3G Business Prospects – Analysis of Western European UMTS Markets

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***Abstract*—This paper introduces to techno-economic modeling and analysis of UMTS operator business case. In addition, it presents some results relating to factors such as delay in launch, price plans and levels, WLAN introduction, and infrastructure sharing.**

Keywords: 3G; techno-economic; UMTS; WCDMA; WLAN

I. INTRODUCTION

The emerging 3G (Third Generation Mobile System) business is in an ambivalent state. There is still uncertainty about which market segments would take the head, which services would be the most important and how high the spending on those might rise.

It seems that new technologies have recently followed each other faster than have been possible to adopt. Nevertheless, new innovations have come true only after the needed infrastructure is in place and lucrative end-user service flora is present. Concerning the 3G, the additional question for the players is: how much the old platforms should be developed and/or "milked" compared to charging to the 3G launch.

Another factor in the recent mobile business has been the availability of the adequate equipment, especially the mass-produced end-user terminals, with lucrative characteristics and functionality. Operators' role has been important in this context by provisioning and subsidizing terminals.

In the current situation, it is not only question of the subsequent platforms or generations, but current convergence happening in the telecom field that bring competition from new frontiers. Especially WLAN (Wireless Local Area Network) is seen both as a competing and as a complementing technology for 3G. Here again, it is challenging to assess the future competitiveness or complementarity of this technology stream in relation to 3G UMTS (Universal Mobile Telecommunication Service) operator settings.

Regulators have been acting a significant and disputed role in the 3G play, either as introducing spectrum license auctions and gathering large amounts of money, or by "beauty contests" with usually strict requirements for the deployment of the infrastructure. These measures have lead to current controversies on regulatory conditions for rollout schedules, infrastructure sharing, bandwidth trading, and co-operation with Mobile Virtual Network Operators (MVNOs). The industry, especially in Europe, is afraid that increasing regulatory intervention will restrict free pricing and cost sharing, thus making the launch of the 3G services more challenging than it already is in this economic situation.

II. SCOPE OF THE STUDY

All the main business aspects introduced have been in the focus of the European Union funded IST project TONIC (Techno-economics of IP Optimised Networks and Services), which work gives the basis for this presentation [1]. The project has created a comprehensive model for UMTS operator's business case. An "incumbent" operator, with a 2G infrastructure and customer base already there, has been selected as the focus for the study case. WLAN is an option for the operator to supplement its infrastructure and service portfolio. In addition, needs and potential benefits by infrastructure sharing are analysed. Discussion about the impacts of admitting MVNO into the network is included too.

The model aims for holistic view that combines demand development estimation, technology rollout, cost modelling, service classification, pricing, and revenue forecasts. By these means it is possible to have a consistent picture, where changes in one factor reflects to others. By having benchmarks or boundary values for different parameters (like ARPU, end-user price level, penetration, etc.) it is possible to have reality checks for feasible input. This is important, as the information is at this stage still fuzzy. Moreover, the model gives possibilities to "simulate" scenarios with different input values, and to make risk and sensitivity analyses with several interdependent variables.

In the case studies, the UMTS economics has been separated from the 2G business to get a focused view on the effects of UMTS demand, rollout and service provisioning on the costs and revenues of the operator. However the underlying 2G/2.5G network, providing e.g. antenna site infrastructure and seamless handovers in case of limited WCDMA (Wideband Code Division Multiple Access) coverage, has been supposed. In this study the 3G UMTS case is looked within a quite large time span (years 2002 – 2011). This reflects the fact that UMTS is a long haul endeavour and opportunity, as the licenses are in most cases for 20 years. On the other hand, ten years describe reasonably well the 3G window of opportunity for the operator, as the pace of emerging new technologies is taken into account.

The study addresses also the current hot topic of 3G or UMTS delay and its effects. The modelling allows the simulation of the delay in service launch or take-up, with related risk and sensitivity analyses. If the general delay, observed recently in the 3G launches, is interpreted as technology, applications, and service immaturity that causes lack of supply and demand for 3G, then the latent potential for the new 3G frequency band and services is only waiting for the right time to break out. This probably relates to the same immaturity that has eroded the WAP (Wireless Applications Protocol) and GPRS (General Packet Radio Service) cases thus far. It seems that repeatedly the challenges have been first underestimated. Another possibility is that the demand is just not as high as anticipated. This assumption leads to different economical scenarios, anyhow possible to cope with the model.

The objective in this presentation is to demonstrate how a 3G operator can come off in the competition with given country demographics, economical constraints, estimated demand development scenarios, and regulatory conditions. This analysis provides generic views on the prospects for certain kind of players in Western European markets and recommendations for the 3G rollout planning. It gives also guidelines for detailed case studies to be run with a techno-economic model using parameter values fine-tuned for the particular case.

III. OVERVIEW OF THE MODELING AND PARAMETERS

A. *UMTS Demand Estimations*

The basic demand forecasts were performed for the Western European market. The demand for 3G services is based on the overall mobile penetration, so the study is started with total mobile subscriber penetration forecasts (based essentially on 2nd generation systems such as GSM today). After that we focused on forecasts for the penetration rates for the following mobile generations:

- 2.5G – HSCSD, GPRS
- 3G – UMTS
- 3.5G – meaning here 3G and WLAN systems as a combined solution

As a basis for forecasting models used, several recent consultancy reports were referred. The Tonic project used a logistic model to perform demand forecasts. This model is recommended for long-term forecasts and for new services.

Based on the assumptions for the evolution of the total subscriber penetration, combined with assumptions regarding each of the mobile systems, we have calculated the default penetration forecast for the four different mobile generations. These penetrations are shown in Fig. 1. It should be noted that the penetrations are depicted according to the highest generation subscribed, so that GSM customer with GPRS subscription is counted only as a 2.5G subscriber. The total GSM subscriber base is thus the sum of the 2G and 2.5G figures, and the total UMTS subscriber base is the sum of the 3G and 3.5G figures.

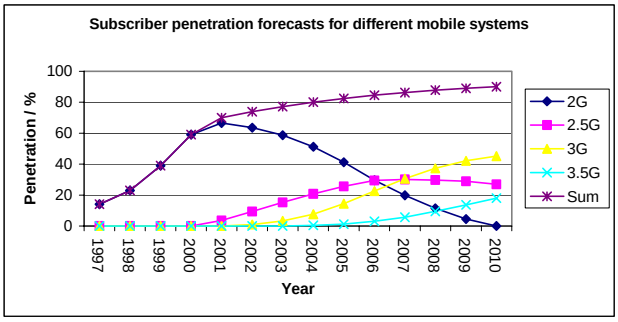

Figure 1. Subscriber penetration forecasts for different mobile systems for Western Europe

B. *Service Classification*

The analysis of the impact of different future 3G services is challenging. All of the potential services are not yet foreseen, not to even mention the "killer applications". For this reason the selected approach has been to abandon individual service demand forecasts and to aggregate services into classes that can support capacity calculations and tariffing and thus revenue potential of the forthcoming 3G services.

First we took into account the four Quality of Service (QoS) classes in the 3GPP specifications:

- Conversational
- Streaming
- Interactive
- Background

The last two are mainly looked as combined (int/backgr.), since the requirements for the network are more alike compared to others. Each of these is further classified according to the bandwidth utilization to:

- Narrowband: with int/backgr. peak bit rate 32 kbit/s
- Wideband: with int/backgr. peak bit rate 384 kbit/s
- Broadband: with int/backgr. peak bit rate > 2 Mbit/s

In this classification the Broadband (BB) class is available only when the WLAN access is possible. Within the Conversational Narrowband (NB) and Wideband (WB) classes we have made additional distinction to Circuit Switched (CS) and Packet Switched (PS) mode. Other classes are based purely on Packet Switched carrier.

C. *Capacity demand calculations*

The estimated usage figures of the services within each service class form the basis for the capacity demand calculations and, together with pricing forecasts, for ARPU (Average Revenue Per User) estimations. The usage forecasts are based on the foreseen service portfolio in each service class. Usage is first estimated as usage (session) time per day in each class. This amount is then multiplied with the mean bandwidth usage during the session. Busy hour and Erlang

calculations are then performed to get the peak capacity requirements.

D. Pricing forecasts

Compared to the old era of mainly voice and then SMS, the new mobile data services bring many new possibilities in charging policy. Variety within tariffing schemes is broad, starting from pure monthly flat rate or transmission volume based tariffs, and continuing to different kind of packages, based on bit rates, minutes, packet amount, Mbytes, subscribed or used services, content, etc.

E. ARPU projections

The UMTS revenues are dependent on the network rollout, as the 3G usage is calculated only if the user is in the coverage area of the UMTS network. Otherwise the service is not available and the demand is not fulfilled or the usage goes seamlessly to the GSM/GPRS network, the revenue from which is not counted.

The ARPU figures are usually counted plainly as the revenues divided by the amount of subscribers. This might cause some confusion in the situation as the operator provides several systems (2G and 3G) simultaneously while we want to separate the revenues from subscribers of different systems. According to knowledge from previous mobile generations the first migrates are clearly spending more than the latecomers. An oppositely affecting factor is that, in the beginning, much of the usage, and thus revenue, goes to the 2G network as the 3G coverage is lacking. Fig. 2 demonstrates the UMTS users' ARPU to rise quite high at first, when the rollout has advanced to good coverage and the high-end users have migrated in, but then to turn into degradation due to incoming lower usage customers and tariff erosion.

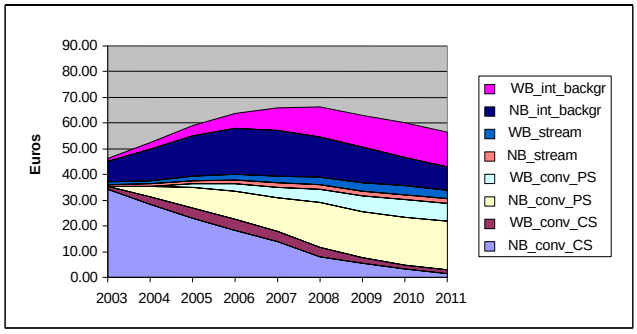

Figure 2. Breakdown of monthly ARPU of UMTS users (without WLAN)

The TONIC model focuses to the UMTS revenues, but for comparison with the commonly presented total subscriber base ARPU figures, also the revenue calculation for all mobile subscribers is presented. This ARPU pattern is presented in Fig. 3, where we see a lower maximum monthly ARPU (about 50 €), which is also reached later, as the bulk of the customer base moves to UMTS only near the end of the period. This reflects the basic assumption that UMTS brings in new types of services and usage, which shifts the consumer (and corporate) spending towards (mobile) telecom consumption during the study period.

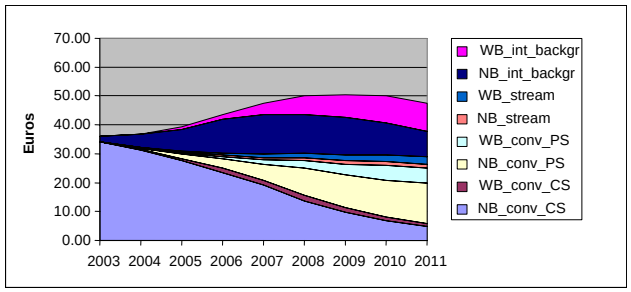

Figure 3. Breakdown of monthly ARPU of all mobile subscribers (without WLAN)

F. Selected country types and rollout schemas

Two generic country types are modeled:

1."Large country" = Western European country like France, Germany, Italy, or UK

2."Small country" = Northern European country like Denmark, Finland, Norway, or Sweden

The country surface area has been supposed to be 370 km^2 for Large country (average from France, Germany, Italy and UK), and 330 km^2 for Small country (median from Denmark, Finland, Norway and Sweden). Also the total populations were chosen accordingly; 65 M for Large country and 5.5 M for Small.

Regulation pattern is another differentiating factor between these basic types: Auction type of spectrum distribution with high license fees is supposed for Large country, as negligible license fees combined with service rollout requirements are modeled for the Small country type. The license fee used for Large country is totaling 6 billion €.

The rollout requirements differ country by country, but the generic schedules used in this study, combined from the licensing data, are for Large country 50% population coverage at the end of 2004, 80% population coverage at the end of 2006, and at least 50% surface area coverage at the end of the year 2008.

As some Nordic countries have introduced very fast rollout schedules, two schedules are compared: a fast one and a slower one. In the fast rollout, 90% of the surface area is covered by the end of year 2004. In the slower scenario the rural area build out is not completed before the year 2011, although the urban, suburban and part of the rural area (e.g. main roads) is covered already by year 2006. For Small country with lower population density, the network is mainly coverage driven.

Radio network modeling is done with three-sector UMTS Base stations so that site coverage area is 2 * (cell range)^2. Average cell ranges used in the model are:

- Dense Urban: 0.57 km
- Urban: 0.89 km
- Suburban: 2.11 km
- Rural: 6.36 km

IV. BASIC BUSINESS CASES

A. *The "Large country" business case*

First we look at an incumbent operator having a comparatively big market share (30%) in 2G GSM and supposed to be able to keep the customer base as it is gradually migrating to the UMTS. With the presented assumptions this Large country business case shows acceptable economic results in spite of the assumed 6 B€ license cost. The pay back period is somewhat long, 7 years, but in accordance with the nature of a long-range investment project. With discount rate of 10% and tax rate 0%, the Net Present Value (NPV) for the Large country pure UMTS case is 5.6 B€ and the Internal Rate of Return (IRR) 18.8%. (NPV describes the value of the project today, as the whole project range is taken into account, and IRR the highest discount rate, which still leaves the case economically feasible.)

Non-discounted investments for the whole study range are not more than 1.9 B€, partly due to a long rollout period and quite rapidly degrading equipment prices. The investments consist of base stations (45%), site build out (20%, with one third of the sites new), switching, routing and control centers (23%) and new billing systems and other OSS and software (11%). The backhaul and transport is modeled as leased line costs thus within Running Costs. See Fig. 4 below.

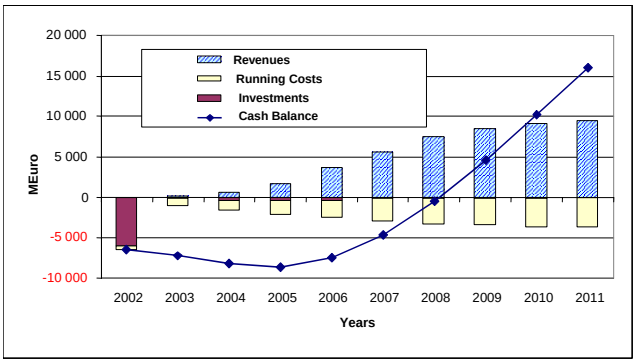

Figure 4. Economics of the Large country incumbent UMTS business case

B. *The "Small country" business cases*

In the first place, the Small country business case is with a fast rollout schedule. It reflects the heavy regulatory requirements to cover virtually the whole country by the end of the year 2004, as e.g. in the original license terms of Sweden. On the other hand, the Small country case, as representing the common "beauty contest" auction scheme, has practically no license fee.

With this very fast rollout schedule the case shows only a slightly positive net result in the long run, with NPV 97 M€ and IRR 12 %. See Fig. 5.

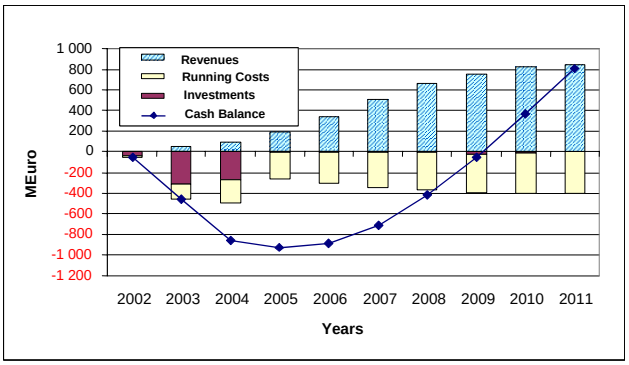

Figure 5. Economics of the Small country business case with fast rollout

This indicates quite a vulnerable business case and it has turned out that this kind of tight regulatory requirements are alleviated in the current situation. The slower rollout business case shows clearly higher and more robust results, with NPV of 3.8 M€ and IRR 10.3 %.

Later it is shown that infrastructure sharing with other UMTS operator, or an MVNO introduction to share the capacity and costs, can make even the Small country case with fast rollout much more sustainable. This has actually been the course of development, particularly in Sweden.

V. FURTHER CASE ANALYSES

A. *UMTS delay considerations*

The UMTS provisioning is now really taking off, with about hundred networks to be launched commercially or as trial this year (2004). The technology is rapidly approaching maturity both on the network and terminal sides, as the "critical mass" is being reached in experience for network interworking and in handset functionalities and form factors. We are getting over the early stages of the new technology generation characterized by the "chicken and egg" situation, where lack of demand prohibits the learning curve of the technology and vice versa the technology immaturity prevents the demand growth.

In the TONIC basic cases the UMTS launch of the operator was scheduled in the year 2003. The model illustrates also the effect of delay on the operator's economical end results. Fig. 6 depicts the Large country NPV change as the UMTS launch is postponed. The assumption there is that the demand (or penetration) curve shifts forward according to the delay. Also the UMTS demand continues respective interval further than in the basic case. As the investments, especially the high license fee, are already made, the profitability of the case erodes as the revenues are postponed.

In the Fig. 7 the assumptions are otherwise the same, but it is supposed that the UMTS life cycle ends like in the basic case, e.g. due to new emerging technologies. Within this scenario the results drop more dramatically: in one year NPV drops from 5.6 B€ to 3.2 B€, and the IRR from 18.8% to 15.3%.

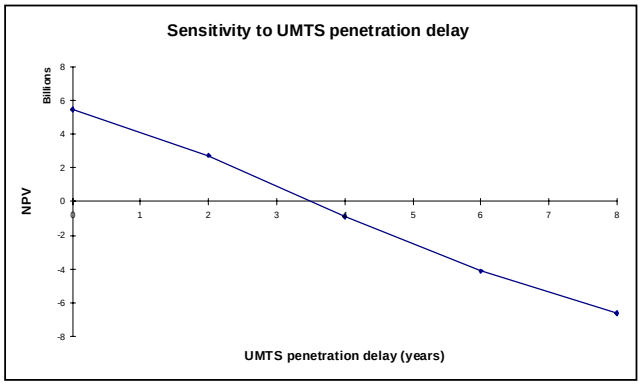

Figure 6. Large country NPV as a function of delay (prolonged life cycle)

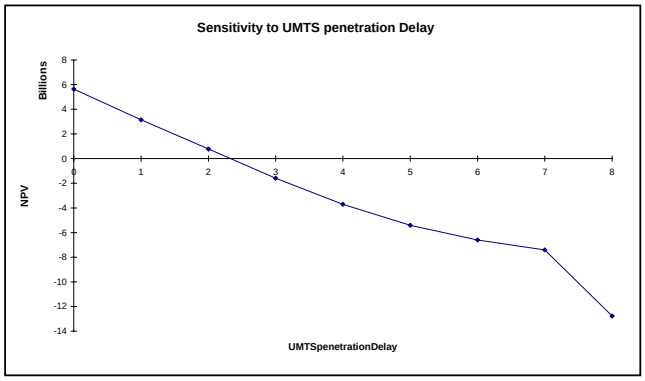

Figure 7. Large country NPV as a function of delay (same life cycle end)

The postponement of investments (network rollout) with the same time shift do not, maybe surprisingly, help, but rather make the case worse: with one year shift also in the rollout schedule gives NPV of 2.4 B€ and IRR of 14.1%. This reflects the fact that even though the launch might be postponed for some market or technology reasons, the recovery from the investments and utilization of the limited technology life cycle demands relatively rapid network deployment.

More distinctive deployment strategies concerning the different area types (like dense urban, urban, etc.) could be tested against the demand assumptions by adjusting the model parameters.

B. UMTS pricing considerations

The tariff level in the model for Interactive/Background service starts from 1.5 €/MB in year 2002, after which the tariff erosion has applied. Currently the GPRS and UMTS tariffs are generally quite complicated, with many alternative price plans. Typically they include selectable quota of megabytes for fixed monthly fee, plus respective MB price for the additional traffic. Depending on the distribution of the customer base into different pricing plans, and their real usage amounts, the average MB tariff may vary quite much. This is affected also by the marketing and service offering by the operator.

We can investigate the economical effects of lower MB prices with higher traffic, while keeping the ARPU figures constant: If the MB price halves at the same time as the traffic doubles, the Large country NPV drops from 5.6 B€ to 4.7 B€, and the IRR from 18.8% to 17.4%. This is not a very dramatic reduction in profits for a doubled capacity demand, reflecting the fact that network build-out costs are relatively low for the needed extra capacity.

C. WLAN effect on UMTS case

The WLAN technology was investigated as a complementing technology for UMTS, providing high bandwidth services on hot spot sites of limited number and coverage. With reasonable modest deployment (about 3.500 sites with some 10.000 access points in the Large country) the effect on the total business case was identified not to be dramatic, but anyhow increasing the NPV from 5.6 B€ to 6.7 B€, and the IRR from 18.8% to 20%.

The effect of WLAN was identified to be at least two-fold: it may cannibalize some UMTS revenues due to lower MB tariffs, but on the other hand the WLAN availability in certain situations may feed the usage of wideband UMTS services generally, provided that the roaming and service inter-working aspects are in place. If the highest capacity consumption is directed to WLAN hot spots areas, also the UMTS rollout costs are reduced.

It is probable that no single operator can cover all hot spots of interest (even due to access rights to the area). Anyhow, with intelligent roaming agreements it seems that the complementary nature of WLAN can be sustained by the UMTS operators in Europe.

D. Infrastructure sharing and MVNO considerations

Infrastructure sharing was identified to be almost obligatory in certain sparsely populated countries, especially if the coverage requirements were high. For the Small country case with fast rollout, already 20% sharing of capacity, and thus build-out costs, improves the case dramatically: NPV increases from 97 M€ to 269 M€ and IRR from 12 % to 17%. For the Large country the improvement is comparatively small, as the investments are mainly capacity driven.

An alternative strategy for infrastructure sharing may be to sell the excess capacity to an MVNO.

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REFERENCES

[1] TONIC project website: http://www-nrc.nokia.com/tonic/ (contains more detailed descriptions of the basic assumptions and modeling, as well as references to related publications)