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Future of Wireless Data Communication

School of Economics and Management

Abstract

Title	Future of Wireless Data Communication
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Purpose	Develop different possible scenarios for the future of wireless data communication
Method	To reach the stated purpose we followed a methodology for constructing scenarios developed by the Global Business Network (GBN). Primary sources and secondary data were collected to get a comprehensive view of current trends concerning technology, market and strategy. Critical uncertainties, i.e. most important and uncertain factors, constitute the foundation for different possible scenarios. Theory has been used within the area of strategy as an analytical tool for possible future implications.
Conclusions	The future for wireless Internet technologies is uncertain. The most important and uncertain factors influencing the future user adoption is considered to be price and mobility. The time of launch for mobile Internet services is also believed to have an immense effect upon the market penetration for cellular technologies. The condensed result is four possible scenarios describing the future of wireless in 2010.
Key Words	Scenarios, Wireless, Technology, Mobile Internet, Path Dependency, Network effects.

Preface

What seemed to be easy and straightforward turned out to be complex and time-consuming. Today, hours, weeks and months later than anticipated this thesis has finally left the beta phase and gone gold. It gives a deep insight into scenario planning and possible futures of wireless data communication. Working with a topic of immediate importance has been stimulating, interesting and instructive but also challenging.

We would like to express our appreciation to our tutor Allan T. Malm and Fredrik Häglund for their valuable support and guidance throughout the thesis. Without Allan's knowledge within the area of telecommunication and strategy the result would have been less multifaceted and significant.

We would also like to thank Martin Börjesson, Peter Gärdenfors, Filip Lindell, Gerald Maguire and Johan Åslund for sharing valuable knowledge that was essential for the completion of this study. The Future of Wireless and Cebit, Gothenburg also contributed with useful and constructive input, and we would like to thank all participants of these two events.

The future is in front of you, turn the page!

Lund, March 18, 2003

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- Part One -
The course

1. Background

During the recent economic boom in the information technology business, we were all enticed by visions of the "Wireless Web". In a near future we were supposed to get access to the web on our handheld devices wherever we went. And of course, content was to be delivered in "true broadband", which meant full-motion video along with other advanced applications. The technology to take us there was the third-generation wireless (3G), a development of the present and second-generation (2G) of cellular telephony.

The promising vision of wireless made venture capitalists pay premium prices for the stocks of companies that were to make the dream come true (Benditt, 2001). The situation at hand further indulged companies to pay huge sums of money when various governments in North America, Europe and parts of Asia auctioned off licenses to use parts of the limited 3G spectrum (Garber, 2002).

Today, the global economic decline, particularly in the technology sector, has put the future of wireless technology in another light. A more sober assessment of 3G's likely financial returns together with technological obstacles has reduced stock value and credit ratings, making it hard getting loans for the purchase of 3G-network infrastructure (Garber, 2002). Financing issues is further followed by doubts whether the consumers will pay for the heavy investments in technology and licenses (Andersson et al, 2002).

The set backs in the industry has caused delays of the 3G's rollout status and raised disbelieves about the possible profitability of the technology (Knorr, 2001). The particulars has created opportunities for opposing technologies, often developed by smaller, risk willing, entrepreneurial companies who were not able to purchase the expensive spectrum licenses (Cooper, 2001). Many of these companies derive from the Internet industry, exposing the telecommunications industry for a never before encountered competition. Internet giants such as Cisco Systems, IBM and Intel are even backing up some of the technologies, making the threat indeed bigger (Earle, 2002).

Today we know that the realization of the wireless dream is going to take longer than what we expected and that it might not happen the way it looked some years ago. But future prospects of the technology are still enormous and the wireless revolution is underway. However, the boundary between telecommunication and the Internet industry is fading, raising questions about the future dominant technology. Will traditional telecommunication companies, such as Ericsson, stand a chance, when strong forces, both commercial and technological, are pushing for other alternatives than 3G? The big question is evident: What will the future of wireless look like?

1.1 Problem Discussion

Numerous new, emerging technologies, enabling mobile Internet, are ready to hit the market. The telecom operators have lost their monopoly in transporting ones and zeros wirelessly and 3G is no longer the obvious next technology. The picture is emphasized by the already intense pre-market competition that is conducted in order to attract potential customers. The future seems all other then definite and it is not an easy task to anticipate which technologies that will survive the upcoming severe competition and possibly dominate the market. Nevertheless, despite the fuzzy future, there is one aspect that can be taken for granted; the industry will change. This fact raises many questions, e.g. how will the competition look alike, will the businesses approach of today change and how will this affect the companies involved in the business?

Given the above prerequisites, these are quite complex subjects and in order to give an accurate and stringent answer one must look into the many different aspects that induce the development of mobile Internet. We have identified three principle areas of interest; Market, technology and strategy, see figure 1.1.

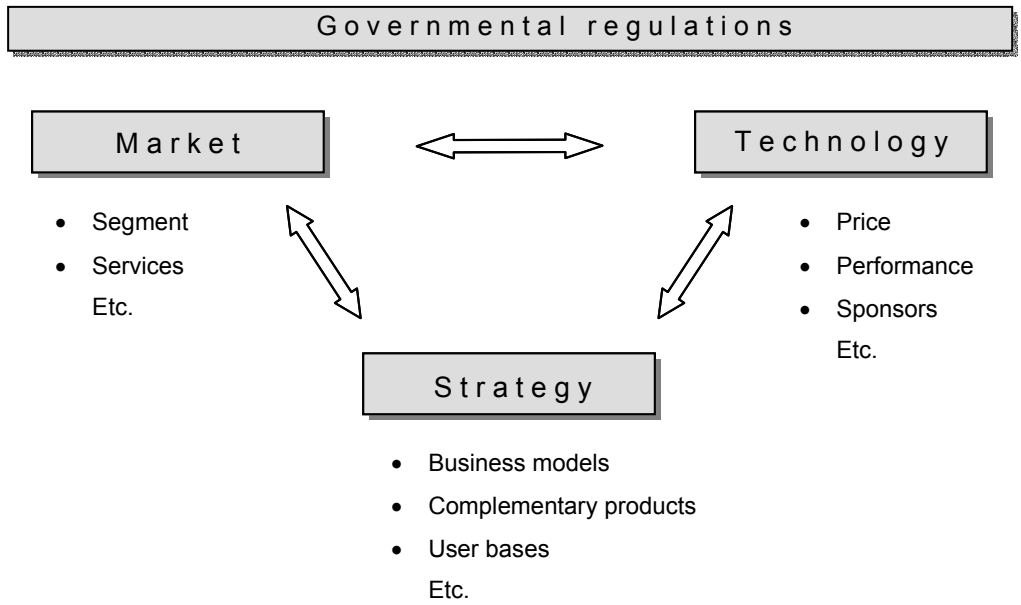


Figure 1.1 Framework

These comprise several variables shaping the characteristics of each area. The areas interact and are interdependent. The development of one area affects the development of the others. For example, depending on which consumer segment that dominates the market, the importance of price and performance at the technology area will differ. It will also influence the supply and features of mobile Internet services. Finally, this will have great impact on

strategical factors, such as possible business models, value of complementary products and magnitude of user bases.

This is one example expressing the dynamics and interaction between the areas. It is also an expression of the absolute necessity to understand this dynamic in order to realistically anticipate the future of wireless communication. At a first glance, one may be tempted to look at just one side e.g. the technology area. The technology with the coolest features and lowest price win. However, depending on which customer segment the firm asks it will discover different needs and different valuation of features and price. Therefore, the firm adds this perspective and tries to balance features, price and customer needs to make the perfect product. Nevertheless, the firm forgets one very important fact. The customer's apprehension is not definite. It is, to a certain extent, possible for a firm to influence and even change its customer's needs and requirements. In some cases it is also possible to completely lock out competing technologies from the market. This can e.g. be done by marketing and the use of strategical realities such as network effects, complementary products and knowledge about concepts like path dependency and increasing returns. The effects are striking. A particular technology may beat competitors offering products that are, from a technologic perspective, much more advanced and, at least before launch, better correspond to the customer's needs.

The three areas of interest constitute the free business environment. However there is one factor constraining them all; governmental regulations. One example is the limitations in the permitted use of spectrum for both cellular net's and w-lan's and possible restrictions in competition, e.g. in form of governmental sponsorship of a certain technology. This factor may impede, or burst, the development of a certain technology that otherwise would have had another market position.

From the discussion above one can draw the conclusion that the principle areas of interest together shape the future of wireless communication. We will analyze these areas through the use of a scenario methodology. We find this methodology suitable as it allows us to look at different outcomes of each area. This is necessary as the development of each area is uncertain and it is therefore not to much use to make a single prediction of the development, since it most probably would be wrong. Read more about this in chapter 2.

1.1.1 Problem definition – Core Issue

Based on the discussion above, we have defined one core issue that we will analyze in depth.

Given certain developments of the three principle areas, how may the future of wireless communication unfold?

1.2 Purpose

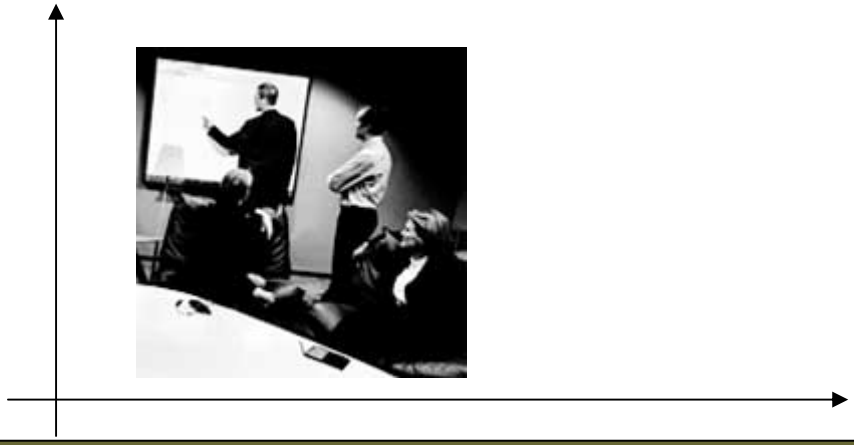
We have two principal purposes we want achieve through this thesis.

1. Through the development of scenarios, this thesis shall serve as a basis for further research within the area of wireless communication. It shall function as a preliminary study and point out interesting subjects where more exploration is adequate and necessary.

2. Through the development of scenarios, this thesis shall guide firms active in the industry by providing them with realistic and internally stringent scenarios of the wireless future. The scenarios will support managers as a basis for strategic decisions and point out paths of development that may differ from the firm's traditional view of the business.

1.3 Delimitations

The scenarios we have developed during this thesis will primarily illustrate the Swedish market. Nevertheless, we have strived towards doing them generally applicable on the European market as well. However, since the national market conditions differ, for example regarding 3G license terms, it would have been impossible to create scenarios covering every aspect of every market. Therefore we have chosen Sweden as our primary market. We chose the Swedish market for two main reasons. First, we are situated in Sweden, making it easy to get in contact with actors on that particular market. Second, the Swedish market is in the front edge of the development of the subject for this thesis, making it a suitable object to study (Kairo Future, 2001).



- Part Two -
Methodology

2. Why explain the past; you can predict the future

This chapter describes our way of working to obtain the stated purpose. Initially, we will define scenarios, their use and appropriateness for this thesis. Subsequently, we motivate and explain the explicit choice of method used during the development of our scenarios. The methodology will run all through this thesis, making the process towards the scenarios transparent for the reader.

2.1 Scenarios – definition and use

We know that there will be major changes in the world over the next decades, but we do not know what these will look like. The use of information technology will probably be one thing that shapes our society, but we do not know in what way. Ringland (1998) argues that the uncertainty of the modern era is the result of the complex interaction of forces of many kinds: technological, social, political, economic and environmental. The complexity and incommensurability of these forces has made it impossible to predict the future, and attempts to develop adequate mathematical forecasting equations, computer models etc. has failed (Ringland, 1998).

Yet, many strategic plans are constructed on "single line" forecasts that, in all probability, will prove to be hopelessly of the mark, as figure 2.1 shows.

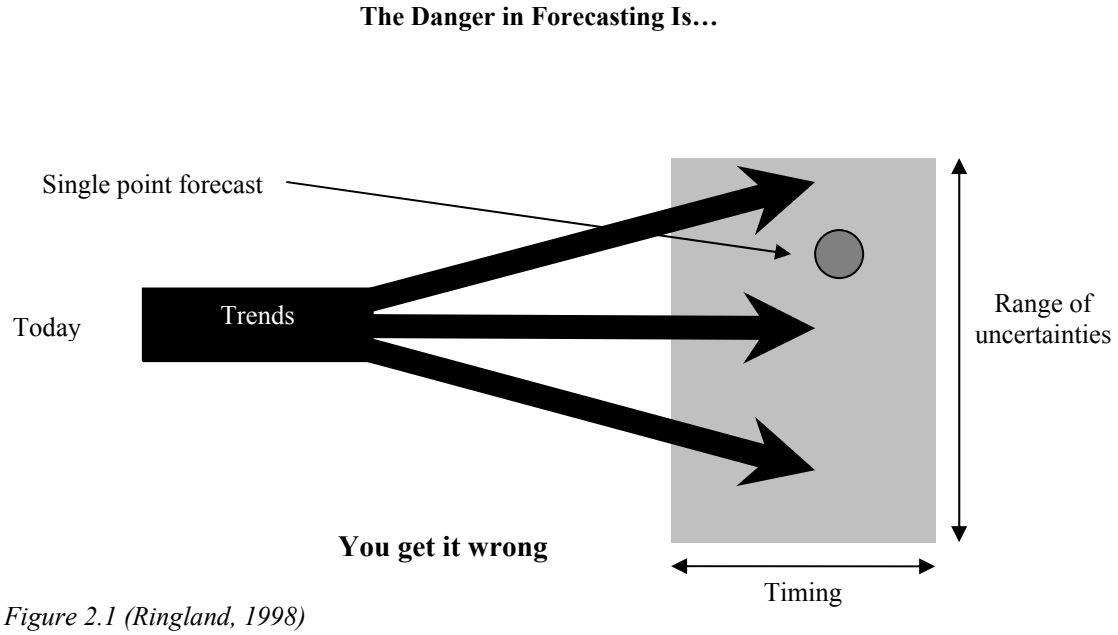


Figure 2.1 (Ringland, 1998)

However, forecasting methods can under particular circumstances, where uncertainty is limited, be reliable. An example of a forecasting technique is the Delphi method, used to achieve a consensus view among experts. The modern Delphi method consists of a systematic interrogation of a group of anonymous experts using questionnaires. The process is repeated several times in order to promote convergence and identify consensus. The method has attained some success, especially in technology futures, where experts have a forward view of the technology's characteristics, i.e. its technical possibilities and limitations (Ringland, 1998).

Another way of thinking about the future is through scenarios. Scenarios are based on the assumption that the future is unpredictable. Therefore, it is necessary to accept uncertainty, to understand it and make it part of reasoning. Van der Heijden (1997) offers three categories of uncertainty: risks, structural uncertainties and unknowables. Risks are related to the probability of outcomes by considering past events of a similar nature. Structural uncertainties are concerned with possible events for which there are no evidence to judge the likelihood of a given outcome. Unknowables represent events that cannot even be imagined. Through the creation of a few consistent pathways into the future, which take the form of stories (scenarios), the complexity of uncertainty is reduced and structurally incorporated in thinking. Scenarios are not concerned with getting the future "right", rather they aim at challenging current paradigms of thinking (Chermack et al, 2001). Thus, scenarios do not predict the future so much as they illuminate it, preparing us for the unexpected (Kenter, 1998).

Nevertheless, the stories need to be trustworthy and scenarios are not developed through ill-founded guesses about the future. Instead, they are founded on comprehensive knowledge about the area of subject. There is a focus on current forces in the world, which already affect the industry or would definitely do so in the near future. By elaborating on the possible implications of these forces and by paying regard to their internally consistent logic, scenarios distinguish themselves from simple tales about possible futures (Schwartz, 1998; Kenter, 1998). The scenario methodology is hence a set of processes for improving the quality of educated guesses of the future. The use of a scenario methodology makes it possible to think about uncertainty in a structured way (Ringland, 1998). The difference between forecasts and scenarios is illustrated in figure 2.2.

Figure 2.2 (Ringland, 1998)

Michael Porter (1985) defined scenarios as:

> *"an internally consistent view of what the future might turn out to be – not a forecast, but one possible future outcome."*

Ringland (1998) further defined scenario planning as:

> *"that part of strategic planning which relates to the tools and technologies for managing the uncertainties of the future."*

The roots of scenario planning lie with the US military, which with the use of stories about the future, enabled training and preparation for what to possibly come. The history of war also shows examples of when the possibility of different futures was neglected. When Josef Stalin negotiated a secret treaty with Hitler in World War 2, he relied upon it from that day forth. As a result he ignored 84 separate indicators of a coming declaration of war by Germany, including a sudden halt of all German merchant shipping traffic and the overnight departure from Moscow of diplomatic dependents (Chermack et al, 2001).

The use of scenarios in companies is today advocated by many, e.g. by Williamson (1999). He means that scenarios will, in the same way as for the military, create a portfolio of strategic options on the future. If a scenario becomes a reality, the company will be able to reposition itself faster through the, in advanced developed, market knowledge and capabilities. In contrary, he argues, a company making investment decisions based only on forecasts, risks becoming a prisoner of its existing investments in capabilities and market understanding. When repositioning becomes necessary the company will be like "an aircraft carrier turning on a dime" (Williamson, 1999, p.2). To cope with the "new" reality, extensive relearning has to take place, which may give the competition a considerable lead. Thus, the development of scenarios implies planning for the future while short-term opportunism is invoked by the exercise of relevant knowledge gathered (Williamson, 1999). The advantage created by having previously considered critical circumstances when they actually present themselves is also known as a *future memory* (Chermack et al, 2001).

2.2 The art of the possible

The road towards the wireless society is as mentioned full of crossroads. There are several factors within our areas of interest (e.g. technology, market and strategy,) that will have its affect as the future unfolds. Today, one can neither say for certain how the technologies will evolve nor what part the market, economy, politicians and companies will play. The high degree of uncertainty makes the scenario methodology appropriate and the use of forecasts inadequate.

Scenario planning is considered to be more a form of art than a scientific methodology (Schwartz, 1998; Börjesson, 2002). Methods have thus been developed in practice and have not been thoroughly documented as a discipline or process (Chermack et al, 2001). Today, there are many methods for the process of building scenarios and, while authors give hints, a detailed, step by step methodology is not documented (ibid.). As a result, it has never been any scientific research on the subject that tries to prove the validity of any distinct method. It

is consequently hard to find any foundation for a good choice among the different methodologies.

However, we have analyzed different scenario planning methodologies which have revealed several themes that run throughout the schools. Although the details are often lacking it is our intent to account for these themes to justify our choice of methodology. The source of information is primarily: Scenario Planning by Peter Ringland, The Art of the Long View by Peter Schwartz and a compilation of articles published by Futures Research Quarterly.

2.2.1 Deductive schools/Development scenarios

A general and recurrent objective/difficulty in the majority of scenario methodologies studied is to find the factors/trends that will be decisive for possible future outcomes. These methodologies implies consequently to discover present trends and to make appraisements of these according to importance and uncertainty. Uncertain factors will through variations constitute different outcomes (scenarios) whereas certain factors will, by their nature as certain, be the same in all scenarios. The scenarios will further only be credible if the uncertain factors take plausible shapes and if the dependencies between the variables are believable. Methodologies that follow this build-up approach are considered to be deductive, i.e. they follow a logical chain of evidence (Ringland, 1998; Schwartz, 1998).

2.2.2 Inductive schools/Situational scenarios

There are also some schools that distinguish themselves by working in an opposite order, like Comprehensive Situation Mapping (CSM). They incorporates principles of system dynamics and system thinking whereby variables and their mutually relationships are not modeled piecemeal, but entire situations are captured at once. The sum is bigger than its parts. Northeast Consulting Resources Inc (NCRI) has a similar approach. They start from end-states whereupon they seek a justification by looking at events and trends. These schools are considered to be inductive (Ringland, 1998).

2.2.3 Different scenario end states

Michael Godet, developer of the “French School”, identified three types of scenarios that may exist in either category of school (Chermack et al, 2001). Trend-based scenarios follow what is most likely. Contrasted scenarios explore extreme themes, e.g. worst case versus best case scenario. Normative/horizon scenarios examine the feasibility of a desirable future. The application of the different types is more or less expressed in different methodologies. Nevertheless it is clear that trend-based scenarios are by far most popular.

One methodology that stands out from the majority is the Reference Scenarios. Its methodological process starts by making a reference scenario for the projection a firm would have if there were no significant changes in the environment. Subsequently they work out a normative, idealized scenario of a desirable future. The goal with the scenarios is a strategic turnaround by being *proactive*, i.e. change the “external environment in order to create the wanted future for stakeholders” (Chermack et al, 2001). The emphasis is thus to create the future, not just wait for changes to happen and then *react* by developing a response.

In contrast, the general purpose with scenarios is to be *proactive* (Ibid.), i.e. predict external changes and established organizational positions before they happen. However, using scenarios in general do not mean that you are a victim of the circumstances. Instead you accept the existence of uncertainties and the fact that you sometimes are without influence. You should nevertheless always work *proactive* and follow a strategy at the same time as you stay prepared to adopt for sudden environmental changes/scenarios. Metaphorical: As a skier that follows a staked out course he/she must always be prepared for unexpected bumps or holes. The two different end states promote consequently different purposes with scenarios that should not be seen as substitutions but rather as complements. See table 2.1.

Inactivity	**Reactivity**	**Proactivity**	**Proactivity**
Ignore changes and continue with business as usual.	Wait for changes to happen and then develop a response.	Predict changes and prepare situational response.	Influence the environment and create the future

Table 2.1 (Chermack et al, 2001)

The distinction in practice between trend-based and contrasted scenarios is relatively vague. The European Commission uses for example the Shaping Factors-Shaping Actors method to find trends and decision makers that shapes future outcomes (Ringland, 1998). From the wide possible range of scenarios they then choose contrasted scenarios like "Pessimistic", "Optimistic" and "Surprise Free" (Ibid.). Consequently they chose extreme ends of what is likely, i.e. a mixture of both trend-based and contrasted scenarios. The meaning of "extreme" is consequently always subjective and strongly dependant upon the knowledge of the subject at hand. Ignorance will extend the variety of extreme possibilities, while knowledge will reduce the range between extreme end-states. Figure 2.3 illustrates extreme ends that based on essential knowledge, and end stated that are pure guesses.

Nevertheless, we believe that a contrasted focus may foster sensational scenarios that push the edges of what is perceived as "likely".

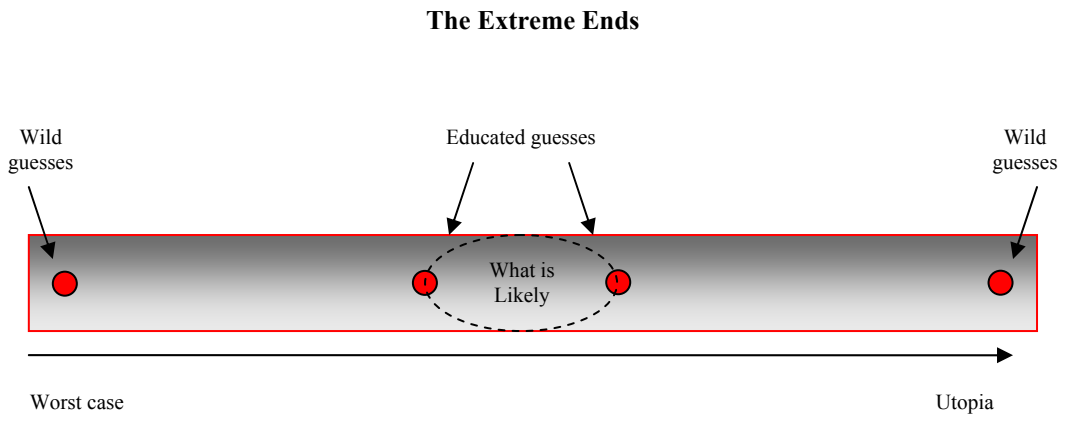


Figure 2.3 Extreme ends

End States	Process: Deductive Schools	Process: Inductive Schools
Trends-based Scenarios	○ The French School ○ Decision Strategies International ○ Soft Creative Methods Approach ○ Battelle's Basics ○ Computer Driven Simulations ○ Global Business Network ○ SRI	○ The Futures Group ○ Comprehensive Situation mapping ○ Northeast Consulting Resources Inc.
Contrasted Scenarios	○ The French School ○ The Copenhagen Institute for Future Studies ○ The European Commission Methodology	
Normative Scenarios	○ The French School	○ Reference Scenarios

Table 2.2 Scenario Schools and End States

Table 2.2 gives an overview of the examined schools; structured according to their different processes and end states. It is not certain that any examined methodology strictly advocates only one type of end states. As pointed out, scenario planning is more of a hands-on methodology that allows for situation-based solutions. Our distinctions are also based on accessible literature and publications which does not always give a complete description of the different methodologies. Some of these descriptions are even based on interviews due to the lack of a documented process, which facilitates for inconsistency and misinterpretations.

2.2.4 Organizational learning

The methodologies examined here all assert that scenarios much challenge the microcosm of decision makers. There are yet some differences. Certain methodologies do not so much focus on developing scenarios as they focus on creating awareness of future situations and implications. Computer driven simulations, like Strat*X focus on learning by managing simulated companies within different industries. The software is designed for the use with groups of 16-30 managers split into teams of 4-6 people. This is a way for managers to test implication of strategies in a fictive future. The Copenhagen Institute for Future Studies use a similar exercise called “The Futures Game” for stimulating creativity and inspiration.

2.2.5 Other distinctions

Some deductive methodologies also emphasize their ideas of how to get all right, i.e. they do not just define "What to do" but also "How to do it". Some methodologies use expert seminars or working meetings with managers to gather information about driving forces and trends, e.g. The European Commission's Methodology. Other methods only define the task without any general outlines for the ones participating, e.g. GBN. Methods like Battelle's Basics and The French School incorporate computer based applications when arranging factors according to importance and internal dependencies, whereas some do not. A number of methods, e.g. Comprehensive Situation Mapping, are also probabilistic, i.e. assigning approximations of probabilities to the outcomes. Table 2.3 shows the different qualities within different methodologies.

Methodology	Deductive	Inductive	Focus on Learning	Computer-based	Probabilistic
Battelle's Basics	✓			✓	✓
Comprehensive Situation Mapping		✓		✓	✓
Computer driven Simulations	✓		✓	✓	
Decision Strategies International	✓			✓	
Global Business Network	✓				
NCRI		✓			
Reference Scenarios		✓			
Soft Creative Methods Approach	✓			✓	
SRI	✓				
The Copenhagen Institute for Future Studies	✓		✓		
The European Commission Methodology	✓				
The French School	✓			✓	✓
The Futures Group		✓			

Table 2.3 Characteristics of different methodologies

2.2.6 Our choice

For us it seems hard to capture the entire situations at once, why we figured a build-up, deductive approach to be more suitable. We further assume that the inductive approach will have difficulties to break with establish models of mind. It might be necessary to follow the implication of uncertain variables to be able to picture an unexpected future than going the other way around. Inductive methods may though be more efficient for experienced scenario developers who are familiar with the subject at hand (Börjesson, 2002).

Considering our stated purpose, our methodology of choice must follow what is most likely. A normative scenario, describing a desirably future, is irrelevant when our interest lies in different and realistic scenarios for the future of wireless communication. We have chosen not

to use contrasted scenarios on the same basis. We do not want to presuppose extreme end states when we believe it makes it easy to go beyond the scope of the possible. For us, working with opposites may in the worst case be no better than making unfounded and perhaps absurd guesses. How hard is it to deliver extreme scenarios, and what is then the use of a deep and extensive research? The credibility of these guesses would consequently be low, why decision makers or readers would barely perceive them as useful. To capture reality we believe in the use of trends and tendencies of today, analysis of uncertainties and a good and stringent development of the possible nuances of tomorrow. Nevertheless these nuances may be extremes in relation to each other, but the trend-based approach does not build them on the same basis as contrast-based scenarios. However, we believe contrasted scenarios to be exceptionally suitable tools for learning, thus extreme ends will provoke and stimulate discussion. Our choice is consequently a deductive and trend based methodology. Table 2.4 shows the methodologies that are both deductive and trend-based.

Methodology	Deductive	Trend-based	Focus on Learning	Computer-based	Probabilistic
Battelle's Basics	✓	✓		✓	✓
Computer driven Simulations	✓	✓	✓	✓	
Decision Strategies International	✓	✓		✓	
Global Business Network	✓	✓			
Soft Creative Methods Approach	✓	✓		✓	
SRI	✓	✓			
The French School	✓	✓		✓	✓

Table 2.4 A choice of deductive and trend-based methodologies

Our intention is to produce a literary product that can be used as a tool for learning by challenging the mental models of the readers, as well as it can be used for strategic decision making. Consequently, methodologies which purpose lies in the process of teaching fall outside the scope of this thesis.

Without any practical experience, it is hard to see the implications of the different procedures. However, we believe that there is no scenario walkthrough that can guarantee correctness, and at the bottom line it is up to the developers whether they succeed. As with qualitative research, construct validity will only be attained if the correct variables are used and internal validity depends on the ability to draw correct casual relations (Yin, 1994). What process can guarantee that all influential variables are considered when working with the future of wireless, and which application can assure the correctness of cause and effect thinking? Guidelines and walkthroughs are just tools, good or bad, and they will never be absolute. To know "What to do" seems more fundamental when dealing with complexity in scenario development. Nevertheless, an approach with exclusively managers or experts as a source of information would for us be impractical. The broad spectrum of the thesis would demand a considerable amount of information from experts of different fields. This would claim an amount of time and means not available. It would at the same be impossible to know what kind of information to look for without any previous research. A mixture of both primary and

secondary data may be just as appropriate, if not better. Our choice is therefore further justified by our amount of resources and the purpose of the thesis.

From our point of view, probabilistic methods would be in contradiction with the very nature of scenarios. Probabilities imply a rank between the scenarios, thereby creating quasi-forecasts. This will likely bring attention to the most probable scenario and suppress the importance of the others. The significant purpose with scenarios, preparing for the unexpected by illuminating the same, will be lost when bringing a focus on the expected.

The remaining companies of choice, SRI International and the Global Business Network (GBN), use very similar approaches. The choice between the methodologies was basically founded on the accessible literatures who advocate the teaching of GBN. GBN is an open network of people that practice scenario methodology. Hence, GBN differs from closed traditional consulting companies, which do not want to share their information and knowledge, and offers several publications and guidelines for scenario developers. GBN was founded by Peter Schwartz (author of The Art of the Long View) and has members including Kees van der Heijden (author of The Art of Strategic Conversation and The Sixth Sense). GBN has also benefited from Shell and SRI International in developing methods, adding lots of real life experience into their methodology.

2.2.7 Method of the Global Business Network – step by step

In ”The Art of the Long View”, Schwartz (1998) offers a checklist to use as the basis for developing scenarios, as described below. This is the core of the GBN approach and the steps are usually similar for many scenario methods, compare for example The European Commission’s methodology, SRI, TAIDA by Kairos Future or The French School.

We will in the following describe the steps of the Global Business Network, and our application of the same. The thesis will follow the methodology and is consequently structured with these steps in mind.

Step 1: Identify focal issue or decision
The first thing to do when developing scenarios is to decide a relevant issue or decision (Schwartz 1998).

Our subject of interest is as declared the wireless industry. The focus is consequently wide and implies broad scenarios. Broad scenarios are related to the world at large, i.e. are not company or situation specific (Schwartz 1998). There is also another way of looking at the same issue, sometimes more comprehensible, when thinking of scenarios. Imaging that you are about to spent a fortune in 3G applications. What will then jeopardize the return on these investments? Is the future as evident as believed? The answer will become clearer when developing scenarios, and allow a better foundation for a decision.

Step 2: Key forces in the local environment
Listing the key factors influencing the outcome of the scenarios is the subsequently step, e.g. facts about customers, suppliers, competitors, etc (Schwartz 1998).

A first part of this step was completed as we defined the problem and purpose of the thesis. We carried through an extensive information gathering by examining articles on the web and in newspapers, magazines, scientific journals along with other university publications. The

outcome of this initial research was the model in figure 1.1**,** which brings a focus to forces within the elements of technology, market and strategy. However, the model is not considered to be complete, and it will be questioned as new information is collected. In part four we will go into detail about the different key forces. This will be attained by further analysis of both secondary and primary data.

Step 3: Driving forces
The third step illuminates the forces behind the micro-environmental factors identified in the second step. These driving forces in the macro-environment consist for example of social, economic, political, environmental and technological forces (Schwartz 1998).

As shown in figure 1.1**,** we have chosen to incorporate the factor governmental regulation. According to several authors, e.g. Anderson, 2002; Garber, 2002; Gannon, 2001, this factor will have great impact on the future of the wireless industry. As with the key factors; the driving force will be analyzed in depth later on.

Step 4: Rank by importance and uncertainty
The next step includes ranking of the key factors and driving forces on the basis of two criteria: the degree of importance and the degree of uncertainty. The point is to identify the two or three factors or trends that are the most important *and* the most uncertain. Schwartz (1998) argues that you should separate certain factors from uncertain by looking for slow changing phenomena like demographics, constrained situations and inevitable collisions. This will exclude the factors in the top row of figure 2.3. However, the disclosure of unimportant factors and the ranking of uncertainties and important factors are left to the subjectivity of the authors. Consequently the step is much determined by the knowledge of the subject and the mental models of the developers.

Answers to these questions will also be searched for in articles and sought-after through interviews. The result will be accounted for and displayed in a matrix in chapter 8.

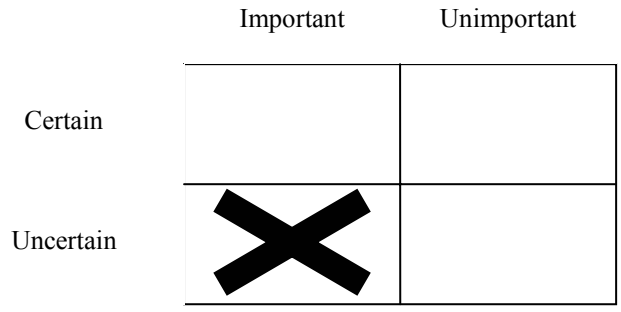


Figure 2.4 Critical Uncertainties

Step 5: Selecting the scenario logics
To explain the future, scenarios use logics that describe how the critical uncertainties might plausibly behave, based on how those have behaved in the past. Some of the critical uncertainties will work together, correlate, and make a logical path for a scenario, a pattern. Other drivers will independently form a possible scenario. This insight is needed to give the scenarios internal consistency and coherence. The purpose of this step is to play with the set of issues until they are reshaped and regrouped in such a way that logic emerges and a story can be told. The point is not to encompass all possible variations of the scenario drivers, but to focus on logic in the themes and plots of a story (Schwartz 1998).

A foundation for the logic behind our scenarios will be strategy theory, which will be presented in the following chapter. The possible outcomes of the critical uncertainties will also be defined through our research.

Step 6: Fleshing out the scenarios
While the logic distinguishes the scenarios, fleshing out the scenarios is accomplished by returning to the key factors and trends identified in steps two and three. Each key factor and trend should be given some attention in each scenario. The pieces should then be woven together in the form of a narrative (Schwartz 1998).

The result of this step will be complete scenarios ready to correspond to the purpose of this thesis.

Step 7: Implications
This step allows a comparison between the focal issue and decision with the developed scenarios. How does the decision look in each scenario? What vulnerabilities have been revealed? If the present strategy only looks good in one of several scenarios, then it is a high-risk gamble. The strategy may have to be adapted or several options for the future may be considered (Schwartz 1998).

This step will not be practiced in our thesis. As declared in our purpose so will the scenarios make a foundation for future research and we have not committed to answer a specific decision.

Step 8: Selection of leading indicators and signposts
The final step is to select leading indicators that will signify that actual events may be unfolding according to a developed scenario. This will facilitate “last minute” preparation for the consequences described in the scenario (Schwartz 1998).

The limited amount of time prevents the research project from further follow-ups why this step is ignored.

2.3 Credibility of the scenarios

The credibility of scenarios has much to do with the developers understanding and knowledge of the field. Without any background knowledge, scenarios can take any imaginable turns. For example, a military preparation for eventual threats from underground or the moon may be seen as appropriate for the ignorant. In contrast the initiated would probably see it as sheer

madness while exercises for eventual air, water or ground assaults would be considered more realistic. As shown in figure 2.3 knowledge will delimit the range of the believed and make the scenarios more realistic.

How is it then possible to judge the knowledge of the authors? Yin (1994) argues that in qualitative methods, *construct validity* depends first of all upon using correct variables and method of measurement. Second, *internal validity* depends on the ability to draw correct casual relations, while external validity considers the possible extent of generalization. Accordingly, construct validity in this thesis depends on ability to perform the methodological steps 2 – Key forces in the local environment and 3 – Driving forces, while internal validity concern step 5 –Selecting scenario logics.

As with qualitative research is it not possible to assign a definite proportion of credibility to scenarios when subjective choices and believes about variables and logics are the determinants in scenario building. Instead it is important to present a documented process that facilitates for the reader to make his/her own judgment of how the author has developed reliable scenarios. We believe that in scenario building this is truly important considering it might be impossible to grasp a possible scenario without seeing the path making it probable. The pathway is further of great importance for learning about the future as well as it is a prerequisite for making strategic decisions. Consequently, our ways through the methodological steps are described throughout the thesis. We present the chosen variables in detail, their internal coherence and their impact on the scenarios. Thus our knowledge and the process towards the scenarios are transparent for the reader.

However, in contrast to qualitative research, scenarios methodology does not deal with generalization, i.e. external validity. Scenarios do not either try to attain a certain degree of probability. This is due to the deliberately incorporation of uncertainties and the acceptance of multiple possible pathways. Consequently, in scenarios it is rather necessary to reveal the possibility of different futures than try to ensure the most probable one. Hence, it is not as important as in qualitative methodology to guarantee the extent of reliability achieved from primary and secondary data. Scenario planning has thus a greater need of a broad scope of qualified believes than a narrow and deep.

2.4 Data collection

In order to achieve unexpected, but possible scenarios, we aimed to consider a huge variation of qualified believes and opinions. The goal was to gain a broad picture and a satisfactory insight in the possible shapes of the future of wireless. Hence, primary data was gathered from spokesmen for different technological solutions as well as from objective experts. Even an interview with a professor within the field of cognition science was conducted to adopt a new approach to the subject. Due to the vast amount of articles written on the subject of wireless, secondary data also made a big contribution for the understanding of different perspectives. The use of secondary data was also essential for the development of relevant questions for the empirical study.

2.4.1 Primary data

Our primary data is essentially gathered from 8 numbers of individual interviews. However, a conference, "The Future of Wireless", initiated by our tutor, Professor Allan T Malm contributed as well.

The conference was conducted by Allan T Malm and Nils Rydbeck from Lund Institute of Technology, and took place the 11th of December 2002. The topics for the debate was structured according to our thesis in three parts; Technology, Market and Strategy. Our purpose was to document the conference with tape recordings and by notes. These helped us eventually to compose a summary of the key issues discussed during the conference. The summary of "The Future of Wireless" is referenced further on in this thesis.

The principal attitude at "The Future of Wireless" was in favor of 3G, as well as the predominant view in the published literature. The critical part of the press made us however consider that a big part of the business might be blinded by a dominant logic. Maybe, they could not see, or did not want to see, the possibilities of a threat against the future of 3G. To reach further beyond the convention, we reached for additional sources of information. An extensive search was at that time conducted to find suitable respondents with different mindsets.

The information needed was achieved through e-mail surveys and semi-structured interviews, both in personal and by telephone. E-mail surveys were followed up when necessary while semi-structured interviews made it possible to obtain some degree of focus while it, at the same time, allowed some digressions (Andersson, 1994). The procedure made it feasible to achieve information and touch topics that were not considered in advance. Further details about the conducted interviews are not considered important for the purpose of this thesis. As explained, scenarios deal with the mere existence of possible futures rather than the probability of a certain one. The reliability of primary data is consequently not an important issue. References to the results of the interviews will be made in the following chapters and under the appropriate headlines.

As a part of the collection of primary data, one of the authors, also visited the Comdex 2003 exhibition in Gothenburg. The result from the interviews conducted is not directly referred to in the thesis, but is used to improve the storyline in the final scenarios.

2.4.2 Secondary data

There is an extensive amount of articles written upon the subject of wireless. Our information gathering included articles in newspapers, scientific magazines, Internet forums, etc. Further contributions to the thesis include company white papers, research documents and previously published master theses. This information is used accordingly in the different methodological steps.

2.5 The number of scenarios

Scenarios tell multiple stories. The number of scenarios used may vary dependant on topic and several authors have different arguments for the ideal numbers.

According to Ringland and Schwartz (1998, 1998) the number of scenarios should be limited to four. The disadvantage with using more scenarios is that they begin to blur and lose their meaningful distinctions as decision tools. The authors also dissuade from using three scenarios since people usually identify one of the three as the "middle" or the "most likely" scenario. The implication is that they will treat the scenario as a single forecast, which will erode all the advantages that derive from using a multiple-scenario methodology. If three is used, the third had to follow a different logic/perspective than the other two. However they also see implications when using two scenarios. The two might not capture reality and they tend to become both extremes of the same line of thinking: the worst case scenario and utopia. Consequently the ideal number is four, but other constellations may be appropriate if the disadvantages are considered and eliminated.

According to Wack (1985), more than three scenarios becomes unmanageable and the ideal number "is one plus two; that is first, the surprise free view (showing explicitly why and where it is fragile), and then two other worlds or different ways of seeing the world that focus on critical uncertainties".

Van der Heijden suggests that more than two stories, but fewer than five, are particularly helpful because they: "1) reflect the uncertainty inherent in the future, 2) allow a multi-disciplinary approach to developing and discussing theories about the world, 3) present findings in a tangible real-world context, and 4) use a casual mode of thinking, which is intuitively comfortable (Chermack et al, 2001).

We will due to these insights use four scenarios. This approach will hopefully avoid the indicated pitfalls through the creation of awareness in the process of developing scenarios.

2.6 Time horizon

Scenarios are broad-based, not point-in-time projections (Chermack et al, 2001). It is therefore hard to give a fixed horizon for when the scenarios will take place. However there must be a suitable span of time considering that the world in year 3000 will have changed more noticeable then what it will until 2005.

The scenario horizon must also be suitable for the issue at hand. Short time investments may use scenarios considering the future in 5 years or less, while the choice of an academic degree may demand a future view in maybe 40 years.

Considering the speed of technology developments we figured the appropriate time to be around 2010. The period of time will allow refinements of the technologies as well as a public acceptance. Thus, we do not consider any new technologies to emerge in the period. Consequently, close to 2010 it might be clear whether any described technology dominates the market, coexist as complements with other technologies or is out of competition.

2.7 Outline of the thesis

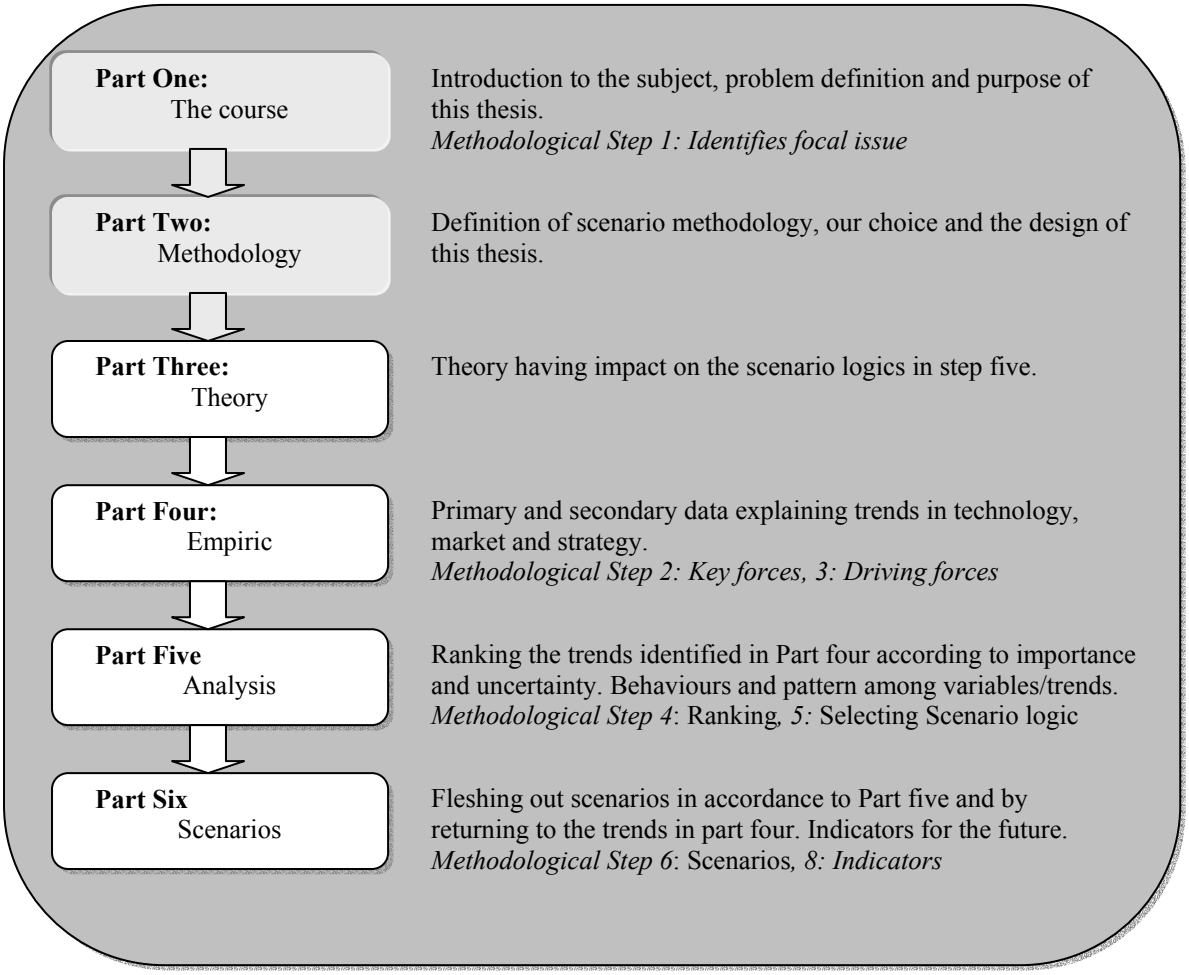


Figure 2.5 Outline of this thesis

- Part Three -
Theory

24

3. How can we analyze trends of today?

We have chosen theories based on the premises that they should help us explain the development of present trends concerning the mobile Internet market, in order to make the scenarios more trustworthy. Therefore, we have looked into theories that can assist us in understanding why a certain technology, or standard, in competition with others, may attain a dominant market position. We also looked at theories that can explain how a new emerging technology may replace the present dominant technology.

3.1 Why does not the best always win?

In the year 1976 two arch rivals stood up for one of the greatest standard wars ever in history, the battle of the Video Cassette Recording (VCR) market (www.sony.com; www.jvc.com). On the one side was Sony, on the other JVC. Each had launched their own VCR system, Betamax and VHS, and both where very keen in securing a convincing advantage in the VCR market that was about to explode (ibid). The Betamax format had a technological advantage over VHS (www.jvc.com). The image quality was better and it had more features (ibid). Nevertheless, in 1988 the battle ended, Sony ceased production of the Betamax format and began producing VHS systems (ibid). VHS was the established standard and today there is more than six hundred millions VHS system in use world wide (www.videocopycentre.com).

Figure 3.1 An American magazine for video enthusiasts features a thorough comparison of the VHS and Beta systems. (www.sony.com)

How could this course of event take place? How could a technologically inferior system defeat a system that by all means was more advanced? Based on some economical theories, within the field of strategy, we will provide a framework that will help answering those questions.

3.1.1 Path Dependency

The path a technology takes in its evolution is often distinguished by a phenomenon called "path dependency" (Schilling, 1999). Path dependency implies that relatively small, random and historical events may have great impact on the final outcome (ibid).

An example of path dependency is the development of nuclear power. There are three types of nuclear reactors: light-water, heavy-water, and gas-cooled. Of the three, light-water reactors are the ones least suited for civilian power use; the other two offer significantly fewer chances of a meltdown. But almost all nuclear power plants today are of the light-water type because of an accident of history. The first organization to use nuclear power was the U.S. Navy. In 1949, they chose light-water reactors for their submarines, because they were smaller and they

had the most research and development behind them, meaning they could be put in action the fastest to meet the Soviet threat. However, neither of these considerations was important in the design of civilian nuclear power plants. But because General Electric and Westinghouse had experience with light-water reactors, and the production lines where already present, they became the natural choice.

Path dependency may inflict inefficiency and non-predictability. As shown in the above example, there is no guarantee, from a long term perspective, that the most efficient technology will win, even though the individual choices are rational. The elements of randomness and chance make the situation even more complex. Knowledge of drivers, preferences and technological developments is not necessarily enough to predict the market outcome and path dependency thereby causes non-predictability (Arthur, 1994).

3.1.2 Increasing Return to Adoption

When a certain technology begins to be adopted by the market a number of self-reinforcing feedback effects are triggered. These effects cause the technology's functionality to progress, making its market attractiveness improve. These effects, commonly referred to as increasing return to adoption, are the source, and magnifier, of path dependency (Arthur, 1994). They may give an early technology, or widely deployed technology, an advantage over its competitors that is practically impossible to catch up with, until the day the technology is rendered obsolete. (Schilling, 1999).

A theoretical example of the consequences path dependency and increasing return to adoption could creates is illustrated in the table 3.1.

Adoptions	0	10	20	30	40	50	60	70	80	90	100
Technology A	10	11	12	13	14	15	16	17	18	19	20
Technology B	4	7	10	13	16	19	22	25	28	31	34

Table 3.1 An example of increasing return to adoption payoffs, among homogeneous agents, (Arthur, 1994)

Both technology A and B show increasing returns. The first agent chooses the more favorable technology A (has a payoff of 10 instead of 4). This improves the incitements of choosing A when it gets even more favorable, 11 instead of 10 in payoff. Therefore, the next agent will also choose A. This continues, with A chosen every time, on the behalf of B. The end results in A totally dominating the market, and B is excluded. If the payoffs increase at the same rate for both technology this development would have been path-efficient. However, if there is a discrepancy in the increase rate, as in table 3.1, the development may be path-ineffective. In the case at issue, after 30 adoptions, all A, the equivalent adoption development, but with B instead of A, would have a resulted in a higher payoff. (Arthur, 1994).

A more concrete example of path dependency and increasing return is the Hollywood based film industry. Around the turn of the century, several filmmakers in Hollywood produced some high-quality silent films. Soon ambitious filmmakers were moving to Hollywood because of its reputation of making good movies, increasing the incitements for other filmmaker to also choose Hollywood. To make movies anywhere else became difficult, due to a shortage of supporting services, experience and talent. The same thing is true of making airplanes in Seattle, autos in Detroit, and book-publishing in New York. (www.korpios.com).

Path dependence and increasing return to adoption creates an inflexible market, which may get increasingly locked-in to an inferior technology (Arthur, 1994). To break the pattern requires group action that involves a high level of agreement, commitment and energy. The ones that could pull off such a task are state governments. For example, the Swedish government currently examines the possibilities to move from using all Microsoft compatible applications to use open source applications such as Linux (www.idg.se, 10/2-03). These are incompatible with Microsoft software, and it would create enormous efforts, and money, to re-configure all concerned systems.

Increasing return to adoption can be split into three major categories of effects; learning curve effects, signaling effects and network externality effects. (Shilling, 1999).

3.1.3 Learning curve effects

As a technology is used, it becomes further developed and is made more effective and efficient. From a corporate perspective firms becomes better skilled in using the technology, resulting in a more productive use, and in most cases, development of an organizational context which improves the implementation of the technology. At the industry level, as more firms adopts the technology, refining it, developing complementary products etc, the attractiveness of the technology, for other firms, increases (Schilling, 1999).

3.1.4 Signaling effects

Even though neither network externalities or learning curve effects does apprehend to a certain market, the size of the install base may influence a technology's chances of being adopted as a domination standard. The size of the install base may serve as a signal to other potential users regarding the quality or value of a technology, especially when these attribute are uncertain or hard for the potential user to measure. (Schilling 1999).

The size of the install base may also send strong signals to developers of complementary goods. If producing the complementary goods requires special recourses, or if there is a cost associated with customization of the complementary products to suite different platforms, producers of complementary goods may choose to support only one technology platform. Since a larger install base equals a larger amount of potential users, the developers of complementary goods are more likely to chose the platform they perceive has the largest install base. Moreover, if there are uncertainties about which technologies that will succeed or fail, the size of the install base may serve as an indicator of the technology's chances of success. (Schilling, 1999).

3.1.5 Network externality effects

In a market characterized by network externalities, the user's benefits of using a technology increase with the amount of other users of the same technology. The most natural examples of markets enjoying network effects are those that are founded on physical networks, i.e. the traditional telephone system. The amount of utility a user perceives from the telephone system is directly related to the number of existing users, i.e. the size of the network. (Shilling, 1999).

Network externalities may also exist in markets that are not dependent on physical networks. There are two textbook cases describing when this occurs. The first is when a user benefits

from additional adopters of the same technology due to compatibility issues. A user may choose a computer platform based of how widespread the platform is, and not primarily based on its technological performance. Choosing the platform with the largest install base, i.e. the amount of adopters of a certain technology, maximizes the number of computers with which the user can exchange files and other information. Moreover, the user's training and experience of that particular computer platform may become more valuable as the install base increases. If the user must invest both time and money to learn a certain platform, the user will probably choose the one he/she consider being the most widespread. (Schilling, 1999).

The second case is when a user benefits from additional adopters of the same technology due to the importance of complimentary goods. Many products are only functional when there are complimentary products available, e.g. videotapes for VCRs, software for computers and films for cameras. Products enjoying a large install base are more likely to attract developers of complementary products, increasing the benefits of the particular product. Since the availability of complementary products will influence the buyer's choice among competing technologies, the availability of complementary products will affect the size of the install base. As the size of the install base impinge on the availability of complementary products a phenomena Shilling refer to as a "virtues cycle" has developed, see figure 3.2. (Schilling, 1999).

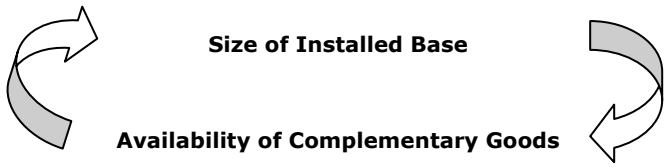


Figure 3.2 (Schilling, 1999)

Shilling exemplifies the power of the interaction between the size of the install base and the availability of complementary goods with the story of how Microsoft came to completely dominate the operating system and graphical user interface market. In 1980, IBM was looking for an operation system to bundle with their computers. They first approached Digital Research and their CP/M system, at the time the dominating operating system, but they did not sign. Why Digital Research turned IBM down is still today a great mystery eagerly debated in computer circles. (Schilling, 1999).

Since IBM was already doing business with Microsoft, they contacted Bill Gates, the founder of Microsoft, and asked if he could provide IBM with an operating system. Gates accepted and created MS-DOS, which quickly achieved a large install base as the customers demand for IBM or IBM compatible PC's was huge. Microsoft later used its dominance to also take control of the market for graphical interfaces, by creating Windows, a graphical shell to sit on top of MS-DOS. (Shilling, 1999).

Parallel to the work with MS-DOS and Windows, Microsoft put great efforts in ensuring that compatible products were developed for the both the applications. Simultaneously to making in-house development, they encouraged third party developers to support the platform. (Schilling, 1999).

Through the great install base and availability of complementary products the users of MS-DOS and Windows enjoyed network externality benefits. This enabled the platforms to lock-out several potential competitors completely out of the market, there among IBM themselves and their operation system OS/2, that actually was more technologically advanced than the, at that date, current version of Windows. (Schilling, 1999; http://www.mit.edu).

3.2 Driving forces of network externalities

The size of the installed base and availability of complementary products are two elements reinforcing network externalities. However, there are also four underlying forces making out the very foundation of network externalities; expectation of agents, co-ordination of agents, compatibility and switching costs due to incompatible technologies (Yang, 1997).

3.2.1 Expectations

When customers purchase a product they have at least some expectations of what the product will do for them. However, in markets characterized by the presence of network externalities, it is not expectations directly related to the product that is most important. Instead, the key issue is the customer's expectations about the ultimate size of the network (Katz and Shapiro, 1986). Customers are interested in which network that has, or will have, the largest amount of users, i.e. the largest installed base (ibid). This is not very astonishing considering the above discussion about the installed base and complementary products.

3.2.2 Co-ordination

When a consumer purchases a product enjoying network externalities, there is always a risk that the majority of other customers will chose another product in a different network, resulting in the first customer not enjoying the network externalities that comes with belonging to a large network. This problem is created by the fact that users normally can not co-ordinate their choices. (Häglund, 2002)

3.2.3 Compatibility

Compatibility between products occurs when the cost of combining them to generate services is zero (Economides, 1996). Most products are compatible with other products within the same network, meanwhile incompatibility is characterizing products within different networks. When people are belonging to the same network, the demand for compatible products increases.

3.2.4 Switching costs

Switching costs, in this context, is the costs occurring when shifting from one network to another. The switching costs create barriers surrounding the networks and causes noticeable look-in effects. (Häglund, 2002)

3.3 There are no guarantees that the best always win!

Several conclusions can be drawn from the above theories. However, we believe maybe the most important lesson learned is that there are, at markets being subject to increasing return to adoption conditions, no guarantees that the best technology, from a performance perspective, will also be the dominant technology. In history we have seen several examples of inferior technologies defeating superior ones. We started this section with the Sony vs. JVC standard war example, and established that JVC won the battle in spite of technological inferiority. We also asked ourselves how this course of events was possible. With help from the theories at hand, and some additional Sony vs. JVC case information, we will explain the outcome.

The Sony down spiral originated from the licensing of the technology. JVC was faster in licensing its technology to other developers and manufactures, making the technology more easily available. Even though Sony also licensed its technology, JVC was faster off and managed to achieve a slight advantage in the install base size. As JVC's market shares increased, the producers of pre-recorded videotapes began adjust their product line, resulting in an increased availability of complementary goods supporting VHS. Even though it initially was no great difference in supply, rumors soon spread, warning consumers that the selection for Betamax was somewhat narrow, in comparison with VHS.

These two events, resulting in a larger install base and availability of complementary goods in favor of JVC and the VHS format, created a virtues cycle magnifying the current trend. On top of this, in 1979, Sony received a lawsuit from Universal Pictures and Disney. They argued that manufactures of VCRs where infringing on the copyrights of producers of movies and TV series. The lawsuit named only Sony, and not JVC, that went by unaffected. Even though the verdict was in favor of Sony, this event may have had consequences for Sony's marketing and customer's perception of its brand. Perhaps this reinforced the already negative trend, which ultimately led to VHS being the dominant standard.

When reading about path dependency and increasing return to adoption it may be tempting to draw the conclusion that these two strategic realities create markets where the development is impossible to predict and where the present firms are victims of the circumstances. How could firms act effectively when the situation today is dependent on historical events, which consequences, at that date, where to a large extent unknown and the expectations of potential customers and their ability to co-ordinate their choices had a major influence on the development. However, the Sony vs. JVC case shows that other elements, possible for firms to influence, also play big parts in forming the future. Sure, there where some elements of chance, e.g. the lawsuit, but JVC's timing in licensing its technology was of much bigger magnitude.

Schilling argues that there are several ways a firm can affect its situation (Schilling, 1999). Even though the learning curve effects are very difficult, some say impossible, to create in the absence of an existing install base, there are several strategies firms can use in order to increase their network externalities and signaling effects (ibid). The firm then has opportunities to reap learning curve advantages, as the install base and availability of complementary goods groves.

Schilling discusses further on how corporate strategies could be shaped in order to stimulate the increasing return to adoption effects (Schilling, 1999). Timing, inter-organizational linkages, diffusion vs. protection of proprietary standards, marketing and promotions are all

examples of tools firms can use in order to improve its likelihood of success on markets being subject to increasing return to adoption conditions (ibid). However, even though we consider the issue interesting, it falls outside the scope of this thesis, and we will not examine it closer.

3.4 The diffusion theory – determinants of market take-off

The diffusion theory concerns the market diffusion of innovations at a society level, in contrast to adoption theories that treats adoption of innovations at an individual level. The diffusion theory takes it starting point in the so called S-curve, which is characterized by a sudden large increase in number of adopters, see figure 3.3. (Rogers, 1995)

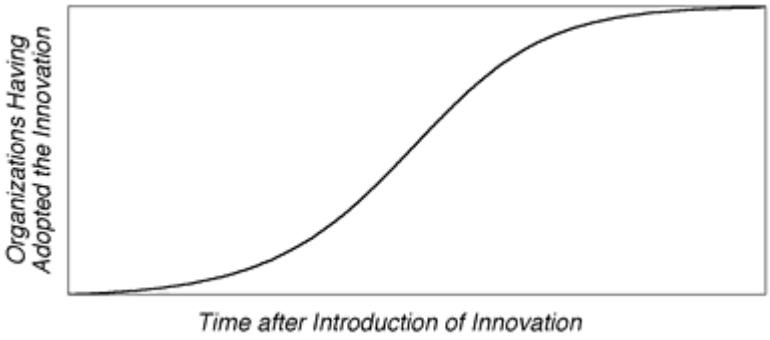


Figure 3.3 The S curve (Rogers, 1995)

Such increase in number of adopters is called market ”take-off” and is the most viable sign of market acceptance of an innovation. To achieve a “take-off” is the primary goal when marketing an innovation. After the “take-off” further diffusion often is a self–sustaining process. (Link, 1997)

The theory states that “take-off” emerge when about 10 – 25 % of the potential market has adopted the innovation. The traditional diffusion theory has explained the “take-off” by interpersonal communications networks (Rogers, 1995). The driving force initiating the sudden increase of adopters is communication of favorable experiences of the innovation from adopters to potential adopters (ibid). A diffusion process may take a considerable amount of time until full market penetration. Malm et al exemplifies with the cellular telephony that existed in twenty years before full market penetration, and SMS that took 5 years from invention to full deployment and use (Malm, Thorngren, 2003).

3.5 Disruptive technologies

Companies compete differently depending on a product’s stage of evolution. At the early stages, when the product not yet has reached the mainstream user’s demands and requirements, the basis for competition is constituted by best product performance (Christensen et al, 2001). Later on, when the technology platform has improved and the mainstream user’s demands are met, the conditions of competition change. The focus moves from performance to convenience, customization, price and flexibility (ibid). The disruptive technology theory illustrates this phenomenon and shows the relationship between technology progress and customer’s ability to use that progress.

According to the theory there are two different performance trajectories at every market (ibid). The first one indicates how much pure performance increase customers can absorb over time; see shaded area in figure 3.4. The second one, illustrated by the two arrows crossing trajectory one in figure 3.4, portrays the performance improvement innovators in the industry create as they launch new and enhanced products. (ibid).

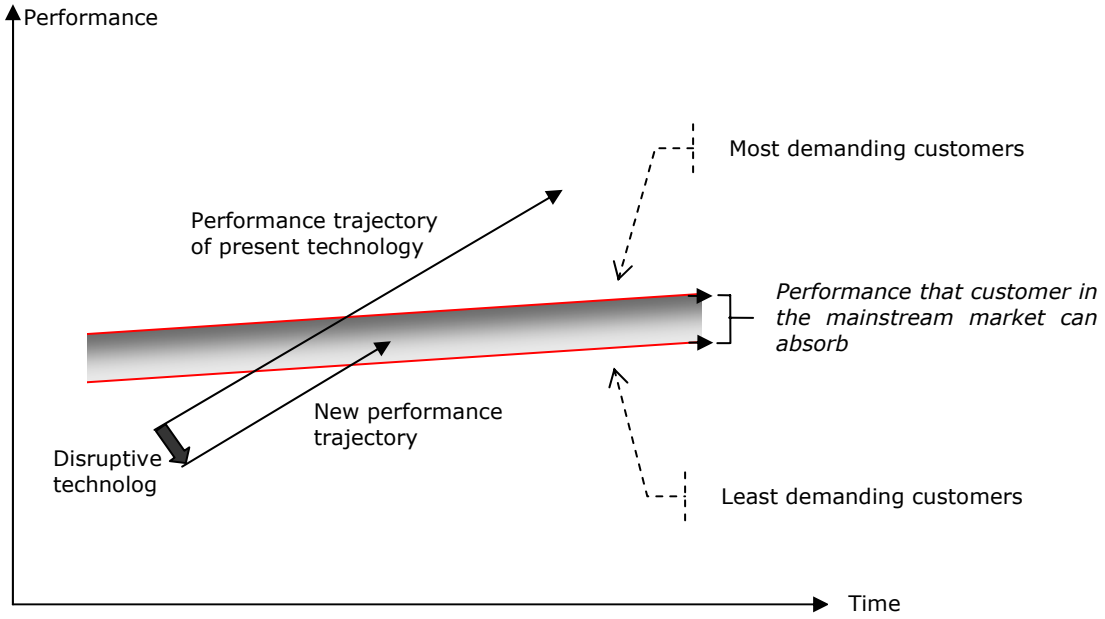


Figure 3.4 The disruptive technology model (Christensen et al, 2001)

The most common situation is that the second trajectory, i.e. the performance of the product, after certain time exceeds the mainstream user's ability to absorb the performance increase. This creates potential for other companies to innovate at other areas and present "disruptive technologies" that are more convenient, cheaper, more flexible etc, but at the same time fits the customer's performance needs, se "New performance trajectory" arrow, figure 3.4.

For those companies possessing the present technology this generates problems. According to the disruptive technology theory most incumbent actors are unaware of the situation at hand. They are so focused on performance development for their upstream market, providing their most sophisticated and profitable customers with cutting edge technology, that they overlook the disruptive elements coming from below. To change competitive focus is not an easy task. It calls for very different organizational structures, both at corporate and industrial level and it may take a considerable amount of time to complete the restructure. Altogether this presents the disruptive technology with an excellent opportunity to establish a strong position on behalf of the present incumbents. (Christensen et al, 2001).

- Part Four -
Empiric

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4. Technology

This chapter gives the big picture of the present and the evolving technologies, ready to take over the wireless communications during the next decade. Special focus is given to the attributes of speed, cost and coverage that will be especially important and affect the experience of users and the profitability of operators and suppliers. This chapter may demand some experience in data or network communications but it can be read without comprehension of the technicalities. For inquiring minds, Appendix; Basic concepts, is for you.

4.1 Telecommunication technologies

Telecommunication technologies include present cell phone technologies such as GSM[1] and newly introduced GPRS, but evolving technologies, ready to make an entrance in the near future, like EDGE and 3G does also make a part. Here, we present the telecommunication technologies that we consider to be of importance in the time span of the future scenarios.

4.1.1 General Packet Radio Service (GPRS)

To make data transmission efficient over cellular systems, a second and a half generation of cellular systems was developed. The different standards enhance the capabilities of the current GSM network. GPRS is one standard being implemented for the moment while EDGE is a technology to come.

The General Packet Radio Service (GPRS) is a non-voice value added service that supplements today's Circuit Switched GSM network, by implementing Packet Switching for data transfer.[2] Packet Switching makes it possible to achieve a theoretical maximum speed of 171.2 kbps over the GSM network with the use of parallel data transmission on all eight timeslots at the same time (Garber, 2002; Buckingham, 2000).

In reality, the speeds of GPRS will be limited by several factors. The number of time slots used for GSM circuit switched traffic at the moment will affect the speed of GPRS data traffic. GSM speech will always have priority over GPRS traffic in order not to reduce quality of service given for regular voice conversation (Buckingham, 2000; Siemens Press, 2002). However, to guarantee some minimum quality of service for GPRS users, some timeslots will be dedicated to GPRS transmission. Further, the amount of data sent by multiple users at the same time limits the transmission speed of the individual user. The currently achievable data-rate is about 40-50 kbps (Siemens Press, 2002).

The use of Packet Switching also gives the advantage of immediacy. No dial-up modem connection is necessary and information can be received immediately. Immediacy is a very

[1] Appendix 11.2.1
[2] Appendix 11.1.8

important feature for time critical applications such as messaging and remote credit card authorization where it would be unacceptable to keep the customer waiting for even thirty extra seconds. The packet switched feature is also commonly referred to as "always connected".

Cost
The use of Packet Switching implies a more efficient use of scarce radio resources and means that users can share the same bandwidth simultaneously. The spectrum efficiency of GPRS reduces the costs of service by serving more customers and by diminishing the need of idle capacity that is only used in peak hours. The Packet Switched network architecture is considered a major improvement. However, the GPRS standard demands only a minor upgrade by network operators needing to add a couple of new infrastructure nodes and some software upgrades (Gannon, 2001).

Coverage
The fact that GPRS is a relative simple update of the GSM cellular networks makes it likely that coverage will eventually be the same as for GSM cellular system. This will make the technology almost worldwide accessible.

Roaming
There is a probability for a high degree of roaming as the technology is an enhancement for GSM operators which already has many roaming agreements. However, there are initially problems with payment models etc, which makes agreements difficult between operators (Northstream, 2002a).

4.1.2 Enhanced Data rates for GSM Evolution (EDGE)

Further enhancements in data capability over the core GSM network will be provided with the introduction of Enhanced Data rates for GSM Evolution. EDGE was initially developed for network operators who failed to win spectrum licenses (www.mobileipworld.com, 2001). EDGE gives the incumbent GSM operators the opportunity to offer data services at speeds that are near to those available on 3G networks.

By complementing the use of Gaussian Minimum-Shift Keying (GMSK) with a new modulation scheme[3] called Eight-Phase-Shift Keying (8 PSK), EDGE will provide theoretical speeds up to 384 kbps by using the existing frequency spectrum and the same timeslots more efficiently (www.mobileipworld.com, 2001; Garber, 2002; Gannon, 2001). However, as for all wireless data technologies the actual data rates available are reduced as a result of network planning, terminal capabilities and capacity dimensions. With ambitious network dimensioning and four available timeslots the actual downlink data rates can reach approximately 150 kbps, whereas less network investments typically lead to 60-100 kbps (Northstream, 2002d).

Costs
The benefit of speed with EDGE technology has its trade-off in price. EDGE is more expensive than GPRS to deploy through the demand of a hardware upgrade at each and every base station (Gannon, 2001).

[3] Appendix 11.1.7

Coverage
EDGE uses the same 8 PSK scheme for modulation as 3G, which makes the technology a potential upgrade towards 3G by implementing the changes in advance (Gannon, 2001, www.mobileipworld.com, 2001). However, Northstream (2002d) believes that an intermediate step is only useful if there is a sufficient time interval between the availability of EDGE and W-CDMA technologies. Consequently GSM operators with 3G spectrum will not benefit extensively from launching EDGE prior to W-CDMA. EDGE can yet also be used as a stand-alone technology, primarily for those operators lacking a 3G license. But currently, very few GSM operators in Europe and Asia remain without, which could make EDGE a niche technology (Northstream, 2002d).

Roaming
EDGE is a part of the GSM/GPRS family which already has an extensive network of roaming agreements. It is thus likely that roaming will be given where there is coverage (Northstream, 2002d).

4.1.3 Third Generation (3G) of cellular systems

Today, cellular telephony is migrating from the present second generation (2G) of GSM systems to a completely new generation of telephony combining voice and high speed data transfer, the third.

3G promises transmission speeds of up to 2.05 Mbits per second in stationary applications, 384 kbps for slow-moving users and 128 kbps for users in vehicles (Garber, 2002). This augmentation in speed will come by an increase in channel bandwidth from former 200 kHz in the GSM system to 4MHz, usage of smaller cells etc. The current speed in the first commercial networks is yet only 384 kbps (Ahlbom, 2003b). But according to the research manager at Ericsson, the ambition is to eventually reach 10Mbps with the implementation of HSDPA, High Speed Downlink Packet Access (Ahlbom, 2003b).

Many observers question the performance of 3G. For example, AT&T's Lab's division manager of broadband-wireless-systems research, Paul Henry, predicts that a typical 3G user will get performance of only 54 kbps. The cause of limitation is that voice conversation will demand resources and that interference from other cells will cause channel errors (Garber, 2002).

Cost
Governmental auctions of the 3G spectrum made many companies pay substantial sums. For example, Vodafone bid $6 billion for a single U.K license and U.K raised $32 billion in its auctions (Gardner 2002). The desire to participate in the 3G market whatever the costs was leveraged by the IT-boom and the financial rise in the late 90th.

Some countries, e.g. Sweden, did not auction off their licenses for money. Instead they raised beauty contests, based on requirements for coverage and speed. However, in some countries the beauty contest was more an auction with only one criterion: vast coverage. Consequently, those who did not pay huge amounts for licenses committed themselves to large expenditure on coverage.

In addition to the high costs paid for licenses, market analysts say that it will cost probably as much to build the 3G infrastructure. 3G uses smaller cells than the 2G because the range of

radio transmission reduces with the higher frequencies used. Also, 3G systems use modulation and power management techniques that needs more base stations and transmission towers.

A recent research by Björkdahl and Bohlin (2003) at Chalmers University pointed out that the aggregated 3G network investments in Sweden will be 2.65 billion Euros. The authors also claim that the sum can be substantially lowered to 2.07 billion Euros by network sharing in rural areas. The network investment is in the research defined as "all equipment necessary for the mobile operator to roll out a technically functioning network with national coverage, in agreement with the Swedish 3G license conditions". Maintenance, future upgrades and replacement investments are not included in the definition, nor are specific investments included to promote the network in a market sense.

By dividing the sum over an estimated population of 8.860.000 inhabitants and over the present 15 years of license duration we got the aggregate investment in Sweden per capita and year to be 19.9 Euros. However the estimates vary greatly and Björkdahl and Bohlin points out that McKinsey present roughly six times higher investment levels. The figure 4.1 provides a comparison between the estimates of aggregated Swedish 3G network investment per capita per year over a 15-year and a 20-year license period, respectively, according to McKinsey and Björkdahl & Bohlin.

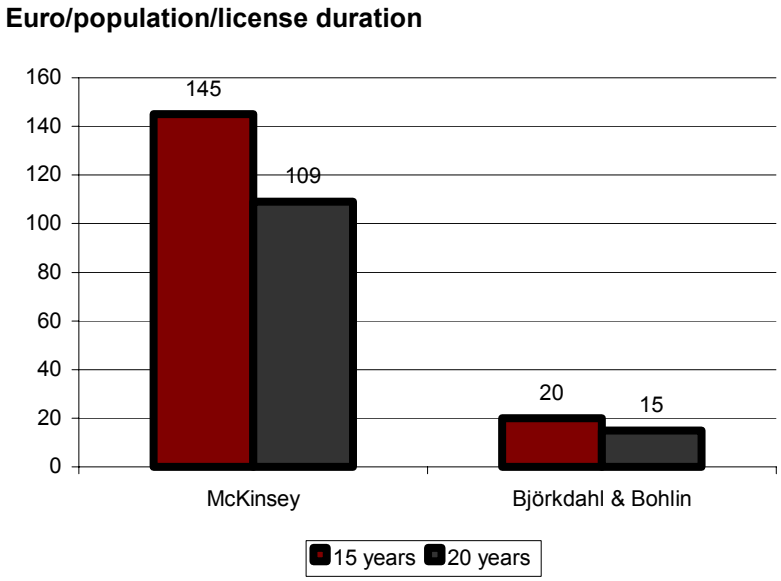


Figure 4.1 Note: McKinsey also provides an estimate on total cost of supply, including replacement investment, but this raises the Swedish figure to almost double the figure above. Investment not adjusted by discount rates. (Björkdahl and Bohlin, 2003)

Björkdahl & Bohlin does also make an international comparison between the level of investment in Sweden, Germany and the U.K. In the estimate, the Swedish license duration is extrapolated to 20 years to facilitate comparison. Figure 4.2 compares the network investments per year and per capita in Sweden, Germany and the United Kingdom (including any applicable license fees), for an average operator during the entire license duration.

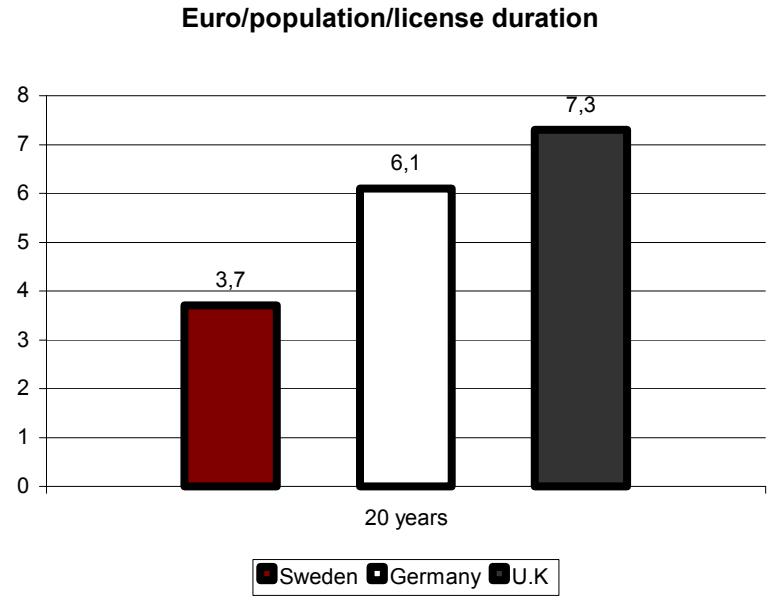


Figure 4.2 Note: The license duration is formally 15 years in Sweden, 20 years in Germany and U.K. However, PTS has announced that the license period can be extended for five years, after an application from the license holder. Investment not adjusted by discount rates. (Björkdahl and Bohlin, 2003)

Considering that Sweden is by many seen as an expensive country for 3G deployment, due to the agreement upon coverage together with an unfavorable environment; sparsely-populated areas, woods, mountain etc. so does the findings by Björkdahl and Bohlin show different. The principal reason for the lower investment costs in Sweden is seen as a lack of high license fees (Björkdahl and Bohlin, 2003). But despite the advantage, countries like Germany and U.K have more potential customers, why they will easier attain high revenues if 3G becomes a success.

Today, many companies are facing great financial pressure, as a result of diminished assessments of 3G's likely financial returns. Revenue forecasts made in 2002 are approximately 25 % lower than those made in 2001 (Northstream, 2002a). The companies reduced credit ratings, will make the structure of capital more expensive and may even endanger their ability to get loans to pay for the purchases (Garber, 2002; Northstream, 2002a; Gannon, 2001). The high fees paid for the licenses and the costs for the enlargement of the network may force the companies to charge consumer high fees for 3G services, which could discourage demand.

Coverage

The cost of implementing 3G can have effects on the degree of coverage. It may be restricted to urban areas because it will not be economical to install 3G in large rural areas. However, companies who have paid license fees will exploit all areas if there is any change of revenues or a possibility to gain a competitive advantage.

Those regulators that practiced beauty contests will in contrast demand coverage according to contracts, usually between 90 and 100%. However, if this rate of coverage is going to be realized depends upon the operators' financial situation and the future expectations on 3G's return on investment.

Roaming
The third generation comprises three primary multiplexing standards: Wideband Code-Division Multiple Access (W-CDMA), CDMA2000 and Time Division CDMA (TD-CDMA). The CDMA technology does not, in contrast to the TDM[4] technique used by GSM, divide a channel into sub channels by using timeslots. Instead, CDMA carriers multiple transmissions simultaneously by filling the entire communication channel with data packets coded for various receiving devices.

Universal Mobile Telecommunication system **(**UMTS) is the global standard set by the International Telecommunication Union (ITU) to replace GSM. UMTS supports W-CDMA why most of Europe and Japan have settled on the technology. The United States is working with all three major standards, but AT&T, a leading U.S carrier, will work with W-CDMA, which could make it the dominant global 3G technology (Garber, 2002). TD-CDMA will probably be used in China, where the specification was developed.

ITU will standardize services throughout the world and provide a roadmap for upgrades. The set of standards are under the banner of International Mobile Telecommunications 2000 (IMT-2000). The standard work is also managed by the third generation partnership project (3GPP). 3GPP is a collaboration agreement, which brings together standards bodies for developing the standards for W-CDMA (www.nokia.com, 2002).

The work of 3GPP and ITU enables 3G-network interoperability. The adoption of a single standard will make seamless roaming possible, even internationally. However, there are several obstacles and seamless roaming is not a matter of course.

4.2 Radio Wave technologies

4.2.1 Wireless Local Area Network – w-lan

The Wireless Local Area Network is a development of the wired Local Area Network (LAN), operating in the same manner except for the non-presence of wires on the client side. By means of a w-lan card connected to the user's laptop, stationary computer or other devices i.e. a PDA, access is given to a specific LAN (ibid). The connection is established as long as the computer is within the operating area of an access point, which is today, indoors, about 100 meters in all directions. If the access points are overlapping in coverage a user may go from one access points to another, a so called handover, without a connection breakdown. The access point handles the communication between the wired server and the wireless device, see figure 4.3. The server provides the user with different kind of services, i.e. an Internet connection or file access. (www.wlana.org).

[4] Appendix 11.1.6

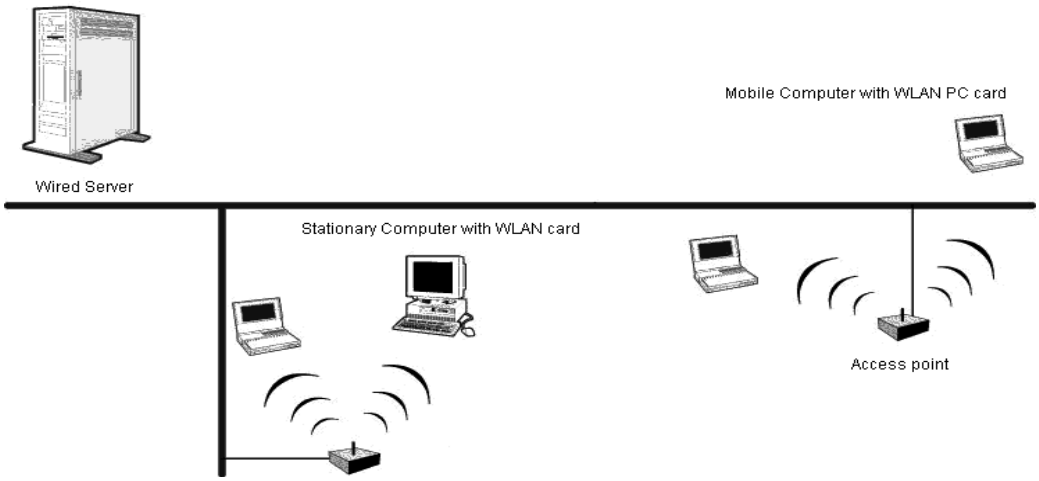


Figure 4.3 The architecture of a w-lan network. (www.wlana.org)

Most w-lans are also able to function without an access point through a so called ad hoc connection. That is, a point-to-point connection, directly established with another w-lan enabled device, see figure 4.4. (www.wlana.org).

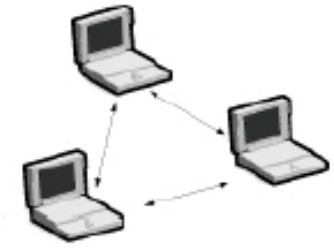


Figure 4.4 A w-lan ad hoc connection (www.wlana.org).

The w-lan technology is, in relation to 3G, a quite heavy power consumer and is therefore best suited to be implemented with stationary computers, laptops and perhaps PDAs.

Today, w-lans are most likely to be found within firms as a successor or complement to their wired nets. There is also a trend towards home implementation of w-lans as the number of households having more than one computer steadily are growing and with that the demand for an easy solution to connect these computers.

The "Hotspot" concept

The newest field of application for the w-lan technology is the so-called "hotspot" concept. A "hotspot" is a location that provides a wireless Internet access to people with devices supporting w-lan. The "hotspots" are being built in strategical areas, such as airports, hotels and coffee shops, where people could be in need of an Internet connection, e.g. for receiving and sending e-mails, reading news, downloading music or perhaps connecting to the corporate network. They are normally operated by a WISP (Wireless Internet Service Providers), e.g. Telia Homerun, but private persons are also able to set up public hotspots, for example in a

park outside their home. Of course, the private networks can not measure up to the commercial ones in terms of speed and capacity. (www.80211-planet.com)

Coverage
The "hotspots" coverage will be limited in comparison to cellular nets. As discussed above they will be concentrated to strategical, densely populated areas. If the user leaves such area he will not be able to connect to the Internet by w-lan. This gets consequences for the mobility aspect when the "hotspot" concept consequently can not offer seamless coverage. If a user move from one "hotspot" to another he must, in most cases, accept a connection breakdown. This is an issue probably impossible to solve, when using w-lan as sole mobile Internet platform, because it is rooted in the very fundamentals behind the "hotspot" concept; to offer a fast Internet connection, at a reasonable price, with services available at certain strategically chosen areas.

Standards and speed of communication
There exist many different standards for the w-lan technology. In a "hotspot" context the dominating one is the commercially called Wi Fi standard, or in technologically terms, IEEE 802.11b. It is communicating with a maximum speed of 11 Mb/s in the unregulated 2,4 GHz band. In addition, there also exists a development of 802.11b, the 802.11a standard. It communicates with a speed as high as 54 Mb/s in the 5 GHz band. Which band the different standards use may for the uninitiated be considered as a small technicality. However, it is of great importance for the possibilities to spread the technology. The 2,4 GHz band is, as mentioned above, unregulated, meaning it is free for everyone to use. The 5 GHz band on the other side is in most countries regulated and prohibited to use commercially. This has a significant impact on the chances to form a common international standard and roaming between countries. (www.wlana.org)

Cost
The Wi Fi technology used for "hotspots" is quite mature, which means it is rather inexpensive, widely available, generally interoperable across manufacturers, well accepted by the market, and standardized. This, together with the use of unlicensed spectrum and consequently avoidance of license costs, makes the "hotspots", relatively 3G, inexpensive to deploy.

The deployment of a complete commercial "hotspot" amounts to about 3000 USD and the price/Mb transferred amounts to between 0,2 and 0,4 US cent in comparison with 3G that has a cost of between 3 and 38 US cent for every transferred Mb.

A w-lan card, used in order to w-lan enable an end user's laptop or stationary computer amounts to about 100 USD (www.datorbutiken.se).

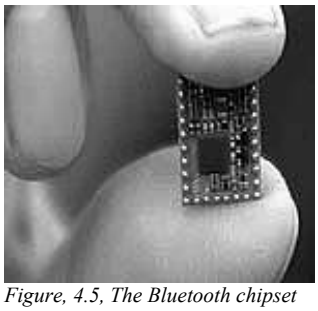
Roaming
There is one major issue concerning the "hotspot" concept and roaming; roaming between different operators. The very idea of "hotspots" are mobility, or perhaps more accurately, portability (see chapter 7 for more about mobility and portability). The user will not accept being tied up or locked out from one area due to his operator's lack of coverage. Therefore, if the operator can not offer ubiquities coverage, it will probably be necessary for operators to collaborate in order to solve the roaming issue. This evokes two new concerns that have to be solved. First, how will the operators split revenues and second how will the user in an easy way authenticate himself when entering another operators network? Both these issues are

currently about to be solved. For example, about 50 different WISP and w-lan vendors have formed a platform for collaboration, “Pass-One”. The idea is to make it possible for subscribers to easily roam between and log in to different operators networks. (Crabtree, 2002; The Shosteck Group, 2002).

4.2.2 Bluetooth

Bluetooth is a global de facto standard for wireless connectivity. It is set to revolutionize the personal connectivity market by providing freedom from wired connections. It is a specification for a small form-factor, low-cost radio solution providing short distance links between mobile computers, mobile phones and other portable, and non-portable, devices. (www.bluetooth.com; www.smarthomeforum.com).

Even though booth Bluetooth and w-lan are wireless radio technologies they differ in most aspects. W-lan is much faster and has greater range. Bluetooth on the other hand is inexpensive to implement, very small and easy too use, for an illustration of the Bluetooth chipset see figure 4.5. It does not demand any configuration and automatically finds other Bluetooth devices. It is capable of establishing ad hoc connections, but also to make use of a Bluetooth access point if necessary. It handles both circuit and packet switching, and consequently support voice calls without the use of IP telephony. (www.zdnet.com).



Figure, 4.5, The Bluetooth chipset

The Personal Area Network

With these qualities, Bluetooth is positioned as a platform for building Personal Area Networks (PAN). A PAN allows devices to work together and share each other's information and services. It could, in a very simple form, consist of a Bluetooth connection between the user’s laptop and printer, where the laptop automatically establishes a connection as the user comes near the printer. A more advanced one could consist of a Bluetooth enabled mobile phone or PDA with which the user controls the home lightning, heating, stereo and television system. The Bluetooth device could also be integrated with the home phone system and, through a Bluetooth access point, automatically recognize the presence of the wired telephone net, and when possible access it instead of the cellular net. (Intercai Mondiale, 2002).

In addition to PANs, there is the mobile PAN concept; a communication device e.g. clipped to the user’s belt could contain a GSM or 3G transceiver that communicates with the wider world. Meanwhile, the same device has a Bluetooth transceiver that communicates with the user’s other Bluetooth enabled devices such as a headset, a PDA, or/and a MP3 player, allowing all these devices to communicate with each other and the larger world. A mobile PAN can also serve a more specific purpose, for example allowing a surgeon and other team members to communicate during an operation. (www.oreillynet.com)

The mobile PAN concept is perhaps, from a Bluetooth perspective, the most promising one when it has a whole new field of application in comparison to 3G and w-lan and really makes use of its qualities.

Other fields of application

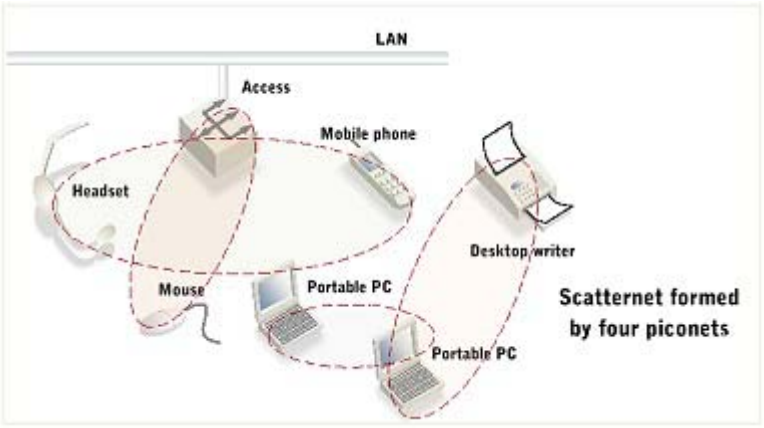
Bluetooth is also thought to be a part of the technological platform that digitalizes and facilitates everyday tasks. Bluetooth qualities, such as auto configuration, size and

implementation costs make the technology suitable for e.g. ticket handling, e - wallets and digital keys. (www.osopinion.com).

Bluetooth can also be used as a simple wire eliminator, e.g. for a cordless mouse or keyboards or as a temporary ad hoc connection between two laptops exchanging e.g. address information. (www.bluetooth.com).

Coverage
A Bluetooth network, also known as a Piconet, see figure 4.6, allows interconnection of eight different devices. It operates in a default radius of ten meters, possible to increase up to 100 meters if increasing the power output. However, with the battery capacity of today, it is not practically feasible for small mobile devices, such as e.g. cellular phones. (www.oreillynet.com)

Up to ten Piconets can overlap to form a Scatternet, linking up to 80 Bluetooth appliances (www.oreillynet.com)



Figure, 4.6 A Bluetooth Scatternet

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Speed
Bluetooth communicates with a theoretical speed of 1 Mb/s. However, in practice, the communication speed is lowered to a maximum of 721 Kb/s. The actual speed is depending on interferences from other devices operating in the same spectrum, e.g. cordless phones, microwave ovens and Wi-Fi equipment. (www.bluetooth.com; www.smarthomeforum.com)

Cost
The Bluetooth chipset (se figure 4.5) used by manufactures to Bluetooth enable their products amount to between 10 and 20 USD (Intercai Mondial, 2002; www.oreillynet.com).

If an end user wants to Bluetooth enable some of his equipment that was sold without Bluetooth features it amounts to between 70 and 200 USD, depending on what kind of devices. (www.datorbutiken.se)

4.3 General technological issues

This section will give further details about technological issues that are independent of the bearer technology.

4.3.1 Handsets

Handsets are more becoming a hybrid between a regular PDA and a cell phone, so called smartphones (Future of Wireless, 2002). PDAs will initially incorporate voice functionality and cell phones will have features like the ones currently available in the PDA.

Concerning wireless data communications; GPRS is today not only restricted to the present cell phones. Vodafone's agreement during 2002 with Dell and IBM that implies that PDAs, laptops and other equipment from the manufactures will be preinstalled for connection to Vodafone's GPRS network (Lieberth, 2002b).

Intelligent Roaming

Intel has developed a technology called "Intelligent Roaming". Intelligent roaming manages users' network connections enabling them to seamlessly roam from network to network depending on how and where they are using their mobile PCs. It will let users seamlessly switch between w-lan, 2.5G and 3G mobile systems without even knowing it happens (www.intel.se. 2003). National Semiconductors is a company that works with a similar solution. Their technology will automatically find different available connections like 2G, 2.5G and w-lan and connect to the cheapest or the fastest, depending on the user's criteria (Inghe, 2003).

Hence, in the future may the handsets not be bound to a certain bearer, and using automatic detection and connection will always make sure that users are connected to the most appropriate network. Consequently, the matter of choosing a handheld will not be a choice of bearer; instead it will concern issues like processor performance, price, functionality, design and size of display. This implies that the characteristic of the networks gets even more important.

Price

Filip Lindell, senior manager of wireless strategies at Ericsson, means that 3G terminals are complex and expensive to manufacture why initially they are going to be expensive (Lindell, 2003). But as with most physical products will handheld prices fall by increased product volume (Lind, 2001). The dominant costs will instead be in network maintenance, service and physical infrastructure as masts, buildings and cables (ibid.). A consequence, according to the common opinion at the Future of wireless, is that most handhelds will become a commodity. Revenues will instead lie in services and software (Future of wireless, 2002).

Battery Performance

Battery performance is considered a bottleneck for mobile technologies because of distance and display power consumption (Lind, 2001; Future of wireless, 2002). Advanced application like streamed movies, television or videoconferences will consequently not be possible before there is battery capacity for receiving large amounts of data over some distance during reasonable time (Future of wireless, 2003; www.3g.co.uk). Today, Japanese subscribers are enjoying less than a days' use before the 3G handset dies (Scuka, 2002). Who will then watch video clips when it kills the battery even faster? A solution on the battery problem may be

methanol driven batteries. They last four times longer than today's rechargeable batteries and are even physically smaller (Eriksson & Hammarbäck, 2002).

4.3.2 Security and health issues

This section will treat general security and health issues concerning all wireless technologies that have been described in this chapter.

If not convincingly solved, these subjects have the ability to undermine the public trust in wireless technologies and thereby deter the development of wireless communications.

Wireless technologies and security

There are four main purposes striving for when protecting wireless networks. From a user perspective, to prevent an unauthorized user to listen to the subscribers traffic, e.g. intercepting and reading e-mails, and prevent unauthorized utilize of a subscription (user authentication). From a network owner's perspective, to charge the right subscriber the right amount of money and protect the network against intruders. (www.oreillynet.com)

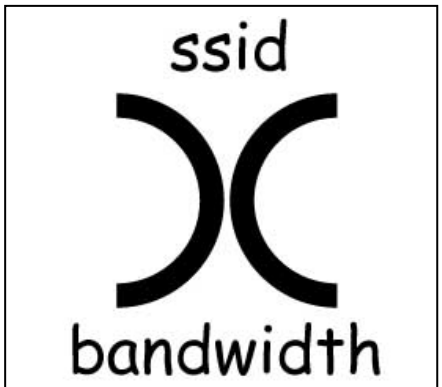

Figure 4.7 The war chalk symbol for an open w-lan access point, with no encryption.(www.wifimaps.com)

If the network owner can not provide a reliable and trustworthy solution to these issues it will be hard to attract customers, especially when most services today are targeting the business segment, for which security matters are very important. For example, one explanation to the failure of Metricom, an early WISP, was the inability to guarantee the safety of their wireless net, which resulted in corporate users many times not allowed to access corporate data and thereby was the use of the network severely limited. (The Shosteck Group, 2002)

Both the 3G and Bluetooth technologies are from these aspects quite secure due to the use of sufficient encryptition when communicating information. In addition, 3G, and older techniques like GSM, uses the SIM chip (see appendix) assuring user authentication and Bluetooth communicates over much smaller distances, minimizing its exposure to potential intruders.

The technology with security problems is w-lan. It has two major concerns. First, the security protocols used with w-lan are rather unsophisticated and relatively easy to break in to. Research indicates that the perceived insecurity of wireless networks is a major inhibitor to further market growth (Viswanathan, 2003). How the security problems affect w-lan depends on the goals and the purpose of the network (www.oreillynet.com). Community networks may be deployed to give away Internet access to the masses, and securing the network from end-user access is not a goal (ibid). At the other extreme, a wireless extension of an Internet based bank service or other financial institution will undoubtedly require strong user authentication to prevent unauthorized users, as well as strong privacy protection to keep information confidential (ibid).

As a result of the w-lan security flaws, web based communities, dedicated to map open w-lan access points, has developed (e.g. www.wirelessanarchy.com, www.wifimaps.com). The

practices are of two categories, war chalkers and war drivers, see figure 4.7 (www.wifimaps.com). War chalkers simply searches cities for open w-lan access points, only using a w-lan enabled PDA or laptop with a special application to find them. When discovering an open access point they mark the building hosting it, see figure 4.7, (www.securityfocus.com). War drivers operate in almost the same manner. The only difference is that they are using a car, instead of walking, and do not physically mark buildings, instead they point them out on a city map (ibid).

Wireless technologies and health issues

The major concern regarding wireless communication and personal health is the perceived possibility that exposure to the radiation emitted from wireless devices could constitute a health risk. The issue gained media attention already in 1993 when a man appeared on the Larry King Live show and claimed that his wife had developed brain cancer as a result of wireless phone use. The law suite that followed was dismissed, there where no scientific evidence supporting the statement. The situation today has not changed much. Although some findings indicated positive correlations between selected wireless technologies and specific health hazards, many other studies found no correlation. (Burell, 2000)

As it appears, the situation is rather unclear. However, from a mobile Internet development perspective, we believe that the most important aspect is the user's perceived health risk, independent of actual scientific evidences. If the health risk is perceived as high it may deter the whole mobile Internet development. This is also supported by Edson who exemplifies with neighborhood resistance towards the buildings of base stations and towers as a direct consequence of health concerns (Edson, 2002).

4.4 Summary

The industry is characterized by a trade off between bandwidth and geographical reach and mobility, as figure 4.8 shows (Lind, 2001).

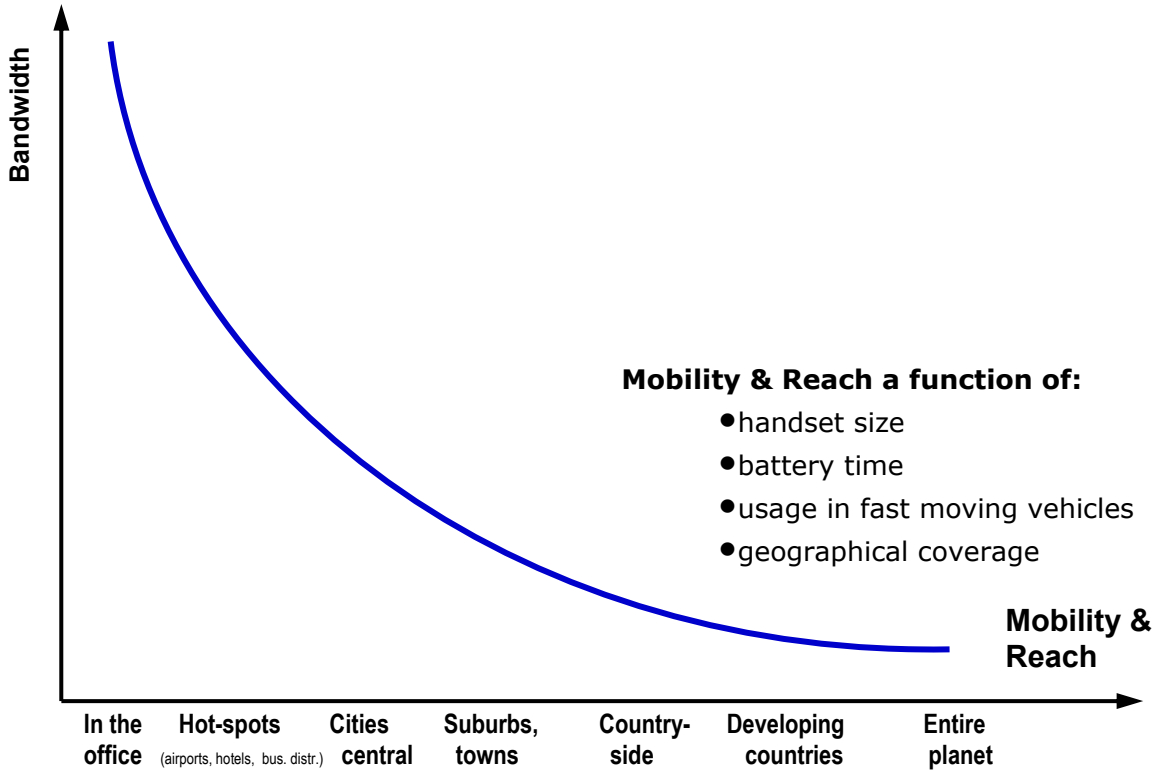

Figure 4.8 Trade off between bandwidth and geographical reach and mobility is a core feature in the industry. (Lind, 2001)

Whereas wired connection is fast but suitable for stationary usage, cellular technologies are at present the ones with most mobility at a cost of speed. Illustrated in figure 4.9.

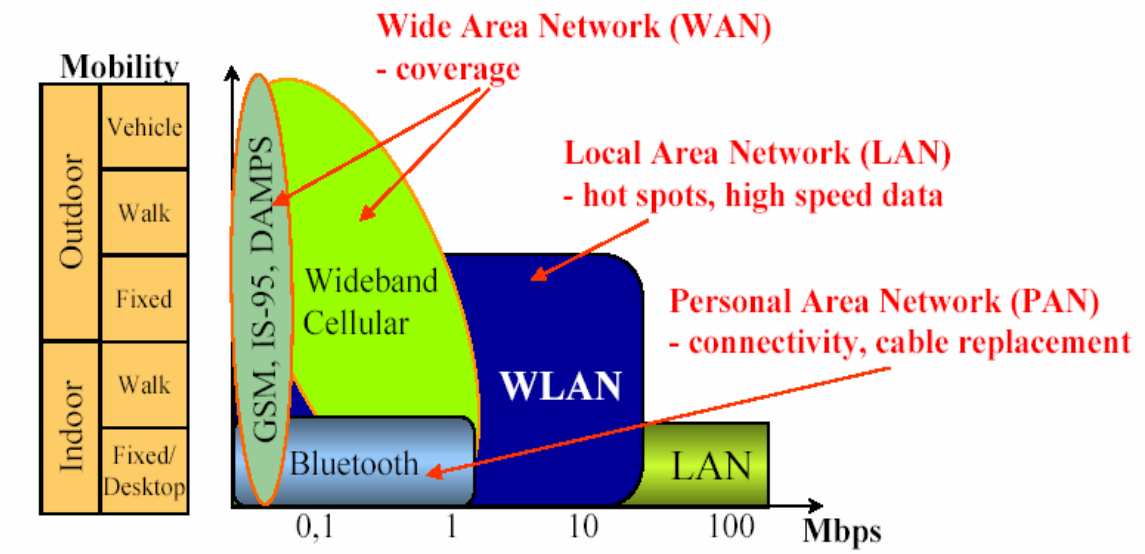

Figure 4.9 Speed and mobility for cellular, LAN Technologies and Bluetooth (Bergljung, 2002)

Table 4.1 summarizes the technological features described in this chapter. The data market in grey is believed to have great influence for future adaptations, why the reader is encouraged to have them in mind for the following chapters.

Attributes	GPRS	EDGE	3G	w-lan	Bluetooth
Speed (actual)	171k (40-50)	384k (60-100)	128-2M (384)	11-54M	1M (721)
Costs	Low	Medium	High	Low	Very low
Geographical Coverage	High	Pending	Pending/Promising	Hotspots	PAN
Roaming	Potential	Potential	Potential	Doubtful	-
Spectrum regulations	Yes	Yes	Yes	Yes/No	No
Commercial handhelds	Cell phones	Cell phones	Cell phones	Lap Tops/PDAs	All devices
Security	High	High	High	Low	High
Battery consumption	Medium	Medium	Medium	High	Low

Table 4.1 Summary of technology attributes

5. Consumer market

As expressed by many authors, the determinants of a technology's success are not in the technology itself (Garber, 2002; Gardiner, 2000; Rangan & Adner, 2001; Ringland, 1998). So, why does the customer not yearn for the best technology available? Simply because there are factors that are considered to be more important, like; price, features, content, brand, etc!

This chapter will enlighten some of these factors. We will analyze trends in user practice along with expectations on future applications. These trends will influence, more or less, which way the future evolves and the success of different technologies. We have combined information from several interviews and research projects, including our own "the wireless future" seminar, to give a comprehensive analyze of the situation at hand.

5.1 Does anyone care for wireless Internet?

Who really wants to connect to the Internet when you are on the move? That is a question many of you might have asked when you first started reading this thesis. However, many people have already used a mobile connection to the Internet since the day modems was built-in cellular phones. This is especially true for businessmen, who maybe connected their laptop to the Internet when traveling by train or when waiting at the airport. And if you think about it, SMS is also a wireless data service. It has nothing to do with the Internet, but SMS is a non-voice application that wirelessly transmits bits of text between cell phones. SMS are now days also sent by servers who deliver advertisements or received by servers who manage competitions and voting sessions. SMS are therefore viewed by many as an indicator of the future success of wireless non-voice applications (Buckingham, 2000). Today SMS continues to grow and has now a penetration level between 55-75% worldwide (A.T Kearney, 2002). In Sweden, more than 36% of the cell phone user has utilized SMS to access content-based services. Between the ages of 16 to 30 is the figure as high as 64 % (PTS T-23157, 2002).

These are not the only factors that indicate a need for wireless services. The use of GPRS in Europe and I-mode in Japan may be even more significant indicators of the markets preferences. In a survey by Accenture (Beal et al, 2001), 99 % of the Japanese respondents said that there was at least some reason to access the Internet from a wireless device. Japan is with a growth from 67 to 72%, the country with the highest penetration of Internet enabled Phones (IEP). Usage is at the same time stable, with around 72% of the IEP owners who have accessed the Internet by their phone. The figures can be compared with Europe's where a major growth from 33% to 45% has gone along with a decline in usage from 25% to 18% (A.T Kearney, 2002). The pending attitude in Europe may presumably be explained by the late deployment of GPRS. Thus, services in Europe are not fully developed or introduced on the market and penetration will consequently demand further time. However, the Japanese market and culture are also different from the European market, making a comparison difficult (Northstream, 2002a). Japan is an overcrowded country with limited space for outdoor activities why electronic gadgets and games usually are seen as a form of leisure activity. The Japanese has also always been high tech freaks who love their communication

devices (Wessman et al, 2002). The European usage rate may thus never reach up to the one in Japan, but it will most probably be higher than today. The figures indicate that: Anyone does care for wireless Internet! However, the possible market penetration of wireless data communication is not clear, and will in much be dependant upon the development of suitable applications, price, speed and mobility.

5.2 A question of speed, mobility, price…

5.2.1 Speed

When confronted with a choice of three possible features of 3G functionality, nearly half of the users in a research by A.T Kearney want fast Internet access for existing information and data services rather than advanced services such as video, pictures and digital music. However, the preference of service differed markedly among age segments, with older age groups preferring fast Internet access over new advanced services (A.T Kearney, 2002). This indicates clearly how speed counts. However, the research does not make clear what services people think is to slow at present. SMS? We believe that people probably are tired of old 56 kbps modems which turn Internet browsing to a long wait. They then compare the alternatives in the reply form and think "No, not more hot features that's not worth waiting for! Give me speed; I rather use basic services as e-mail than waiting for a 'cool' picture".

There are no studies that truly investigate the importance of speed that we know of. But, as experienced Internet users we know that speed is of outmost importance. The speed of the carrier determines the limitations of the application, e.g. high resolution games, moving pictures and sound do not match with GPRS or 56kbps modems. Speed is therefore a relative concept that depends on the type of task performed. The same respondents would therefore probably want new advanced services if they came within fractions of a second. The issue of speed is therefore tightly connected to the application, and will as a result be handled in the passage about content.

- Users want speed. But speed depends on content, why content is decisive!

5.2.2 Mobility

The importance of mobility is another tough issue. The examined technologies show today great differences in their ability to cover both cities and countryside. W-lan will so far only permit connections at hotspots which delimit mobility and capabilities like hands-off and roaming. Cellular technologies have on the other hand the potential to gain world wide coverage through international standardization.

Mobility is for many a key variable that will give 3G a decisive advantage (Future of Wireless, 2002). A comparison can be made with the rivalry between cellular and telepoint in the late 80's (Volant, 2003). Telepoint was promoted as a low-cost portable alternative to the analogue cellular mobile services and offered digital phones that could be used in high-traffic public areas. Although services were launched in several countries few survived telepoint's inability to handle incoming calls, and the need for users to go to specific locations created the perception of a "poor man's" rather than a "low-cost" mobile service. Mobility does consequently seem as a decisive issue, sometimes even when compared with price. However,

data communications is different compared to voice, basically because the matter of speed determines content which in turn adds another dimension to the competition.

Mobility is nevertheless important and will ultimately be reached when a user can connect wherever with whomever. But as declared, mobility today comes with the cost of less speed for a higher price. Will people really pay this price for the extended mobility?

- What is mobility worth for the user?

5.2.3 Price

One of the crucial factors behind the success of a technology is its price. Potential users will always consider the value of any service, and bluntly reject it if it does not come up to expectations. A survey by Post och Telestyrelsen, the Swedish regulatory agency, points out that the primary reason among Swedes for not using a cell phone, is that they do not need it. However one out of three state that it is to costly (PTS T-23157, 2002). Internet enabled phone (IEP) users are also increasingly cost-conscious according to a research by A.T Kearney (2002). They cite high costs, slow access and lack of interest respectively as the primary reasons for not using the Internet capabilities on their mobile phones. The future of wireless is thus much dependant upon the price of its services.

The reason behind the success of Internet has much to do with the almost free bandwidth in the fixed networks (Oliphant, 2002). Today, Internet offers most of its content for free, but buried in banner advertisements, pop-ups, and spam. Nevertheless, there are a number of companies that have tried to charge Internet users just to realize that nobody are willing to pay. Adult sites are currently the only type of online business that generates significant income from paid content. Of the €252 million spent on content by Western European Internet users in 2001, 70% was spent on adult content, with the rest being generated mainly from games, finance and business news (www.paidcontent.org, 2002). According to a Jupiter MMXI survey by Olivier Beauvillain, 47% of European web users would not even consider paying for content on the Internet in the future (Ibid). Give a minute to think about it yourself: what services are you willing to pay for on the web?

But in contrast to Internet, mobile phones seem to be a much better billing platform. The same report from Jupiter MMXI shows that in 2001, €590 million was spent by Europeans for content on their mobile phones, such as ring tones, logos, sports scores and stock prices (www.paidcontent.org, 2002)). This is more than twice the €252 spent on the PC. The figures may indicate that wireless services may have more potential than estimated, when comparing with Internet. Maybe electronic greeting cards will remain a popular, mostly free service on the web, but consumers will actually pay for them on their mobile phones, as they have been paying for ring tones and logo downloads?

Even though it might be easier to charge customers for wireless services, they will not pay whatever price for it. The cost of wireless bandwidth is high, especially for 3G, but also diversified among technologies like GPRS, EDGE and W-LAN. Somehow these operators need to charge for the use of their technology. Subscribers will therefore not just pay for the content, but also for the transport of a carrier. Considering that users are cost-conscious, every technology must then really show that its qualities are worth the price.

Whether the services are considered highly attractive there is also a question of how much money the users can afford spending on wireless data services. The number will roughly indicate the amount of money available for the wireless value chain, and thus constitute a limit for the profitability of wireless technologies. Several participants at "Future of Wireless" (2002) believe that existing consumption of communication services works as a starting point for an analysis.

In Japan, the average NTT DoCoMo subscriber spends as much as €79 per month and the average i-mode user spends €21 per month only on i-mode (Northstream, 2002f). The comparison with Japan is although not unmistakable when the Japanese culture and market has distinctive features. The wired Internet has for example a low penetration level (Ibid), why mobile Internet may take advantage and profit as a substitute. But on the other hand, the value of mobile Internet may also take advantage of extensive Internet use, communication may breed communication. The effects of extensive Internet use are thus not clear. What we do know about the Japanese culture is that they tend to put the needs of the group before those of the individual. This is considered one explanation why communication technology has such a success (Wessman et al, 2002). Europeans have also less income to spend than Japanese, why we believe that the revenues from Europeans subscribers will be less.

The ARPU (Average Return per User) levels are much lower in Europe. The monthly ARPU from cell phone in Sweden has for example declined to €21 in June 2002 (Williamsson, 2002). The difference in revenue between business and private subscribers are most noteworthy, €55 respectively €13. The Swedish ARPU for Internet access during the same period was €16. This makes a sum of €37 that Swedes spends on wireless voice and wired data services. The sum can be compared with the spending on wireless voice and data in Japan. The figures indicate that the Swedish user spends a considerable smaller amount on wireless communication and data services than the Japanese.

However, some maintain that it will be possible to get revenues from services that lie beyond the traditional communication services. This opinion gets support in a report by the consulting group Accenture (Beal et al, 2001) which emphasizes that work we do not even think of as computing or communication will be replaced by wireless data services. An illustrative example may be the talking Coca Cola vending machine that informs its keeper when it is time for refill or when it's out of order. Or consider McDonald's customers ordering food from their mobile devices through a register interface. Yet this usage is on an imaginary level, and what sum companies will pay to incorporate wireless services is so far unknown.

Wireless data services will hence not only reallocate resources from existing communication services. It will create new markets, not only for productivity services like the Coca Cola machine, but also for entertainment services like games, chat etc. Entertainment services, if considered attractive, will reach funds far beyond those of today's communication services. The budget for wireless data services is thus harder to define. Nevertheless, Morgan Stanley Dean Witter estimates that consumers in the US can afford to spend $24-$50 per month for wireless data services based on current spending patterns for communication and entertainment (Qualcomm, 2002). An important parallel can also be drawn with South Korea, a country in which 3G services are currently most developed. There a 2G customer spends only 1.9 Euro, a 2.5G customer 4.6 Euro and a 2.5G customer with a color screen in their mobile 7.6 Euro a month on wireless Internet services (Strand Consult, 2003).

- How will wireless services be valued by costumers?

- How much money will be available for the wireless value chain?

5.3 … And content

Content in multiple forms, e-mail, chat, games, news, etc, is the essence of wireless data services. The promised revenues of these services, has made the cellular industry evolve from a simply telephone service, offering coverage and mobility, to comprise content (Oliphant, 2002). This step has put the established telecommunication industry in competition with the dynamic Internet industry. The big challenge for wireless operators is how to make content attractive and useful for customers to be willing to pay for them (Oliphant, 2002).

Profound understanding of the customers' preferences is crucial when content driven services are to be developed. This includes managing customer expectations while, at the same time, understand customer needs and behaviors (Beal et al, 2001). The history shows many examples where technology has failed due to the lack of appropriate content. "We have to pay for this stuff" was a common reaction to cable TV service in the United States until the 1970s when pay-per-view movies started to appear. What changed the subscribers' perception of cable TV forever was a transmission of a boxing match between Muhammad Ali and Joe Frazier, exclusively to cable viewers (Oliphant, 2002).

The example demonstrates how new and exciting content can change the fate of a technology. The situation has parallels in the mobile phone industry today. We, like numerous of others (e.g Andersson et al, 2002; Turek & Turocy, 2000), believe that the, so far, low market penetration of WAP is a consequence of its unappealing content.

The battle between Internet-based technologies like w-lan, radio routers and telecommunication technologies as GPRS, EDGE and 3G will be truly influenced by the content presented. Internet, however, is built upon content why the industry seem to have a competitive advantage against the telecom industry, which traditionally only had to deal with just voice and simple SMS data.

5.3.1 Richness

Content will only be demanded if delivered for an appropriate price at a proper speed. As explained no one will probably pay for high resolution games or videos if not almost instantly delivered. A three minute long MP3 song will for example take 31-41 minutes to download with a second generation mobile phone at 10kbps. With a speed of 2Mbps (theoretically available for 3G) the same song will take 11 seconds. The fact speaks for it self when thinking of the suitability for MP3s or videos for slow speed mediums. The content consequently needs to be adjusted according to the speed of the bearer.

But will customers be satisfied with services for slow speed carriers? Who wants to pass the good parts? The question is relevant when the answer will indicate the comparative advantage between technologies. May GPRS and EDGE be enough for most of the mainstream applications or is the speed of w-lan necessary to fulfill the need of users? High speed demands might be predicted by observing the penetration of fast speed Internet (Future of Wireless, 2002). In Sweden, ADSL has increased during the last six month by over 40 percent and constitutes 11 percent of the Internet access market (Williamsson, 2002). This

development will probably accustom users of high speed and instant access to video clips, pictures, etc. It might thus be hard to make people, spoiled by their 2 Mb connection, accept a wireless version were the price is more than doubled and the speed is decreased down to a tenth part?

However, the call for fast wired Internet may be a false indicator. First, because you overlook the aspects of mobility, second because you do not consider the pattern of usage. We believe that another and more appropriate clue of the need for data-intense applications might be revealed by observing content preferences among users. The content demanded will then indicate the appropriateness of different bearers. But again, content is not written in stone and new applications will be developed that satisfies user need or that creates a need.

Messaging & Information

Data-based services are better suited for packet switched data due to the irregularity in down- and upload.[5] Packet switching also brings the feature of "always connected" which makes certain services, such as messaging, appropriate. Messaging services similar to PC applications like ICQ and MSN Messenger will bring notice about connected friends and allow for instant messages. In the same way as Internet chat groups have proven popular, communities of interest can also use non-voice mobile services as a means to communicate and discuss (Buckingham, 2000). SMS has today similar range of uses, but with the difference that you have to connect for sending messages. Consequently SMS-users are never truly "online", which also makes messages less instant. SMS also limit the message length to 160 characters which affects the information flow. The high penetration of SMS indicates a need for new, improved, messaging services.

The most common application among IEP users today is e-mail, especially in Japan. E-mail is followed by news and travel that are by far more popular than banking, purchasing and games. Globally, e-mail usage is fairly stable, but unlike SMS, usage is dominated by older age groups in-between 25 and 44, which comprise 92% of all Mobile Internet users (A.T Kearney, 2002). Even though Japan was the first country to launch a 3G network, South Korea has developed the most advanced market for 3G services in the world. According to a report by Strand Consult, South Korea represents the first real 3G lessons in the world (Sutherland, 2002). It is then remarkably that the Koreans are also using their high speed, color screen, Java enabled mobile phones to mostly read and write e-mails (ibid.). What interesting is also that they are using a resident Java-based e-mail client with a color interface that gives the user a more "friendly" experience without unnecessary downloads. The South Korean CDMA 2000 1X network is technically still a 2.5G network offering speed up to 144 kbps, but is running download speeds of around 80 Kbps (www.cellular-news.com, 2003). The network is consequently able to handle more data-intense applications than needed at this time. However, one reason cited for the success of e-mail is that the price is cut by just sending text instead of multimedia and that users are paying for the bits transmitted instead of paying by service or minute.

Text-based services like e-mail and messaging are suitable even for low speed mediums like GPRS. The core of these services is information, which makes text enough for presentation. The amount of data transferred is thus relatively limited and enables for fast downloads even at slow speed. However, slow carriers limit the ability to incorporate advanced attachments, high resolution graphic-based portals or any form of additional make-up that is not stored in the phone.

[5] Appendix 11.1.8

Multimedia Messaging Service (MMS) is an adaptation of Short Message Service (SMS) that allows users to send and receive voice- , textual messages, still and moving images, etc to and from MMS-compliant handsets, e.g. GPRS phones. MMS messages are like SMS not delivered in real time because they follow a "store and forward" model. The MMS system is hence not developed for instant interaction services. If used as an end to end connection between sender and recipient, transmission delays are most likely to occur.

M-Commerce

The definition of mobile commerce or mobile e-commerce vary from those who see it as any commercial activity done using a mobile phone to those who mean direct transactions (Northstream, 2002e). Here we follow the approach of mobileinfo.com. They define M-commerce as:

"any electronic transaction or information interaction conducted using a mobile device and mobile networks (wireless or switched public network) that leads to transfer of real or perceived value in exchange for information, services or goods." (www.mobileinfo.com/Mcommerce)

This includes all forms of product or service ordering or purchasing like purchasing movie tickets, restaurant booking and reservation, mobile payments, mobile advertising, ring-tones, etc. The definition is consequently quite broad, and services such as offering ring-tones has little similarities to developing and marketing a mobile payment solution.

Northstream (2002e) sees two main aspects of M-Commerce:

- *"M-Commerce as an enabler of totally new products and services – this include specific mobile related services such as selling of ring-tones, location related sales, mobile coupons, etc."*

- *"M-Commerce as a new distribution channel for existing products and services – this includes services such as purchasing cinema tickets, buying stock or making bank transactions, etc."*

A third aspect of M-Commerce is also M-Payments (Northstream, 2002c). M-Payments are a category in its own where the mobile device is used only as a payment mechanism.

Northstream (2002e) highlights four major parameters affecting the user acceptance of m-commerce: *Need and benefits*, *usability* and *security*.

It is hard to predict user needs and benefits, especially for new products and services. It is even debatable whether a need for M-commerce really exists. Which services can provide clear benefits in the form of availability? However, M-commerce services can and has already been launched using technologies such as 2nd generation SMS for selling logos, ring-tones, deliver advertisements, payment for parking space and directory enquires. Today, the most common service after e-mail, among IEP users, is news (A.T Kearney, 2002). Usage of MMS are at the same time in most parts of the world focused around downloads of ring-tones and logos (A.T Kearney, 2002).

Usability implies a fit between the offered service and the overall user experience. News and downloads of ring-tones and logos have in common that they are relatively well adjusted for the present 2.5 generation of cellular. They do not require more bandwidth to fulfill their purpose of just pure textual information and download of one graphical logo or ring-tone. In contrast, services that demands more information in order to make a well thought-out purchase, like books, vehicles, CDs, etc. will take advantage of increased bandwidth. Would you, for example, buy a CD or DVD without being able to listen to chosen tracks, see the cover, track list etc. On top of this, consider that without a proper bearer, browsing for different CDs or DVDs would take an unreasonable amount of time. But even if the bearer could deliver data fast enough, would you accept all vital information and graphics to be displayed on the tiny size of a handheld device? Usability is consequently associated with the appropriateness of the bearer, the handset technology, presentation, etc.

When it comes to transferring money, users must feel safe enough to use new services. Risk is only accepted if it involves certain repayment. Like on the stock exchange or in a lottery, users do not want to gamble with their money if it is not worth the risk. The reason why people use e-commerce on the web is because it is considered totally safe or because the limited amount of risk is worth the possibility of getting it cheaper, more convenient, etc. Providers of services or products through M-commerce must consequently reduce the user's liability in case of fraud.

The willingness to use the m-payment mechanism; m-cash (where handsets store money for micro-payments) is quite high. According to A.T Kearney, 2002) 39% respectively 74% of the European and Japanese respondents claim that they would use it if widely available. The functionality is on the other hand only used by 3% in Japan and 1% in Europe. M-payment does not have use of fast bearers though financial information is limited and receipts etc, only need to be based on text. The main issue is consequently not technology but usability and security. Mobile banking, i.e. where you manage accounts and payments, is used in a few countries today, but still mainly to deliver information rather than make transactions (Nortstream, 2002e).

The particulars furnished above make us believe M-commerce to be suitable for products or services that has a limited assortment or can be bought without any visual and textual information that exceed the present capacity of speed. Existing technologies do consequently not pose a major barrier. Our view get some support in a survey by Northstream (2000), where there is a consensus view among experts that services like ordering tickets, banking, seeking information, reading news and sending pictures will have penetrated the market in 2005. Future technologies thus hold the potential to enhance the user experience from M-commerce by adding voice, textual and graphical content. But until these are implemented there is a possibility to make the most out of existing technologies by producing services that are usable, attractive and make commercial sense.

The following sections will discuss the possibilities of new services for m-commerce.

Mobile application download services

Downloadable services will enable customers to browse for new applications on their portable devices, download them over a network and execute them locally (Northstream, 2002b). The big difference with downloadable applications in relation to downloadable pictures, web pages etc, is that you use them several times. Instead of just browsing a website or downloading a map for a one time purpose, you use applications over and over again.

Downloadable applications are nothing new at all. Internet had been used for a long time to download all kinds of clients, updates and patches. Obviously, downloading applications is something users do less frequently than browsing different websites, which will justify longer download times.

Northstream (2002b) believes that future key applications download are:

- *Gaming and entertainment*: horoscopes or gambling clients, erotic services, screen savers.
- *Travel applications*: including maps and location guides.
- *Business applications*: stock tickers, expense calculator, currency converter and world clocks.
- *Corporate applications*: includes corporate access client, sales catalogue, etc.
- *Mobile services*: includes clients for such as messaging, video or browsing.

Application downloads are primary used as a service enabler, i.e. clients like ICQ, Netscape, and Acrobat Reader makes it possible to use services belonging to them. But they can also be used as services in their own right, such as a gaming download service. Applications that act as a service enabler allows operators to attain revenues besides the initial download by bundling downloadable applications with value-added service. The potential of these services has a wide range from such as community features, messaging, skins, etc. This will permit network operators to increase data traffic and tighten their customer relationship.

Online gaming is an excellent example of an enabled service with great potential. It can be used by many kinds of bearers due to that processing is executed locally and that only coordinates and other information about the players are sent over the network. The bottle-neck will thus not be so much in the speed of the carrier, but in the processing power of the handheld device.

Nokia's forthcoming multi- entertainment platform, N-Gage, including a game platform, mp3 player and a cell phone, has gaming in focus. Users will be able to buy games at a local dealer which will make it possible to attain large applications without time consuming downloads. Consequently mobile application download might not be as profitable for the operators as the services surrounding them. Operators must then partner with content providers who have a wide choice of attractive applications in order get revenues by offering online gaming, downloadable levels, characters etc.

Location Based Services (LBS)
The term Location Based Services refers to:

"mobile services in which the user location information is used in order to add value to the service as a whole"
(Northstream, 2001).

By using any Location Determination Technology (LDT) such as Cell-ID, EOTD or A-GPS, the user location is given by X-Y coordinates. This will allow users to find out where they are,

or to tell others their position. According to Northstream (2001), main service categories for LBS include Emergency and Safety, Communities and Entertainment, Information and Navigation, Tracking and Monitoring, and M-commerce.

LBS will for example make it possible to offer maps of the users' position together with near allocated restaurants, gas stations, hotels, cinemas or even friends. Other possible services include traffic information, positioned-based live games, etc. For the business segment, vehicle positioning applications can be used for such as remote vehicle diagnostics and stolen vehicle tracking. Safety applications are also of great importance when you can get the position of people in need, available ambulances, etc. In the US, operators has already been forced to provide subscriber' location data for safety applications.

Advertising or pop-up discount coupons are also an interesting service if based on location. A person entering a mall or who is in the immediate vicinity of a store can receive offers directly to the mobile device. These services have also the potential to be refined by incorporating information about user preferences. User-adapted ads together with a store in the personal surroundings will encourage impulse buying and make it possible to control sales of specific merchandise. In the fist six months of 2002, growth in the use of SMS for advertising messages has accelerated across all regions (A.T Kearney, 2002). Location based advertisements has potential to increase the data traffic, but Peter Gärdenfors (2003), professor in cognitional science at the University of Lund,, also warns that people might find this kind of advertisements pushy, and refuse to be exposed.

Japan is the leader in adoption of Location Based Services, with 25% usage by those owning an IEP phone. Unlike SMS, adoption is consistent across all age segments, demonstrating the mass market potential (A.T Kearney, 2002).

Location-appropriate downloadable applications are used to enhance the content of a location based service. The Arena program (www.cdt.luth.se/projects/arena), funded by Ericsson, Telia, the University of Luleå and others, provides in-depth data, and video about sports events directly to fans in the stands. Their application aims to change the fact that television spectators get better information than people in the stadium. The system will for example send player statistics, replays from several different angles and offer such things as quick polls etc. Another Swedish company, Appear Networks (www.appearnetworks.com), has developed a product that downloads applications to handhelds when they come within a range of a specific wireless network. The system can also uninstall the programs as they leave the vicinity. This can be used to automatically transmit Arenas application to handhelds when entering a stadium and to disable it as soon as they leave. Consequently it can make the application a part of the draw to the stadium (Needleman, 2003).

As with all kinds of wireless services, the richness of LBS depends of speed. However, the position of a mobile device does not demand much information. Common GPS coordinates are usually 60 characters in length, making GPRS and even SMS appropriate to use. But streaming media and advanced downloadable apps will demand much more bandwidth then the current cellular generation supports. One possibility is yet to buy applications, bundles with maps, etc. and just transfer coordinates that makes the service valuable.

Voice over IP (VoIP)
Today, mobile telephony is circuit switched, which implies that there are little or no delays when having a conversation.[6] However fast speed packet switched networks makes it possible to use IP telephony. When two IP-based terminals exchange voice over the Internet protocol it is called voice-over-IP (VoIP). Furthermore if the terminals are mobile it is sometimes called voice-over-IP-over-wireless (VoIPoW).

This feature is today widely used among high speed Internet users by using services incorporated in for example MSN Messenger. The benefits with using IP telephony is that is more or less free all over the whole world, you just pay for the regular Internet connection. The drawback is that it may suffer from delays because transmissions is lost or distorted. But used in a broadband environment and/or with a prioritized Quality of Service (QoS) level[7], VoIP provides almost as good service as the circuit switched network, i.e. regular or mobile telephony (Noréus, 2001). However, every IP packet consists also of overhead, i.e. sender-recipient information, packet order etc. The overload of each packet results in a heavy workload for the network, thus VoIP has low spectrum efficiency, as shown in figure 5.1.

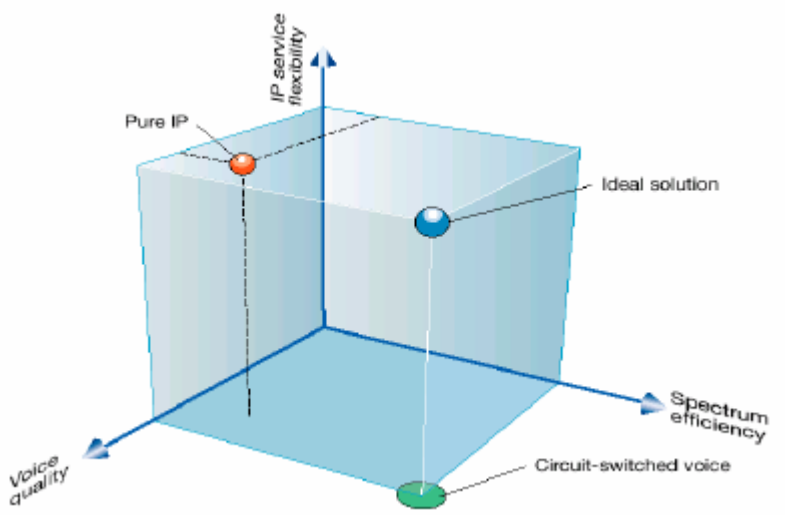

Figure 5.1 (Noréus, 2001)

Despite low spectrum efficiency, even VoIPoW are expected to be more cost effective than circuit switched telephony, especially for long distance calls (www.protocols.com, 2003) Except that IP telephony is cheaper it also comes with "service flexibility", i.e. it is much easier to make applications for the Internet Protocol than for circuit switched networks (Noréus, 2001). While talking, you can for example at the same time send images, graphs or videos to better illustrate your intentions.

Because the delays are affected by the speed of bearer, technologies like w-lan may be appropriate for IP telephony, but probably not 3G and Edge. This is quite a revolutionary function when it allows Internet technologies to override the present and almost monopolistic telephony over circuit switched telecommunication services. The data communication business has always lived in competition and is therefore used to produce fast and specialized solutions. VoIP is by many considered to be a major threat when the services are extended

[6] Appendix 11.1.8
[7] Appendix 11.1.9

and mobility issues etc. are solved (ibid.). In a resent rapport, IDC predicts an increase in sales of IP switchboards during 2003 with 66% (Lövgren, 2003).

There are many companies that try to exploit the opportunities with VoIPoW. Flarion (www.flarion.com) offers solutions based on radio router technology while Optimobile (www.optimobile.se) promotes a solution based on w-lan and Bluetooth.

The evolvement of content
According to Peter Gärdenfors (2003), communication between mobile users will evolve to better imitate the dialog "Face to Face" between humans. This evolvement is already noticeable through the use of pictures instead of just simple text- and language oriented messages. But users have and will at the same time adapt their self to the available technology. Many services today lack several attributes that are evident in a normal conversation, like voice, eye contact, facial expressions, etc. Think about it, even such an advanced service as videoconference lacks eye contact. However, he further claims that a lack of a certain attributes may create a structure of communication that also is coveted. Some people may prefer to be unseen when talking in the telephone and many youngsters takes advantage of not being heard when communicating via SMS. He maintain that this is one reason for the success of SMS but price. The possibility to express oneself without having the need of a real conversation is also important.

However, Gärdenfors believes that, in general, people will make use of every technology that can improve communication and develop the expression of content. In the same way as people has used the increased capacity of PCs to make applications to a larger extent communicate by the help of graphics etc, people will use increased bandwidth to attain more complex and visual attractive services. Consequently over time, the nature and form of the wireless communication will probably, like Internet, get less textual and more visual. It will move from

"text messages to icons and picture messages to photographs and blueprints to video messages and movie previews being downloaded and on to full blown movie watching via data streaming on a mobile device"
(Buckingham, 2000).

Today MMS has already made the move to picture messages, but further graphic intensive applications will demand faster data carriers. Today tested versions of 3G reaches a speed that will not be appropriate for streaming movies. Consequently we will soon see poorer versions with low resolution, small video images. Better version of non-voice applications will demand faster mediums than current cellular technology, such as w-lan or radio routers.

As we have expressed in this section there is a need for many services that do not necessary have to make use of faster mediums than what exists today. But facing a situation, where content makes the only difference, people will probably go for the bearer that can offer more advanced content-based applications. Technologies that have a weak position when it comes to speed must then accordingly take advantage of other variables like mobility, usability, price, etc.

- May GPRS/EDGE be enough for wireless?
- Is the middle course taken by 3G needed?
- Is the speed/mobility ratio of w-lan desirable?

5.3.2 Reach

Internet has made it possible to communicate across the globe. The standardized network has made it unproblematic to connect with a computer in Beijing as in Buenos Aires. Today, we take it for granted that Internet, like the wired telephone, works worldwide.

So how will the mobile Internet work? As explained in the technology chapter, all mobile technologies do not guarantee this feature. The different generations of cellular technologies require upgrades of the existing network infrastructure, and at the same time, new phones are needed to handle the data. Consequently, without either one, a picture sent from Sweden will not even reach its destination in Denmark. Moreover there is a need for an agreement between operators that regulate the payments of traffic. Will the sender pay for all, as with SMS, or will there be a model like the one for voice, where the sender only pays within the country of origin whilst the receiver pays for the remaining part? Even today a MMS picture can not be sent between different operators in Sweden, even though this most probably will change.

It is clear is that content will not reach its optimum value until these issues are solved. For what good are communication technologies if the blazing new content can't be shared? Consider the anecdote about A G Bell which tells that initially he could only call himself, and when calling the line was consequently busy.

Technologies based on the wired Internet do not have the same problem. The Internet network is from the beginning configured for packet-based data, and the terminals are easily upgraded through software applications. The open network is also based on a business model that implies that traffic is paid by connection fees. Technologies like w-lan will consequently have the same reach as wired Internet today.

- How will reach affect user preferences of the technologies?
- Will the drawback with reach be solved, if so, when and to what extent?

5.4 The "Killer App"

The killer application is a service, or perhaps a bundle of services, that will drive the penetration of a given technology. The killer app should be suitable for the technology, boosting its use and give it a competitive advantage over competing solutions. What is common for killer apps is that they are driven by a market pull, i.e. users eager for the applications that new technologies enable (Garber, 2002; Future of Wireless, 2002). The need for a killer app is essential for all bearers of wireless data. SMS, besides voice, is considered a killer application for the second generation cellular phones. Mario Bros was the killer app for Nintendo as Photoshop was for Apple's Macintosh, whereas spreadsheets and word processing was killer applications for the PC. Without those applications these technologies would probably be considerable less successful, if not marginalized.

MMS is by many considered a killer app for 2.5 and 3 generations of telecommunication networks (e.g. Future of Wireless, 2002). But the consultant company Monitor has calculated the value of the European MMS market to €4.3 billions in the year 2006, which is considerable less than the €8.4 billions that the more simple SMS services generated during the last year (Wistrand, 2003). The prognosis is based on the presumption that MMS will take traffic from SMS, and thus not lead to an extensive increase in data traffic for the operators.

The interoperability problems will most likely further hold back the usage of MMS. Adult content is also seen by some as the next killer application. Pornographic has shown its potential on the web and may even yield high revenues from wireless users. However there is a contradiction with porno in public environments when the usual behavioral pattern takes expression in the private. But again, considering that three Spanish politicians was caught browsing adult content during a debate about acts of violence in the home environment, porno might be something of a killer app for wireless technologies.

Ethnologist Truls Erik Johnsen claims that communication and human interaction is the key in killer applications (Hedberg, 2002b). Services like ICQ, which makes it possible to see who is connected or at a meeting, will have the same success for the mobile network as it has on the wired Internet. Services without direct connection to communication between users will at the same time get only a marginal market share.

Nobody knows which one is going to be the killer application for the wireless Internet. But it will for sure have attractive attributes considering mobility, price and content. It is though not certain that it needs to be an application that demands high speed. Take SMS as an example, it does not demand any extensive bandwidth, and is after all a killer application at the same time as high speed Internet penetrates the market.

The need of a killer application seems not that crucial for technologies that can make use of the content on the World Wide Web, such as w-lan (Lindell, 2003). Using laptops with the same screen size as PC's will let the great variety of Internet content be available for mobile users. And Internet per se has already proven its attractiveness. However, making Internet wireless creates an opportunity to enhance services beyond a stationary mode.

Does a killer app have to have an all market appeal? No, we do not think so. In the same way as Macintosh was driven by advertising agencies, a killer application can be driven by different users segment who demand specific applications, tailored for their needs. Some segments will require applications for *saving time*, i.e. make present work easier and more efficient. Other prefers applications for *killing time*, i.e. games and amusement. Killing apps may then be developed for distinctive segments. Nevertheless, in a survey by Northstream (2000), 59 experts were questioned of which a great majority believed entertainment services will generate most potential revenues. The future of wireless will yet be very influenced by different segments, their requirements and their specific impact as driving forces. These factors will be further analyzed in the next chapter.

6. User Segments

This section will give a comprehensive picture of the potential users of mobile Internet. It will show how different user groups have different preferences, demands and expectations for their mobile world. Why should we then care about different user groups? Does it affect the development of today in any direction, or maybe more important, does it contributes to our comprehension of the events that will take place tomorrow? As a matter of fact it does!

6.1 Why bother about user segments?

Historically there has usually been one particular segment that has acted as the driving force behind a new technology or service. For example it was the business segment, or the so called Yuppies, that boosted the development of cellular telephony world wide in the 80th and in Japan it was the younger generation that initially kept i-mode funded with their willingness to pay for entertainment services (Beal et al, 2002). Even though the technology or service eventually will spread to other segments the early adopter segment will in a noticeably manner set its stamp on the content. For example, today teens only account for 7% of NTT DoCoMo's (Japans largest i-mode operator) user base, but still 60 % of the their content is entertainment oriented (ibid). The point is that the driving segment not only contains early users, but also opinion-formers that most probably will influence other potential users in some direction. Thereby they will take an active role in forming the future.

So far we have discussed the driving segment's impact on content. However, the driving segment may also have considerable power in boosting a certain technology on the behalf of other competing technologies. As discussed in chapter 4 different technologies have different strengths and weaknesses. For example 3G has mobility and coverage factors as its major advantages meanwhile w-lan has speed and price. This have implications on how well a certain technology may serve as a bearer of a specific service. If a segment demands services that are very data intensive 3G for instance may not be able to serve that segment in a satisfying manner, resulting in w-lan as the only acceptable option. The opposite is also possible, that w-lan can not fulfill the user's requirements of coverage and 3G, or an older version like gprs, may be the most suitable alternative. The conclusion is that user group's preferences concerning services may indirect influent the future being of existing technology platforms.

Our aspiration is that the classification should be applicable on most of the modern world markets, especially in EU and USA. Therefore we have chosen classification models that are founded on surveys made on the Swedish market. The Swedish market is appropriate from several bases. According to an international study the Scandinavian people represent much of the future values of the whole world (Kairo Future, 2001). This is especially valid when it comes to values related to wireless behaviors.

"*The most highly evolved country in this study, Sweden represents the outer curve of attitudes and behaviors related to wireless use*."

(The Mobiles: Social Evolution in a Wireless Society: Extended Table of Contents, 2003)

In Sweden the penetration level of wired Internet and cellular telephony is among the highest in the world. This gives the Swedish market a rather unique position in terms of practice and technology matureness. The Swedish people are also, together with the Americans, those with most experience of online shopping. All together the values of the Swedish market should serve as a relevant guide for the future preferences, demands and expectations of different user groups independent of national borders (Kairo Future, 2001).

The literature on the subject is quite limited, especially if one is restrained to the Swedish market. We have found two different segmentation models, specific for the mobile Internet market. The first is originating from Kairo Future, a Swedish firm offering research and consultancy services. The second also derives from a Swedish firm, NetLight. They offer a different approach to segmentation for which will be accounted later on. In addition, we conducted an interview with an employee at NetLight, Johan Åslund. He works with user segmentation for the mobile Internet market and had some new perspectives on the use of segmentation analysis as a whole. We also performed an interview with Peter Gärdenfors, who is presented in chapter 5.

6.2 Kairo Future: The mobile users of tomorrow

The Kairo Future report identifies three distinguished user segments (Kairo Future, 2001):

- MOKLOFs (mobile kids with lots of friends)
- YUPPLOTs (young urban professional (parents) with lack of time)
- SALLIES (senior affluent life-lover enjoying a second spring)

6.2.1 MOKLOF

The MOKLOFs are in all ages up to 30 and are most commonly childless. The segment is commonly seen as an early adopter of both new technologies and services. They are interested in almost all new mobile services, but their primary field of application is entertainment and communication services, rather than utilitarian services, e.g. downloading music, play online-games and use videophone abilities, all services that generates quite heavy data traffic and therefore requires a well developed infrastructure.

Most users are somewhat split before the possibility to always stand in touch with friends, family and work. From one aspect they find it positive, but a lot of users also apprehend it as stressful with no moment of complete spare time. This is a feeling quite homogeneous over different user groups. The only exception is MOKLOFs who to a larger extent finds the possibilities only positive and rather perceive it as a mean towards achieving personal freedom and independence.

The MOKLOFs do not value integrity issues as very important. For example, they are open towards submitting personal information to businesses if getting something in return, e.g. better offers or reduced prices. However, they do not trust that firms treat the data in an ethical manner. This suggest that the willingness among MOKLOFs to share personal data is not an expression of naiveté, but rather that they perceives personal information as a

merchandise to use for trade. This will make it easier for the content providers to develop custom-made services that really fit the potential user's demands and requirements.

Overall, the MOKLOF is the group with greatest interest in mobile Internet services. At the same time they are the ones, relative the other segments, with the weakest purchasing power.

6.2.2 YUPPLOT

The YUPPLOTs are in the ages between 30 and 50. They are often well educated with a high income, commonly both working and living in urban areas. As with MOKLOFs they are seen as early adopters, but differ in that they are very price insensitive. They have very high expectations on them selves, their surroundings, and life in general. They want to be the perfect husband, parent, colleague and manager meanwhile developing on a personal level.

In contrast to MOKLOFs, their major problem is lack of time. They are generally very mobile using laptops, cell phones and PDAs and are foremost interested in gaining time, increase their personal productivity and use idle time to keep them updated, e.g. utilitarian oriented services. Examples of services are scheduling tools, news and e-mail services.

Meanwhile the YUPPLOTs primarily sees the new mobile technologies as a mean for saving time they are, in contrast to the MOKLOFs, the ones most stressed by the ability to always bee accessible. They are all at the same time dependent on, entertained by, and resentful to their mobile devices. This is most probably connected to the constant time pressure that the YUPPLOTs live and work under.

The attitude towards integrity issues also differ greatly from the MOKLOFs. The YUPPLOTs generally do not like sharing personal data. However, a bit paradoxical, they have much greater trust in firms and their treatment of the information they receive.

6.2.3 SALLIES

The SALLIES constitute barely 30 % of the age group 50+ in Sweden. They are healthy, rather wealthy and have finished their worse career hunt. The time pressure of YUPPLOTs does not correspond to the SALLIES. Mostly their children have moved and they have a lot of spare time. In comparison with others in the same age group they have noticeably more experience and interest in technology and mobile Internet.

As YUPPLOTs they are mostly interested in utilitarian services, but in another field of application, not that oriented towards business facilitators. Examples of services are electronic surveillance, computerized encyclopedias and different medical services.

The SALLIES are the group that most value and emphasize integrity issues. This could be connected to the characteristics of preferred services that may contain sensitive data. It could also be related to life cycle oriented values that differ from the MOKLOFs who grown up with Internet and the consequences it may have got for integrity subjects.

6.3 NetLight: Female applications for the M-Generation

The NetLight model has a different approach than Kairo Future. First it excludes the segment of older age. Second it adds a new view, the gender perspective. Apart from this they are quite similar. Instead of the MOKLOF term it uses its own definition, the M-Generation, but the sense is the same. The same goes for the YUPPLOT, NetLight simply call them Business users in their model. The key features of the segmentation model are summarized in figure 6.1. As concluded in the figure, the M–generation is oriented towards communication and entertainment, meanwhile the business segment focus on a professional use. This is independent of gender and in conformity with the Kairo Future model.

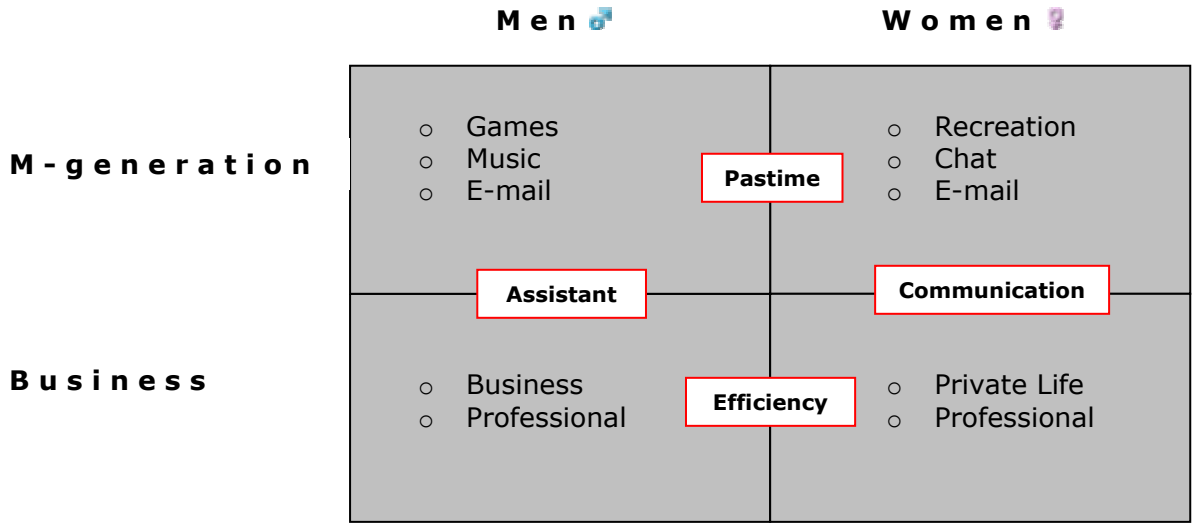

Figure 6.1 Mobile Value - NetLight User Matrix (Eriksson et al, 2000)

According to the model there are some similar purposes, independent of segmentation belonging, behind the use of the technology. For example, men and women in the m-generation have in common that they want to kill time, instead of saving time, and women in both the business segment and m-generation segment are especially interested in the mobile technology as a communication mean, see figure 6.1. Consequently, content developers may address several segments with the same service (Åslund, 2003).

6.3.1 The gender perspective

The gender perspective is quite interesting. Kairo Future proposes in one survey that gender is one factor that may have some importance in a wireless context (Kairo Future, 2001). However, they reckon it as subordinate to age and argue that most services are gender independent (ibid). Therefore they choose not to account for it in their segmentation model. NetLight, on the other hand, argues that the gender perspective is qualified to participate in their model because of its great market potential. They deem that applications existing today are developed by men for men and that women as a group to some extent is neglected (Eriksson et al, 2000). As an example they mention the language used in applications, such as “Ignore” and “Execute”, that not appeal to women. They also referred to the gender biased

language, such as the constant use of “he” instead of ”he or she”. All together they claim that there is a gap between the women’s demands and what the market can offer (ibid). This gap could be used commercially through applications, and devices, customized in order to address women’s requirements (ibid). However, to enable the customization it requires knowledge about women’s preference and demands. Therefore it is suitable to treat women separately in the segmentation model (ibid).

6.3.2 Additional perspectives

Unrelated to a specific segmentation model there are some general perspectives that could be added in order to give a more comprehensive illustration of the market for mobile Internet, and the overall usefulness of segmentation models.

Completion on the Gender perspective

According to Gärdenfors, the differences between men and women’s use of technology are often exaggerated. However, he adds that research confirms some dissimilarity concerning the interaction with devices and applications. Men generally appreciate a more spatial interface than women. This means a very ordered interface, much like those we use today. Women, on the other hand, are oriented towards a more socially adjusted interface. This method include more interaction with the application, such as possibilities to present questions instead of access a specific function through a designated menu. An example of the two interaction methods is the Microsoft Office help function. It can be used in two different manners. Either the user can access a menu, enter a key word and receive a list of related items to choose from, a good example of spatial interaction. The other option is to call for the “Office Assistant”, an animated creature to which the user can ask questions and receive answers about the help issue, see figure 6.2. This method does not involve accessing different types of menus, the user simple click on the assistant and enter a question. This is a typical example of a socially oriented interface. (Gärdenfors, 2003).

Figure 6.2 The Microsoft Office Assistant in action, an example of a social oriented interface.

A new trend - Communities

Mankind has always lived in communities (Gärdenfors, 2003). Until recent, physical meetings and later to some extent the wired telephone has been the dominant contact form. However, today we see an evolution of the communities (ibid). The information technologies have enabled people to easily communicate independent of geographical locations, meanwhile the need for social interaction still standing strong (The Mobiles: Social Evolution in a Wireless Society: Extended Table of Contents, 2003, p2; Gärdenfors, 2003). This has resulted in new forms of online communities where the information exchange has increased and the networks are more extensive, comprehending more people, not necessary ones we have met physically (Gärdenfors 2003). An extreme example of this new community trend is the online gaming world, with hundreds of thousands members participating, see figure 6.3. More modest communities are also grooving stronger. People with the same hobby activities or life situation joining together on the Internet, discussing new ideas and helping each other. (ibid)

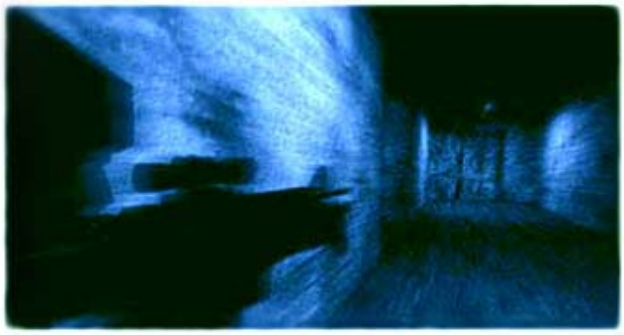

Figure 6.3 The immensely popular online game Counter – Strike with more than 100 000 participants 24/7.

The community trend is to some extent age related. It started off in the younger ages, among MOKLOFs or the M – generation, and is also most spread among that group. For example, the Swedish online community Lunarstorm has captured the attention of more than 60% of Sweden's 15-25 year old population (Rheingold, 2001). However, according to Gärdenfors, this will almost certainly change. Already today the community trend is spreading to other user segments, and when people currently constituting the MOKLOFs, or M – generation, grow up they will probably not give up online communities. Consequently the community trend will most likely, after some time, prevail in all user groups.

So far most online communities are dependent on the wired Internet. The next step in evolution is to launch the online communities on the mobile Internet. Lunarstorm is one of the pioneers in the genre and has already done this. They have evolved to also playing the role as a virtual mobile operator. Besides offering all standard phone services, the SIM card also acts as a "remote control" for the users Lunarstorm account (Rheingold, 2001). The user may, via SMS, read guestbook entries, place new ones, send e-mails and chat with users currently online on the wired Lunarstorm community (www.lunarstorm.se). The role as a virtual mobile operator enables users to move seamlessly between the wired Internet community and the mobile version.

The new mobile forms of online community will generate an enormous amount of data traffic and revenues (Rheingold, 2001). Around the world, billions of SMS messages already are

transmitted every day. And with the evolvement of mobile online communities it is expected to increase even more (ibid).

Problems with the practical use of segmentation models
The segmentation models used in this thesis, we believe, gives a straightforward and clear picture of the market for mobile Internet. It is quite easy to identify different user groups, their preferences, demands and requirements and to understand why that knowledge is important. The problem is that this is in theory, not in practice. All segmentation models are generalizations, the attributes in the models does not suite everyone. This is a necessity, without generalizations there would be impossible to construct any forms of segmentation models, and it is an issue concerning the majority of all research. Nevertheless this implicates that segmentation analysis should be used with carefulness.

Another problem with the use of segmentation models is that the borders between different segments are not that clear as they may seem. This appears briefly in the NetLight model, where different user groups in some cases have the same underlying purpose with their usage, see model 6.1. Due to this it may not be that useful to conduct segmentation analysis. Many applications will be evenly adopted over different segments. This is reflected in the discussions of which segment that will be the driving segment. Åslund deem that, at least in Sweden, the business segment, or YUPPLOTS, will be the one that push the development of mobile Internet. First, they are the most financially strong group and the developers will always go to where the money is. Second, they are the ones with the most advanced and well suited terminals. According to the segmentation logic the developers should therefore focus on production oriented services. However, Åslund mean that this does not have to be true. Even though they belong to the business segment they may also be interested in entertainment services, e.g. adult content. The important factor is that the service can be paid by the employer. (Åslund, 2003).

6.4 User modes

Independent of which consumer segment the user belongs to, some general wireless Internet usage patterns can be distinguished. These patterns define two user modes; the mobile and the portable mode.

Today, the vast majority of wireless networks are designed to primarily support mobile phones. The networks are managed by voice cellular network operators which offer wireless Internet services to their customers. These are designed for brief interrogation of information services and information updates, such as sport results and phone number enquiries. The services are highly limited, but are designed to serve users who are in motion. This kind of use defines the “mobile mode”. In this mode, a lightweight and small device with good battery power is preferred.

The portable mode is not intended for those in motion. It aims at replicate the use of a desktop computer, with a richer information experience, where the user sits down for e.g. creating content or use application specific devices like a digital camera. It is characterized by a more complex interaction, for a wider range of devices, and reliance of services originating from the Internet rather than those services provided by network operators. For an overview of characteristics for the user modes see figure 6.4.

Characteristics of Use	Mobile Mode	Portable Mode
Information search style	Interrogating	Browsing
Session length	Brief, bursty	Brief to lengthy
User device	Small, light, cheap	Range of sizes & costs
Information input	Confirmations, menu selections	Rich interactions
Services	Updates, impulses	Complex transactions
Psychology of satisfaction	Immediate gratification	Broad, deep content
E-commerce	Simple purchases	Complex choices
Network	Slower, high latency OK	Faster, low latency required
Protocols	WAP, MMS, other wireless industry sponsored architecture and protocols	IP, Mobile IP, other Internet architectures and protocols
Content and services	Provided by network operator and partner	Provided by Internet and corporate enterprise

Figure 6.4 User modes characteristics (The Shosteck Group 2002)

7. Corporate market

In this chapter we will describe the market from a corporate perspective. We will account for actions and events that have or will have impact on the future success of technologies. The chapter will enlighten movements that have been taken so far and trends that are visible. Subsequently we will account for different business models that companies can take into play.

7.1 Movements and trends

7.1.1 General Packet Radio Service

Today there are GPRS networks in over 58 countries. Besides, there are 8 countries who have a GPRS networks in deployment while 16 countries have GPRS networks planned (www.gsmworld.com, 2003).

7.1.2 Enhanced Data rates for GSM Evolution

In Europe almost no GSM operator remains without a 3G license after the completion of spectrum allocations (Northstream, 2002a). Among the licensees, very few public EDGE indications have been given. Bouygues Telecom in France is one operator that stands without a license and has indicated plans for an EDGE-based evolution (ibid.). But in late September 2002 the French Telecoms regulator (ART) expressed a favorable opinion in Bouygues Telecom's bid for a UMTS license (www.bouygues.fr, 2003). In Scandinavia W-CDMA coverage regulations and time limits have in practice shut the door for an intermediate step through EDGE (Northstream 2002d). Unlike GPRS and W-CDMA, which are regarded as necessary for GSM operator evolution, many in the industry view EDGE as just an add-on technology with unclear benefits. Consequently the implementation of a different cellular technology in Europe than GPRS and UMTS seems uncertain.

In parts of America, Asia and Australia EDGE is still considered a potential path for fast data transmissions over the core GSM network, see appendix table 11.1. Peoples Telecom, one of the smaller operators in Hong Kong, is going to deploy EDGE networks by the end of this year. Peoples did not obtain a 3G license and they state that the data speed is sufficient for the next two or three years, before 3G is functional and affordable to the customers (www.3gnewsroom.com, 2003). Both Ericsson and Nokia declared at the fair in Cannes 2003 that they will give EDGE extensive focus (Ahlbom, 2003a, c). Nokia stated that the majority of their cell phones will be equipped with EDGE functionality as from autumn 2003. Nokia has also delivered EDGE equipment to 27 GSM operators in 18 countries and they will test run EDGE in 15 commercial networks during the spring 2003. However, Northstream (2002d) does not believe EDGE to get global acceptance without adoption from leading GSM operators with 3G licenses.

7.1.3 Third Generation

The commercial launch of 3G networks has until today been quite limited. W-CDMA is deployed by individual operators in Japan and Isle of Man (UK), while CDMA 2000 EV-DO is commercially launched in South Korea and USA (www.tomiahonen.com).

Operator announcements show that 3G is delayed across Europe and that operators expect initial launches in mid 2003. Some operators indicate "soft launches", i.e. non mass market launches, without any major revenues at that stage (Northstream, 2002a).

The commercial launch is considered delayed due to handsets availability and network functionality. More tests are needed to ensure interoperability between terminals and infrastructure and between network nodes in case of multiple vendors. There is neither a clear solution for handover, roaming and cell reselection between GSM and 3G, in case of insufficient 3G coverage (ibid.). The operators' financial situation, with needs for greater external financing at higher costs, does also have impact on their capacity to rollout networks. Thus, there are still doubts whether these essential problems are solved before the currently planned launches (ibid.).

The market is also characterized by fewer operators than originally anticipated which will have effect on competition (ibid.)

7.1.4 Wireless LAN

An increasing portion of companies in North America, Asia and Europe are using w-lan in their offices. The global w-lan equipment market grew around 70% in 2002 (Northstream, 2003). In the US, IEEE 802.11b w-lan cards are rapidly becoming a standard component in new PC's, especially laptops (Volans, 2003). The 12th of March 2003 is this development considered to boost as Intel launches a new processor-platform for laptops called Centrino (Zirn, 2003). Centrino will have w-lan technology 802.11a and 802.11b directly built-in the platform and is further developed for electricity-saving (ibid.). Intel's goal is to make all portable PC's wireless and they expect the big majority will deliver Centrino-based laptops directly after introduction (ibid.). Roland Chamia, spokesman for Cisco, truly believes that Intel's launch will speed up the enlargement of public w-lan networks (Zirn, 2003).

Public hotspots are currently popping up across the US, in airports, hotels, restaurants and coffee shops (Northstream, 2003). For a fee customers can kill time while waiting for a flight or for their espresso to arrive. Today there are already a handful of companies in the US that sells subscriptions for several hundreds of w-lan hotspots. In Europe Scandinavia is leading the way. Scandinavian Airlines (SAS) has teamed up with the operator Telia to install w-lan access points in all of its international business lounges (Volans, 2003). At present, there are hotspots at airports in for example Seattle, Chicago, New York, Brussels, Paris and Milan. Telia Homerun has also over 400 hotspots in Sweden and in the Nordic countries. They have signed roaming agreements with the Italian operator Megabeam, Finnish Sonera and the British operator BTOpenzone, and are constantly looking for new international collaborators (www.telia.se).

A principal reason for the increasing amount of operators is that the costs associated with w-lan are low compared to other public communication networks. Consequently with low barriers to entry, there are today many operators that compete in a fierce price war. In Stockholm, Sweden, there are currently five actors competing and even though the operator

Telia Homerun lowered its prices by over 80% during 2002, the cheapest competitor offers a 24-hour subscription at half the price of Telia Homerun's (Northstream, 2003).

The major obstacles with w-lan are roaming and the technology short-comings when it comes to reach coverage besides the often isolated hotspots. The roaming agreements, like the ones by Telia, are still limited and not near a solution for global portability.

In December 2002, Intel, IBM and the operator AT&T announced that they will deploy a network of w-lan hotspots over big parts of the USA (Hedberg, 2002c). The cooperation will go through a commonly owned company, Cometa Networks, which will deploy over 20 000 w-lan hotspots within a few years. Cometa Networks does also consist of Big Blue, Apex Partners and 3i and is formerly known as Project Rainbow. The goal is to eventually launch w-lan all over the United States, but already in 2004 they expect the network to cover 50 major American cities (www.computersweden.idg.se). Intel that contributes with a great part of the dollar investments does also supply technical expertise. IBM will have the responsibility for local installations while AT&T will arrange for communication between the different hotspots (ibid.).

Vast investment by conglomerates like Cometa is a possible solution for roaming problems. With one big operator covering different geographical areas there is no need for roaming agreements and subscribers can use the same services in many geographical areas without changing login details or worry about different connection fees. Cometa's intention to cover major cities may also make handoffs between hotspots possible which will bring a degree of mobility for the technology.

Another roaming solution is considered by the Swedish company Aptilo. They make a technical solution where the user does not need a subscription to use services. Payments are instead based on duration and completed with the use of credit cards or charged against cell phone bills. The technology is considered for standalone operators that have few customers, e.g. hotels and coffee shops. So far, Aptilo has delivered its technology to nine countries besides Sweden.

The vision of a free public mobile Internet has also taken some shape in several parts in the world. Freenetworks.org is a *"voluntary cooperative association dedicated to education, collaboration and advocacy of the creation of free digital network infrastructures"* (www.freenetworks.org). They have links to several free w-lan projects in more than 20 countries, by which you can search and get connection information about free access points. See also www.personaltelco.net for information about additional access points. Elektrosmog is an example of a Swedish community for discussions about wireless networks. They have currently information about 30 free hotspots spread all across Sweden. Nevertheless, the impact of the free network movement seems at present quite limited, but as more coffee shops and hotels starts implementing open hotspots they might constitute a threat against revenue seeking operators. However, today there is also a question of usability, thus users need different logins for each node.

IP-telephony over w-lan will also soon be put on the market. Sharp in Japan announced in December 2002 that they will introduce the technology in April 2003 (Brohult, 2002). The service requires a w-lan equipped PDA called Zaurus and a w-lan subscription at the operator NTT. It is however not possible to receive calls and the PDA does not allow usage of neither GSM nor GPRS which makes telephony delimited to NTT's hotspots.

The use and profitability for public w-lan is pending and none of the operators that have exploited a w-lan business model has shown profits (Northstream, 2003). Economies of scale might thus be possible through conglomerates like Cometa, and after all, the technology is in the introduction phase and far from mature. The charge-free business model may also have potential for a prosperous future.

7.2 Regulation

European ministers have previously warned that the costs of building third-generation (3G) mobile networks could threaten the economic growth of the EU. If the carriers run into financial problems, it could delay the rollout of 3G mobile services. There have consequently been suggestions that necessary steps may be taken to ease the burden on telecoms operators which paid billions of Euros for 3G licenses (www.3gnewsroom.com). Among suggestions for easing the debt burden are that license holders should be allowed to share the cost of building 3G infrastructure, and governments should defer payments for the licenses.

In Sweden, where high degree of coverage is agreed (100% of the population at the time of agreement), the minister of infrastructure, Ulrika Messing, had recently a bill passed that makes it possible to force the coordination of the expansion of 3G base stations (Svidén, 2003). This will affect the number of base-stations build in Sweden, and probably reduce the cost for building the 3G network. But it may also limit the potential to attain competitive advantage by offering superior coverage. The decision is nevertheless also a consequence of the widely spread worry among the citizens for cell station radiation, and the fact that governmental institutions are overloaded with applications for cell station building permits. Swedish operators are also faced with contracted time limits for the end of 2003, which has made three out of four 3G license-holders to apply for a respite for the network expansion. So far Vodafone and Orange have been turned down while the operator 3 still is waiting for an answer from the Swedish Post & Telestyrelsen (PTS 02-12280/23, 2002; PTS 02-10223/232, 2002). However, Ulrika Messing has expressed that they consider changing the rate of expansion for all 3G operators. Nevertheless she emphasize that the rate of coverage is fixed and that 3G will reach the whole population (Lieberth, 2002).

The trend is common all over Europe and license conditions that have been altered include timing of service launch, timing of coverage milestones, network sharing, extension of the license period and revision of payments for fees associated with license (Northstream, 2002a). This indicates that there is a slight change of regulatory focus from market liberalism to 3G market facilitation.

8. Business models

This section will discuss different types of business models that could be used by the mobile Internet service industry. The choice of business model may have great impact on how offered services will be used by customers, and relations between Network Operators/WISPs and content providers.

8.1 Why trouble about business models?

"A business model depicts the content, structure and governance of transactions designed so as to create value through the exploitation of business opportunities."
(Amit & Zott 2001)

When using a mobile Internet service, the transaction involves different parties. Normally there are mobile network operators (MNO) or WISPs, a content provider, a portal provider, and customers. The business model regulates the relationship between the different parties. (Andersson et al, 2002).

One of the key issues concerning business models is different forms of revenue models. The purpose of the revenue model is to capture the created value that the service generates and turn it into revenues. The revenue model consists of three activities; valuation, appropriation and allocation. Valuation implies determination of the actual value of the different transactions being executed. The result could be used as a base for setting prices. Appropriation concerns the activities being performed in order to transform value into revenues, e.g. customer billing basics. The allocation activity means apportion of the revenues among different parties involved in the conducted transaction. (Andersson et al, 2002)

With starting-point from the context of this thesis, we believe business models are important to discuss for two major reasons. First, different customers have different preferences regarding how they want to pay for content (Kairo Future, 2001). According to a survey conducted at the Swedish market, 50 % of the respondents wanted to pay for the services they actually use, meanwhile 24 % preferred a flat rate pricing (ibid). 26 % of the respondents did not want to pay anything for the content (ibid), se figure 8.1.

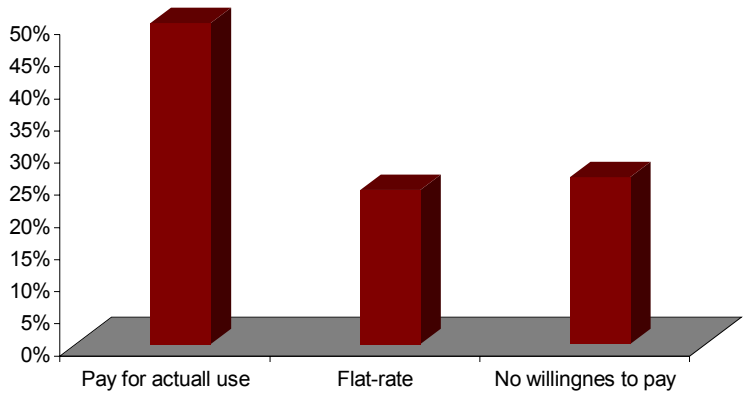

Figure 8.1 Customer preferences regarding charging methods (Kairo Future, 2001)

We believe the survey emphasizes the need for different business models depending on the target segment, in order to maximize the amount of customers and thereby increase the install base.

Second, many believe the relationship between the network operators and content providers need to change and improve (Future of Wireless, 2002). The European market of mobile telephony has been characterized by fairly closed structured business models where the operators have refused to act in order to get their business models really beneficial also for the content providers (ibid). They have consistently avoided revenue sharing, and instead hired the content providers to develop services for a one-time fee (ibid; Andersson et al, 2002; Turek et al, 2000.). However, this is not a long term solution. Because of the closed business models the incitements for third party content providers has been rather low, resulting in a narrow supply of attractive services (Future of Wireless, 2002). The operators are experts in transferring data, not developing services (ibid).

So far our discussion has been focused on business models for mobile telephony and related services. Even though these also may fit w-lan transactions, the prerequisites are somewhat different which calls for new customized business models. For example, if viewing a w-lan connection as a bitpipe, only giving access to Internet, the relationship between content providers and WISPs is not by far as interesting as in the mobile telephone business. However, the hotspot business is still in its infancy, in Sweden there only exists one real commercial WISP, Telia Homerun, a subordinate to Telia AB, and there is currently a prevail lack of relevant business models.

We will focus our discussion on three issues. First, basics for billing customers. Second, the MNOs/WISPs and content providers relationship. Third, design of w-lan business models. We will also briefly discuss some concrete business models primarily suited for mobile Internet based on cellular technology.

8.2 Basics billing issues

We have already established that there exists a need for support of flexible billing basics and revenue models. Some of them can be used as a part of business models with equivalent business logics; other may call for a new business model, ruled by fundamentally different

business logic. This point of view is shared by Vodafone that emphasizes the importance of the ability to offer customers the opportunity to choose a method of charging that suits them (Andersson et al, 2002).

There exist several methods for billing customers. Subscription based billing is one option. The user is charged a monthly prepaid fee in order to get access to a certain service. Duration is another method, probably, at this date, the most used after the subscription method. It is a rather logical, and well established, method, easy for the customers to apprehend. The longer time the service is used, the higher fees will be charged. Two other methods that could be used are location and destination. Location based billing identifies from where the connection is established and use that information to charge separate rates depending on user location. Destination works in the same manner as normal circuit switching, i.e. higher fees for long distance calls. The last method is volume. It charges the user based on the transferred volume, e.g. amount of transferred kilobits. Most of these methods could be combined. (www.umts-forum.org)

The volume based method has been quite heavily debated. One side argues that it is an impossible method. The customers would never accept such billing method, because the correlation between the user's perceived value of the service and what he/she is charged is to diffuse. For instance, the fee for sending an SMS would differ dependent of its length. They mean that this altogether will slow down the demand and use of mobile Internet services. (Future of Wireless, 2002)

The other side deems that the volume based method is the only realistic solution because it most accurately reflects the actual costs that the service generate, and that the customers must learn to accept such model. They also reckoned it as a quite natural model when there will be severe differences in data transfer costs depending on the technological platform used, e.g. wired Internet, w-lan and 3G. (Future of Wireless, 2002)

8.3 MNOs/WISPs and content provider relationship

As mentioned above, the European market has been characterized by closed business models. The MNOs has put great effort in controlling and limiting the content providers' access to end customers (Turek, 2000). This attitude has limited the range of services the customers can choose from. Not only because of the low incitements it creates for third party content providers to develop services, but also because of the control the MNOs exercises; not everyone are able to get their services out on the market, only the ones the MNOs chose to do business with (ibid). As a consequent, when a user powers up e.g. a WAP device he/she can only chose among services predefined by the MNO (ibid). Nevertheless, it should be emphasized that the user technically can choose a service from an independent content provide (ibid). This is though practically difficult. The user must know the url to the service provider, search engines like those we find on Internet is not by far as easy to use (ibid).

This type of strategy that the MNOs use is called "walled garden" strategy (Turek, 2000). According to the operators, they use it in order to maintain security for wireless transactions, control e-mail spam, and manage billing from multiple sources (ibid). Another reason, not expressed by the MNOs, is that the operators are afraid of being turned into dumb bit pipe providers, with severe value migration away from the MNOs as a consequence (ibid; Future of Wireless, 2002). However, the "walled garden" strategy has not been very successful,

many MNOs are now slowly abandoning it (ibid). In Sweden for example both Vodafone and, before they retired from the Swedish market, Orange, has begun to adopt new business models with a higher degree of revenue sharing.

8.4 Concrete business models

We will now continue by illustrating how some concrete business models could be designed.

8.4.1 The paid for content business model

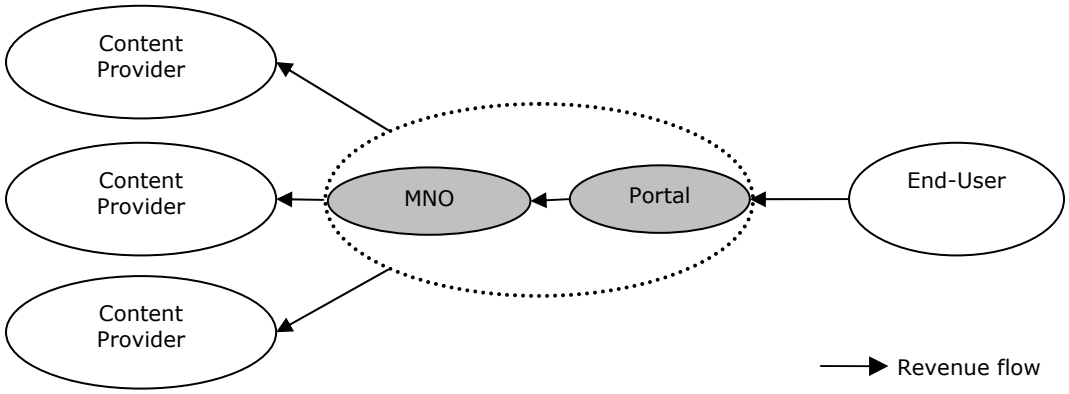

Figure 8.2 The paid for content business model (Andersson et al,, 2002)

The business logic of this model is that customers should pay for content. The revenues derived from the transactions are divided between the MNO, the portal provider and the content provider. The MNO may have double roles, both as MNO and portal provider, see figure 8.2.

This model is an example of the abandoning of the "walled garden" strategy, where the MNOs agree to revenue sharing with the content providers. An MNO using this model is the Japanese operator NTT DoCoMo. They use it to deliver its service i-mode. The content providers, that are independent of NTT DoCoMo, are responsible for delivering services. NTT DoCoMo generates revenues through three activities. First, they are responsible for billing customers for all services used and charge the content providers a provision fee of 9 % of the price for all services used. Second, NTT DoCoMo charges the customers a certain fee for every kb of data they receive or send. Third, they charge the customers a monthly subscription fee for the access to the i-mode service. (Future of Wireless, 2002; Andersson et al, 2002.)

However, this does not implicate that i-mode uses a truly open business model. NTT DoCoMo co-operate with device manufactures that develops i-mode terminals. These

terminals can only be used with i-mode, resulting in a lock-out of all other mobile Internet services. NTT DoCoMo also has very high requirements on their content providers regarding the quality of the services they deliver. As a consequence, only large firms with high capacity participate in the development of services for i-mode.

NTT DoCoMo is, through i-mode pioneers in using this business model, but it is about to spread to other MNOs. In Sweden for instance Vodafone recently launched its service Vodafone Live!. It works very similar to i-mode, with the exception that Vodafone charges the content providers with a higher provision fee.

8.4.2 The free content business model

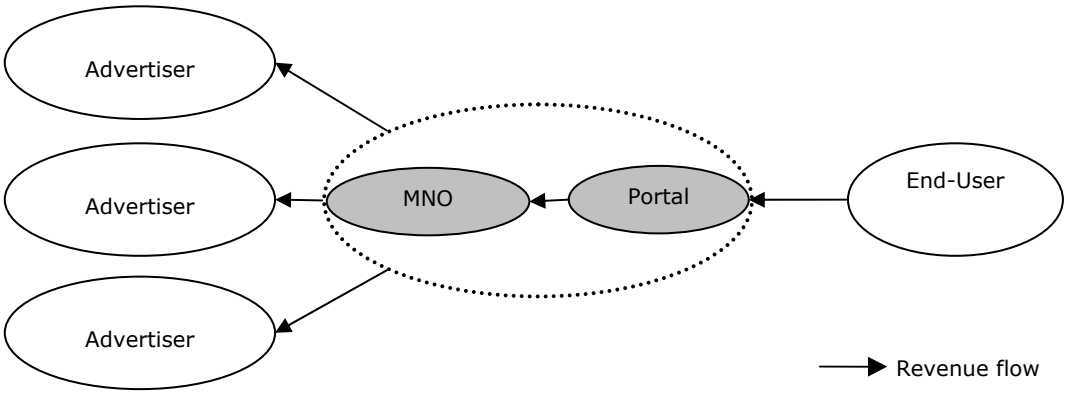

Figure 8.3 The free content business model (Andersson et a,2002)

The business logic of the free content model is that the end-user pays for the traffic in the mobile network, but that the content is free (Andersson et al, 2002). The MNOs and portal providers using this model believe that customers are not prepared to pay for services delivered via mobile Internet (ibid).

The portal providers offer the customers content for free and generate revenues by selling advertising space on the portal. The major content providers are the advertisers and they are charged on basis of the revenues they generate through the portal. The portal providers pay the MNOs a fee for the network access. This is not true if the MNO and portal provider are the same. The user only pays a traffic fee that could be based on any of the above discussed methods, e.g. volume or subscription fees. See figure 8.3. (Andersson et al, 2002)

An example of an MNO using this model is Telecom Italia Mobile (TIM). They run a service called TIM spot, with which they have reached enormous success. It is based on free SMSs sent to customers, delivering a mixture of news and advertisement. (www.tim.it)

8.4.3 The intelligent facilitator business model

The MNOs that adapt the intelligent facilitator business model strive towards value maximization of the mobile network and to provide a leading edge infrastructure (Andersson et al, 2002). The business logic of this model is to offer third parties, such as content- and portal providers, different kind of support services (ibid). The services can range from network capacity, billing services and hosting of different kinds of services etc (ibid). The intelligent facilitator business model is an example of a truly open structured business model, which also may evolve the MNOs into the role of bit pipe providers. However, according to Vodafone, this role does not necessary need to be negative. In contrary, the role as bit pipe provider may open up for new business opportunities and generate new revenue sources (Andersson et al, 2002; Future of Wireless, 2002).

This business model is not commonly adopted; actually we have not found any concrete example of an MNO using the model. However, it is believed to be more attractive when the 3G network, or equivalents, is launched. (Andersson et al, 2002)

8.4.4 The MVO business model

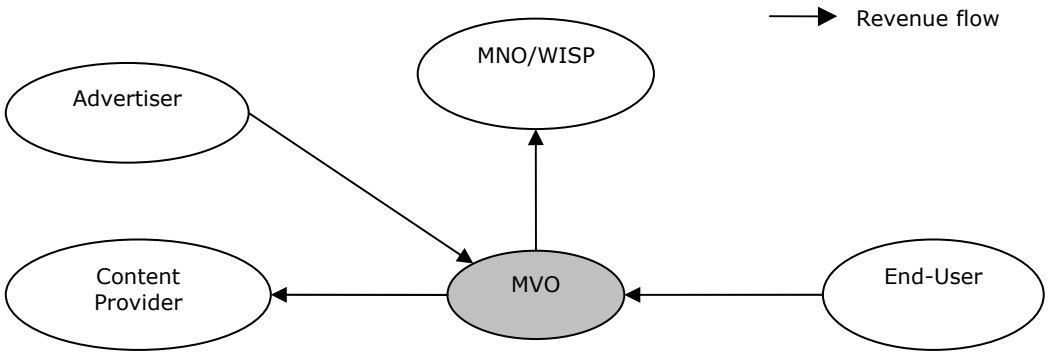

Figure 8.4 The MVO business model (Andersson et al,2002)

The business logic of the Mobile Virtual Operator (MVO) business model is that the MVO buys network capacity and services from the MNO and resell it to the end customers, together with its own services. See figure 8.4. The MVOs does not own the infrastructure and is thereby able to exclusively focus on branding and service development. MVOs normally have a wide range of services in their portfolio, which they use to develop solutions for the customers. (Andersson et al, 2002)

The branding focus is rather important, when it enables an entirely new type of mobile operators that normally are not forming associations with mobile communication (Future of Wireless, 2002). These MVOs can streamline their mobile services according to their traditional core activities, and develop a value-adding extension of their core product (ibid). They also have the ability to make use of their current install base to gain new mobile subscribers fast. An example of such potential MVO could be MTV. Playing the role as an MVO would enable MTV to offer its customers e.g. streamed music videos, reportages etc.

They would also have the ability to send custom made advertising messages since they get all personal information they need when the user signs up for the subscription (ibid). Lunarstorm, the Swedish online community, has already evolved into an MVO (www.lunarstorm.se). Their mobile subscription works as an extension of their wired online community (ibid). Read more about Lunarstorm in chapter 6, Communities.

The MVO business model is commonly perceived as a threat by the MNOs. They loose control and the independence of MVOs increase (Future of Wireless, 2002). However, it is an unchallenged fact that the MVOs increase the traffic in the MNOs networks (Anderson et al, 2002). Dial n' Smile, a MVO, adds that the virtual operators make it easier for the MNOs, when they only need to manage one customer (ibid). Vodafone is of the opinion that if they must compete with the MVOs Vodafone might as well profit from them (ibid).

8.4.5 The w-lan business model

The business models appropriate for w-lan services differ from those customized for mobile Internet accessed by cell phones, or other similar devices. A w-lan service simply provides a connection to the Internet, working in the same manner as those the users have in their home or at work. This eliminates the need for special portal providers and, at least at this date, content providers. Instead, the co-operation and revenue sharing between different WISPs is of much greater importance, in order to maximize coverage and make the service practically useful for the customers.

According to Ovum, telecom analysts firm, there are two basic business models for public w-lan; either the user is charged for the service or it is free (Ovum, 2001).

The free of charge business model

The free of charge business model is commonly used by standalone operators, which do not have the w-lan service as their business core activity. Instead the w-lan service is a mean to add value to its other services. Those businesses believe that the costs for running the w-lan service is offset by the increased competitive advantage that they probably gain, or increased revenues from other channels, produced by the w-lan service. For example, a café or bar may sell an extra beer or coffee when their customers stay a little longer because of the w-lan service. There are even w-lan equipment providers that are targeting this type of businesses and explain the benefits of a hotspot in very non-technological terms such as: "You can pay back your wireless LAN running costs by selling an extra three beers per day".

The paid-for business model

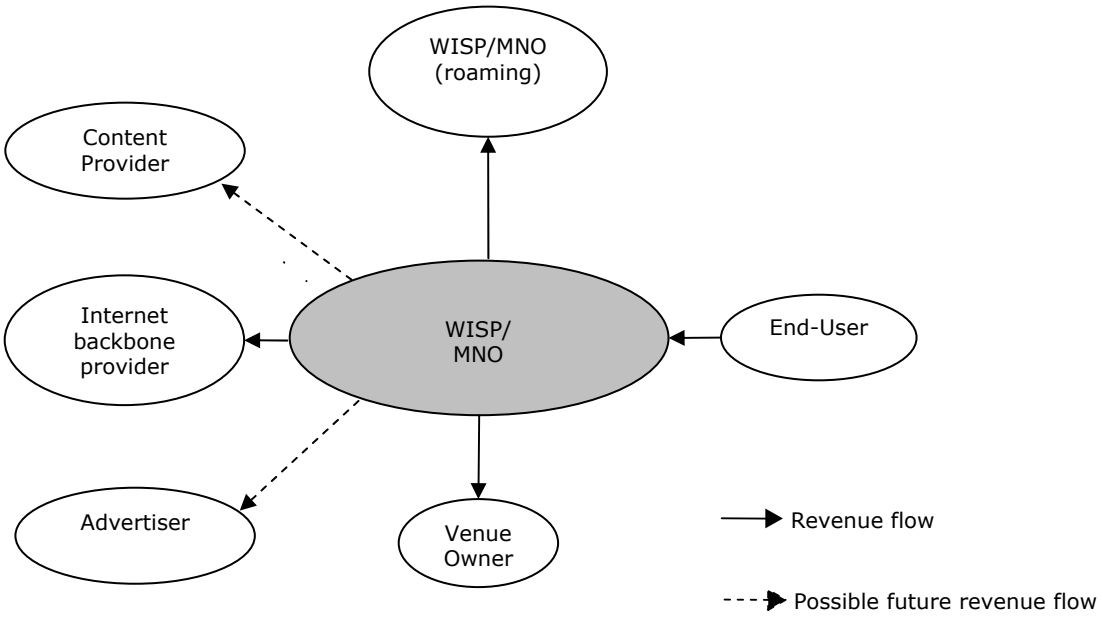

Figure 8.5 The paid for w-lan business model

In the paid-for business model the user should pay for the w-lan service, see figure 8.5. The service is provided by a WISP who can run one or more different hotspots. There are two major methods for charging customers. The user could pay a subscription fee, based on flat rate or volume, or purchase a so called Surf card. The Surf card will be sold in retail stores like today's mobile telephony cards, and gives access to the hotspot for a predefined time span.

The WISP pays a fee to the venue owner, e.g. an airport or hotel, for the rights to set up equipment at the venue. It could be based on traffic volume, but most likely it is a fixed fee. The WISP also pays a fee to the Internet backbone provider. Finally, if there exist a roaming agreement, the revenues generated are apportioned between the involved WISPs. That situation could occur if for instance a Telia Homerun customer wants to access a hotspot run by another WISP having a roaming agreement with Telia Homerun.

As a w-lan service simply provides a fast Internet connection there are no advertisers or content providers directly involved in the transaction. Of course, the user may access content at the web that is charged for, but that is a separate transaction, not involving the WISP. However, these are the conditions of today. For example, a w-lan service may be venue dependent; through w-lan, a restaurant may for instance make their menu available to the customer or a gallery could provide additional information about the artists exhibiting and other works. These types of services open up for both advertiser and content providers to get more direct involved in the transactions.

- Part Five -
Analysis

9. What we know is that we do not know

This chapter will analyze the factors, trends and driving forces explained so far in the thesis. First we will rank the factors according to importance and uncertainty as described in the methodological step four. Subsequently we will make scenario skeletons by examine different possible outcomes of the critical uncertainties and their internal coherence, i.e. methodological step five.

9.1 Critical uncertainties

All factors described have importance for how the future of wireless data communication will unfold and none of them do we see as absolutely certain. Nevertheless, some seem to be more important than others and some seem to be less certain. Table 9.1 gives a general view of the factors concerned in this thesis.

Technology	Consumer market	User segments	Corporate market	Business Models
Speed	Speed	User segments and user modes	Movements and trends	Revenue models
Costs	Mobility and Reach		Regulations	Billing issues
Coverage and Roaming	Price			
Handsets issues	Content			
Security and Health issues				

Table 9.1 Factors referred to in the thesis

The scenarios will ultimately illustrate the usage of wireless services, why user adoption is in focus. It is thus necessary to see how these factors may influence adoption of the technologies. As described in *Consumer market*, users will valuate the technological attributes, i.e. speed, mobility etc. that constitute a boundary for the possible. The technological services are thus not static but may evolve through research or change by corporate actions, e.g. roaming agreements, revenue models or by governmental regulations. In addition, content i.e. the actual services, is dependant not only on the technological capacity but also of the creativity of the content providers. However, theories do also imply that the best technology does not always win, why path dependency, network externalities etc. are important realities to take into consideration.

Next we will describe the implications of the technological differences upon user adoption and competition. Subsequently, we will justify the factors that we consider critical uncertainties.

9.1.1 Technological trade-offs

As previously explained, user preferences are uncertain and it is hard, if not impossible, to valuate the appropriateness of new services. We can nevertheless, based on our empirical research, assume that users would like as fast, mobile and cheap services as possible.

But, as described, speed comes for the price of diminished mobility, or seen the other way around, mobility comes for the price of diminished speed. Thus, there is a trade off between the factors as figure 9.1 points out.

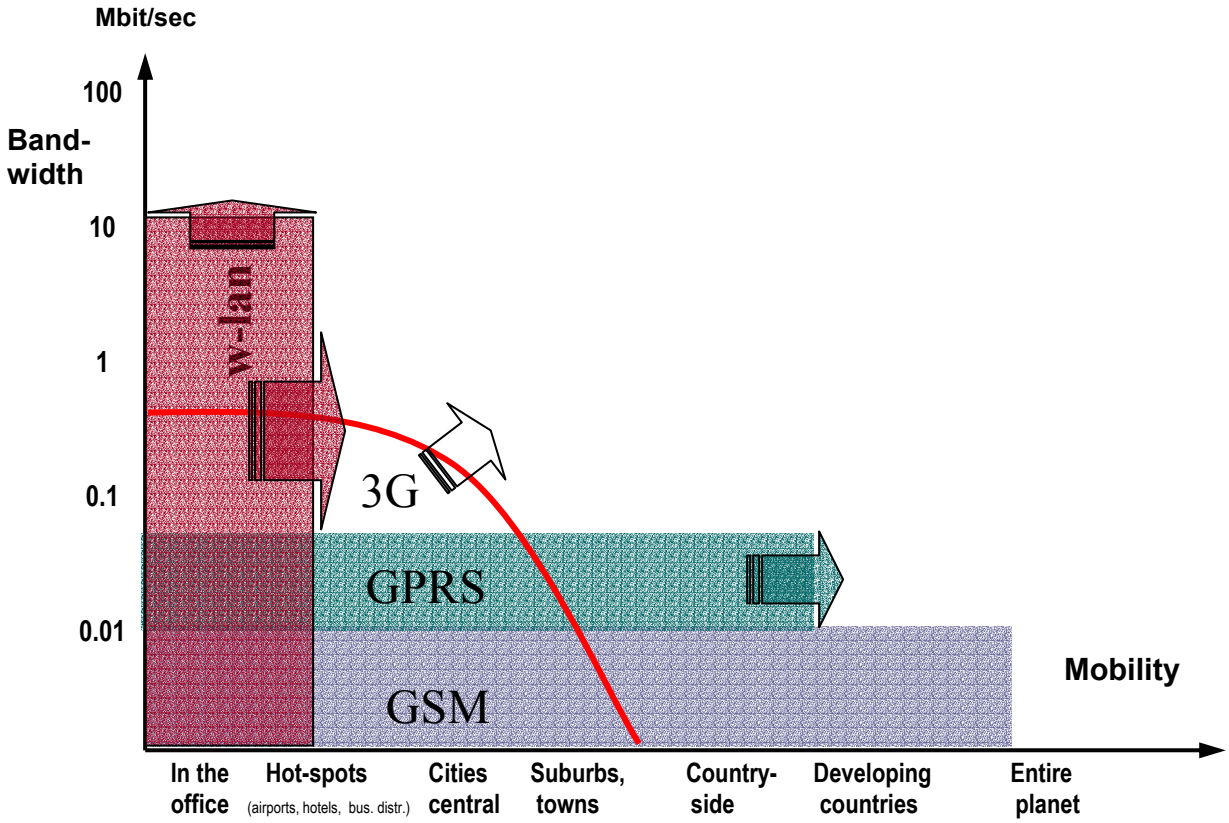

Figure 9.1 Trade off between bandwidth and mobility for users choosing between technologies.

The varying strength of the different attributes makes it impossible to consider GPRS/EDGE/3G/w-lan perfect substitutes (Ericsson, 2002). The differentiated products will instead fulfill diverse user needs or suit different segments, why competition is less fierce than between perfect substitutes (Lindell, 2003). However, it is difficult to ascertain how close substitutes the products are for different users/segments. The closer substitutes; the more decisive is price in the choice of a specific technology. If considered less close substitutes it is possible to charge a higher price without loosing all customers. The demand curve D_1 in figure 9.2 shows a product that has close substitutes, whereas D_2 shows a product that has relatively less close substitutes.

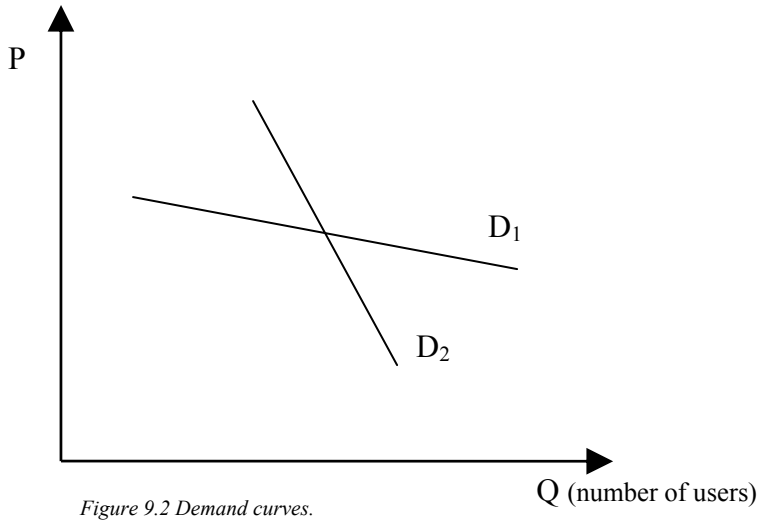

Figure 9.2 Demand curves.

User preferences of mobility and speed will thus decide the chargeable price of using a technology. At present, the cost of the speed/mobility ratio is inconsistent between the technologies. W-lan and GPRS appears to be inexpensive to deploy whereas 3G seem to be relatively expensive due to high spectrum license or coverage demands. To cover the high expenses of 3G it is consequently important that many users have preferences for mobility rather than speed and that they do not see the alternatives as close substitutes.

Hence, there is a widely spread view that mobility is so essential that w-lan can not substitute for cellular technologies. Jens Zanders, professor in radio technology at KTH in Stockholm, argues that w-lan is not suited for truly mobile users, which makes it an inappropriate alternative to cellular (Lundqvist, 2001). Thus, many analysts see the technologies as complementary rather than competitive (Mörner, 2002; Earle, 2002; Lotsson, 2001). Ericsson states that *"w-lan complements 2G and 3G wireless access in a hot spot environment"* (www.ericsson.se, 2003). As complementary services; cellular technologies will supply high access range while w-lan will compensate with high speed which altogether will raise the total benefit of wireless services (Northstream, 2003; Ericsson, 2002; Earle, 2002). An UMTS Forum Chairman Dr Bernd Eylert has also suggested that the use of w-lan can help seed customer demand for 3G services with full mobility (www.3gnewsroom.com, 2001).

However, the need for mobility is not clear. And even if short range technologies never can completely substitute for cellular technologies, every user or segment that valuates speed before mobility will cannibalize on cellular revenues (Lindell, 2003). The technologies will consequently affect each other and the market dominance. The degree of competition will nevertheless be dependant on if the technologies are viewed as close substitutes or not.

A parallel can be made with the transport market: Airplanes and trains are often considered less close substitutes as they fulfill different user needs. They do also complement each other in the transport market as an itinerary is often completed by using both vehicles, e.g. the plane to the airport and the train from the airport to the final destination. But if for example the airlines disregard the railway as competitor and a possible substitute they will make a serious mistake. People do not usually consider flying as the only option. Instead they valuate flying or going by train by factors such as price, speed, convenience etc. Consequently, for many people train and planes are considered close substitutes. And even if some people have strong

preferences for airplanes, it is the possibility of flying that makes it an alternative to trains. An absence of airplanes would not prevent people from getting from one place to another. Hence, a new customer for the airlines is usually a loss of a customer for the railroad.

The similarity with wireless technologies is remarkable. It might thus be an illusion that mobility ca not be substituted in the same way as believing that speed of flying can't be substituted. And even if some people will not substitute speed for mobility, it is dangerous to believe that different target markets does not imply competition. The deployment of new products/technologies may foster refinement of preferences towards a possible shift of use. Consequently, upcoming alternatives have the potential to gain users and revenues at the cost of incumbents.

The use of mobility – a review

Full mobility is considered a key issue for wireless services as it lies in the nature of being wireless. It is thus widely held that the mobility of cellular technologies is a competitive advantage that will boost the usage far beyond the achievable of w-lan (Mörner, 2002; www.ericsson.se, 2003; Northstream, 2003). Linsey Watt, senior consultant at Cap Gemini Ernst & Young's Telecom Media Network Practice, claims that the outcome of 3G/w-lan struggle will rest on whether users need true mobility or will accept a portable service (Volans, 2003). However, one can conclude that some applications will require attention and focus on the screen, similar to services on the World Wide Web, which makes sitting or standing necessary. Northstream however argues that the hotspot concept is at large suitable for corporate travelers accessing corporate information and e-mail while traveling (2003). The nomadic behavior of these user groups is relatively predictable and therefore manageable by using strategically access points like hotels, airports etc. The need for wireless data communication in the target group is nevertheless unknown which makes the potential market share uncertain.

The need for speed – a review

Many even seem to think that the speed of GPRS to be quite sufficient for all mobile data applications for many years to come (www.cellular-news.com, 2003). But saying that anything IT related will be enough for many years to come has often been proven wrong. Consider following statements by people in the business:

- In 1943, Thomas Watson, Chairman of IBM said "I think there is a world market for maybe five computers."
- In 1977, Kenneth Olsen President and founder of Digital Equipment said "There is no reason for any individual to have a computer in their home."
- In 1981, Bill Gates said 640Kb (internal memory in a PC) ought to be enough for anybody.

As described about content in the market chapter, slow mediums like GPRS are fine for many applications like messaging and e-mail. But once you start looking at heavy applications that need some bandwidth in order to function reasonably well, GPRS and even EDGE and 3G may fall short of the mark. Peter Gärdenfors (2003) argues that people will make use of any bandwidth available and that there is nothing as fast enough. He makes a comparison with when users went online over ADSL instead of a dial-up modem. Initially, everyone thought that those consumers would not actually surf more on the Internet, but just spend less time waiting for content to download. But in fact, when people get ADSL they surf much more, for

much heavier content and for longer periods of time. Exactly the same scenario has happened on mobile phones in South Korea, where ARPU is over 3 times higher on 2.5G mobile phones than it is on 2G (www.cellular-news.com). And there is a reason why GSM operators are not satisfied with GPRS performance and strive to deploy 3G. Jan Eldenmalm, founder of Amazingports that implements w-lan, means that 3G will not deliver speed rates sufficient for multimedia and streaming video, why it isn't going to be used in the cities (Hedberg, 2002a).

9.1.2 Variables affecting user adoption

The future of wireless data communication will essentially be described by how different segments use services and accordingly possible technology dominance. The scenarios are consequently in a way seen as educated guesses about users' preferences or the degree of user adoption.

User adoption and preferences for present technological attributes is per se a critical uncertainty and works as a foundation for the scenarios. But to reach beyond the simple assumption that users/segments either adopt 3G, w-lan, GPRS or EDGE based on current technological features, we use additional factors that influence or drive user adoption of the technologies. These factors are both critical and uncertain and they will change user adoption and the market state towards different scenarios, dependant on outcome. The foundation for these factors is the question: How might user adoption become if this or that happens? Companies may for example alter technology attributes or use strategic options to influence user preferences. Our logic is build upon the factors previously explained, illustrated in short in figure 9.3.

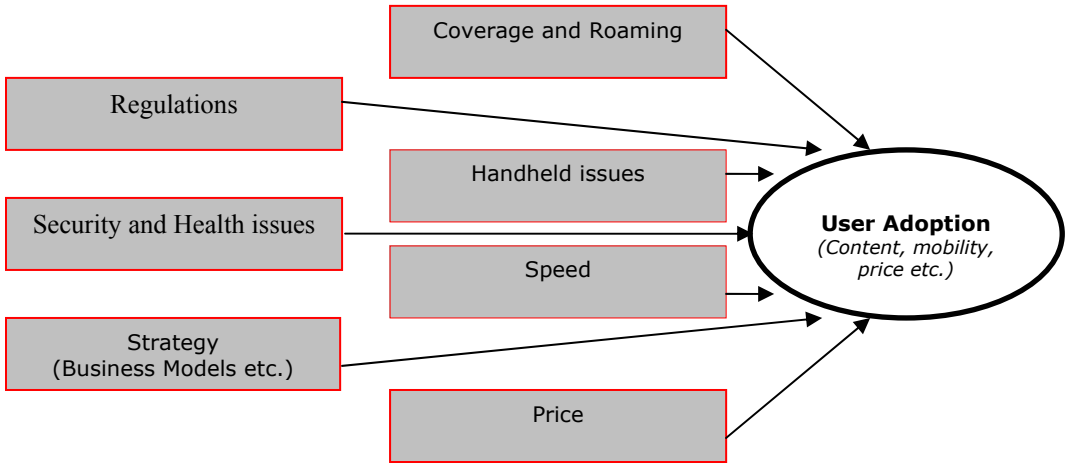

Figure 9.3 Variables affecting user adoption

Technological framework

Technological attributes are something that evolves continuously why it is hard to definite them as fixed. However we believe that the different performance in speed between the technologies is so prominent and apparent that the present gap will be fairly the same for a long period of time. Consequently speed is an important factor, but not uncertain enough to be considered appropriate for building different scenarios.

The same may be considered with the cost of the implementation of technologies. 3G does have high license fees or/and high implementation cost compared to w-lan. GPRS on the other hand is relatively inexpensive to deploy. Nevertheless the issue of network cost relative to a commercial price is dependant of business models, market penetration, economies of scale etc. The view of the technologies as substitutes will also have a great impact on a chargeable price, why we consider price a critical uncertainty.

Critical Uncertainty 1: **Price**

The issue regarding coverage and roaming is at present truly uncertain and important for offering mobility. GPRS does seem to offer almost world wide mobility due to cheap implementation while 3G probably will be deployed according to license agreements, and where coverage is not contracted; dependant of expected revenues etc. The deployment of w-lan seems at present much dependant of profitable business models. A high degree of coverage and roaming can today be achieved by either a company push, i.e. deployment of technologies to create demand, or by a market pull, where demand triggers the deployment of an attractive network. Consequently, coverage and roaming agreements, especially for w-lan are most uncertain and will have an important affect on technology substitutability. Mobility is thus seen as a critical uncertainty.

Critical Uncertainty 2: **Mobility**

Battery consumption, security and health issues etc. are also important factors that will influence user adoption. However, we believe that they are of less importance than the factors previously stated. Battery consumption will for example facilitate mobility for w-lan and high speed services and will thus be used to support the eventuality of a high/low mobility scenario. Security and health issues can in the same way support a possible development. These factors are consequently not used as critical uncertainties that drive the scenarios; they are rather used as supportive factors in the actual scenarios as stated in the methodology.

Early launch of mobile Internet services – theoretical perspective

Being first on the market with mobile services creates an opportunity to achieve an installed base before other technologies constitute an alternative. If these services are considered attractive, an increase in numbers of adopters can lead to a market "take off" after which further diffusion can be a self-sustaining process through network externalities, signaling effects and learning curve effects.

As indicated, successful services comes from an understanding of the demand of services rather from the technology (Gardiner, 2000). Consequently services do not have to make use of a certain amount of bandwidth, instead there are various opportunities for slow speed bearers to develop messaging, m-commerce, mobile application download services and location based services. Creating a simple service such as messaging by taking advantage of "always connected" can easily imply network externalities if adopted. Using the same service over the same network assures compatibility and is a guarantee for functional communication between the users; which will attract more users of the same technology. The installed base may evoke complementary services which further will reinforce the size of the installed base

as in the "virtues cycle" described by Schilling (1999). Developing attractive services such as location based services etc. may take advantage of signaling effects by indicating the value of the technology to potential users. As more users become aware of the advantages of using a certain service an increasing amount will adopt the technology. Usage of a technology does also imply learning curve effects that will create a more productive use. Learning curve effects generate switching costs and resistance to adopt new and later developed technologies, which makes technology dominance hard to break.

Creating a market for mobile services will generate revenues that can be reinvested in further technology deployment and thus enhance the degree of mobility for the users. Additionally, the adoption of services will increase knowledge of customer demand and provide an opportunity to improve and develop new and more suitable services (Northstream, 2002b). As more users adopt the technology increasing return to adoption comes in to play through the described effects and creates lock-in effects and switching cost that makes it hard for opposing forces to constitute a threat.

Critical Uncertainty 3: **Launch of mobile Internet services**

Interoperability

Today users face a choice between the different technologies. But it is doubtful whether one's choice is fixed and appropriate in all situations. We believe users may have contingent preferences why a choice of a technology may be dependant of time and location. A user may prefer high speed prior to mobility, but in absence of a connection that meets the user preferences, he/she would probably like to use any available service.

However, today, terminals and subscriptions will make a switch between technologies hard. There is no commercially available handheld that support both cellular and w-lan technology with mutual roaming, and there is no collective subscription. Consequently if you want to use all technologies you currently need a GPRS/EDGE/3G enabled cell phone and a w-lan enabled device together with adherent subscriptions. Additionally, learning curve effects will create resistance to change usage behavior. A switch from 3G to w-lan is for example nothing of a spontaneous matter since you need to attain knowledge about available hotspots and adherent logins. And mostly important, switching between technologies imply that you have to change habituated services for unfamiliar services. Switching costs are apparently so high that a choice between technologies is somehow inevitable for the average user.

But as explained there is a possibility that users do not have to choose between cellular and w-lan. Per Stein, head of Intel Wireless Competence Center, argues that it does not have to be a question of either or, instead handhelds will be able to automatically roam between cellular and Internet connections. The same evolvement is expected for applications, which will adjust content dependant on available bandwidth for the terminal (Zirn, 2003).

The evolvement would give the technologies a true complementary aspect as users can derive advantage by w-lan and cellular attributes according to situation and without any effort. The condition that standards permit interoperability changes the affects of our previously chosen critical uncertainties. Mobility, however initially important, will erode as a reason for technology acceptance as mobility is granted as the total coverage of both w-lan and cellular.

Consequently in a situation where both technologies are available, the choice stands between speed and price. In the same way, early adoption of particular services becomes unessential as the user may use the same services or any adjusted version that make use of the available bandwidth. Consequently, users will base their choice of technology in every actual situation of usage upon the factors of price and speed, whereas price remains as the most important critical uncertainty.

The situation of competition will thus change as mobility ceases to be a technological advantage that influences the choice of users. Nevertheless, coverage will still be desirable for operators as it will affect their internal position on the market. To the extent that w-lan offers superior price and bandwidth; additional hotspots are believed to take usage from the cellular network

9.2 Scenario logics

In the previous section we explained why we chose the three particular forces illustrated in figure 9.4. We will now further discuss how these forces affect each other and look at different possible outcomes. We will do this by constructing four basic scenario frameworks, based only upon our three key factors. In the next section we will complement the frameworks with other factors concluded primarily from the empirical chapter, in order to flesh out four complete scenarios.

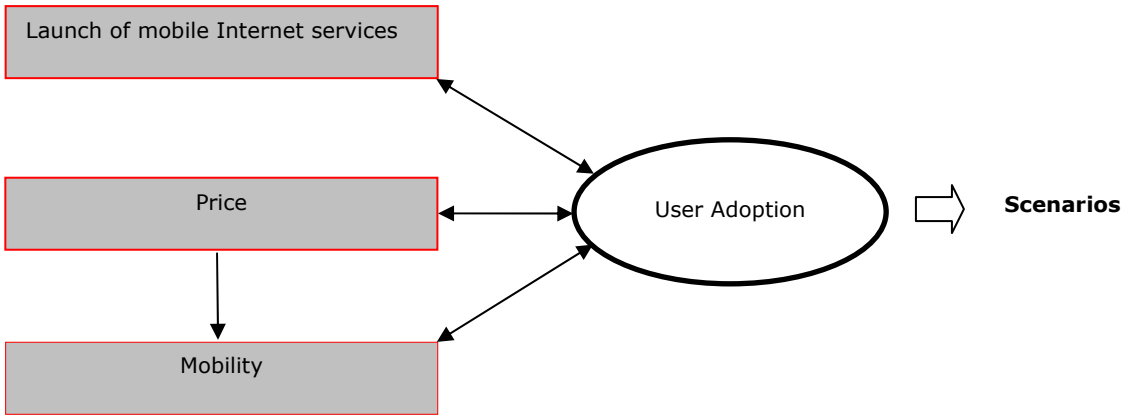

Figure 9.4 Critical Uncertainties affecting user adoption

Services for w-lan are today well defined as the technology makes the content on Internet portable. Mobile services for cellular technologies are however more uncertain. The first variable *"Launch of mobile Internet services"* is thus considered for cellular technologies. The distinction between early and late is in relation to w-lan adoption; where early implies an adoption of services before w-lan gets any substantial influence at the market. The second variable *"price"* is most uncertain for 3G why we will base our scenario variances upon the possibility of high respectively low end-user price for cellular technologies. Our definition is that high implies that it is suitable for the business segment whereas low indicates a mass market appeal. The third variable *"mobility"* is considered for w-lan as coverage and roaming is truly uncertain at this point. High mobility is considered when w-lan guarantees coverage and roaming between different WISPs in big parts of the populated areas.

All variables and their different possible outcomes are illustrated in table 9.2. From the table it appears that the variables create eight combinations that all could form scenarios on their own. We have chosen four of them to act as foundation for our scenarios. When choosing variable combination we have strived towards finding those that are clearly distinct. For example, the first combination of variables in table 9.2 is very similar to both our "Best of World" and "The queen is dead! Long live the queen!" scenarios. However, to some degree the scenario falls in between the two scenarios and therefore risks being blurry with no evident course of direction.

Launch of mobile Internet services	Price	Mobility	Scenarios
Early	High	High	
Early	High	Low	
Early	Low	High	**Best of worlds**
Early	Low	Low	**Quick adoption**
Late	High	High	**The queen is dead! Long live the queen!**
Late	High	Low	**Slow Development**
Late	Low	High	
Late	Low	Low	

Table 9.2 Different possible scenario outcomes

An early development of cellular services may, as previously discussed, generate a large installed base and create a market "take off". Possible networks externalities will bind users to these services, which limits the opportunity for w-lan to enter the market. W-lan may thus still attract a narrow segment of professional users that can not substitute the need for speed. Nevertheless, the size of the market will reduce the incitements to improve the coverage rate and make w-lan more mobile. The end-user price, as previously discussed, affects the technology attractiveness for different user segments and therefore also the size of the installed base.

Consequently, with an early development of mobile services and a low price, the possibility to obtain mobility for w-lan is truly questioned. However, we believe that a combined factor of interoperability and intelligent roaming could have the potential to neutralize the strong 3G position. These features will allow users to automatically switch between networks without any effort, or even without noticing it. Such development would render the previous 3G network externality drivers obsolete as the both networks are perceived as one. Competing for the same customers as 3G will raise incitements for w-lan to augment coverage in order to obtain a larger market share. We define such a scenario "*Best of Worlds*", as users will take full advantage from the attributes of both w-lan and 3G. If interoperability and intelligent roaming are not a reality the scenario "*Quick Adoption*" will come into play where w-lan coverage is delimited due to the high market share of 3G.

Another possible course of direction is a late launch of mobile Internet services, in combination with a high price. This development opens up for w-lan to achieve a high share of the market and building a large installed base. In the scenario, "*The queen is dead! Long live the queen!*", high mobility for w-lan is achieved through aggressive deployments of hotspots together with far-reaching roaming agreements. This makes it very difficult for 3G to reach market success beyond those in need of truly mobile services. The fourth scenario takes a late launch of mobile Internet services, high price, together with limited w-lan coverage into consideration resulting in a "*Slow development*" scenario.

- Part Six -
Scenarios

10. Scenarios

10.1 Best of worlds

Peter wakes up by the well known, but so hated, buzz from his alarm-clock. He is even more tired than usual; he was up half the night before playing the immensely popular online game Counter-Strike, but it was worth it. He played really good and improved both his ranking and reputation within the user community he belongs to.

Peter is 18 years old and makes his final semester at a senior high school in Gothenburg, Sweden. He is a rather stereotypical MOKLOF with a passion for music and gaming. He has a wide circle of friends he enjoys being together with in "real life", his rather ironic name of the non-computerized world. He also has a lot of acquaintances, spread all over the world. All communication is performed through user communities, with people sharing the same passion for music and gaming. Some of the members he would even consider friends, but when Peter reflects upon it he perceive it as somewhat awkward, as he has never met them in person and know them only by nicknames as 3LajT!, Morph, kid and numerous other

Half awake, half asleep, Peter reaches for the remote control at the bedside table and turns on his desktop computer. The customized wake-up program starts with some soft tunes from Peter's favorite artist and then cross fades over to the morning news, streamed over the w-lan Internet connection. After additional 20 minutes in bed and a quick shower Peter is ready for breakfast and grabs the smart flatscreen positioned at the desktop and walks down the stairs, meanwhile the morning news continues streaming out from the built-in loudspeakers.

During breakfast Peter reads the newspaper on the smart flatscreen; when at home he prefers it instead of his personal PDA, since it is more comfortable reading from. He also checks the television schedule for tonight and marks the shows he is interested in. This is not really necessary, as the family's intranet server is aware of his preferences and automatically records all shows Peter could be interested in. At least according to the salesperson promoting the server, but Peter's experience is somewhat different, and he wants to make sure that he won't miss the broadcast from the World Cyber Athletic Games later tonight.

Just as Peter is about to leave for school the smart screen announces an incoming transfer. It is his grandparents requesting a videoconference. Peter sighs to himself. When his parents told him they both would have to leave for a three day long business trip, Peter was looking forward to a mini vacation, including gaming, parties and late nights. Unfortunately it didn't turn out that way. His parents seemed to have been stroked by a combination of bad conscience and paranoia, and where checking in on him at least three times a day, requesting videoconferences, voice calls, e-mails and photos. And as that wasn't enough they seemed to have involved his grandparents as well, resulting in a veritable communication hysteria. For the first time ever, as far as Peter could remember, he cursed the technological evolution.

After a quick video conversation, assuring his grandparents everything was alright, Peter left the house. Equipped with his PDA and wireless Bluetooth headset, constituting the foundation of his Body Area Network and an extension of himself, he set his PDA status to appear online for friends, but offline for parents, and, not to mention, grandparents. In return he receives an

overwhelming feeling of freedom. The BAN was provided by the music channel MTVs MVO/WISP branch and so far Peter is really satisfied with the equipment. Sure, he has to stand some customized, location based commercials and agree to leave personal data, but it is absolutely worth it. In return he got a really cool device at a cheap price and favorable fees for the data transmission, including 15 Mb of 3G transfers and 100 Mb of transfers over the w-lan network, every month, all included in the subscription fee. In addition MTV provides him with some truly nice services, related to their television shows, and a cutting edge user community.

At the bus heading for school Peter connects to the gaming community he belongs to. This will cost him some money as w-lan isn't yet a standard at public buses and he have to use the 3G network. But he simply must see the reactions on last night's excellent gaming session. He exchanges some instant messages with Morph, who is rather impressed, and enters his guestbook to read and answer new entries. He also takes the opportunity to check if his best friend William is in the neighborhood. But as it seems he is offline, almost certainly still asleep.

When Peter walks through the gates into the campus his PDA makes a small beep, indicating it has switched from the 3G network to the campus hotspot network, all according to Peter's predefined preferences regarding price, speed and other communication rules. The beep isn't really necessary but Peter like to keep track of what network he currently uses as his finances is somewhat limited. Peter is for once in time for school and he takes the opportunity to listen through some new songs he downloaded yesterday. In the middle of an extraordinary great song by the Spanish group Mana, Peter's older sister Linda appear online. Peter hasn't seen her for quite some time as she works in London, and he requests a voice over IP conversation. Unfortunately, Linda can't accept it. Due to corporate policies VoIP applications are prohibited, since they are perceived as neither reliable nor secure enough. Whether this is true or not is an open question, but for sure voice over IP is coming strong. Instead, Lisa makes a cellular call, in relation to VoIP rather expensive, but it's on the company. During the call they exchange some photos, and Peter uploads the new Mana song to Linda. Then he closes the connection and heads off for this morning's first class,

Linda walks down the hallway at the Work is Fun headquarter, with Mana streaming out of her headset. She really likes the tune and reflects over how much fun Peter seem to get out of the technology. For her it's a completely different case. Sure, she sometimes downloads an mp3 file and the communication abilities let her stay in touch with her friends all over the world. But there it ends. Almost everything else is work related, and even though the technology saves time, the workload virtually seem to increase with her boss only a click away, 24 hours a day, seven days a week. What if she just sometimes could… Linda's thoughts are interrupted by her PDA reminding her of the 10 o'clock meeting.

Linda is 32 years old and is a typical YUPPLOT. She lives with her boyfriend in central London, where they also work. They both have a substantial salary, but work very hard. They are childless; there is simply no time and the career comes in first hand.

Hurrying down the corridor, Linda manages to enter the meeting room just in time. As she sits down by the meeting table, together with her boss and two other co-workers, John Andersson, the Nordic division sales manager, appears on the big screen at the wall. He is actually at home, but through his w-lan network he is able to enter the videoconference and access his files at the corporate server. After a mandatory greeting procedure the group turns their focus

on business issues. Andersson uploads the latest sales figures, which is today's matter of concern, and it materializes on the big screen. Apparently Linda's boss isn't completely satisfied and a discussion on how to improve them takes place. Linda uploads her marketing plan, which seemed to have worked above expectations in England, and through real-time notes on the screen the group tries to adopt it to the Nordic conditions. Andersson complement the analysis with a recent segmentation survey together with the latest strategic development plan, both uploaded to the, by now, rather cluttered big screen.

After another hour of eager discussions the meeting is over. Linda has a lunch date with her boyfriend, but as she leaves the building she receives an e-mail from John Andersson, he wants to further discuss the marketing plan, and an instant message from her boss who wants to see the modifications they agreed upon during the meeting as soon as possible. Linda sighs, and sends her boyfriend a video recorded message telling him that she can't make it to their meeting. She also uses the opportunity to ask him to buy some china food for dinner. Then she turns around and walks back to her office for another screen lunch.

10.1.1 What a development – how is it possible?

This scenario starts like the "Quick adoption of 3G", where 3G succeeded in attracting a large install base. Most market factors indicate a clear dominance of 3G as the platform for mobile Internet services. However, through a combination of society pull and technology push, the radio wave technology movement succeeds in altering this course of direction.

The increased use of heavy Internet applications, both at the consumer- and corporate market, created a need to take them to the next level, i.e. making them mobile. 3G did not have the technological abilities to support most of them, therefore w-lan became the most realistic option. However, the deployment and diffusion of w-lan was restrained by several factors. The most important one were the strong market position 3G possessed, defended mainly by network externalities and signaling effects, giving WISPs rather limited incitements to further deploy w-lan, as the future of the technology was somewhat uncertain. This state was fundamentally changed by two technological innovations; intelligent roaming and interoperability.

Intelligent roaming allowed the user to automatically switch between the 3G network and w-lan hotspots, creating opportunities for seamless roaming. The switching was performed based on the user's preferences regarding price and speed. Interoperability meant that the same applications and services could be used with both 3G and w-lan as communication platform. This was made possible through smart portals and applications, which were able to adjust the content presentation depending on characteristics, concerning primarily the speed, for the platform currently in use. These two innovations practically neutralized the barriers surrounding the 3G network, as there no longer were two, but one network. As the technologies were implemented in all new devices the foundation for competition was fundamentally changed. However, this only created a technological platform to build upon. In order to have real market effects it required the MNOs and WISPs to make use of it, primarily through increased coverage rate and roaming deals.

As the confidence in w-lan grew, the WISPs invested heavily in further w-lan deployment. Their prime target was the core of cities and especially public places with many people circulating. However, even though the coverage rate was improved, the market was still, from a customer perspective, rather fragmented, with many different actors. This made it difficult

to easily connect through w-lan, as it was far from certain that a particular hotspot belonged to the user's WISP. Before intelligent roaming and interoperability, when the w-lan coverage rate was limited to hotels and airports, this was not a great problem. The user accepted the procedure of alter network settings and enter his credit card number, or Surf Card code, when accessing a hotspot not belonging to the user's WISPs network. The user knew he would be using the w-lan access for quite some time, and the procedure of accessing the w-lan service actually consumed a small part of the total time the service was in use. But, as new services making use of intelligent roaming and interoperability emerged, the customers demanded that a more spontaneous use should be supported. For example, the possibility to check the upcoming cinema films and watch previews through the cinema hotspot was implemented. For this type of use the old method of connection just wasn't acceptable, it was to slow and complex and restrained spontaneous use.

The MNOs and WISPs responded to this new user demands by, in addition to increase the coverage rate, signing roaming deals in order to fully make use of the new possibilities, making it very simple to switch between technologies and access services, and ultimately altered the traditional user pattern of w-lan, from a scheduled or planed use, to a more spontaneous use.

The terminals that were used looked like the PDAs of today, however somewhat larger, or small high performing laptops. They almost exclusively had both w-lan and 3G abilities integrated, and were used in conjunction with a wireless Bluetooth headset. The larger terminals allowed for better batteries, a very important factor, as w-lan still requires more power than 3G.

In the initial state of the development there had been some concerns regarding the wireless technologies and their impact on the human health. However, soon independent reports were presented, showing that the radiation from the technologies did not affect the human body in any negative way. This was a great relief for the market actors as it otherwise had the potential to hold back the development. Another great concern was security issues. W-lan had suffered from rather serious glitches regarding security, preventing business user from connecting to their corporate server. However, most of them were solved, and w-lan was by now as secure as a wired lan. Nevertheless, remote connections were not perceived as completely safe. The increased use of Internet based services as a whole had attracted quite many spiteful hackers doing its outmost to break in to mainly corporate systems. This was though not a problem exclusively associated with w-lan, but with all systems connected to the Internet, and the security consultants enjoyed increased profits.

The development that took place changed the industry as a whole. The MNOs had initially played by the old rules, including rather high prices, volume based charging and rather closed business model. The strategies adopted by the WISPs were from many aspects completely different. They had lower prices, a flat rate oriented base for charging and open business models. As the diffusion of w-lan increased and the market "take-off" emerged, the contrast between the MNOs and WISPs simply became too obvious, and a balancing trend occurred. Still the price for w-lan was more favorable than that for 3G, mainly because of the high costs for development and deployment of the 3G network. But the foundation for charging moved to a combination of volume base and flat rate, which became the common standard. However, the greatest change, was the abundance of "walled garden" strategies. The MNOs was forced to adopt an open business models with revenue sharing between content providers and MNOs.

The technologies were adopted by all segments. An interesting trend was a new focus on female applications. The content and equipment providers realized that the female user group was an unexploited group, and a potential gold mine, that until now had received very little, if any, attention from the market actors. Many new devices designed to appeal to women occurred at the market. The situation was very much like the one that emerged when Nokia started to launch cell phones with the youth segment as target group. However, it was not only the devices that where customized for female use. The interfaces also changed, to becoming more socially oriented.

Services targeting different segments were developed in a high pace, resulting in a broad supply. Most services were sold in bundles, oriented towards both pleasure and business. This was a very successful move, as it seemed to increase the overall use. For example, most YUPPLOTs were primarily interested in time saving services and would seldom buy pleasure oriented services as stand alone products. However, when being offered them, as perceived, free of charge, they also started to use them, increasing the data traffic, resulting in better revenue flows.

10.2 Quick adoption

Year: 2007

It's the end of March and it is Friday morning. The sun is shining and it really feels like spring is on its way. Sophie is having her breakfast in bed, determined that she won't take class today, the weather is too beautiful. She is checking her mail and browsing the morning news with her brand new 3G phone. They have been expensive for a long time now, but recent drop in prices got her to upgrade from the ancient GPRS enabled phone. Most of her friends also have one, and she badly wanted one so she could use the new communication services. GPRS was good for e-mail and textual information, but she felt excluded when she couldn't join the video meetings the rest of her friends were using.

"Wonder who is online", Sophie thinks and opens her messenger client. Jenny and Madeleine are the only ones awake; the rest must be sleeping after the late party at their students' club. She invites Jenny to a video meeting.

"Hi, you look tired, what happened last night", Sophie asks.

"Oh, I met this guy, he was kind of cute, but his was nothing for me, I actually think he was a bit annoying, but I gave him my e-mail."

"So will you keep in touch?"

"Well, I won't let him see when I'm online, but he can send me an e-mail if he has the guts."

As Sophie and Jenny talks about last night, they check the pictures uploaded on the students' club webpage. Jenny is pleased because she wasn't caught together with "that guy", and she actually thinks she looks okay on the pictures. Sophie on the other hand is quit dissatisfied with her looks; those faces just do not look natural. Last night playlist is also available on the web and Sophie starts downloading it. It will come to use at tonight's party.

A couple of hour later she meets up downtown with Jenny and Madeleine for an ice-cream. As they absorb the early spring sun, Jenny receives a location based ad from H&M. They got a special Friday price on party tops if you bring the ad.

"Why don't I get one of those?" Sophie asks quite annoyed.

"You have to become a member. Your operator won't let you receive spam so you have to approve every company sending advertisements."

"Alright, I have to become a member then, I really could use something for tonight."

The girls finish their ice-cream and head for H&M. Jenny who is used to use her phone teach the other two how to access the store's webpage.

"Just start your web-client and approve the invitation to be directed to the webpage", Jennie explains. "Here you have the members section, just enter your personal details and I think you will receive the ad. You can also download the sales catalogue; however it's quite hard to watch it on the small screen so use Bluetooth to transfer it to your PC when you get back home".

At the counter they have to transfer the ad identification to a Bluetooth receiver in order to get their discount.

"Cash or phone"

A couple of years ago, credit cards were practically abandoned. VISA, MasterCard and American Express were the first to introduce a paying functionality handled by a cell phone.

The same information that was stored on a credit card is instead stored in the phone, and you have to use your personal code whenever you make a withdrawal or make a purchase.

"Phone, please"

"Your receipt, it is also stored at your personal member page, so if you wish to change you just have to bring your phone."

"Ok thanks, bye."

Amazing, Sophie thinks. It is hard to imagine how life would be without her cell phone. Before she could just talk and send some simple messages. Today there are so many services that the phone is a big part in whatever she does. And for keeping in touch with friends it is indispensable. Even her grandparents got one as a gift last Christmas, and they send lots of pictures and messages. Before we never talked on daily basis", Sophie thinks. But today it's so effortless to just say good morning or send a pictures of whatever you been doing, and it is really appreciated. The new technology really brings the family back together, Sophie concludes. Her elder brother has been having a 3G phone for quite a while since he got a company subscription. Even though he uses it mostly in work, she has noticed that he plays at lot of online games. He and his friends got some kind of a clan, and they play in worldwide tournaments. Sophie does rarely play games, she thinks it's childish and can't understand the excitement.

"Anybody up for a movie?" Madeleine asks.
"Do we really have the time", says Jennie, "We have to prepare for tonight."
"Well we can anyway see what's on for the moment"
The theatres have really adapted to the wireless concept. By using the cell phone you can view résumés, previews and even book and pay your ticket.
"Now, let's go. We can go and have a drink?" Sophie replies.

As the friends slowly walk on, the sun goes down behind the big church in the west.

10.2.1 Hallelujah, but what happened, and what about w-lan?

In this scenario we saw an early launch of mobile Internet services, both suited for 2.5G and 3G. The MNOs did early on open up for content providers which developed a vast amount of services available even before the 3G network was commercially launched. The launched services, which offered more than just logotypes and tones, together with different billing methods suited for individual needs did fast attract new users. However, most users chose to pay a subscription fee including transmission of several megabytes of data, whereupon they were charged for additional megabytes and for the specific content, even though much content were also subsidized through advertisements.

The demand reinforced the incitement to develop new and refine present services. The fast growth in the installed base initiated signaling effects resulting in regained trust and expectations, generally in mobile Internet services, and particularly in 3G. People started to believe in 3G as the next big platform for mobile Internet and the MNOs slowly dared to really consider 3G, in a foreseeable future, as a revenue source. The unexpectedly large installed base triggered network externalities that further magnified the user perceived value. The interest in 3G accelerated the technological development and soon a speed of two mb per second was achieved even during peak hours.

In Sweden the MNOs cost situation has radically improved. PTS has eased their demands of 3G installation in sparsely populated areas, resulting in operators being able to perform a more aggressive build up where the demand is at its peak. As a consequence, the price towards end customers also has been lowered. However, even though 2G and 2.5G still dominates outside the dense populated areas, MNO collaboration, primary in Sweden but also in the rest of Europe, has resulted in a steady rate of expansion of 3G in rural areas.

E-mail and in particular instant messaging are considered the "killer apps" that made cellular technologies succeed. E-mail was well adopted by YUPPLOTs who had a significant need for written communication when traveling. When 3G was commercially deployed it was a natural update for the user segment. The speed made e-mail handling faster and attachment downloads worth while. The network made it possible to achieve a secure and fast link to the corporate LAN, why it's extensively used to attain any necessary files. However, 3G is more often used by the segment in combination with a bigger device, such as a laptop. Much of their work demands a large keyboard and screen which makes the 3G smart phone unsuitable.

Instant messaging succeeded SMS and brought textual communication to another level. First implemented for GPRS many MOKLOFs used it to see connected friends and to send short messages. 3G made the features even more advanced and the speed made it possible for sending large files. The development made instant messaging an interesting service even for YUPPLOTs as they could use it for effective file transfer while being on the move. Today your messaging client includes several features: status of people in your address book, textual messages, file transfer, voice and even video communication. Video conferences or meetings are commonly used among all users. However, battery consumption is still a limiting factor that refrain far travelers from using the services.

It was quite difficult to take M-Commerce from the basic logos and ring tones purchases made by MOKLOFs. Location related mobile coupons did however prove to increase impulse buying. Buying profiles is today very effective and makes most commercials suited for the individual receiver. The concept is widely used and a valuable mean for controlling the stock-in-trade. But as with banking, cinema tickets and other services that demand extensive information; advertisements were first truly adopted as 3G made it possible to transfer high resolution graphics and video clips.

Online gaming is really big at the moment. In particular MOKLOFs are challenging each other and having tournaments over the cell phones. However, mobile games do not challenge the use of PC as a game platform but are rather used as a complement when the users are away from home. The games are usually incorporated in the phone, but can also be downloaded or bought and installed over the counter.

Location based services was in 2003 achievable through GPRS phones. However, the limited speed made users consider the services too costly and slow. But some users bought maps when traveling or used the phone as a GPS at sea or when hunting. Today, the mostly used location based services over 3G are; position-based live games and downloadable services for various kinds of product information, both moving and textual, when entering stores.

The quick adoption of 3G has put w-lan, and other radio technologies, in the shadow. The initial w-lan hype ebbed away. Several explanations were presented. For example, the associated costs for running a hotspot was much underestimated. This resulted in many small WISPs declaring bankruptcy and larger one's had to moderate their expansion plans. It also

had consequences for the price towards end-users, which was forced to be set higher than expected.

Because of rather poor coverage, higher than expected end-user price and lock-out effects caused by the success 3G; the installed base never really took-off. This had a slowdown effect on the incitements for expanding the hotspot network in order to increase coverage and mobility. W-lan, and other radio technologies, could therefore not offer a viable alternative to 3G. The portable mode offered by w-lan was in most cases substituted by 3G services or a 3G connection used together with a laptop. Nevertheless, the hotspot concept was not all dead. Still a small segment of business users who really needed the speed w-lan could offer used the technology. The availability, however, was limited to very specific locations, such as business hotels and airports, and they charged high fees for the service.

The industry is characterized by MNOs that received a 3G spectrum license and a considerable number of MVO, who were attracted by the fast success of 3G. The MVO offers subscriptions, often bundled with services derived from their core business, tailored to suit different target markets. Most MNOs and MVOs are today also offering w-lan access as a complement for 3G. Subscribers can thus use their 3G account for hotspot access in hotels and airports and are getting a joint bill. Stand alone w-lan providers don’t merely exist.

10.3 The queen is dead! Long live the queen!

Year: 2010
Jonatan approaches the 18th tee at Delsjö Golf Club. It is a splendid day, the sun stands high in the sky and the bird chirps in the surrounding woods. Jonatan pulls out his PDA and realizes, from the electronic scorecard, that he has the possibility to improve his handicap, if he makes a par on this last hole. He studies the map illustrating the course and marks the spot where he would like the ball to land after the first, very important, swing. The PDA respond by suggesting a suitable club in order to reach that particular spot, based on either this day's performance, or any other time span defined by Jonatan. Jonatan follows the suggestion and nervously snatches his new driver from the likewise new golf bag. Equipment is really the key to success, Jonatan whispers to himself, as he prepares himself for the swing of his life.

Jonatan is 61 years old and retired from his post as a CEO at a small consultancy firm 6 years ago. He must be characterized as a SALLIES, enjoying his retirement, and all the free time it created, opening up for golf, travels and pure quality time for him and his wife. His youngest children, of three, left the house four years ago, contributing to a sense of freedom Jonatan hasn't experienced since he was a child.

Twenty minutes later Jonatan returns to the club house. He didn't improve his handicap, but on the other hand, he didn't worsen it either, so altogether the morning must be considered as rather successful. Jonatan signs his scorecard on the PDA touch screen and pushes the send button. Instantly the scorecard is transferred, through the golf club hotspot, to the club's database and integrates with Jonatan previous statistics. If his handicap would have changed, the server would have sent him a new electronic handicap card with the correct scores. And maybe next time it will, at least if I buy that new putter, Jonatan thinks wishfully.

Jonatan moves over to the outdoor cafeteria and pours himself a cup of coffee. He then uses his PDA's w-lan ability to connect to the web based statistics page at the Delsjö Golf Club homepage in order to analyze his game. The more he looks at it, the more convinced he gets that the new putter would really leverage his play. It is always his close play that fails, and it's thereby the major obstacle towards new successes within the noble sport of golf, and as such it must be eliminated. As Jonatan is about to upset himself over that damn putter, Lars and Pieter comes by. They have just finished their round and sits down by the table. Jonatan tells them the story of how his putter virtually destroys his otherwise fine play. Lars and Pieter sympathize with him, and very soon they have formed a piconet through their PDA's Bluetooth abilities. They all download their personal golf statistics, through the golf club hotspot, to store locally on their PDAs and then share it by the piconet. Lars has even recorded some video clips of his swing taken from different angels, and especially Pieter is very impressed by Lars creative use of the technology. Like eager schoolboys, they compare statistics and discuss what can be improved, and how. Even though someone carefully suggests that lessons may do the thing, it all ends up with them scheduling a meeting at the golf shop the next morning. Lessons, Jonatan skeptically thinks, what nonsense.

As Jonatan drives his car heading for home, he reflects over how much his technology usage pattern has changed over the last years. When he worked at that consultancy firm Cactus, it was a completely different world. He always had a high-end cellular phone, and updated to a new PDA every year, but for what use? At that time, to even try doing anything useful on a cellular phone, besides voice call, with that microscopic screen, clumsy keyboard for text

input and a painfully slow Internet connection, borders on insanity, or at least an expression of great naiveté. And the PDA wasn't much better. Sure, it had an acceptable screen and good enough text input abilities, but where was the Internet connection? Of course he could connect through his cellular phone, but he seriously questioned that the salespersons promoting that type of solution had ever tried to configure a gprs phone, and got it working with another device, especially through that annoying IR interface. So it ended up with Jonatan using his high-end, multifunction, cellular phone for voice calls exclusively, and his 700$ PDA as a calendar and address book. And then came 3G, the supposed Saviour and answer to everyone's prayers, but what was the entire buzz about. Jonatan couldn't understand it. Of course, data transfers became faster, but was it fast enough? He had once tried a videoconference over 3G. And he wasn't impressed. Besides the rather high fees charged, the quality was bad, and it simply wasn't a enjoyable, or usable, service. In addition, all other problems, concerning screen size, text input etc, remained unsolved and Jonatan doubted that the equipment providers, at that time, even considered them a problem. If he only had had this piece of fine equipment of today when he was active in his professional life, who knows what he would have accomplished, not to mention the aspect of effectiveness, Jonatan fantasizes.

During the ride home, Jonatan makes a quick call to his wife telling her he will be home soon. He does this by using his arm wrist gprs phone, integrated with his watch. He prefers having his cell phone as a standalone product, even though there exist PDAs with integrated cell phones. Jonatan wants to make sure that he always have the ability to make a voice calls, and as there are occasions when he doesn't have his PDA available, he has chosen this solution. Besides, the cell phone and the PDA can always communicate through Bluetooth, so he does not actually loose any functionality. It was really a relief when the equipment providers realized that it had to be easy using two communication devices in conjunction. But as always concerning almost all aspects of 3G, the understanding of user needs came too late.

After finishing the voice call, Jonatan starts preparing an e-mail to his son, currently living and working in San Diego. Through the PDA's built-in microphone he dictates the e-mail. He could have chose to either use the touch screen or keyboard instead, but as he is driving he consider that a rather dangerous method. Besides, the voice input application works flawlessly under these circumstances and is much faster than the other text input methods available. At least when one considers Jonatan's limited typewriting skills.

As soon as Jonatan steps out of his car, his PDA localizes an available open hotspot and instantly establishes an connection. Jonatan steps inside and opens up the e-mail he prepared in the car and transfers it. He then calls for his wife, wondering where she is, but is interrupted by his PDA reminding him it's time for medication. Jonatan suffers from a light heart condition problem and participates in a group that tries out a new medication method. Half an hour after taking the medication, his PDA sends another reminder. It's time to fill in the evaluation report on the backside of the medication container. He simply uses a pen to mark different options in the survey, and then marks the finish field. The cardboard box uses its built-in short distance radio transmitter to transfer the survey results, together with information on how many dosages that has been consumed. Jonatan's PDA receives the results and retransmits it, through the w-lan Internet connection, to the medical company's database and his personal physician. If the dosage should need to be altered, Jonatan would receive an e-mail about this, and the PDA would automatically change its alarm pattern, if necessary.

At first, Jonatan was somewhat skeptical about the thought of sending this type of sensitive information over the Internet. But the security of w-lan has increased immensely the latest years, and if even the most paranoid multinational companies perceives it as alright sending delicate business secrets in the same manner, why not? It saves him a lot of time, and all information collected by the medical database is treated anonymously.

Even though the security over w-lan is very good, the hacker and virus attacks haven't decreased. Only this morning, Jonatan's firewall indicated three intrusion attempts, all avoided. Jonatan did send the IP numbers of the supposed hackers to the abuse section at his MVO, but knew it's rather meaningless, no one perform such attack from its own IP number. The most common manner is to "kidnap" another unprotected computer and perform the attack through it, in order to hide the real source of the attack.

The stereotypical hacker is a kid, about fifteen years old, with nothing better to do, trying to earn his own kind of weird respect. Jonatan is really sick of them, and would like to put them all behind bars, or at least prohibit them from using computers. Jonatan's quite harsh attitude origins from an incident about a year ago, when such a hacker succeeded in accessing the golf club main server. All player statistics were deleted. Jonatan was furious and non-contactable for almost a week and his heart condition wasn't better off. Since then the club security has improved a lot.

But that's history now, Jonatan says to himself, pours himself another cup of coffee and starts his PDA in order to further analyze this day's game of golf. I must have that new putter…

10.3.1 What happened to 3G?

In this scenario the MNOs fail in launching attractive services at an early stage. The few services that actually reach the market initially gain some media attention, but fall short in retaining users. The services are either of low quality or to impractical to use. For example it shown to be very difficult to make common corporate network applications to work together with 3G business applications. Instead of positive user experiences, the only information communicated about 3G concerns delays in the scheduled expansion rate. MNO after MNO declare that they will not get their nets ready in time and that the coverage will be severely limited in relation to the original plans.

Contributing to the already difficult situation was the birth of a Swedish movement focusing on health issues. Their standpoint was that the radiation from 3G transceivers most probably will cause damage to the human body, through e.g. cancer. Therefore they argued that all 3G deployment should cease until the consequences had been properly investigated. They managed to attract a large amount of members, and local politicians, going for a re-election, bent in front of the strong public opinion, resulting in a praxis of dismissing 3G building permits. Despite loud protests from the MNOs, the decision stood strong, resulting in a drawn out legal proceeding that the MNOs eventually won. The building permit authority had no legal rights to take the question of radiation into account when evaluating building permit applications. Nevertheless, the damage was already inflicted; 3G had suffered additional delays and, as the verdict didn't proved that 3G was harmless, the public didn't know what to think about the health issues. Some reports deemed it was absolutely harmless, other that it was associated with danger of life and a third group of reports simply said that it's impossible to foresee the implications, given there are any

In Sweden all delays made the regulatory authority, PTS, to react by threaten the MNOs with high conditional fees. However, this didn't improve the situation. The MNOs already had enormous economical problems and their hands were tied by their high debts. Orange had retired from the Swedish market, and others, not only in Sweden but also in the rest of Europe, were about to walk the same path. The problems originated in a 3G credibility crisis; the serviced presented were rather pale and impractical to use, and due to the high cost the end-user price was unattractive for most user groups, resulting in a very small market demand for 3G. As a consequence the MNOs, that otherwise would have been prepared to initially take some loses, hesitated in adding extra funds to finance the overall 3G expansion. Both the public, and the MNOs, confidence in 3G as the next platform for mobile Internet was heavily reduced.

The slow start of 3G, and all cellular based mobile Internet services, gave radio wave technologies, with the already extremely hyped w-lan technology leading the way, a necessary push forward. The expansion of hotspot enabled venues had continued as in the beginning of 2002, with primarily USA as a source of inspiration for other countries. At first, the WISPs targeted the business segment and charged them premium prices. However, they soon came to the conclusion that the segment was to narrow to be profitable and therefore broaden the target group. In the same time span, with initiative from WISPs in the USA, the prices towards end-customers was substantially lowered, even though the total costs associated with running a hotspot was higher than expected. Nevertheless, lowering the price was a necessity that couldn't be avoided. The WISPs had to increase their installed base in order maximize the capacity use. In retrospective, this shown to be a very successful move. As the hotspot availability increased and the end-user price decreased, the whole hotspot concept fast attracted a large installed base, further increasing the expansion rate of hotspots.

The success of the hotspot concept couldn't only be explained by the attractive price and high expansion rate. Another key issue was the inter WISP co-operation. The WISPs soon understood that in order to be a viable alternative to cellular technologies they had to meet the customers' demands regarding coverage and availability, i.e. mobility. Even though the individual WISPs performed a quite aggressive build up, they on their own, had not the resources to provide the necessary national, and international, coverage, in order to maximize user mobility. Therefore they agreed upon roaming contracts, which would allow a certain WISP's installed base to make use of other WISPs' hotspots, and vice versa, normally without any extra charges.

Besides the commercial expansion of hotspots, an underground movement, driven by the MOKLOFs, contributed heavily to the quick diffusion of the radio technologies. Initially the segment didn't attain much attention from the big market actors. They were perceived as early adopters, but without financial strengths, and therefore not particularly interesting from a business perspective. But it was actually the lack of financial strengths, and the tradition of an Internet free of charge, that drove a rather unique development. When more households invested in w-lan, in order to eliminate the cords and to create an extension of their business environment, a trend towards opening up the individual access points started, giving passers by a free w-lan Internet access. The ones that had bought the equipment, namely the MOKLOFs parents, were initially mostly unaware of their network being purposely exposed to the whole world, by their children. But as the diffusion process increased the number of w-lan equipped households, the behavior to open up ones wireless network, moved from being an underground culture to common law. Soon whole neighborhoods were cluttered with war chalk symbols, a symbol of freedom according to many. The very fragmented, non-

commercial, hotspot networks were organized by the user community, at first through many different web pages and organizations, but later only through the One community. They worked with mapping of available hotspots, "how to get started questions" and managed the relations with commercial WISPs. Of course, these types of networks generally couldn't compete with the commercial ones, but that wasn't the purpose either. They complemented each other, as the non-commercial network mostly covered areas where the commercial WISPs weren't interested in deploying anyway, such as suburbans and residential districts. But it certainly helped the WISPs; the coverage rate was improved and even if many new users initially was satisfied by only using non-commercial, free of charge, networks, they soon created a need for greater coverage and a more reliable service, and signed up at one of the commercial WISPs.

The above factors contributed to create a backbone infrastructure for handling radio technology transfers, and working business models, with a paid-for model and a free of charged model complementing each other. However, this wasn't enough. 3G had suffered quite heavily from technological limitations regarding terminals. The 3G terminals had the old design of 2 and 2.5G phones as a raw model, and inherited the built-in weaknesses regarding screen size and input method, limiting the usefulness of new services. W-lan terminals, on the other hand, were initially exclusively used in conjunction with laptops. This became the natural raw model for w-lan terminals, allowing much more advanced services and a more enjoyable user experience. The problem was the price. Laptops are rather expensive, especially in relation to cell phones, and this was a possible threat to the continuing growth of the installed base. However, the problem was overcome as specialized w-lan terminals appeared at the market. They were much smaller than laptops and looked like the high-end PDAs of today. They combined an enjoyable user experience with an attractive price and became an immediate success. Some of them had built-in 2.5G cell phones, but the most common user pattern was to have a really small phone device, with only the most basic functionality. Generally this type of equipment was integrated with for example an arm wrist watch or a necklace.

The larger sized w-lan terminals made it possible to implement more powerful batteries and this, in combination with general technological improvements regarding battery length, solved the earlier problem where for instance a single video conference almost emptied the battery source. Parallel to this, the old, and generally considered worthless, Wireless Equivalence Privacy (WEP) protocol was replaced by a new version, assuring the same security as over a wired lan. This eliminated the problem occurring when corporate users wanted access corporate servers. Before the new version of WEP, most firms' security policies didn't accept remote accesses from public hotspots, resulting in a limited usefulness of the technology. The new WEP protocol changed this, and as a result the business market penetration rate increased significantly.

Concerning services, the majority was based on the traditional web. The old values of content free of charge still dominated, resulting in revenues almost exclusively deriving from subscription and traffic fees, giving specialized application developers a hard time. The industry did its outmost to change these values, but no rational arguments seemed to work. However, the corporate market was more willing to pay for very advanced services, and thereby constituted a starting point to continuous the hard work from.

However, the fast adoption of radio wave technologies didn't constitute the end for traditional cellular technologies. Even though the hotspot coverage was near 100 % in the core of cities,

the suburban and countryside at some places had substantial glitches regarding coverage. The fundamental need of always being able to make a voice call remained, and created a market primarily for 2.5G enabled phones, as a complement for the w-lan units, which had become a standard for data communication. 3G, however, failed in meeting customer needs, not being able to compete with the hotspot concept regarding data communication, and being too expensive to exclusively use for voice calls and simple data services that 2.5G, or even 2G, could perform just as well.

The failure of 3G, and the veritable explosion in the use of radio wave technologies, resulted in substantial structural changes in the tele- and datacom industry. Two very distinct trends could be identified. First came a phase of consolidations and boom-and-bust syndromes. The traditional MNOs wanted to get into the hotspot business before it was too late to get a piece of the promising revenues. Both merges and pure takeovers, between MNOs and WISPs, became a common scene, very similar to the one that appeared when the 3G licenses were auctioned, and reports of new corporate constellations and joint ventures flooded the business press. News about merges between WISPs also became a familiar element in the business press. The major driver was the market excess capacity that did arise as too many new entrants virtually made the market over-crowded. Another driver was the need for financial strengths to keep up with the hunt for coverage. The second distinct trend was the appearance of MVOs, buying capacity from both MNOs and WISPs. Most of them were very successful as they early could offer their customers just one bill for both cellular voice calls and the w-lan access. Their lifestyle oriented image also attracted customers.

All together the industry was characterized by a sense of “wild west”, a new Klondike gold rush, not unlike the one in the late 1990, when everything seemed possible. The closed gate, which for so long had been carefully guarded by the telecom operators, was now wide open and everyone was invited.

10.4 Slow development

Year: 2010
Jakob wakes up with a start; he's been having one of those nightmares again. He can never really tell what they were about, except that it felt like falling endlessly.

"It must be the pressure of work", he thinks while he slowly realizes that he should be on his way.

Jakob is a typical YUPPLOT, he is in his mid thirties and he has made quite a career after his degree at the University of Lund. He finds his work challenging and interesting but he knows that he can't keep up the pace for much longer. His last girlfriend left him years ago when she realized that he would "never have the time" and right now it seems hard to find an opportunity to find someone he likes.

He takes the tram downtown; it is much faster during rush hour and at the same time cheaper since the Iraqis burnt their oil resources during the war 7 years ago. Jakob does also find the tram ride an occasion for checking his inbox and send some e-mails. He picks up his cell phone and turns it on.

The GPRS/3G enabled phone has been on the market for a while but he rarely finds it useful. They still heavily promote downloadable logos and ring tones, but Jakob consider himself to old for using such services. He uses the phone mainly for work, but occasionally he sends messages and pictures to his friends.

"Five new messages, some do obviously work more then me", Jakob mutters to himself. He briefly checks the senders. Three of them are just spam, and he deletes them instantly. The other two are from members in his project; a rescheduled meeting and report of the project status including a quite large attachment. Even though the 3G enabled phones let him download the attachment he can't stand the wait. Instead he puts the phone back in his pocket, thinking that he works it through when he gets to work.

Jakob spends most of his day in meetings. The company w-lan allows him to stay connected and keeps him updated whether he is in or in between a meeting. Jakob enjoys the freedom of being able to use his laptop anywhere. He is rarely behind his desk, though it was a great relieve when they got rid of the cables. These days he brings his laptop wherever he goes, sometimes he works in the different "inspiration rooms", the cafeteria or even outside on sunny days. He rarely uses his cell phone at office as all calls goes directly to his phone client using VoIP. The latency is not even noticeable and the company saves a lot by avoiding the high cellular fees. Most of his communication is as well not only voice-based and requires that he can share documents, use digital whiteboards etc. Videoconferences is thus used on a daily bases whether he communicates with customers or co-workers in Stockholm, Paris or Shanghai.

"Jakob, have you informed Jonathan about the next project?" Maria asks

"Sorry, I spoke with him on the cellular but he couldn't reach a hotspot so there was no chance to give him the details."

"It's a shame that there aren't more hotspots available."

"I know, but I catch him later."

"Ok, make sure you brief him as soon as possible. I need to get his opinion."

The availability of hotspots was really limited. But there was always a connection at the airports or in the hotels. Well, in the respectable ones anyway. Jakob and all other workers that travel frequently have a Telia Homerun subscription. It works quite well, but as long as you are away from Sweden or the major international airports you have to solve it in some other way. The most common WISPs use SMS to attain a temporary password and bills your cell phone, which Jakob considers okay if he plans to spend some time at the hotspot. However, for security reasons none at the company is allowed to access confidential information from a hotspot, but who cares, Jakob doesn't follow the rules if it makes him more productive. If Jakob just wants to check his e-mail, he does usually use his cell phone considering it takes some time before you have received a login and is connected. But using the cellular for much more than e-mail do rarely happen. Off course, instant messaging is appreciated, and Jakob thinks it is great for keeping in touch with friends and to see if they are connected. When it comes to anything more advanced Jakob thinks 3G won't do the trick.

On his way home from work, Jakob receives an instant message from his best friend, reminding him that he is going to make the main course for tonight's dinner. He jumps of at the mall, puzzled with what he is going cook.

"Maybe they got some good recipes on the web", Jakob thinks and pick up his cell phone. He doesn't get the time to browse the web for long before he sees the sign:
- Get connected; become a member or just browse our recipes for inspiration. Free of charge hotspot connection! Login: dinner.

"Why not, it is anyway better than the cell phone", Jakob thinks while he boots his laptop. When connected he automatically receives their webpage with special offers, links to the membership pages and a recipe search engine. After some browsing he decides to go for sushi whereupon he is being asked if he wants to download a five step video "how to make sushi". Jacob, who barely ever cooks himself, goes for the offer thinking he might need some interactive help preparing the dinner. Before picking the groceries he marks the box "blueprint for where to find the ingredients".

Back in his flat; Jakob sends some late MMS invitations to some forgotten friends.

"This is going to be fun", he thinks, while starting the sushi video.

10.4.1 Is this possible, what happened to the mobile revolution?

In this scenario we saw a general slow user adoption trend of all mobile Internet services. 3G is too expensive for regular users and adopted chiefly by the business segment. GPRS and EDGE has become a carrier for e-mail, instant messaging, logos and ring tones and is mostly used by young people. W-lan is used as a portable extension of Internet suitable only a limited portion of people.

The long economical regression during the first decade of the century made it hard for the debt burden 3G operators to attract venture capital. Deployments of network infrastructure were consequently delayed and past most of the dates stipulated in license agreements. The regulation authority in Sweden (PTS) was one of many who allowed delays without any economical consequences. However, issued license fees were never refunded and coverage agreements were not altered. In 2008, 3G was deployed in most European cities. Operators in countries with no coverage agreements abandoned 3G for suburban areas; instead GPRS and to some extent EDGE was used as a complementary bearer.

The financial situation had severe consequences for service development. Even though operators relatively soon abandoned the "walled garden" strategy, content provider were deterred by the financial situation and the possible threat of disruptive technologies like w-lan. The services customized for 3G were thus launched slowly and are for the moment quite few. The technological evolution was also hampered and 3G does at the moment allow speeds up to 384 kbps but is more than often limited 150-200 kbps dependant of location and the amount of users.

MNOs target group was initially business users and they actually succeeded in attracting a respectable share of this segment. However, due to high prices and promotion of services towards business users, most of the remaining segments, constituting a quite substantial part of the total amount of potential users, chose not to update to 3G.

The mostly used service among the business segment is e-mail, while location based and entertainment services haven't yet achieved any attention. E-mail is though not considered a "killer app" as many business users still are satisfied with the pure textual information obtained by GPRS. The lack of interest for any heavy services that demand the full capacity of 3G stills worries operators. Battery consumption is seen as a possible explanation; moving images just seem to suck the life out of batteries which limits the cell phones to their primarily usage: voice. But recent polls also shows that users consider many services unattractive and to costly.

As a consequence, operators have lately moved their focus to a younger segment, the MOKLOFs. Today this segment is moderately interested in services transferred by GPRS. Usually teens in the age of between 8 to 18 years download logos and ring tones and use instant messaging services while other services have been neglected. Operators hope they can make use of 3G's speed to develop entertainment services appropriate for a younger target market. The strategy will make it necessary to reduce the price and go for a larger number of users.

The speculated boom for w-lan never happened. Initially w-lan did expand, but ended up only covering mostly airports and business hotels in Europe and USA. There were two fundamental problems. First, it showed to be very difficult to make the hotspot concept commercially successful. A w-lan free of charge trend, principally led by the hotel business, made it problematical to get customers willing to pay for the service. It started by some business hotels offering their customers an Internet connection through w-lan as an extra service, free of charge, hoping it would give them a competitive advantage over other participants in the industry. Initially, it also did, but was rapidly neutralized when other hotels also migrated to offering free w-lan services. Soon almost every business hotel provided the same service, very much appreciated by the customers but perceived as a matter of course, and nothing anyone was willing to pay for. This created a situation where the hotspot equipment providers generated one-time revenues, originating from w-lan installations at different venues. The venue owners/WISPs didn't generate any revenues directly originating from the hotspot, besides the initial increased customer flow that the first movers enjoyed. The situation at hand made it rather unattractive for large WISPs to deploy hotspot networks with a high coverage rate, as they where aware of the substantial difficulties in creating volume or subscription based revenues. Consequently the expansion rate of hotspots was low, and the revenue flows deriving from the hotspot concept was not able to fully cover the associated costs.

The other factor contributing to the slow adoption of w-lan was the lack of roaming contracts. Even though it was hard to make the hotspot concept a commercial success, some WISPs tried. For example they signed contracts with coffee shop and restaurant chains to set up w-lan equipment at their venues. However, the WISPs failed to agree upon roaming contracts as they concluded to the same logic as the traditional MNOs; limiting roaming contracts to international parties. The result was, from a user perspective, a very fragmented market with significant glitches regarding coverage. The overall customer value didn't seem to match the costs associated with the offered service, and the necessary market "take-off" didn't appear to be achievable.

From a long term perspective the situation was far from optimal, neither for the venue owners/WISPs, nor for the users. The WISPs provided a popular service that they didn't get paid for and the user had limited availability of a service they had a need for. Some kind of turning-point came when the venue owners, such as hotels and airports, realized that, even though the initial deployment cost of the hotspot was low, there were several other costs associated with the service. For example, the maintenance and support expenses shown to be rather high as it fell outside the core competences of the venue owner and involvement of third party consultants was therefore necessary. In addition, the backbone Internet connection didn't came cheap either. The WISPs stood two choices; they could either withdraw the service, as its present form was not financially justifiable, or they could start charge customers. As the service fulfilled a customer need, the WISPs gradually started to charge customers.

W-lan is in particular used by the business segment while traveling. Hotspots at hotels are mostly appreciated as the user can prepare presentations and meetings. There are yet still security issues worrying managers, why access to the corporate LAN is usually restricted. Many companies have as a result installed secure servers where users can upload documents and important material for hotspot access. There are hotspots at almost every airport but they are not used as much as anticipated. Business users are shown not to spend a considerable amount of time waiting for flights why hotspot access is considered too complex. Instead travelers usually make use of their cell phone for quick e-mail handling.

The usage of w-lan among other user segments is indeed limited. University students are thus the most frequent users. They can afford the expensive laptop or PDA needed for a w-lan chipset and they have no fixed offices providing them with a wired connection. Students have also shown behavior suitable for a portable mode. They use hotspots when studying, particularly when they collaborate in team assignments, or when they are having breaks at the local diners. Hotspots are accordingly deployed in the campus surroundings making w-lan a good business opportunity for local keepers of restaurants and coffee shops. The hotspots at the University are thus often free of charge for students. Besides for studying purpose and Internet browsing, some students, mainly men, use the hotspot for Internet gaming.

The industry is today characterized by a few large MNOs that have survived the market consolidation. The few MVOs that entered the market initially, left as soon as it seemed hard to attain revenues. The w-lan WISP constitutes of a limited amount of stand alone operators and some larger actors that covers strategically important areas like hotels and airports.

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www.zdnet.com

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11.3.1 Future of Wireless. School of Economics and Management, Lund, 2002

Participants:

Anders Cedervall	Teleca
Mats Ekstrand	SonyEricsson
Kristina Eneroth	School of Economics and Management
Tomas Holmstrand	KiConsulting
Fredrik Häglund	School of Economics and Management
Peter Höjerback	IT Öresund
Mikael Karlsson	Axis
Ulf Körner	LTH
Vicky Long	Ericsson
Allan T. Malm	School of Economics and Management
Christer Månsson	Arena WI.SW BTH
Fredrik Neuman	Orange
Sven-Christer Nilsson	Startupfactory
Nils Rydbeck	LTH
Martin Tidell	Vodafone
Magnus Wide	School of Economics and Management
Riku Österman	Sonera

11.3.2 Interviews

Martin Börjesson. 2002 Scenario Planner, CR&T, Göteborg

Peter Gärdenfors. 2003 Professor of Cognitive Science, University of Lund

Filip Lindell. 2003 Senior manager of wireless strategies, Ericsson, Stockholm

Professor Gerald Q "Chip" Maguire Jr. 2002 Professor Computer Communication, KTH Stockholm

Johan Åslund. 2003, Consultant, Netlight, Stockholm

11.3.3 Comdex in Gothenburg

Microsoft

BrightSpeech

Possio

IP Mental

11.3 Oral sources

11.3.1 Future of Wireless. School of Economics and Management, Lund, 2002

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Anders Cedervall	Teleca
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Peter Höjerback	IT Öresund
Mikael Karlsson	Axis
Ulf Körner	LTH
Vicky Long	Ericsson
Allan T. Malm	School of Economics and Management
Christer Månsson	Arena WI.SW BTH
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12. Appendix

12.1 Basic concepts

12.1.1 Cellular concept

Despite the development and enhancement through different generations, the fundamental of cellular telephony is still the concept of cells. The figure below (figure 12.1) shows how the cellular service divides the area to be covered into a number of geographical regions, called cells. Each cell has a cell site that contains the carrier's radio antenna and a transmitter/receiver. The cell site handles the communication between the subscriber's cell phone and the Mobile Telephone Switching Office (MTSO). If the other party is also a cellular customer, the MTSO sends the signal back out to the other party's cell site. If the other party is on a regular telephone, the MTSO passes the signal to a local carrier (Panko, 2000).

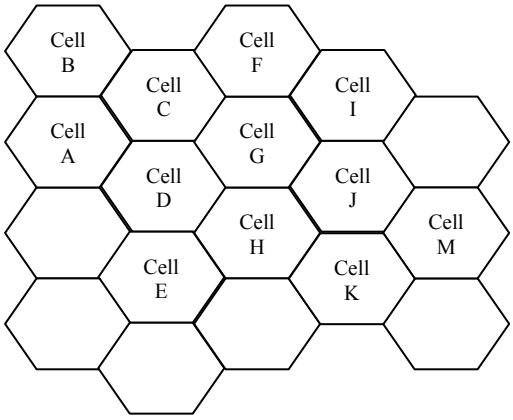

Figure 12.1 Cellular Telephone System, Source: Panko, 2000

12.1.2 Handoffs and roaming

When a subscriber moves from one cell to another the system automatically execute a handoff, passing responsibility for service to the subscriber's new cell site. This happens so rapidly that few people are aware when it occurs.

Roaming takes place when a cell phone moves from one cellular system to another. Within countries, i.e. between cities, roaming is usually well working while international roaming can be more limited. Roaming is a key to mobility and therefore is great efforts made for standardization. A common standard will allow users to experience the same services wherever they travel worldwide, i.e. seamless roaming (Panko, 2000).

12.1.3 Channel reuse

Signals from cell phones do not travel very far which enables channel reuse in the same cellular system. The same channel can be used in nonadjacent cells making it possible to reuse a channel every 7 cells. If someone talks in Channel 1 in Cell E, someone can be talking on Channel 1 in Cell A (figure 12.1). Channel reuse is an important way of using the bandwidth more effective. The number of channels also delimits the number of subscriber that can be served within a cellular telephone system (Panko, 2000).

12.1.4 Frequencies – spectrum – service bands – channels

Electromagnetic signals consist of waves. The frequency of waves is measured in Hertz. One hertz is one cycle per second. For higher frequencies, in increasing factors of 1000, we have kilohertz (kHz), megahertz (MHz) and gigahertz (GHz).

The range of frequencies from zero hertz to infinity is called the frequency spectrum. The spectrum is divided into service bands for particular uses, such as cellular telephony or radio bands. These service bands are subdivided into individual channels. Signals in different channels do not interfere with one other (Panko, 2000).

12.1.5 Bandwidth

The difference between the highest and the lowest frequency in a channel is the channel's bandwidth. For example, if the highest frequency is 12 MHz and the lowest 10 MHz the channels bandwidth is 2 MHz.

Shannon discovered the relationship between bandwidth, noise and maximum possible transmission speed. His equation shows that the most important factor for speed in a channel is bandwidth even if signal-to-noise ratio is important (Panko, 2000).

$$W = B \, Log_2 (1 + S/N)$$

W is the maximum throughput in bits per second. B is bandwidth in hertz and S/N is the ratio of signal strength to noise energy strength.

12.1.6 Multiplexing - timeslots

Multiplexing is a way to mix the bursts of many connections onto a single line. Radio transmission uses the technique when dividing the spectrum into channels (frequency division multiplexing, FDM). Another method is time division multiplexing (TDM) used by splitting radio channels into timeslots. Timeslots allows users to share a channel through sending and receiving data in different periods of time (Ekelund, 2000; Panko, 2000). The GSM system has divided every channel into 8 timeslots, each of which has the capacity to move data at 9.6 Kbps. In a GSM call, a user occupies one timeslot during the entire connection (Siemens, 2002).

12.1.7 Modulation

To transmit digital signals over the telephone system you must convert the ones and zeros into electromagnetic signals. This is called modulation and is actually the function of modems, which transform digital signals into an analogue form and the reverse when receiving, i.e. modulates/demodulates.

There are several ways of modulating a signal. For instance, figure 12.2 shows frequency modulation and amplitude modulation. In the former a high frequency represents a one and a low frequency represents a zero. In the latter, ones and zeros are represented at different amplitudes.

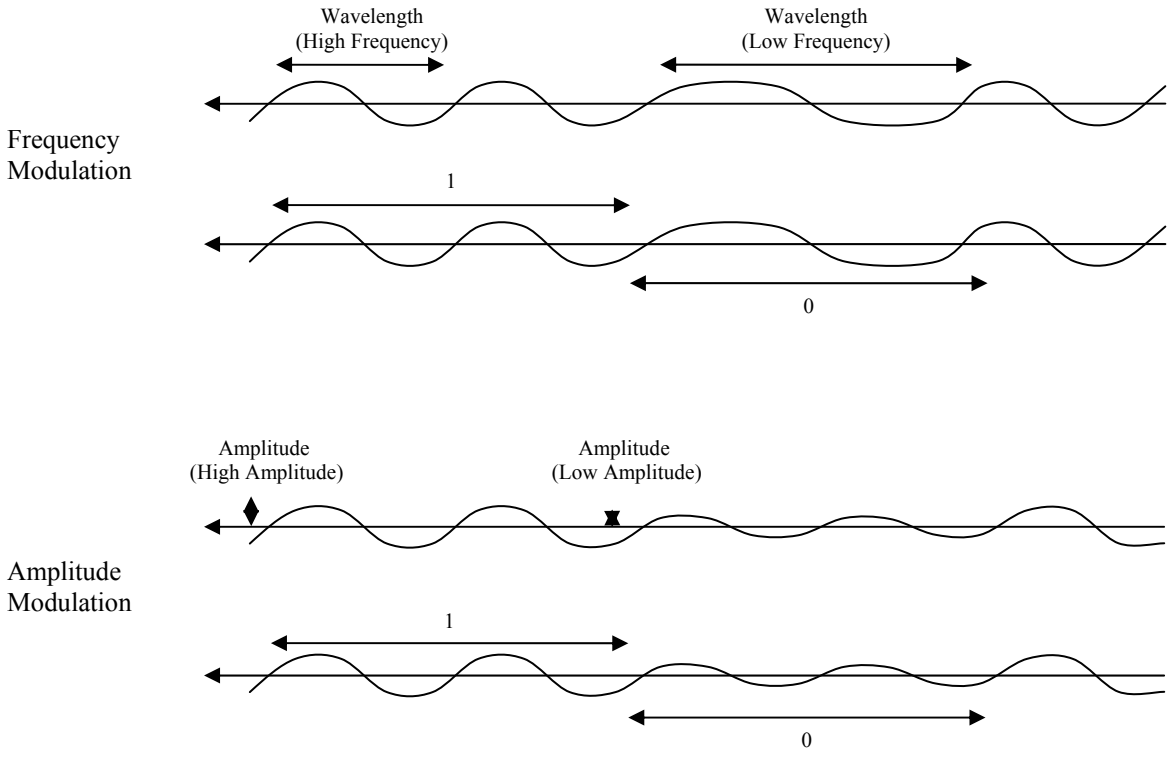

Figure 12.2 Frequency and Amplitude modulation, Source Panko, 2000

There are more complex modulation schemas that combine multiple forms of modulation, so that they can send more bits per line change. However, the many states may increase the error rate and thus the need for error correction. Modulation is one way to affect the speed of transmission without changing the bandwidth (Panko, 2000).

GSM and GPRS implements Gaussian Minimum-Shift Keying (GMSK) modulation which includes four coding schemes (CS) while EDGE implements the Eight-Phase-Shift Keying (8 PSK), including nine modulation coding schemes (MCS). Each of the coding schemes employs different data coding (user payload) and channel coding (header and protection) rates as figure 12.3 illustrates. All are designed to deliver the optimal throughput under different radio environments. The lowest throughput gives the highest error correction while no error correction gives the highest throughput (Locke Terry et al, 2002, Vitanen Timo, 1999).

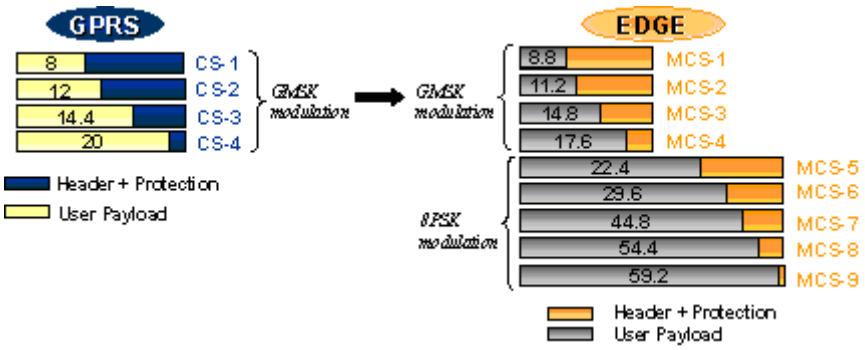

Figure 12.3 (Locke et al, 2002.)

12.1.8 Packet switching & circuit switching

The telecom system uses circuit switching, which reserves capacity for the call until the user hangs up (Panko, 2000). The frequency is hereby occupied whether the user sends something or not. An obvious usefulness with circuit switching is that no matter how busy the network gets, there will be no delay when talking. On the downside, the dedicated capacity is costly and greatly limits the number of users.

In contrast to a voice call, when you speak almost all the time, data transmission is bursty. For example, when using the World Wide Web, downloaded bursts are usually followed by several minutes when you neither receive nor send bits of information, i.e. you examine the downloaded information. In data communication you often transmit or receive less than 5 % of the time (Panko, 2000). Yet with circuit switching, you pay for the capacity 100 % of the time.

Because circuit switching is not good for bursty data traffic, data networks use a different type of switching called packet switching. With packet switching, the information is split into separate but related packets of data before being transmitted and reassembled at the receiving end. Packets can be sent through different parts of the network, taking advantage of spare capacity and can be reassembled in correct order at the destination (Panko, 2000). Packet switching means that the network is used only when users are actually sending or receiving data. Consequently, the capacity of the network is more efficiently used, e.g. pauses during transmission, is available for other users and will not remain unused as with circuit switching. The actual number of users served depends on the amount of data being transferred, instead of as in circuit switched networks, the number of available timeslots or channels.

The GSM system uses circuit switching by dedicating different timeslots to each connection. This makes it necessary to bill the user for the entire time connected, regardless of the transmitted data volume (Siemens Press, 2002). GPRS technology allows users to share timeslots by sending packets of information, which consequently demands new pricing models.

12.1.9 Quality of Service

The high voice quality is provided through a system that simulates the circuit switched connection-based network, called quality of service (QoS). QoS is a way of matching the amount of allocated bandwidth with the quality requirement of each specific transmission service. The purpose of QoS is to provide time critical transmission with more bandwidth, thus using the frequency spectrum as efficient as possible (Noréus, 2001).

Eriksson et al defines four application-related service-classes that are four different QoS-levels (Noréus, 2001):

1. The background service class is meant for e-mail, SMS and file transfer. These services do not require low transmission delays and are therefore given the lowest priority of the four service classes.

2. The interactive service class applies to services on the Internet like browsers and Telnet. Minor transmission delays are accepted, yet the service has to have a low error rate.

3. The conversational service class is used for voice telephony, videoconferencing and other services where low transmission delays are important.

4. The streaming service class is used for one-way transports like video and audio streaming with high demand for low transmission delays.

12.2 The early generations

12.2.1 First Generation (1G) of cellular systems

In Europe, several different analogue cellular standards were used, like the Nordic Mobile Telephone standard (NMT). The frequency spectrum capacities were quit limited, so that only a fairly limited number of customers could be served. The European market eventually gathered around the digital standard, Global System for Mobile (GSM) technology. GSM spread to be used in almost all other nations than the United States (Panko, 2000).

The United States settled on the Advanced Mobile Phone Service (AMPS). AMPS is an analogue standard which later, in only a small percentage of channels, became converted to the digital variant, Cellular Digital Packet Data (CDPD).

12.2.2 Second Generation (2G) of cellular systems

The use of micro cells in the 1990's form the shift to the second generation of cellular telephony also called Personal Communication System (PCS). A PCS micro cell covers only a quarter or less of the area of old cells. This increase the number of cells used and extends the channel reuse, which is the real key to capacity improvements in PCS. The size of micro cells also decrease the distance for a signal to travel between the subscribers cell phone and the cell site, lowering power requirements and permitting cell phones to be smaller, lighter and less expensive (Panko, 2000).

The service of the second generation also improved by assigning bandwidth in the range between 1.5 GHz to 3 GHz. Allowing 150 MHz of capacity, compared to 50 MHz in the first generation systems. Bandwidth is the most important factor when improving speed.

A third key to improved capacity is signal compression. The voice signal is compressed to about 12 kbps to 20 kbps, instead of 64 kbps.

Overall, the second generation cellular system can serve more than 100 times as many subscribers as the former generation.

In Europe and in most parts of the world the second generation is the Distributed Communication Service (DCS). DCS is even known as DCS 1800 because it operates at 1710 to 1785 MHz and 1805 to 1880 MHz. Because DCS is a modification of GSM technology, DSC is usually known as a GSM system.

In the United States no single standard has emerged. The use of multiple technologies limits roaming within the U.S. and internationally (Panko, 2000).

12.3 EDGE deployment

Country	Operator	Status
Anguilla	Cable & Wireless	Planned
Antigua & Barbuda	Cable & Wireless	Planned
Argentina	Telecom Personal	Planned
Australia	Telstra	12/2004
Australia	Optus	Planned
Barbados	Cable & Wireless	Planned
Bermuda	Telecom	Q1-Q2/2003
Bermuda	The Bermuda Telephone Company	Planned
Canada	Rogers AT&T Wireless	03/2004
Cayman Islands	Cable & Wireless Cayman Islands	Planned
Dominica	Cable & Wireless Dominica	Planned
Grenada	Cable & Wireless Grenada	Planned
Hong Kong	Peoples Telephone	Planned
Hong Kong	Hong Kong CSL	In Trial
Hong Kong	Sunday	In Trial
Jamaica	Cable & Wireless	Planned
Mexico	Telcel	Planned
Singapore	StarHub	Planned
Montserrat	Cable & Wireless	Planned
St Kitts & Nevis	Cable & Wireless	Planned
St Lucia	Cable & Wireless	Planned
St Vincent & The Grenadines	Cable & Wireless	Planned
Turks & Caicos Islands	Cable & Wireless	Planned
Singapore	StarHub	In Trial
USA	AT&T Wireless Group	Deployed
USA	Cingular Wireless	Deployed
USA	Dobson Communications	Deployed
USA	T-Mobile USA	Deployed

Table 12.4 Worlds EDGE deployment (www.gsmworld.com, 2003)