Wireless Fidelity

A Scenario Analysis

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Abstract

Title: Wireless Fidelity – A Scenario Analysis

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Discussion: The most significant impacts on the telecom industry over the past decades have been the rapid growth of the Internet and mobile telephone services. Currently these two worlds are converging. Moreover, the fast expansion of wireless high capacity Internet access, increased distribution of local/public hotspots and rapid development of wireless network cards have opened new opportunities for the mobile telecom industry.

Research Questions: To what extent could the explosion of local and public wireless networks, using WiFi technology, affect the future telecom industry? Who will ultimately master the WiFi innovation and to what degree could this innovation open new possibilities for external players to enter the mobile voice industry?

Purpose: The purpose of the Master Thesis is to provide Sony Ericsson Mobile Communication AB with the most transformational scenarios, which will enable employees to recognise patterns and interpret the meaning of WiFi-related events as they unfold.

Conclusions: In the US telecom industry there are signs of disruptive elements with overshot customers and non-market circumstances. Entrant WiFi/VoIP providers might pose a threat to incumbent players, by bringing voice services into new context, built on low-cost business models. An early convergence between VoIP and WiFi combined with freestanding widespread wireless IP networks indicates a future disruptive path. However, incumbents' willingness to co-opt the WiFi technology innovation, by creating fixed mobile convergence, may generate a non-asymmetric situation pointing towards the direction of a sustaining industry development.

Key Words: WiFi, Scenarios, Disruptive Innovation, Telecom, US

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Lund, June 1, 2006

Ola Mellberg Jens Mårtensson

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1 Introduction

This chapter will present the overall framework of the Master Thesis, describe the content of the thesis and state the research question along with the purpose. Finally, the authors will communicate constrains and chosen limitations in addition to the thesis road map.

1.1 Background

Across the sweep of history, industry leaders have done a poor job identifying the innovations that have had the most transformational potential and impact on industries.[1] Back in the 1940s, the CEO of the IBM Corporation Tom Watson uttered: "I think there is a world market for maybe five computers." Moreover, Bill Gates founder of the Microsoft Corporation, expressed that "640 kilobytes of memory ought to be enough for anybody."[2]

One can understand that these types of estimations are extremely difficult to make, especially in markets with a high degree of innovations and converging value chains. To better cope with these decisions at executive levels, e.g. which widgets or services to offer and how to develop them, successful managers need to learn how to carefully consider the way they analyze information and the way they create and evaluate options. At a corporate level, successful decision making becomes more about listening than telling and more about understanding than directing. Hence, leaders need to be inclusively flexible and integrative to secure an open pipeline of information as well as a free flow of organisational knowledge.[3]

The industry of telecom is a large and globally significant industry, which has a long and illustrious history of innovations. Today, US telecom-related expenses account for roughly three percent of the gross domestic product. Moreover, within this industry the two most important impacts over the past decades have been the explosive growth of the Internet and mobile telephone services. The Internet brought the benefit of data communications with email, Web and eCommerce, while mobile service has enabled "follow-me-anywhere/always on" telephony. The Internet furthermore, helped accelerate the trend from voice to data networking and currently these two worlds are congregating. The above outlined phenomena offer the benefits of new interactive multimedia services coupled to flexibility and wireless mobility.[4]

In the present day, the voice market is continuously moving towards a converged infrastructure based on Internet Protocols, but the Internet revolution is incomplete

[1] Christensen C. M., Anthony S. D., Roth E. A (2004) S*eeing What's Next*, p. xxii
[2] Ibid.
[3] Brousseau et al. (2006) *The Seasoned Executive's Decision-Making Style*, p. 114
[4] William L., McKnight L. W. (2003) *Wireless Internet Access: 3G vs. WiFi?* , p. 353

and the business models are still under development. Incumbent operators have been slow to offer broadband voice services to the customer and further allowed a window of opportunity to develop.[5]

1.2 Problem Discussion

The explosive growth of high capacity Internet access, increased distribution of public and private hotspots and rapid development of high capacity wireless network cards have created opportunities for mobile telecom.[6] Voice and data communication has earlier only been possible through an Internet connected computer. However, the resent improvements in wireless technology, i.e. the WiFi 802.11 standard considering physical size and decreased energy consumption, provides an prospect to integrate a high capacity network card into the mobile handset.[7]

The WiFi 802.11 standard allows the user to connect to the Internet using a wireless high capacity connection without the use of wires. This outlook offers the possibilities of wireless access to the Internet, using a mobile handset, not merely in homes, offices, airports and cafe's, but also in metropolitan areas using mesh standards. Since WiFi has a high capacity, is inexpensive and easy to set up, corporations as well as municipals are currently considering deployment of WiFi networks. The corporations and municipals are mainly consider WiFi as an alternative to traditional Local Area Networks or 3G to improve internal efficiency and decrease telecom costs. The WiFi technology is thereby a threat to the cellular industry which has invested heavily in the 3G technology to provide Internet access. [8]

Moreover, WiFi-enabled handsets in combination with software, from for instance Skype, might bring voice services to the end user at no additional cost. Studies show that a majority of all mobile traffic occurs in locations where WiFi access could be available in the future, such as homes, offices or in other indoor environments.[9] Today, Skype gains more then 150 000 new users everyday, in addition to the 100 million current customers and the prospect has shocked many incumbent voice players, such as the mobile operators. [10] A worse case scenario, which the major existing voice players might face, is the appearance of a critical mass of WiFi-enabled handsets. This fact could unleash a significant structural change in the voice market by removing a large proportion of public switched telephone network revenues.[11] Several operators are at the moment considering to block this kind of application of their subsidized handsets.[12]

[5] Analysys (2004) *Emerging Business Models in Voice* p. 10
[6] Allan Sundström, Lund 2006-02-02
[7] Johan Karlberg, Lund 2006-01-16
[8] Analysys (2004) p. 2-4
[9] Johan Karlberg, Lund 2006-01-30
[10] Skype Official Webpage, 2006-04-29
[11] Analysys (2004) p. 1
[12] Johan Karlberg, Lund 2006-01-19

So, is WiFi to become next big communication revolution? It might be, but since radio signals travel in the air, security could be an issue. Furthermore, as the world grows to be wireless, problems with co-existence in the free license spectrum might occur. These problems could be solved over time, which might facilitate an exceptional WiFi technology diffusion. However, legislation against municipal wireless at federal level, heavy promoted by operators, may also be a potential stumbling block as the WiFi development progresses. A challenge for the WiFi industry is how to cope with these and other governmental issues that might arise in the future due to the increased utilization and availability of WiFi networks.

A major question for incumbent voice players, fixed or mobile is whether or not there are potentially strong business models, which players outside the cellular voice industry, such as Skype or WiFi providers, could use to transform the marketplace. However, the improved technology clearly opens gates for the future telecom industry by lowering industry barriers, increasing competition and fragmenting existing market. [13] These opportunities and markets forces carefully have to be addressed and evaluated by the incumbent operators to avoid being forced out of the marketplace. Thus, the mobile handset manufacturer Sony Ericsson Mobile Communication (SEMC), that today retails a majority of its handsets to mobile operators, carefully have to follow market development to be able to make the right decisions as new technology and new players might enter the marketplace. [14]

Deriving from the outlined material above the main research questions for this Master Thesis has been formulated in the following manner:

> To what extent could the explosion of local and public wireless networks, using WiFi technology, affect the future telecom industry? Who will ultimately master the WiFi innovation and to what degree could this innovation open new possibilities for external players to enter the mobile voice industry?

1.3 Purpose of the Master Thesis

The purpose of the Master Thesis is to provide SEMC with the most transformational scenarios, which will enable employees to recognise patterns and interpret the meaning of WiFi related events as they unfold.

1.4 Target Audience

The target audience for this thesis are employees at SEMC working at a corporate level in general and individuals functioning at departments such as Business Strategy, Product and Application Planning in particular. The thesis is also intended for those who are academically interested in the area of WiFi technology development.

[13] Analysys (2004) p. 5-6
[14] Johan Karlberg, Lund 2006-02-06

1.5 Constrains and Limitations

The empirical findings, scenarios and conclusions will be focused and deployed on the US marketplace, since the US WiFi industry is far developed and the marketplace contains a great deal of the industry and political forces which are to be found in Western Europe. Though, the west European marketplace, especially with regional political differentials, dramatically increases the number of possible scenarios and portrays a rather complex marketplace image. Moreover, the US marketplace has come a long way developing wireless cities, which is remarkable and potentially could enable mobile voice over IP to entire communities. Finally, in corporation with experts regarding the scenario methodology approach, the timeframe of the thesis has been set to the interval between four to six years. This interval is long enough to make the scenarios interesting as well as short enough to make the thesis both appealing and achievable.

1.6 The Thesis Road Map

This Master Thesis encloses ten individual chapters, which together form the framework of the thesis. In chapter 2 a methodology study in two parts is undertaken. In the first part, the scenario related literature was studied and evaluated and in the following part the importance of proper research design was assessed according to scenario specific criteria.

In addition, the authors engaged in a theoretical dialogue, which is to be found in the theoretical framework of chapter 3 and the concluding features from the theoretical discussions are Clayton Christensen's disruptive innovation theory, which brought understanding to the argumentation regarding the significance of the innovations within the US telecom marketplace.

Chapter 4 is mainly dedicated to the essential history of the US telecom industry, whereas chapter 5 focuses on the technology within the US telecom industry. Furthermore, in chapter 6, the factors affecting the present industry structure are outlined and towards the end of this chapter a scenario system is defined by the authors. The scenario system illustrates the context and set the boundaries for the scenario analyses, which are central in this thesis.

In chapter 7, major trends which influence the scenario system from the outside are assessed and in the forthcoming chapter 8 and chapter 9, the empirical findings blend together with the research question and theoretical framework. This unification develops an overall understanding of possible scenarios, concerning the future US telecom industry. Finally, in chapter 10, the authors recapitulate the main conclusions deriving from the thesis in general and the scenario analyses in particular.

2 Methodology

The main purpose of this chapter is to clarify and illustrate in what manner the thesis has been undertaken. The methodology is furthermore meant to guide the reader through the thesis and empower him or her with the understanding concerning the authors' proceedings. The chapter is divided into two parts: a scenario methodology study as well as a reflective part covering the importance of proper research design.

2.1 Introduction

The large and significant telecom industry has a long and illustrious history of innovations. Today, US telecom-related spending accounts for roughly three percent of the gross domestic product.[15] Making incorrect decisions, like choosing wrong technologies, could therefore have fatale results and as a consequence executive decisions need to be broadly defined and consist of multiple courses of action. To be able to make these types of decisions, executives need to have a large number of inputs and be happy to explore a wide range of viewpoints, including those that conflict with their own, before arriving at any conclusion.[16] That is, wait as long as possible to make any decisions at all,[17] or as Sir Winston Churchill once said:

"The plan is nothing; planning is everything"

Perhaps it sounds un-counterintuitive, but this is how a large amount of military planning works; one tries to anticipate every contingency, but recognises that the battlefield is going to follow its own disorderly logic, and that the most valuable thing planning will amount to is an ability to improvise when the moment comes.[18] Therefore, the authors believe that the use of an inductive driven scenario methodology in combination with a deductive theoretical framework, with focus on innovations, will provide the proper tools to successfully answering the thesis research question. Furthermore, this will deliver understanding regarding telecom events, as they might appear and create the opportunity for SEMC employees to make the right decisions at the right time.

2.2 Scenario Methodology

There are a number of ways to embark on a scenario analysis, but based on the above argumentation and conducted interviews together with a substantial methodology investigation one scenario methodology branch have turned out to be the one best suited for the task at hand. This scenario development branch has been named

[15] Christensen C. M., Anthony S. D., Roth E. A (2004) p. xxxiv
[16] Brousseau et al. (2006) p. 114
[17] Berth Eklundh, Lund 2006-02-04
[18] IFTF Official Webpage

Intuitive Scenario Development (ISD) by the authors. Information regarding the path to this choice as well as additional specifics concerning scenario methodologies may be further explored in Appendix 4 of this thesis.

However, as it turns out there are a range of different methods and processes are available within the ISD branch alone. In Appendix 4, seven of these methods have been outlined and compared. Throughout this outlining exercise, the authors have found that the seven different methods have evolved somewhat in different directions during the last decades and today they range from an informal imaginative exercise performed by a single individual to a systematic group process. Furthermore, the scenario writers Postma et al. argue that there is no standardized process and many differences can be observed between the various approaches, however in general they show some basic structure.[19] In addition Berth Eklundh, scenario consultant and originator of Profounder, argue that the methodology alone does not create value and stresses the fact that it do not exists such thing as an ultimate scenario methodology. For every new occasion and every new market the methodology needs to be adjusted to fit the situation at hand. If not, and if one method is copied and used straight from the textbook, the outcome is likely to be inflexible and might not deliver high level scenarios.[20]

After considering facts and thoughts from various scenario thinkers, the authors have come to the conclusion that a specific model for this particular thesis needs to be chosen and possibly slightly modified to fulfil the specific needs. Before choosing such model though, a few key areas of concern have to be taken into consideration. First of all, one has to be aware of the fact that several methodologies only make use of two scenario dimensions when creating scenarios, as Figure 2.1 below demonstrates. When investigating the telecom industry in general and the highly complex and dependent WiFi technology in particular the authors have learnt that, in it in this particular case is nearly impossible. Consequently, the method used in this thesis ought to have more dimensions present.

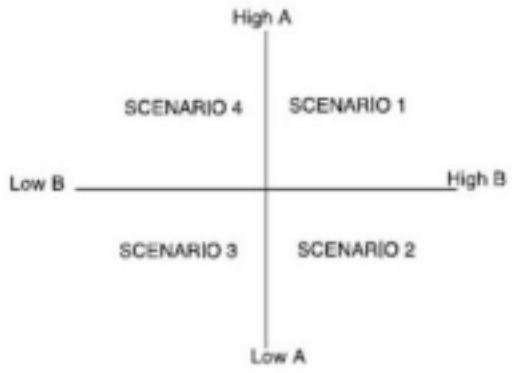


Figure 2.1: *The two dimensional scenario cross*[21]

[19] Postma T.J.B.M, Liebl F. (2005) *Technological Forecasting & Social Change*, p. 163
[20] Berth Eklundh, Lund 2006-02-04
[21] Postma T.J.B.M, Liebl F., (2005) p.164

Moreover, the method should be based on an existing method, since skilled individuals have put a lot of thought into these models in the past and therefore it would be unnecessary to invent the wheel again. Finally, one has to keep in mind that scenario creation is all about collecting meaningful pieces of a puzzle within a given framework. In current time the future is undetermined and the ways that the future may develop might grow exponentially, which the left figure below illustrates. Still, only a few of these options will actually happen, which the figure on the right indicates. Consequently, one can not predict the occurrences in future time, which are impossible to imagine in current time.[22]

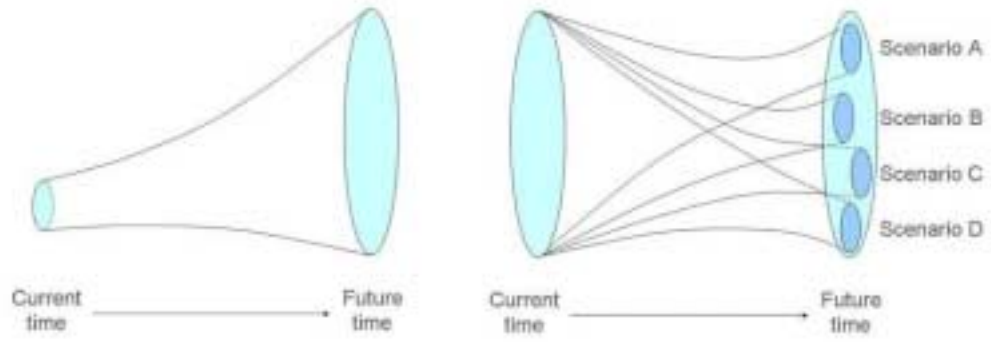


Figure 2.2: *Undetermined futures*[23]

Though, using a suitable scenario planning methodology one can utilize the scenarios as a tool (exemplified with a car driving in reverse) which helps to navigate backwards into an uncertain and unpredictable future. When reversing, it will be possible to see the warning flags, representing early indicators, passing by on the both sides of the freeway bound for the future. As the future is vague this scenario planning vehicle, driving in reverse, will make it possible for the driver to act in an early stage to prevent going in the wrong direction or taking a wrong turn further ahead, that is, scenario planning is not a crystal ball, but rather an instrument of early indication.[24]

After considering the above areas of concern the authors felt that the method, which will be the most suitable for the task at hand, is the one presented by Bood and Postma.[25] This is a model with six individual phases and it has been developed as a reference or generic model to illustrate the main steps, which they have concluded are common throughout the ISD methodology chaos. Bood and Postma's generic methodology has a broad range of references, but has the deepest roots in the methodology presented by Peter Schwartz.[26] However, after finalizing the decision regarding scenario planning model the authors have, together with Berth Eklundh,

[22] Berth Eklundh, Lund 2006-02-04
[23] Ibid.
[24] Ibid.
[25] Bood R., Postma T. (1997) *Strategic learning with Scenarios,* p. 634-635
[26] Ibid., p. 634-635

reviewed the model and made necessary modifications in order to meet the requirements of the highly evolving US telecom marketplace as well as the purpose of this Master Thesis. The conclusion of this exercise might be examined below.

Phase 1

The first phase proposed by Bood and Postma is the identification of a focal issue, which constitutes a real problem to be investigated. During this phase the local context of the focal issue is demarcate i.e. the time horizon of the scenarios is determined. [27] The identification of focal issue as well as the time horizon has previously been outlined in this thesis and more specific in the opening chapter under the "Purpose of the Master Thesis" and "Constrains and Limitations" headings.

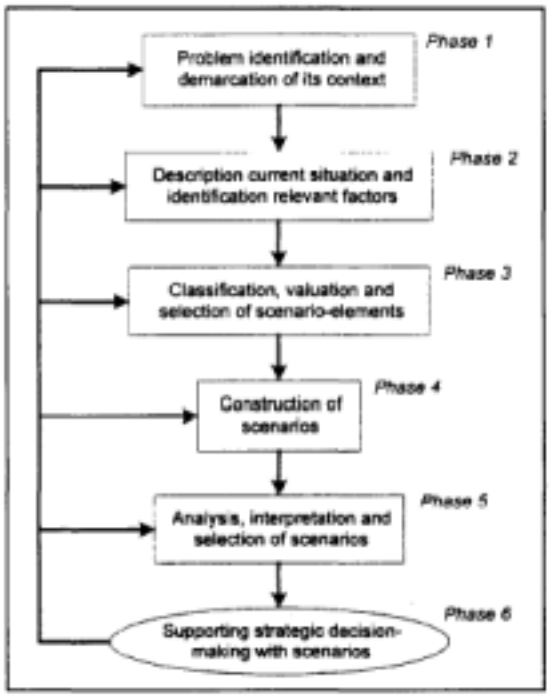


Figure 2.3: *Scenario Method used in the thesis* [28]

Phase 2

Next, the current situation should be studied and relevant factors ought to be identified.[29] In the "current situation analysis", the authors mainly gathered empirical material from journal articles, analytical rapports and interviews. Since this particular information often is possessed by individuals within organisations, it does not have high focus in most scenario planning methodologies. One exception however, is the methodology that KAIROS Future AB proposes, which has a unique tracking part in the scenario planning process. The main purpose of their tracking segment is to

[27] Bood R., Postma T. (1997) p. 634-635
[28] Ibid.
[29] Ibid.

follow up on historical data, present status as well as the identification of key trends.[30] The authors have found inspiration from that particular step in their model and the gathering of empirical material in historic, present and future time is to be found in chapter four to six in this thesis. Moreover, the part where the "relevant factors" ought to be determined is crucial, as these factors fundamentally determine future developments. Nevertheless, as usual when it comes to scenario methodology literature there is a lot of different terminology available to choose from. Peter Schwartz and van der Heijden uses the word "driving forces"[31] while Porter makes use of the term "causal factors"[32] and Bood and Postma utilizes the expression "relevant factors" in their model. However, to narrow down the possible confusion, the authors have use the most common way of describing this rather important term, which subsequently led to the use of the driving forces idiom.[33] Finally, phase 2 in the Bood and Postma generic method, is equal to the analyses carried out by the authors in chapter eight of this thesis.

Phase 3

In phase 3, Bood and Postma, propose that a classification/valuation exercise should be carried out as well as implementation of the scenario elements or scenario logics. The authors have chosen to label this the scenario logics, since the term is better known and the scenario logics main function is to make sure that the scenarios are utilizing the same starting point and underlying foundation, to be able to deliver reliable scenarios. Nevertheless, the driving forces have been presented in a matrix where the diverse scenarios are identified and their characteristics are entered. Finally, the logic of a given scenario have been characterised by its location in the matrix. The classification exercise arranged the previous identified driving forces into two main categories, the predetermined elements, which might be exemplified by demographics and the uncertainties, which typically are clarified with the example of public opinion. [34] The classification of the two elements represents a crucial step in the scenario development process, but the uncertainty turns out to be the most significant of the two and by artificially varying fundamental uncertainties, in the scenario logics, each scenario might portray another future state. In doing so, the scenarios highlight the importance and consequences of the uncertainties.[35] More differences between the two above outlined elements as well the rather complex process of scenario logics creation, will be further outlined in chapter eight under the "Driving Forces" and "Scenario Logics" headings.

Phase 4

From the process of creating the scenario logics a few general scenario themes should emerge. These initial scenario skeletons might be implausible, inconsistent or irrelevant, but they are important as they provide the future scenario boundaries.

[30] Göran Krafft, Telephone Interview, 2006-02-17
[31] Schwartz P. (1991) *The Art of the Long View*, p. 101-108 & van der Heijden (2002) *The Sixth Sense*, p. 169-171
[32] Porter M. (1985) *Competitive Advantage*, p. 447-450
[33] Bood R., Postma T. (1997) p. 634-635
[34] Ibid.
[35] Ibid.

Additionally, they are also serving as a framework used to organize the possible outcomes and trends about. As the trends by definition appear in every scenario, they can be given more or less weight or attention in different scenarios. This will also be examined and outlined in chapter eight under the "Scenario Skeletons" headline.

To be accepted by the organisation the scenarios constructed have to be understandable, feasible and internally consistent. Hence, they should not reflect the "most likely" future nor should they be perceived as good or bad, as such qualifications are meaningless given the great number of future uncertainties. Basically the scenario should be viewed as a process of formally codifying knowledge for a wider group[36]. The construction phase normally starts as the logics of the scenarios have been selected and ends with stylised stories.[37] According to Schwartz, the main challenge of the story writing is to identify the design that best capture the dynamics of the situation and communicate the point in an effective manner. This can be accomplished by returning to the lists of driving forces and trends identified in previous phases. If possible, each driving force and trend should be given some attention in each scenario and one should then weave the pieces together in the form of a story or a sequence of events. A useful control question might be: What events might be necessary to make the end point of the scenario believable? [38] Finally, the goal is to end up with merely a few scenarios, which make a difference to decision within the organisation. If the scenarios are to function as a useful learning tool, the lesson they teach must be based on issues stated in the first step of the process. In this case, it means going back to the purpose and research question of the thesis and evaluate if the questions have been answered. [39]

This is the end of the active scenario developing phases in the scenario methodology, presented by Bood and Postma. The scenarios are then ready for exploitation and, in this case, to be utilized as a tool for analytics at SEMC to recognise patterns and interpret the meaning of WiFi related events as they unfold.

Phase 5-6

When browsing trough scenario related literature one most certain will have the feeling that there are a range of different steps left before the scenarios are ready. However, the authors believe, that these steps proposed by e.g. van der Heijden are mainly present because it is his way to differentiate from other methodologies and be unique. Van der Heijden has found this uniqueness through a obvious focus on organisational learning, which of course is a good thing, but one might be able to compress the last three (out of seven) process steps to one single "organisational learning step". Bood and Postma have noticed this fact and writes that "this may not be as important as the scenario literature strongly suggests". Bood and Postma furthermore suggest that the active construction of the scenarios, in phase 1 to 4, is more important then the actual use of the scenarios in phase 5 and 6.

[36] van der Heijden K. (2002) p. 213-214
[37] Bood R., Postma T. (1997) p. 634-635
[38] Schwartz, P. (1996) p. 245-247
[39] van der Heijden K. (2002) p. 217-219

Nevertheless, the authors have decided to make use of one of the concluding steps presented by many scenario literature writers, which is the utilization of early indicators. Once the different scenarios have been created a few indicators to supervise an ongoing way should be described. If those indicators are selected carefully and imaginatively, the firm may gain a jump on its competition in knowing what the future might hold in the given industry. In this manner, the scenarios will be able to translate movements of a few key indicators into a neat set of industry specific propositions. In this way, the logical consistency that was built into the scenarios will allow logical implication of leading indicators to be drawn out of each scenario, which SEMC in this case might benefit from.[40]

2.3 Limitations of a Scenario Methodology

Some of the main characteristics of the scenario planning methodology are equal to the positive aspects with a scenario approach, including making managers aware of environmental uncertainties and producing indications of future possibilities as well as triggering the processes of organisational learning. However, there are limitations too, but before leaping into a discussion regarding these limitations one should note that scenarios are to be used in situations where the high levels of uncertainty more or less exclude the use of other techniques.[41] There are, in fact, numerous limitations to be found in contemporary scenario planning literature. However the authors have chose to examine three limitations, which all are of a major significance to this thesis.

The first and most noteworthy limitation is the issue of "unknowables", which is the principal of being able to deal with what is known and what is not known in order to provide relevant information for early indication purposes. According to Postma & Liebl, scenarios focus on predetermineds and uncertainties. Predetermineds exist based on the assumption that the alternative future outcomes and probabilities are a prior known, but in case of uncertainties, the outcomes are known but not their probabilities. These two will be further outlined later on in this thesis. On the contrary, in the case of the unknowables, neither the probabilities nor the outcomes are known. As the name clearly states, the unknowables can not be forecasted, thus they could become very relevant for decision makers.[42] To clarify this rather complex issue, Schoemaker argues about future relevant knowledge by distinguishing between three categories of knowledge[43]:

Things we know we know
Things we know we do not know
Things we do not know we do not know

The initial category is fairly evident and in this case scenario building is especially helpful at supporting knowledge exemplified by the second category. However, the

[40] Schwartz P. (1996) p. 245-247
[41] Bood R., Postma T. (1997) p. 635
[42] Postma T.J.B.M, Liebl F. (2005) p.166
[43] Schoemaker P. (1995) *Scenario Planning: A tool for strategic thinking*, p. 41

main challenge is to transform the knowledge in category three back to category two and precisely that is what represents a good scenario analysis with a system of early indicators.[44] The authors have stressed this particular issue as a conclusion of each scenario presented in chapter 9 of this thesis.

The second limitation is that individuals within the organisation expect from the scenario method to deliver more than it really does and it is also expected that plans will come out of the scenario process, which is not true.[45] In addition, one should not forget that scenarios focus on organisational awareness and learning. They can be used as "test beds" for the various strategies, but they do not produce specific plans for decision making.[46] So, how should this issue be addressed? According to Postma & Liebl, the key is to truthfully deal with new, future unknown and paradoxical trends which are essential for the future of an organisation and must therefore not be neglected. The authors have given this issue some serious thought in the specific trend chapter of this thesis. In addition, the authors have developed a theoretical framework that, based upon Clayton Christenson's disruptive innovation theory, supports the concept of being able to value new underperforming innovations and organisations, which is very important when one wishes to see the larger picture in general and, in this case, the US telecom industry in particular.

The third main limitation involves the number of scenarios that should be generated and in most cases many scenarios are needed in order to cover all the possible developments. However, it is very difficult for the human brain to handle too many scenarios and the best number of scenarios to be generated is around three.[47] Though, one should be careful, since three scenarios might be considered as the cynical option i.e. the optimistic, the crazy and of course the most likely one. On the other hand, two scenarios might be considered as the good and the bad case. The authors have taken this issue into consideration as the scenarios have been developed in chapter 8. One can not pay too much attention to this during the process of developing the scenarios, since one need to be flexible throughout the process. Hence, the reflections made towards the end of this thesis have been written after the four constructing phases of the scenario process were finalized.

[44] Postma T.J.B.M, Liebl F., (2005) p.166
[45] Bood R., Postma T. (1997) p. 635-637
[46] Bradfield et al. (2005) *The origins and evolution of scenario techniques in long range business planning*, p. 806-809
[47] Wack P. (1985) *Scenarios: shooting the rapids*, p.140

2.4 The Scenario System

To become more specific regarding what to include in the scenarios, the authors created a scenario system, which is demonstrated below. Inside the system, symbolised by the cloud, the empirical findings, including technologies and industry structure as well as non-market context, for instance governmental agencies, illustrates the context of the various empirical components. In addition, market related trends are affecting the system from the outside, which is illustrated by the arrows pointing at the system cloud. Together, these individual components set the boundaries for the scenario analysis in this thesis and moreover create the "world" where the authors are living in as the scenarios are created. A nuclear war, for example, is not a part of the scenario system and if it was, it would have been visible in the system illustration below.

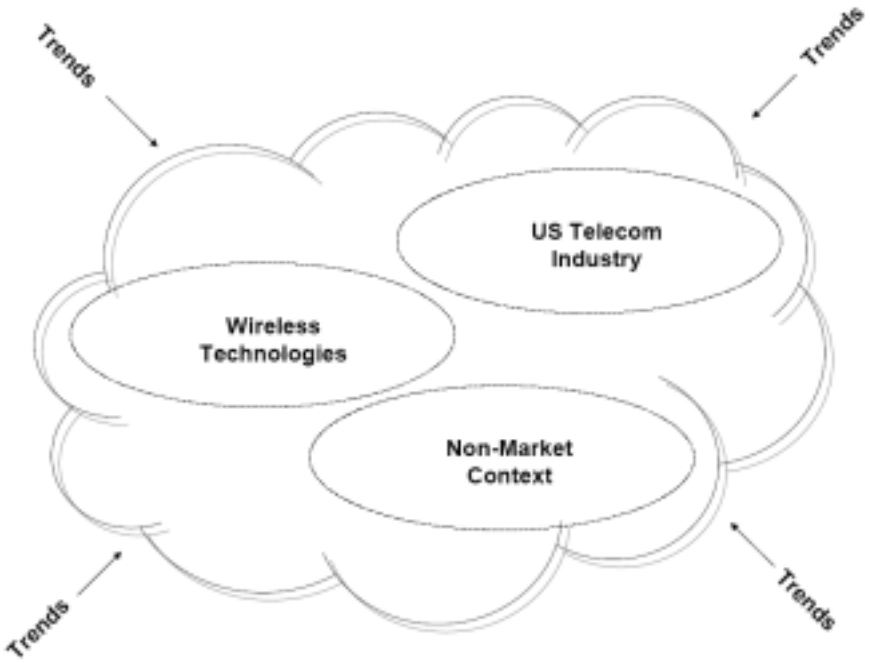


Figure 2.4: *The system which set the boundaries for the scenarios*

2.5 Research Design

In previous assessed scenario planning literature the authors found support for the choice of a qualitative approach when using an ISD methodology. Millet[48] for instance, argued that if no probability is attached to the scenarios the output should be of a qualitative nature and Bradfield et al.[49] mark that scenario development is subjective and largely qualitative in nature. Furthermore, as overlooking the extensive research on the subject of quantitative in opposition to qualitative research conducted by Bryman & Burgess, the authors became even more convinced that the qualitative one was the right way to approach the subject matter presented in this thesis. Their conclusions and the authors' comments are summarized below.

		Quantitative	Qualitative
(1)	Role of research	Preparatory approach	Exploratory approach
(2)	Relationship between researcher and subject	Distant	Close
(3)	Researcher's stance in relation to subject	Outsider	Insider
(4)	Relationship between theory and research	Verification of theory	Discovery of theory
(5)	Research strategy	Structured	Unstructured
(6)	Scope of findings	Irrespective of time and place	Specific time periods and locales
(7)	Impact and role of social change	Neglect	Embrace
(8)	Nature of data	Hard & reliable	Rich & deep

Table 2.1: *Differences between quantitative and qualitative research* [50]

(1) As outlined earlier, the ISD approach to scenario planning places this thesis in the qualitative column of the above table, since this thesis is set to explore and examine the future WiFi market characteristics and not conduct preparatory work for further investigations, as the quantitative approach often is associated with.

(2) Furthermore, the authors' excursion to the US has provided an extensive overview of the US marketplace and a number of qualitative interviews have been carried out with important players according to the research subject at hand. This is not a typical quantitative behaviour, as these projects rarely involve any contact with the individuals, which are being studied.

[48] Millett M. S. (2003) *The future of scenarios: Challenges and opportunities*, p.19-20
[49] Bradfield et al. (2005) p. 806
[50] Bryman A., Burgess R. G. (1999) *Qualitative Research*, p. 35-45

(3) A quantitative researcher commonly applies a pre-ordained framework the subject being investigated and is involved as little as possible in that world. The authors have, on the contrary, aimed to "live the consumer" and really be a part of what is going on in the industry today, to be able to predict what will happen around the corner, a number of years from now.

(4) According to the authors´ qualitative research design, the theory is used from an innovation perspective, to develop new ways of thinking of the competition on the future US telecom marketplace. On the other hand, quantitative researchers often reject the idée of using theory as an originator to an investigation and rather use their empirical material to accept or reject a specific theoretical argument.

(5) Quantitative research is often very structured in its approach as the methodology demands highly controlled surveys and experiments to ultimately come to a conclusion. In contrast, the authors have chosen a more unlocked approach to the subject with the objective to stay unaffected as far along the process of writing as possible.

(6) The authors have a clear scope including the limitations in chapter one as well as the scenario system, witch were described earlier in this chapter. The time limitations of four to six years and the geographical area, which were limited to the US marketplace, are also indications of a qualitative approach. On the contrary, a qualitative approach would have searched for general findings, which could be estimated to hold irrespective of time or place.

(7) Quantitative research communicates an image of the reality which is principally static and has a tendency to neglect the impact and role of social being. On the other hand, the authors will embrace the social change as it is a vital part of the scenario planning concept in general and important driving forces in the process of developing the scenarios in particular.

(8) Quantitative data commonly exhibit rigorous precision, have been collected by systematic procedures and may easily be checked by another investigator. These assumptions are not true regarding quantitative research as well as this thesis since the data is collected through interviews, which are read and interpreted by the authors.

Moreover, for a student writing a Master Thesis, the knowledge regarding the above outlined models are vital to be able to gather information and pursue science. It is important to master the art of thinking critically to be able to sieve and recognise whenever literature is tainted with the scientist's personal values and believes. The philosopher Karl Popper has an opinion on this subject and he states that scientists never can verify a hypostasis to one hundred percent. On the contrary, he argues that a scientist can prove if the hypostasis is false, falsify it. Hence, the truth, according to Popper, is only temporary and is a subject of change in the future.[51] The authors have noticed this issue when conducting interviews and Swedish IT entrepreneur, Jonas

[51] Thurén T. (1991) *Vetenskapsteori*, p. 61-71

Birgersson, provided a thought that clearly addressed this particular concern. The reflection explained the fact that individuals in the industry are likely to think of technology development in linear terms. However, history and statistics clearly shows that the development is nothing like linear. It is rather exponential in its nature, which one has to be aware of when conducting these sorts of interviews with technologically influenced individuals throughout the telecom industry.[52]

When one is about to embark on scenario planning with internally consistent storylines and adequate reliability and validity, a number of different approaches are available.[53] In scenario literature the common methods for this process are inductive, deductive and incremental.[54] The authors have not use the latter of the three approaches to secure validity and reliability, due to the rather simple fact that there will not be a debate regarding a most likely future, as the business strategy department at SEMC puts value and trust into the process of developing scenarios. However, the authors have not merely used one of the other, but instead concluded that a combination of the two is suitable for this thesis. Initially the inductive methodology has been applied, as the authors used the empirical findings to locate and developed the driving forces, the scenario dimensions as well as the scenario logics. Thereafter, to create understanding, the inductive part is coupled with the theory and the scenario development process in a deductive fashion, as the scenario skeletons were established and formed. This type of joint relationship between the two methods is by Alvesson & Sköldberg described as the abductive approach, which in this particular case offered superior value above one single approach.[55]

To sum up, the qualitative method was chosen and a combination of the different ways of reaching reliability and validity, the process of abduction, was used. Finally, to be more specific and to exemplify how the empirical material has been collected and utilized throughout the thesis, the actual data collection procedure has been outlined here beneath.

2.6 The Actual Data Collection Procedure

To perform the scenario analysis, additional information needed to be collected and several interviews were necessary. The authors approach to the interviews has been semi structured, which means that an inspiring discussion has been prioritized rather than a formal question-answer technique.[56] Moreover, virtually all empirical findings that have been used are from primary resources that have been gathered through interviews with a number of individuals throughout the industry. Initially, the interviews were held with SEMC employees to establish a main understanding regarding the rather complex industry structure. As the thesis progressed and due to the choice of narrowing down the scope to the US marketplace the authors embarked on an interview and study trip to the US. The excursion became an opportunity for

[52] Jonas Birgersson, Lund 2006-05-08
[53] van der Heijden K. (2005) *The Art of Strategic Conversation*, p. 236
[54] Ibid., p. 196
[55] Alvesson, M., Sköldberg K. (1994) *Tolkning och Reflektion*, p. 42
[56] Andersen I. (1998) *Den uppenbara verkligheten*, p. 29

empirical collection from a range of different perspectives and the interview objects were carefully chosen and the meetings were all well planed before leaving Sweden.

The first stop was at the Muniwireless convention in Atlanta, which basically is the collective organisation for citywide wireless broadband projects. In this environment a number of interesting and well reanimated individuals were interviewed and several question marks concerning the future industry were straitened out to exclamation marks. The outing then continued with a visit to the city of St. Cloud, which is the first municipality to offer free WiFi to its citizens. The Mayor of the city, the Head of IT and the president of MRI[57] was interviewed. The authors also attended a workshop meant for the citizens of St. Cloud and learned about their relations to the free WiFi project. Furthermore, an informative interview with former Ericsson CTO Nils Rydbeck was undertaken and the pioneer wireless handset vendor Calypso Wireless was also visited. The authors concluded the trip with several interesting and applicable interviews in the New York City area, where important individuals in the wireless movement FON and city officials from the New York City council were interviewed, all in the semi-structured approach described above.

During the last weeks of scripting and scenario writing, complementary interviews were undertaken, e.g. was the Swedish Internet entrepreneur Jonas Birgersson consulted, as an authority in the Internet marketplace in general and as an FON associate in particular.

[57] Please consult Appendix 1 for a Organisational Overview

3 Theory

This chapter presents the theoretical framework of the thesis. The main intension will be based on innovation theory and the possibilities to identify market changes and disruptive innovations within an industry. Finally the authors will present a method for using disruptive innovation theory to analyse and predict industry change.

3.1 Disruptive Innovation Theory [58] [59]

The concept of disruptive innovation theory came from Clayton Christensen's research concerning the disk driver industry. The research identified more than hundred innovations and classified them as either sustainable or disruptive. Sustainable within firm, to that extent they allowed the firm to provide better and more profitable products to their customer. Disruptive, because they initially offered less performance in dimensions that existing customers cared most about. Christensen's findings indicate that incumbents companies to a high degree can cope with the sustaining innovations, but often tend to fall for disruptive innovations.

The following Figure 3.1 illustrates the disruptive innovation theory. A market is made up of many different groups of customers, whose needs are illustrated in the figure with dotted lines. These customers can be classified by how demanding they are, that is, what kind of problem they want to solve and what types of products they require to solve those problems. Figure 3.1 only illustrates a few customer groups, in reality most industries contain several customer groups from not very demanding to very demanding. The majority of the customers are somewhere in the middle and are often called the core of the market or the mainstream of the customer.

[58] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 277-279
[59] Christensen C. M. (2003) *The Innovator's Dilemma*, Ch. 4

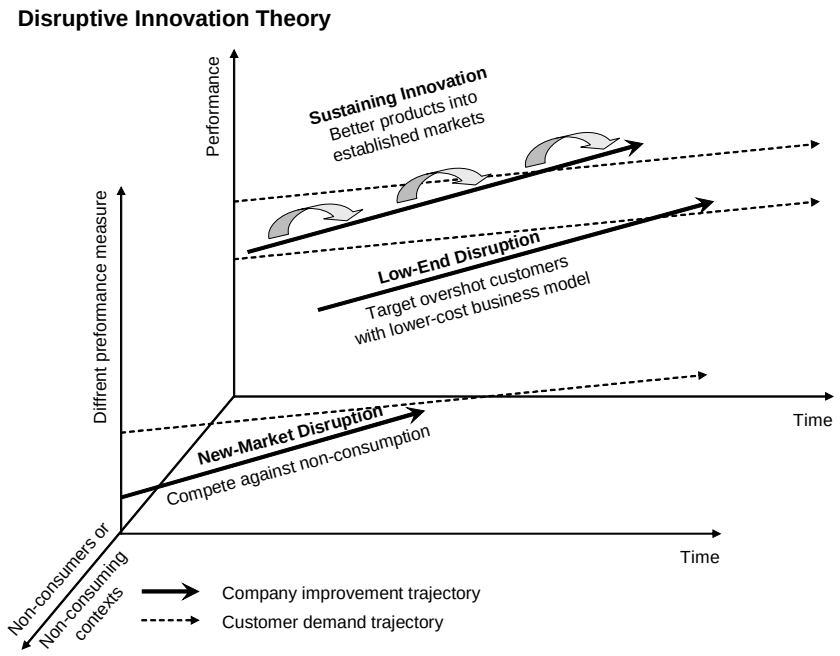


Figure 3.1: *Disruptive Innovation Theory*[60]

Incumbent firms in the industry have very strong incentive to innovate and move up-market as more demanding customers tend to pay premium prices for products or services that solve the toughest problems for the customers. Commonly throughout the industry, companies are capable of innovating faster than the end consumers are able to adapt and move up their requirements from which value is measured. Hence, the pace of sustaining innovations frequently exceeds the ability of costumer to absorb it, illustrated as the black lines in Figure 3.1.

The above facts, open doors for disruptive development and disruptive products or services that are initially inferior to existing products in turn of quality by which the mainstream customers measure value. However, they are typical more affordable and simpler to use than products in the existing companies product portfolio. All disruptions are predicated on creating growth opportunities way from the core of the incumbents markets. There are two distinct opportunities for entrants to capture on incumbents market and build disruptive business. They can compete against non-consumption market by establish an entirely new market, *new market disruption*, or they can enter from the low end by deploying a business model that serve the less demanding part of the market, *low end disruption.* In the latter case the market leaders are happy to share as they themselves move up-market heading for premium prices.

[60] Christensen C. M., Anthony S. D., Roth E. A (2004) p. xvi

Initial disruptive innovation is not good enough to meet the performing requirement of the core mainstream market. However, the disruptive innovators aggressively move up-market on their own sustaining improvement trajectories as they chase more attractive margins. Eventually, when the disruptive innovations are good enough to meet the needs of the larger mainstream customer group the incumbents are forced further up-market or completely out of the market. Hence, disruptive innovations typically pose difficulties for industry incumbent leaders, who are faced with the choice of investing to improve their products along the sustaining trajectories or investing in disruptive innovations. The choice is difficult because sustaining innovations in short term perspective appears to be much more attractive than disruptive innovations, even though disruptive innovations often ultimately drive more long term growth.

3.1.1 Resources, Processes and Values Theory [61] [62]

The resources, processes and values theory (RPV) explain why existing companies tend to have such difficulties managing disruptive innovations. The RPV theory holds resources (what firms has), processes (how firm does its work) and values (what firms wants to do) collectively define an organisation's strengths, weaknesses and blind spots.

Resources are assets that organisations can buy, sell, build or destroy e.g. individuals, technology, products, equipment, information, cash et cetera. Processes are established ways of turning resources into products or services e.g. hiring and training, product development, manufacturing, planning and budgeting, market research. Values determine the criteria by which prioritization of decisions are made e.g. cost structure, income statement, costumer demand, size of opportunity. Firms are able to successfully undertake opportunities when they have the resources to succeed, when their processes facilitate what needs to get done and when their values allow them to give sufficient priority to that particular opportunity in the face of all other demands that compete for the company's recourses. Existing firms master sustaining innovations because their values prioritize them and their processes and resources are designed to deal with specifically those types of innovations. Incumbent firms fail in the face of disruptive innovations because their values will not prioritize disruptive innovations and the firms´ existing processes do not help them do what needs to get done.

3.1.2 Jobs to Be Done Theory [63] [64]

The jobs to be done theory hold that products are successful when they connect with a job that the customers find necessary to get done. That is, products that make it easier for customers to do something they are already trying to accomplish. Products that successfully match the job that the customer find important will end up being the real

[61] Christensen C. M. (2003) Ch. 8
[62] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 279-280
[63] Ibid., p. 281
[64] Christensen C. M. (2003) Ch. 3

"killer applications". By identifying what jobs individuals really care about and develop products that make it easier to achieve these jobs, companies can identify new markets that they were previously unaware of, which could not be uncovered by ordinary market research. Understanding those jobs that are not adequately satisfied by current products provides deep insight to what are and what will be the truly innovative products that please existing customers.

3.1.3 The Value Chain Evolution (VCE) Theory[65] [66]

The VCE theory argues that industries tend to evolve from states of independence, where leading firms need to be integrated vertically, to modularity in which specialist firms that are responsible for critical pieces of the value chain. By producing key product components they can earn an unbalanced share of value in an industry.

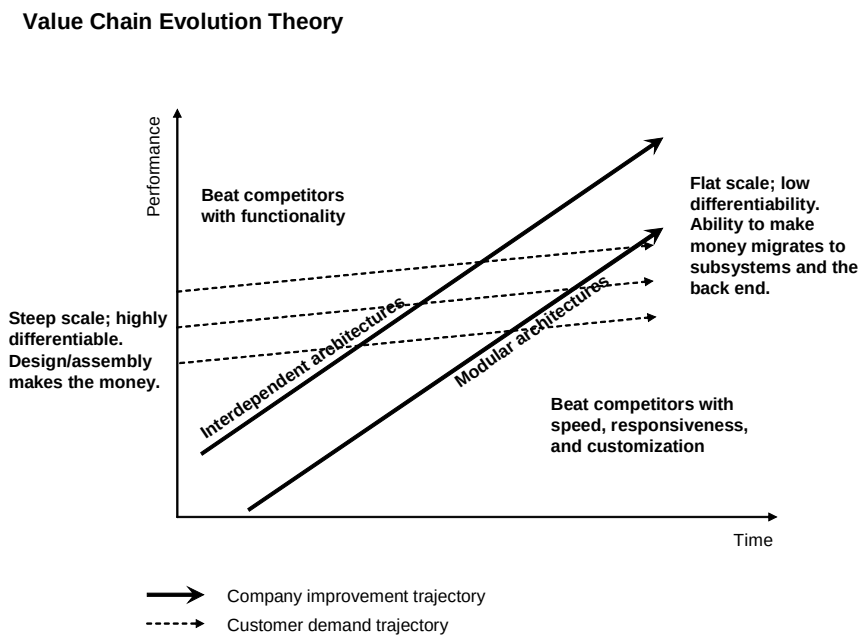


Figure 3.2: *Value Chain Evolution Theory*[67]

Before a product or service is good enough to meet mainstream customer needs, integrated firms that control the entire production and delivery process are best suited to coordinate the complexities developers are facing when they try to improve the product. Companies that solve these problems are rewarded with an out of proportionate share of industry profit.

[65] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 281-283
[66] Christensen C. M. (2003) Ch. 5-6
[67] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 282

To improve products, firms often must use new and unproven technologies or put existing technologies together in new ways, creating new patterns of interaction and new problems. Pushing the edge of what is possible requires proprietary, independent architecture and in this circumstance, integration gives firms a full platform to run engineering experiments to wring out continued improvements.

As companies overshot their customers' needs they no longer need the benefits that integration brings, instead they compete based on capacity, flexibilities or convenience. In an effort to develop products or services more quickly companies tend to standardize interfaces between various parts of the products or services. These standards eventually evolve into an industry wide standard and allow product architecture to become modular. Modular products or services allow companies to get to the market faster because they can replace a component without redesigning an entire product. Modular architecture also enables specialist firms capable of delivering products that fit these interfaces. This change leads integrated firms to outsource pieces of their product to vendors that meet their specifications.

3.2 Using Innovation Theory to Predict Industry Change

Christensen has developed a three step process using disruptive theories to predict industry change, which is further explained in Figure 3.3 below.

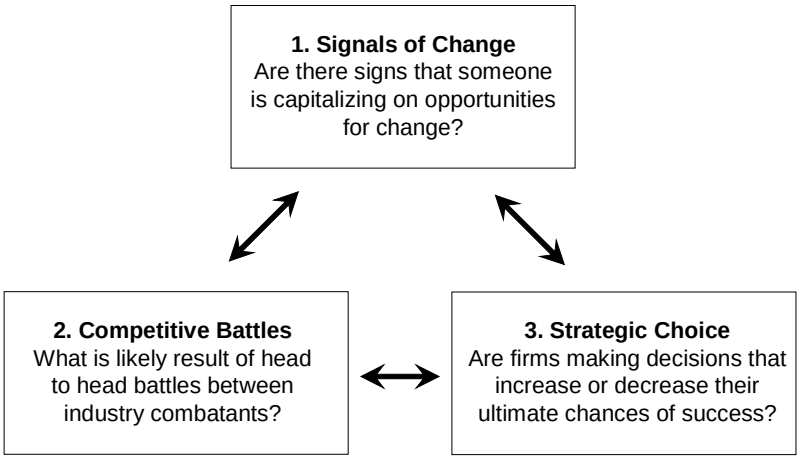


Figure 3.3: *The Process of predict industry change* [68]

[68] Christensen C. M., Anthony S. D., Roth E. A (2004) p. xxxiii

Step 1: Identifying Signals of Change[69]

The first part of predicting industry change by using disruptive theory involves understanding when innovations might lead to the emergence of new companies or new business models that could cause industry chance.

The core signals of change question involve evaluating three customer groups:

1. Consumers not consuming any products or consuming only in inconvenient settings (non-consumers)
2. Consuming customers who are undershot
3. Consuming customers who are overshot

Each customer group creates unique opportunities for both entrants and incumbents. Companies can create new-market disruptive innovations to reach non-consumers, they can focus on sustaining innovation to reach and satisfy undershot customers and they can launch low-end disruptive innovations to reach overshot customers. Moreover, it is important to the overall industry circumstances and trends as it defines what sort of innovation that will not succeed. That is, if circumstances favour up-market sustaining innovations, one should expect firms following a low-end market strategy to find themselves in struggle. Observers often tend to watch developments among a sub-segment of the second group known as lead customers, those at the high performance demanding end, to predict how a market will change. Sustaining innovations are frequently deployed in this group and then trickle down into the volume segment of the market. With disruptive innovation the lead customers are in new markets or in the low end of the existing market. Predicting whether disruptive innovations are taking place and to what extent they will affect the majority of the market therefore requires watching the low end, new markets and new contexts.

The Table 3.1 summarizes the customer groups and shows how to identify each group, the opportunity each group present and the signals indicating something or someone tries to take advantage of the opportunity.

[69] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 3-27

Overview of Potential Customer Groups

Customer Group	What Could Happen	Identifier	Signals
Non-consumers	Individuals who lack the ability, wealth, or access to conveniently and easily accomplish an important job for themselves; they typically hire someone to do the job for them or cobble together a less-than- adequate solution	disruptive innovation	New- market
Undershot customers	Consumers who consume a product but are frustrated with its limitations; they display willingness to pay more for enhancements along dimensions most important to them	Sustaining up-market innovation (radical and incremental)	New, improved products and services introduced to existing customers Integrated companies thrive; specialist companies struggle
Overshot customers	Customers who stop paying for further improve-ments in performance that historically had merited attractive price premiums	Low-end disruptive innovations Displacing Innovation Downward migration of required skills	New business model emerges to serve least-demanding customers Emergence of specialist company targeting mainstream customers Emergence of rules and standards - widely propagated statements of what causes what Migration of provider Closer to end customer

Table 3.1: *Overview over potential customer groups* [70]

[70] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 5

Context for innovation[71]

Non-consumers, undershot customers and overshot customers all present different opportunities for new firms or business models to be developed. Before, describing step 2 in predicting industry change, the authors furthermore want to mention the non-market context in which an innovation take place. Non-market forces, i.e. governments and its regulatory agencies might play a very important role in shaping that context and forms a crucial component of the signals of change question. This fact is particular visible in industries such as telecom, health care, financial services and education where governmental involvements are high. Looking into the future, these industries will require a way to analyze how non-market players affect innovation.

Two factors can be identified where innovations break through: motivation, defined as market incentives to innovate; and ability, defined as the capability to obtain resources, craft them into products and services and offer those to customers. There are numerous free markets where motivation and ability exist in abundance, but non-market forces such as industry standards, unions, cultural norms, state of technological development and, most important, governmental regulations that affect the motivation and ability to innovate. The framework above states that innovations thrive when companies have both the motivation and ability to innovate. Market contexts that are lacking in motivation or restrict ability are acting in opposite direction to innovation.

Step 2: Competitive Battles[72]

Companies improve their products and services because they want to serve more profitable customers who are willing to pay premium prices for improved products. In fact, it is often more a need than a desire from the company's point of view.

Porter noted that there are two generic strategies for creating a competitive advantage: low cost and differentiation[73]. As low-cost attackers enter a low end of the market they only have this advantage as long as the high cost incumbents remains in the market. When a low-cost competitor drives out the higher-cost competitors it must continue to reach further up-market to be able to continue to compete against the even higher-cost competitors. Likewise, a firm that creates competitive advantage through differentiation must constantly search for new markets that value the position of differentiation. Only by moving up and into new markets can firms sustain advantages. This pattern implies a circular process, that is, when firms first start to target non-customers they typically undershot their needs. Consequently, they need to introduce up-market sustaining innovations and companies trying to meet their customers´ needs will eventually overshot their customers.

[71] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 20-22
[72] Ibid., p. 29-51
[73] Porter M. (1985) *Competitive Advantage*, p. 11

The Table of the Tape: Evaluating Strength and Weaknesses[74]

Sooner or later firms will face competition. Predicting who will win these battles requires an evaluation of the combatants' strengths and weaknesses especially those typically not visible even to those working within a firm. To be able to predict the outcome of a battle one need to compare the two combatants´ strengths and weaknesses. This can quickly be done by flipping eyes on the resources for instance their technology, product lines, cash revenues, brand, the résumés of its management team and think that superior resources determine the success. This tale-of the-tape chart provides a reasonable good sense of what the strengths and weaknesses are for each combatant.

As previously described, RPV theory provides a more comprehensive view of what embraces a firm's strengths and weaknesses. That is, beyond a company's resources the strengths and weaknesses are defined of processes and values. Firms thrive at opportunities that fit their resources, processes and values and struggle with opportunities that do not answer to those strengths.

Evaluating a company's RPV requires answers to the following questions. [75]

1. Does a firm have or can it marshal the resources required to attack an opportunity?

2. Do the firm's processes effectively and efficiently facilitate it doing what needs to be done?

3. Do the firm's values allow it to prioritize one opportunity over other options on its plate?

The remaining question is how to identify a firm's RPV? Resources tend to be visible and a firm's processes can be visible through tough problems firms repeatedly must solve. A firm's income statement and its investments in the past can furthermore provide important clues of its values.

Step 3: Strategic Choice[76]

The third step in process to predict industry change includes how to identify important choices a firm makes and understand their impact and meaning. The innovation theories explain the natural forces that affect a firm. These forces typically appear in a faint way and in the everyday decisions managers make. Most managers and firms surrender to those forces without even realizing it. In that sense they make decisions, which appear to be correct rational decisions. However, the winner of a competitive battle is rarely predetermined. Firms are complicated and the path of a disruption has many twists and turns. Whether an innovation is deployed in a

[74] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 29-37
[75] Ibid., p. 54-55
[76] Ibid., p. 53-71

disruptive or sustaining way is thereby a typical management decision. Companies can create advantages and they can act in a way that opposes the possible advantages. Thus, choices matter and the main question is to what extent firms are making decisions that increase or decrease their ultimate chance of success.

Christensen has identified three critical choices that can change the natural path of industry evolution:

1. Entrants following the **wrong preparation regime**. A preparation regime consists of a firm's hiring decisions, its strategy-making processes and its funding sources. The wrong decisions can create initial conditions that lead entrants to the wrong entry point in the marketplace.

2. Entrants creating **overlapping value networks** that provide easy path for incumbent co-option. A value network involves upstream suppliers, downstream channels to market and ancillary providers. If an entrant chooses to compete in an incumbent's values, thereby erasing the asymmetries that the entrant needs.

3. **Incumbents earning their black belts** and developing the ability to master the forces that act upon them.

The Wrong Preparation Regimes Often Lead to Wrong Foothold [77]

Finding the wrong entry point or foothold can easily put entrants on the wrong side of the asymmetries. The entrants will immediately and consequently face a tempting choice. Developing new products is hard, finding new markets are harder, but identifying large existing markets is easy. Further the most demanding customers in tend to pay the highest prices. Trying to reach these customers involves following a sustaining and not disruptive strategy. To forehand tell whether entrants are likely to set off down these treacherous paths one need to understand the preparation regimes that entrants take to get ready for the fight. Table 3.2 below illustrate the important components of a firm's preparation regime, the tool suggested for the firm to use and signals indicating that the firm is using the right tool.

[77] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 55-60

Analyzing the Preparation Regimen

Area	Appropriate Tool/Theory	Signals
Strategy Making	In uncertain situations, encourage emergent forces that allow firms to find appropriate market/business model	Limited fixed-cost infrastructure that encourages experimentation Demonstrated willingness to adapt to market signals Business plan that test rather than assume
Hiring	Schools of experience in situations company likely to face	Managers in prior assignments have wrestled with problems that are similar to those the new venture will confront
Funding	Uncertain situations require investors that are patient for growth but impatient for profits	Values of investors (need for quick growth) Relationship between company and investors

Table 3.2: *Analyzing the Preparation Regimen* [78]

Overlapping Value Networks Can Facilitate Incumbents Co-option[79]

All companies exist in a value network, which includes its upstream suppliers, downstream retailers, distributors, its partners and supplementary industry players. Overlapping value networks with check points can limit the ability to create asymmetries. When there are overlapping suppliers, distribution networks, sales forces or supplementary providers firms might face severe pressure to create something that makes sense to the competitor and lead to symmetrical motivation and skills. A potential low-end disruptor therefore needs to develop a different production model or have lower overhead costs to make attractive returns at low price point. However, if a would-be disruptor uses the same suppliers as an incumbent, the disruptor will face pressure to adapt to incumbent's cost structure. Similar, when an entrant tries to use an existing sales channel or similar distributor to reach the customer the entrant business model must obey the rules to the channel's resource allocation criteria. If it does not, the sales force and the channel cannot prioritize selling the entrant's product or service.

[78] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 56
[79] Ibid., p. 63-65

Ways for incumbents to Earn Their Black Belts[80]

Companies can learn strategies, which allow them to control disruptive forces. They can specifically, set up own separate organisations to launch disruptive counterattacks or develop internal capabilities to create disruptive growth again and again. However, none of these approaches will grant success or creating spinouts. The development of internal disruptive engines will fail unless incumbents also follow the right preparation regimes and use the accurate strategy creating processes, i.e. hiring the right managers and getting funding from the right sources.

[80] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 65-69

4 US Telecom Industry History

In this chapter the authors will guide the reader through the telecom history from the revolutionary innovation of telephony to the evolving of data services generated by third generation cellular networks. The authors' main intension is to enlighten the importance of innovation and regulatory aspects in the US telecom industry.

4.1 Wired Telephony Evolving

Telecom has traditionally been a regulated sector of the US economy. A regulation was imposed in the early part of this century and still remains in various parts of the industry. The telecom sector is regulated both by the federal government, the Federal Communication Commission (FCC)[81] and at state level. The main idea behind regulations was that the market for telecom services was a natural monopoly and therefore would a second competitor not survive.[82] As early as year 1900, it stood clear that all telecom markets were not natural monopolies, as shows from the existence of more than one competing firm in many regional markets. Over time it came clear that markets, which had been natural monopolies in the past, were not so anymore and that it was more appropriate to allow competition in these markets, while keeping the remaining regulated.[83]

After a series of expansion and consolidations in the 1920s, the fixed operator AT&T[84] had an overwhelming majority of telephone exchange and in 1934 the governance passed the Communication Act, which put in place the regulatory scheme that still largely rules the US telecom industry. The act pictured a monopoly telephone service company and established the FCC as a primary regulator. The act passed half a century after telephony commenced and over thirty percent of all households had a telephone before the governance accepted the phone as public good and required government regulations to protect the public interest.[85]

Regulations of US telecom markets were marked by two important regulative antitrust lawsuits that were brought against AT&T. In the first one, United States vs. Western Electric, in 1949, the Department of Justice claimed that the Bell Operating Companies practiced illegal exclusion by buying only from Western Electric, a part of the Bell System. The case was settled in 1956 with AT&T agreeing not to enter the computer market but retaining ownership of Western Electric. The second major antitrust suit, United States vs. AT&T, was started in 1974. The government alleged that AT&T's relationship with Western Electric was illegal, and that AT&T monopolized the long-distance market. The case was settled by the Modification of

[81] Please consult Appendix 1 for Organisation Overview
[82] Economides N. (1998) *US Telecom Today*, p. 7-13
[83] Ibid.
[84] Please consult Appendix 1 for Organisation Overview
[85] Christensen C. M., Anthony S. D., Roth E. A (2004) p. xxiii

Final Judgement and the verdict broke AT&T into seven Regional Bell Operating Companies (RBOCs). Each RBOC was comprised of a collection of local telephone companies that were part of the original AT&T. RBOCs remained regulated monopolies, each with an exclusive franchise in its region.[86]

Until the 1960s the telecom market was considered an end to end monopoly and did not show any signs of fractures or breaks. Nevertheless, the first crack appeared as a consequence of the emergence of competition in the customer premise equipment market, which basically is the market for anything that a customer plugs into the network and uses.[87] Furthermore, long distance microwave transmission, that transmits power through outer space without the need for wires, was a major breakthrough, which created the possibility of competition in long distance.[88] The microwave transmission was followed by technical breakthroughs in transmission like satellite and fibre optic wire. In addition, the break up of AT&T in the early 1980s crystallized the acknowledgment that competition was possible in the long distance, and placed MCI Worldcom as a true competitor to AT&T, while the local market remained a natural monopoly. Moreover, the adjustment to the Modification of Final Judgement in 1982 split AT&T into a long-distance company and a group of twenty-two RBOCs, which also allowed AT&T to enter new business lines. The RBOCs would continue to be regulated individually as they controlled the golden "last mile", which is the set of wires that connect individuals home and business to the rest of the network. A series of merges between the RBOCs resulted in the creation of four large local telephone companies: BellSouth, SBC, Verizon and Qwest.[89]

After the great success of competition in the long distance market the US Congress allowed competition in the local markets in the Telecommunication Act of 1996, while allowing RBOCs into the long distance market after they met certain requirements. The 1996 Act attempted to adapt the regulatory structure to technological reality and chip away some of the last barriers to competition in the local market by forcing the RBOCs to share their lines with competitive local exchange carriers. Many local exchange carriers failed, some quite spectacular, but competition in the local market slowly started to increase.[90] The competition in long distance became a great success and the market share of AT&T fell drastically. Since the break up of AT&T and competition was allowed in the long distance marketplace, the number of competitors has increased dramatically, prices of long distance calls have decreased significantly and the average revenue per minute of AT&T's swished services has been reduced. A long distance phone call is currently carried by local telephone companies of the place it originates and the place it terminates and is only carried in its long distance part by long distance companies.

[86] Economides N. (1998) p. 7-13
[87] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 220
[88] Wikipedia: The Free Encyclopedia
[89] Economides N. (1998) p. 5-11
[90] Atkin D., Lau T. Y., Lin C.A. (2006) *Still on hold?* p. 80-85

4.2 Mobile Services Evolving

Arriving in the 1980s with the introduction of bulky car phones, US were one of the first countries to introduce mobile communications with cellular voice services. From a technology point of view, these wireless services were a disruptive innovation.[91] The basic functionality measured by call quality was worse than with traditional wired alternatives, i.e. standby, talk-time and call quality was poorer and the phones were clumsy and expensive. However, early adopters valued the innovation for its attributes of additional convenience, the ability to make calls anywhere and at any time. [92]

As with all disruptions, the chase of growth and profit caused wireless phones to improve rapidly.[93] Within twenty years, in the late 1990s, signs started to emerge that the consumers were ditching their wired phones entirely. College students, young adults sharing apartments and parents needing a second phone line all began to choose mobile phone over fixed-line. Next in line were the long distance carriers as wireless companies, which started to bundle an increasing amount of "anywhere anytime minutes" that included long distance calls. This added tremendous pressure on the long distance companies and users simply waited until the anytime minutes kicked in a made those calls from the mobile phone instead. By year 2002, analysts estimated that the mobile phone had replaced twenty six percent of the landline market and the wireless market was by that time dominated by six big national operators, explicitly Verizon Wireless, Cingular Wireless, AT&T Wireless, Sprint PCS, Nextel and T-Mobile. [94] These six operators had a combined market share of eighty percent of the US wireless subscribers benefiting from national coverage, long-term operating experience, a large embedded network and customer support infrastructure. In addition, some also benefited from wired-line parent companies and this is especially desirable as the wired parents actively promote converged wireless/fixed services to their existing customer base. [95]

4.3 Wireless Data Evolving

The Wireless Data Services begun during the late 1980s as engineers started to develop the so called third generation technologies, 3G. This new technology increased the service providers' use of their share spectrum allocations for voice services and in this establishment face, 3G offered higher data transmission making it useful for data application. However, engineers primarily designed 3G to improve voice services, but for this particular service data capabilities were somewhat limited.[96]

[91] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 229
[92] Nils Rydbeck, Summerland Key 2006-03-13
[93] Christensen C. M., Anthony S. D., Roth E. A (2004) p. xxviii
[94] Ibid., p. 230
[95] Ibid., p. xxviii
[96] Ibid., p. 251

Due to the exponential growths of mobile voice and the Internet in the 1990s, not surprisingly, groups grew more excited about combining the two. Existing wireless companies also saw the opportunity and invested billions of dollars trying to stretch the 3G technology to meet the data need of deep-pocked businesspeople i.e. cramming. It turned out to be a classic cram with disappointed customers and the executives now had two choices. They could introduce simple, low-bandwidth application with voice upgrade and incrementally introduce high-capacity applications, or they could stretch the technology to deliver advance high-capacity applications like wireless-videoconferences. For most executives the choice was simple, they had to transform 3G to deliver higher transmission capacity capable of delivering advanced data services that could reach the most profitable markets and consequently the operators spent additional billions trying to improve the technology. Moreover, developers tried to modify 3G to enable the seamless requirement and delivery of up to two megabits per second of data, which was more than ten times faster than the capacity it was designed to deliver making the tolerance for error essentially low.[97]

It soon became clear that 3G technologies was a disappointment and could not meet the customer expectations. Many within the industry began to put their hopes on up-coming fourth- generation technologies to deliver the dream of a true high-capacity wireless world. However, most operators fell preying as they tried to stretch the underperforming 3G innovation to meet the needs of demanding customers in the mainstream segment.[98]

[97] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 252
[98] Nils Rydbeck, Summerland Key 2006-03-13

5 Technologies

After describing the evolution of telephone communication the authors will continue to describe the main technologies associated with the industry and the technologies knocking on the door. However, first the authors will explain Voice over Internet Protocol, which potentially these new technologies are candidates to carry.

5.1 Voice over Internet Protocol

Voice over Internet Protocol or VoIP is the routing of voice conversations over the Internet or any other IP-based networks and is also widely known as IP telephony, Internet telephony or Broadband Phone. [99] Using IP to transmit voice calls is fundamentally different from using connection-oriented technologies. IP is connectionless and it provides best effort delivery of data package over a network. Data is divided into packages and sent out in every direction along the network. Although, using IP is flexible and inexpensive, it historically was not good enough for voice transmission and it is actually a very demanding application considering the rather simple task of completing a voice call. The call requires flawless real-time interactions between numerous components at different levels of the telecom network. Packages travelling over a connectionless network can be delayed or lost. Those delays or disappearances are fine for e-mail messages as the packages can be continuously retransmitted until the whole message can be displayed. For voice conversation, lost package often result in significantly degradation of call quality.[100]

Early users did not care about VoIP's low quality as they were very inexpensive due to the fact that the calls travel over the public network. Students and other who had tight budgets or placed frequent overseas calls accepted the low quality that others would find unacceptable. At this stage, VoIP was not yet good enough to move into more demanding market areas, but as always data networks enhanced and thereby the voice quality improved. [101] However, since IP does not provide any mechanism to ensure QoS[102] guarantees, for instance that data packets are delivered in sequential order, VoIP implementations are facing problems dealing with latency issues. In addition, other VoIP service issues are VoIP traffic trough firewalls and difficulties of geographically locating network users. The latter concern makes emergency calls virtually impossible.[103] Given this situation, it is not entirely clear whether there will be a significant higher demand for VoIP among consumers, however, this issue will be further outlined later on in this thesis.

[99] Wikipedia: The Free Encyclopedia
[100] Christensen C. M., Anthony S. D., Roth E. A (2004) p. 233-236
[101] Ibid., p. 233-236
[102] Please consult Appendix 2 for Technical Clarification
[103] Howard DeYoung, St. Cloud 2006-03-09

5.2 The WiFi Technology

WiFi technology emerged from the computer and networking industry. Technologists refer to the technology by its IEEE[104] specification number, 802.11, and non-technologists typically reach for the word WiFi, that is "Wireless Fidelity".[105] Local Area Networks (LAN) emerged in the late 1980s allowing collections of computers, terminals and other devices to share resources such as printers, access servers or share storage devices. WiFi enables mobile devices such as laptops and mobile handsets to connect to the Internet through a LAN without using a wire and a person with a WiFi-enabled appliance can access the Internet when in reach of one of the network's access points. A geographical region covered by one or several of these access points is called a hotspot or hotzone.[106]

An advantage of WiFi based products is, unlike 3G and other cellular technologies, that WiFi operate on the so-called unlicensed spectrum at 2.4 or 4.9GHz, which have initially been set aside by the US government to encourage experimentation and innovation. As a consequence, no expensive licenses are necessary, which makes the technology relatively inexpensive for the providers. Moreover, WiFi has become a universal standard and as a result it is widely distributed and used in many different parts of the world, which also puts WiFi equipment on a rapid cost reduction curve as the volumes increase on a daily basis.[107] In addition, the current generation of WiFi, the 802.11 b and g supports up to 54 Mbps data rates, within hundred meters of the base station. However, the next generation WiFi, the 802.11n standard which will be launched mid 2007 and early 2008[108], will offer a realistic data throughput of 100Mbps and increased coverage compared to the current b and g standards[109]. The standards, their approximate timeframe and their throughput might be examined in Figure 5.1 below as well as in Appendix 3.

[104] Please consult Appendix 1 for Organisation Overview
[105] Al-Alawi A. I. (2006) *WiFi Technology: Future Market Challenges & Opportunities*, p. 13
[106] Wikipedia: The Free Encyclopedia
[107] Al-Alawi A. I. (2006) p.13
[108] IEEE Official Webpage
[109] Martyn Levy, Atlanta 2006-03-06

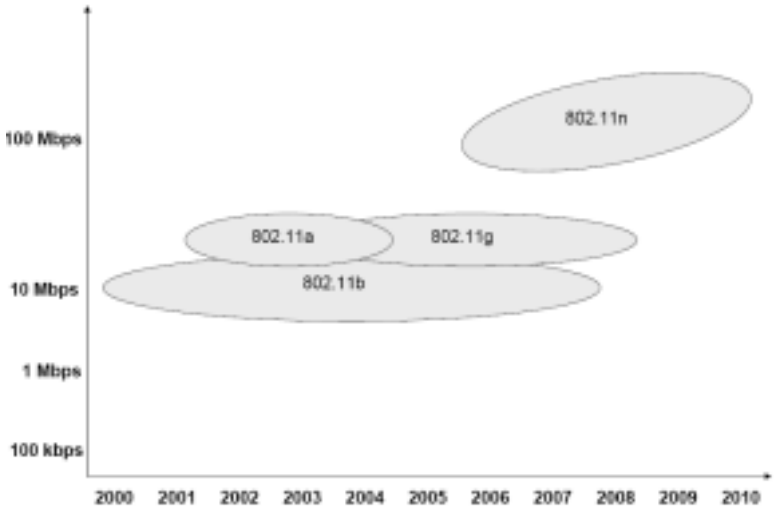


Figure 5.1: The *802.11 standards* [110]

Most typical, WiFi is implemented as a part of a private or public network and the base station and surrounding equipment may be owned and operated by for instance the end user, municipals, or a corporate enterprise and in some cases Internet access is free of charge to the end user.[111] Furthermore, the WiFi technology typically facilitate low cost market entry e.g. enabling a coffee shop with a WiFi connection cost as little as $500 for equipment and $50-100 per month for a DSL line, which many shops already have to fulfil internal communication needs.[112] One obvious problem though with WiFi technology is the fact that each base station only can cover a typical hundred meters of range. However, this issue might be prevented and initially solved by connecting the access points to each other, which forms a contiguous coverage over a wider area by utilization of a mesh network solution.[113]

5.2.1 Mesh standards

Briefly described, mesh technology enables WiFi to be deployed affordably in campus and metro arenas. The standard is primarily used for outdoor hotzone implementations, which typically extends the WiFi networks coverage by using multiple 802.11 radios as routing nodes. The data is pasted along these connected nodes, which enables the network to use less backhaul connections.[114] Companies such as Tropos Networks, BelAir, SkyPilot, Strix Systems and RoamAD are currently

[110] Algell L. (2005) *Voice over IP in Mobile Networks*, p. 65
[111] Lehr. W and L. W. Mcknight (2003), Wireless Internet Access: 3G vs. WiFi?
[112] The Yankee Group Research Inc. (2004) *Wi-Fi Billing, Customer Care and Business Models Will Play a Pivotal Role in Revenue Generation*, p. 2-3
[113] Ed Myers, Atlanta 2006-03-07
[114] Crowley Cathleen, Atlanta 2006-03-07

leading in the deployment of WiFi mesh networking. However, today's vendor solutions need to continue to evolve to support the requirements of full scale voice over the WiFi technology, which is not supported by the first generation mesh networks illustrated in Figure 5.2 below.

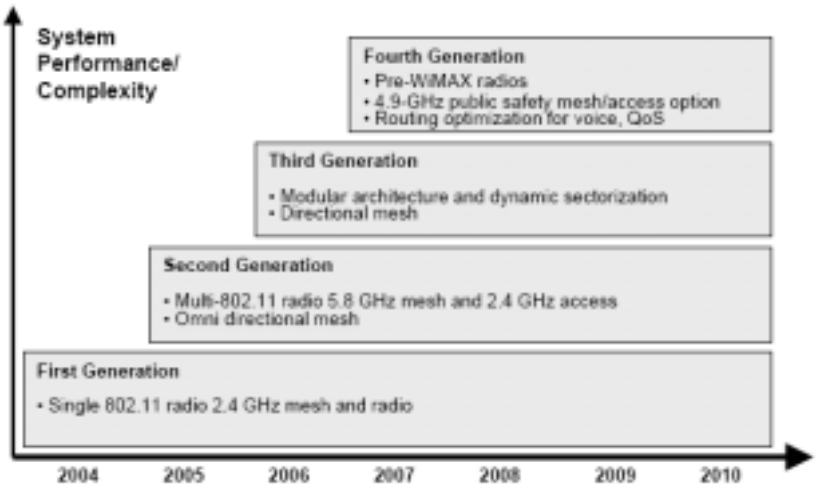


Figure 5.2: *WiFi mesh networking evolution* [115]

The first generation is living with the limitation of single-radio mesh technology, where nodes and clients share the same radio spectrum. Systems cannot extent beyond 3 to 5 nodes without self interference and latency issues and this fact makes them unsuitable for voice or video applications.[116] However, to be able to exploit full scale voice over mesh, networks need to be equipped with dual-radio nodes (second generation), but also quality of service features like roaming intelligence and traffic prioritized (third and fourth generation) networks, are required for public full scale voice applications.[117] As one can observe in the above figure, third and forth generation are in the development face, which is one of the reasons why they still are more expensive than the first generation to deploy.[118] This fact is also valid in a debating exercise regarding different business models, in context of which mesh networks are used when US municipals are constructing their wireless mesh networks. Finally, the mesh standard, 802.11s, is yet to be approved by the IEEE and today only proprietary solutions are released on the market, which means that the network is dependent upon network operators and vendors.

[115] The Yankee Group Research Inc. (2006) *Myth and Realities of WiFi Mesh Networking*, p. 1
[116] Dolmetsch John, Atlanta 2006-03-07
[117] Levy Martyn, Atlanta 2006-03-07
[118] Cathleen Crowley, Atlanta 2006-03-07

5.2.2 Issues Regarding Voice over WiFi and Mesh Networks

There are a number of issues associated with the emergence of voice over WiFi and these are mainly related to the nature of the underlying protocol of the 802.11 family. The WiFi technology was developed for data usage and delivering high quality voice has not been a priority.[119] Offering VoIP services in the WiFi network environment will eventually put extra pressure on network management, as the system has to consist of enough nodes to ensure low packet loss and sufficient capacity. Furthermore, the network has to be monitored so that no access point is receiving a disproportional amount of traffic. The network also has to be carefully planned so that effective penetration through walls, floors and ceilings can be assured. Additionally, the challenge of roaming between different access points and sub network has to be addressed and the main goal is that the switchover can be made in less than 50ms. Bandwidth is also a potential problem in WiFi networks as the bandwidth offered by a base station is most adequate in an unloaded network with a support of 5-8 calls simultaneously using 802.11b, but with a number of users running real time applications like voice, packet loss will be inevitable.[120]

5.2.3 UMA and IMS (Fixed Mobile Convergence)

Fixed Mobile Convergence (FMC) is currently one of the crucial strategic issues in the telecom industry.[121] With the convergence between the wireless and fixed line networks, telecom operators can provide services to users irrespective of their location, access technology or handset. [122] The Unlicensed Mobile Access (UMA) is currently the only standard available that offers seamless FMC.[123] The technology provides access to mobile services over unlicensed spectrum technologies, for instance WiFi, and by deploying a UMA technology, mobile operators is still in charge of the call process and in the same time increasing coverage as well as relieving pressure of existing core network. When at home, subscribers will have WiFi coverage and when on the road the user will utilize the existing cellular networks, all conveniently seamless connected from the cellular network to the WiFi hotspots. Accordingly, this is the debated concept of one handset, one number and one bill, which many consumers and industry players have been waiting for to occur. [124]

Additionally, IP Multimedia Subsystem (IMS) is another standard that in the future will support supplementary features, including real-time communication on the Internet, instant messaging, video conferencing, multimedia conferencing and on-line chat sessions.[125] Whereas the UMA technology is focusing on existing mobile services, as voice and SMS, the IMS technology will concentrate more on new

[119] Levy Martyn, Atlanta 2006-03-06
[120] Ed Myres, Atlanta 2006-03-07
[121] Wikipedia: The Free Encyclopedia
[122] Magnus Blomqvist, Lund 2006
[123] Wikipedia: The Free Encyclopedia
[124] Magnus Blomqvist, Lund 2006
[125] Wikipedia: The Free Encyclopedia

services like VoIP and multimedia applications.[126] Nevertheless, the UMA and IMS technologies both enable the operators to keep control over the unlicensed wireless network and thereby the ability to charge customers for the services.[127] Many handset vendors for instance Nokia, Motorola, LG, Ben-Q, Sony Ericsson and small US proprietary players such as Calypso Wireless[128] are currently releasing dual-mode handset with UMA facilities. The availability of these products and the relative rapid standardization process, where 802.11n and 802.11e will be important steps, is expected to act as catalysts for growth in the wireless market.[129]

5.3 Cellular Technologies

Cellular technology, which today without a doubt is the leading technology on the existing US voice market, is split into two camps, CDMA[130] and GSM[131].[132] Voice was the major driver for these 2G mobile technologies and has been a phenomenal global success. After 2G came 2,5G, enabling Internet access, email and basic data services such as text messaging and other low-bandwidth applications such as ring tones and simple games. Today video, mobile TV and other high bandwidth demanding services are driving 3G deployment and eventually Super 3G and 4G. The cellular technologies also have the potential to deliver IP through the cellular networks. This fact might enable mobile operators to offer enhanced voice services such as attendance management, conference facility and broad multimedia content, but still be in charge of the services.[133]

5.3.1 The 2.5-2.75G Technology

General packet radio service (GPRS[134]) is a 2.5 generation packet based network technology for GSM networks that can theoretically reach capacities of up to 170kbps. The major drive for the 2.5G and other packages based networks is the always on capabilities. Packet based technologies allow the use of infrastructure and facilities only when a transaction is required rather than maintaining facilities in a session-like manner. This concept provides tremendous improvements in efficiency and services deliveries, which mean that a GPRS customer could receive content or services without manually, raise a service or transaction which has significant implications for mobile commerce and location based services.[135]

As basic voice average revenue per unit is declining in most of the developed markets such as the US, there is a need to offer new data centric services to improve the user

[126] Magnus Blomqvist, Lund 2006
[127] Johan Karlberg, Lund 2006
[128] Please consult Appendix 1 for Organisational Overview
[129] Al-Alawi A. I. (2006) p.14
[130] Please consult Appendix 2 for Technical Clarification
[131] Please consult Appendix 2 for Technical Clarification
[132] Analysys Research Limited (2005) *The US Mobile Market*, p. 9
[133] Infonetics Research Inc. (2006) *Service Provider Plans for next Gen Mobile Wireless Broadband* p. 12-15
[134] Please consult Appendix 2 for Technical Clarification
[135] Infonetics Research Inc. (2006). 12-13

experience. Since 2G systems are reaching their capacity limit, 2.5G networks provide an evolution path towards 3G and sometimes a complementary option to WiFi for mobile operators that do not own any 3G spectrum e.g. T-Mobile offers WiFi/EDGE services.[136] EDGE[137] or 2.75G, is sometimes referred to as the US version of the GPRS.[138]

5.3.2 The 3G Technologies

There were two main focuses when developing third generation network, first and foremost it was seen as necessary to increase the capacity of handling voice calls. The second reason was the possibility of offering new and advanced services and developers found it most suited to give the standard both circuit- and packet switched capabilities. The higher bit rates provided by the network may enable services such as video telephony and interactive gaming.[139]

W-CDMA (Wideband - Code Division Multiple Access) is the leading 3G-radio access technology and is sometimes said to be the European 3G technology, referring to CDMA2000 as the American version.[140] W-CDMA and CDMA2000 uses the same core network as GPRS and is one of the main technologies for the implementation of the third generation cellular system. CDMA2000 represents a further enhancement of the older CDMA technology, which in its new suit will improve support for VoIP. However, the role of VoIP in this technology is somewhat unclear as well as the overall prospects for future revisions. [141] Ultimately, the W-CDMA and CDMA2000 core network will develop to embrace a full mobile IP infrastructure including VoIP over mobile networks. W-CDMA is theoretically capable of delivering up to 2 Mbps in a fixed location. In the US marketplace CDMA operator is today launching 3G services using W-CDMA whilst the GSM operators have focused their attention on EDGE as a low-cost alternative to W-CDMA.[142] However, latency could potentially be a problem for VoIP communications in current releases of W-CDMA and these latency issues will furthermore become even more problematic in loaded networks.[143]

5.3.3 The 3.5-3.75G Technology

Turbo 3.5G or High Speed Downlink Package (HSDPA) enhance downlink data and has a theoretical bandwidth of 1.8 Mbps compared with 0.384 Mbps for current 3G technology. Other improvements compare to 3G is more efficient data packaging and lower latency. The 3.5G technologies also have great advantage over WiFi technologies in turn of coverage and mobility aspects, but at the same time disadvantages in bandwidth and service cost. Moreover, by reducing the cost per

[136] Infonetics Research Inc. (2006) p. 12
[137] Please consult Appendix 2 for Technical Clarification
[138] Mike Lindstrom, Atlanta 2006-03-07
[139] Martyn Levy, Atlanta 2006-03-06
[140] Algell L. (2005) p. 51
[141] Infonetics Research Inc. (2006) p. 13-14
[142] Analysys Research Limited (2005) p. 9
[143] Algell L. (2005) p. 51-55

megabyte of downlink data the business case for VoIP will be improved with this technology. However, uplink latency will continue to be major issues for VoIP applications. [144]Similar to HSDPA, High-Speed Uplink Packet Access (HSUPA) is a data access protocol for mobile phone networks with extremely high upload, with speeds up to 5.76 Mbps. HSUPA is considered as 3.75G.[145]

5.3.4 Super 3G and 4G Technologies

Other cellular technologies, which have merely started there development are Super 3G and 4G. These technologies are predicted to enter the industry somewhere between 2008 and 2010 and might be the mobile industry's answer to the WiFi technology. The super 3G is an upgrade of the W-CDMA technology and the prediction is that it will operate at levels as high as 100 Mbps. This concept, as well as the 4G concept, is currently being defined with the objective of providing improvements in capabilities and cost per megabyte. Several vendors and operators see enhanced support for VoIP as a key requirement for these future technologies. However, the technology has a long way to travel before one can really grasp what is to come, but the technologies may deliver the benefits 3G has not been able to set free such as high-quality video streaming and audio. [146] While current 3G services are working to enable transactional wireless communications like LBS (Location Based Services), wireless shopping, personal services, email and multimedia data transfer, 3G is at much lower capacities compared to the 100 Mbps to 1 Gbps of 4G. As demand builds for high-quality, streaming video and audio, 4G seems to be the only cellular technology to be able to house growing consumer and business expectations.[147] Figure 5.3 below sums-up the above outlined cellular technologies.

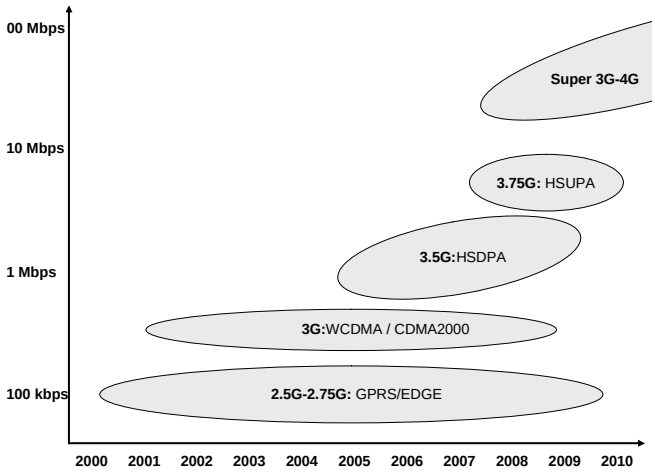


Figure 5.3: *The evolution and sum-up of the main cellular technologies*[148]

[144] Analysys Research Limited (2005) *Wireless Voice Over IP: technical and commercial prospects*, p. 5-7
[145] Wikipedia: The Free Encyclopedia
[146] Analysys Research Limited (2005) p. 5-7
[147] Algell L. (2005) p. 55-56
[148] Algell L. (2005) p. 55-57

5.4 The WiMax Technology

Amongst the broadband wireless access technologies, three main combatants are to be found. These are Flarion´s *Flash-OFDM*[149], ArrayComm´s *iBurst*[150] and *WiMax*.[151] However, the authors have chosen WiMax since the technology is the dominant broadband access technology in the US telecom industry at the moment. For more information regarding the other two motioned technologies, please see Appendix 2. WiMax is an acronym that stands for Worldwide Interoperability for Microwave Access. The WiMax standard, IEEE 802.16, is basically a wireless technology that provides high-throughput broadband connections over long distances. Confusingly however, there are two kinds of WiMax, the fixed WiMax and the Mobile WiMax, where the mobile WiMax might be perceived as a second phase initiative and substantially different and improved from its fixed precursor. The authors have chosen to mainly focus on the mobile WiMax, officially known as 802.16e, in this thesis.[152]

The WiMax technology uses microwaves for transmission of data wirelessly and the technology can run signals very close to each other without disrupting one another. This allows the technology to offer more traffic on a narrower bandwidth, which can be advantageous for wireless last mile DSL and cable service providers, as they can serve more customers. Moreover, WiMax operates in a fixed upgradeable spectrum and the technology functions in two licensed frequencies- 2.5 GHz and 3.5 GHz and one unlicensed frequency of 5.8 GHz. WiFi, on the other hand, operates only in the unlicensed frequency. Since WiMax also function in the licensed frequency it is able to generate more power and therefore better signal strengths than the WiFi standard. WiFi can for instance offer signals up to a hundred meters from the transmitter. Though, in the WiMax case, a capacity of 75 Mbps can be offered several kilometres away from the transmitter with good strength. To be able to combine a variety of services including VoIP, WiMax need to support QoS just as the WiFi and cellular technologies.[153] Moreover, WiMax might be used for a number of applications, including "last mile" broadband connections, hotspots and cellular backhaul as well as high-capacity enterprise connectivity. VoIP may enhance the business case for WiMax deployment, particular for non-mobile operators, which might bring new voice market candidates into the competition with incumbent mobile operators.[154] Furthermore, there are some interesting and strong players behind the development of WiMax standard. Intel[155] is one of them and plays an important role as the primary leader in the development of WiMax 802.16e standard along with the WiMax

[149] Please consult Appendix 2 for Technical Clarification
[150] Please consult Appendix 2 for Technical Clarification
[151] Analysys Research Limited (2005) p. 39-48
[152] Wikipedia: The Free Encyclopedia
[153] Analysys Research Limited (2005) p. 39-48
[154] Brown G. (2005) *Mobile WiMax: Who Goes Where?*, p. 5
[155] Please consult Appendix 1 for Organisational Overview

Forum[156]. In fact the president of the WiMax Forum, which has over two hundred companies as members, is an Intel manager. [157]

5.5 Technology Sum-up

After presenting the above technologies, the authors concludes this chapter by providing the reader with a complementary graphical outline, regarding the different segment features visible between the WiFi, Cellular and WiMax technologies.

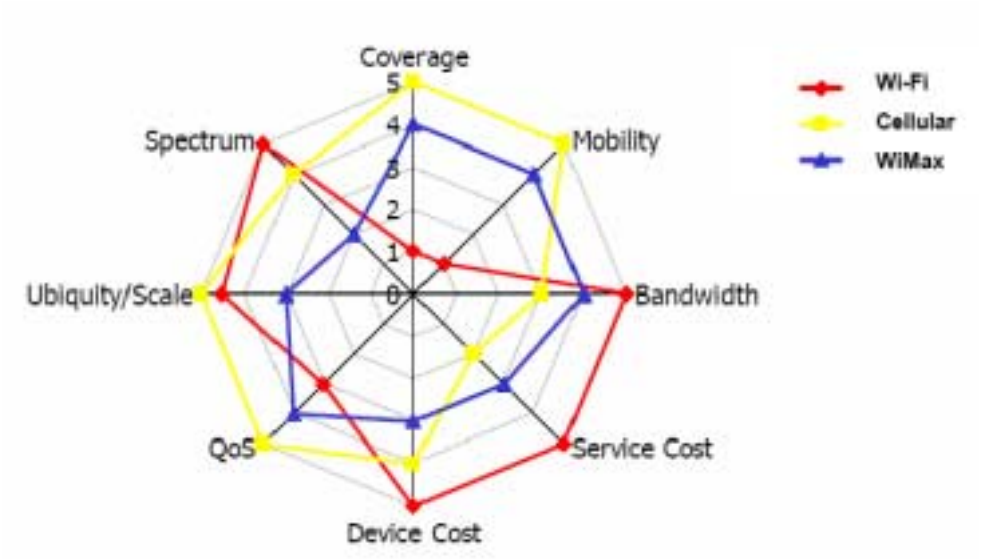


Figure 5.4*: Sum-up the main technology features* [158]

[156] Please consult Appendix 1 for Organisational Overview
[157] Analysys Research Limited (2005) p. 39-48
[158] Strategy Analytics (2006) *Wireless Operator Outlook*, p. 20

6 Present US Telecom Industry

In this chapter the authors will presents the US telecom industry and its main voice combatants, which are the mobile operators, WiFi providers and VoIP providers. Moreover, the "free to the end user" business models as well as municipal wireless projects together with political/regulatory contexts will be subject of investigation.

6.1 Mobile Operators

At present, the United States is one of the most developed telecom markets in the world. It is also one of the largest, generating nearly US$281 billion in service revenues in 2005. This is roughly three times the size of the Japanese communications market and four respectively five times the size of the Chinese and UK ones. [159] The US is also attractive from a revenue standpoint, with the average subscriber generating an average of twenty percent above the Western European figure.[160]

With Cingular Wireless´ acquisition of AT&T Wireless completed in 2004, followed by the Sprint Nextel merger, the wireless market dynamics has changed. From being a broadly competitive marketplace to a landscape that is dominated by three mega-operators, i.e. Cingular Wireless, Verizon Wireless and Sprint Nextel, which together boasted 168 million subscribers in March 2006.[161] T-Mobile, the forth largest industry player, is however somewhat unique as they not only operate a cellular network, but also function as a WiFi provider and operates more than 7,000 hotspots in the US alone.[162] T-Mobile and their wireless strategies will be further examined later on in this chapter.

Nevertheless, the US wireless market has evolved from rapidly growing focusing on increase market share towards a more mature market with profit, customer loyalty and efficiency as primary goals. This change is primary caused by slowing demand and future saturation of the wireless voice market as well as the move towards offering wireless data to a diverse and demanding audience. Operators are responding to this rather mature industry dynamism by targeting specific user segments such as enterprises, youth and families with fit phones, prices plans and data offers.[163] Finally, and as a sum-up, the mobile operators in the US industry today are displayed below illustrating their specific networks as well as market characteristics.

[159] Pyramid Research (2006) *Country Outlook: Communication Markets in the US*, p. 8
[160] Ibid., p. 3
[161] Pyramid Research (2006) *Mobile demand forecast*, p. 2
[162] Magnus Danielsson, Telephone Interview, 2006-02-29
[163] Ovum (2004) *US mobile market*, p. 2-4

Operator[164]	**Networks**[165]	**Subscribers and Market Share**	**National Coverage**	**WiFi strategy**
Verizon Wireless	AMPS CDMA CDMA2000	• 57.6 million • 26 %	83%	No need for WiFi
Cingular Wireless	AMPS TDMA GSM EDGE WCDMA	• 58.3 million • 26 %	99%	As a complement to cellular in high traffic areas
Sprint Nextel	CDMA CDMA2000 iDEN	• 52.9 m • 24 %	89%	As a complement to cellular in high traffic areas
T-Mobile	GSM GPRS EDGE	• 25.1 m • 11 %	95%	WiFi for the mass market

Table 6.1: *Data regarding the main US mobile operators*[166],[167]

[164] Please consult Appendix 1 for Organisational Overview
[165] Please consult Appendix 2 Technical Clarification
[166] Pyramid Research (2005) *WLAN-Cellular Convergence*, p. 65-68
[167] Analyses Research Limited (2005) p. 6

6.2 WiFi Providers

In late 2005, there were more than 31.000 public hotspots in the US, mainly including cafés, hotels and airports. In addition, there are hundreds of thousands more, which mainly belongs to private home networks, small retailers offering free wireless Internet and office WiFi. There are, as Table 6.2 below indicates, three major players on the US hotspot marketplace today i.e. T-Mobile, Boingo and Wayport. [168] The "Others" segment is mainly made up by players such as Cingular Wireless, which mainly view upon WiFi as a mean of limiting overcrowding on the 3G networks in certain high-traffic areas and new players like Helio[169], who see the technology as a integral part of building the Helio community.[170]

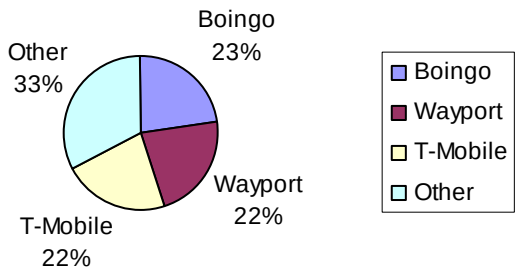


Table 6.2: *The major players on the US hotspot market place* [171]

T-Mobile currently operates two wireless communications technologies. The first one is a GSM based cellular network and the second one is the WiFi network with more than 7,000 hotspots.[172] The wireless strategy is the previous described UMA standard, which main focus is to realize FMC starting in mid 2006.[173] The unique hotspot part of the firm, T-Mobile Hotspot, was launched in 2002 after an acquisition of MobileStar Network Corp and included in that deal was the exclusive rights to WiFi connections in Starbucks coffeehouses. As one can se in the pie diagram above, T-Mobile Hotspot has approximately a quarter of the market share of the US hotspot market today, which is as large as the other main WiFi providers, Boingo and Wayport. [174]

[168] Pyramid Research (2005) p. 63
[169] Please consult Appendix 1 for Organisational Overview
[170] Pyramid Research (2005) p. 63
[171] Ibid., p. 63
[172] Ibid., p. 65
[173] Magnus Danielsson, 2006-02-29
[174] Ibid.

Boingo is the largest, with more than 7,800 locations in the US[175], compared to Wayport´s 7,000. However, considering all the hotspots owned by the companies world wide, Wayport has a larger number of hotspots in their name and uses that fact to provide deployment services and management of IP connectivity for a variety of organisations, including McDonald's restaurants.[176] One obvious example of this strategy is their deployment of free hotspots in restaurants for the WiFi-enabled handheld Nintendo DS device and the owners of such gadget may for instance play multiple players through a hub at McDonalds.[177] In contrast, Boingo encourages smaller Wi-Fi providers to integrate with its network and offers products as franchises of the Boingo brand. Moreover, Boingo have also formed strategic alliances with VoIP providers such as Skype.[178]

6.3 VoIP Providers

A VoIP provider is basically a company that enables Voice over Internet Protocol calls to be made from the user's single or dual-mode handset, where the single-mode handset is a WiFi phone only and the dual-mode one is a combination of cellular and WiFi technology in the same device. Ultimately this feature might enable the user to seamlessly roam between the two different networks without loosing the call using UMA or a proprietary solution. Industry analytics believe that services from established players such as Vonage and Skype will grow rapidly during the next couple of years. Moreover, fairly new entrants like Google have a strong community of users for its GoogleTalk service and both Yahoo and MSN have added VoIP to their messenger services.[179]

Skype is a proprietary peer-to-peer VoIP application and with the software installed in the handset or computer one will be able to make free VoIP calls within a closed island of units with the same application installed. To receive or make calls outside this island one need to install SkypeIn or SkypeOut at additional cost.[180] With a SkypeIn subscription one will receive a regular and personal phone number, which means that the handset can be reached from units which are not using Skype, wherever the user is in the world, as long as the user are connected to the Internet. The calls are at a cost of a local call and will consequently deliver abroad calls at local fees excluding roaming expenses.[181] SkypeOut, on the other hand, makes it possible to make outside calls from your Skype units to fixed regular phones or handsets at local rates. [182] Skype is today looking at disrupting the wireless industry as well, by developing cell phone supported software. Moreover, as the first major VoIP software, allowed individuals to talk over the Internet for free many home users with broadband capability switched to Skype and placed their calls over the Internet.

[175] The Boingo Official Webpage
[176] Pyramid Research (2005) p. 69-71
[177] The Wayport Official Webpage
[178] Pyramid Research (2005) p. 69
[179] Strategy analytics (2006) p. 27-28
[180] The Skype Official Webpage
[181] Ibid.
[182] Ibid.

Skype has also attracted large corporations who are beginning to switch from their traditional phone companies for their internal calls, which has become a major concern for these firms.[183] Being a very attractive organisation with appealing business model, Skype were acquired by the large eBay cooperation in October 2005 and in April 2006 Skype reported that they now had more than 100 million registered users. [184]

Vonage, on the other hand, is a commercial VoIP network company that provides telephone service through a broadband connection. Vonage is known as the "Broadband Phone Company" and has recently marketed itself as "Leading the Internet Phone Revolution." While companies such as Skype have more subscribers than Vonage, it was Vonage that has led the Voice over Broadband industry through its aggressive consumer marketing in the US. Moreover, in order to use the service, customers must purchase or use a branded "VoIP router" or a phone adapter that connects to their main router or broadband modem.[185] Vonage offers services to subscribers throughout the United States and as of April 2006 they had over 1.6 million subscriber lines throughout the US marketplace.[186]

The above exemplified VoIP providers are a part of a series of strong trends that include the decoupling of services from underlying networks. The VoIP service can be offered through various technologies, both over public and private Internet connections by a wide variety of players. These do not necessarily have to be established within US telecom industry. Especially, the recent rapid adoption of the peer-to-peer variant of VoIP raises the possibility of the appearance of a critical mass of users that could unleash a significant structural change on the voice marketplace. The VoIP providers such as Skype and Vonage clearly has the potential to remove a large proportion of the incumbent operators' revenues and the combination of a user with dual-mode or single-mode handset with the suitable application software installed would have potential of bypassing the existing mobile operators. [187] Figure 6.1 illustrates how a call bypasses the operators' most important resources, their core network, and the operators thereby loose the ability to charge and bill for the services.[188] More importantly the call travels on the Internet infrastructure that is already in place, which makes it relatively inexpressive for the VoIP provider to offer the service.[189] In Figure 6.1, a phone call can travel three different ways from the caller to the receiver. In the first two situations, the mobile operator has the control over the phone call regarding e.g. billing, but in the third alternative the operator is bypassed.

[183] Wikipedia: The Free Encyclopedia
[184] The Skype Official Webpage
[185] Wikipedia: The Free Encyclopedia
[186] The Vonage Official Webpage
[187] Analysis Research Limited (2004) p. 7-14
[188] Christensen C. M., Anthony S. D., Roth E. A (2004) p. xxx
[189] Magnus Blomkvist, Lund 2006-01-16

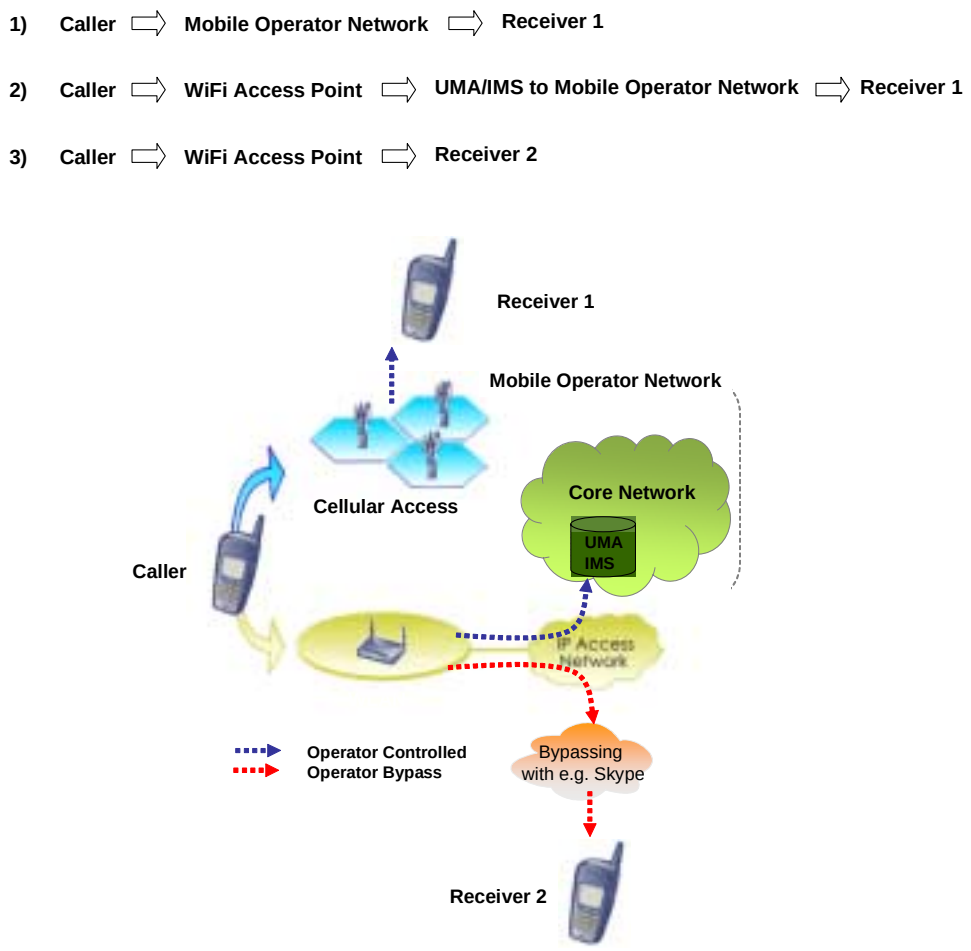


Figure 6.1: *Mobile VoIP call bypassing operator controlled networks*[190]

Furthermore, in the first outlined situation above the end user is generally using a single-mode cellular handset, but in the remaining alternatives a single-mode Wi-Fi handset, e.g. from Vonage, or a dual-mode handset, e.g. from Sony Ericsson or Calypso Wireless and software from Skype, might be used.[191] A dual-mode device would of course give the user greater possibilities and enables all three alternatives. Future possibilities regarding the third alternative, the bypassing, might be enhanced by different movements and wireless project, which are currently moving forward, somewhat on the limit of the current US wireless telecom industry.[192]

[190] Johan Karlberg, Lund 2006-01-26
[191] Magnus Blomkvist, Lund 2006-03-01
[192] Martyn Levy, Atlanta 2006-03-07

6.4 Free WiFi for the Masses

There is a growing movement of so-called “Free Nets” or wireless movements, which are striving towards free Wi-Fi for the masses i.e. the “always on” mentality that celebrates the concept of wireless connectivity for anyone, everywhere all the time.[193] However, nothing is really for free, at least not in the long run and someone somewhere is most definitely earning money of the fact that individuals can access the net for free. One such organisation that has the approach of delivering “free” Internet is FON. Despite their noble and revolutionary-like approach on their webpage, the fact is that they are heavily backed by players such as Skype, Google and eBay.

6.4.1 FON

FON Technology SL is based in Madrid and is an Internet start-up that attempts to build a shared, global network of wireless hotspots. The firm, which calls its users "Foneros" allows them to use special software to share each other's Internet connections. The goal is to setting up a million WiFi Internet hotspots around the globe by 2010.[194] A “Fonero” basically permit anyone with a WiFi-enabled device within the range of his or her access point to access the Internet. In return, the “Fonero” may use all other “Foneros´” Internet connections for free when in their range, which is called the “Linus” option after Linus Torvalds. There are other options as well, which has a built in paying system. [195]

At present, the software is still in beta phase and the only option that is actually up and running is the "Linus" option. However, a possible conflict might be that participation in the FON network might sometimes clash with the terms of use of some Internet service providers, but until today FON has made agreement with some ISPs to allow DSL-sharing. Jonas Birgersson, CEO of Internet service provider Labs2 and in charge of a FON project in Lund Sweden, talks about FON in terms of a “movement”, but according to a US contact the “movement” has not yet started. At least in the US they need to lie low, since the FON strategists do not think that the world is quite ready for this type of movement just yet. Instead the “FON movement” in the US marketplace does not advertise at all and is currently only visible as an access point vendor. Or as Wendy Seltzer, Internet layer and board member, puts it: “Before one can start a movement one has to prepare the ground work and in this case the groundwork is a FON access point in every US home”. [196]

6.4.2 Google and Feeva

Another example of a business model were the end user could use the network free of charge is in San Francisco, where the worlds largest Internet search company Google

[193] Dewayne Hendricks, Atlanta 2006-03-06
[194] Wendy Seltzer, New York 2006-05-15
[195] Ibid.
[196] Ibid.

exploit a technology start-up's proprietary solution. The mentioned start-up is Feeva Technology Inc., which actually is an advertising technology start-up that develops an innovative technology to accelerate the relevance of online advertising. Their core asset is a database with geographic, demographic and psychographic figures, which is available in real-time to online advertisers, such as search engines and WiFi providers. Moreover, the main function of the technology is to improve the targeting and accountability of online advertising, which enables the network provider to determine the end users position in the network, targeting the individuals profile and deliver the accurate advertising material. Returning to the San Francisco case, Google sponsored a Wi-Fi hotzone downtown San Francisco together with Feeva and this in turn would allow Google to target advertising using GoogleMaps and Feeva´s demographic data base. Hence, the cost of the network will be paid for by advertisers and the user will be able to use the network at no additional cost, except for the advertising that one would get in the WiFi-enabled device, that is.

6.5 Municipal Wireless Projects

6.5.1 Municipal Wireless Projects

The municipal wireless project in St. Cloud Florida is another example of such a business model that brings WiFi free to the user. In this particular case and apart from the larger municipal projects, which will be outlined later, the "Cyber Spot" project in St Cloud is the first municipal project with one hundred percent city coverage, free of charge for all 27,000 citizens and guests of the city. In 2005, the Cyber Spot expanded to provide a unique free WiFi service to the entire city of St. Cloud and the mayor of St. Cloud, Mr. Glenn Sangiovanni, proudly expressed the below statement.

> "This free city service will save the average family's fifty percent more than their entire city tax bill, making living in St. Clod virtually tax free"

As mention in earlier, mesh standard can be used to deploy and distribute WiFi broadband in a corporate or outdoor environment. Cities or towns taking this initiative are a major trend in the US and today more than thirty five states have ongoing municipal projects. These networks typically evolve from downtown hotzones, like St. Cloud, to city- and county-wide wireless networks. Moreover, large cities that have commenced with city wide WiFi projects are for instance Philadelphia and San Francisco, while projects in Chicago and Boston are under construction. Of these big four, the Philadelphia project is in front and today the Internet service providers Verizon Communications and EarthLink offer broadband service, not for free, but rather for a fee ranging between US$ 10 – 20 per month.[197] The planning process started 2004 and as the first large scale municipal project, Philadelphia has became somewhat of a role model and the process and decisions they have made along the way might potentially help the other 14,428 cities in the US to unwire.[198]

[197] Settles C. (2006) *Fighting the Good Fight for Municipal Wireless,* p 7-10
[198] Ibid., p 25

Although, when deploying any kind of network, capacity is always a crucial and the mayor of Philadelphia John F. Street early pointed out that "the issue of capacity is critical". The wireless service that Philadelphia is offering today has a 1 Mbps both ways connection and that is not much compared to European and Asian standards. However, as the WiFi technology evolves the city of Philadelphia argues that they will offer capacity closer to international broadband capacities.[199] According to the Philadelphia CIO Dianah Neff, this is possible since WiFi is based on standards with backward compatibility and the city will be able to update their services to faster standards of WiFi without having to replace the existing infrastructure.[200]

6.5.3 Municipal Wireless Business Models

Evaluating the technological aspects of the WiFi technology in general and the previous discussed capacity issue in particular, one will find that capacity is directly tied to costs and business models to support these costs. The authors have identified several main features in municipals´ business models that for instance will increase public safety efficiency, attract new businesses to the cities, educate residents and ultimately bring down unemployment. Moreover, many cities will also use the deployed networks to cut telecom costs and in Philadelphia alone, these costs savings are calculated to several million dollars. Streamline operations and improve productivity for city employees such as police officers and building inspectors, for whom mobility is a critical part of the job, are other main features found in business models.[201] Osme Vos, founder of the "blog" Muniwireless.com, states that as much as eighty percent of the wireless municipals are using the networks for some form of "internal" application to support their business models and the portion of these can be view in Table 6.4 below.[202]

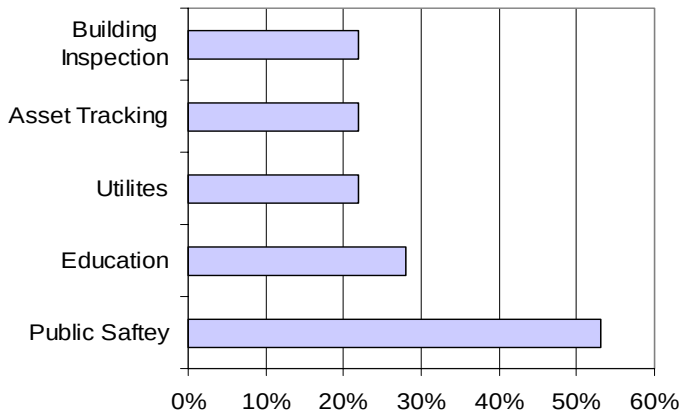


Table 6.4: *Municipal wireless applications deployed in 2005* [203]

[199] Settles C. (2006), p 5-6
[200] Dianah Neff, Philadelphia 2006-01-10
[201] Ibid.
[202] Osme Vos, Atlanta 2006-03-07
[203] Ibid.

However, today no single strong business model exists and the networks have to be designed for multi-applications services to deliver ROI. Furthermore, cities with tight budgets are unwilling to take risks and will consequently settle for the most tested and reliable networks. These facts, regarding ROI deliverables, in combination with the fact that there have not been any successful dual-mesh networks up and running for a longer period of time, municipals are choosing single-mesh networks.[204] As mentioned earlier, an unloaded network node in a single-mesh network could hold about 5-8 voice users, which means that the networks deployed today will not support a full scale public voice application.[205] However, according to a trial made by the authors (using a Wi-Fi enabled Qtek 8310 handset), the single-mesh network is not the only problem to be overcome in the future, but also the fact that the radios in the mobile phones are way to powerless as in current state. The transmitter in a mobile handset typically has a power of 20mW compare to the 300-600mW from a mesh node, as the high power nodes are used to reduce the number of nodes in the network and thereby decrease the deployment and operation costs. This reality is made rather clear when one attempt to use the Wi-Fi enabled mobile device in the Wi-Fi network. The device is receiving signals, but the Internet connection is lost due to the handset's much too powerless radio transmitter. This issue clearly decreases the ability of duplex connectivity to the handset and severely increases the energy consumption.[206] As a consequence, to be able to deliver full scale voice the mesh network has to be build for this application from beginning with a high density of nodes where voice applications are to be utilized.[207]

6.6 Political and Regulatory Context

6.6.1 Related to Municipal Wireless

Currently, mobile operators are aggressively lobbying against the municipal wireless initiatives on the grounds of unfair competition. However, as small municipalities increasingly are joined by larger communities in building out their own wireless infrastructure, more and more cities are predicted to offer free access, which presumably will even more fuel the above lobbying activities. Here, the previous described business models, such as the Feeva/Google project, are serving as forerunners and there will be battles regarding whether or not it is acceptable to allow the cost of a network to be subsidized by someone other than the end user e.g. advertising or cost savings of previous outlined municipal operations.[208]

6.6.2 Related to the Industry as a Whole

The past decades have seen a remarkable transformation in structure and regulation of telecom markets worldwide and the impact of these changes is not limited to the individual countries in which they occur. This means that it has become necessary to

[204] Howard DeYoung, St. Cloud 2006-03-09
[205] Martyn Levy, Atlanta 2006-03-06
[206] Howard DeYoung, St. Cloud 2006-03-09
[207] Martyn Levy, Atlanta 2006-03-06
[208] Osme Vos, Atlanta 2006-03-07

address telecom issues from a global point of view and wireless players, which were formerly restricted to their own national industry, are now crossing borders to compete for foreign markets. Hence, in the US, an energetic debate is currently taking place, which mainly has been focused on whether the FCC should continue to have a role in reviewing telecom mergers. The more complex issue of whether the commission should retreat entirely from regulation of telecom operators has received somewhat less attention, but has lately emerge as a serious question for long term policy.[209]

In many countries, the first transition has been from government monopoly to a privatizing entity controlled by an independent regulator. The next transformation on horizon is away from the independent regulator and towards regulation through general competition law. Australia and New Zeeland made this move in the 1990s, but in the US the transition away from telecom-specific regulation is likely to be selective and slow. Furthermore, the transition has come a long way in the US, as it comes to telecom mergers, but then again it is progressing much more slowly when it comes to removal of specific regulations designed to constrain behaviours of dominant players. [210] At last, many of the new regulations created by the 1996 Act, to promote competition, may eventually be fazed out and with them the need for a great deal of the sector-specific regulation, which today governs telecom in the US, will also be of less importance or disappear completely.[211]

6.7 Industry Sum-Up

So far in this thesis, the main technologies associated with the industry, i.e. the Wi-Fi, Cellular and WiMax technologies, have been outlined. Moreover, the US telecom industry and its main voice combatants i.e. the mobile operators, WiFi providers and VoIP providers, have been identified and covered. Finally, the “free to the end user” business models as well as municipal wireless projects together with political/regulatory contexts have all been of subject investigation. To sum-up these enclosed chapters, the below table combine the above sections in a comprehensive fashion, which primarily will address what potential commercial opportunities and threats VoIP might bring to the current and potential providers. However, if these threats and opportunities will become facts in the future US telecom industry is still an open question. This issue will be further addressed later on in the scenario analysis, as they are considered together with important drivers regarding the Wi-Fi technology.

[209] Shelanski H. A. (2002) *From sector-specific regulation to antitrust law for US telecom: the prospects for transition*, p. 354
[210] Ibid., p. 355
[211] Atkin D., Lau T. Y., Lin C.A. (2006) p. 85

	Wi-Fi	**Cellular**	**WiMax**
Mobile Operators	The main *opportunity* is potential provision of the fixed mobile convergence e.g. trough the UMA technology. The main *threat* is the deployment by fixed operators of services that may damage the prospects for the fixed/mobile substitution.	The *opportunities* include enhanced services e.g. the integrated voice and data as well as reduced costs from an IP network. The obvious *threat* is that their voice services might be bypassed.	An *opportunity* involves a deployment as an alternative to cellular technology. Possible *threats* might include competition from other players deploying the WiMax technology, enabling mobile voice.
WiFi and VoIP Providers	Enhancement of existing VoIP services by provision of WiFi voice services is a major *opportunity* for these payers.	The major *opportunities* are mobile voice revenue from bypassing mobile operators' voice services.	Generation of additional voice revenue is a major *opportunity* in this category.

Table 6.5: *Potential commercial opportunities and threats of VoIP* [212]

Considering the above table, as well as the fact that the voice telephony still accounts for a significant proportion of mobile operator's average revenues pre user the battle is definitely a tempting prospect for many organisations, of course including WiFi and VoIP providers. For instance, Skype has worked together with Siemens to develop a new wireless handset that provides access to the Skype's VoIP service, while Vonage and Boingo are working together on the development of a WiFi hotspot service.[213]

[212] Analysys Research Limited (2005) p. 10
[213] Ibid., p. 13

7 Trends

Although, the trends by definition appear in every scenario, they are of major importance and were given more or less weight or attention in different scenarios. In this chapter the authors will present these mobile industry trends bundled in two levels; the macro and communication trends.

7.1 Trends in Macro Environment

To be able to understand the future of telecom one has to be aware of the major macro trends that has influenced and still are influencing the industry. In this environment, four major trends have been changing the industry over the last two decades, as the industry today is reaching its mature state. The four trends are digitisation, consolidation, deregulation, and globalisation.[214]

7.1.1 Digitisation

Digitisation means that technologies for processing and diffusion of information have begun to use the same language. That is the computer language and the binary code. The digital language facilitates the convergence of computers, telecom, office technologies et cetera. Digital integration, furthermore, offers capacity, flexibility, reliability as well as low costs. In other words, better technical quality at lower prices.[215]

The most notable impact of the digital society is that it empowers the individual. This empowerment categorically changes his or her relationship to and dependence on existing social structures; personally, locally, regionally, nationally and for the first time ever also, globally. In addition, digitisation reinforces a social process in which the production and distribution of information evolves into the most important economic activity in a society. Information technologies begin to function as the key infrastructure for all industrial production and information itself becomes a product tradable on the global market. What is more, digital technology is a synergetic technology. This means that its growth leads to growth in other sectors of the economy and it creates an infrastructure around its products and services, similar to the car technology earlier in the 20th century. [216]

7.1.2 Consolidation

As all signals converge into the digital format, whether they carry sound, data, or pictures, they become different in substance and identical in a technological sense. As

[214] Hamelink C. J. (1996) *Trends in World Communication*
[215] The VRC Active Media Official Webpage
[216] Moira A. G. (2001) *The Societal Consequences of Digitalization,* p. 5

a consequence, telecom, the Internet and broadcasting converge can be provided by TV cable networks or over other IP infrastructure and TV signals can be carried by telecom operators or over the Internet. This raises complex regulatory problems and also consumer questions, regarding the quality of services. Although, today it is still possible to distinguish computer manufacturers, telephone service companies, media, broadcasters, film and music producers as separate actors, but they are rapidly converging into one industrial activity. [217] Furthermore, technical convergence leads to institutional convergence and to the consolidation of national and international provision of information and culture into the hands of a few mega-providers. To remain competitive in world of communication, companies need to bring formerly separate talents under one roof. [218]

7.1.3 Deregulation

The trends towards the digitisation and consolidation go together with a shift from public service with controlled regulated condition of information and telecom services, to a competitive environment for the trading of these services by private market operators. At the same time the trend towards deregulation strongly reinforces both digitisation and consolidation.[219]

Within the US marketplace, the first period of privatisation emerged in the late 1950s. As telecom users became aware of their growing dependence on telecom they organised to lobby government authorities for specific, far reaching change in the rules governing domestic telecom requirements. With the development of trans-national data networks and the growth of trans-boarder data flows, the trend towards deregulation is further exported from core to border countries. This fact raises the question concerning the sufficiency of globalizing, a policy that starts in a specific historical context to all countries at the same time.[220]

7.1.4 Globalisation

Globalisation results in trends becoming very similar globally, for example among young people. Globalisation and the impact of mass media make trends diffuse and spread much faster on a global scale.[221] Technological innovations, especially in the land of information, telecom and their convergence have in great deal assisted the processes of globalisation. In fact, one could argue that communication/information technologies provide the vital infrastructure for global transactions.[222]

7.2 Trends in Communication Industry

In the telecom industry, technological development, brutal competition and deregulation have changed the industry from being static to dynamic and turned the

[217] Jin Ki Kim (2005), *Telecom Merger Trends in Context of the Convergence*, p. 5-30
[218] Ibid., p 5-30
[219] The VRC Active Media Official Webpage
[220] Ibid.
[221] Ericsson White Paper (2005) *Evolution towards converged services and networks*, p. 5
[222] Hamelink C. J. (1996)

segmented markets into one converge.[223] The increased competition in the marketplace has forced players to discover new markets and business models. Removed entry barriers, as a result of deregulations, have given telecom carriers an opportunity to enter the market and create new markets for bundling services. These internal and external forces drive telecom operators to search for new breakthroughs, such as digital convergence. The convergence in telecom has lead to the emergence of bundled services across market boundaries as well as several changes in the communication industry. The first one is exchange between telecom services. This exchange is followed by the convergence between telecom services and broadcasting services. The second impact of digital convergence is that the value chain of the communication industry has changed, which means that several distinct value chains are linked together with each other. The value chain is increasingly being deconstructed as new and powerful players enter and restructure the industry. [224] Moreover, the rapid technological developments and increasing market turbulence have added new dimensions to an already complex situation. The value chain is rapidly evolving into value networks, with several entering and exit points illustrated in Figure 7.1 below.

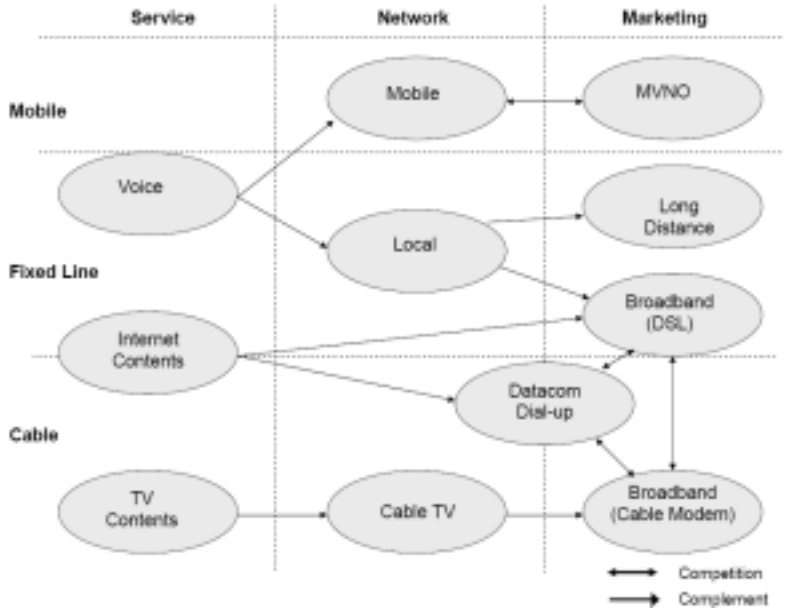


Figure 7.1: *General communication value chain illustrating relationship among services*[225]

[223] Jin Ki Kim (2005) p. 3
[224] Ibid., p. 5-30
[225] Ibid., p. 3

8 The Scenario Build-up Process

In this chapter the authors embark on the scenario logics section of the scenario development. The goal is to evaluate whether WiFi entrants could pose a long term threat to mobile voice incumbents and with help of the previous introduced disruptive innovation theory, identify crucial decisions and battles firms could take to change the outcome. Furthermore, this chapter will, in a disruptive manner, generate the skeletons for the upcoming scenario creation.

8.1 Driving Forces

As earlier described, driving forces are those primary forces that fundamentally determine future developments and should be identified inside the system. In this thesis the system has been presented in chapter 2.4 as the boundaries for the scenarios. The authors have identified the driving forces, by brainstorming together with industry experts for important drivers regarding the WiFi development. These drivers are available for the reader in Appendix 5. Moreover, as stated earlier in the thesis, a few driving forces are predetermined e.g. demographics and several are considered to be uncertain e.g. public opinion. However, when creating scenarios one can not differ over predetermined elements as these elements are bound to be the same in all scenarios. The authors have identified, for instance processor capacity, as a technological predetermined driving force, by reason of the industry knowledge that the capacity most certainly will increase with a predefined number, as the years go by. Thus, the predetermined elements were consequently left out from further discussions towards the goal of developing the scenarios. The authors proceeded according to the scenario methodology, to distinguish the drivers, which should have the largest impact of the scenario logics creation.

> "Remember that it is only the driving forces, which are both highly uncertain as well as highly important, that should be a part of the scenario creation"
>
> - Berth Eklundh

According to the above quotation as well as previously examined scenario literature, the driving forces, obviously excluding the predetermined ones, were further investigated to uncover the real uncertainties, which have an impact of the future scenario system. This action was carried out according to Figure 8.1 below, where the drivers were marked, ranging from 1-45, and after a careful debating exercise positioned into the figure. What is more, the drivers in the grey area incorporate both high levels of impact as well as high degree of uncertainty and are therefore, by the authors, considered to be of greatest importance to the forthcoming scenario logics creation. These "True Driving Forces" is available for browsing in Appendix 5.

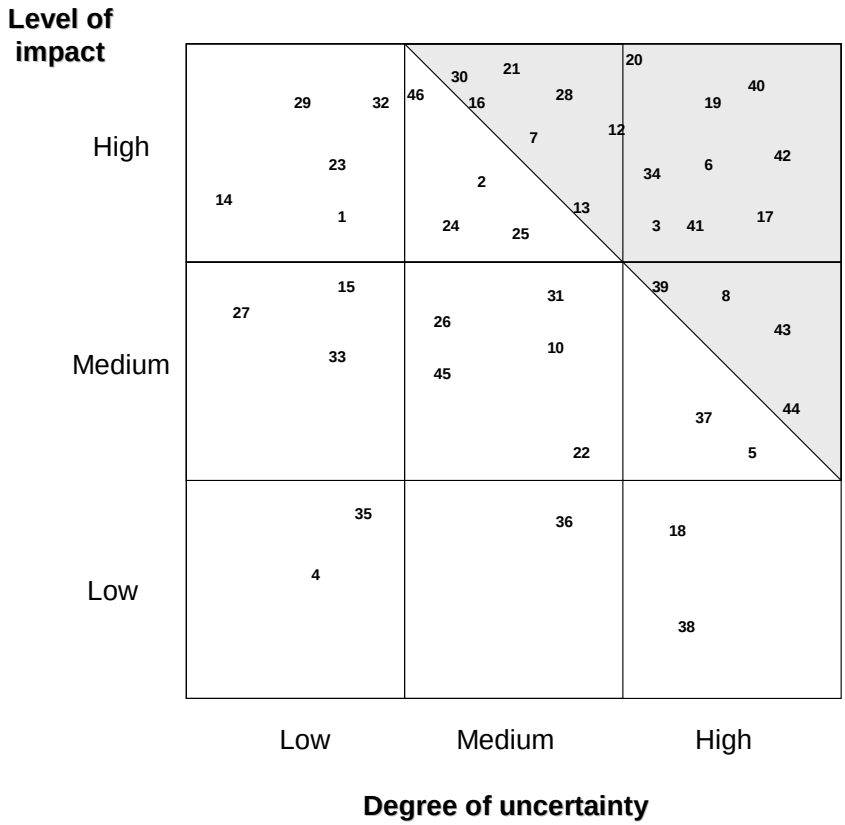


Figure 8.1: *Process of single out the most important driving forces*

8.2 Scenario Logics Creation

As the authors previously pointed out, the scenarios need to use the same sort of logics to be reliable in their position of explaining possible futures. The above outlined, “True Driving Forces” are the engines of change and as one artificially altering these fundamental uncertainties each scenario portray another future state. By doing so, the scenarios highlight the importance and consequences of the uncertainties as well as illuminates potential blind spots. Subsequently the authors have made them the “Star of the Show” by using them to determine the scenario dimensions. The largely iterative process of determining these dimensions is by many scenario literature authors, the most important step in the entire scenario generating process. Peter Schwartz once said “While one may boil the logic down to very few dimensions the process for getting there is not at all simple or mechanical, it is rather more like playing with a set of issues until you have reshaped and regrouped them in such manner that logic emerges and a story can be told.“ Moreover, Berth Eklundh

more recently said to the authors that "This part of the exercise is definitely more like art, than anything else".

Bearing the above descriptions and quotes of a rather complex process in mind, the authors embarked on the scenario logics section of the scenario development with great caution. Initially a grouping exercise was carried out, where the "True Driving Forces" were moved around, tested and evaluated in an iterative fashion to ultimately end up with six groups of driving forces. These groups were then thought of in terms of dimensions of the scenario logics and these dimensions evolved from yet another iterative process, which is illustrated with the two circular arrows in Figure 8.2 below. Furthermore, the graphic attempts to express the extremely important, yet indistinct, process of developing the scenario logics, which have been described in text above.

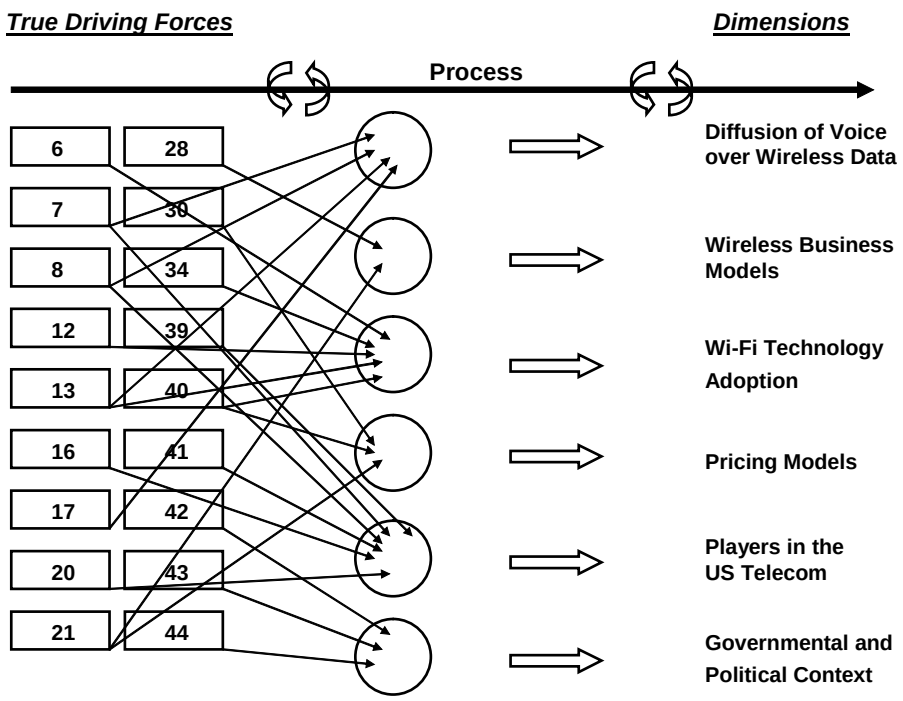


Figure 8.2: *The process of developing the scenario logics*

Due to illustrative issues, the authors have further on in the thesis, chosen to present the evolved dimensions in a somewhat different order than presented in Figure 8.2 above and the first dimension that the authors have drawn out from the above outlined scenario logics creation system is the **WiFi Technology Adoption** one. This dimension describes to what extent the WiFi technology will be utilized in the future. Will the technology be used in existing environments such as homes, offices, cafes, airports or in extended environments such as municipal areas, mobile handsets, TV's et cetera?

The second dimension is **Diffusion of Voice over Wireless Data**. This dimension describes to what extent the WiFi technology will be used as an infrastructure for voice applications, with end points ranging from present stage of selective pioneers to the common application for voice by the mainstream segment.

The third dimension consider to what degree there will be new **Players in The US Telecom i**ndustry and their motivation to adapt WiFi technology contra the entrance of new Players in Mobile voice industry with new value chains and low cost business models.

The forth dimension describes whether the **Wireless Business Models** will be few and diverse or several and strong. For instance, how many applications will be run over WiFi networks and how strong is their ability to deliver ROI.

The fifth dimension is **Governmental and Political Context.** With this dimension the authors want to describe the governmental and political context, ranging from legislations against municipal wireless projects to expanded free lisenced spectrum and deregulations in telecom by the FCC.

The last dimension covers the **Pricing Models** for WiFi access, ranging from being free at all locations to additional cost at every hotspot.

8.3 Creating Scenario Skeletons Using Disruptive Theory

The authors' goal with this section is to evaluate whether WiFi entrants, such as Boingo, T-Mobile and VoIP providers, such as Skype could pose a long term threat to mobile voice incumbents in telecom industry. With support from the previously introduced disruptive innovation theory the authors will further identified crucial decisions and battles firms could make to change the future outcome. Moreover, this section will, in a disruptive manner, create the skeletons for the upcoming scenario creation. However, before embarking on these deliberations, a glance back to the thesis research questions is of relevance:

> To what extent could the explosion of local and public wireless networks, using WiFi technology, affect the future telecom industry? Who will ultimately master the WiFi innovation and to what degree could this innovation open new possibilities for external players to enter the mobile voice industry?

Or, in other words; could WiFi providers and VoIP providers create a disruptive threat to incumbent voice players? Well, companies do bring voice services into new contexts and generating demand for broadband services "on the go". They are also creating low-cost business models as well as new skills, to meet the needs of the low end customer groups. However, entrants and incumbent operators´ strategic choices will, as always, play a major role in the future to come and finally decide who will ultimately master the innovation.

Using disruptive innovation theory the authors will continue by evaluate the incumbent's strengths and weaknesses, which in short term will answer to the question whether incumbents can co-opt the WiFi technology. Furthermore, the authors will identify *Signals of Change* and discuss which *Strategic Choices* might play important roles for the future to come.

8.3.1 Industry Players Strengths and Weakness

By identifying the incumbents' most important resources, processes and values (RPV), the authors will create an overall framework of the incumbent firms' strengths and weaknesses. The telecom incumbents will be able to successfully undertake the new WiFi technology when, or if they have the recourses to succeed, their processes facilitates the job that needs to be done and when the opportunity is given sufficient priority overall other demands for a company's resources.

To begin with, the incumbents' strong cash balance, existing customer base and powerful brands are their most obvious *resources.*[226] Moreover, their large established networks are their most essential and important resources. [227] Unless new entrants

[226] Nils Rydbeck, 2006-03-13
[227] Berth Eklundh, 2006-04-13

want to undertake the significant cost of building their own network, they have to rely on the existing operators networks. Several of the incumbents' most important skills, their *processes*, are their ability to build and maintain large networks as well as provide network services.[228] The latter skill is essential and includes the two components; transport and value adding services. Historically, these two components have required integration and the deliveries of the services have fully relied on the physical network. In addition, most communication products and services depend on the integration with the physical infrastructure such as origination, circuit switching, provisioning, billing and termination. Hence, providers have to integrate transport and services to optimize the network performance. In the past, integration generated an unquestionable source of competitive advantage. One firm could simply not be a specialist provider, as changes to the services required changes to the transport medium and vice versa. Today, the value networks and modular value chain architecture, based on IP infrastructure, render the emergence of specialist firms such as Skype and Vonage, delivering voice services over any IP infrastructure. Incumbent operators have further solved voice related problems such as roaming and network efficiency related to the cellular networks, which indicates that their processes facilitate this type of issues.[229] Another important skill is incumbent operators' long history in the regulated telecom industry, which has provided the incumbents with important abilities of managing in a regulatory context.[230] So, what about incumbent *values*? Telecom tends to be a high margin business as providers need to reimburse the fixed costs of building and maintaining networks.[231] Incumbent operators make money selling phone calls and services. Historically, industry players have focused on voice services, where they billed and allocated cost based on the length, location and what time of the day the users placed the call.[232] Over time, operators responded to the increased demand for data traffic, by overlaying these services onto their existing business models and networks.[233]

As mentioned, the above resources processes and values of the incumbents define the firms' strengths and their potential weaknesses. Next, the authors turn from recognising the industry players to identify whether circumstances support the introduction of wireless disruptive innovations.

8.3.2 Signals of Change

The disruption theory suggests that *non-consumers* and *overshot customers* present the greatest opportunities for industry transformational innovations. To identify these groups Christensen argued that there was an important question that one ought to ask. The question is: Are there ways to bring communications into new contexts, where individuals may want to use their voice to communicate, but cannot?

[228] Berth Eklundh 2006-04-13
[229] Mike Linstrom, 2006-03-07
[230] Wendy Seltzer 2006-03-15
[231] Nils Rydbeck 2006-03-13
[232] Ibid.
[233] Mike Linstrom, 2006-03-07

As individuals generally cannot use their voices to communicate in many data settings, e.g. students and teenagers communicating with friends using instant messaging, they have to type their message instead of speaking. Moreover, individuals working in partnership with their colleagues over the Internet and then might want an easy way to communicate. Hence, there are contexts where individuals want to use their voice but cannot. The availability of IP enabled handset and wide covering WiFi hotspots would add mobility to instant messaging, future voice application and IP voice services as well as add convenience with always on features. Developing products and services to serve these *non-consumption* customers could lead to disruptive development. Vonage could be one of those highly disruptive firms and since their service rides over existing connections, there is no need for them to provide, set up or maintain any connectivity. With Vonage, area codes are no longer fixed to the users´ home connection and one can select the area code of choice and take that area code on the road. The QoS is not as good as traditional wire line or mobile service or even cable VoIP, but it is inexpensive, offers new features and enables consumption in new contexts.

The second customer group that is able to create disruptive growth is *overshot customers* i.e. if the functionality and reliability of services that existing companies provide overshot what their customers can and will use. So, is there any sign of overshot customers? For example, the fixed telephone companies, traditionally committed to the "five 9s" reliability, which means that the service is available 99.999 percent of the time including during power outages[234]. This makes voice communication possible even in the worst emergency situations due to the power that the fixed telephone provides.[235] As a result thunder could knock down every power line in the city and the handset would still have function. In addition, the market's perception of "good enough" has evolved downward to encompass lower quality service, arguably due to the uneven quality of mobile telephony. Conclusively, the authors believe that there are customers that find these services to be more than they need. Thus, they will tolerate "not as good" technologies in exchange for the convenience of wireless and what customers identify to be low marginal prices for individual calls. Moreover, open standard Internet Protocol has greatly decreased the cost of transport and switching equipment, making it more inexpensive for new players to build new freestanding networks. If one analyse cable companies for instance, they already have physical connections into consumers' homes and now they can enter the telephone industry with a product that is "good enough" for many consumers using VoIP. These players could, with handsets utilizing seamless handover between WiFi and GSM/GPRS from for example Calypso Wireless, provide mobile phone calls as long as the handset is in reach of a wireless connection.

8.3.3 Strategic Choices and Competitive Battles

As described earlier, one big advantage of WiFi products is that, unlike the incumbents' cellular 3G networks, WiFi operates in the free licensed spectrum and does not require obtaining licenses from the government. Companies early began

[234] Nils Rydbeck 2006-03-13
[235] Mike Linstrom, 2006-03-07

using WiFi to set up wireless local area networks. In short, individuals started to set up WiFi networks in their homes, freeing them from the limitations of wires. WiFi providers began sprouting up services in heavily trafficked areas such as airports, cafés and downtown business districts. Today, one can further see an increasing interest from municipals and shopping centres, deploying mesh networks covering wider areas or entire cities. Using mesh networks, the actors are attempting to construct networks with no central architecture and devices are communicating with other devices. In terms of disruptive innovations, this is classic *new-market disruptive growth*, as WiFi brings network access to previously unlikely places. Furthermore, the access points are easy to set up and uncomplicated to use, which means that WiFi makes it easier for individuals to do something they historically prioritized, i.e. accessing data anywhere, anytime and at high capacity.

As can be seen in Table 6.2, Bingo is one of leading WiFi providers and is attempting to build a business model aggregating micro-carriers, ranging from a wireless access point in someone's living room, to the network in a hotel. FON is of course another interesting player, as they make an effort to aggregate individuals' home access points, to a worldwide covering network. In addition, Google's trail network in San Francisco offers free Internet access to the end consumer by the utilization of Feeva's propriety solution, which enables determination of the user position and advertising through GoogleMaps. This concept also creates a business model with free to the end user Internet access. However, to be able to move up-market and push incumbents even further up and eventually out from the marketplace, these providers need to overcome some serious technological challenges. Issues include the limits in distance, roaming, security and so forth, which all affect a profitable business model. Below the authors will discuss strategic choices and battles that could power disruptive or sustaining future scenarios.

Entrants Strategic Choices that could Power Disruption

As incumbents multibillion dollar companies was trying to stretch 3G services to meet the demand from the high end segment, early WiFi market development could rely on the shield of *asymmetric motivation*. The WiFi market was too undersized to really matter, which caused the incumbents to ignore the WiFi growth for a long period of time.[236] This caused the need for entrants to develop their own and unique business models and skills. Furthermore, WiFi enable networks to be set up in an independent and freestanding environment, although the networks obviously need to be connected to an Internet provider. This relation is a true point of modularity and gives the entrants the ability to develop free business models, not based on the minutes of use. Consequently, they could offer much lower prices since no need for building extensive networks is present. A new group of WiFi providers could bring together enough wireless access points to create some emergence of national coverage. Or at least cover home, business and public areas were the golden 67 percent of all mobile calls are made. This could bring wireless data into a new context and if these providers subsequently could work out a way to solve VoIP related issues and provide voice traffic over these networks, they possibly will be a disruptive threat

[236] Mike Linstrom, 2006-03-07

to incumbent voice providers. This disruptive prospect would leave incumbent as network providers with only a backhaul role. Furthermore, in this potential disruptive scenario, entrant additionally need to maximize their independence from the value networks, develop new ways to reach new customer and find ways to combine 802.11 and voice to avoid co-option by incumbents. If successful, the bypass of the operators' core network might be reality.

Early Competitive Battles could power Co-option

Next question to be raised is whether incumbents will ignore WiFi technology long enough, for entrants to get far enough on the disruptive path. As early as 2003, signs were indicating that incumbent did not suffer from asymmetric motivation to capture the innovation. Various carriers such as Verizon, T-Mobile and AT&T were experimenting in different ways to complement their networks. For instance, T-Mobile started to retail WiFi access at Starbucks and in late 2005 they announced their UMA trails. Furthermore, it is unclear if competing in local areas really requires unique skills compared to overseeing large national networks. Moreover, WiFi providers need to solve problems such as roaming between networks, managing user accounts as well as processing small transactions. Large incumbents need to overcome equal type of problems, indicating that their skills might match this opportunity quite well. Consequently, the authors presume that if entrants cannot create an asymmetric situation, the incumbents will have a good chance of co-opting WiFi technology.

8.4 Identifying the Most Transformational Scenario Skeletons

Using disruptive theory the authors could at a first glimpse identify the most obvious disruptive and sustaining scenarios. However, even if incumbents may seem to co-opt WiFi technologies, heading for sustaining scenario, two future evolvements could develop true disruption. First, the convergence of VoIP with wireless technologies that could allow WiFi providers to develop new business models, for which users pay a one-time charge or even are free to receive unlimited voice and Internet access. The second disruption scenario possibly will be the development of new technologies such as WiMax. As described earlier in chapter 5, WiMax products will provide access bandwidth up to 50 Mbps and with a functional range of several kilometres. The WiMax technology is still in its early stage suffering from teething diseases and limitations related to mobility and roaming. However, if development progress as projected WiMax could be a real game-changer.

After identifying the three scenario skeletons, i.e. the near-term and later **Sustaining Scenario**, the **Disruptive Scenario** by early convergence between voice and WiFi technology and a last the **New Technology Disruption Scenario**, the authors proceeded towards the scenario creation. As mentioned, the scenarios should basically be viewed as a process of formally codifying knowledge for a wider group, which ultimately ends up with stylised stories that has the soul purpose of delivering the message to the reader, in a comprehensive fashion. This was performed via determining the future location of each scenario in the previous outlined dimensions, by artificially positioning and varying the individual scenario characteristics (green,

blue and yellow dots) within the limitation of the upper and lower extremes. Subsequently and after a largely iterative process, the three different scenarios evolved as the authors pencilled in matching coloured lines between the positioning-dots, illustrated in Figure 8.3 below. Each of the three, evolved scenarios was evaluated in terms of three possible sequences of events. This was made by returning to the "True Driving Forces" and trends, which assisted the authors in the process of creating the stories of these three most transformational scenarios. The future scenario stories were then written and are individually presented in the following chapter.

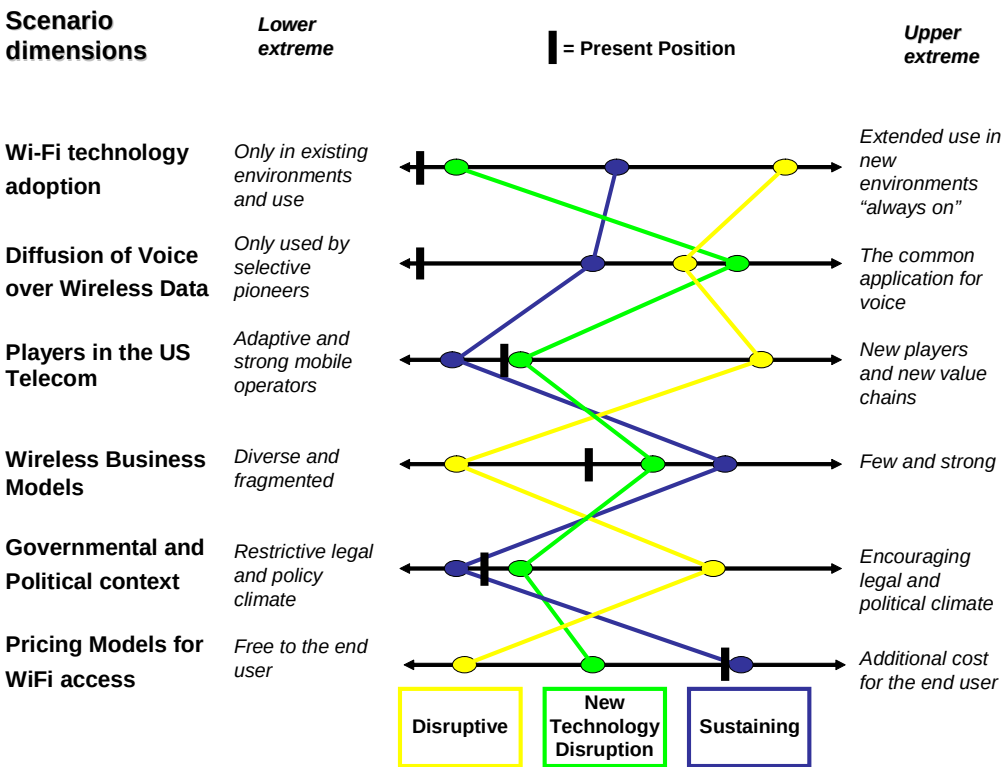
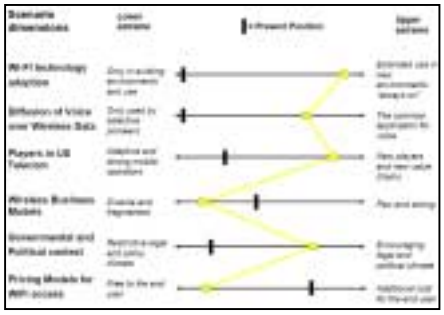


Figure 8.3: *The three most transformational scenarios*

9. The Scenarios

9.1 Let's have FON (Disruptive)



As one look at the Internet today and the way it has become a critical part of the individual's everyday life, it is easy to forget that the modern Internet is barely ten years old. More importantly, no one was really quite sure how it would be used beyond a few very obvious applications. Very few, if anyone, could have imagined the blinding array of use and applications that have been developed over the years and touches our lives in every way.

With falling equipment and component costs private WiFi networks became common in every home and offices during **2006**. The convenience of wirelessly connecting the laptop to the Internet, checking mails and chatting with friends from the couch or garden, grabbed customers with storm. Moreover, WiFi-enabled handsets started to emerge in the high end segments enabling high capacity applications such as music, video and other entertainment download. Although, during 2006 the WiFi technology still lacked the ability to deliver high quality voice applications forcing T-Mobile to further delay its intended launch of their UMA services.

Philadelphia's network deployment project started to show great success surpassing their goals with decreasing telecom cost and internal efficiency, which even created increase demand for VoIP services. Furthermore, the encouraging legislation passed by the US congress, regarding municipal wireless broadband deployment, provided funds to rural communities to roll out these networks. The increased interest and social enhancement by deployment of WiFi networks also encouraged the FCC to disclose more spectrums for unlicensed use, at lower frequencies, towards the end of 2006. This further improved WiFi as an alternative for municipal network deployment.

During **2007-2008**, the new 802.11n standard emerged in several wireless devices such as laptops and mobile handsets. The new standard with exceptionally increased bandwidth, coverage and decreased energy consumption further increased the popularity of the WiFi technology. The greater number of applications ran over the municipal networks and the success of a few big projects further encouraged the deployment as well as the choice of third generation mesh network, which supported modularity and full scale voice applications. Hence, VoIP and WiFi convergence emerged and by the end of 2008 eighty percent of the US citizens had WiFi coverage

supporting voice application at home, at the office as well as outdoor in urban environments. The convergence was achievable as the networks were using the 802.11n and e standard supporting QoS with low latency and prioritization of voice applications as well as roaming and seamless handover.

With strong business models, municipals were able to distribute free to the end user networks paid by increased municipal efficiency. Furthermore, as WiFi network providers like Boingo and EarthLink entered into successful partnership with municipals, in the role of operator and network provider, nationwide WiFi networks were rapidly created. The many times doubted FON movement gained momentum in 2008, as their coverage started to develop in an exponential fashion when coverage increased and network affects became established. Towards the end of 2008, FON had routers covering almost sixty five percent of the US. As new WiFi providers were focusing on delivering wireless IP networks Skype, with the launch of new handset software, liberated the network providers form the need of developing their own software for bring voice services to their networks. Moreover, Calypso Wireless started to gain market share in the end of 2008 by offering its proprietary solution for seamless handover to municipals and cable companies. This enabled municipals to decrease there telecom cost significantly. The cable companies entered the voice market by subsidise the dual mode and Skype-enabled handset form Calypso to their customers. This prospect facilitated free phone calls, as long as in reach of a subsidised wireless router or any other free to end user WiFi network.

All through the timeframe of **2009-2010** almost all handsets, even in the lower price segments, were enabled with WiFi chipsets. This outlook added water to Google's free to the end user network, which in combination with Feeva's technical solution could deliver individual advertisement, providing its search and GoogleMaps services to network users. Furthermore, with a strong and progressively increased demand for instant information and always on services, WiFi-enabled handsets could deliver free constant Internet access and voice service, which was perceived as natural as the concept of free e-mail back in 2006. The large mobile operator "mammoths" was experiencing an ice age from exceptional decrease in voice and data revenues. Toward the end of 2010 their function had been diminished to backhaul providers and had consequently lost their position as the major voice distributor at this moment in time.

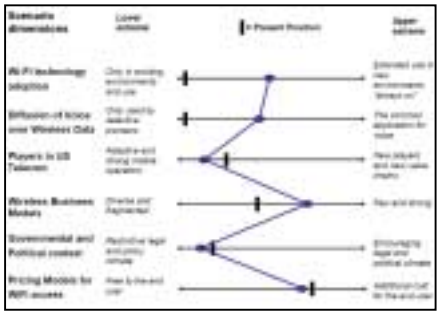
Subsequently, from **2011 and onwards** Google, Boingo and other similar new players in the US telecom industry will be the new mobile voice providers with their freestanding WiFi networks covering the golden 67 percent.

Scenario Discussion and Early Indicators

As mentioned earlier, entrant WiFi providers could pose a threat to incumbents voice operators if they could scramble together enough wireless access points to create some emergence of national coverage or, at least cover home, business and public areas were the golden 67 percent of all mobile calls are made. As a consequence, this is a true indicator for disruption. Furthermore, the sooner convergence between VoIP

and WiFi come about the harder it will become for the incumbents to co-opt the technology. Standardisation of mesh and increased free licensed spectrum is another indicator that would significantly increase the business model for municipal wireless and the possibility for deploying voice over municipal wireless networks. Incumbents also lack various skills that are required for success in the WiFi industry including software development. From a SEMC perspective, this disruptive scenario would cause lost of most of their current customers. Hence, SEMC need to find new retailer or attempt to reach the end customers with unsubsidised handsets. With WiFi dual-mode enabled handsets Municipals, WiFi providers and Internet providers would be potential strong new customers.

9.2 Operators World (Sustaining)



Many are those who believe that WiFi might take off in the future, but the technology might, on the contrary, end up in a mobile operator controlled environment, providing only Internet connection within official buildings, companies or private homes.

During **2006** the mobile operators, which did not put their hope in forthcoming 3G and 4G technologies, were optimistically looking forward to the new opportunities created by the WiFi technology. The main driving force were improved indoor coverage and relieved heavily loaded networks, arguments which also the leading WiFi operator T-Mobile used as they successfully launched their UMA service in Q3 2006. On the other hand, those who earlier had invested in 3G, for instance Verizon Wireless, were unwilling to invest again in another technology that seemed not as attractive and they instead supported the development of improved standards like 3.5G or 4G. Moreover, the demand for hotspots developed slowly due to insufficient voice capabilities and several municipal projects hit setbacks as legislation at the state and federal level were established. However, the restrictions did typically not outright prohibit the deployment and opportunity for municipals to charge their citizens for their new deployed networks. Furthermore, the Philadelphia municipal WiFi network was considered as a massive and expensive failure, which brought major cities to withdraw from large scale deployments. Hence, public access WiFi services continued to have modest impact on the businesses of the three giant US mobile operators. Nevertheless, the use of WiFi in home and office environments had a more profound impact.

Throughout **2007**, the WiFi technology provided a window of opportunities for companies pursuing fixed mobile convergence strategies to integrate landline and mobile services. T-Mobile was earlier described as the pioneer, but the strong and powerful Cingular Wireless pursued the UMA wave in Q1 2007 and together, yet separately, their business model grew aggressively providing a link between the customers' landline and mobile services, using widespread dual-mode WiFi /mobile

devices. The FMC was a great success with increased coverage as well as pressure relieving functionality on existing networks. In addition, as the voice calls generally travelled on the Internet, FMC did further reduce the cost of providing a voice call by nearly fifty percent, which eventually also profited the end customer by decreased price and added minutes to the widespread flat-rate subscription. The entrant WiFi access providers such as Boingo, emerging in hotspot world, were initially providing a complementary high capacity data network, which was able to deliver intensive local bandwidth services and Cingular Wireless as well as Verizon Wireless, continued to keep the WiFi technology on a distance.

2008-2009 became interesting and eventful years, as basically all US communication companies were focusing on bundling services, e.g. fixed telephony, mobile telephony, TV and Internet as well as pure fixed mobile convergence. Even certain broadband players glance at the mobile industry as a potential market opportunity, which further ensured the fierce competition with an elevated need for market differentiation as outcome. However, T-Mobile turned out to be an industry exception with only mobile and hotspot network property, while other major players such as Sprint/Nextel grasped the opportunity of being a part of the FMC movement. Moreover, towards the end of 2008, IMS started to emerge and was initially launched by Cingular Wireless, closely followed by T-Mobile.

By **2009-2010** the WiFi providers had solved most of the issues correlated with voice over WiFi such as mobility, latency and voice prioritization and were now able to deliver high quality and reliable voice service within their networks. As a consequence, the mobile operators saw a great opportunity to extend their core networks with local WiFi areas, enabling UMA services. Furthermore, in mid 2009 a new acquisition wave was initiated in the US telecom industry, the example was set by Verizon Wireless as they acquired Boingo and several other comparable acquisitions were to be seen during the next couple of years. Incumbent mobile operators, now stronger than ever and with the high percentage of handsets containing IMS, was a great complement to their 3,5 and 4G network.

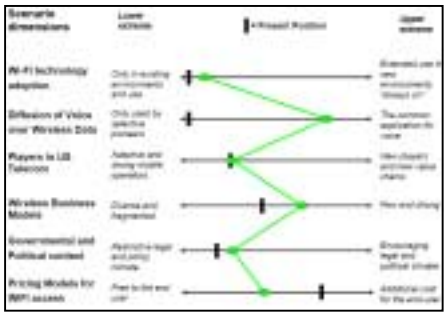
Nevertheless, by **2011 and onwards** the IMS technology is rapidly gaining ground and the strong operator controlled mobile voice industry generates benefits for both the end consumer and the mobile operators. The end consumers´ main profit include more inexpensive home telephony, improved indoor wireless coverage and the convenient concept of one number, one handset and one bill. The mobile operators, on the other hand, also gain in indoor coverage and possibility to differentiate the way the charge.

Scenario Discussion and Early Indicators

Signs that incumbent do not suffer from asymmetric motivation creating FMC services to capture the innovation is an indicator for a sustaining scenario path. Early experimentation with UMA and FMC indicate that incumbents were willing to co-opt the WiFi innovation. Furthermore, it is unclear if competing in local areas really requires unique skills compared with overseeing large national networks. WiFi

providers need to solve problems such as roaming between networks, managing user accounts as well as processing small transactions. Large incumbents need to overcome equal type of problems, indicating that their skills might match this opportunity quite well. Furthermore, regulation against municipal wireless, heavily promoted by the operators, would severe decrease the possibility to build nationwide freestanding networks and is therefore an indicator for a sustaining scenario. Furthermore, signs of entrants' willingness to sell to incumbents could point at near-term disruptive and later sustaining scenario. From a SEMC perspective this scenario would create an early operator driven demand for UMA, IMS and dual-mode handsets. The operators will continue to be the main customer and their position and influence on the telecom industry will increase.

9.3 King Max (New Technology Disruption)



As WiFi nearly vanishes from the marketplace with only the image of a bridging technology remaining, another technology will evolve for wide area connectivity and eventually become a standard for wireless connection everywhere.

The new technology is WiMax. Yet **in 2006** there are only a few existing proprietary WiMax based networks, although the equipment vendors claim they will provide upgrades to the service providers once the WiMax standard is finalized. Intel had a key role in this development, as the major WiMax chips manufacturer, and their promotion of WiMax fuel a more aggressive push for WiMax networks. Thus, **during 2007**, the fixed WiMax standard really took of and rapidly gained popularity as a backhaul for WiFi hotspots.

Throughout **2008-2010**, WiMax providers started to deploy networks in rural districts and in underserved areas, a trend that could especially be observed in developing countries. In mid 2009 WiFi hotspots and other fragmented WiFi locations started to use mobile WiMax technology and the greater range of WiMax, around fifty kilometres as compared to less than 100 meters for WiFi, became a supplementary driving force for the WiMax growth. In addition, important factors such as the seamless use while on the move without any break in signal and good capacity further boosted the popularity of the technology. The high coverage, enabling fast and cost efficient deployment of WiMax networks, allowed new network providers to emerge, which offered truly converge services with small price tags. Moreover, the US municipal wireless market grew at high pace, as the mobile WiMax standard were adopted and broadly supported by the vendor community. Towards the end of 2009, mobile WiMax became the "killer technology" for municipal wireless projects and a great part of the US were covered with municipal, and other mobile WiMax providers´, networks.

Furthermore, in the region of **2010-2011**, the increasing popularity of mobile WiMax empowered the development of devices enabled with mobile WiMax chips-sets, such as laptops, mobile handsets and PDA units. Initially, the laptops were manufactured including both WiFi chips for local access and mobile WiMax chips for wider area access. The same were the case with mobile handsets and other devices, which supported both mobile WiMax and WiFi. This fact further improved the revenues for the new entrant providers, since they were able to offer voice over mobile WiMax networks using, for instance, Skype software. The mobile operators had lost most of their revenues from voice services over their core networks and were left as backhaul providers for the mobile WiMax and WiFi networks. WiMax providers had created a freestanding nationwide network, capable of delivering both data and voice services, at low cost and high quality. Furthermore, the WiMax technology has entered homes, offices and hotspots, which earlier were dominated by WiFi. Towards the end of this time period, this trend has accelerated the manufacturing of devices like mobile phones and laptops with merely the WiMax chip-sets and the simplicity of one less component have been a major cost advantage for both manufacturers and customers.

So, by the year **2011 and onwards**, mobile WiMax will not only be the main source of broadband access in wider metropolitan areas, but also replace WiFi networks in homes and offices to propose a complete end to end solution for the consumers. Finally, the WiFi technology has nearly vanished from the marketplace and only the image of a bridging technology is remaining through a number of hobby-like networks, still in service amongst the first cities adopting the municipal wireless concept back in 2006.

Scenario Discussion and Early Indicators

As WiMax, or another new technology, enable the deliverance of high-capacity connection with wide area coverage, the possibility of building freestanding nationwide networks significantly increases. To resolve WiFi related issues, such as roaming, will not be as important in the WiMax case, due to the fact that this technology covers a larger geographical area. In addition, the greater coverage will increase the need for the technology to efficiently handle a larger amount of calls simultaneous. Hence, the mobile WiMax technology will therefore be suitable for voice over municipal networks with stable and relatively low amount of network voice users. The technology could thereby be a significant growth factor for municipal deployment with decreasing internal telecom costs as a major driver.

Consequently, the standardisation of mobile WiMax, 802.16e, is a strong indicator for this scenario. Furthermore, for early indication purposes, one should follow the deployment of WiMax networks in developing countries and rural areas. These districts might be too small to matter for incumbent players and may therefore not lead to immediate response, which would leave a window of opportunity for entrant WiMax providers. Similar to the WiFi disruptive scenario, early converge of VoIP and WiMax would facilitate entrant WiMax providers and voice providers to ride on the incumbents' lack of skill handling VoIP software development. From a SEMC perspective, this disruptive scenario would notably lead to increased demand for

mobile WiMax enabled handset. Similar to the WiFi disruptive scenario, SEMC would loose most of their current mobile operator customers. In addition, SEMC need to find new retailers or try to reach the end customers with unsubsidised handset. With mobile WiMax enabled dual-mode handsets, municipals and a wide range of WiMax providers would be potential new customers.

10 Conclusions

Creating future predictions, as basis for executive decisions, in a highly innovative telecom context is considered to be a very complex task. To be able to deliver value in these predictions, one has to seize the innovation that matters the most and has the largest potential to influence the industry. By combining the theories of disruptive innovation with a scenario methodology, the authors have been enabled to answer the research questions while identifying the innovations with most transformational power. Furthermore, the combination of the theory and the iterative process of the scenario methodology have added benefits serving the need for successful management decisions.

In the US telecom marketplace, there are signs of disruptive elements with overshot customers and non-market contexts. Entrant WiFi providers might pose a threat to incumbent voice players, by bringing voice services into new contexts built on low-cost business models. However, the business decisions of entrant and incumbent players will have great impact on future decisions, concerning who will ultimately master the innovation in the US telecom marketplace. Early convergence between VoIP and WiFi, combined with freestanding widespread wireless networks, such as WiFi or WiMax, strongly indicates a future disruptive development path. Though, incumbents' willingness to co-opt the WiFi technology and create fixed mobile convergence in an early stage may generate a non-asymmetric situation, indicating a sustaining future scenario. Finally, signs of entrants' willingness to build up their firms with the single purpose of selling to incumbent players, as WiFi and VoIP converge. This scenario would indicate at near-term disruptive and later sustaining scenario.

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Appendix 1: Organisational Overview

AT&T Wireless: AT&T Wireless Services, Inc. was, before October 26, 2004, the third largest wireless telephone carrier in the US. AT&T Wireless then completed a merger with Cingular to become the largest wireless carrier in the US. Under the agreement, only the Cingular brand would survive and every single AT&T Wireless store was rechristened under the Cingular banner.[237]

Calypso Wireless: Calypso Wireless developed the solution that allows any mobile device to seamlessly roam between cellular networks and wireless local area networks. They has successfully demonstrated the seamless flow of data while switching between cellular GSM/GPRS to a local Wi-Fi access point and back to GSM/GPRS again. Several mobile carriers have recognized the potential of the technology and have signed field trial agreements to install and test the system.[238]

Cingular Wireless: Cingular Wireless is, with the recent acquisition of AT&T Wireless, the largest wireless firm in the US, with more than 50 million subscribers. As mentioned in chapter 4, the company is from the start a joint venture between BellSouth and SBC and has inherited its WiFi hotspot business through the acquisition of AT&T Wireless in 2004. The network has around 4,600 hotspots throughout the US and the WiFi service was launched in 2003. [239]

FCC: The Federal Communications Commission is an independent United States government agency, directly responsible to Congress. The FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite and cable. The FCC's jurisdiction covers 50 states.[240]

Helio: Helio is a soon-to-be launched mobile virtual network operator based on the CDMA experience.[241] The WiFi technology is expected to be an integral part of building the Helio community. There are plans to allow not only communication

[237] Wikipedia: The Free Encyclopedia
[238] The Calypso Wireless Official Webpage
[239] The Cingular Wireless Official webpage
[240] The FCC Official Webpage
[241] The Helio Official Webpage

between handsets and WiFi access points, but also between handset and handset to facilitate interactivity between Helio subscribers.[242]

IEEE: It stands for Institute of Electrical and Electronics Engineers and is an international non-profit, professional organisation for the advancement of technology related to electricity. It has the most members of any technical professional organization in the world, with more than 360,000 members in around 175 countries.[243]

Intel: Intel Corporation was founded in 1968 as Integrated Electronics Corporation, is a US based Multinational Corporation that is best known for designing and manufacturing microprocessors and specialized integrated circuits. Intel also makes network cards, motherboard chipsets, components, and other devices.[244]

SEMC: Sony Ericsson Mobile Communications AB is a joint venture established in 2001 by the Japanese consumer electronics company Sony Corporation and the Swedish telecom firm Ericsson to make mobile phones. The company's global management is based in London and the R& D sites are located in Sweden, Japan, China, the United States, and the United Kingdom. [245] The organisation has approximately 5,000 employees in total worldwide and according to the IT research consultants Strategy Analytics Sony Ericsson was , in Q4 2005, the fifth largest mobile phone manufacturer, behind LG, Samsung, Motorola and Nokia, and held market share of around 6.6 percent.[246]

T-Mobile: T-Mobile had in the third quarter of 2005 with 20 million subscribers, which makes them the fourth largest mobile operator in the US telecom industry. The firm currently operates two wireless communications systems i.e. a GSM cellular network and a wireless broadband network with more than 7,000 hotspots. [247] The wireless strategy is the UMA standard, which main focus is to reach FMC. The unique hotspot part of the company, T-Mobile Hotspot, was launched in 2002 after an acquisition and included in that deal was the

[242] Pyramid Research (2005) p. 68
[243] The IEEE Official Webpage
[244] The Intel Official Webpage
[245] The Sony Ericsson Mobile Communications AB Official Webpage
[246] Strategy Analytics (2005) Global Handset Market Share Update Q4 2005, p. 1
[247] The T-Mobile Official Webpage

exclusive rights to WiFi connections in Starbucks coffeehouses.[248]

Verizon Wireless: Until the merger of Cingular Wireless with AT&T, Verizon Wireless was the largest mobile operator in the US. Currently, Verizon Wireless has 57.6 million customers and was the first US operator to move towards the 3G technology with the launch of its CDMA2000 network in 2004 and today over half of the US population is covered by CDMA2000. Sprint Nextel, the only other mobile operator in the US that offers this technology, can be considered as Verizon's closest competitor in terms of service deliverables.[249]

Sprint Nextel: On December 15, 2004, Sprint and NEXTEL announced that they would merge to form Sprint Nextel Corporation. While billed as a merger of equals, the transaction was actually the purchase of NEXTEL communications by Sprint Corporation. At the time of the merger announcement Sprint and NEXTEL were the No. 3 and No. 5 leading providers in the US mobile phone industry.[250] Today, Sprint Nextel operates the third largest wireless telecom network in the US behind Cingular Wireless and Verizon Wireless with 52, 9 million subscribers, under both the Sprint PCS and Nextel brands.[251]

WiMax Forum: The WiMax Forum is working to facilitate the deployment of broadband wireless networks, based on the IEEE 802.16 standard, by helping to ensure the compatibility and inter-operability of broadband wireless access equipment. The organization is a non-profit association formed in June of 2001 by equipment and component suppliers to promote the adoption of IEEE 802.16 compliant equipment by operators of broadband wireless access systems.[252]

[248] Pyramid Research (2005) p. 65-69
[249] The Verizon Official Webpage
[250] Wikipedia: The Free Encyclopedia
[251] The Sprint Nextel Official Webpage
[252] The WiMax Forum Official Webpage

Appendix 2: Cellular and Wireless Broadband Standards[253]

AMPS: Is short for Advanced Mobile Phone System and is an analogue mobile phone system standard, which was officially introduced in the US 1984. AMPS is a first-generation cellular technology, which basically means that each conversation is divided simply by using a different channel. However, the technology has suffered from some downfalls when compared to today's digital technologies i.e. since it is an analogue standard, it is very vulnerable to static and noise and has no protection from eavesdropping using an illegal scanner. Today, AMPS has foremost been replaced by newer digital standards, such as GSM, and CDMA, which brought improved security as well as increased capacity.

CDMA: Is short for Code-Division Multiple Access, a digital cellular technology that uses spread-spectrum techniques. Unlike competing systems, such as GSM this technology does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum and the individual conversations are encoded with a pseudo-random digital sequence. Moreover, CDMA provides good capacity for voice and data communications as well as allow many subscribers to connect at any given time. It is finally, the common platform on which 3G technologies are built.

CDMA2000: Is a family of third-generation mobile telecom standards that use CDMA, a multiple access scheme for digital radio, to send voice, data, and signalling data between mobile phones and cell sites. It is the second generation of CDMA digital cellular and several standards have seen or will see the light of the US marketplace, including CDMA2000 1x, CDMA2000 1xEV-DO , which all are approved radio interfaces.

EDGE: Or, Enhanced Data rates for GSM Evolution, is a digital mobile phone technology, which acts enhancement GSM/GPRS networks. Moreover, EDGE provides Enhanced GPRS, which can be used for any packet switched applications such as an Internet connection. High-capacity data applications such as video services and other multimedia benefit from increased data capacity. Due to the technologies high data capacities, EDGE has meet the requirements for a 3G network, and has

[253] Wikipedia: The Free Encyclopedia

been accepted into the family of 3G standards. EDGE has been introduced into GSM networks around the world since 2003, initially in North America.

Flash-OFDM: The Flash-Orthogonal frequency-division multiplexing is a complex modulation technique for transmission based upon the idea of frequency-division multiplexing i.e. a mobile broadband system enabling LAN-like communications in a cellular environment. The FLASH-OFDM system enables a mobile operator to deploy an all-IP, packet-switched nationwide system that has the possibility to deliver value to an enterprise or mass-market subscribers.[254]

GSM: Is an acronym for Global System for Mobile Communications and is currently the most popular standard for mobile phones in the world. GSM service is used by over 1.5 billion people across more than 210 countries and territories. The widespread fact of the GSM standard makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. Moreover the GSM technology differs significantly from its predecessors in that both signalling and speech channels are digital, which means that it is considered a second generation (2G) mobile phone system.

GPRS: Stands for General Packet Radio Service and is a mobile data service available to users of GSM mobile phones. It is often described as "2.5G" i.e. a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate capacity data transfer and the packet-switched technology, which it is built upon, means that multiple users share the same transmission channel and only transmitting when they have data to send. This means that the total available bandwidth can be immediately dedicated to those users who are actually sending at any given moment. Web-browsing, receiving e-mails as they arrive and instant messaging are examples of uses that require intermittent data transfers, which benefit from sharing the available bandwidth.

iBurst: Is a wireless broadband technology using IEEE 802.20 as base standard. It optimizes the use of its bandwidth with the help of smart antennas, with are integrated into the wireless equipment and networks, offering a high performance gains with low engineering effort and technical risk.

iDEN: It stands for Integrated Digital Enhanced Network and is a mobile communications technology, developed by Motorola, which provides its users the benefits of a Walkie Talkie and a cellular telephone. Sprint Nextel is the largest US retailer of iDEN services. iDEN places more users in a given spectral space, compared to analog cellular systems, by using time division multiple access (TDMA).

TDMA: Is short for Time Division Multiple Access and is a technology for shared medium networks. It allows several users to share the same frequency by dividing it into different timeslots. The users transmit in rapid succession, one after the other, each using their own timeslot and this allows multiple users to share the same transmission medium, whilst using only the part of its bandwidth they require. The technology is used in the GSM, and iDEN digital cellular standards and it is also used extensively in satellite systems, LANs, physical and combat-net radio systems. The name "TDMA" is also commonly used in the US to refer to a specific second generation mobile phone standard. However, TDMA has been competing against GSM and systems based on CDMA for adoption by the network carriers, although it is now being phased out in favour of GSM technology.

W-CDMA: Wideband Code Division Multiple Access is a type of 3G cellular network and is the technology behind the 3G UMTS standard that is allied with the 2G GSM standard. More technically, W-CDMA is a wideband spread-spectrum 3G mobile telecom air interface that utilizes CDMA.

Appendix 3: The Main 802.11 Standards[255]

802.11 is a family of networking specifications developed by a working group of the Institute of Electrical and Electronics Engineers (IEEE). There are several specifications in the family.

802.11a – Standard that operate in the 5GHz band, supports a theoretical bandwidth of 54 Mbps but more realistically it will achieve somewhere between 20 to 25Mbps in normal traffic conditions. In a typical office environment, its maximum range is 50 meters at the lowest capacity, but at higher capacity, the range is less than 25 meters. The standard has four, eight, or more channels depending on the country. There are certain advantages to the higher frequency range, including faster data transfer capacity, more channels, and reduced vulnerability to interference with other radio products due to the higher frequency. The disadvantage is the decreased range. WiFi products based on 802.11a technology were coming to market in 2003.

802.11b – this standard operates in the 2.4 GHz band and supports a maximum theoretical data rate of 11 Mbps, with average throughput of 4 to 6 Mbps. In a typical office environment its maximum range of 75 meters at the lowest capacity, but at higher capacity its range is decreased to about 30 meters. Bluetooth devices, 2.4 GHz cordless phones and even microwave ovens are sources of interference and could thus create poor performance for 802.11b networks. Minimizing interference can be difficult because 802.11b uses only three non-overlapping channels. The Standard was langue 1999 and mutual with the WiFi Alliance the wireless surf zones had its break though.

802.11e – Improvement to 802.11 provides Quality of Service (QoS) support for WiFi applications, which will be critical for delay-sensitive applications such as mobile VoIP. The standard will provide classes of service with managed levels of QoS for data, voice, and video applications. Thereby voice call can be prioritized and voice quality secured.

802.11g – Uses the same frequency as 802.11b but are designed for a higher-bandwidth, 54 Mbps (23Mbps realistic transfer). Its backward compatibility with 802.11b means that when a mobile 802.11b device joins an 802.11g access point, all connections on that access point slow down to 802.11b capacities.

802.11i – Improvement to 802.11 that offers additional security for WiFi applications. It describes the encrypted transmission of data between systems of 802.11a and 802.11b WiFi. It defines new encryption key protocols including the Temporal Key Integrity Protocol (TKIP) and the Advanced Encryption Standard (AES).

802.11k – This standard enables interoperability between different vendors' access

[255] The IEEE Official Webpage

points and switches, but it does not let WiFi systems assess a client's radio frequency resources. Consequently, this limits administrators' ability to efficiently manage their networks. As a proposed standard for radio resource measurement, 802.11k aims to provide key client feedback to WiFi access points and switches. The proposed standard defines a series of measurement requests and reports that detail Layer 1 and Layer 2 client statistics. In most cases, access points or WiFi switches ask clients to report data, but in some cases clients might request data from access points.

802.11m – The standard, sometimes called "802.11 housekeeping" or "802.11 clean-up," is an initiative to perform editorial maintenance, corrections, improvements, clarifications, and interpretations relevant to documentation for 802.11 family specifications. The term 802.11m also refers to the set of maintenance releases itself.

802.11n – The next generation of WiFi standard. It operates in the 5GHz band and its throughput is estimated to reach a theoretical 540 Mbps and a more realistically 100Mbps data transmission. This makes the standard up to 40 times faster than 802.11b, and near 10 times faster than 802.11a or 802.11g. It is projected that 802.11n will also offer a better operating distance than current networks. The standard will appear in WiFi products in the mid 2007 and early 2008.

802.11p – The standard, also referred to as Wireless Access for the Vehicular Environment (WAVE) defines enhancements to 802.11 required to support Intelligent Transportation Systems applications. This includes data exchange between high-capacity vehicles and between these vehicles and the roadside infrastructure in the licensed ITS band of 5.9 GHz.

802.11r – Is the unapproved standard that specifies fast BSS ("Basic Service Set") transitions. This will permit connectivity aboard vehicles in motion, with fast handoffs from one base station to another managed in a seamless manner. Handoffs are supported under the “a”, “b” and “g” implementations, but only for data. Today the handover delay is too long to support applications like voice and video. The primary application currently envisioned for the 802.11r standard is VoIP via mobile phones designed to work with WiFi, instead of, or in addition to, standard cellular networks.

802.11s – Is an unapproved standard for Mesh networking. The purpose of the standard is to provide a protocol for auto-configuring paths between APs over configuring multi-hop topologies in a Wireless Distribution System to support both broadcast/multicast and unicast traffic in an ESS Mesh using the four-address frame format or an extension. The Wi-Mesh Alliance has presented a proposal that will enable seamless communications for wireless users regardless of equipment. It specifies an extension to the IEEE 802.11 MAC to solve the interoperability problem by defining an architecture and protocol that support both broadcast/multicast and unicast delivery using "radio-aware metrics over self-configuring multi-hop topologies. Task group TGs hopes to narrow-down the 802.11s proposals into a single joint proposal by the end of 2006 or the beginning of 2007. The standard is targeted to be approved by 2008.

802.11t – The goal of the 802.11t project is to provide a set of measurement methods, performance metrics, and test recommendations that enable manufacturers, independent test labs, service providers, and end users to measure the performance of IEEE 802.11 standard equipment and networks. The project is scheduled for completion in January 2008.

802.11u – Is the Interworking with External Networks standards for the IEEE 802.11 family of standards. TGu is working on an amendment to the IEEE 802.11 standard to allow a common approach to interwork IEEE 802.11 access networks to external networks in a generic and standardized manner. The specification covers alteration to the PHY and MAC layers. Specifically, some of the issues are seamless handoff, session persistence, and authentication, IP addressing, data rate changes, E-911 and CALEA location. The 802.11u standard is in its early proposal stages.

802.11v – Is the Wireless Network Management standard for the IEEE 802.11 family of standards. TGv is working on an amendment to the IEEE 802.11 standard to allow configuration of client devices while connected to IEEE 802.11 networks. The standard may include cellular-like management paradigms. The 802.11v standard is still in its early proposal stages.

802.11w – Is the Protected Management Frames standard for the IEEE 802.11 family of standards. TGw is working on improving the IEEE 802.11 Medium Access Control layer to increase the security of management frames. WiFi send system management information in unprotected frames, which makes them vulnerable. This standard will protect against network disruption caused by malicious systems that forge disassociation requests that appear to be sent by valid equipment. The 802.11w standard is in its early proposal stages. The target for ratification is March 2008.

Appendix 4: Scenario Methodology

History

”Thinking about the unthinkable” - Herman Kahn

With an origin in war games in the military organisation scenarios was brought to the civil world by “supergenius” Herman Kahn.[256] During the Second World War he worked with Rand Corporation as a physicist and mathematician and it was within Rand he introduced the scenario planning methodology.[257] Kahn argued that the use of scenarios in the military based Rand Cooperation was a medium to think about the unthinkable and consequently a superior way for a military organisation to seek other alternatives rather than extermination and surrender. During the 1950s and 1960s his input to this turf had a major impact on Pentagon’s thinking and the work was published in the book *“On Thermonuclear war,* which was published 1960.[258] Khan resigned 1961 from Rand Cooperation, established the Hudson Institute and became one of the founding fathers of the futurology movement with profoundly contributions to the methodological and theoretical foundations of the scenario planning concept. [259] During the time after Khan’s resignation Rand he published several books and articles on the futuristic subject and the most controversial publication in the cluster were most diffidently *“The year 2000”*, which was in print 1967. Previously, scenario thinking had mainly applied regarding forecasting in public policy. However, the methodology further developed and reached new dimensions in the early 1970s when Kahn’s ides come to use in the London office of Royal Dutch/ Shell. [260]

Pierre Wack was the planner who brought the scenario methodology in to the business environment and away from the much too broad macro economic thinking[261].[262] With a methodology adjusted for micro economic circumstances at Shell, Wack guided the organisation through two major oil crises in the 1970s.[263] His devise was; “If the future is hundred percent uncertain planning is obviously a waste of time. The primary task is therefore to separate what is predictable from what is fundamentally uncertain.” The trends that the planners experienced in the early 1970s could no longer be taken for granted and a need for a wider analysis of what the future had to offer the business environment was therefore necessary. As a consequence, the scenario methodology was born even in the business environment.

[256] van der Heijden K. (2005) p. 3
[257] Schwartz P. (1996) p. 7
[258] Bradfield et al. (2005) p. 798
[259] The Hudson Institute Official Webpage
[260] Bradfield et al. (2005) p. 799
[261] Schwartz P. (1996) p. 7-10
[262] Porter M. (1985) p. 446
[263] Schwartz P. (1996) p. 7-10

[264]Due to the new methodology's popularity amongst major US consultant groups, scenarios entered the field of strategic planning during the 1970s and when the 1980s came around, scenario planning was used by a large number of organisations, world wide. In the mid 1980s, scenarios became even more popular, due to Pierre Wack's publication in Harvard Business review on the subject of the Shell success story. As a consequence, the methodology started to appear in contemporary management literature e.g. Michel Porter (Competitive Advantage, 1985), Henry Mintzberg (Strategic Planning, 1993) and Peter Senge (Learning Organisation, 1990). In the late 1980s the scenario planning concept where further developed and differentiated by names like Peter Schwartz and Kees van der Heijden among others. [265]

Terminology

According to Gill Ringland, the author of several books on the subject of future studies, there are three widely spread methodologies in evaluating the future; forecasts, scenarios and foresights. *Forecasts* are described as a "conjectural estimate" i.e. signs one can see in the present environment, which can be translated to future conditions or events. The methodology is often viewed upon as an expert's judgment or a black box which should either be approved or rejected. Thus, forecasts are mainly used in industries where there is a well known and well defined pathway from the initiation to conclusion of a project e.g. R&D.[266] In this dissertation, the authors have covered the subject of forecasting by critically evaluated a number of analytic rapports as well as conducted several interviews. These interviews have been carried out with individuals handpicked due to their telecom experience. However, the main issue on the subject of forecasts is that the environment must be stabile if the forecast is to be correct and caused by the uncertainty of forecasts, in an unstable environment, the use of scenarios have become increasingly popular over the last decades[267].

According to Ringland, *the scenario methodology* is, outlined as "a set of logical consistent, but distinctly views of what the future might be" i.e. a simple and powerful tool used to capturing and exploring multiple images of the future. [268] Scenarios also possesses an educational and learning role in the organisation, as they help managers to understand the key drivers of the future, by considerate what causes the change, instead of just spotting it. In addition scenarios test the firm's strategy towards possible future outcomes.[269] Finally, *foresight* is portrayed as "a process for developing research policies with a long term perspective", which merge the forecast information with the powerful tool of scenario analysis to ensure that an organisation is focusing on the correct business strategies and an ongoing decision process.[270]

[264] Schwartz P. (1996) p. 7-10
[265] Godet M., Roubelat F. (2000) *Scenario Planning: An Open Future,* p. 2
[266] Ringland G. (2003) *Using scenarios to focus R&D,* p.46-47
[267] Ibid.
[268] Ibid.
[269] van der Heijden K. (2002) p. 171-175
[270] Ringland G. (2003) p.46-47

However, *scenario planning* is the most frequently used collective idiom for the above outlined concepts and as a consequence scenario planning will hereafter be the term used by the authors in this dissertation. The terns *scenario development*, *scenario analysis* and *scenario methodology*, which are used in the same the context, will also be used when extensive explanations is necessary regarding the actual processes and specific techniques. Unfortunately, this type of terminology chaos is a common phenomenon in the scenario literature and one scenario thinker expressed this fact as: "Few techniques in future studies have given rise to so much confusion as scenarios"[271].

Schools of Scenario Development

In addition, and to amplify the confusion even further, the literature of scenario planning is rich regarding scenario developing techniques. Methods variety from refined mathematical models to merely perceptive approaches and Bradfield et al. make an attempt to sort up the confusion by proposing three different schools of scenario techniques; the intuitive logics school, the probabilistic modified trends school (PMT) and the La prospective or the French school. On the other hand, Ringland amongst others, contribute with another suggestion. She agrees with the intuitive logics school, but split the PMT into two different categories; trend-impact analysis and cross-impact analysis. [272] Consequently, Ringland utterly leaves out the French La prospective school, which according to Bradfield et al. has happened as the English spoken parts of the world tend to dominate the world of strategy, as well as the tools acquainted to it.[273]

The French *La prospective school* is a mathematical, probabilistic and tool-based approach to scenarios, but might be perceived as a slightly more integrated approach i.e. a mixed tool resembling a combination of refined mathematical models and perceptive approaches.[274] However, according to Bradfield et al., the model is "more elaborate, complex and more mechanistic rather than an openly intuitive approach to scenario development. The methodology output may be both qualitative and quantitative and interviews with key players in the specific area of interest are vital part of the methodology. The main difference however, to the American developed methodologies that focus globally, is the fact that the French methodology mainly focus on the socio-political future locally in France. Michel Godet is considered to be the father and greatest supporter of this methodology and today the approach has evolved from a one man show to a number of tools, including a fairly well known instrument called MICMAC. [275]

Trend-impact analysis (TIA) has evolved from traditional forecasting methodology and relies on relatively simple extrapolations of historical data without considering

[271] Khakee A. (1999) *Participatory Scenarios for Sustainable Development*, p. 229-232
[272] Ringland G. (1998) *Scenario Planning: Managing the future*, p. 24
[273] Bradfield et al. (2005) p. 803
[274] Ringland G. (2003) p. 217-222
[275] Bradfield et al. (2005) p. 801-808

the effects of upcoming future events.[276] There are probabilities attached to each scenario, which most frequently are identified by experts within the organisation as well as external consultants. The identification is often solved by Delphi surveys, which consists of a set of carefully designed sequential questionnaires and takes the form of a structured dialog among experts. Furthermore, the methodology has both qualitative, i.e. scanning and monitoring the environment, and quantitative i.e. trend extrapolation, structures. The multiple outputs are the main differencing factor of TIA and the reason why the methodology has broad acceptance and are widely used in many different sectors.[277] Finally, TIA was initially developed and used by a Connecticut based international strategy and research firm, but have been widely spread and are currently used by several other consulting groups world wide.[278]

Resembling TIA, the *cross-impact analysis* (CIA) is an analytical tool and the scenarios in this methodology are calculated with a software program that extrapolates historic data.[279] Nevertheless, CIA differs from TIA by incorporating more layers of complexity. The methodology might use the Delphi surveys, but will not settle for expert's opinion to resolve the probability issue. In contrast, the followers of the CIA methodology attempts to determine probabilities of future events given that a range of events have or have not occurred, which means that the relationships in the methodology describes how a change in one variable will affect others. CIA was initially developed at the RAND Corporation and the University of Southern California. After a decade though, the initiative were coupled with Ohio based consulting group Battelle, which still is the main player for this particular school of scenario thinking.

The *intuitive-logics school* (ILS) emphasizes creativity and imagination and the followers of this methodology suggest that an alternating future can not be reliably forecast. However, one can envision and play with the thought of a possible future and thereby learn from it i.e. scenario building is not about predictions, but rather about unfolding alternative, hypothetical images of the future challenge. This branch in the scenario literature is often referring to as "The Shell approach to scenarios" and is in most cases a product of brainstorming encouraging creative thinking, which is important in an uncertain future environment. Furthermore, the method has developed in several, yet similar, direction and the main figure has been the President of the Global Business Network, Peter Schwartz. Moreover, the methodology differs from the other methods by not suggesting one future, but rather several possible futures. Furthermore, the ILS is relatively easy to follow and communicate i.e. it does not involve any mathematical probabilistic concepts.[280] Finally, the 2-4 scenarios generated must be equally probable and no probability should attach to the scenario.[281]

[276] Bradfield et al. (2005) p. 801-808
[277] Ibid.
[278] Ringland G. (2003) p.223
[279] Millett M. S. (2003) p. 18
[280] Ibid.
[281] Bradfield et al (2005) p. 801-808

The authors have, after assessing the four schools of methodologies, decided to re-develop Millett's[282] view and create a more comprehensive and easily understood mapping over the main scenario development approaches. The most important feature is the addition of the French La prospective school and the partition of two main directions of scenario development. The *intuitive scenario development* (ISD) and *analytical scenario development* (ASD) are the authors' two directions and the re-development can further be reviewed in Figure A.3.2 below. What is more, a choice between the ISD and ASD methodology will be made by the authors and as a consequence the chosen methodology branch will be further explained.

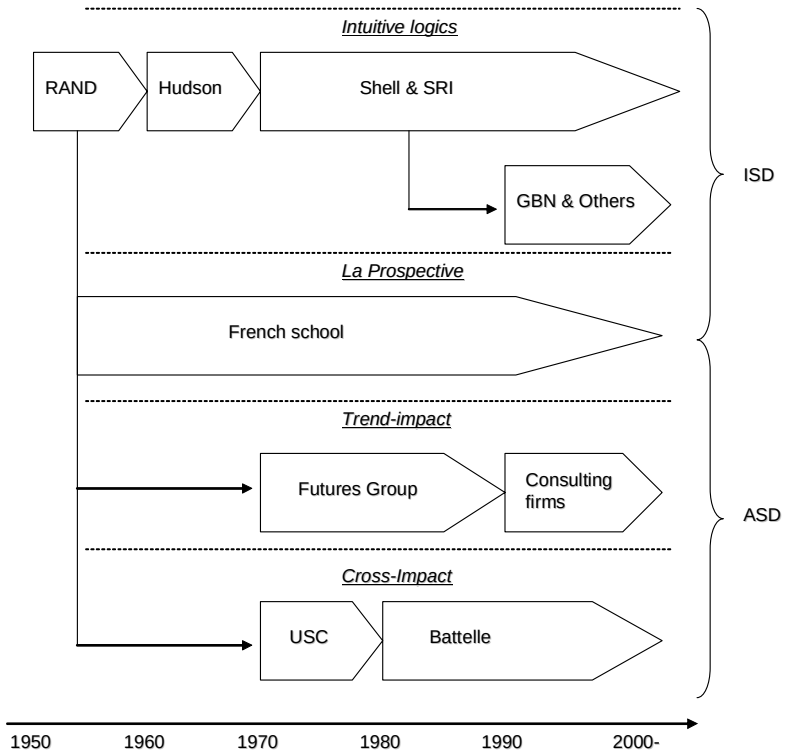


Figure A.3.2: *The history of scenario methodology development* [283]

Before one embarks on scenario planning, the choice of methodology must me clear to the user. Burt & Van der Heijden proposes a framework with four main purposes of scenario work, which one might use when commencing a project. The four main areas are as follows; making sense of a particular puzzling situation, developing strategy, anticipation and adaptive organisational learning. The "making sense quadrant", quadrant (a), is of interest when one has puzzle such as "I do not understand what is going on in the industry or I have not seen a satisfying explanation of why Ericsson's Mobile Division did not succeed in the late 90-ies". In (b) the brainteaser might involve the management teams need for relevant information, to be

[282] Millett M. S. (2003) p. 17
[283] Ibid.

able to articulate better to the investors that they are on top of the business. The dilemma faced in the (c) quadrant is often that management might be caught off-guard to often and must get better at understanding the signs that point towards the future . Finally, in (d) SEMC, as a large company, are too horizontal to get stuck in standard procedures and business as usual. The organisational ought to learn to adapt more quickly and create a more agile cooperation.[284]

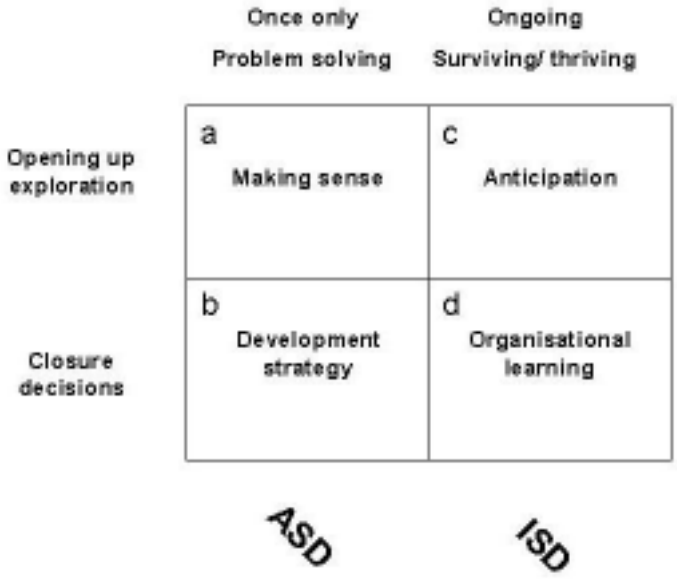


Figure A.3.3: *Which methodology to choose for which purpose* [285]

As described earlier, the ISD methodology is known to be flexible, easy to use and contribute to creative thinking within the organisation. These characteristics of the methodology make use of itself to a wide range of scenario purposes included in all four of the above quadrants. However, in recent literature the main focal point has been the learning and anticipation in the right-hand quadrants, which highlights that the process is more important than the end product itself. On the contrary, the main objective, of the more computer-based ASD methodology, is generally to determine the most likely evolutionary development of particular phenomenon with the view of improving the effectiveness of strategic decisions i.e. outcome oriented. [286] However, as stated in the introduction the purpose of this dissertation is to provide SEMC with a foundation of knowledge that will enable analytics to answer strategic queries, but even more important to learn and reflect whilst doing so. Or as Pierre Wack puts it: "Scenarios deals with two worlds; the world of facts and the world of perceptions"[287]. Based on the above argumentation the authors are certain that the ISD methodology is

[284] Burt G., van der Heijden K. (2003) *First step: Towards purposeful activities in scenario thinking and future studies*, p. 1023
[285] Ibid.
[286] Bradfield et al. (2005) p. 801-808
[287] Wack P. (1985) p.140

the one best suited for the task at hand and consequently that particular methodology branch has been chosen for the Master Thesis.

Methods within the ISD direction

There are numerous methodologies left within the main ISD approach, making the decision rather complex and not yet finalized. The once that the authors have encountered in the scenario literature are briefly described below.

Stanford Research Institute (SRI): Is a six step approach, primarily lied out by Peter Wack. The methodology uses this experienced approach to create focused scenarios as the basis for strategy and decision making. [288]

1. Clarification of the strategic decisions
2. Identification of key decision factors
3. Analysis of environmental forces
4. Development of the scenario logics
5. Description of the scenarios
6. Strategy implementations

Global Business Network (GBN): The president of GBN Peter Schwartz is responsible for this methodology and it is based on eight individual steps. The methodology has grown out of, and therefore benefit from, SRI in developing market strategies.[289]

1. Identify focal issue or decision
2. Key forces in the local environment
3. Driving forces
4. Rank by importance and uncertainty
5. Selecting scenario logics
6. Fleshing out the scenarios
7. Implications
8. Selection of leading indicators and signposts

Kees van der Heijden: In six main steps van der Heijden proposes a similar, yet developed and modernized, GBN framework. This process has more focus on scenario development in a team environment, but the main subject matter, addressed by van der Heijden, is the concept of accelerating organisational learning within the firm with scenarios.[290]

1. Structuring the scenario process
2. Exploring the scenario context
3. Developing the scenarios
4. Stakeholder analysis

[288] Ringland G. (1998) p. 247-257
[289] Ibid., p. 227-234
[290] van der Heijden K. (2005) p. 224-272

5. System check
6. Impacting organisational thinking and acting

Northeast Consulting Resources Inc. (NCRI): Their methodology is called Future mapping and is based upon finite sets of events and states geared to developing market strategies.[291]

1. Mapping out a strategic direction
2. Choice of most desired end state
3. Analysis of common and divergent elements in the scenarios
4. Teams present their scenarios to group
5. Each team chooses events that logically lead to their end state
6. Select end state teams – one per end state
7. Conventional wisdom scenario: what the group thinks likely or unlikely to happen

Porter: In his book, Competitive advantage 1985, Michel Porter went back to the basics and proposed the use of scenarios as important tools for understanding and getting ahead of trends. Consequently, he recommended firms to build scenarios, in six steps, as a form of sensitivity analysis.[292]

1. Identify the uncertainties that may affect industry structure
2. Determine the causal factors driving them
3. Make plausible assumptions about each important causal factor
4. Combine assumptions about individual factors into internally consistent scenarios
5. Analyse the industry structure that would prevail under each scenario
6. Determine the sources of competitive advantage under each scenario

KAIROS Future AB: is a Swedish based futures think-tank and research firm, which focus on three broad knowledge areas i.e. trends and society, consumer and marketing, leadership and change. As a consultant firm their specialty is interactive reorientation processes in which they work closely with the clients and long-term sustainable strategies are developed on the basis of trend and scenario analysis in five steps, according to their TAIDA approach.[293]

1. Tracking - follow change and identify key trends
2. Analyzing – analyze connections between changes and trends. Identify scenarios
3. Imaging – conclude on vision, direction and identity
4. Deciding – conclude on strategic goals and special needs of change
5. Acting – conclude on short term goals, development needs and forms of feedback

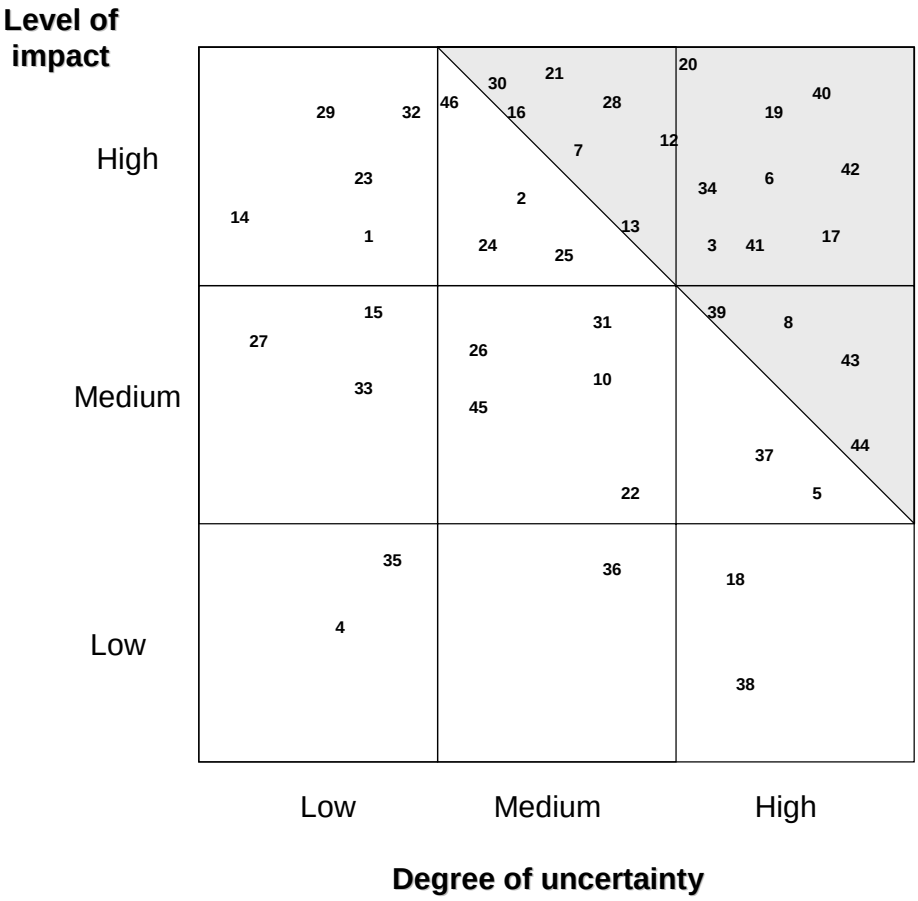
[291] Ringland G. (1998) p. 235-246
[292] Porter M. E. (1985)
[293] Krafft G., Telephone Interview, 2006-02-17

Mercer, Robust Strategies in a day: "In the future we will probably see scenario methods that eliminate, reduce or automate some steps to decrease the time, effort and expense while preserving the benefits from the current development." [294] This was a quote from Stephen Millet's article "The Future of Scenarios" and Mercer has done just that, by proposing a framework of five comprehensive steps that enables a management team to develop strategies in only one day, including coffee breaks.

1. Decide the drivers for change
2. Bring drivers together into viable framework
3. Produce initial (7-9) mini scenarios
4. Reduce to 2-3 scenarios
5. Write the scenarios

[294] Millett M. S. (2003) p. 23

Appendix 5: Driving Forces



Italics text with numbers = "The True Driving Forces"

Regular text with numbers = Uncertain and Important

Without numbers = Predetermined

(1) The power limitation

(2)The limitation of distance

(3) Possible interference with other devices

(4) If weather conditions might reduce the performance

(5) Future new to the market technology developments

(6) ***Future applications of WiFi and its probable impact of the system, defined by the authors?*** A wide range of individuals within the industry predict that usage of WiFi-enabled devices only is the beginning of something larger, a new era, and that the usage and applications virtually will explode in an future wireless society. The force of these new applications or ways of using the wireless fidelity is diffidently of high level of impact as well as a high degree of uncertainty.

(7) ***The impact of the possible battle between 3G and WiFi.*** There is a great deal of impact and uncertainty surrounding this issue, especially due to the hype concerning the 3G services offered by cellular companies in order to allow users to access data at a reasonable high speed. In fact, many cellular service providers paid billion of dollars to obtain the licence for 3G and after the rise of WiFi there have been question marks surrounding whether the 3G industry will be washed out or if a potential co-existence between WiFi and 3G might appear.

(8) ***Impact of possible battles between WiMax and WiFi.*** There are many pros and cons to the two technologies for instance WiFi operates only in the unlicensed frequency and since WiMax operates in the licensed frequency it is able to generate more power and therefore better signal strengths than WiFi. Furthermore, WiMax is easier to install than WiFi and will provide benefit for the service providers. Some individuals within the industry believe that WiFi will be used inside the home and offices while WiMax will be used outside. WiMax could also be used as a backhaul for WiFi hotspots and it may be used to connect the hotspot location to the hotspot service provider. However, this co-existence matter is difficult to foresee and will therefore be an object of further discussions in the future telecom marketplace.

(9) The impact of improvements in security of WiFi transmissions

(10) The future effect of 4G

The Impact of future competition from enhanced 3.5G (HSDPA)

(11) Fixed WiMax might bring coverage to WiFi

The impact of subscriber devices is independent of the network service

(12) ***The impact of WiFi enables phones and devices in the low-end segments*** will increase the demand for high speed applications such as high quality video and audio streaming, Local Based Services (LBS), Social Networking Applications (SNA) and work as a driving force for public and private WiFi hotspots and municipal wireless.

(13) ***The postponement of the mesh standardization 802.11s*** will act as a driver for municipal and public mesh networks as the network will be independent of the

manufactures today's proprietary solution, i.e. if the network provider and operator will find struggle to survive the hardware and software as a standard will be able to be operated of any network operators.

Mesh networks might enable scalability

Impact of the 802.11 standard might bring economic of scale

(14) Impact of the 802.11e standard and Quality of Service

(15) Impact of seamless handover between GSM, WiFi, GPRS, CDMA & 3G

(16) ***Impact of Fixed Mobile Convergence (FMC)*** using UMA for voice and IMS for data applications. Incumbent landline operators are pursuing fixed/mobile convergence strategies that include bundle mobile voice and data offerings. If this prospect takes of, it may be a real game changer in the future telecom marketplace.

(17) ***Implementations of third and fourth generation mesh networks.*** The modular architecture will enable flexibility in system design an easier upgrade to future technologies, including WiMax. These third generation systems also provide advanced features such as mobility within the networks, auto discovery, QoS, 3D coverage, seamless handover and roaming. These features are very important enabler for the expansion of the WiFi technology. However, it is at the moment largely unclear whether or not the municipals will adopt this new technology.

Processor capacity

Energy consumption

Data memory size

(18) The development and launch of future 802.11 standards

(19) Industry players adapting the WiFi technology

(20) ***The effect of cable industry (ISP) with WiFi.*** The cable industry is somewhat of in a crossroad as virtually all of them are evaluating new business models, including the WiFi technology. They actually might a great opportunity to earn money by bundling services etc.

(21) ***The effect of WiFi on telecom companies business models.*** Telecom firms have the advantage of already having an infrastructure and they merely need to offer additional WiFi services to gain significant benefits. Hence, there might be lower number cellular subscribers, but they may endure through increased revenues from the WiFi business i.e. if they decide to enter it. The above declaration brings both uncertainty and are of great impact to the WiFi marketplace.

(22) Effect on related industries like home appliances and consumer electronics

(23) Added value, which will benefit the service industries like hotels, coffee shops hospitals etc to attract more customers

(24) Future stakeholders in the WiFi technology

(25) The WiFi technology influence

The impact of the increasing competition from different type of service providers

(26) The increasing availability of broadband access

Impact of low barriers for entering the voice market

(27) Impact of low cost of market entry

(28) ***The possibility of being able to determine positioning of a handset within a network*** is an issue that has been frequently argued over the last couple of years and little has really been accomplished on this subject matter. However, the resent San Francisco cooperation between the companies Google and Feeva show signs on improvement in this area of concern. If or when this technology will be a fact in the majority of handsets is today uncertain, but when it does, it might be somewhat of a revolution of telecom business models.

(29) Skype and MVNO are competing aggressively with low or free tariffs and free on net calling.

(30) ***The impact of billing models and different pricing possibilities.*** Flat rates are very popular and revenue sharing is very rare on the US market. The rates are similar to those on the ISP market, which was driven to "all you can eat model" around $ 15-20 per month. How these billing models will be transformed as the WiFi technology is entering the marketplace is both important for the business models as well as tainted with high uncertainty.

Price levels will continue to fall

Increase in efficiency and productivity for enterprises

(31) The impact of the ISPs getting into voice market by deploying full scale voice capable WiFi networks

Indoor coverage improvements

Reveal pressure of existing core network

Reducing operational costs

(32) VoWiFi will be released mid 2006

(33)The impact of radiation specific issues

(34) ***Demand of information anywhere, everywhere.*** The world becomes an increasingly digital place to live in, where people and organizations are striving for the need of information all the time to improve their business performance. With extreme competition and mature markets, companies might truly benefit from receiving critical information at the right time, to be able to differentiate themselves from their competitors. WiFi may be an answer to this requirement, as it is not bound by the limitations of wires. The concept of "always on" is a powerful mania, which might change the game of the future telecom industry. Hence, it is clearly one of the greatest uncertainties to be aware of when constructing WiFi related scenarios.

(35) The digital divide

(36) Legal aspects of 911 features

(37) Customer's adoption of new telecom WiFi innovations

(38) The importance of the security issue for the customers

(39) ***The development and deployment of municipals wireless*** is to great extend dependant upon the success of new business models that allows the cost of the network to be paid for by someone else rather than the end user e.g. advertising or municipal operations. Furthermore, a few big successful municipal wireless projects in larger cities like Philadelphia and Chicago as well as a possible prices fall due to increased competition among equipment providers might be important growth factors for municipal wireless. Thus, the future growth and spread of these projects, all over the nation, is a vital part in the wireless movement in the US and is therefore of great importance to the scenarios in this dissertation.

(40) ***The success of FON and other wireless movements.*** At this moment in time FON has set its ambitions high, but intentionally act otherwise i.e. they only operate as an access point vendor as a first step in the process to "free the world from cables and large telephone/internet bills". The following steps obviously includes "the free the world argument", by encouraging the people of the world to share their wireless internet connection and let everyone have the opportunity to surf the net and live the "always on" mentality. Of course this concept might be a utopia, a least in the timeframe of this thesis, but if only some part of this is will come true it might have profound impact of the telecom industry in the US i.e. the driving force is both highly uncertain as well as of major importance to the scenario process.

Impact of the 802.11e standard and QoS for voice applications

(41) ***Impact of seamless handover between GSM, WiFi, GPRS, CDMA & 3G*** will enable customers to move outside the edge of a WiFi network without losing and ongoing call. Handset supporting seamless handover will be out on the market mid 2006, for instance T-Mobile using UMA or Calypso Wireless using a proprietary solution. This might rock the industry and opens up a range of possibility for WiFi related business models.

Increased coverage trough hot-spots

WiFi technologies could be used to relieve existing core network.

(42) ***Effect of expanded free licensed spectrum.*** As the world grows to be wireless, problems with co-existence in the free license spectrum might occur. These problems could be solved over time and then only the sky might be the limit for the WiFi technology.

(43) ***Relieved requirements for use in licensed spectrum.*** New license spectrums might increase the market volatility and an encouraging legislation regarding municipal wireless broadband deployment might provide funds to rural communities to roll out their networks. Furthermore, the increased interest and social enhancement by deployment of WiFi networks could also encouraged the FCC to disclose more spectrums for unlicensed use in the future.

(44) ***Legislations regarding municipal wireless***. Currently, mobile operators are aggressively lobbying against the municipal wireless initiatives on the grounds of unfair competition. However, as small municipalities increasingly are joined by larger communities in building out their own wireless infrastructure, more and more cities are predicted to offer free access, which presumably will even more fuel the above lobbying activities. The legislatives might possibly work in the opposite direction as well, which would fuel the municipal wireless projects. These issues incorporate both high uncertainty and important aspects, as the business models for municipal wireless are changing.

No spectrum licenses required

(45) FCC Controlling the merges and acquisition in telecom

(46) Poor mobile phone indoor coverage