Alternatives for mobile operators in the competitive 3G and beyond business

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Abstract

The importance of analyzing different business models and technologies in the mobile industry has become more crucial for the investment policy of the telecom operators. This paper aims to cover some of the most interesting business alternatives in providing the new 3G and beyond services including cases where the operator already has an existing second-generation cellular network and perhaps even a license for the 3G UMTS network, and cases where the operator does not have any existing network. Three cases for incumbents and new entrants are foreseen, those having a UMTS license and those lacking it – leaving alternatives for new competing 3G technology deployment or acting as a mobile virtual network operator (MVNO) without owning any radio infrastructure. The scenarios have been analyzed in different country groups that are not exactly representative of any defined country, but rather share typical demographic characteristics.

Key Words

Mobile services, mobile market, business models, telecommunication, network rollout, service provisioning, MVNO, GPRS, EDGE, 3G, WCDMA, UMTS, CDMA 450, OFDM.

1. Introduction

Mobile business has become one of the drivers of the world economy during the last 10 years. Implications of new technologies, regulations, and business models have to be understood, as creating a successful investment strategy for the network, service and virtual operators. The winning schemes and the financial margins for each investment plan have to be discovered.

Offering rich broadband services in conjunction with the traditional mobile voice services seems to be the next step for most of the European network and service operators. Network operators are extending their network coverage (towards rural areas) and capacity (for wideband/broadband applications), whereas service operators promote new services that are more profitable and more attractive to the customers. 3G mobile technologies have opened up the possibility of providing new and advanced value-added data and content services such as rich video and audio, games and m-commerce. Service related aspects have to be combined with different technologies, and all the possible rollout plans should be investigated by the players, making the "3G", "UMTS", "EDGE", "OFDM", etc. game more complicate than ever.

In this paper, a representative set of possible business scenarios have been selected, including cases for incumbents and new entrants, those having a UMTS license and those lacking it – leaving a choice between using an alternative technology or acting as a mobile virtual network operator (MVNO) without own radio infrastructure. These scenarios will be described in the next chapters, with the aim of answering to specific research questions in the upcoming broadband mobile era.

The presented results are based on the work within EUREKA Celtic project ECOSYS. For more details, please see the reference [1], especially the Deliverable 9.

2. Business Scenarios Selection

In this paper, a scenario approach to cover some of the most interesting business alternatives in providing the new 3G and beyond services has been applied. The opportunities and strategies differ between operators that already have an existing second-generation cellular network and possibly a license for the 3G UMTS network, and operators that do not have any existing network.

Three cases are foreseen for incumbents and new entrants, those having an UMTS license and those lacking it – leaving alternatives for new competing 3G technology deployment or acting as a mobile virtual network operator (MVNO) without own radio infrastructure.

The first scenario (Scenario 1 (2G incumbent operator with or without UMTS license)) analyses the incumbent player, i.e. one who has an existing 2G network, and wants to deploy its own 3G network. This study setting includes, and compares, two alternatives: UMTS deployment (with license), and a new competing 3G technology deployment. As we are here looking at incumbent players, we normally have clear connection between the Service Operator and the Network Operator sides of the business. So in this scenario we have currently only one Service Operator and one Network Operator linked together.

Even as such, however, this separation gives interesting insight to the economical dynamics of these entities.

The competing 3G technology here is loosely defined as "OFDM", the characteristics of which include full IP compatibility throughout the network, and an effective OFDM radio frequency utilization. However, the wide UMTS license band is not supposed to be available for this technology, and the bandwidth of the used frequency band is supposed to be only 1.25 MHz. Within both basic alternatives full GPRS coverage is already built, and it is possible to utilize also EDGE technology as a fast upgrade for new services.

As all the investigated technologies have different performance characteristics, which on their half affect the user behavior in the service take-up, the modeling of these characteristics is of crucial importance.

The first scenario tries to find answers to questions like: Is it possible in the Western European context to compete UMTS with some other technology, if no license for UMTS frequencies is possessed? How the business situation differs for the Service Operator compared to Network Operator? What are the differences, in respect to new services, between the end-user segments? Is an intermediate EDGE deployment paying back in the end results?
It should be noted that the modeling and the results are still at this point preliminary. The scenario will be developed further for the final results, as well as the modeling will be completed with more accurate parameterization.

In the second scenario (2G AND 3G Service Provider/MVNO) the lack of new licenses for GSM/UMTS networks will be analyzed. Many firms, working in the telecom sector or not, have expressed their interest to enter the market through the networks operation or the service provision channel. For those, which have been left without license, a new channel to enter the market and take part to this big game is the MVNO channel or the service-provisioning channel. A lot of research questions should be analyzed concerning the difference between the SP and MVNO business models as well as the service creation and their value. This scenario is very important for comparing the investment levels, cost structures, and revenue streams between the SP and MVNO scenarios as well as analyzing the key differences between these two models in terms of business profitability.

In the Scenario 3 (CDMA450 Business Case) the possibility of building a CDMA 450 network will be analyzed This scenario has been pointed out since CDMA450 has attracted keen interest in the industry because the initial driver for CDMA450 was the urgent need to find a digital replacement for the ageing NMT450 analogue cellular systems. These systems had been widely deployed, not just in the Nordic countries but also in many countries in Central and Eastern Europe. In addition, CDMA450 inherits all the technical and service advantages of the CDMA2000® system. It boasts wide coverage of the 450MHz spectrum and enables the building of a 2,5-3G mobile network with different service capabilities. This means that technology can become a 3G solution for some operators without UMTS licenses. The case describes a Greenfield CDMA 450 operator entering the market described in section with 2G and 3G mobile networks. In this case study the economics for two build out strategies - a full country coverage case and a rural roll out case will be studied.

2.1. Country types

For all the cases two generic country types are modelled taking into account geographic characteristics: The country types are according to the population.

1. "Large" = Western European country like France, Germany, Italy, or UK
2. "Small" = Northern European country like Denmark, Finland, Norway or Sweden

The country surface area has been supposed to be 370 000 km2 for "large" country (calculated average from France, Germany, Italy and UK), and 330 000 km2 for "small" country (median from Denmark, Finland, Norway and Sweden, leading to about the size of Finland and Norway). Also the total populations were chosen accordingly; 65 M for "large" country and 5.5 M for "small". The license fees for different countries are not included in the calculations, but can be considered when looking for the final results of each country. The country demographics are presented in the Table 1 below. The overall size of the surface area isn't the sum of all the sub-areas because certain areas (e.g. lakes, mountain tops etc.) are not taken into account.

Table 1 Population covered in Large and Small country examples

Country Type	Large	Small	Description
Area size	370,000	330,000	Size of surface area of the country (km^2)
Area dense	185	17	Size of dense urban area (km^2) .
Area urban	2,960	264	Size of urban area (km^2)
Area suburban	37,000	3,300	Size of suburban area (km^2.
Area rural	303,400	264,000	Size of rural area (km^2).
Population dense	50,000	50,000	Number of inhabitants in dense urban area per km^2
Population urban	4,000	4,000	Number of inhabitants in urban area per km^2
Population suburban	1,000	1,000	Number of inhabitants in suburban area per km^2
Population rural	40	3	Number of inhabitants in rural area per km^2 (during busy hour)
Total Population	65,000,000	5,500,000	Total population

3. Results and Discussion

3.1. 2G incumbent operator with or without UMTS license case

This scenario analyses the incumbent player, i.e. one who has an existing 2G network, and wants to deploy its own 3G network to survive in the new 3G and beyond service competition. This study setting includes, and compares, two alternatives: UMTS deployment (with license), and a new competing 3G technology deployment.

3.1.1.Technology alternatives investigated

As an evolution path for GSM and GPRS technologies, EDGE and UMTS technologies are modeled. To represent an alternative technology approach for an operator without UMTS license, OFDM (Orthogonal Frequency Division Multiplexing) based technology has been modeled too. As there are various OFDM based technologies under continuous development, the technology is not named more specifically at this point, but the most important parameters are explicitly presented. Some of the nearest technology candidates are e.g. FLASH-OFDM and WiMAX (IEEE 802.16e). The rollout is considered later than in the UMTS case, starting in the year 2005. This is somewhat optimistic and later rollout should be considered especially for WiMAX case, lowering the results. Availability of 1.25 MHz carrier in e.g. 450 MHz band for this usage is supposed.

It has been presumed that UMTS is ready for launch in the beginning of 2005, and the OFDM one year later. Worse availability and choice of the OFDM handsets is seen in the lower service take-up figures in the beginning.

The OFDM technology, which is deployed in the lower bands, has larger site coverage area than UMTS. This has cost saving effects especially in the rural areas, where the capacity need per surface area is low. In the more urban areas the capacity per cell is more important.

The base station costs for 1Mbps are supposed to be same for OFDM as it is for UMTS (price erosion assumed for both). UMTS is further in the mass production phase already, but certain benefit from more pure IP architecture is counted on the account of the OFDM solution. This hypothesis has been used at this preliminary state, but will be adjusted later as more information has been accumulated on OFDM market evolution.

As the UMTS site is supposed to evolve to higher capacities than OFDM by HSDPA (and HSUPA), it has been calculated that the UMTS site capacity approaches two times the capacity of the OFDM site by the end of the period (year 2011), when the HSDPA capable handsets have become common among the heavy data users. This relates also to the assumption that we have the 5MHz UMTS carrier in use, compared to the 1.25 MHz carrier for OFDM. That results savings in the site build out costs. The savings with the 5MHz UMTS carrier may be even higher, but this relation has been used at this preliminary state. The yearly investments are presented later in connection with each presented technology scenario.

3.1.2.Rollout schemes and related investments

The study period starts from year 2004 (first calculated investments) continuing until year 2011. In the beginning the Network Operator has the GSM capacity built up to support the traffic level at the year 2004. Also the initial quite low data traffic is supported by the existing GPRS capability. After that point, the needed extra GSM/GPRS capacity is rolled out and calculated in the model. If the EDGE capability update is decided to be rolled out, it takes place in the year 2004.

For the UMTS there are regulatory rollout requirements, which differ country by country, but we have used generic schedules. UMTS rollout starts in the year 2004, and the service is provided from the beginning of the year 2005. The deployment starts at the same time in all area types, but takes one year to cover the Dense area, two years for the Urban, three years for the Suburban, and 7 years to cover the whole rural area.

OFDM rollout schedule has the same pace as UMTS, but starts one year later and the rural rollout takes one year less. The development of population coverage for different technologies is presented in the following figure. GSM/GPRS has full coverage already in the beginning.

3.1.3.Preliminary results and conclusions

Five sub-scenarios will be presented: "UMTS plus EDGE deployment", "UMTS without EDGE deployment", "OFDM plus EDGE deployment", "OFDM without EDGE deployment", and the "Plain EDGE deployment". At this phase only the large country type is deployed. For the NPV (net present value) calculations, discounts rates of 10% and 20% are applied. The higher one is due to the fact that in the turbulent markets and heavy technology competition the future revenues from the investments are somewhat unsure. With reasonably high discounts rate, the possibly positive results are more dependable.

The model implemented at this point is still only of partial nature. No final decisions can be made based on currently completed work, although some implications can already be identified.

In all cases Service Operator cash balance grows fast at the end. It is possible that in reality competition forces the und-user price reduction to be steeper, which would result in lower NPV for the SO. The Network Operator on the contrary has a rather straight growth line for the cash balance.

Network Operator has negative cash balance in the beginning, so that the technology risk is higher compared to the Service Operator, who does not have to make so big investments. As the SO has the flexibility in selecting different technology providers, it would be considerable that the NO should try to rise the interconnect price level from the current assumption.

According to the preliminary results shown in the table 2 below (10% or 20% discount rate, tax rate 30%, Large Country) below, it seems that successful competition is possible by utilizing another 3G technology, when the UMTS license is not available. The results for OFDM are somewhat lower than for UMTS, but the license costs (which are not included here), might be lower for the other technology. However, there are still uncertainties relating to the new technologies, which are not in mature mass production phase yet – neither for the network nor the terminal/handset part.

Table 2 Network Operator and Service Operator investments and NPV summary

Technology deployment	unit	NO INV	NO NPV /20%	NO NPV /10%	SO INV	SO NPV /20%	SO NPV /10%
UMTS with EDGE	B€	3.9	5	8.3	0.31	11.4	18.1
UMTS without EDGE	B€	4.8	3.9	7.1	0.31	11.3	17.9
OFDM with EDGE	B€	3.6	4.8	7.6	0.23	10.5	16.5
OFDM without EDGE	B€	4.8	3.4	6	0.23	10.4	16.2
Plain EDGE	B€	2.6	4.1	6.3	0.23	9.6	14.8

Plain EDGE deployment does not give optimal results, but is best as an auxiliary solution together with UMTS or OFDM.

The auxiliary EDGE deployment has clearly higher effect on the Network Operator business than on the Service Operator. This reflects that the investment savings are considerable. These findings are due to the fact that EDGE is deployed in the beginning of the study period, and if the EDGE is not deployed, more low capacity GPRS base stations have to be rolled out, raising the costs.

The better results from UMTS and OFDM relate to the End-user modeling results indicating that the growing revenue potential of especially business segment can only be captured with the higher-level technologies.

The main identified risks, left for the further study, are for the plain EDGE case that the market share is lost due to only secondary service (here constant market share supposed). For the OFDM case, especially if without EDGE, a substantial risk rises from the potential delay to market maturity, for both handsets and network deployment.

3.2. 2G and 3G Service Provider / MVNO Case

The SP/MVNO business case can be analyzed from many viewpoints. One interesting option would be to study the feasibility of different types of MVNO strategies (e.g. cost leadership vs. service leadership) for players with different backgrounds (e.g. fixed line operators, retailers, media houses). The quantitative nature of ECOSYS methodology and tool, however, is better suited for studies with emphasis on the cost (OPEX/CAPEX) and revenue structure of different technology options. In this case study, the differences between two most commonly used virtual operator business models are analyzed, including a Service Provider (SP) scenario and a Mobile Virtual Network Operator (MVNO) scenario.

As discussed, becoming an SP/MVNO is a possible strategy for operators with many different backgrounds, e.g.:

1. Operator with 2G license and without 3G license (>> 3G SP/MVNO)
2. Operator with 3G license but without 2G license (>> 2G SP/MVNO)
3. New entrant without any licenses (2G/3G SP/MVNO)
4. Operator acting as an MNO in some geographical markets and as an SP/MVNO in another.

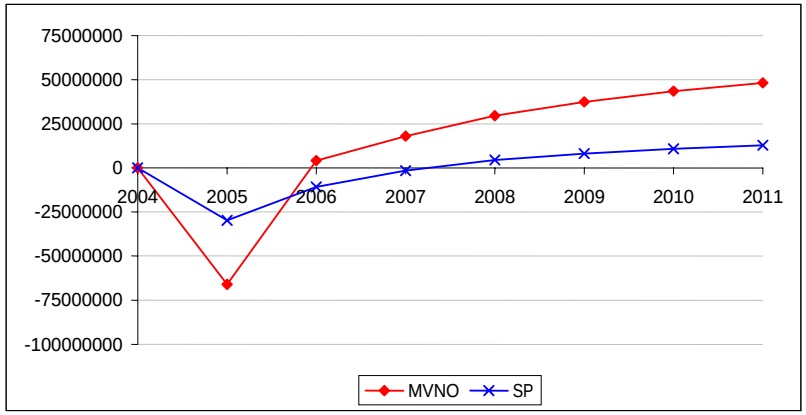
In this study, the third case is assumed, i.e. the operator is assumed to have no spectrum licenses in any markets.

The case study concentrates on building a flexible model for comparing the investment levels, cost structures, and revenue streams between the SP and MVNO scenarios. The model can be used to gain insight to the tradeoffs

between costs and revenues when deciding on the most suitable level of outsourcing. Furthermore, by comparing the results of this study to the other studies, the general feasibility of both SP and MVNO models can be assessed.

3.2.1. Preliminary results

Figure 1 illustrates the economic results for the SP and MVNO scenarios in a small country using the base assumptions. The MVNO business case proves to be significantly more profitable, giving investment payback time of two years, clearly positive NPV, and an IRR of 29% (Discount rate 10%, tax rate of 30%). The SP case is unprofitable with the base assumptions.



Scenario	NPV	IRR	Payback time
MVNO	60 402 716 €	29 %	1,9 years
SP	-17 275 264 €	-2 %	3,2 years

Figure 1: Economic results for MVNO and SP scenarios in a small country (Cash Balance)

Reasons for the differences lie in the MVNO's higher share of revenue that more than compensates the higher initial investment. This is illustrated in Figure 2, which shows the differences in the OPEX structure vs. revenue for both cases. The MNO share of revenue dominates the OPEX in both scenarios, but is even more important in the SP scenario. In the MVNO scenario, also the revenues are slightly higher due to net profit from termination fees.

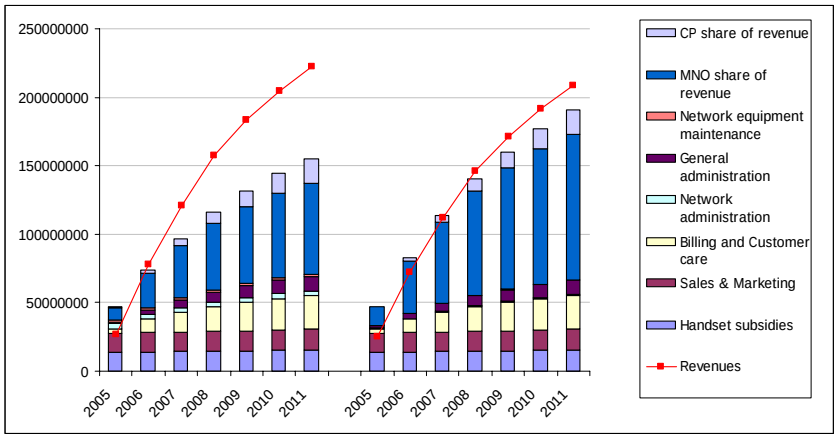


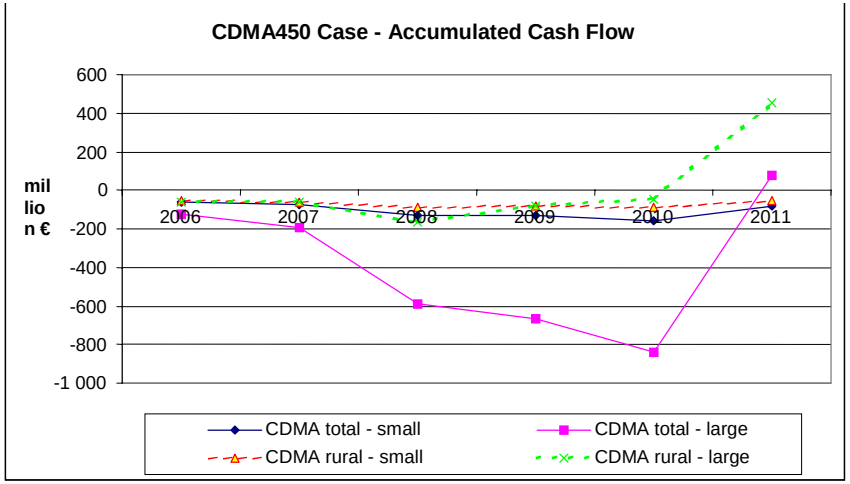
Figure 2: Revenues and OPEX distributions for MVNO (left) and SP (right) scenarios

3.3. CDMA 450 case

This scenario investigates the potential of CDMA2000 technology in 450 MHz frequency band, also known as *CDMA450*.

The studied case includes a Greenfield CDMA450 operator entering the Western-European market to compete with 2G and 3G mobile networks. The CDMA450 operator has acquired a license for the 450-frequency band with the possibility to use up to 3 x 1,25MHz carriers. The operator enters a mature market in terms of communication facilities. There are already several GSM/GPRS and UMTS operators in the market. A fixed access operator owns and runs a fixed network infrastructure that the newcomer will need to lease capacity from. We assume that N-mode terminals that enable roaming between CDMA450 and GSM/GPRS/W-CDMA networks are not available on the market. In this case study the economics for a Network Operator for two build out strategies – CDMA450 covered in the whole country or just in rural areas. Assumed study period is 2006-2011. Monthly ARPU is €28,44 and is an average of business and consumer segment, calculated as 50% of end-user ARPU.

The main economics results are given in Figure 3. The presented results are obtained assuming Discount Rate of 15%. Presented values IRR and NPV are values before tax reduction.



Scenario	NPV [million€]	IRR	Payback [years]
CDMA total - small	-66	-3 %	7
CDMA total - large	238	26 %	5
CDMA rural - small	-53	-8 %	7
CDMA rural - large	424	62 %	5

Figure 3 CDMA450 business case - Main results

Results show that CDMA450 is not a competitive in small Western European countries due to rather high investments and low customer base. On the other hand the case could give a pay back (5 years) in large country where customer base is much higher. As seen the NPV is positive for the large country cases both for the full country coverage and rural area coverage. The best case is the rural large country case. In this case the reach of each base station is one of the assets for CDMA 450. Since the case is based on no dual mode terminals the market share is very uncertain. Altering the customer base will alter the profitability considerably.

4. Conclusions

In this study from ECOSYS project three mobile business scenarios have been evaluated, trying to analyze what are the optimal and economically viable solutions for Europe. New economic opportunities generated by emerging mobile technologies and service concepts have been identified and the profitability figures of various scenarios have been calculated.

Three scenarios for incumbents and new entrants have been defined – those having a UMTS license and those lacking it – leaving alternatives for new competing 3G technology deployment or acting as a mobile virtual network operator (MVNO) without own radio infrastructure. All these scenarios have been analyzed in different country groups that are not exactly representative of any defined country, but rather share typical demographic characteristics. In most of the cases, the incumbent operators are the winning players. There is some space for the newcomers to maneuver but the risks are much higher.

The first scenario (Scenario 1 (2G incumbent operator with or without UMTS license)) analyses five sub-scenarios (UMTS plus EDGE deployment, UMTS without EDGE deployment, OFDM plus EDGE deployment, OFDM without EDGE deployment as well as Plain EDGE deployment) providing preliminary results about the profitability of all cases. In most of the cases the profitability is high due to the position of the operator in the market and previous investments in 2G network. According to the preliminary results, it seems that successful competition is also possible by utilizing other 3G technologies, when the UMTS license is not available. The results for OFDM deployment are somewhat lower than for UMTS, but the license costs (which are not included here), might also remain lower. However, there are still uncertainties relating to the new technologies, which are not in mature mass production phase yet – neither for the network nor the terminal/handset part. Plain EDGE deployment does not give optimal results, but pays back as an auxiliary solution together with UMTS or OFDM. The auxiliary EDGE deployment has clearly higher effect on the Network Operator business than on the Service Operator. This reflects that the investment savings are considerable.

The case study, based on the End-user behavior modeling, shows that the growing revenue potential of especially business and youth segments can only be captured with the higher-level technologies. Crucial factors for the Service Operator in the future competition are the provision of enough capacity and competitive usage characteristics as the services mature and the demand grows. For the Network Operator profitability, in addition, the long term capacity build-out costs and operational expenditure are vital. The results are based on modeling and evaluating these factors for the alternatives of baseline UMTS deployment and a competitive OFDM-based technology.

In the second scenario (2G AND 3G Service Provider/MVNO) the differences between two possible new entrant strategies are compared, including a Service Provider (SP) scenario and a Mobile Virtual Network Operator (MVNO) scenario. The two scenarios are different in the outsourcing levels, cost structures, and revenue streams. SPs outsource all the core, access, and service infrastructure to a licensed MNO, handling only customer acquisition, billing, and customer care functions. MVNOs, on the other hand, control a larger part of the value chain, and have their own core network elements and value-added service platforms. The case study recognizes and analyzes the key differences between these two models in terms of business profitability (very short payback period). The MVNO business case proves to be significantly more profitable, giving investment payback time of two years, clearly positive NPV, and an IRR of 29%. The SP case is unprofitable with the base assumptions. Reasons for the differences lie in the MVNO's higher share of revenue that more than compensates the higher initial investment. The MNO share of revenue dominates the OPEX cost in both scenarios since a lot of money should be paid back to the MNO, but is even more important in the SP scenario. In the MVNO scenario, also the revenues are slightly higher due to net profit from termination fees. These results are naturally sensitive on the uncertain assumptions regarding e.g. investment and OPEX levels, market share evolution and most importantly, the agreement terms and revenue sharing ratios between MNO and SP/MVNO. The sensitivity curves show that a reduction of 7% in the SP wholesale tariffs still leads to a positive NPV, whereas for MVNO the NPV results remain positive until the wholesale tariffs have increased by 40%.

In the third scenario (CDMA Business Case) the possibility of building a CDMA 450 network has been analyzed. The case describes a Greenfield CDMA 450 operator entering the 2G and 3G market. In this case study the economics for two build out strategies - a full country coverage case and a rural roll out case will be studied. Only the large country case gave positive accumulated cash flow during the 6 years period. This was due to the much larger customer base compared to their investments and operational costs. Large-scale benefits and a better divide between cost and revenue gave a result that could be pursued in further detail.

Although the technology has a clear strength in rural areas compared to e.g. GSM and UMTS, due to the very low frequency band (450 MHz), it is not considered to be a competitive technology in rural areas in Western Europe. This is mainly due to limited market share of the CDMA450 network operator due to rather late entrance to Western European market. Another rather huge barrier is the lack of dual mode terminals and therefore limited possibilities for roaming. If the whole country is not covered with CDMA 450 the user would need to acquire two terminals, which would be a major drawback for the CDMA 450 operator. The bottom line is that the CDMA 450 technology does not have very many advantages in terms of business profitability to e.g. GSM and UMTS. This is due to the fact that it is mainly capacity that is the driving aspects concerning BS density and NOT the range of the base stations.

In this paper several possible business scenarios have been selected, including three cases for incumbents and new entrants (licensed or not). This work will be expanded and all scenarios will be further developed (new technologies, new services, and new business profiles) for providing final results including risk analysis.

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Jarmo Harno received his MSc degree in Mathematical Analysis from the University of Helsinki in 1983. After working in the SW industry he joined Nokia in 1987, and has worked as systems analyst and manager in R&D, Quality Assurance and Product Management. He started as a senior research scientist on techno-economics with Nokia Research Center in 2001. Doing research on the future telecom technologies and service concepts, he has also taken part in the EU 1ST framework co-operation project TONIC (20012002), investigating the 3G UMTS services combined with WLAN deployment. In the co-operation project ECOSYS on "Techno-economics of integrated communication systems and services" started in 2004 under the EUREKA's CELTIC initiative, he has been leading the work package for "Mobile and wireless network economics beyond 3G". Mr. Harno has authored/co-authored several international journal articles and conference presentations, and has also some international patents on telecom technology and services.