio was initially smaller than one", and "[…] as the technology becomes more standardised, costs fall as the industry's attention turns to process technology, and benefits may rise as incremental innovation 'tunes' the technology or innovation to the needs of different kinds of consumers."

8.2.3 Consumer adoption of innovations

For a long time, literature about diffusion among individual consumers, in short consumer adoption, reflected the same concepts as the general diffusion literature. Still there is much overlap between diffusion theory, which is focused on the diffusion of innovations in the social system, and the adoption theory, which is more centralised towards the individual consumer. However, Gatignon and Robertson (1985) provided a view of diffusion theory that is relevant to consumer behaviour. Gatignon and Robertson used the model of Rogers as a foundation and added some relevant concepts of consumer adoption of innovations. The most important components of this model are the adoption process, personal influence and opinion leadership, the social system, the diffusion process itself, personal characteristics and perceived innovation characteristics.

The adoption process describes the extended decision making of an individual when a new idea, product or service is involved. It is composed of four factors. The first factor concerns the amount of cognitive processing expended in the adoption of innovations. Normally, the hierarchy of effects of the adoption process is: awareness of the innovation, knowledge, attitude formation towards the innovation, trial, and finally adoption (Gatignon and Robertson, 1985, p. 854). However, under conditions of low cognitive processing, another model appears to represent the adoption process more accurately: awareness of the innovation, trial, attitude formation, and adoption. To determine the level of cognitive processing of innovations, four variables can be distinguished:

1. The degree in which innovations require high consumer learning, for example with technology-based products;
2. The costs involved in adoption;
3. The social relevance of the product, and
4. The extent to which the adoption decision involves other household members or organisation staff.

The second factor, which is relevant with regard to the adoption process, is the width and depth of adoption. The maximum diffusion potential increases with the width and depth of adoption. By width is meant the number of people within the adoption unit who use the product, or the number of different uses for the product. On the other hand, depth indicates the amount of usage or the purchase of related products (such as accompanying software) (Gatignon and Robertson, 1985, p. 854).

Thirdly, it is important to examine how an innovation fits into existing consumption system and inventory patterns. A major barrier to diffusion occurs if consumers already use a similar product, such as in case of the Mobile Internet a wired Internet connection. Should the innovation then be positioned as more extreme in order to maximise the disparity with existing inventory? A further barrier to diffusion occurs when the innovation does not fit within the existing consumption system – for example, when a new product requires the consumer to change the way in which the entire consumption event is conducted. Also, since all consumption decisions involve an allocation of resources, an innovation can break the priority acquisition pattern (Gatignon and Robertson, 1985, p. 854 and 855).

And fourthly, the speed of adoption depends on the degree of advertising and other marketing actions directed to the consumer (Gatignon and Robertson, 1985, p. 855). Engel et al. (McCarthy & Hogg, 1997) stated (see the next page):

"For most situations, marketing programs for innovative products are most likely to succeed if they are directed to people of high social status, who are upwardly mobile, educated and/ or literate, and who are privileged relative to others in the social system. Income is almost always useful in profiling innovativeness. Higher-income people not only have the ability to buy more new products, but they also have the ability to take the risk of trying new products."

Personal influence is another basic underlying component of adoption theory. As shown in the previous section, opinion leadership and word-of-mouth publicity are central to the role of communication strategies for innovations. Personal influence is only relevant when the involvement of the customer in the purchase decision of the innovation is high, which is the case with innovations which require relatively high cognitive processing. Personal influence is interdependent, but complementary with mass media. The effect of personal influence is most pronounced at later stages of the adoption process, whereas mass media's effect is most pronounced at earlier stages of the adoption process. When conflict occurs between personal influence and mass media, personal influence has greater impact. Also, most personal influence is transmitted within a network of people who possess similar demographic characteristics. Generally, research has shown (Gatignon & Robertson, p. 856 and 857) that negative personal influence has greater persuasive impact than positive personal influence, assuming a credible source and consistent information content. Furthermore, personal influence can be either verbal ('word of mouth') or visual. Especially in fashion or cars, visual influence could be more persuasive.

The social system is also distinguished by Gatignon and Robertson as an important determinant of consumer adoption of innovations. In the previous section, the social system and the dimensions along which it can be characterised have been described in more detail.

The diffusion process is the fourth major component of the model of Gatignon and Robertson. This process is already treated in the theory about diffusion in paragraph 8.2.1. Together with the social system, at this point the model of Gatignon and Robertson has overlap with the diffusion theory of Rogers.

Personal characteristics play a remarkable role in adoption of innovations. Normally, few people adopt the innovation very quickly, another limited group is very reluctant to adopt the innovation, and the majority adopts at some point between the two extremes. In the previous section, the five adopter categories were treated. Also, the greater the individual's propensity to use information from mass media or from sources external to the immediate social system, the earlier the adoption (Gatignon and Robertson, 1985, p. 862).

The characteristics of an innovation obviously affect the likelihood and speed of its diffusion within a social system. The following characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption (the degree and speed with which an innovation spreads throughout a social system) (Rogers and Scott, 1997):

- **Relative advantage** – this is the degree to which an innovation is perceived as better than the existing product, service or idea it replaces. The degree of relative advantage usually is measured in economic terms. Nevertheless, social status, convenience, and satisfaction are also important factors. The greater the perceived relative advantage, the faster the rate of adoption will be;
- **Compatibility** – the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. The adoption of an incompatible innovation often requires the prior adoption of a new value system, which is a relatively slow process;

- **Complexity** – the degree to which an innovation is perceived as difficult to understand and use. Innovations that are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings;
- **Trialability** – the degree to which an innovation may be experienced on a limited basis. An innovation that is trailable represents less uncertainty to the individual who is considering it for adoption, who can learn by doing, and
- **Observability** – the degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt it.

Summarised, innovations that are perceived by individuals or groups, as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations.

8.3 Diffusion of Mobile Services

8.3.1 Diffusion of the Internet

The speed of diffusion of technological innovations depends on the consumer's ability to develop new knowledge and new patterns of experience (Gatignon and Robertson, 1985, p. 863). The speed will be highest among those consumers who already have some related knowledge or experience. New products represent only an extension of the existing consumer experience base. For many new products – like mobile solutions – consumers may have to develop new consumption patterns. Firstly, a few recommendations will be made with regard to diffusion of the Internet. After that, in the next section diffusion of the Mobile Internet will be studied in more detail.

It seems reasonable to consider the Internet as an IT innovation and consequently to study its diffusion from a diffusion of innovation perspective. Van Slyke considered the Internet not to be a single innovation but a cluster of related technologies. [177]
Charlton et al. gave the answer to the question "Why the Internet is a special case of innovation". In a paper of Shabelnik, they outlined four major reasons: [178]

- The innovation itself provides a medium for its own diffusion. In the case of the Internet, the innovation itself is a medium of communication, which may indeed become equally or more important than all other communication media. As an innovation, the Internet is capable of acting as a medium for its own diffusion, including diffusion into organisations that have no direct access to it;
- The innovation can be conceived as part of a global, worldwide social system. The social system, within which information about this innovation is being disseminated, is global and almost unconstrained. In this case, the adoption of the innovation would be in the interest of almost all members of the social system;
- The Internet has been around for a long time and yet only recently, in the 1990s its potential as a vehicle for Electronic Commerce has been attended to, and
- The innovation is constantly changing. In the case of the Internet, we have an innovation, which is evolving time lag in adoption for itself.

Bazar and Boalch have built a preliminary model for diffusion of the Internet. [179] The diffusion process is believed to follow a pattern of a few areas of application. Usually, research institutes introduce the Internet. The next area of application is usually educational organisations, like universities. They stated that the use of the Internet by students plays an important role in diffusion of the Internet. Internet developments are accelerated when

[177] http://hsb.baylor.edu/ramsower/ais.ac.97/papers/vslyke.htm , 02-05-2001
[178] Shabelnik (2000)
[179] Bazar and Boalch (1997)

businesses join the Internet community. When businesses use the Internet, two trends are usually observed. Firstly, investments in network infrastructure increase, leading to increased networking capacity - bandwidth and geographical coverage improves. Secondly, commercial Internet Service Providers (ISP's) emerge, leading to increased competitiveness among service providers, and decreased access and service costs for users. These trends, particularly the latter one, play a significant role in forming the critical mass necessary for diffusion of the Internet. With the increased availability of Internet services and decreased cost of such services, the adoption of the technology by individuals and organisations increase, thereby making the Internet available to the public.

These comments about diffusion of the Internet can also be applied to the Mobile Internet. In our opinion, the Mobile Internet has major similarities with the Internet at the points mentioned above. In the next paragraph, an attempt will be made to examine diffusion of mobile services.

8.3.2 Diffusion of the Mobile Internet

In this paragraph a closer look will be taken at diffusion of the Mobile Internet. What kind of innovation is the Mobile Internet? There are similarities with the Internet, and the theory for diffusion of the Internet holds also for some part for diffusion of the Mobile Internet. However, as mentioned in previous chapters, wireless developments and the Mobile Internet are not the same as a wireless version of the Internet. This implies that you cannot extend the diffusion theory of the Internet towards wireless technology developments.

The introduction of the Mobile Internet is positioned between a dynamically continuous innovation and a discontinuous innovation. It is a dynamically continuous innovation, because it can be seen as an extension of the Internet. But it can also be seen as a discontinuous innovation because it is one of the emerging forms of interactive media, which proves to fundamentally change the way of living. So, it influences behaviour patterns of people.[180]

According to a research paper of Cottone and Goel (2000), "[…] the wireless services offered today don't deliver enough value to the customer in order to create a market pull." Furthermore "Technology is in the driver seat and not the customer needs. We think that the diffusion of wireless at this stage is a classical technology push process." In relation to this, the same authors distinguish two factors that drive or block diffusion of the wireless technology. The first factor has to do with the innovation itself. Cottone and Goel (2000) state that a dominant design for wireless devices is not yet identified. Today, three different major designs for wireless handhelds can be distinguished: the personal digital assistant (PDA), the low-end smart phone (handset) and the high-end smart phone (a PDA handset hybrid). Cottone and Goel (2000) believe that the reason for the many different devices with different operating systems lays in the lack of identifying a design, which best addresses the specifics of wireless services. Different devices offer a problem for the diffusion of these devices, because customers do not know which will be the surviving technology and are therefore reluctant to buy expensive hardware. If a dominant design can be identified, it is very likely that the market moves towards this design and diffusion of wireless devices will increase. Cottone and Goel (2000) consider a dominant design and standards necessary for the takeoff of wireless technologies, as can be shown in the S-curve of wireless below (see the next page).[181]

[180] McCarthy and Hogg (1997)

[181] http://architecture.mit.edu/%7Ea_goel/15.567/wireless/dd.htm (04-12-2000)

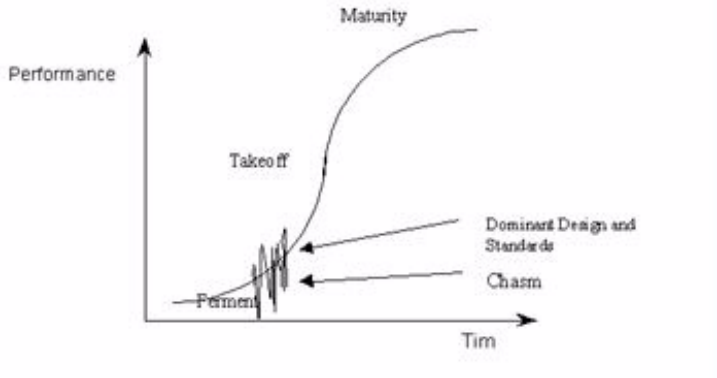


Figure 8.1 S-curve of wireless technologies

A second factor that influences the rate of diffusion of wireless devices is the amount of applications and services available. The more different applications and services there are, the more probable it is customers will step into the wireless world.

So-called vintage effects also play a role in the diffusion of wireless devices and the Mobile Internet. These effects appear to characterise the diffusion of a number of industrial technologies. The innovation, in this case the Mobile Internet, may create significant benefits for all potential customers, but customers may differ in the relative age of their equipment. If customers wait until their existing cellular phones are fully depreciated before buying new ones with the Mobile Internet, diffusion will be gradual. [182] This corresponds with a news article from AnyWhereYouGo, which stated that panel members of separate wireless seminars agreed unanimously that customer adoption would proceed in 'baby steps'. Furthermore, it stated: "Wireless innovation will continue to outpace consumer adoption, so manufacturers and service providers must bring the customer along through marketing and education." [183] Time is thus also an important factor with regard to diffusion of the Mobile Internet.

Cottone and Goel (2000) also use Henderson's model, which was introduced in the previous paragraph. They position wireless developments in the fourth quadrant of the diffusion matrix. In other words, the technology evolves over time and the customers are different. Because in the case of wireless devices, different customers with different needs have to be addressed, it is very important to segment the customers and to try to understand their different utility functions.

8.3.3 Network effects in the mobile market

An important factor that influences diffusion of wireless devices and the Mobile Internet are network effects or network externalities. In this paragraph, a description will be given of network effects and the way they influence diffusion and adoption of the wireless concept.

The mobile network is a communication network, in which each user wants to link directly to other users. Consequently the demand for products or services that exist within a network, like mobile phones or the Mobile Internet, is not only a function of its price, but also a function of the expected size of the network (Katz and Shapiro, 1994, p. 96). Owners of mobile phones find those phones more valuable as others also buy mobile phones, because no consumer would value owning the only mobile phone in existence! If each consumer supposes that no other consumer purchases a mobile phone, then no one will purchase it, and there is subsequently a fulfilled expectations equilibrium with no sales. But now, suppose that each consumer believes that a large number of other consumers are going to purchase mobile phones. Then many would purchase mobile phones, and this outcome is a second

[182] Henderson (1999)

[183] *CES Panelists See Cellphones For Every Occasion*, This Week In Consumer Electronics, 22-01-2001

fulfilled expectations equilibrium (Katz and Shapiro, 1994, p. 97). Cottone and Goel (2000) also confirm the importance of network effects in the diffusion of mobile devices, as they say:

> "In the case of wireless devices, network externalities and complementary assets are very important concepts, which influence the consumer's buying decisions. A consumer is interested in buying a product, which can be used in the different regions he or she is working or travelling to. On the other side it may be important to buy a device which is widely used by other persons in order to exchange data or being able to communicate with as many people and services as possible. The value of the device increases with the amount of devices used by the population."

In addition, the adoption of the wireless innovations by a small group of people is very important for the spread of this innovation towards the other part of the social system. Henderson (1999) remarks:

> "While high valuation consumers may adopt first, their adoption may in turn create value for later consumers through the creation of various kinds of network externalities. Simple adoption by a leading group may create a 'risk reduction' or a 'knowledge' externality – if consumers vary in their taste for risk, the fact that one group has adopted the technology successfully may make it less risky for the second, and so on across the market. An increasing market for the innovation may stimulate investment in complementary products or services, further increasing the benefits of adopting the innovation and persuading formally marginal consumers to adopt."

Katz and Shapiro (1986, p. 822) distinguish compatibility as another factor with regard to network effects: "The benefit that a consumer derives from the use of a good often depends on the number of other consumers purchasing compatible items." Two kinds of compatibility can be distinguished. Firstly, the so-called hardware/ software paradigm, a system in which each consumer must buy two components to generate benefits, like computer hardware and software (Katz and Shapiro, 1994, p. 97). Most examples of network externalities and compatibility entail this kind of provision of a durable good and a complementary good or service. The question of compatibility is whether different brands or technologies of the durable good (e.g. hardware) can utilise identical units of the complementary good (e.g. software) (Katz and Shapiro, 1986, p. 823). This kind of compatibility is not very important with regard to the Mobile Internet, because hardware and software are most of the time combined in one device. However, in the PDA and other handheld industries, this problem can arise, because sometimes separate software is necessary when using these devices. Secondly, there is compatibility over time. This is the degree in which newer systems are compatible with existing products. Additionally there is the phenomenon of excess inertia. This is an alleged bias towards existing products or systems over newer, superior systems that lack an installed base of users (Katz and Shapiro, 1992, p. 73).

8.4 Consumer Adoption: Criteria for Designing Wireless Services

8.4.1 Criteria from the consumer adoption theory

In their article, Cottone and Goel (2000) give a number of criteria for the design of wireless services, mainly based on the consumer adoption theory. These criteria are crucial for the adoption of wireless services. In this paragraph, these criteria will be mentioned, together with some other criteria based on the aspects, which were mentioned in this chapter.

Positioning of the Mobile Internet

First, the positioning of the Mobile Internet went wrong. Wireless was presented as a mobile version of the Internet. However, user interaction, transaction types, screen size and environment differ significantly between the Web and mobile devices. Many customers were disappointed because the Mobile Internet could not meet the expectations people had when

it was introduced. Cottone and Goel (2000): "There is no value in having web-based services on wireless devices unless they address their contextual reality. There is more to wireless than accessing information 'anytime, anywhere'. It is a context where a customer might need some relevant information while being in the real context." De Klein and Vos (2000, p. 67) come to more or less the same conclusion. They argue that the Mobile Internet is a supplement on the Internet, and that it will be used for other activities. Using your WAP or handheld device takes place in a highly dynamical environment. The user wants to have quick and short answers to his questions. Important properties to consider when setting up WAP or Mobile Internet services might therefore be: time-specificity, location-specificity, personalisation, context-driven and easily executable, both in terms of time and money (Cottone and Goel, 2000).

Customer segmentation
A lot of services are available to the customer, but there is a confused road map of wireless services and customer segments. There is a lack of segmentation of wireless services. Because wireless services fall into the fourth quadrant of the Henderson-matrix (evolving technologies, different customers), segmentation is an absolute prerequisite when introducing wireless services.

Cottone and Goel (2000) distinguish two basic kinds of customers, who can act as early adopters and therefore as opinion leaders in the introduction of mobile services, namely the business customer and the normal customer. The business customer is a business professional that is typically an early adopter, who is extremely time-conscious. He wants to use mobile services to get up-to-date specific business news, stock trading, client information, etc. Related to the business professional is the enterprise customer, for example a salesman from the automobile industry, where LBS based on GPS technologies could be used for an Intelligent Traffic Guidance System. The other kind of consumer, who can be an early adopter, is a young student who is curious after new technologies, but is typically more price-conscious and is more interested in entertainment services. Cottone and Goel (2000) argue that although there is lot of hype, selling LBS and mobile trading services to a price-conscious student or a privacy-conscious business professional would not make sense. They stated that to accelerate the diffusion of wireless, one would need the right kind of bundling and targeted marketing.

User-interface
A third issue that is important with regard to mobile services is its user-interface. The present user-interfaces are highly inadequate, also because of the fact there is no dominant design of device. Cottone and Goel (2000) give the following suggestion:

> "The "anytime, anywhere" context of wireless needs a user-interface that is most convenient and effortless to use. It does not mean "anyhow". One of the most important applications of the wireless Web on phones is the voice-recognition. This is one technology that fits in the character and purpose of using wireless devices. Handheld devices with their constraints of size could use voice-recognition to augment the textual and spatial data."

So, in the area of user-interface and design a lot of space remains for further research.

Devices
Strongly related to the user-interfaces provided by different devices is the number of different devices. Cottone and Goel (2000) state that the market still needs to decide whether there would be different devices for different types of services or there is going to be one device with different levels of customisable and bundled services. They further recommend that one standardised device has to be filtered out that could offer different levels of services depending on the value to the customer. Furthermore, they say it is imperative that a dominant design emerges, both for the device and its user-interface.

Barriers to pick up mobile services
Still, there are a lot of barriers in picking up mobile services. Firstly, not enough sites have reconfigured their services for the few lines of text that mobile phones can display. Secondly, data-transfer speeds are slow and each information or transaction can cost a lot of money to the customer, especially with current WAP technologies, which are still circuit- switched. Thirdly, connection is very instable. There is a risk of the mobile phone losing the connection, which means a user could get most of the way through an arduous on-line order and then be dropped (Cottone and Goel, 2000).

Besides these technological barriers, security and privacy violation reasons also raise barriers. For example, companies are reluctant to bring money transactions to mobile devices, because security is still less than perfect on wireless networks. This makes it extremely difficult for transaction services to be a success at least in the short-term. Cottone and Goel (2000) mention LBS as another set of much hyped services that might not be very successful with the consumers, since it is still unclear how consumers will feel about having their every move tracked by wireless companies.

8.4.2 Criteria from theory on building web-sites
In chapter 9, WAP-sites will be reviewed to investigate what makes a WAP-site successful. Before doing this, a few main steps necessary to build a successful site will be examined in theory. It is very important to define a clear goal before starting to build a site. This overview will be used to compose a checklist for reviewing WAP-sites. This checklist can be helpful in analysing sites. A great part of the theory on composing WAP-sites corresponds with the theory on building Web-sites. Nevertheless, there are a few important differences. Most importantly, it is recommended to constantly remember the core proposition of the Mobile Internet: The Mobile Internet allows the customer to access the service always and everywhere, on an actual, personalised and location-based basis. As part of the goal of the WAP-site, the customer focus of the site must be defined. Which customers can be attracted with the site? Are this existing customers or mainly new customers? And how can these customers be approached, now and in the near future? It is also important to consider what the added value for the customer can be to use the service everywhere. Both customer focus and added value of the service can be put together to draw up a core proposition for the specific service on the Mobile Internet. Besides this core proposition it is also important to look at the benefits the service-provider can have by offering such a WAP-service. Both those benefits and the core proposition of the service define the goal a certain company can have by starting a mobile service.

After defining the goal of the site, it is important to look at the product or service itself. Several important factors have to be considered. Firstly, an important aspect of WAP-sites is the fact that they have to be updated on a regularly basis, like Web-sites. Secondly, a few questions about the service itself can be asked. For example, is the service location-dependent or not? What is the degree of personalisation of the service? Is the WAP-site integrated with telephony service (for example: is there a possibility to call a helpdesk)? Thirdly, payment is an aspect that has to be considered. For which fee is the service offered and who is going to pay this fee (the customer, advertisers or for example a portal or another company)?

The attainability of the site is important when offering a service. How can the so-called initial visit rate (the first visit to a site) be increased? Van der Heijden (2000) gives a few examples. Firstly, by signing agreements with portals of mobile operators, search engines or sites, which are linked to the site. Secondly, by choosing the right URL-address. A clear domain name attracts many visitors who are searching a site intuitively and try to "guess" the URL-address. Keep in mind the fact that entering an URL-address through the keyboard of a mobile phone is far more difficult than through the keyboard of a PC. So keep it short and simple. Advertisement-banners and -buttons are a third way to increase the attainability of the site. On the other hand, the screen of a mobile device has restricted space. This is a thing

to keep in mind by using banners. And finally, generating a lot of publicity about the site can increase the attainability.

After a potential customer is attracted to the site, it is important to keep this customer. A service provider does not want his service to be visited once, but hopes a customer uses the site more often. How can this revisit rate be increased? In this case, Van der Heijden (2000) distinguishes also several factors. Firstly, the site must be useful and stay useful. Speed is important in mobile telephony. It is important a site has a lot of user-friendliness and can be loaded quickly. Graphics are funny, but take a lot of time to be loaded and are not very useful in considering a Mobile Internet-page. The small screen of a mobile phone can also experience difficulty getting the picture on the screen. This combined with the fact that graphics make the page very slow, do not make a site more attractive. It only works annoying. Secondly, the navigation of the site must work well. People who are getting lost on the site are not motivated to visit the site once more. Thirdly, the site must look attractive and trustworthy. This is especially important when the site offers on-line-services. For example, on-line-payments have to be secured well. A professional layout and good programming are a prerequisite for a good site. Consequently, the interface (navigation structure and layout) is a very important aspect of the site. The interface of a WAP-site has to fit with the home style of the company, has a professional look, must allow fast download times and offering the visitors of the site a user-friendly navigation system. Therefore, for WAP-sites, functionality is more important than originality or creativity. At the end, the degree of interactivity can stimulate the revisit rate. Is it possible to fill out an order, send an e-mail message or make a phone call to a helpdesk?

8.5 Summary and Conclusions

Diffusion can be defined as the cumulated adoption processes of individuals within a social system. Rogers and Scott (1997) give the following definition of diffusion:

> "Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system."

In this definition, four main elements in the diffusion of innovations can be distinguished. These are 1) the innovation, 2) communication channels, 3) time, and 4) the social system.

Gatignon and Robertson used the model of Rogers as a foundation for their adoption theory and added some relevant concepts of consumer adoption of innovations. The most important components of this model are the adoption process, personal influence and opinion leadership, the social system, the diffusion process itself, personal characteristics, and perceived innovation characteristics. With regard to innovation characteristics, innovations that are perceived by individuals or groups as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations.

Two factors that influence the rate of diffusion of the wireless technology can be distinguished. Firstly, a dominant design for wireless devices is not yet identified. The existence of different devices offers a problem for diffusion of these devices, because customers do not know which will be the surviving technology and are therefore reluctant to buy expensive hardware. If a dominant design can be identified, it is very likely that the market moves towards this design and the diffusion of wireless devices will increase.
A second factor that influences the rate of diffusion of wireless devices is the amount of applications and services available. The more different applications and services available, the more probable it is customers will step into the wireless world.

So-called vintage effects also play a role in the diffusion of wireless devices and the Mobile Internet. If customers wait until their existing cellular phones are fully depreciated before buying new ones with the Mobile Internet, diffusion will be gradual.

Another important factor that influences diffusion of wireless devices and the Mobile Internet are network effects or network externalities. The demand for products or services that exist within a network is not only a function of its price, but also a function of the expected size of the network. Compatibility can be distinguished as another factor with regard to network effects.

Wireless developments can be placed in the fourth quadrant of the diffusion matrix of Henderson. In other words, the technology evolves over time and the customers are different. Because in the case of wireless devices, different customers with different needs have to be addressed, it is very important to segment the customers and to try to understand their different utility functions. However, wireless services offered today do not deliver enough value to the customer in order to create a market pull. Technology is in the driver seat and not the customer needs.

A number of criteria for the design of wireless services play a crucial role in the adoption of wireless services. Wireless developments are wrongly positioned. The Mobile Internet was presented as a mobile version of the Internet. Many customers were disappointed because the Mobile Internet could not meet expectations people had when it was introduced. Furthermore, there is a lack of segmentation of wireless services. To accelerate the diffusion of wireless, one would need the right kind of bundling and targeted marketing. Thirdly, the present user-interfaces are highly inadequate, also because of the fact there is no dominant design of device. The conclusion is that the market still needs to decide whether there would be different devices for different types of services or there is going to be one device with different levels of customisable and bundled services. It is important that a dominant design emerges, both for the device and its user-interface.

In building WAP-sites, it is recommended to constantly remember the core proposition of the Mobile Internet: The Mobile Internet allows the customer to access the service always and everywhere, on an actual, personalised and location-based basis. As part of the goal of the WAP-site, the customer focus of the site must be defined. It is also important to consider what the added value for the customer can be to use the service everywhere. The interface of a WAP-site has to fit with the home style of the company, has a professional look, must allow fast download times and offer the visitors of the site a user-friendly navigation system. Therefore, for WAP-sites, functionality is more important than originality or creativity.

In the next chapter, an explorative consumer survey will be set out to examine the adoption criteria of this chapter. Also the criteria for designing wireless services and WAP-sites will be used to compose a WAP-site reviewing checklist.

9 Empirical Research on The Mobile Market

9.1 Introduction

This chapter contains two empirical research projects carried out for this thesis. One of the goals for these projects was to gain experience in fieldwork. Paragraph 9.2 is about a consumer survey on mobility and paragraph 9.3 is about reviewing and evaluating WAP-sites.

9.2 Consumer Survey on Mobility

In the analysis of location-based services and the mobile market in the previous chapters, already quite a few results from consumer surveys on wireless technology were mentioned. These surveys state conclusions about what people think about wireless technology, both in private and in business life. In order to see whether these conclusions are justifiable, a consumer survey was developed. Existing surveys were used and extended with new questions. This paragraph describes the goals, methodology and results of the survey and discusses these results and the survey itself.

9.2.1 Goals

The consumer survey was developed with four goals in mind, namely to examine:

1. Characteristics of consumers of mobile services;
2. By consumer group consumer adoption of and consumer's opinion on mobile services and in particular LBS;
3. Which mobile services consumers are most likely to use in the future, and
4. What is consumer's opinion on strengths and weaknesses of the mobile market.

In chapters 6, 7 and 8, a number of issues regarding mobile services and communication have been discussed. The most important findings of these discussions are taken for this consumer survey and have been transformed into questions. This way, these findings can be verified. From chapter 6, the following issues were taken: Personalised advertisements, killer applications, messaging and e-commerce/ m-commerce. Several questions were designed on these issues to find out what is consumers' opinion. From chapter 7, three issues were taken: Threats of and barriers to mobility, privacy issues and personalised advertisements.

Chapters 6 and 7 delivered a number of specific issues to be examined in the consumer survey. From chapter 8, vintage effects and the general concept for the survey were taken. This chapter deals with customer segmentation, customer value and – most importantly for the survey – customer needs. Customer needs are not being addressed correctly at the moment, since the developments are still technology-driven. Approaching the customer in the correct way, fulfilling his needs, is very important for fast innovation adoption. In the consumer survey, customer needs will therefore be examined.

With the four goals, and the topics from the previous chapters in mind, several subcategories were developed. For every subcategory, several questions have been designed. An overview of the goals and subdirectories of the survey, including the mentioning of which question belongs to which subcategory can be found in Appendix II.

9.2.2 Methodology and procedures

After having designed the consumer survey, four experts have looked at it and gave some good comments. After these comments were processed, the survey was presented to 10 respondents to test whether the questions asked were clear, if used terminology was transparent and if filling in the survey did not take more than 15 minutes at the maximum. The next step after the processing of the test results was to send the survey to Survissimo. This organisation specialises in publishing surveys on the Internet. An expert of Survissimo

gave some useful comments on the survey. People could surf to the URL where the survey was published, fill in the survey and send the results directly by e-mail in one automated process.

Because of the explorative nature of this survey, 50 to 100 respondents were thought to be enough for the analyses. Because the survey is published on the Internet, everybody who has the URL can do the survey. This means that students and non-students can do the survey, people from all over the world. The results have been requested from Survissimo in SPSS-format. This way, analyses could easily be performed.

9.2.3 Results

With 69 results and 7 results excluded, 62 results were valid. It is obvious that no statistically valid conclusions can be drawn from such a small number of results. The set up and the results of the survey are described in more detail in Appendix II. Because the nature of this survey was explorative only preliminary conclusions and suspicions are permitted. They are described here.

Customer segmentation

- 77% of the respondents own a mobile phone, and
- Older people are more interested in the use of mobile services, probably because they have higher incomes and are more often business employees than younger people. As was found in chapter 8, business employees are more likely to be innovators or early adopters.

E-commerce/ m-commerce

- Most people do not think they are going to use their mobile phone for financial transactions in the near future. This is probably caused by security issues, and
- Older people have a more positive attitude towards paying with their mobile phone. The result is probably correlated with the same factors as mentioned above; higher income and more business employees.

Messaging

- Messaging is the most popular mobile service, regardless of age.

Killer applications

- People are the most positive about: Messaging, e-mail, information services (general news, traffic news and personalised news) and web-browsing, and
- People are the most negative about: Entertainment services and m-commerce.

Vintage effects

- Low possession and use of WAP functionality is probably caused by the fact that people still use their old mobile phones and keep using it until it is fully depreciated.

Threats of and barriers to mobility

- Low network speed, security issues, limited terminal display and functionality are the greatest barrier to the take-up of mobile services.

Privacy issues

- Especially younger people are reluctant to give personal data to their network provider, and
- Older people see usage of their location data by their network operator to send them location-based information less as a privacy violation.

Personalised advertisements

- When receiving advertisements, people prefer personalised advertisements, and
- Especially older people are reluctant to receiving location-based advertisements. This seems contradictory to the fact that older people are more willing to receive location-based information. A reason for their interest in location-based information and their reluctance towards receiving location-based advertisements could be that older people are more mobile than younger people and thus need location-based information more frequently, and older people are probably less interested in receiving discounts in combination with advertisements: They earn enough money to pay for the mobile service without needing the discount. They probably find the disturbance factor of advertisements (e.g. privacy violation) more important.

Customer value

- Ease of use is the most important feature for mobile services;
- The pricing of mobile services is important. As mentioned above, the suspicion is that pricing is less important than privacy violation with older people.

Customer needs

Customers prefer mobile communication and information services. The services must be easy to use. Networks need to become faster and people want bigger terminal displays and better functionality. Privacy and security issues have to be addressed. People want to be 100% sure no personal or location data is misused. Customers want to have the feeling to be in control. These results correspond with the results from other consumer surveys. For example, the study performed by Boston Consulting Group [184] mentioned in paragraph 3.4.3 found that slow transmission speeds, difficult user interfaces and high costs are the three main sources of customer frustration with WAP. These three sources of frustration came up also in the consumer survey. Of course, the results from this survey are only explorative.

9.2.4 Discussion of the results

Merits of the survey

One of the most important merits of the consumer survey on mobility is that it confirms other research that was performed previously on this subject. Furthermore, the survey resulted in preliminary conclusions and suspicions that can be used to adapt and deepen the survey in case the survey will be carried out again in one year for example. And for the researchers involved, the consumer survey offered an opportunity to gain more experience in surveying and analysing results.

Limitations of the survey

It is important to recognise the fact that the survey results are biased. The survey was set out by mailing friends, family and colleagues, asking them to mail two or three others the link to the survey. Because it was done like this, the results are biased: A lot of friends are not at all familiar with the new mobile developments, and in the categories of age above 25, a lot of working people from the *Vrije* Universiteit and companies like Origin, ZAO etc., filled out the survey. They represent a specific part of the working class, namely the part that works with computers a lot. Therefore, they neither are a good representation of the working class, or of consumers as a whole. Most people from these categories are probably higher educated and are businessmen (100% of the class 36+ is male, in the class 26-35 that is 74%) and therefore more familiar with the new mobile market.

The fact that almost every respondent uses the Internet can be explained by the fact that the survey was carried out on the Internet. This makes the survey more biased, because certain consumer groups are excluded from participating in the survey this way.

[184] *Mobile Commerce on A Roll*, NPN, National Petroleum News, 09-05-2001

A number of concepts seemed to be unfamiliar to people. For example, a great number of respondents did not know the term location-based services. It would have been nice to ask more detailed and more specific questions about various mobile concepts, but this was not possible since the concepts are not very familiar. A conclusion that can be drawn from this is that the survey was set out too early: a number of concepts has not found its way to the mass market yet. However, since this thesis has a deadline, the survey could not be postponed any further. We recommend doing this survey again next year to see if consumer's opinion on mobility changes over time. Also, it would be interesting to measure the consumer's opinion again in 2003 to see if any changes occur during the time faster networks are introduced etc. It takes time for people to get used to the mobile concept. Once this adoption process has matured, we expect people's opinion to change for the better.

The number of respondents was low. Therefore, this research is only explorative of nature; no other conclusions can be drawn from it than just preliminary conclusions and suspicions.

Process evaluation
In general, the survey went very well. Little comment was received on the questions when they were put on the Internet. From the results however, it can be concluded that in the case a question about Mobile Internet services was posed and an answering category 'Other' was included, more people tend to give the reply 'No opinion'. This is probably caused by the fact that the answering category 'Other' is far from clear. Also, on question 8 we got the following comment: "for question 8 I would have liked another range better, e.g yes, between 1 and 5 times, between 6 and 10 times, more than 10 times." We have chosen for once, five and ten to be able to be more specific, but as the nature of the survey was explorative anyway, ranges would have been all right also. Finally, a comment on questions 18 and 19: "I have answered yes […] because it is not clear if the network operator has asked permission to use my personal and location data. […]". This question could have been formulated clearer indeed. The first four days the survey was available on the Internet, more than 50 results were generated. The rest of the nine days the survey was available, only 20 results were generated.

Reflections on the survey results
The results of the survey correspond with existing surveys in the area of mobile services and communication. However, we do not acknowledge any results regarding difference in age in the survey, since the division of age among the respondents is unequal and the group of older people is very small. We recommend that, in the case this survey is carried out again in one year, a greater number of respondents of all ages be sought, in order to obtain more significant, age-related data.

It could be that the results of the survey also are biased by the fact that a number of members of a Christian student association in Amsterdam have participated in the survey. It is not known exactly how many members have participated. The bias could be caused by the fact that the group of Christians that these students belong to has a traditional and conservative nature. In the diffusion theory of Rogers, discussed in chapter 8, it was concluded that conservative people more often belong to the 'late majority' or 'laggards' adopter categories.

9.3 Reviewing WAP–sites

9.3.1 Introduction
Quite a few technologies have been discussed in this thesis so far, including WAP. Working with SPSS Market Research, WAP phones have been used to do surveys on conferences. Also, WAP-phones and emulators have been used to take a look at WAP-sites in order to get familiar with the technology and the content of WAP-sites. From these experiences, the idea rose to set up a WAP-site review for this thesis. This way, more could be found out about

success factors of WAP-sites. The idea was worked out and also it was decided that this WAP-site review would be turned into an annual event, carried out by the WAPstad students research group. The plans are to give an award to the best WAP-site.

9.3.2 Goals

The goals of the WAP-checklist are twofold:

1. Obtain better insight in the most important characteristics of WAP-sites, and
2. Evaluate which characteristics of WAP-sites are needed to be successful.

(1) Based on literature-study, a number of characteristics are defined, which WAP-sites should possess in order to be able to be successful. In theory, WAP-sites need to be actual, personalised and location-based. Furthermore, the interface of a WAP-site has to fit with the home style of the company, the site must have a professional look, must allow fast download times and offer the visitors a user-friendly navigation system. Functionality is more important than originality or creativity. The goal with this checklist is to increase and test knowledge about this.
(2) With this checklist, the initial goal was to check if the characteristics found in the literature-study are indeed indicative for success. Because it is hard to define success (it is not known how many visitors the various WAP-sites have, nor if the sites are profitable), this initial goal was altered. The goal is now to compose the checklist and in doing that, check the proposed definition of successful characteristics. If a WAP-site scores high on the checklist, it is considered to be successful, if a WAP-site scores low, it is not considered to be successful.

9.3.3 Methodology and procedures

The background theory offered in paragraph 8.4.2 can be used as a starting point for a WAP-checklist. For evaluating WAP-sites, a questionnaire with evaluation criteria is developed. The manual of the Internet Monitor Government websites 2000 was used as a source for developing the questionnaire. Since this source evaluates websites, it was altered to make it suitable for WAP-sites. Also, a list of criteria for evaluating WAP-sites was composed. This list and the one from the government were put together to make the final list of evaluation criteria. The Internet-related questions of the government monitor are far more suitable for the WAP-site evaluation process than the Content-related questions, since the content-part of the government evaluation list is specifically covering government websites. Firstly, the set up and use of the questionnaire are described. Because the government evaluation list contains a good working method also, this is used in the WAP-site evaluation process in a slightly altered form.

The categories Internet and Content of the "Internet Monitor Government websites 2000" were used as a starting point in defining four new categories. These four categories split the content of the checklist into different fields and contain variables that are indicative for success. These categories have been chosen in order to examine success factors on these particular fields of WAP-sites separately. The variables that are indicative for success and the working method in analysing WAP-sites can both be found in Appendix III.

9.3.4 Results

These are the results of the WAP-site reviewing (see the next page) (note: scores are on a scale of 0 to 100):

WAP-site	Score	Ranking
mmm.wapvocaat.nl	33.8	1
mmm.jobbingmall.nl	32.4	2
mmm.natasja.com	31.1	3
mmm.geodan.nl/a2g	27.0	4
Wap.genie.nl	25.7	5
2on.com	23.6	6
Wap.snelklaar.nl	20.9	7
mmm.anwb.nl	20.3	8
Mgo.to/eredivisie	17.6	9
Mgo.to/paris	17.6	9
Mgo.to/smartianwapwork	16.2	11
Wap.goudengids.nl	16.2	11
Wap.htm.net	14.9	13
Wap.specialbite.com	13.5	14
Wap.diningcity.nl	10.8	15

Table 9.1 Results WAP-site reviewing

From the results of the WAP-site reviewing, a few conclusions can be drawn:

Interface

- Lay-out is almost always consistent. Screen size prevents WAP-site builders to be creative in their interface design. As a consequence, almost all sites contain nothing but text and hyperlinks, and
- The level of interactivity of the sites is generally very low. Most of the sites do not have an option in which users are invited to comment on the site or to subscribe to a mailing-list. Also, hyperlinks for calling and/ or sending email messages are missing.

Connectivity

- All sites generally load within ten seconds, and
- Only 6 out of 15 WAP-sites replied on the question with which type of WAP-phone they originally tested their WAP-site.

Meta-content

- The reviewed sites generally give less information about the organisation and the task of the organisation, and
- Many sites do not have a disclaimer in which responsibility for the content is refused. As a result, the content of the site and especially information related to the organisation has to be improved.

Content

- There are relatively few sites with applications that can be run on-line. In addition to this, location and time dependent applications are rare. Therefore, the level of personalisation of sites was very low. In this area, current sites can gain a lot of improvements. Only one site has the possibility for location determination.

The highest ranked sites generally differ from the other sites because they contain an option to comment on the site, they contain hyperlinks for calling and/ or sending e-mail, they have a disclaimer and have links to other organisations. It is striking that all of these sites do not have LBS components and yet score high.

The fact that screens are difficult to read is a conclusion that corresponds with literature on WAP-sites discussed in previous chapters. The fact that content has not developed enough yet in order for WAP-sites to be really attractive, did not came up in the theory discussed, but the WAP-site reviewing found it to be an important factor. Finally, the fact that speed is too slow – a fact that was mentioned in the literature discussed – did not prove to be a relevant barrier during the reviewing process. However, it has to be mentioned that emulators were used with a fast Internet connection. When real phones were used,

speed would probably have been much slower. Also, no download options or graphics were present on the reviewed WAP-sites. With the sites only containing text and hyperlinks the speed is higher, but sites are less attractive.

9.3.5 Discussion of the results

Merits of the WAP-site reviewing

Obtaining the first goal of the WAP-site reviewing is the main merit of this reviewing process. Since more insight into the developments of WAP-sites is obtained now, the WAP-checklist can be improved for the next evaluation.

Limitations of the WAP-site reviewing

It has to be concluded that the first goal is successfully obtained. The second goal of the reviewing process however was not obtained. This is caused mainly by the fact that, at this moment, WAP-sites do not have much content and are fairly simplistic. The same recommendation can be given as with the consumer survey: do the WAP-site reviewing again next year. Perhaps than, WAP-sites will have evolved to a more acceptable level.

A known limitation of this WAP-site reviewing pr ocess is that only the Ericsson R380 WAP-emulator was used to evaluate WAP-sites. This is a limitation for two reasons. One, an emulator was used instead of a real WAP-phone. Two, only one emulator was used. It is recommendable to use different kinds of WAP-phones c.q. –emulators when reviewing WAP-sites, because it can happen that a WAP-site works better or worse depending on which device is used to visit the site.

Process evaluation

Firstly, it has to be noted that one of the researchers originally tested his part of the WAP-sites with another version of the R380 WAP-emulator. There were only two sites that were influenced by using different versions of the WAP-emulator. These were sites with more complex (graphical) features, namely mgo.to/paris and mmm.geodan.nl/a2g. Links and buttons did not work the same or did not work at all by using the older version of the emulator. It is unclear why this is the case. In order for this version difference not to influence the site reviewing, the researcher has reviewed his sites again with the same version of the WAP-emulator as the other researchers used.

Secondly, a few questions may not be formulated well or appeared not relevant or applicable for doing WAP-site reviewing:

- The question about the option to participate in a discussion group may be not relevant for WAP-sites;
- There are no sites with a site-map. On the small phone display, there is no room for a site-map. Only a site index will probably do the job, since WAP-sites are far less complex than Web-sites;
- There is only one site on which job offers are presented. We think the question is too specific, because it is strongly related to the activities of the organisation;
- There are no sites with press releases or an archive with press releases. We think WAP-sites are not suited for articles to be displayed, since it is not very readable on the small phone screens, and
- There are no sites for which you have to pay. And even if there were any, then our suspicion would be still that a payment function could not be analysed by using an emulator.

Reflections

We recommend doing a site-reviewing like this annually. By doing this, it is possible to see if the quality of WAP-sites evolves. We suspect when faster networks are introduced and screen size of the device improves, the quality of WAP-sites will improve and thereby scores will get higher.

9.4 Summary and Conclusions

In this chapter, two empirical research projects were presented. Firstly, a consumer survey on mobility was carried out and secondly, WAP-sites were reviewed and evaluated.

The consumer survey was developed with four goals in mind, namely to examine:

1. Characteristics of consumers of mobile services;
2. By consumer group consumer adoption of and consumer's opinion on mobile services and in particular LBS;
3. Which mobile services consumers are most likely to use in the future, and
4. What is consumer's opinion on strengths and weaknesses of the mobile market.

It has to be mentioned that the results from this survey are only explorative. The most interesting results and preliminary conclusions that could be drawn from this survey, are: Customers prefer mobile communication and information services, the services must be easy to use, networks need to become faster and people want bigger terminal displays and better functionality. Furthermore, privacy and security issues have to be addressed. People want to be 100% sure no personal or location data is misused. Customers want to have the feeling to be in control.

The results of the survey correspond with ex isting surveys in the area of mobile services and communication. However, we do not acknowledge any results regarding difference in age in the survey, since the division of age among the respondents is unequal and the group of older people is very small. We recommend that, in the case this survey is carried out again in one year, a greater number of respondents of all ages be sought, in order to obtain more significant, age-related data.

A WAP-checklist was composed in order to review WAP-sites. The goals of the WAP-checklist are twofold:

1. Obtain better insight in the most important characteristics of WAP-sites, and
2. Evaluate which characteristics of WAP-sites are needed to be successful.

The main results of the site reviewing are: Lay-out is almost alway s consistent, the level of interactivity of the sites is generally very low, all sites generally load within ten seconds, the reviewed sites generally give less information about the organisation and the task of the organisation and relatively few sites contain applications that can be run on-line. The highest ranked sites generally differ from the other sites because they contain an option to comment on the site, they contain hyperlinks for calling and/ or sending e-mail, they have a disclaimer and have links to other organisations. It is striking that all of these sites do not have LBS components and yet score high.

A known limitation of this WAP-site reviewing process is that only the Ericsson R380 WAP-emulator was used to evaluate WAP-sites. This is a limitation for two reasons. One, an emulator was used instead of a real WAP-phone. Two, only one emulator was used. It is recommendable to use different kinds of WAP-phones c.q. –emulators when reviewing WAP-sites, because it can happen that a WAP-site works better or worse depending on which device is used to visit the site.

It has to be concluded that the first goal is successfully obtained. The second goal of the reviewing process however was not obtained. This is caused mainly by the fact that, at this moment, WAP-sites do not have much content and are fairly simplistic. The same recommendation can be given as with the consumer survey: do the WAP-site reviewing again next year. We suspect when faster networks are introduced and screen size of the device improves, the quality of WAP-sites will improve and thereby scores will get higher.

10 Conclusions

Summary

This thesis started in chapter 2 with taking a look at the Information Revolution. This revolution meant an enormous change in the way of living. Rapid changes are still taking place. One of these changes is the increasing importance of mobility.

Chapter 3 described technological developments in the mobile market. Mobile standards like WAP and i-Mode are also described. One conclusion is that until now, WAP has failed because it costs too much, user interfaces are too difficult and data transmission speed is too slow. Beside these reasons, wrong expectations management could be indicated as the major failure.

In chapter 4, several important positioning technologies and drivers and characteristics of LBS were discussed. It is believed that LBS will be among the most used mobile services, and that they will generate a significant part of mobile data revenues within five to ten years. However, there are misplaced and unrealistic expectations about LBS in the short-term. The full potential of LBS will not be disclosed before accurate location determination technology has arrived, network bandwidth will be significantly higher and better devices and protocols will be available.

Chapter 5 showed that sharing knowledge and skills is increasingly important in organisations. The concept of knowledge management was explained by introducing the WAPstad-project of the GIS-group of the *Vrije* Universiteit.

Chapter 6 explored the emerging mobile market from a business point-of-view. Competition is heavy among the many players in this dynamic market. The number of applications (kinds of services) has grown. Already a killer application is messaging. Future killer applications are expected in the field of LBS, comparison-shopping, streaming media, banking and (personal) information services. Wireless technology is far from being mature. Visions on the future from companies like HP, oracle and Nokia were discussed. Finally, the Five Forces-model of Porter was used to analyse the forces that influence the mobile market.

Chapter 7 described the mobile market from a (business) consumer point-of-view. Collecting consumer data in the mobile age, opportunities and threats of mobility were discussed. The theory proved that the awareness of privacy issues is increasing. The Mobile Internet can be helpful for providers to achieve a higher degree of personalisation, but people think it can threaten their privacy. Customers only want to give personal information when they can define who is going to use the information, for which purposes, and when it pays off.

In chapter 8, diffusion and consumer adoption theory was examined. This theory was applied to the introduction of the Mobile Internet. Based on these theories, criteria for designing wireless services were given. A few factors block consumer acceptation of the Mobile Internet and mobile services. Firstly, mobile services are too much technology-driven instead of customer-oriented. Secondly, a dominant design for wireless devices is not yet identified. Thirdly, the amount of applications and services available influences the rate of diffusion. Network effects play a role in the adoption of mobile services. The adoption of wireless innovations by a small group of innovators and early adopters is very important for the spread of this innovation towards the other parts of the social system. Also, consumers will accept a new technology faster when it is compatible with other items or existing technologies.

Chapter 9 contained two cases. The first case was an explorative consumer survey. This survey is set out to obtain insight into the consumer's point-of-view on the mobile market. It seemed customers prefer mobile communication and information services, the services must be easy to use, networks need to become faster and people want bigger terminal displays and better functionality. Furthermore, privacy and security issues have to be addressed.

In the second case, a selected number of WAP-sites was reviewed to investigate current WAP-applications and –sites and to learn what features are important to implement in WAP-sites. The main results of the site reviewing were: Lay-out is almost always consistent, the level of interactivity of the sites is generally very low, all sites generally load within ten seconds, the reviewed sites generally give less information about the organisation and the task of the organisation and relatively few sites contain applications that can be run on-line.

Conclusions

Firstly, before presenting the conclusions of this thesis, the goal of the thesis and the research question are repeated below. Secondly, the conclusions will be presented, divided per sub question. Thirdly, the research question will be answered.

Goal of the thesis
In this thesis, concepts regarding mobility and the Mobile Internet are explored in order to insight into the market of mobile services and in particular location-based services (LBS). Wireless concepts are investigated, both from a business and a (business) consumer point-of-view.

Problem formulation: research question
The following research question is formulated for the thesis:

> *What does the mobile market look like from a business and a (business) consumer point-of-view, how does the mobile market evolve and what can be the added value of location-based services?*

Sub questions
This research question leads to a number of sub questions that must be addressed. These are:

What is the Information Revolution?
The Information Revolution can be seen as a paradigm-shift from a technology based primarily on cheap inputs of energy to one predominantly based on cheap inputs of information derived from advances in microelectronics and telecommunications technology. Information is the key word of the Information Revolution. Since information is part of all human activities, all aspects of life are affected by the new information technologies.

Knowledge has become a strategic asset through the ICT-Revolution. Sharing knowledge and skills is becoming increasingly important in organisations. There are more possibilities to work together, regardless of location and time. But there are restrictions to be overcome, since not everybody is 'virtually present' yet and networks are not yet that extended.

Furthermore, fierce competition together with a new wave of innovation- and technology-based products and services have shortened the time between market introduction of new products and services and replacement by superior products and services. As a consequence, company engineers must constantly look for new opportunities to make their products better or faster.

What are the main supporting technologies for mobility?
GSM is the network we use today. GPRS is coming soon, along with other technologies. The advantages of technologies like HSCSD, GPRS and EDGE are that they can be built into existing GSM networks. If these technologies will emerge on a large scale and will be successful, depends for a great deal on the expected time of introduction of UMTS. If there is sufficient delay, there is a technological gap to fill between GSM and UMTS, so the technologies mentioned above have a chance… The two main reasons for introducing UMTS are possible lack of network capacity in the near future and necessary increase of speed.

i-Mode and WAP offer Internet-like services, the first in Japan and the other in Europe. i-Mode is a success because it is cheap, it has a large user-base and a large number of services available. With WAP, it is a different story. WAP is not a success. Three main sources of consumer frustration can be pointed out: slow transmission speeds, difficult user interfaces and high costs. Providers have over-promised WAP, resulting in public mistrust and dissatisfaction. An advantage of WAP is that it uses an open standard, where i-Mode does not. The battle between i-Mode and WAP is not over yet, especially when faster network technology, like GPRS, is arriving and WAP can also get an 'always on' connection, just like i-Mode.

Bluetooth is a de-facto standard for short-distance wireless communication. Given Bluetooth's broad support among computer OEMs, there is little chance it will not be adopted. The 802.11 lb specification is similar to Bluetooth but is generally designed for wireless Ethernet LANs. Bluetooth and 802.11 lb both want to conquer the same market. They are expected to coexist however.

What is the added value of mobility?
The Mobile Internet cannot be seen as a mobile version of the Internet. Users will use their mobile devices in other situations, for other purposes, in other places and at other times of day compared to the Internet. Therefore, the Mobile Internet is supplemental to the Internet.

It can be concluded that location-based and personalised information are the main elements that can give a mobile device added value over wired Internet services. Beside location and personalisation, other important properties to consider when setting up WAP or Mobile Internet services might be: time-specificity, context-driven service and ease of use.

What are location-based services?
Positioning is a relevant development to support the mobility of the user with specific location-based services (LBS). Positioning can bring the user many new applications, which are meant to make life easier. LBS are services that add value by using the location component. There are three major drivers of LBS: The US regulation for wireless emergency services (e911), the distinct relationship between mobility and location and the need for operators to differentiate their offerings and to generate revenues from channels other than voice. There are also some major inhibitors to the deployment of LBS: Operators are only willing to implement LBS in their strategy when market, financial and commercial implications of LBS are clearer, location technology is not (yet) a core competence of mobile operators and the technological uncertainty that surrounds the whole mobile industry.

Several location technologies are trying to dominate the (future) LBS market. Stable and reliable device-independent platforms are key to implementing successful location-based services and interoperability is crucial. The Location Interoperability Forum and the Open GIS Consortium are trying to set up standardisation. A truly open standard must be developed if LBS is to spread worldwide.

Predictions of several analysts indicate LBS will be among the most used mobile services, and that they will generate a significant part of mobile data revenues. However, in the short-term, the full potential of LBS will not be disclosed before accurate location determination technology is in place, network bandwidth will be significantly higher and

better devices and protocols will be available. Mass-market services will not routinely tap location information for five years. Until that time, companies will probably build location-sensitive services that act independently of location-sensing technology offered by operators.

What does the mobile market look like from a business point-of-view?
Many players are involved in the mobile market. Compared to the demand in the mobile market however, there are not that many suppliers, which enlarges the power of suppliers and raises prices. In introducing new services suppliers of devices often are a critical factor, because phones are very personal devices. Mobile operators have a strong starting point in the mobile market, because of their knowledge of mobile networks, their ownership of the SIM-card, their privileged position to select the browser for the devices, their invoice relationship with the customer, their powerful distribution and communication position and finally, their knowledge of the local market.

Member propositions and on-line registration give the provider of a mobile portal a lot of valuable customer information. This data can be used to offer better customer service. There are a lot of candidates to fulfil the role of mobile portal. Content providers are another player in the market. Content providers who are able to deliver actual, personalised and location-based information can add the highest value.

Because of the possibility to communicate one-to-one with a (business) consumer through his mobile phone, advertising can have a lot of impact. Advertising can be made even more specific when positioning is integrated. However, LBS could be a Trojan horse for location-based advertising, because customers will object to their exact position being logged by marketeers. Hopefully the services' usefulness will outweigh privacy fears. Therefore, advertisers will have to offer consumers something in return for the receiving of advertisements.

To survive in this highly competitive and dynamic market, companies are joining forces by signing alliances or other forms of co-operation. It is relatively cheap for existing and new competitors to adapt offered services on a Web-site or WAP-site to national or even local preferences. This makes the market more unpredictable: new entrants can appear suddenly. To avoid that, there are barriers of entry in effect. Knowledge and speed are in most cases stronger barriers of entry than money. Also, the ownership of a cellular license is a monumental barrier of entry. Next to that, switching costs are high for a current user of a wireless service to switch to another provider.

The Mobile Internet can be, like the Internet, an instrument for customers to bypass traditional sales channels and directly do business with the supplier. The Mobile Internet offers various opportunities because of its low costs and personalised approach.

The power of customers will increase with the rise of the Mobile Internet because the products offered will become more transparent. In the end, the customer defines if an offered service adds value to his way of living. However, wireless services offered today do not deliver enough value to the customer in order to create a market pull. Technology is in the driver seat and not the customer needs.

How will the mobile market evolve?
The mobile market is still in its infancy and is expected to grow, but at a slower pace than it did in the past two years. The market will mature. Players will have to focus more on keeping customers rather than attracting new customers.

Phones and computers are converging, but no one knows exactly what the result will be. Users that are communication-centric will probably choose one of the next-generation smart phones that offer PDA-like functionality. Meanwhile, users that are primarily data-centric will choose somewhat larger and more costly devices for their data processing

capabilities, with add-on wireless communications as a secondary benefit. A one-size-fits-all mobile device is not expected to meet the needs of all users.

Integration of mobile devices with GPS receivers is also on its way. Because of the high costs of the equipment, the combination of GPS and mobile phone is not yet available for the mass market.

Furthermore, two-and-a-half generation networks (GPRS) will be launched at the end of this year, followed by third generation networks in the next couple of years. Although in its infancy, Bluetooth is coming.

The most successful wireless businesses will use the unique advantages of a mobile phone, namely mobility and ubiquity. Killer applications are or will be: Comparison shopping, on-line banking, location-based advertising, LBS, streaming media, games and messaging. Messaging is already one of the most popular data features of mobile phones and will evolve from Short Messaging Services to Enhanced Messaging Services to Multimedia Messaging Services.

What are critical success factors for WAP-sites?
The Mobile Internet in theory allows customers to access the service always and everywhere, on an actual, personalised and location-based basis. It is important to consider what the added value for the customer can be to use the service everywhere. The interface of a WAP-site has to fit with the home style of the company, has a professional look, must allow fast download times and offer the visitors of the site a user-friendly navigation system. For WAP-sites, functionality is more important than originality or creativity.

From the WAP-site reviewing, the fact that screens are difficult to read is a conclusion that corresponds with literature on WAP-sites. The fact that content has not developed enough yet in order for WAP-sites to be really attractive, did not came up in the theory discussed, but the WAP-site reviewing found it to be an important factor. Finally, the fact that speed is too slow – a fact that was mentioned in the literature discussed – did not prove to be a relevant barrier during the reviewing process. However, it has to be mentioned that emulators were used with a fast Internet connection and with the reviewed sites only containing text and hyperlinks, the speed is higher.

What does the mobile market look like from a (business) consumer point-of-view?
Mobility affects life. In general, the following issues are seen as opportunities of mobility for society: Mobility saves time and money, it causes higher efficiency and productivity levels and supports the integration of personal and business life. Mobility makes more information more widely available and creates an opportunity for LBS to be introduced, and finally, mobility increases availability of products and services since closing times of shops and physical location become less important.

Threats of mobility that must be mentioned are: Threat of privacy violation, high costs of mobile services and the lack of standardisation in both hard- and software in the mobile market. In our opinion, consumers will less be hesitative to buy a mobile device with one standard because they fear another standard will become *the* standard. Next to these threats, expectations have been set too high in the past too often. The players in the mobile market will have to make sure they will be more realistic about developments towards customers. Finally, health issues (radiation) and mobile phones used during criminal activities are two threats of mobility for society.

Which privacy issues are involved?
Encompassing the trend towards more localisation and personalisation combined with the growing importance of the consumer is a distinct trend towards greater consumer awareness of privacy issues. Consumers do not allow companies to fail in protecting privacy. With the rise of mobile devices and thereby with mobile services, the privacy concept will increasingly

be subject to public debate. Misuse of location information is condemned heavier than misuse of other personal information because a wireless subscriber can be tracked or located through his or her use of a mobile device. Legislation falls short in defining the ownership of information and the degree in which it can be used by third parties. T here is a low barrier for companies to use location information for marketing or other purposes. Legislation, preferably on a European level, will have to be designed in the near future.

With regard to privacy, two kinds of services are distinguished: pull and push services. Pull services are those services in which the customer requests information. With this kind of services the consumer experiences no privacy violence makes the privacy problem less relevant. The problem is with push services, in which the consumer receives advertisements or information unasked. To solve this problem, we suspect permission marketing will become more important. An example of permission marketing is that the customer 'opts in' to receive advertisements periodically when signing up for the wireless service, potentially by getting a discount. New legislation will very likely ban the 'opt out' option, so the customer will always have to 'opt in'. This enhances customer privacy protection. Consumers are willing to provide personal information as long as they are truthfully informed about the uses to which the information will be put, have a choice not to participate, and are assured that their personal information will be safeguarded. Customers are more willing to receive advertisements when they think they are in control.

How can innovation diffusion and adoption theory be applied to wireless concepts?

Two factors that drive or block diffusion of wireless technology can be distinguished. Firstly, a dominant design for wireless devices is not yet identified. Customers do not know which will be the surviving technology and are therefore reluctant to buy expensive hardware. A second factor that influences the rate of diffusion of wireless devices is the amount of applications and services available. The more different applications and services available, the more probable it is customers will step into the wireless world.

So-called vintage effects also play a role in the diffusion of wireless devices and the Mobile Internet. If customers wait until their existing cellular phones are fully depreciated before buying new ones, diffusion will be gradual.

An important factor that influences diffusion of wireless devices and the Mobile Internet are network effects or network externalities. The demand for products or services that exist within a network is not only a function of its price, but also a function of the expected size of the network. Compatibility can be distinguished as another factor with regard to network effects. The benefit that a consumer derives from the use of a good depends on the number of compatible items.

A number of design criteria – crucial for the adoption of wireless services – were discussed: Wireless developments are wrongly positioned. The Mobile Internet was presented as a mobile version of the Internet. Many customers were disappointed because the Mobile Internet could not meet the expectations people had when it was introduced. Setting realistic expectations is important. Furthermore, there is a lack of segmentation of wireless services. Because wireless services fall into the fourth quadrant of the Henderson-matrix (evolving technologies, different customers), segmentation is an absolute prerequisite when introducing wireless services. To accelerate the diffusion of wireless, one would need the right kind of bundling and targeted marketing. Thirdly, present user-interfaces are highly inadequate, also because of the fact there is no dominant design of device. It can be concluded that the market still needs to decide whether there would be different devices for different types of services or there is going to be one device with different levels of customisable and bundled services. It is important that a dominant design emerges, both for the device and its user-interface.

Research question

The research question ('What does the mobile market look like from a business and a (business) consumer point-of-view, how does the mobile market evolve and what can be the added value of location-based services?') is answered below:

Many players are involved in the mobile market. In introducing new services, suppliers of devices often are a critical factor. Mobile operators have a strong starting point in the mobile market, because of their knowledge of mobile networks, their ownership of the SIM-card, their privileged position to select the browser for the devices, their invoice relationship with the customer, their powerful distribution and communication position and finally, their knowledge of the local market. Member propositions and on-line registration can give the provider of a mobile portal a lot of valuable customer information. Content providers who are able to deliver actual information related to the preferences and location of the user can add the highest value. Because of the possibility to communicate one-to-one with a (business) consumer through his mobile phone, advertising can have a lot of impact. Advertising can be made even more specific when positioning is integrated. Advertisers will have to offer consumers something in return for the receiving of advertisements. To survive in a highly competitive and dynamic market, companies are joining forces by signing alliances or other forms of co-operation. The mobile market is very dynamic. A year ago, expectations were very high and the exchange rates were skyrocketing. The mobile market is expected to continue to grow, but at a slower pace than it did in the past two years. The market will mature. Players will have to focus more on keeping customers rather than attracting new customers.

Phones and computers are converging, but no one knows exactly what the result will be. A one-size-fits-all mobile device is not expected to meet the needs of all users. Integration of mobile devices with GPS receivers is also on its way. Because of the costs of the equipment, the combination of GPS and mobile phone is not yet available for the mass market. Furthermore, two-and-a-half generation networks (GPRS) will be launched at the end of this year, followed by third generation networks in the next couple of years. Although in its infancy, Bluetooth is coming.

Mobility affects life. In general, the following issues are seen as opportunities of mobility for society: Mobility saves time and money, it causes higher efficiency and productivity levels and supports the integration of personal and business life. Mobility makes more information more widely available and creates an opportunity for LBS and personalised services to be introduced. And finally, mobility increases availability of products and services since closing times of shops and physical location become less important. Threats of mobility that must be mentioned are: Threat of privacy violation, high costs of mobile services, lack of standardisation in both hard- and software in the mobile market, not enough services and applications available and lack of customer segmentation. Expectations have been set too high in the past too often. Finally, health issues and mobile phones used during criminal activities are two threats of mobility for society.

Positioning can bring the user many new applications, which are meant to make life easier. Location-based services (LBS) are services that add value by using the location component. Stable and reliable device-independent platforms are key to implementing successful location-based services and that interoperability is crucial. A truly open standard must be developed if LBS is to spread worldwide. Predictions of several analysts indicate LBS will be among the most used mobile services, and will generate a significant part of mobile data revenues. However, in the short-term, the full potential of LBS will not be disclosed before accurate location determination technology is in place, network bandwidth will be significant higher and better devices and protocols will be available on the market. Mass-market services will not routinely tap location information for five years. Until that time, companies will probably build location-sensitive services that act independently of location-sensing technology offered by operators.

Recommendations

For the mobile market to be successful in the future, several points of attention will have to be addressed:

- Legislation, especially with regard to privacy issues will have to be designed, preferably on a European level;
- Standardisation of devices (in particular display size) and (location determination) technologies is necessary. Also, stable and reliable device-independent platforms are key to implementing successful location-based services and interoperability is crucial. The Location Interoperability Forum and the Open GIS Consortium are trying to set up standardisation;
- Applications and content with regard to WAP-sites will have to take more into account the added value they can have for customers;
- Better expectations management is needed;
- Better customer segmentation and more addressing customer needs is a prerequisite for success, and
- Faster networks and more capacity are also a critical success factor.

Next to these recommendations, a number of other thoughts and ideas for further research are presented below.

The idea of the 'Digi-vault', as was mentioned in paragraph 6.3.1 can be explored further. More research on people's opinion can be done, security issues can be explored and technology tested.

It takes time for people to get used to the mobile concept. Once this adoption process has matured, we expect people's opinion to change. Therefore we recommend to do research on WAP ownership and usage next year again to see the position of WAP improves over time. Also, it would be interesting to measure the consumer's opinion again in 2003 to see if any changes occur during the time faster networks are introduced etc.

It is recommended to repeat the site-reviewing annually. By doing this it is possible to see if the quality of WAP-sites improves when time passes by. We suspect when faster networks are introduced and screen size of the devices improves, the quality of WAP-sites will improve and thereby scores will get higher.

Skills management of students and researchers on the WAPstad-project can be improved. When the research group on LBS at the *Vrije* Universiteit expands, one researcher should be assigned as Virtual Office Manager in order to keep the overview of content and update processes.

An overview article can be written about the difference in adoption of m-commerce in the United States, Japan and Europe. Also, differences in telecommunication technologies and standards can be discussed at the same time, in order to obtain insight in the differences and to see if these differences influence the adoption process.

This thesis covers many aspects of the mobile market. It is recommendable to zoom in on separate aspects like for example customer adoption, privacy issues, legislation, network technologies, LBS, etc., in order to obtain more insight in these subjects.

References

Airbiquity Inc., *No "L-Commerce" without "L-Privacy"; Fair location information practices for mobile commerce*, May 2000
http://www.airbiquity.com/downloads/Privacy-Airbiquity.PDF (07-03-2001)

Atkinson, Robert D. and Court, Randolph H., *'The new economy index: understanding America's economic transformation'*, Progressive Policy Institute, November 1998
http://www.neweconomyindex.org/ (05-01-2001)

Bazar, Bayaarma and Boalch, Gregg, *A Preliminary Model of Internet Diffusion within Developing Countries*, Southern Cross university, July 1997
http://ausweb.scu.edu.au/proceedings/boalch/paper.html (02-05-2001)

Beinat Ph.D., Euro, 'Location-based Services, Market and Business Drivers', *Geo-Informatics*, April 2001

Birkin, M., Clarke, G., Clarke, M. en Wilson, A., 'Intelligent GIS: Location decisions and strategic planning', *GeoInformation International*, Cambridge 1996

Bosworth, Barry P. and Triplett, Jack E., *What's new about the new economy? IT, Economic Growth and Productivity*, Brookings Institution, December 2000
http://www.brook.edu/views/papers/bosworth/20001020.pdf (05-03-2001)

Castells, Manuel, *The rise of the network society*, Cambridge, MA and Oxford, UK, 1996

Castells Manuel, *Information Technology, Globalization and Social Development*, Geneva, June 1998
http://www.unrisd.org/infotech/conferen/castelp1.htm (07-03-2001)

Cottone, Christian D., and Goel, Aradhana, *Topic: What drives diffusion of the wireless technology?*, Massachusetts institute of Technology, December 2000
http://web.mit.edu/a_goel/www/15.567.html (22-05-2001)

Dana, Peter H., 'Global Positioning System Overview', *The Geographer's craft*, 1999
http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html (01-05-2001)

Dornan, Andy, *The essential guide to Wireless Communications Applications: from cellular systems to WAP and M-commerce*, Prentice Hall PTR, 2001

Forrester Report, The, *Shortcuts to Mobile Location Services*, Forrester Research B.V., May 2001

Gatignon, Hubert and Robertson, Thomas S., 'A prepositional inventory for new diffusion research', *Journal of Consumer Research*, volume 11, March 1985.

Geodan Mobile Solutions, 'Pilot draadloos informatie-systeem voor de politie', *Eindrapport Politie regio Gelderland Midden* (confidential), 2000

Guttman, E., Perkins, C., Veizades, J. and Day, M.: *Service Location Protocol*, Version 2 RFC 2608, 1999

Henderson, Rebecca, *A (Short and Preliminary) note on Diffusion*, September 1999
http://www.mit.edu/afs/athena/course/15/15.932/www/slides/diffnote.html (29-05-2001)

Heijden, Dr. J.G.M. van der, *Prestatie-indicatoren voor e-commerce websites*, February 2000
http://www.topmanagement.giarte.com/show.html?art_id=6 (05-04-2001)

Hodes, T. D., Katz, R., Servau-Schreiber, E. and Rowe, L., *Composable Ad hoc Mobile Services for Universal Interaction*, Budapest, Hungary, 1997

Hove, Norbert van den, Heijs, Jeroen en Linde, Rick van der, 'Informatiemaatschappij: economische en ruimtelijke gevolgen', *Rooilijn*, no. 2, februari 1999, p. 93-98

Hurn, Jeff, *GPS, A Guide to the Next Utility*, Trimble Navigation, 1989

Imielinski, T., Viswanathan, S., *Adaptive Wireless Information Systems*, Tokyo, Japan, 1994

Imielinski, T., Navas, J., *GPS-Based Addressing and Routing*, RFC 2009, 1996

Katz, Michael L., and Shapiro, Carl, 'Technology adoption in the presence of network externalities', *Journal of Political Economy*, vol. 94, no. 4, 1986

Katz, Michael L., and Shapiro, Carl, 'Product introduction with network externalities', *The Journal of industrial economics*, vol. XL, no. 1, March 1992

Katz, Michael L., and Shapiro, Carl, 'Systems Competition and Network Effects', *Journal of Economic Perspectives*, vol. 8, 1994

Keuning, Dr. D. And Eppink, Dr. D.J., *Management en Organisatie – Theorie en Toepassing*, Stenfert Kroese, 1996

Klein, Pieter de & Vos, Ingrid, *M-Business, ondernemen op mobiel internet met WAP en verder*, Uitgeverij Tutein Nolthenius, Delft 2000

Leiner, Barry M. et al., *All About the Internet: A Brief history of the Internet*; Internet Society (ISOC), August 2000
http://www.isoc.org/internet-history/brief.html (27-03-2001)

Lopez, X., *Oracle eLocation: An Internet and Wireless Location-Based Services Platform*, Oracle Corporation, September 2000

McCarthy, Ben and Hogg, Margaret, *Consumer behaviour: Lecture 7, Diffusion of innovations and consumer adoption*, 1997
http://info.sm.umist.ac.uk/ugdocs/bscman2/conbeh/cnotes/1cbho07.htm (01-05-2001)

Norton, R.D., *The Geography of the New Economy*, Regional Research Institute, WVU, 2000
http://www.rri.wvu.edu/WebBook/Norton/contents.htm (02-01-2001)

Rietveld, P., *Substitutie van fysiek transport door telecommunicatie*, Rooilijn, 1997, p. 406-410

Rogers, Everett M. and Scott, Karyn L., *The Diffusion of Innovations Model and Outreach from the National Network of Libraries of Medicine to Native American Communities*, Department of Communication and Journalism, University of New Mexico, December 1997
http://www.nnlm.nlm.nih.gov/pnr/eval/rogers.html (05-01-2001)

Rosenberg, J., Schulzrinne, H., Suter, B.: *Wide Area Network Service Location. Work in progress from the Service Location Working Group of the IETF*, 1997

Rui, José and Davies, Nigel, *Scalable and Flexible Location-Based Services for Ubiquitous Information Access*, 1999
http://www.dsi.uminho.pt/~rui/research/pub/luc99lbs.pdf (03-01-2001)

Scourias, John, *Overview of the Global System for Mobile Communications*, 1997
http://ccnga.uwaterloo.ca/~jscouria/GSM/gsmreport.html (02-04-2001)

Shabelnik, Tatiana, *Diffusion of Internet Technologies within Developed and Developing Countries*, MTU, August 2000
http://www.lib.mtu.edu/jrvp/personal/Tatiana/portfolio/diffusion_of_innovations.htm (01-05-2001)

Turban, Efraim and Aronson, Jay E., *Decision Support Systems and Intelligent Systems*, fifth edition, Prentice-Hall International Inc, 1998

Valentine, Debra A., 'About Privacy: Protecting the Consumer on the Global information Infrastructure', *Federal Trade Commission General Counsel*, December 1998
http://www.ftc.gov/speeches/other/dvaboutprivacy.htm

Whalen, David J., *Communications Satellites: making the Global Village Possible*
http://www.hq.nasa.gov/office/pao/History/satcomhistory.html (27-03-2001)

ZBC Consultants *Een checklist met aandachtspunten en tips, voor als u met uw website aan e-commerce wilt doen*, maart 2000
http://www.zbc.nu/kb?t=presinhoud&p=Aand_site (16-08-2001)

Consulted web-sites

A history of Internet Telephony,
http://www.cs.tcd.ie/courses/baict/bac/jf/projects/99/telephony/history.html (02-04-2001)

An Education on Common Objections to Cell Phone Legislation
http://www.geocities.com/morganleepena/rebuttal.htm (20-02-2001)

An Introduction to Mobile Positioning,
http://www.mobileipworld.com/wp/positioning.htm (18-04-2001)

Ericsson's new mobile positioning system uses standard GSM phones, Ericsson press releases, 05-11-1998
http://www.ericsson.com/press/archive/1998Q4/19981105-0039.html (04-04-2001)

GPS Applications Exchange, http://gpshome.ssc.nasa.gov/scripts/gpsover.asp (18-04-2001)

Intel to unveil its "Internet on chip"
http://news.cnet.com/news/0-1006-200-5952785.html, (18-05-2001)

Internet-based Global Differential GPS, GIPSY-OASIS (GOA III) Software Package
http://gipsy.jpl.nasa.gov/igdg/system/index.html (18-04-2001)

On – The New World of Communication, *The next next generation*, December 2000
http://on.magazine.se/technotes/technotes.asp?articleID=464&categoryID=3

http://architecture.mit.edu/%7Ea_goel/15.567/wireless/dd.htm (04-12-2000)

http://college.hmco.com/hjinstruct/powerpt/ch10/sld011.htm (13-12-2000)

http://hsb.baylor.edu/ramsower/ais.ac.97/papers/vslyke.htm (02-05-2001)

http://itch.uvic.ca/itch2000/AHASAN/AHASAN.HTM (07-03-2001)

http://pacificrim.bx.com/telecom/telemarch.html (20-05-2001)

http://www.bluetooth.com/

http://www.cni.org/Hforums/ninch-announce/1997/0087.html (07-03-2001)

http://www.cooltown.com (23-04-2001)

http://www.cooltown.com/beliefs.htm (23-04-2001)

http://www.cooltown.com/ctfaq.htm (23-04-2001)

http://www.cooltown.com/papers/webpres/WebPresence.htm (23-04-2001)

http://www.cooltown.com/vision.htm (23-04-2001)

http://www.cooltown.com/vision-cservice.htm (23-04-2001)

http://www.ericsson.com/developerszone/ (12-07-2001)

http://www.euronext.com/

http://www.financieeldagblad.nl/

http://www.geodan.nl/ (25-06-2001)

http://www.igeb.gov/sa (18-04-2001)

http://www.igeb.gov/sa/faq.shtml (18-04-2001)

http://www.its.bldrdoc.gov/projects/t1glossary2000/_ephemeris.html (10-07-2001)

http://www.itworldcanada.com/search/DisplayArticle.cfm?V=CW,MAIN,8AFAC6C0-AB81-11D4-AA6600A0CC574E58 (23-04-2001)

http://www.microsoft.com

http://www.microsoft.com/PressPass/features/1998/12-4autopc.asp (26-06-2001)

http://www.netscape.com

http://www.nokia.com/mobilecity/boulevard.html (26-06-2001)
http://www.nokia.com/mobilecity/index.html (26-06-2001)

http://www.oracle.com

http://www.palmos.com/dev/tech/tools/emulator/ (12-07-2001)

http://www.psionpress.com/gpress/releases/pr129302.asp

http://www.spss.com

http://www.udel.edu/communications/COMM256?johnc/diffusion.html (01-05-2001)

http://www.wapworld.nl/Achtergr.htm (02-01-2001)

http://www.wapworld.nl/bluetooth/achtergrond/bluetooth_achtergrond.htm (03-01-2001)

http://www.wapworld.nl/gprs/gprs_inleiding/gprs_inleiding.htm (03-01-2001)

http://www.wapworld.nl/imode_achtergronden.htm (03-01-2001)

http://www.wapworld.nl/imode_inleiding.htm (03-01-2001)

http://www.wapworld.nl/imode/imode_wap/imode_wap.htm (10-07-2001)

http://www.wapworld.nl/umts/umts_achtergrond.htm (03-02-2001)

http://www.wapworld.nl/umts/umts_inleiding.htm (03-01-2001)

http://www.wilco-telephony.co.uk/telephony.html (02-04-2001)

http://www.wti.co.kr/rc.htm (18-06-2001)

http://www.xdrive.com/index_express.html (12-07-2001)

http://wwwi.wu-wien.ac.at/Studium/Abschnitt_2/LVA_ss01/se_mc/portal/products/dataservices/ems.htm (26-06-2001)

http://wwwi.wu-wien.ac.at/Studium/Abschnitt_2/LVA_ss01/se_mc/portal/products/dataservices/mms.htm (26-06-2001)

http://130.37.52.14/gis/research/VIR/LBSCOM/default.htm (12-07-2001)

http://w2.oraclemobile.com/site/aboutus/pastpr/20000919wasp.htm (02-05-2001)

http://w2.oraclemobile.com/site/aboutus/pastpr/20000919screaming.htm (02-05-2001)

http://w2.oraclemobile.com/site/aboutus/pastpr/20001211studiopr.htm (02-05-2001)

http://w2.oraclemobile.com/site/solutions3/index.htm (02-05-2001)

News articles from news papers

Britse zaktelefoons krijgen waarschuwing tegen straling, Trouw, 28-11-2000

BT en Deutsche Telekom leggen samen UMTS aan, Trouw, 13-06-2001

Digikluis voor elke burger, Spits, 30-03-2001, p. 4

Een commissie wil voor elke burger een beveiligde digitale kluis met persoonsgegevens. Gewenst?, Metro, 30-03-2001, p. 23

Gsm-antennes vergunningvrij – Maatregel moet tekort aan zendmasten oplossen, Trouw, 12-12-2000

UMTS-netwerk hangt op 'antennekwestie', Trouw, 09-12-2000

3D-zaktelefoon, Trouw, 04-10-2000

News articles from the Internet – AnyWhereYouGo.com

Anthropologists Study Wireless Usage Worldwide, Newsbytes News Network, 11-01-2001

Australians Mystified by WAP, Newsbytes News Network, 07-05-2001

Bluetooth taking off at low end of market, Newsbytes News Network, 23-01-2001

British Airways WAPs Away Queues, M2 Communications, 05-05-2001

British Telecom Delays First 3G Mobile Launch, Xinhua News Agency, 14-05-2001

Cancer Fears Raise Call for Phone Shields, Crain, 25-02-2001

CES Panelists See Cellphones For Every Occasion, This Week In Consumer Electronics, 22-01-2001

Confusion prevails on the way to 3G, 123Jump, 02-01-2001

Ericsson Ships First GPRS Phone, Ybreo, 08-04-2001

Ericsson to Cut 4,000 Jobs, Associated Press, 18-05-2001

High Cost a Turn Off for Mobile Web Users, VNUNet.com, 25-02-2001

McDonald's tests wireless payment technology, Cosmiverse.com, 10-01-2001

Meta Group Sees 'WAP Abandonment' Among Corporate Users, Business Wire, 23-05-2001

M-games Gladiator conquer wireless Web arena, PR Newswire, 30-01-2001

Mobile Commerce on A Roll, NPN, National Petroleum News, 09-05-2001

Mobile location services to generate USD 18.5 billion global revenues by 2006, says Analysys, PR Newswire, 14-02-2001

Mobile Revolution May Affect Sanity, World Entertainment News Network , 28-03-2001

NewHomesDirect.com, Hotpalm.com launch new mobile real estate application, PR Newswire, 09-02-2001

Nippon Columbia starts music distribution via mobile phones, Jiji Press English News Service, 02-01-2001

Novatel Wireless ships the Minstrel 540, a wireless modem for the HP Jornada 540 Series Pocket PC, Business Wire, 09-01-2001

NTT DoCoMo finally deliver 3G videophones, Asia Pulse, 25-06-2001

NTT DoCoMo Postpones High-Speed Service Launch, BridgeNews, 24-04-2001

NTT DoCoMo to offer i-Mode in Europe later this year, Associated Press, 18-01-2001

Optimistic Forecasts Fuel Wireless Hype, Computerworld, 07-05-2001

OracleMobile Renounces Its Past: Announces New Product, Unstrung.com, 07-02-2001

Over 200 billion GSM text messages forecast for 2001, M2 Communications, 12-02-2001

Philips components launches thinnest, lightest wireless Internet, Asia Pulse, 08-01-2001

Pitney Bowes Study Reveals That Messaging Tools Help Workers Link And Integrate Personal, Professional And Mobile Lives, Business Wire, 05-12-2000

Recent warnings may portend wireless slump, Ben Charny and Corey Grice for CNET News.com, 12-01-2001

Report: Only five pan-European mobile operators seen surviving past 2007, BridgeNews, 05-01-2001

Report: WAP Has Been Undermined by Service Providers, M2 Communications, 07-03-2001

Satama develops wireless restaurant locator for TGI Friday's, PR Newswire, 26-03-2001

Siemens Launches New GPRS Phone, Ybreo, 11-04-2001

SNAZ, Rogers AT&T Wireless to Launch Canada's First Wireless Shoppin Mall, Business Wire, 18-01-2001

Sprint to unveil first full-color cell phone in US, MobileDataBiz.com, 29-03-2001

Study: Wireless Ads OK, But Consumers Want Incentives, Philips Business Information, 07-03-2001

TDMA 850 Operators Join GSM 3G Party, Phillips Business Information, 04-05-2001

Text Messaging May Prompt Repetitive Strain Injuries, World Entertainment News Network, 08-04-2001

The rush to exploit the rich new wireless market is sparking a competitive scrap over who will establish a dominant wireless data transfer standard. But why do we need a standard? What will it achieve?, AnyWhereYouGo.com, 12-10-2000

UMTS will cover all of Europe by 2010, VNUNet.com, 15-12-2000

Vizzavi Acknowledges Failure of WAP, FT World Media Abstracts via Comtex, 04-05-2001

WAPs going on?, Director, 16-10-2000

Wireless data users to reach 1.3 billion, Computer Dealer News, 05-01-2001

Wireless Developers Need Better Debugging Tools, PR Newswire, 30-04-2001

Wireless Web Providers Now Avoid Comparisons with Desktops, New York Times Syndicate, 11-01-2001

Wireless 2000: Where's WAP?, 123Jump, 04-01-2001

2.5G Phones Go on Sale in UK, Press Association, 18-05-2001

3G Wireless Secrets and Lies, The Industry Standard, 25-06-2001

News articles from the Internet – GISCafe News

Fiat and Autodesk bring location services to mobile individuals, 23-01-2001

Garmin introduces new GSM cellular phone/ GPS for Europe, 22-02-2001

MapInfo unveils PSAP Pro to accurately locate mobile callers and reduce 911 response time, 09-01-2001

News articles from the Internet – Wireless Internet Daily

Intel, SignalSoft demonstrate location based movie trailer app., Wireless Internet Daily, 08-02-2001

NTT DoCoMo may increase KPN Mobile stake, 12-02-2001

Virgin Mobile intros first interactive WAP Shopping Services, Wireless Internet Daily, 09-02-2001

Wells Fargo first major bank to launch nationwide wireless banking, Wireless Internet Daily, 08-02-2001

Glossary

A

ADSL = Asymmetric Digital Subscriber Line, a form of Internet subscription

ANSI = American National Standards Institute, the North-American version of the European ETSI

API = Application Programming Interface

ARPANET = The ARPANET is a network from the Department of Defense, it is the predecessor of Internet

ASP = Application Service Provider

ATF = AutoTeleFonie

B

B2B = Business-to-Business

B2B2C = Business-to-Business-to-Consumer

B2C = Business-to-Consumer

C

CDPD = Cellular Digital Packet Data, the North-American version of the European GPRS

Cell-ID = See 'COO'

cHTML = compact Hyper Text Markup Language, a subset of HTML, used by i-Mode in Japan

COMSAT = Communications Satellite Corp oration, the organization that launched EARLY BIRD in 1965, the first commercial communications satellite

COO = Cell of Origin, a Mobile Positioning System that sorts out location by determining at which base station and thus in which cell a mobile phone is sending and receiving signals

CPNI = Customer Proprietary Network Information, owner of US customer location information

CPU = Central Processing Unit

CRM = Customer Relationship management

D

DBMS = Database Management System

D-GPS = Differential Global Positioning System, a GPS system with a static reference point on the ground, originally developed to correct the standard error in the Precise Positioning System

DSP = Developer Service Provider

E

e-commerce = Electronic commerce, the buying and selling of products and services through the Internet

EDGE = Enhanced Data rates for Global Evolution, modulates the mobile signal, speeding up the connection

E-OTD = Enhanced-Observed Time Difference of arrival, an overlay triangulation technology for Mobile Positioning Systems, based on timing or angle of signal transmission and reception at the handset

ERP = Electronic Resource Planning

ETSI = European Telecommunication Standards Institute, the European version of the North-American ANSI

F

FCC	= Federal Communication Commission
FDMA	= Frequency Division Multiple Access

G

GIS	= Geographic Information System
GML	= Geographic Markup Language
GPRS	= General Packet Radio Service, a packet-switched network, always online, pay-per-use
GPS	= Global Positioning System, a system with 24 (American military) satellites that enables location determination everywhere with a small device
GSM	= Global System for Mobile communications, a circuit-switched network

H

HDML	= Handheld Markup Language
HSCSD	= High-Speed Circuit-Switched Data, a GSM compatible network that uses more connections at the same time
HTML	= Hyper Text Markup Language, the language in which WWW-pages are written
HTTP	= Hyper Text Transfer Protocol, the client-server TCP/IP protocol that is used on the World Wide Web to exchange HTML documents

I

iAS	= Internet Application Server
IETF	= Internet Engineering Task Force
IGDG	= Internet-based Global Differential GPS, a very accurate form of GPS that uses the Internet to transmit location data
IMT-2000	= See 'UMTS'
INTELSAT	= International Telecommunications Satellite Organization, controls the ownership of satellites and has responsibility for the global system
IP	= Internet Protocol, the protocol within TCP/IP that manages addressing and transmission of TCP packages over the network
ISDN	= Integrated Services Digital Network
ISP	= Internet Service Provider, a company that offers other companies or individuals access to the Internet, very often in combination with various other services like management of Internet sites
IT	= Information Technology

L

LBS	= Location-based services

M

MPS	= Mobile Positioning System
MSS	= Mobile Support System, manages wireless cells within the Wireless Information System according to Imilienski

N

NCP	= Network Control Protocol, the initial ARPANET host-to-host protocol

O

ODBC	= Open Database Connectivity
OEM	= Original Equipment Manufacturer, means that a company (the OEM) is selling licenses of a product or a subset of a product
OGC	= Open GIS Consortium
OLAP	= On-Line Analytical Processing
OTN	= Oracle Technology Network

P

PC	= Personal Computer
PDA	= Personal Digital Assistant, a small handheld computer with simple options like agenda, address book, word processing, spreadsheets etc.
PDF	= Portable Document Format
PPS	= Precise Positioning System, the (former) accurate version of GPS for authorized users only

R

RDS	= Radio Data System, a system that can broadcast short chunks of data along with a radio signal
RF	= Radio Frequency
RSI	= Repetitive Strain Injury

S

SGML	= Standard Generalised Markup Language
SIG	= Special Interest Group, a forum for the development of Bluetooth as a worldwide standard
SLP	= Service Location Protocol, is a standard for service location with a single administrative domain, designed for local area networks under a single administrative design
SMS	= Short Messaging Service, a bi-directional service for short alphanumeric messages
SPS	= Standard Positioning System, the (former) common version of GPS
SPSS-MR	= SPSS-Marketing Research

T

Telco	= Telecommunication company
TCP/ IP	= Transmission Control Protocol/ Internet Protocol, TCP is a connection-oriented protocol that divides information into packages. For IP, see 'IP'
TDMA	= Time Division Multiple Access
TDOA	= Time Difference Of Arrival, an ove rlay triangulation technology for Mobile Positioning Systems, based on timing or angle of signal transmission and reception at the handset
TOA	= Time Of Arrival, an overlay triangulation technology for Mobile Positioning Systems, based on timing or angle of signal transmission and reception at the handset

U

UIS	= Universal Interaction System, a LBS technology designed by Hodes
UMTS	= Universal Mobile Telecommunication System, a third generation network, also known as IMT-2000
URL	= Uniform Resource Locator , an agreement on the Internet on how an address is written

V

vXML = Voice-XML

W

WAP = Wireless Application Protocol, a set of agreements on how information from the Internet can be made available on mobile devices

WCPSA = Wireless Communications and Publ ic Safety Act, a US law of 1999 about location information and its proprietary rights

WML = Wireless Markup Language, the language in which WAP-sites are written, it is for WAP-phones what HTML is with the Internet

WUI = Web User Interface

W3C = World Wide Web Consortium

W-CDMA = Wideband Code Division Multiple Access, with which a special code is assigned to every conversation

W-TDMA = Wideband Time Division Multiple Access

WWW = World Wide Web

X

xHTML = extensible Hyper Text Markup Language

XML = extensible Markup Language, the international standard for writing Internet pages. The difference with HTML is that with XML, information and context are separated

Note: Source of the explanation of a number of terms and abbreviations:
http://www.wapworld.nl/woordenlijst.htm

Appendix I Field Experiences with Mobile Surveys

Report on the ESOMAR Conference, Berlin, Germany (October 22nd –24th, 2000)
The welcome reception in the hotel offered an opportunity to make contact and to invite people to come to the SPSS MR-stand one of the following days to participate in a WAP survey.

During lunch breaks, the WAP survey demonstration was run and new business contacts for SPSS MR were obtained. The WAP demonstrations were very successful. A lot of conference participants had heard of the technology of doing surveys and analysing them in real time, on-line, but they had never seen it work. The survey was done with three WAP-phones, of which one broke down during a survey (it was a prototype). Also an emulator that was running on a laptop worked fine. The second day of the conference, a SPSS-employee connected a Siemens C25-phone to a Palm with an infrared connection, so the survey could be run on the Palm. However, it was difficult to keep the mobile phone and the Palm stable in one hand. The display of the Palm is larger, so it was nicer to view.

Report on the MRS Conference, Brighton (March 20th – 23rd, 2001)
After doing some testing and changing of SIM-cards, two devices worked: an Ericsson r380 and a Nokia Communicator. However, it has to be noted that the Ericsson r380 found connection automatically and the Communicator must be connected manually. Also, there were problems with signal reception. According to Richard Collins from SPSS MR UK, the reason was that "[…] the Metropole [the hotel where the conference was held] is right on the beach and always suffers from a poor signal. […]".

The conference opened at 12.30 hrs, so from that moment the WAP-surveys started. The participants of the conference got a demonstration how a WAP-survey works. If people were more interested, they were pointed to the SPSS-stand. Generally, people looked interested and sometimes even surprised. Some people had already heard of the possibility to do on-line surveys but never seen it working. That day, 35 interviews were conducted.

The second day was again a long day and the most successful one, as expected. This day, more than 65 interviews were done. This was also due to the fact three devices were working today. Especially during the coffee breaks, a lot of people could be addressed. Friday was the last day of the conference. The first part of the day another 20 people got a demonstration of the WAP-surveys. Totally up to 115 surveys were collected.

Appendix II Consumer Survey on Mobility

A. Overview of goals and subdirectories of the consumer survey

The characteristics of consumers of mobile services

1. Characteristics of the consumers
   - *Sex* — *Q28*
   - *Age* — *Q29*
   - *Nationality* — *Q30*
   - *Income* — *Q31*
   - *Job status* — *Q32*

2. Experience with mobile phones and (mobile) Internet
   - *Has/ hasn't got a mobile phone* — *Q1 - Q2*
   - *Uses/ doesn't use Internet* — *Q6*

3. Characteristics of mobile services that are used
   - *Prepaid/ postpaid* — *Q3*
   - *SMS functionality* — *Q7*
   - *WAP functionality* — *Q4 – Q5*

By consumer group the consumer adoption of and the consumers' opinion on mobile services and in particular location based services

4. Consumer awareness
   - *Familiarity with the currently offered mobile services (a.o. LBS)* — *Q10*

5. Consumer opinion
   - *Attitude towards e-commerce* — *Q8 – Q9*
   - *Degree of interest towards mobile services* — *Q25*
   - *Degree of acceptation of receiving ads on the mobile phone* — *Q16*
   - *Security aspects of (paying by) mobile phone* — *Q20 – Q21*
   - *Degree of personalization allowed/ privacy violation* — *Q17 - Q18*
   - *Degree of localization allowed/ privacy violation* — *Q19*

Which mobile services consumers are most likely to use in the future

6. LBS/ Mobile services
   - *Expected usage of mobile data services by the end of 2001* — *Q12*
   - *Expected usage of entertainment services by the end of 2001* — *Q13*
   - *Expected usage of information services by the end of 2001* — *Q14*
   - *Expected usage of m-commerce services by the end of 2001* — *Q15*
   - *Attitude towards route-information services* — *Q22 – Q23*
   - *Attitude towards on-line reservation services* — *Q24*

What is the consumers' opinion on strengths and weaknesses of the mobile market

7. SWOT mobile market
   - *Greatest barrier to the take up of Mobile Internet services* — *Q27*
   - *What service feature will be the most important* — *Q11*
   - *What influences are important in the take up of Mobile Internet services* — *Q26*

B. The consumer survey as published on the Internet by Survissimo

Consumer survey on the mobile market and Location Based Services (LBS)

Welcome!

We, Machiel and Jasper, are two students who write a thesis on the mobile market and Location Based Services. We want to know how (possible) consumers think about the new wireless concepts of the mobile market et cetera. Therefore we have designed a survey with questions about Mobile Internet, WAP, Internet and Location Based Services. On this site you can find the questionnaire. We kindly ask you to fill out the form. It will take you only 10 to 15 minutes. Thank you for your participation!

Machiel Reinders and Jasper Dekkers

PS If you have any questions and/or remarks about the survey, please feel free to email us at mjreinders@econ.vu.nl or jec.dekkers@std.vu.nl.

This data is collected purely for the purposes of completing our master thesis at the Vrije Universiteit Amsterdam and will in no way be used for commercial or any other purposes.

1. **Do you have a mobile phone?**

   - ❑ yes
   - ❑ no

2. **Do you have plans to buy a new mobile phone?**

   - ❑ yes
   - ❑ no
   - ❑ don't know

3. **Do you pay prepaid or postpaid (this means you have a subscription)?**

   - ❑ prepaid
   - ❑ postpaid
   - ❑ not applicable

4. **Does your mobile phone have WAP functionality? (WAP is an open, worldwide supported standard that enables mobile phones to use simple, Internet-like services)**

   - ❑ yes
   - ❑ no
   - ❑ don't know
   - ❑ not applicable

5. **Do you use the WAP functionality?**

   - ❑ yes
   - ❑ no
   - ❑ not applicable

6. Are you currently using Internet on a normal PC or laptop?

- ❑ yes
- ❑ no

7. On average, how often do you use the SMS functionality?

- ❑ never
- ❑ once a month
- ❑ once a week
- ❑ once a day
- ❑ once an hour
- ❑ not applicable

8. Have you ever bought physical products via the Internet?

- ❑ no, never
- ❑ yes, once
- ❑ yes, five times
- ❑ yes, ten times

9. What is your attitude towards buying physical products via the Internet?

- ❑ Very positive
- ❑ Positive
- ❑ Negative
- ❑ Very negative
- ❑ No opinion

10. Which of the following mobile Internet services currently offered have you heard of?

- ❑ Entertainment services
- ❑ Information services
- ❑ Transactions / M-commerce (using your mobile phone to buy and sell products and services)
- ❑ Financial services (e.g. AEX indices)
- ❑ Messaging / email
- ❑ Surfing the Web
- ❑ Location based services (LBS, also called location specific services. These are services that are adapted to the location where you are)

11. How important do you think are the following Mobile Internet service features?

	Very unimportant	Unimportant	Important	Very important	No opinion
a. Ease of use	❑	❑	❑	❑	❑
b. Content & applications	❑	❑	❑	❑	❑
c. Pricing	❑	❑	❑	❑	❑
d. Personalisation	❑	❑	❑	❑	❑
e. Location specific services	❑	❑	❑	❑	❑
f. Customer service (for example email, helpdesk)	❑	❑	❑	❑	❑

12. How likely do you think it is you are using the following mobile *data* services by the end of 2001?

	Very Unlikely	Quite Unlikely	Quite Likely	Very Likely	No opinion
a. Entertainment services	❑	❑	❑	❑	❑
b. Information services	❑	❑	❑	❑	❑
c. Transactions / M-commerce	❑	❑	❑	❑	❑
d. Financial services	❑	❑	❑	❑	❑
e. Messaging / email	❑	❑	❑	❑	❑
f. Web browsing	❑	❑	❑	❑	❑
g. Location specific services	❑	❑	❑	❑	❑

13. How likely do you think it is you will use the following mobile *entertainment* services by the end of 2001?

	Very Unlikely	Quite Unlikely	Quite Likely	Very Likely	No opinion
a. Music	❑	❑	❑	❑	❑
b. Games	❑	❑	❑	❑	❑
c. Gambling / Lottery	❑	❑	❑	❑	❑
d. Personalised MMI services (for example ring tones)	❑	❑	❑	❑	❑
e. Location specific Radio (listening to a station which broadcasts in your area)	❑	❑	❑	❑	❑
f. Horoscopes	❑	❑	❑	❑	❑
g. Other	❑	❑	❑	❑	❑

14. How likely do you think it is you are using the following mobile *information* services by the end of 2001?

	Very Unlikely	Quite Unlikely	Quite Likely	Very Likely	No opinion
a. General news	❑	❑	❑	❑	❑
b. Personalised news	❑	❑	❑	❑	❑
c. Entertainment news	❑	❑	❑	❑	❑
d. Weather	❑	❑	❑	❑	❑
e. Traffic news	❑	❑	❑	❑	❑
f. Sports news	❑	❑	❑	❑	❑
g. Travel information	❑	❑	❑	❑	❑
h. Financial information	❑	❑	❑	❑	❑

15. How likely do you think it is you are using the following *M-commerce* services by the end of 2001?

	Very Unlikely	Quite Unlikely	Quite Likely	Very Likely	No opinion
a. Ticketing	❑	❑	❑	❑	❑
b. Books	❑	❑	❑	❑	❑
c. Music	❑	❑	❑	❑	❑
d. Electronics / software	❑	❑	❑	❑	❑
e. Gifts (e.g. Flowers)	❑	❑	❑	❑	❑
f. Other	❑	❑	❑	❑	❑

16. Up to what degree do you want to receive advertisements (ads) on your phone, if that makes the different services offered on your phone cheaper?

	Never	Once a month	Once a week	Once a day	Once an hour
a. Ads for all products and services	❑	❑	❑	❑	❑
b. Ads only for products and services which I have indicated to like, e.g. personalised advertisements	❑	❑	❑	❑	❑

17. If you could indicate on your mobile phone that you are looking for a specific product or service, do you want to receive an sms if you're near to a shop that has the product or service you want?

- ❑ Yes
- ❑ No
- ❑ don't know

18. Suppose your network operator collects personal data from you, by asking you to fill out a form or by asking you two questions each time you buy a product with your mobile phone: Do you think your privacy is violated when this personal data is used to send you personalised information?

- ❑ Yes
- ❑ No
- ❑ don't know

19. When your phone is turned on, your network operator can determine your location: Do you think your privacy is violated when this location data is used to send you location based information?

- ❑ Yes
- ❑ No
- ❑ don't know

20. Do you think a mobile phone is secure enough to do payments with?

- ❑ Yes
- ❑ No
- ❑ don't know

21. Do you think you are going to use your mobile phone for payments when this is possible in the near future?

- ❑ Yes
- ❑ No
- ❑ don't know

22. Do you think your mobile phone can be a helpful device for route or traffic information?

- ❑ Yes
- ❑ No
- ❑ don't know

23. What user-interface would you prefer when getting route information?

- ❑ graphical information (digital map)
- ❑ textual information (typed text)
- ❑ vocal information (speech)
- ❑ no preference

24. Do you think a mobile phone can be useful in making online reservations (e.g. not by calling, but by using a Mobile Internet service)?

- ❑ Yes
- ❑ No
- ❑ don't know

25. Are you interested to use any of the services mentioned in questions 12 through 19?

- ❑ yes, very
- ❑ yes, somewhat
- ❑ don't know
- ❑ no, not so much
- ❑ no, not at all

26. How much influence do you think will the following aspects have on the possible success of Mobile Internet services?

	No Influence at All	Little Influence	Quite Influential	Very Influential	No opinion
a. Fashion	❑	❑	❑	❑	❑
b. Phone availability	❑	❑	❑	❑	❑
c. Applications / content	❑	❑	❑	❑	❑
d. Reliability	❑	❑	❑	❑	❑
e. Cost	❑	❑	❑	❑	❑
f. Industry push (branding / advertising)	❑	❑	❑	❑	❑
g. Ease of access & use	❑	❑	❑	❑	❑
h. Penetration of multimedia in your home	❑	❑	❑	❑	❑

27. How much of a barrier do you think the following aspects will be for you to start using Mobile Internet services?

	Major barrier	Minor barrier	No barrier at all	No opinion
a. Lack of phones	❑	❑	❑	❑
b. Limited terminal display & functionality	❑	❑	❑	❑
c. Data transfer speed	❑	❑	❑	❑
d. Mobile network coverage (e.g. can you call from anywhere in the country or are there some places where you don't have any 'coverage'?)	❑	❑	❑	❑
e. Lack of content (e.g. meaning that there are not enough sites and services available for use)	❑	❑	❑	❑
f. Security	❑	❑	❑	❑
g. Pricing	❑	❑	❑	❑
h. Perception of currently available services (e.g. do you know what services are available?)	❑	❑	❑	❑

28. What is your gender?

- ❑ Male
- ❑ Female

29. What is your age?

- ❑ 0-12
- ❑ 13-18
- ❑ 19-25
- ❑ 26-35
- ❑ 36-49
- ❑ 50+

30. Where do you live?

- ❑ Africa
- ❑ Asia: Japan
- ❑ Asia: Other
- ❑ Australia
- ❑ North America: Unites States
- ❑ North America: Other
- ❑ South America
- ❑ Eastern Europe
- ❑ Western Europe: Belgium
- ❑ Western Europe: France
- ❑ Western Europe: Germany
- ❑ Western Europe: Great Britain
- ❑ Western Europe: Ireland
- ❑ Western Europe: Italy
- ❑ Western Europe: the Netherlands
- ❑ Western Europe: Portugal
- ❑ Western Europe: Spain
- ❑ Western Europe: Other

31. What is your income-range per year? Note: we presume $ 1,00 = fl 2,50 = Euro 1,13

❑ 0 - 5.000 $	(0 - 12.500 fl)	(0 - 5672 Euro)
❑ 5.001 $ - 15.000 $	(12.501 fl - 37.500 fl)	(5673 Euro - 17.017 Euro)
❑ 15.001 $ - 25.000 $	(37.501 fl - 62.500 fl)	(17.018 Euro - 28.361 Euro)
❑ >25.000 $	(>62.501 fl)	(>28.362 Euro)

32. What is your job status?

- ❑ high school (e.g. in Dutch: middelbaar onderwijs)
- ❑ student (e.g. in Dutch: HBO/University)
- ❑ Working
- ❑ Jobless
- ❑ Retired
- ❑ other (e.g. In Dutch: overig, waaronder LBO, MBO et cetera)

33. If you have any further remarks on issues mentioned in this survey, please feel free to make them here

Thanks for your participation.

C. Division of the consumer groups

A distinction between three classes of people was made in the survey. This distinction is based primarily on age. The classes are 19-25, 26-35 and 36+. This distinction is chosen because it appeared that:

- Age is related with job status: students are younger people (e.g. 19-25), the working class are older people (26-35 and 36+), and
- Age is related with income: younger people are gaining less than older people.

Therefore, when the distinction on age is made, indirectly the distinction on income and job status is also made. Originally, the distinction on age was divided into six classes: 0-12, 13-18, 19-25, 26-35, 36-49 and 50+. But because there were not any results from the class 0-12 and very few results in classes 13-18 and 50+, it was decided to merge some classes and drop some others:

Q29. What is your age?

Before	**Class**	**Frequency**	**Percent**	**After**	**Class**	**Frequency**	**Percent**
Valid	13-18	1	1.6	Valid			
	19-25	30	47.6		19-25	30	48.40
	26-35	23	36.5		26-35	23	37.10
	36-49	6	9.5		36+	9	14.50
	50+	3	4.8				
	Total	**63**	**100**		**Total**	**62**	**100**

Table II.1 Question 29 consumer survey

The one result in the class 13-18 was excluded from the results by our decision. We received 69 results. Five results were not valid, because they were all from the same person and were all the same. This person probably submitted his results six times in a row or an error with his browser occurred. Also one other result was not valid because one person submitted his results twice. The second result differed from the first on one answer. We decided to drop the first result from this person, reasoning that this person probably decided to answer a question which he or she did not answer the first time.

D. Results of the consumer survey

The results from the consumer survey will be described, divided into the four goals set out for the survey.

The characteristics of consumers of mobile services

- The age of the people who filled out the survey is already discussed above. Age is related to income and job status. The younger people who participated in the survey, gain less and are more often students than the older participants. It is not interesting to give averages on income, since there are few results;
- Of 62 respondents, 42 were male and 20 were female. The class of age 36+ is entirely male;
- The participants on the survey live all over the world. 50 out of 62 live in the Netherlands, 4 in Portugal, 3 in Great Britain and 1 in France respectively Germany, Asia, US and Africa;
- The possession of mobile phones increases when age increases. The consumer groups 26-35 and 36+ have a relatively higher ownership of mobile phones. In total, 77% of the respondents own a mobile phone;
- The division prepaid/ postpaid is fifty-fifty in the category 19-25, but increases in favor of postpaid when age increase. It seems strange more people in the category 26-35 have postpaid than in the category 36+, since we would expect that older people - with higher incomes - would more often have postpaid (that is clear from the results when we make a cross tabulation of income and prepaid/ postpaid). However, the number of respondents in the last mentioned category (36+) must be taken into account (this number is very low), and
- Most of the respondents (88,5%) indicate they do not have WAP functionality on their mobile phone. A little majority (57%) of the users who own a mobile phone with WAP functionality uses this functionality also. So, 57% of 11,5% uses WAP. On 61 results on this question, that means 4 people are actually using WAP. This is very low.

By consumer group the consumer adoption of and the consumers opinion on mobile services and in particular location based services

- Most people don't want to receive ads for all products and services (70 to 90%, depending on age). But when it is about personalised advertisements, 30 to 50% never wants to receive ads and at the same time, people want to receive ads more frequently than with just ads for all products and services. The result are as follows (see the next page):

Q16. Up to what degree do you want to receive advertisements (ads), if that makes the different services offered on your phone cheaper?

		Class of Age							
		19-25		26-35		36+		Total	
		#	%	#	%	#	%	#	%
All products and services	daily	-	-	-	-	-	-	**-**	**-**
	weekly	4	13	3	14	1	11	**8**	**13**
	monthly	2	7	4	18			**6**	**10**
	never	24	80	15	68	8	89	**47**	**77**
	Total	**30**	**100**	**22**	**100**	**9**	**100**	**61**	**100**
Personalised advertisements	daily	3	10	2	9	2	22	**7**	**12**
	weekly	8	27	6	27	2	22	**16**	**26**
	monthly	5	17	3	14	2	22	**10**	**16**
	never	14	47	11	50	3	33	**28**	**46**
	Total	**30**	**100**	**22**	**100**	**9**	**100**	**61**	**100**

Table II.2 Question 16 consumer survey

It seems that people in the class 36+ change the most for the better when going from all products and services to personalised ads:

- With question 17, about receiving an SMS if you are near a shop that has a product you want, about 40% of the people want to receive an SMS for this purpose in the classes 19-25 and 26-35. But at age 36+, this percentage decreases to just over 10%, and
- On the question if peoples' privacy is violated when their network operator uses personal data to send them personalised information (question 18), the results are as follows:

Q18. Suppose your network operator collects personal data from you, by asking you to fill out a form or by asking you two questions each time you buy a product with your mobile phone: Do you think your privacy is violated when this personal data is used to send you personalised information?

	Class of Age							
	19-25		26-35		36+		Total	
	#	%	#	%	#	%	#	%
Yes	22	73	12	55	4	44	**38**	**62**
No	5	17	7	32	4	44	**16**	**26**
Don't know	3	10	3	14	1	10	**7**	**11**
Total	**30**	**100**	**22**	**100**	**9**	**100**	**61**	**100**

Table II.3 Question 18 consumer survey

- Based on these results, the suspicion arises that when age increases, people tend to see usage of personal data by their network operator to send them personalised information less as a privacy violation;
- The same suspicion goes for the results on question 19. That is basically the same question as question 18, but then personal data is replaced by location data. The results show the same tendency as with question 18: older people see usage of their location data by their network operator to send them location based information less as a privacy violation;
- The answers on question 20 and 21 about using your mobile phone for payments show a more positive attitude when the respondent is older: when age increases, at both questions (20: do you think a mobile phone is secure enough to do payments

with? And 21: Do you think you are going to use your mobile phone for payments when this is possible in the near future?) there are more answers 'don't know', less answers 'no' and more answer 'yes', and
- In general, older people are more interested in the mobile services mentioned in the survey (question 25).

Which mobile services consumers are most likely to use in the future
- Question 12 was about the usage of mobile data services in the future. People at all ages think it is (very) unlikely they will use entertainment services and m-commerce by the end of 2001. People at all ages are the most positive about the use of messaging and email, information services are second, web browsing are third. Remarkably, with answer 12.g – location specific services, more people have no opinion than with answers 12.a through 12.f., probably because less people are familiar with the term location specific services and/ or location based services. This fits with the answer on question 10 (which of the following Mobile Internet services currently offered have you heard of?), because there, only 19 out of 62 people have heard of LBS;
- With question 12, it was mentioned that people say they are unlikely to use mobile entertainment services. This answer is acknowledged by the answer on question 13 about various mobile entertainment services. All answers are on average negative at all ages;
- On future use of mobile information services (question 14), people are most likely to use general news, traffic news and personalised news. After these three, weather news scores the best. One extra thing to mention: traffic news scores much higher at ages 26-35 and 36+, than at age 19-25. This is probably related to the fact that older people are working instead of being a student and will probably own a car an travel for work;
- As for m-commerce services (question 15), people are most likely to use a ticketing service at the end of 2001, although still not many people are positive about it (in total, only 27% of the people think it is quite or very likely that they will use this service). It seems that older people are more positive about this service than younger people. With the other m-commerce services, people are negative at all ages;
- Regardless of age, people think a mobile phone can be a very helpful device for route or traffic information and for making on-line reservations, and
- When receiving route information, the user interface people prefer changes with age: at every age, a graphical interface is the most preferred, but younger people tend to have a stronger preference in this direction as older people.

What is the consumers' opinion on strengths and weaknesses of the mobile market
- Of the various Mobile Internet service features mentioned at question eleven, ease of use is the most important feature. All the features are important on average, but ease of use is very important;
- Question 26 about the influence of some aspects on the possible success of Mobile Internet services generated the following results: Fashion, Applications and content, Industry push and penetration of multimedia in peoples' homes tend to be less influential when people are older, whereas phone availability, reliability, cost and ease of access and use are on average influential at all ages, and
- When people are older (36+), mobile network coverage and pricing are less of a barrier to start using Mobile Internet services (question 27), while lack of content becomes a greater barrier. Speed, security and limited terminal display and functionality (in that order) are generally considered the greatest barriers.

More facts and results from the survey

- Almost every respondent (97%) uses the Internet. This result is definitely biased, because we made the survey only available on-line;
- The results of the survey did not confirm the hype around SMS.

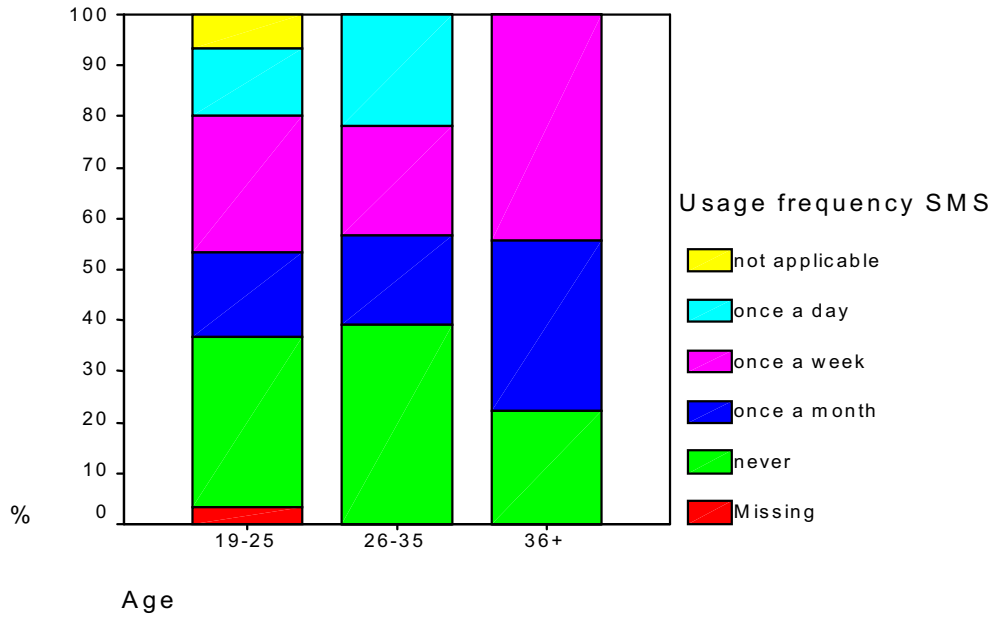


Figure II.1 Usage frequency SMS

Not one respondent answered 'once an hour' on the question how often they use on average their SMS functionality. The answer 'never' has been given frequently. However, we will have to recognize that of the people who don't have a mobile phone, quit a few have answered 'never' on this question, while they should have answered 'not applicable'.

- In total, 29% of the respondents (both mobile phone owners and respondents who don't have a mobile phone) is planning to buy a new mobile phone and another 7% doesn't know yet. For the specific classes, the results are as follows:

	Class of Age							
	19-25		**26-35**		**36+**		**Total**	
	#	%	#	%	#	%	#	%
Yes	6	20	8	35	4	44	**18**	**29**
No	20	67	15	65	5	56	**40**	**65**
Don't know	4	13					**4**	**7**
Total	**30**	**100**	**23**	**100**	**9**	**100**	**62**	**100**

Table II.4 Question 2 consumer survey

It seems that older people are considering buying a new mobile phone more often than younger people, and

- The categories 26-35 and 36+ more often buy products from the Internet. This is correlated with the question about their attitude towards buying products from the Internet. The groups, which more often buy products, also have a more positive attitude towards buying products from the Internet.

Appendix III WAP-site reviewing

A. List of variables and checklist

Some variables are drawn from the "Internet Monitor Government websites 2000", others are defined based on our own research experiences and literature-study. These variables are measured by asking several questions per variable. Because of the way the checklist is set up, the questions are already clustered through the variables.

1. Interface
    a) Presentation and navigation
    b) Interactivity
2. Connectivity
    a) Technical service quality
    b) Organisational service quality
3. Meta-content
    a) Task and working method
    b) General
4. Content
    a) Actuality
    b) Functionality
    c) Location and mobility

d) General

The complete checklist is displayed below:

1) Interface

a) Presentation and navigation

a1	Can you search on keywords (and does it work)?
a2	Is there a consistent lay-out?

b) Interactivity

b1	Is there an option to ask general questions through a general emailadress?
b2	Is there an option to participate in a discussion via an email-board/news-groups/chat-groups/discussion-platforms?
b3	Is there a way you can stay up-to-date with the latest news (for example via a mailing-list)?
b4	Does the site owner invite the user to comment on the content/structure of the site?
b5	Can the customer indicate fields of interest, after which he/she can be kept up-to-date by the organisation about the latest developments in that field (by email or newsletters)?
b6	Is there a possibility to make a phone call through clicking a hyperlink?
b7	Is there a possibility to send an email through clicking a hyperlink?

2) Connectivity

a) Technical service quality

a1	Do the pages of the site generally load within 10 seconds?
a2	Are there any dead links?

b) Organisational service quality

b1	Is it possible to request brochures/ reports (by email)?
b2	Is there a response (doesn't matter how) from the organisation on the question with which type of WAP-phone they originally tested their WAP-site (within 2 days)?
b3	Reaction on type of WAP-phone for testing within 5 working days
b4	Is there a content-related response from the organisation on the question with which type of WAP-phone they originally tested their WAP-site?

3) Meta-content

a) Task and working method

a1	Is there a description of the organisation?
a2	Is the task of the organisation explained?

b) General

b1	Is information available on how to file a complaint?
b2	Is the visiting address of the organisation displayed?
b3	Is the telephone number of the organisation displayed?
b4	Is there a list with Frequently Asked Questions (FAQ's) present?
b5	Does the site contain a disclaimer?
b6	Is all responsibility for the content of the site refused in there?
b7	Is there a site-map?
b8	Are there links to other services or relevant organisations?
b9	Are partners of the organisation mentioned?
b10	Are there job offers presented of the organisation? (search via the menu-structure)

4) Content

a) Actuality

a1	Are there any press releases (from the past month)?
a2	Is there an archive available with press releases (sorted on date (more than 1 month) or subject or search term)?
a3	Is there a news function (relevant news, other than press releases or other sources than from the organisation)?

b) Functionality

b1	Do you have to pay for accessing the site?
b2	Is there a function for paying for services (by creditcard or by billing via your telephone bill or by calling another number)?
b3	Are there any applications you can run on-line (and do they work) without paying?

c) Location and Mobility

c1	Are any components of LBS present?
c2	Is location determination possible?
c3	Are there any location-dependent applications?
c4	Are there any time-dependent applications?
c5	Is there any location-dependent information?
c6	Is there any time-dependent information?
c7	Can you search an address and obtain route-info?

d) General

d1	Are services or information of other organisations offered via the site?
d2	Does the site contain information on products and services of this organisation?
d3	Does the site contain commercial advertisements?

B. Working method in analysing the WAP-sites

General

- Maximum evaluation time = 25 minutes;
- Total average evaluation time = 15 minutes;
- Evaluation on the basis of scoring lists with 43 evaluation criteria;
- The scoring list is the same for all sites;
- When there is any doubt on the evaluation of a site, the site gets the benefit of the doubt;
- Scores will be filled in on paper at first, and
- After evaluating a Web-site, the data will be filled in electronically. The original evaluation paper will be stored.

Working method and guidelines

- The sites will be evaluated with a WAP-emulator: the Ericsson R380-emulator;
- In the Excel-file of the questionnaire it says who must evaluate which sites. The given link will we used to visit the Web-site;
- Surf the site for 5 minutes in order to get to know the site and to get an impression of the different parts and the scale of the site. Answers can be taken down immediately;
- Then start answering the Interface and Connectivity questions on paper. For each question you review if the site lives up to the evaluation criteria. These questions should take 5 minutes at the maximum;
- Start the Meta-Content and Content questions. You can take half a minute per question for this part at the maximum. If you haven't found the evaluation aspect you are looking for in this time, you indicate that you can't find it or that it isn't present. Guideline with searching is first to use the menu-structure and if that doesn't work you can use the search-engine;
- Use the last 5 minutes to examine the scoring list (are all questions answered) and to fill in gaps;
- Enter the data carefully in the database, and
- A dead link (question 2.a.2) has to be a generated error. With the WAP-emulator, it can take up to one minute for a page to load. We will wait one minute for a page to load. After one minute, the browser gives an error. We can try again to load the page, depending on the sort of error (for example with a server error, we can try again to load the page). If the page also doesn't load the second time, the page becomes a dead link. If the page does load the second time, we don't count the page as a dead link. The average loading time for this page however (question 2.a.1) will be high: take the average loading time for the two tries (first: one minute, second: x seconds).

Scoring

Some questions are related directly. These are the questions:
2.b.2 + 2.b.3 + 2.b.4
3.b.5 + 3.b.6
4.c.1 + 4.c.2
4.c.3 + 4.c.4
4.c.5 + 4.c.6
We think of these questions as one question. Taking this into account, we see the checklist consists of 37 questions. We have 100 points to divide, because we use a scale of zero to one hundred to grade the sites. So, we see every question is worth 2,7 points (100/37). For the questions mentioned above, this means that for example a positive answer on question 4.c.1 scores half of 2,7 points. A positive answer on question 4.c.2 also scores half of 2,7 points. Together, these two positive answers amount to the full 2,7 points.

With questions 2.b.2 + 2.b.3 + 2.b.4, 2.b.2 generates half of 2,7 points, 2.b.3 generates half of half of 2,7 points (so, that's a quarter of 2,7 points), and 2.b.4 generates half of 2,7 points. With 2.b.2 and 2.b.3, either the first or the last gets a positive answer and thus points, not both. See the questions and you will understand why this is done. One further remark: with question 2.a.2, a negative answer generates 2,7 points, a positive answer generates zero points.

Sites to be evaluated

We evaluate the WAP-sites with three people, Nils de Reus, Machiel Reinders and Jasper Dekkers. Each of the three will visit 5 sites, so in total we will review 15 sites. This research project is explorative, so we consider this to be a sufficient number of sites to visit. The names of the sites we review can be found in the next paragraph.

Before starting the actual evaluation, Machiel Reinders and Jasper Dekkers evaluated three WAP-sites each to see if the checklist was good and if the working method was OK. These sites were wap.tmf.nl, mmm.wapbode.com and mgo.to/horoscopes by Jasper, and wap.studentmenu.nl, wap.alternate.nl and wap.everydate.nl by Machiel. In this evaluation process, a few shortcomings of the checklist popped up:

- Evaluating the WAP-sites took far less time than we expected. We expected one hour per site, but it turned out to be a quarter of an hour averagely;
- Question 1.a.2 'Is there a consistent lay-out?' was not very useful. It turned out that with WAP-sites layout is almost always consistent, since the page normally just contains text (hyperlinks and information). We decided to keep this question in the checklist, because we expect that in the future, WAP-sites will develop and become more complex. A consistent lay-out is no longer self-evident then;
- With the question 'Is there an option to comment on the content/structure of the site?' (question 1.b.4) it was unclear to us if this option was available if there was an email address available. Because we also have a question in the checklist about an option to ask general questions (for example through email, question 1.b.1), we decided that the site should specifically ask for comments in order to be able to answer the question with 'yes';
- It was unclear how long we should wait for a page to load before taking it down as an error (question 2.a.1 and 2.a.2). Our emulator however sometimes returned an error after one minute of trying to load a page. We decided to wait for the error to occur, because in theory in could be possible a page loads after 50 seconds. In real life, such a loading time would be not acceptable;
- Both question 1.b.1 and 2.b.1 are about emailing. We decided that with the first question, email through the WAP-page was a requirement to answer with 'yes. With the second question, emailing through a Web-site of the same organisation was also allowed. The reason for this decision is that with 1.b.1, the question is about the WAP-site interface, whereas with 2.b.1, the question is about the organisation. All organisations with a WAP-site have a web-site, and reasoning that people will not often request brochures and reports through their phones (most of the time, that will not be that urgent probably), we decided to include an email-option through the Web-site also, and
- Questions 3.b.5 and 3.b.6 are related, so we decided so split the points between these two questions. We have described this already under the heading 'Scoring' at the previous page.

We altered the checklist and working method, based on these shortcomings. Then we did the actual site evaluation. In the next section, the results are presented.

C. Results

	Machiel Reinders									
	mgo.to/eredivisie		mgo.to/smartianwapwork		wap.genie.nl		wap.goudengids.nl		mmm.natasja.com	
1)	**answer**	**points**	**answer**	**points**	**answer**	**points**	**answer**	**points**	**answer**	**points**
a1	yes	2.7	no	0.0	yes	2.7	yes	2.7	no	0.0
a2	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
b1	yes	2.7	yes	2.7	yes	2.7	no	0.0	yes	2.7
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b4	no	0.0	no	0.0	no	0.0	no	0.0	yes	2.7
b5	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b6	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b7	yes	2.7	no	0.0	no	0.0	no	0.0	yes	2.7
2)										
a1	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
a2	no	2.7	no	2.7	yes	0.0	yes	0.0	yes	0.0
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
3)										
a1	no	0.0	yes	2.7	no	0.0	no	0.0	yes	2.7
a2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	no	0.0	no	0.0	yes	2.7
b4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b5	no	0.0	no	0.0	no	0.0	no	0.0	yes	1.4
b6	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b8	no	0.0	yes	2.7	yes	2.7	yes	2.7	yes	2.7
b9	no	0.0	no	0.0	no	0.0	no	0.0	yes	2.7
b10	no	0.0	no	0.0	yes	2.7	no	0.0	no	0.0
4)										
a1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a3	no	0.0	no	0.0	yes	2.7	no	0.0	no	0.0
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c1	no	0.0	no	0.0	yes	1.4	yes	1.4	no	0.0
c2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c5	no	0.0	no	0.0	yes	1.4	yes	1.4	no	0.0
c6	yes	1.4	no	0.0	yes	1.4	no	0.0	no	0.0
c7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
d1	no	0.0	no	0.0	yes	2.7	yes	2.7	yes	2.7
d2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
d3	no	0.0	no	0.0	no	0.0	no	0.0	yes	2.7
	Total	**17.6**	**Total**	**16.2**	**yes**	**25.7**	**Total**	**16.2**	**Total**	**31.1**

Table III.1 Results WAP-site reviewing Machiel Reinders

	Nils de Reus									
	mmm.geodan.nl/a2g		mgo.to/paris		mmm.jobbingmall.nl		mmm.wapvocaat.nl		2on.com	
1)	**answer**	**points**	**answer**	**points**	**answer**	**points**	**answer**	**points**	**answer**	**points**
a1	yes	2.7	no	0.0	no	0.0	no	0.0	no	0.0
a2	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
b1	no	0.0	no	0.0	yes	2.7	yes	2.7	yes	2.7
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b4	no	0.0	no	0.0	no	0.0	yes	2.7	no	0.0
b5	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b6	no	0.0	no	0.0	no	0.0	yes	2.7	no	0.0
b7	no	0.0	no	0.0	no	0.0	no	0.0	yes	2.7
2)										
a1	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
a2	no	2.7	yes	0.0	no	2.7	no	2.7	no	2.7
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	yes	1.4	yes	1.4	no	0.0
b3	no	0.0	no	0.0	x	0.0	x	0.0	yes	0.7
b4	no	0.0	no	0.0	yes	1.4	no	0.0	yes	1.4
3)										
a1	yes	2.7	no	0.0	no	0.0	yes	2.7	no	0.0
a2	yes	2.7	no	0.0	no	0.0	yes	2.7	no	0.0
b1	no	0.0	yes	2.7	no	0.0	yes	2.7	no	0.0
b2	no	0.0	no	0.0	yes	2.7	no	0.0	no	0.0
b3	no	0.0	no	0.0	yes	2.7	no	0.0	no	0.0
b4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b5	no	0.0	no	0.0	no	0.0	yes	1.4	no	0.0
b6	no	0.0	no	0.0	no	0.0	yes	1.4	no	0.0
b7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b8	no	0.0	yes	2.7	yes	2.7	yes	2.7	yes	2.7
b9	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
b10	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
4)										
a1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	yes	2.7	yes	2.7	no	0.0	no	0.0	no	0.0
c1	yes	1.4	yes	1.4	no	0.0	no	0.0	no	0.0
c2	yes	1.4	no	0.0	no	0.0	no	0.0	no	0.0
c3	yes	1.4	no	0.0	no	0.0	no	0.0	no	0.0
c4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c5	yes	1.4	no	0.0	yes	1.4	no	0.0	no	0.0
c6	no	0.0	no	0.0	yes	1.4	no	0.0	no	0.0
c7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
d1	no	0.0	no	0.0	yes	2.7	no	0.0	yes	2.7
d2	no	0.0	no	0.0	yes	2.7	no	0.0	no	0.0
d3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
	Total	**27.0**	**Total**	**17.6**	**Total**	**32.4**	**Total**	**33.8**	**Total**	**23.6**

Table III.2 Results WAP-site reviewing Nils de Reus

	Jasper Dekkers									
	mmm.anwb.nl		wap.diningcity.nl		wap.htm.net		wap.snelklaar.nl		wap.specialbite.com	
1)	**answer**	**points**	**answer**	**points**	**answer**	**points**	**answer**	**points**	**answer**	**points**
a1	no	0.0	no	0.0	no	0.0	yes	2.7	no	0.0
a2	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	yes	2.7	no	0.0	no	0.0	no	0.0	no	0.0
b4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b5	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b6	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
2)										
a1	yes	2.7	yes	2.7	yes	2.7	yes	2.7	yes	2.7
a2	no	2.7	yes	0.0	no	2.7	no	2.7	no	2.7
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	yes	1.4	no	0.0	no	0.0	no	0.0	yes	1.4
b3	x	0.0	no	0.0	no	0.0	yes	0.7	x	0.0
b4	yes	1.4	no	0.0	no	0.0	yes	1.4	yes	1.4
3)										
a1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a2	yes	2.7	no	0.0	no	0.0	yes	2.7	no	0.0
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	yes	2.7	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	yes	2.7	no	0.0	no	0.0
b4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b5	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b6	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b8	no	0.0	no	0.0	no	0.0	yes	2.7	no	0.0
b9	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b10	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
4)										
a1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
a3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b1	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
b3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c1	yes	1.4	yes	1.4	yes	1.4	no	0.0	yes	1.4
c2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c4	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
c5	yes	1.4	yes	1.4	yes	1.4	no	0.0	yes	1.4
c6	yes	1.4	no	0.0	yes	1.4	no	0.0	no	0.0
c7	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
d1	no	0.0	no	0.0	no	0.0	yes	2.7	no	0.0
d2	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
d3	no	0.0	no	0.0	no	0.0	no	0.0	no	0.0
	Total	**20.3**	**Total**	**10.8**	**Total**	**14.9**	**Total**	**20.9**	**Total**	**13.5**

Table III.3 Results WAP-site reviewing Jasper Dekkers

In general, it can be concluded that the scores are disappointingly low. This is caused by the following facts:

- Although nearly 50% of the sites include an option to ask general questions through a general email address, most of the reviewed sites do not have a special option in which users are invited to comment on either the content or the structure of the site;
- Only one site gives users the opportunity to submit to a mailing-list or to indicate the field of interest to stay up-to-date with the latest news;
- Another missing feature on almost every reviewed site is the possibility to make a phone call or send an email by clicking on a hyperlink;
- There are no sites which contain a possibility to request brochures or reports;
- Only 6 of 15 companies replied on the question with which type of WAP-phone they originally tested their WAP-site;
- 25% of the sites give information about the organisation and the task of the organisation. Also the visiting address and telephone number of the organisation is not displayed in most of the cases;
- Up to 87% of the reviewed sites do not have a disclaimer;
- There a few sites with applications that can be run on-line (without paying);
- It is striking that more than 50% of the sites has LBS components, but only one site has the possibility for location determination. Also location and time dependent applications are not there yet (this is strongly related with the fact there are few sites with applications that can be run on-line);
- There are no sites with a possibility to search an address and obtain route-info, and
- Only 7% of the sites contain information on products and services of other organisations or commercial advertisements.

Other interesting results that came up are:

- Every site has a consistent lay-out;
- All sites generally load within 10 seconds;
- 33% of the sites has dead links;
- 60% of the sites contain links to other services or relevant organisations. This percentage is probably so high, because in our site reviewing we included WAP-portals like genie.nl;
- 53% of the sites contain location-dependent information, 33% of the sites contain also time-dependent information, and
- 40% of the sites offer services or information of other organisations via the site.

One thing that was remarkable was that the average score per reviewer varied enormously. To see if this was not caused by any error from their side, the two other researchers checked the sites from Nils de Reus also and found that the scores were right. This meant that the big differences are in order, because Nils just had better sites to review. Also, these differences do not say much because of the small number of sites that were reviewed.

Average score per reviewer	
Nils de Reus	26.9
Machiel Reinders	21.4
Jasper Dekkers	16.1

Table III.4 Average score per reviewer

Appendix IV Division of Research Work

Subject	Author(s)
Executive Summary	Together
Prologue	Together
Chapter 1 Introduction	Together
Chapter 2 A New Era: The information Age	
2.1 Introduction	Machiel Reinders
2.2 The Information Age	Machiel Reinders
2.3 Macro-Environmental Analysis of the Information Age	Machiel Reinders
2.4 Summary and Conclusions	Machiel Reinders
Chapter 3 Towards a Mobile Market	
3.1 Introduction	Jasper Dekkers
3.2 The Rising of The Internet	Jasper Dekkers
3.3 The Evolution of Mobile Communication Systems	Jasper Dekkers
3.4 Developments in the Wireless World	Jasper Dekkers
3.5 Towards The Mobile Internet	Machiel Reinders
3.6 Summary and Conclusions	Together
Chapter 4 Location-Based Services	
4.1 Introduction	Jasper Dekkers
4.2 Location Determination and Positioning Technologies	Machiel Reinders
4.3 Location-Based Services	Jasper Dekkers
4.4 Summary and Conclusions	Together
Chapter 5 Knowledge Management	
5.1 Introduction	Jasper Dekkers
5.2 The Information Revolution and Knowledge Management	Jasper Dekkers
5.3 WAPstad: A Knowledge Management Project	Jasper Dekkers
5.4 The Virtual Office	Jasper Dekkers
5.5 Summary and Conclusions	Jasper Dekkers
Chapter 6 The Mobile Market: a Business Analysis	
6.1 Introduction	Jasper Dekkers
6.2 Market Developments	Machiel Reinders
6.3 Visions on The Future	Jasper Dekkers
6.4 The Five Forces of The Mobile Market	Machiel Reinders
6.5 Summary and Conclusions	Together
Chapter 7 The Mobile Market: a Consumer Analysis	
7.1 Introduction	Together
7.2 The Effects of Mobility on Consumers	Jasper Dekkers
7.3 Issues Concerning Consumer Data	Together
7.4 Summary and Conclusions	Together
Chapter 8 Diffusion and Consumer Adoption of Mobile services	
8.1 Introduction	Machiel Reinders

8.2 Diffusion and Adoption of Innovations	Machiel Reinders
8.3 Diffusion of Mobile Services	Machiel Reinders
8.4 Consumer Adoption: Criteria for The Design of Wireless Services	Machiel Reinders
8.5 Summary and Conclusions	Together
Chapter 9 Empirical Research on The Mobile Market	
9.1 Introduction	Jasper Dekkers
9.2 Consumer survey on Mobility	Together
9.3 Reviewing WAP-sites	Together
9.4 Summary and Conclusions	Together
Chapter 10 Conclusions	Together
References	Together
Glossary	Together
Appendices	Together