Wireless Personal Communications (2006) 36: 129–142
DOI: 10.1007/s11277-006-0027-5

On the Economics of 3G Mobile Virtual Network Operators (MVNOs)

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Abstract. The paper assesses the market conditions and dynamics, the architectures and the different approaches for deployment of 3G Mobile Virtual Network Operators (MVNOs), in an attempt to address specific advantages and pitfalls. Following the definition of appropriate service sets and tariff structures, and taking into account demand scenarios, a techno-economic model has been developed, in order to compute key economic indicators. The paper presents techno-economic results of specific business cases and deployment alternatives for an average "large" European country and a smaller, Nordic-type country. Fixed and variable costs have been identified and the business case shows how different service sets lead to different costs. Different MVNO business profiles have been investigated. Profitability for all scenarios and business profiles has been calculated, presented and discussed. Major opportunities and threats, as well as critical parameters and uncertainties have been identified through sensitivity analysis.

Keywords: mobile virtual network operators, (MVNOs), UMTS, 3G market, 3G systems, 3G economics, mobile internet economics, techno-economics, mobile operators, virtual network operators

1. Introduction

While the majority of European counties have already assigned third generation mobile licenses and a growing number of countries worldwide are starting to assign their licenses, there is a number of firms working in this sector which have been left without a license in the race towards mobile telecommunications, widely regarded as a business opportunity characterized by an extraordinary potential for profit. On the other hand, license fees have risen to such heights in some countries that they now act as an economic burden for the "winning" companies. For those companies the question is how to exploit third generation (3G) mobile markets with other partners. This situation favours solutions for those building their business without a radio access network. Many firms, either working in the mobile sector worldwidely or not, have expressed their interest to enter this market through the networks operation or the service provision channel. For those, which have been left without a license, a new channel to enter the market and take part in this big game is the Mobile Virtual Network Operator (MVNO) channel.

The ability and the attractiveness of MVNOs to offer competition will be severely limited if Mobile Network Operators (MNOs), who effectively control facilities and infrastructure and share available frequencies with MVNOs, are in a position to charge monopoly prices for their services. Because MNOs are in many cases vertically integrated into the competitive 3G markets, they may also have incentives to restrict access to the facilities required by competitors

through the imposition of prices, which make it unprofitable for MVNOs to enter the market and effectively compete for 3G customers.

As mobile market becomes more competitive and mature, cost-based charging for access to a 3G MNO's network by MVNOs would become less necessary but could also damage incentives to invest in infrastructure, particularly in the early stages of investment in 3G systems. These arguments should be assessed within the context of the overall objective of promoting and strengthening the competitive framework for mobile services, which is the prime rationale for allowing MVNOs to operate in the market in the first place [1]. Market factors such as population density, customer type, timing of entry and penetration levels by new entrants will determine which strategy is used in different areas and at different stages of market development.

The European Union (EU) Information Society Technologies (IST) TONIC project [2] is a precursor in the investigation of the economic side of telecom investment projects and consequently this paper based on TONIC MVNO business case is a first step in the assessment of the market conditions, the architectures and the potential for a profitable business case of a MVNO. The MVNO business case is based on 3G business cases, particularly regarding the technical infrastructure, but the 2,5G underlying infrastructure as an initial step is also taken into account. Following the definition of appropriate service sets, and taking into account demand scenarios established within the project, this work has focused on developing a techno-economic model, based on TONIC tool. Tariff structures have been applied to compute the key economic indicators, Net Present Value (NPV), Internal Rate of Return (IRR) and Payback Period.

2. Current Situation Regarding MVNOs

2.1. MVNO Business Models

According to press releases and company reports [3, 4], by next year there will be more than 100 virtual operators in the European markets, and almost 40 existing and planned virtual operators in USA. In the 2G world, a lot of markets are coming fast to a phase of maturity, above all thanks to the results obtained with the first 2G licenses. In many countries, the reserved 2G frequency band is nearly saturated at least in the urban areas, so not much room is left for new players. Obviously, the existence of a market for mobile services is more than confirmed today and there are always more people who see in UMTS the possibility to take part in a big game.

While entry into fixed telecom markets may be relatively straightforward, the story is different for those seeking to become a cellular operator. Traditionally, there are two main routes used to supply cellular telephony services: network operation or service provision channels. But supplying services through one's own network requires spectrum; a resource that is limited in supply.

One of the possible ways to enter the world of 3G services, which in recent times have drawn considerable attention, is that of the MVNO model, which assumes the conclusion of commercial agreements with an MNO.

An obvious doubt hangs over the degree to which an operator is considered *virtual* in comparison with actual network operators. The points of view can be very different, particularly if the definition of the virtual operator is taken too literally and restrictively. For example, certain analysts affirm that a MVNO must necessarily have a network code and SIM cards of its own

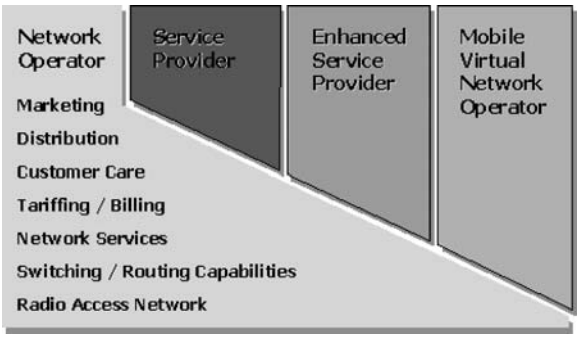


Figure 1. MVNO types and operations vs MNOs and ESPs.

[5]. On the other hand, the UK Regulator (OFCOM) considers as a MVNO, those without a SIM card, which can be considered as Enhanced Service Providers (ESPs) [6]. A MVNO provides cellular services without owning spectrum access rights. From the customers' point of view, a MVNO looks like any MNO, but a MVNO does not imply ownership or operating base station infrastructure. Figure 1 illustrates the MVNO idea comparing to other mobile business schemes.

There are different scenarios for a MVNO approach and consequently different architectures for the MVNO such as:

- A full MVNO, with its own SIM card, network selection code and switching capabilities as well as service center but without spectrum [5].
- Indirect Access MVNO (IA-MVNO) or ESP without SIM card, but with own core network (circuit switched and/or packet) and service facilities, e.g. own IN or IP application servers [6].
- Wireless Internet Service Provider (WISP) without own core network; basically an Internet portal providing wireless IP services.

Technological developments such as Virtual Home Environment (VHE) services [7] open a new market for MVNOs and therefore exploitation opportunities for their MNOs. It is foreseen that MVNOs can act as an important driver for emerging 3G markets since potentially they would offer customers additional choices of services.

In a few countries, the 3G witness the emergence of one or two new operators but, in many cases, the licenses have been assigned to existing 2G operators. The mobile market is, without doubt, considered important by a lot of firms and in view of the surrounding uncertainty, "big" new entrants will be content with taking the opportunity of the virtual model, at least for the time being.

Considering the fact that, for the user, the emphasis is placed on the user interface and much less on the network infrastructure management, the virtual model, combined with a careful preparation of the contents and portals, could bring many advantages for operators addressing family users, for example. The new entrants inclined towards the virtual model, will in most cases be quite well known names, with considerable experience in the marketing, distribution and the management of customer relations. These companies will focus prevailingly on services of great added value and, above all, on m-commerce.

The virtual operator can represent a threat for new entrants on the 3G markets. In an environment of mass market, where social, emotional and cultural criteria often prevail, each

new entrant will attract a lot of attention. It is nonetheless reminded that the network operator, following an agreement such as that of the Virgin model (which according to OFCOM is an ESP [6]) obtains new clients and new earnings without investing actually anything additional in infrastructure and in the management of new services.

This prospect, in the 3G world, could become clearer, bringing 3G network operators immediate revenues so as to recover, as soon as possible, at least a part of the investment made. Furthermore, the virtuality offers prospects of expansion at an international level in markets that, up to now, have been closed to the participation of operators from different areas. For example, the European 2G operators could become virtual operators on the CDMA networks in U.S. and vice versa. However, at least for the time being, the reticence towards the virtual model will in all the likelihood go on creating impediments and brakes to its diffusion. In reality, both in the long and short run, the MVNO model represents a profitable option for all parties involved. The fear of losing customers to a virtual operator could in fact make mobile network operators lose an opportunity for development.

2.2. Regulatory Framework Regarding MVNOs

Regulators' views towards MVNOs vary significantly at present and in many countries regulators are still considering whether and to what extent regulatory intervention is necessary. Within the EU, directives on telecommunications regulation currently do not mandate MVNOs access to a licensed 3G operator's network. In many European countries, discussions and consultation about MVNO regulation have been initiated but no regulation actions have been undertaken so far.

Those in favour of regulation argue that the mobile network operators control the available radio spectrum, which is a scarce resource and an entry barrier for new mobile network operators. Also, mobile network operators are less likely to provide MVNO access unless it is a regulatory requirement. On the other hand, mobile operators have very high profit margins and in some cases significantly over costs. Current regulation, as interpreted by some national regulatory authorities, already gives them the power to enforce an access obligation on existing operators following the paradigm of "local loop unbundling".

OFCOM recently assessed the state of policy development on MVNOs in other European countries and found that, with a few exceptions, it is premature for European regulators. Issues surrounding the MVNO concept have not been discussed in great detail, and hence most regulators are not yet in a position to provide statements of policy, with the exception of Scandinavian regulators which have formally ruled on disputes relevant to the MVNO concept in response to requests they have received from Sense Communications (a Norwegian based service provider), which had attempted to negotiate access to airtime from the existing operators.

The Hong Kong regulator, the Office of the Telecommunications Authority (OFTA), has indicated that 3G networks should be opened up to MVNOs. In an analysis paper based on an industry-wide consultation [8], OFTA proposed a 3G licensing framework based on an "open network" requirement. Under this requirement, 3G service provision would be separated from network operation in order to enhance competition in services and provide customers with more choice and price packages. Successful bidders of 3G licenses have been required to make at least 30 per cent of their network capacity available to unaffiliated MVNOs and content and service providers. Furthermore, any successful bidder that currently operates a 2G network must agree to offer domestic roaming service to all new entrants.

2.3. Interconnection Models

Cost-based prices are desirable, especially for regulatory efficiency, in situations where competition is ineffective or immature as in the 3G markets. However, the determination of costs is anything but uncontroversial and objective [9, 10]. In general, it is widely accepted that termination costs are higher on mobile networks than on fixed-line networks [11]. This is mainly based on the additional costs associated with mobile network elements such as stations that do not exist in fixed-line networks. The costing of fixed-mobile interconnection is similar to those of interconnection in general with the exception of the different investments and the rapid changes in the technology. It is not clear which is the best methodology, or even if the resulting prices are consistent with what happens in the competitive mobile market.

A recent study of Europe-wide mobile costs for the European Competitive Telecommunications Association (ECTA) [12], indicated the controversy and the sensitivity of costing methodologies in the rapid changing mobile market. The Long Run Incremental Costs (LRIC) methodology, used in this analysis, showed that mobile operators charge around 40 to 70% above their LRIC costs and operators argue that LRIC methodology was inappropriate for dynamic and rapidly growing markets [13].

As already described, there are different strategies that could be employed by an MVNO in order to enter the 3G markets. As a consequence, the pricing principles that apply to the provision of services to MVNOs should reflect the nature of an MVNO and the extent to which it is engaging in interconnection or pure resale of network capacity. An operator-like MVNO with extensive networks of its own will only make minimum use of the MNO's infrastructure and should be entitled to interconnection on the same basis as the MNO.

OFCOM takes the view that the logical principle for MVNO charging would be retail-minus which sets an interconnection price by looking at foregone costs and deducting these from the retail price. The costs foregone would be those associated with customer care, billing, provision of value-added services and transportation. OFCOM concludes that simple resale of 3G capacity can encourage entry of efficient service providers of retail 3G services.

3. Methodology and Assumptions

The techno-economic modeling was carried out using the TONIC tool, which has been developed by the IST-TONIC project [2]. This tool is an implementation of the techno-economic modeling methodology developed by a series of EU co-operation projects in this field. The tool has been extensively used in several techno-economic studies [14–16] among major European telecom organizations and academic institutes.

The core of the model's operation is a database, where the cost figures of the various network components are reposited. These figures are constantly updated with data gathered from the biggest European telecommunication companies. The database outputs the cost evolution of the components over time. A dimensioning model is used to calculate the number of network components as well as their cost, for the set of services and the network architectures defined. Finally, the future market penetration of these services and the tariffs associated with them, which have been calculated through market forecasts and benchmarking, are inserted into the tool. All these data are forwarded into the financial model of the tool that calculates revenues, investments, cash flows and other financial results for the network architectures for each year of the study period. An analytical description of the methodology and the tool can be found in [17].

The MVNO business case has exploited useful insights from previous 2G and 3G business cases [15, 16]. Following the definition of appropriate service sets, specific demand scenarios and tariff structures, the key economic indicators have been calculated, namely NPV, IRR and payback period. Risk analysis has also been performed to identify the most critical parameters influencing the profitability of this business case.

A time frame of ten years (2003–2012) has been selected, as well as a discount rate of 10% reflecting a mean value among the major European Telecommunication Operators. The modeling takes into account two kinds of basic deployment areas: a large European country such as Germany or France, and a small European country exemplified by Scandinavian countries.

Two different business profiles of a Full MVNO have been constructed and analysed. In the first profile, the MVNO is a telecom operator or a power company without a mobile license but well known as an operator aiming to complement/expand other services such as fixed broadband services. This will be the *Operator-like MVNO* business profile. This kind of MVNO take advantage of several issues such as initial market share, lower training costs etc.

In the other profile, the MVNO is a high brand-value and large customer base company aiming to expand its business in the mobile area and therefore to attract market share from every MNO. Therefore several advantages (e.g marketing costs) and pitfalls (e.g. leased lines costs and personnel costs) must be taken into account as key element in this case. This is actually a *Service-oriented MVNO* business profile.

Different demand models and service penetration rates have been defined in order to take into account these two different cases for a MVNO. This business classification leads to specific service packages offered by these potential MVNOs and has been attributed to MVNO business profiles.

The country types differ in several points, in addition to their geographical and demographic features. Firstly, the operator in the large country is assumed to have significant license costs – 100€ per inhabitant. As in the case of France, these fees are staggered. Secondly, the subscriber saturation level is estimated to be higher in the small country type – 95% versus 90% in the large country type. Thirdly, consumption differs in that the Scandinavian users are assumed to have 20% greater usage than their counterparts in the larger country. This consumption leads to a proportionately larger ARPU. Lastly, terminal subsidies are 150€ per new subscriber in the large country type and 40€ in the small country type. The two profiles for each type of country are differentiated in terms of greater usage (20% increase of the service-oriented MVNO) and associated consumption and ARPU. In addition, different initial market position is taken for granted between them. For the operator-like MVNO an initial market share of 2% is considered which is based on observations among all third and fourth entrants in the 2G markets.

4. Results and Discussion

In this analysis, which is based on assumptions described previously, the profitability of the two full MVNO profiles both in large and small countries has been presented through specific calculations.

The main economic results for the four basic scenarios are illustrated in Table 1. These results show that companies aiming to operate 3G services can be benefited from acceptable NPV and IRR figures. In more detail, operators investing in MVNO rollout benefit from more or less the same payback period and rather interesting economic figures. It can be also observed

Table 1. Summary of the basic results

Country type	Large		Small	
MVNO type	Operator – like	Service oriented	Operator – like	Service oriented
NPV (M€)	111	332	259	28
IRR	12%	15%	40%	14%
Rest Value (M€)	48	39	5	2
Pay-back period (years)	8.2	7.7	5.0	7.6
Number of customers	4,800,000	3,600,000	640,000	210,000
Total mobile penetration – end	90%	90%	95%	95%
Total UMTS penetration – end	76%	76%	80%	80%
Investments (M€)	144	121	55	49

that the investments are more or less proportional to the population for the large country but almost double for the small country. This difference is based on the necessity to offer coverage and therefore buy equipment that is not fully utilised. The below-described figures are for rather pessimistic market shares (all are considered more or less new entrants) and surely MVNO can expect more optimistic results.

For the case of a small country, the initial position of the MVNO in the 2G world, is mandatory for a successful business in the emerging 3G market. On the other hand, stronger service differentiation is followed by larger investments while the payback period is remaining the same (Figure 2).

The breakdown of total investments in the large country case is given in Figure 3. This chart confirms that the bulk of the OPEX (>70%) is accounted for the interconnection costs. The Running cost items include the following:

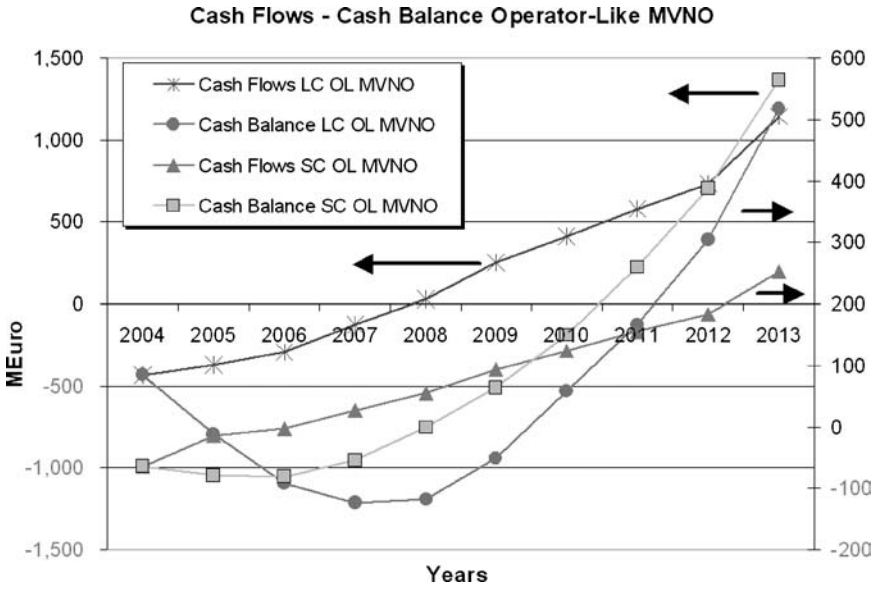


Figure 2. Cash balance and cash flows for a operator-like MVNO operating in two different countries. (Large country → Left axis, Small Country → Right axis) (LC = Large Country, SC = Small Country).

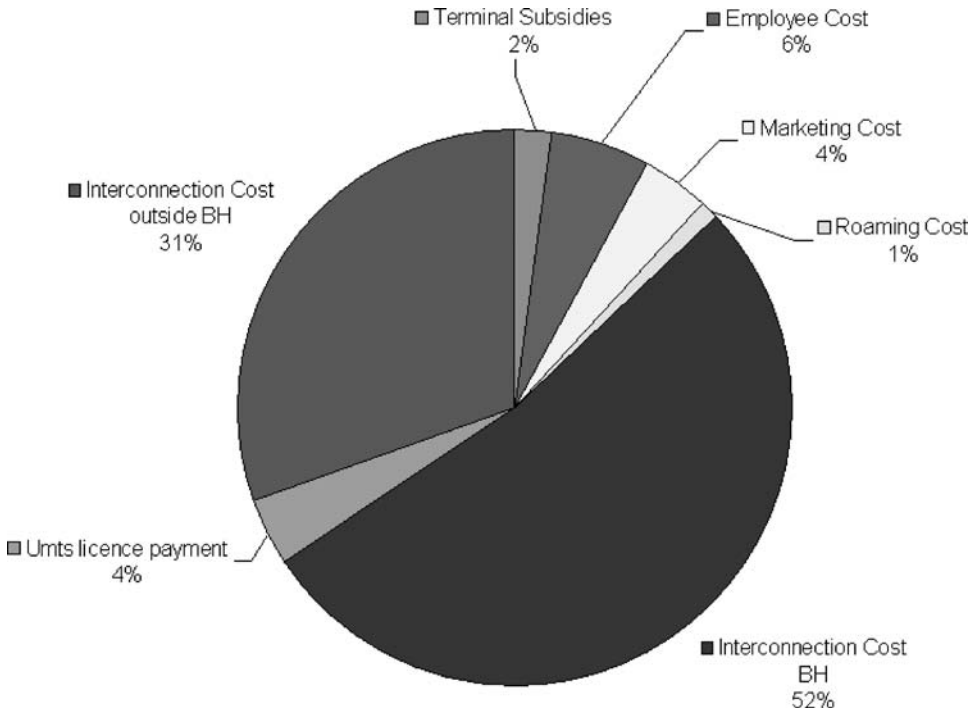


Figure 3. Breakdown of non-discounted Operational Expenditures (OPEX), large country scenario (operator-like).

- *Leased Line Costs* for connecting to MNO network, the number of which is calculated according to the downlink capacity needed.
- *Interconnection Costs*: calculated on a retail-minus basis through the traffic generated by MVNO's customers.
- *Terminal subsidies* which differ between country types; 150€ in the "large" country and 40€ in the small country.
- *Employee and Training Costs* which are related to customer service and incurred essentially during the first years.
- *Marketing Costs* including advertising and sales costs.
- *Maintenance for all equipment* on an annual basis as 5% of the investment cost.

The main difference between running costs in the large and small country types is the marketing costs, which is associated with the population. Terminal subsidies are also lower in the small country (40€ versus 150€). Personnel costs included both technical training costs, and customer service costs, which increase in proportion to customer numbers, then tend to flatten. Marketing costs largely predominate in the starting year. These costs will also most likely continue at a high level during the actual service launch year.

Outlining the findings of this work, acceptable business opportunities can be observed through these calculations in terms of forecasted and actual mobile penetration across Europe. Agreements with Mobile Network Operators (MNOs) for spectrum usage and interconnection give to MVNO enough space for business opportunities and acceptable profit margins.

Sensitivity analysis is used to identify the most critical parameters affecting the performance of the MVNO but also to find the impact of specific uncertainties regarding market inputs and

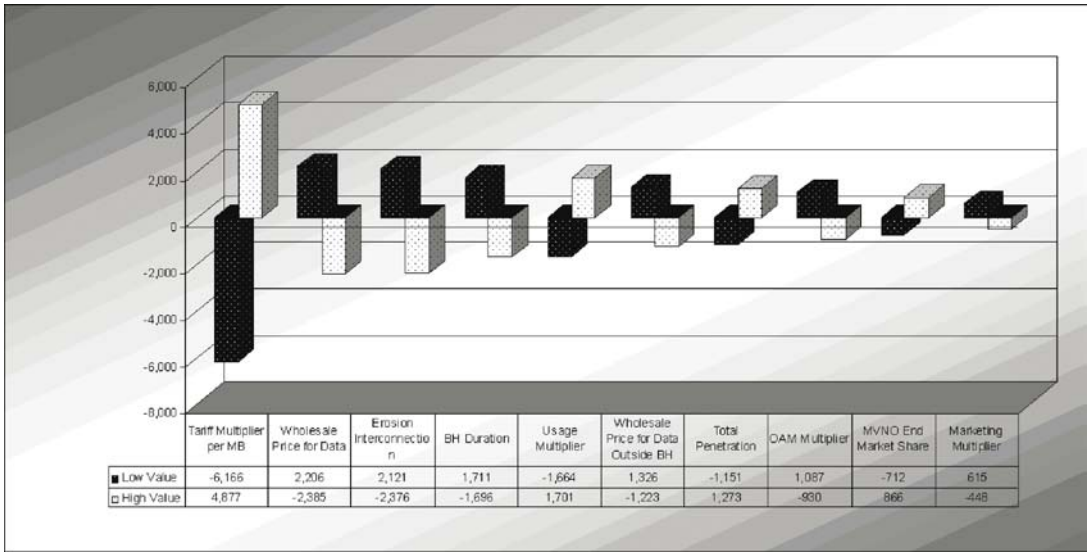


Figure 4. Sensitivity results for an operator-like MVNO in a large country (NPV in Meuros).

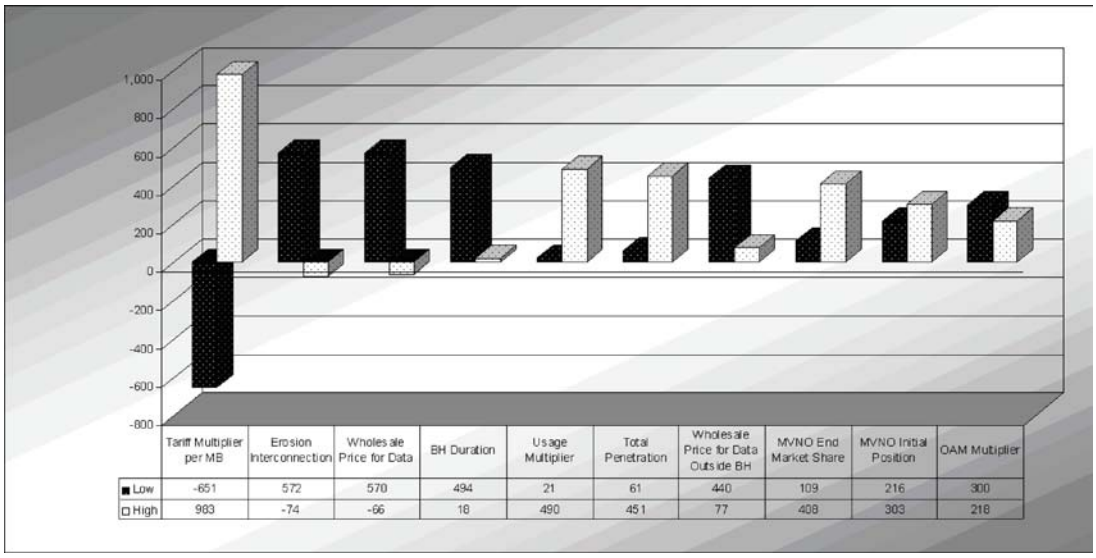
business agreements such as interconnection costs, which could be the turning point for this business case and the MVNO must have hard negotiation with the MNO in order to keep the interconnection costs as low as possible. In the other hand the regulators should protect the new companies and ensure that the interconnection price level will boost the overall competition.

Regarding the other cost structures, usage and tariff levels have greatest impact. All the sensitivity results are illustrated in Figures 4 and 5. The "low value" represents the value obtained when the nominal parameter value is reduced by 50% and the "high value" represents the result when the nominal parameter value is increased by 50%.

The tariff and usage levels are the most critical parameter for the economic criteria NPV and IRR outside the interconnection related costs. The model links revenues with usage levels, which means that a 50% increase in revenue corresponds to a 50% increase in usage. Under these circumstances, it would be expected that network costs would increase accordingly. However, since network costs are essentially dictated by coverage constraints and not by capacity constraints, an increase in usage translates only as greater revenues, while the corresponding increase in costs is minimal, and relates to core network elements.

In the large country scenario, a 50% reduction in tariff/usage levels leads to a negative Net Present Value over the study period (-6166 Meuros, Figure 4), and a 35% reduction leads to a null NPV, i.e., cumulative costs (CAPEX + OPEX) are only just recovered by 2011 (Figure 4). This information provides the operator with an idea of its latitude for changing rates in response, say, to sharp price reductions triggered by a competitor, all other parameters remaining equal.

In the small country scenario, NPV is becoming negative for a 50% reduction with respect to the nominal usage level (which is 20% greater than in the large country). In the large country, if this saturation level is reduced to 50%, the NPV is negative (-114 MEuros), and it is zero for a 20% reduction, which means a level of 72% for the total mobile penetration (Figure 4). This



	Tariff Multiplier per MB	Erosion Interconnection	Wholesale Price for Data	BH Duration	Usage Multiplier	Total Penetration	Wholesale Price for Data Outside BH	MVNO End Market Share	MVNO Initial Position	OAM Multiplier
■ Low	-651	572	570	494	21	61	440	109	216	300
□ High	983	-74	-66	18	490	451	77	408	303	218

Figure 5. Sensitivity results for an operator-like MVNO in a small country (NPV in Meuros).

information is good news for the operator, since overall mobile penetration already exceeds this critical point. In the small country (Figure 5), we cannot find a null NPV for overall mobile penetration of 50%. Here again, this level has been largely exceeded in the Nordic countries, hence there is no cause for concern over this parameter.

In the large country scenario, the 3G MVNO is assumed to have a 2% market share throughout the study period. However, the impacts of variations in both start and end market share is of great interest. The graphs show that the beginning and end market shares indeed affect NPV and IRR. For the small country, only an initial position of more than 1% can lead to a profitable business. But this is probably the case for every company aiming to enter 3G market. On the other hand, a larger end market share can overcome this.

Regarding the other parameters, only Operations and Maintenance costs seem to have a significant impact. However, these costs are quite inelastic since they are related to personnel costs, and the operator does not usually have much leverage to reduce them significantly.

5. Conclusions

The interest of companies, working or not in the mobile sector, entering this market is self-evident and many of them are looking for specific channels to start offering services. The channel of MVNO is either complementary to service provision channel or to operator channel but it is still a way to take part in this big game.

This paper is a first step in the assessment of the market conditions, the architectures and the potential for a profitable business case of a full MVNO aiming to operate in a large or small European country focusing on either wide market or lucrative market segments. In this analysis, subject to assumptions described herein, the profitability of MVNO both in large and small countries has been presented. Furthermore, the two different business profiles associated with different plans for service provisions have been analysed. The profitability for all these cases has been presented and acceptable for shareholders NVP and IRR figures have been calculated.

Acceptable business opportunities can be observed through these calculations in terms of forecasted and actual mobile penetration across Europe. Agreements with Mobile Network Operators (MNOs) for spectrum usage and interconnection give to MVNO enough space for business opportunities and acceptable profit margins.

Both infrastructure costs (which are high due to difficulties to obtain volume discounts) and interconnection costs are too critical for the success of MVNOs. Marketing and entry costs in general can be a burden for a potential MVNO but this can be overcome by means of a high brand firm or an already operating company. Although revenues from the provision of broadband services are missing from current MVNO business plans this could be another opportunity for the MVNO to expand its business in the future. In reality, the MVNO way to 3G games represents a profitable option for all involved parties and a key enabler for technology, network and services providers.

Acknowledgments

This work has been performed in the framework of the IST project IST-2000-25172 TONIC, which is partlialy funded by the European Union. The authors would like to acknowledge the contributions of their colleagues from Nokia Coorporation, Telenor AS Research And Development, France Télécom Research and Development, National and Kapodistrian University of Athens, ATLANTIDE, Swisscom AG, Universidade de Aveiro and T-Systems Nova GmbH.

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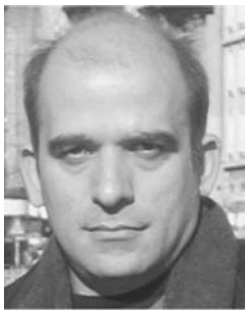

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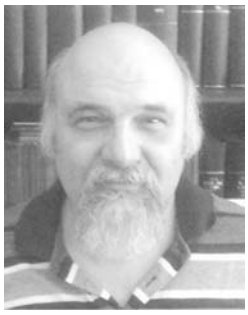

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