Techno-Economic Evaluation of 3G & WLAN Business Case Feasibility Under Varying Conditions

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Abstract

This paper presents a techno-economic evaluation of combined UMTS and WLAN operator business case spanning years 2002-2011. The study is based on the work by the TONIC project [1] under the European Union IST (Information Society Technologies) programme [2]. The study provides a framework to compare all the main factors affecting the UMTS operator's business case and evaluation of the WLAN profitability impact as complementary access technology. The example cases differ in country demographics and rollout plans relating to competition and demand situation and regulatory requirements.

Introduction

The emerging 3G business is in a very turbulent state. There are many scenarios on which market segments would be the first to take off, which services will be the most important and how much the spending on those might be.

It seems that new technologies have now followed each other faster than could have been possible to adopt. New innovation is true only after the whole infrastructure is in place. This means that the real end-user service flora is present in a lucrative form. The problem might easily be that if there are too many technology platforms, the critical mass of new applications is not achieved. Concerning the 3G, the question for the players is also: how much the old platforms should be developed or "milked" compared to charging to the 3G launch.

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

In the current situation, it is not only question of the subsequent platforms or generations, but current convergence happening in the telecom field bring competition from new frontiers. Especially WLAN is seen both as a complementing and competing technology for 3G. Here again, it is difficult to see the future demand and significance of this kind of technology enabler. WLAN has been seen as a promising supplement for the fixed broadband access, first and foremost for Internet/intranet access outside office or home. And, from an opposite angle, as a complement for mobile offering in provision of higher data speeds in hot spots. The angle affects also to the question of seamless handovers - should it be provided or not.

Regulators have been acting in significant 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 dilemmas 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 to restrict free pricing and cost sharing will make the launching of the 3G services more difficult than it already is in this economic situation.

All these aspects have been in the focus of the IST project TONIC (Techno-Economics of IP Optimised Networks and Services), which gives the basis for this paper. The project has created a comprehensive model for UMTS operator's business case. An "incumbent" operator, having a 2G infrastructure and customer base already in place, has been selected for this study case. WLAN is an option for the operator to supplement its infrastructure and service portfolio.

The model aims for holistic view combining 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 changing of one factor is reflected in others. By benchmarking or boundary values for different parameters like ARPU (Average Revenue Per User), end-user price level, penetration, etc., it is possible to have reality checks for feasible inputs. This is important, as the information is at this stage still very fuzzy. The model gives also possibilities to "simulate" scenarios with different input values, and make risk and sensitivity analyses[1] with several interdependent variables.

In the model, the UMTS economics has been separated from the 2G business to get a focused view on the effects

[1] The detailed results of the sensitivity studies are not included in this paper. See the TONIC deliverable number 11 "Final results on seamless mobile IP service provision economics" [3].

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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 (where limited WCDMA coverage) has been taken into account. In this study the 3G UMTS case is looked within a quite large time span 2002 – 2011. This reflects the fact that UMTS is a long haul endeavour and opportunity. Also taking into account that the licenses are in most cases for 20 years. On the other hand, keeping in mind the pace of emerging new technologies, it is considered that ten years describe well enough the 3G window of opportunity for the operators.

Basic 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, focus was put on the forecasts for the penetration rates of the following mobile generations:

2.5G: HSCSD, GPRS
3G: UMTS
3.5G: 3G and WLAN with roaming capabilities

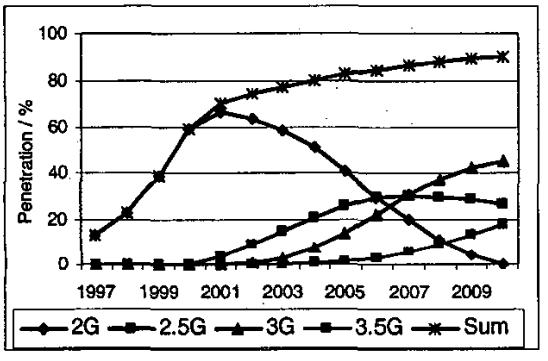

Figure 1. Subscriber penetration forecasts for different mobile systems for Western Europe

Service Classification

Analysing the impact of different future 3G services is challenging. All of the potential services are not foreseen yet, not to mention which are really going to be the "killer applications". For this reason the selected service classification approach in this study has been to broaden the granularity and use a classification that can help in assessing the penetration, usage, bandwidth and other requirements, pricing and thus revenue potential of the forthcoming 3G services.

First, the four Quality of Service (QoS) classes in the 3GPP specifications [4] were taken into account. These are:

- *Conversational*
- *Streaming*
- *Interactive*
- *Background*

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

- Narrowband: e.g. 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 over 2 Mbit/s

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

Services are launched in the beginning of 2003, except the Packet Switched Conversational and the BB classes, which are introduced in 2004. In the beginning the Circuit Switched Conversational NB services dominate (mainly CS voice), but gradually the Packet Switched services take over. In the end on the study period (2011) other classes have levelled the Conversational class in usage.

The estimated usage figures of the services within each service class are the basis for the capacity demand calculations. The usage estimations are based on the foreseen service portfolio in each service class.

Pricing forecasts

Pricing is another difficult issue at this phase, as different new tariffing schemes are just emerging. Compared to the old era of mainly voice and then SMS, the new mobile data services bring many new possibilities in charging policy. Starting from pure monthly flat rate or transmission volume based, to different kind of packages based on bit rates, minutes, packet amount, Mbytes, subscribed or used services, content, etc.

The aim of the end-user pricing is to get best possible revenue out of the 3G investments. This means among other things that the network resources should be utilised optimally, implying that revenues from each service should be proportional to the load generated to the critical resources, especially the air interface capacity during the peak period. This with the condition that the value-adding component of the service, which is not related to the traffic resources, is handled separately. In practice this is hardly possible to implement as a clear-cut method.

The price of services for end user should not grow linearly, e.g. as function of megabytes transferred. To boost the usage, volume discounts are needed. On the other hand there are limits for the spending of individual users. The pricing can be seen as optimisation question to get the maximum revenue per user without too high load on the

resources. Especially in the beginning of the rollout when, e.g. the radio resources might be sparse, it is important to guide the customers to certain kinds of usage patterns, so that the quality of all services is sustained on a sufficient level. This might mean even raising tariffs when crossing certain traffic amount. However the actions of the competitors make it difficult to find one optimal pricing strategy.

In the TONIC model the end-user monthly charging is in the first place based on the transferred Mbytes. Each service class has its own tariff per MB, which is degrading as the bit rate of the service class increases. On the other hand, with the interactive/background traffic the user is paying only for the active sending and maybe receiving of the user data packages, not for constant bit rate channel as with conversational traffic, so it is assumed that the price level per bit is higher. WLAN tariffs are supposed to be clearly lower per MB compared to UMTS, due to cheaper technology with more capacity but restrictions on availability. Tariff erosion is naturally included in the modelling.

The model gives freedom for simulation with different pricing plans, which may consist of combination of a traffic related part and a traffic independent part for each service class. It is possible to introduce e.g. a plan, where there is an average flat rate for the service class users and an additional traffic related tariff, or even a pure flat rate model. The megabyte based price level estimates used vary significantly between service categories range being from 0.15 €/MB up to 6€/MB.

Results for Selected Country Types and Rollout Schemas

Six scenarios are analysed. All the scenarios start the network deployment in year 2002 from the dense urban areas and continue towards the less populated areas. Two basic country types are modelled:

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

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

The country surface area has been supposed to be 370 km^2 for "large" country (calculated average from France, Germany, Italy and UK), and 330 km^2 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 million for "large" country and 5.5 million for "small".

The service usage varies a little between these country types, due to different business/residential user profile; residential market including also the low end pre-paid customers.

Regulation pattern is another differentiating factor between these basic types: Auction type of spectrum distribution with high license fees is supposed for the Large country, whereas in small country a negligible license fees combined with service rollout requirements are modelled. The license fee used for Large country is totalling 6 billion euros.

The rollout requirements differ country by country, but the generic schedules used here, have been combined from the licensing data. 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 2008 are assumed.

In the small country two roll-out scenarios have been investigated. In "slow" roll-out 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. In the "fast" roll out scenario, due to assumed strict license requirements, all areas are covered by end of 2005.

For the WCDMA coverage and capacity, only one 2*5 Mhz carrier is assumed, as in most large countries only two carriers are granted per licensed operator and the second one is reserved for the micro layer. In the small country with lower population density, the network is clearly coverage driven.

Radio network modelling 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

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, from which revenue is not counted in this study.

The WLAN network deployment is started in 2003 and services are launched in 2004. WLAN network roll-out is based on hot spot coverage concept. Places like airports, hotels, cafes etc. are equipped with Access Points (AP). In large country case some 3400 hot spot sites are covered by 2008 and in small country case 500 sites respectively. On average TONIC model assumes three Access Points per hot-spot site.

The ARPU figures are usually counted simply as the revenues divided by the amount of subscribers. This might cause some confusion in this case study as the operator provides several systems (2G and 3G) simultaneously and 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 limited. In

the TONIC model these factors are taken into account, but for the reference to the commonly presented ARPU figures, also the average revenue calculation taking into account all user and 2G & 3G networks is presented below. This ARPU pattern is much the same for all country and rollout cases, and is presented in the Figure 2.

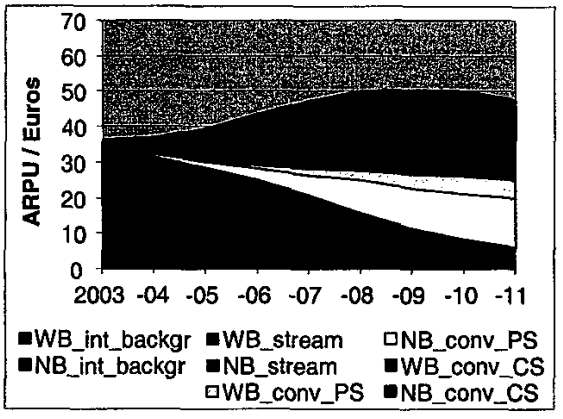

Figure 2. Breakdown of monthly ARPU estimates including all (2G&3G) subscribers without WLAN.

Large country business case results

With this kind of ARPU assumptions the Large country business case looks rather lucrative despite of the 6 billion euro license cost and somewhat long pay back period. With discount rate of 10% and tax rate 0% (zero tax assumed for all results in this paper), the Net Present Value (NPV) for the Large country is 6.7 billion euro and the Internal Rate of Return (IRR) 20%.

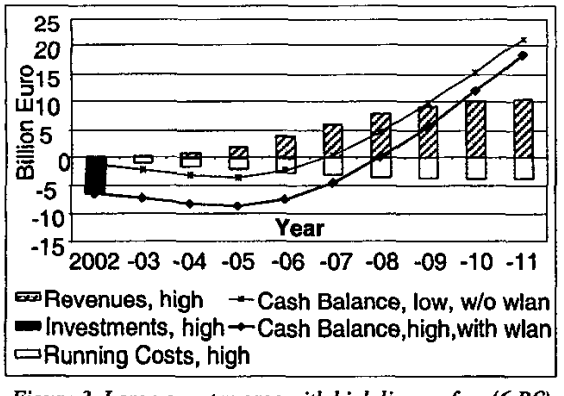

Figure 3. Large country case with high license fees (6 B€) providing WLAN and with lower license fee (1.2 B€) with and w/o WLAN.

Non-discounted investments, excluding the license fee, are for the whole study range not more than 2 Billion €, partly due to a long rollout period and degrading equipment prices. The investment breakdown is shown in following figure. The backhaul and transport is modelled as leased line costs thus they are part of Running Costs.

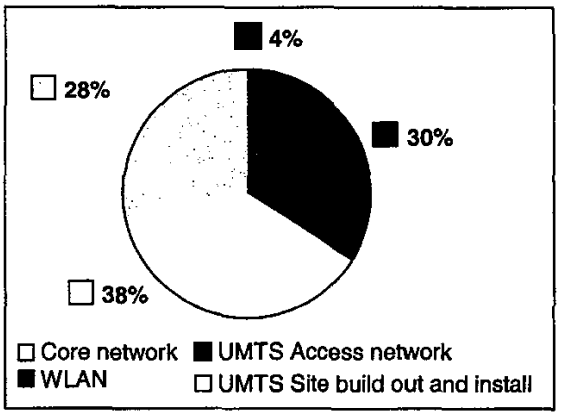

Figure 4. Cumulated Investment breakdown-Large country case

We retained in TONIC model for large country case a license cost of 6 billion euro, a bit below the extreme license costs in UK and Germany, and for small country, 6 million euro, this amount being more related to the situation of Nordic countries. The incumbent operator in large county has a good prospects for positive financial balances even though the high license fee, but a lower one (20% of high license fee = 1.2 billion) would gain one year in terms of Pay back Period and would also double the IRR.

Small country business case

The following figures show the economic results for small country case. Especially the effect of roll-out pace was studied for small country cases. Results show that accumulated investments are cut by 14 % in slow rollout case. On operational costs side, same slow rollout case has 18 % less cumulated running costs than in fast roll out case.

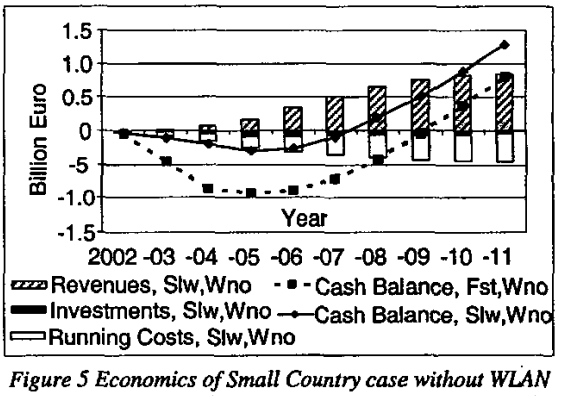

Figure 5 Economics of Small Country case without WLAN with fast and slow roll out (slw=slow, Wno=w/o WLAN).

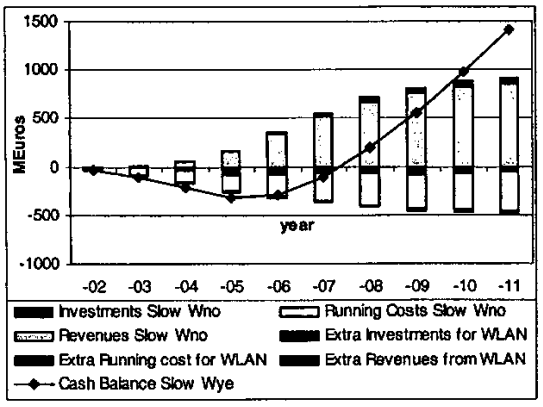

Figure 6. Economics of Small country with slow roll-out highlighting the WLAN effect.

Small country business case with reasonably slow rollout plan gives a very positive case, NPV 690 M€ and IRR 39%, with total non-discounted investments of 580 M€ and no licensing fee. On the other hand, if the operator decides or is obliged to fulfil tough license coverage commitments, within two years a full coverage, we can compare the graphs and that peak funding need, i.e. cash balance lowest point, is almost multiplied by three and pay back period is lengthened of almost two years.

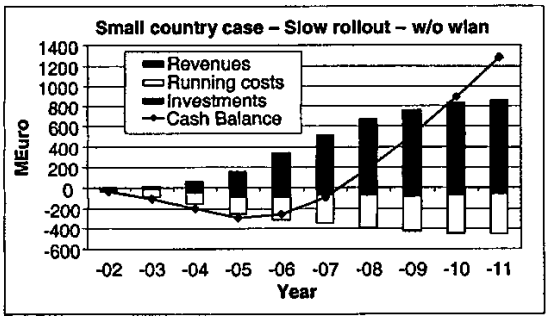

Figure 7. Economics of the Small country business case with slow rollout and without WLAN service.

Summary of the results

The following table summarises the key economic feasibility indicators for all analysed scenarios.

Table 1. Summary of the results (PbP=Payback Period, NPV at 10% discount rate)

Scenarios	NPV (M€)	IRR	PbP (year)
Small Country with slow roll-out, without WLAN provisioning	635	39%	6.3
Small Country with slow roll-out, providing WLAN service	690	39%	6.4
Small Country with fast roll-out, providing WLAN service	155	13%	8.0
Small Country with fast roll-out w/o WLAN	98	12%	8.1
Large Country with high license fee, not providing WLAN service	5 639	19%	7.1
Large Country with high license fee, providing WLAN service	6 703	20%	7.0
Large Country with lower license fee w/o WLAN	9 754	39%	5.9

Results discussion

There has been much concern that the rise of public access WLANs will impact on 3G by cannibalising potential 3G revenues. It is often said that revenues diverted away from 3G networks by WLAN type of stand-alone networks is a big risk, since the latter are supposed to be much more cost efficient. Based on the results of this study it can be concluded that this view is not justified and that 3G and WLAN are essentially complementary within a total mobile data services portfolio.

TONIC research moderates the anticipated impact of WLAN networks on 3G economics, demonstrating that it is much more a completing than a competing technology.

WLAN impacts mostly on one service category of 3G service provision, namely Mobile Intranet/Extranet Access. This category is specifically defined as being for workers on the move who have a need to access corporate intranets and the Internet remotely. Such workers are likely also to be the main users of public WLAN services. By combining a public WLAN service with their 3G service, operators will be able to offer a seamless mobile data communications solution for the business user.

Although WLAN represents only a small percentage of total 3G revenues, the Mobile Intranet sector is significant. As including also the email access, it is a primary service offering for the corporate sector. TONIC conclusion is that WLAN revenues are rather small in relative terms compared to the whole 3G business case, so the economics are proportionally not much impacted: Additional requited investment in large country case for WLAN deployment is of 1 % while 6 % of total revenues are generated from WLAN services and additional operational costs are limited to 4 %.

Same analysis on small country case gives slightly less favourable figures: Additional requited investment for WLAN deployment is of 2 % while 6 % of total revenues are generated from WLAN services and additional operational costs are limited to 5 %.

Risk of investments is strongly related with postponements in their utilisation. The highest risk generally associated to 3G-business case, is the possibility of delay of the UMTS breakthrough. The foreseen reasons for the delay of the UMTS breakthrough can be general lack of demand, lack of interesting or useful applications and services, lack of willingness to pay for telecom services (esp. mass market mobile data services), unavailability of equipment, too

high price level and weak economical position of the interest parties or combination of these, coupled with unwillingness to take the risk of initiative by the players.

Most of the abovementioned factors are taken into account in this study. The learning from Japan (FOMA) shows clearly the problem in situations, where the new system has not seamless roaming capabilities to the prevailing (2G) system, and where dual mode handsets are not available. Both of these shortages should be overcome in the European approach, but short delays in both handset mass-market availability and seamless roaming functionality between different vendor's systems may occur.

Finally we see firm decisions by part of the UMTS license holding operators in Europe to start the launch in original schedule. In most cases, if the operator's initial market position and financial situation are in acceptable level, the UMTS case is not seen vulnerable, even in case of heavy licenses, as the license period gives enough room to make profitable business. This gives even some flexibility for delays in rollout at least by some players.

Sensitivity analysis results[2] show that the point where business cases turn negative is somewhere near 3.5 years delay in market take-up. We see a low probability for a long delay of UMTS because infrastructure has been readily available and the rollout and upgrades have started by many European operators already last year; and also because availability of the dual mode UMTS/GSM handsets in the year 2003 will be good in relation to the TONIC penetration estimates.

Conclusions

This business case study gives a positive prospect on the economics of European UMTS operator in all analysed basic cases. The penetration and ARPU figures differ somewhat from many recent forecasts, with the reasons discussed earlier. The license and investment costs are not, even in the heavy license fee case, seen too high for making profitable business in the long run, as the license period is in most cases as long as 20 years. Yet the technology generations emerging afterwards have to be taken into account. The pay back periods are generally around 7 years, which is not to be considered too long against the magnitude of the project. Only an efficient cooperation between operators, vendors, investors, application, content and service development/provisioning business, as well as regulatory and standardisation bodies can minimise the risk of delayed UMTS deployment and take-up of the services.

This study concludes, that the common opinion that public WLAN could destroy 3G business case is not justified. Instead, it shows the economic profitability of WLAN as a complementary, rather than a competing solution for 3G operators towards broadband mobile service provisioning. Thus, WLAN is expected to boost UMTS multimedia take up and usage and to generate some 6% of the combined UMTS-WLAN revenue stream in large countries, with additional overall investments and operating costs of just 1% and 4% respectively. For small countries, the additional investment and operational costs are 2% and 5% respectively, resulting in a similar UMTS-WLAN revenue composition. In terms business key figures, a 3G operator in a large country with high license fees is expected to see the Net Present Value of its investment go up by 18% thanks to WLAN service provision. In a small country with a slow network roll out, the Net Present Value premium for WLAN usage is estimated to be 9%. This stems from the fact that small countries are prone to higher investment and operational cost levels per inhabitant in newly established networks.

Sensitivity conclusion is that a delay of 3,5 years in terms of usage penetration could turn the business case negative both for large and small country case. Nevertheless, TONIC estimates that UMTS business cases will have low risk to face such long delays, because the availability of dual mode terminals combined with seamless roaming between 2G and 3G networks is seen as the key success factor in smooth migration to UMTS.

[2] Not fully covered in this paper, see [3].

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