Decoupling of revenues and traffic - Is there a revenue gap for mobile broadband?

Bengt G Mölleryd, Jan Markendahl, Jan Werding and Östen Mäkitalo

***Abstract*— Mobile broadband is increasing rapidly both when it comes to traffic and the number of subscriptions. Operators are challenged by the fact that revenues from mobile broadband are de-coupled from the traffic. In this paper we will analyze if this de-coupling results in a "revenue gap" for the combined voice and mobile broadband business and, if this is the case, how significant the gap is. We analyze a country and operator case where the increasing user demand requires network upgrades. The impact of increasing traffic, revenues and costs is analyzed in terms of profit margin for the voice and mobile broadband businesses. The results show that the overall profit for the modeled operator decreases due to declining voice revenues. The contribution from mobile broadband depends heavily on the amount of traffic growth and prices.**

***Index Terms* — Mobile broadband, profit, revenues, network cost and capacity, pricing, flat rate, cost structure, cost allocation**

I. Introduction

Mobile broadband data access over cellular networks has been established as a major service in just a few years. The share of mobile broadband subscribers in relation to population is around 10 per cent in Western Europe, of which Austria and Sweden are in the forefront with a penetration rate around 15%. More than 75% of network traffic is broadband data, and the data volumes are growing rapidly. But the revenue generation is the opposite as the average for operators in Europe is that 77% is voice, 10% SMS and 13% data.

Mobile voice and mobile broadband data service are however built on two quite different business models. Mobile voice pricing is volume based. Revenues depend linearly on the number of voice minutes i.e. the bandwidth requirement. Cost of the required stock of infrastructure depends also linearly on the number of voice minutes. So revenues grow in proportion to bandwidth growth and in line with network operating costs and required infrastructure investments. The infrastructure based business provides a strong cash flow as it is volume driven. Mobile voice business with high capacity utilization should be a quite profitable enterprise based on strong internal financing. The actual outcome of course depends on a lot of factors, such as the level of competition, growth rate on the market and cost structure. But it is quite independent of variations in traffic growth.

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Mobile broadband data service on the other hand is flat fee based. Revenues are decoupled from traffic and therefore also from operating costs and investment requirements. Costs are dependent on traffic per user, but not revenues. Profitability as well as internal financing will suffer from increasing traffic per user when networks are reaching capacity constrains unless the flat fee can be raised, other revenues can be obtained and/or operating costs and investments can be reduced accordingly.

Observable trends and all available forecasts indicate strong growth of traffic per user in the next five year period. This outlook indicates a prospective revenue gap. That is not only a profitability and cash flow issue. It may also severely restrict the industry's revenue and profit growth potential if it is handled mainly by cost-cutting. The revenue gap may even induce destructive downsizing, a proven very difficult situation for any industry. Although the mobile broadband constitute a significant market opportunity for the telecommunications industry it is also a challenge to existing business practices due to its different characteristics compared to the voice business. The revenue gap concept therefore offers a way to analyze the ongoing development and explore the impact of flat prices and de-coupling of traffic to revenues.

The paper is explorative to its nature as we are examining an ongoing development, which force us to build the analysis on a forecasted development and apply a techno-economic paradigm [1]. The paper is organized as follows. Section II discusses the ongoing academic as well as industry research around the issue of revenue gap. We are, in the following section, modeling the development of mobile broadband by elaborating two different scenarios. The results are analyzed in section IV, followed by a conclusion.

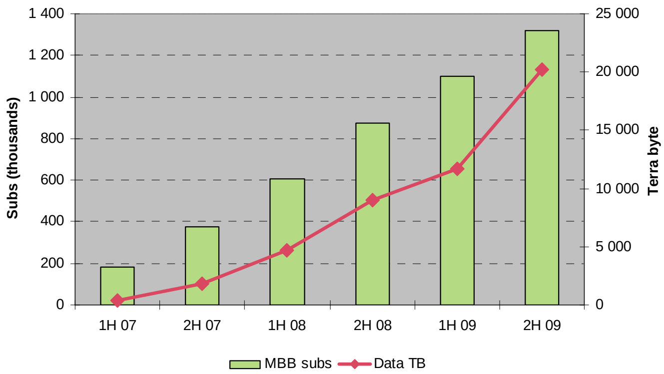

Figure 1: Traffic & number of Mobile broadband subscribers in Sweden Source: The Swedish Post and Telecom Agency

II. Related work

A major area of techno-economic evaluation is the modeling and analysis of networks, demand, costs and revenues. These kinds of results have been reported from several European projects like TERA, TONIC, ECOSYS [1][2][3][4]. A good overview of the background, drivers and results of these projects can be found in [5]. Similar financial analysis of the 3G infrastructure has been presented in [6] and [7]. Recent work on techno-economic evaluation for network deployment of fixed broadband is presented in [8] and [9].

For mobile broadband the network costs and the relation to bandwidth and capacity was examined early in [9]. Revenues were not directly included, but the scalability problem of cellular systems using a fixed amount of spectrum was identified. An implication of the analysis was that volume based pricing would not be viable. Modeling and analysis of network costs of mobile networks were included in PhD thesis on cost effective deployment strategies [10] where the costs were compared to different levels of price. .

Projects like TONIC and ECOSYS use a quantitative approach with modeling of technology rollout, cost structure, service classification combined with demand, pricing and revenue forecasts. The objective of the TONIC project was to demonstrate the business case (revenue – cost performance) for a 3G operator in a country for given user demand, deployment scenarios and economical constraints. The modeling and analysis include a multitude of scenarios and parameters, e.g. many service classes, small/large country, fast/slow rollout, large/small license fees, use of WLAN or not. However, data revenues were assumed to be volume based and contained value-added elements. It was a revenue growth scenario. The issue of revenue gap did not emerge.

Several studies in 2007 - 2008 advocated flat-rate business models for mobile broadband. It was assumed to stimulate operators' revenues from value-added services [11] and [12]. Doubts started to arise in 2009, as summarized by The Economist [13] , based on tendencies that third party service providers gained major shares of added services. The profitability of flat rate mobile broadband per se was insisted upon by others e.g. Blennerud [14].

Revenues have not been discussed previously in relation to costs in a long term perspective. We will contribute by elaborating more on the concept of revenue gap using a similar approach as the Tonic project.

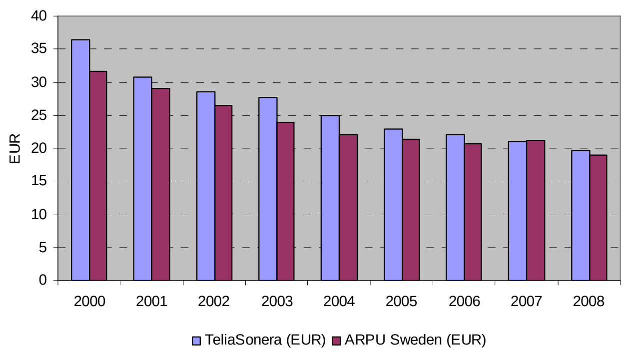

Figure 2: Revenues for Voice Services in Sweden 2000 – 2008

III. Problem Analysis and Research Questions

This paper focus on the impact of flat rate and de-coupling of revenues and network cost. The aim with this paper is to contribute to the ongoing discussion on the concept of revenue gap. We are tentatively defining it as: A revenue gap exists when revenue development cannot sustain long term growth and profitability. The business model is not sustainable. Cost-cutting may retain margins but businesses with revenue gap are shrinking. The question is if this is a probable outlook for mobile network operators.

The outcome of an analysis is certainly dependent upon how the calculation is made, and what costs are included in the calculation and what investments are regarded as sunk cost.

The operator has inevitable to carry historical costs as long as they have not been fully amortized or written off, while previous investments could be disregarded in a stand alone analysis of mobile broadband. This will then be in a more favorable position compared to if it has to also carry part of the historical cost as well as overall operational expenditures.

It seems to be a commonly adopted opinion that a pure cellular mobile connectivity operation, with circuit switched voice, SMS and narrowband data, is not a long term viable business in developed countries. Volume and subscriber growth has stalled and revenues are declining rather than growing in mature markets as the average revenue per user is declining in mature markets such as Sweden, see e.g. Figure 2. Offering VoIP services in competing mobile broadband networks may accelerate this development.

Virtually all mobile operators in developed countries have, however, already taken the step into mobile broadband data. Mobile broadband traffic has expanded briskly in just a couple of years after commercial launches in 2007. Competition in content and value-added services from third party Internet service providers have however stifled expected revenue growth from other sources than pure wireless internet service provision at flat rates.

Direct internet access has been estimated at 96 -99 per cent of all mobile broadband traffic. Prospective regulatory constraints and volatile consumer behavior represent further obstacles to profitability.

A revenue gap exists, as we underscore in our definition, when revenue development cannot sustain long term growth and profitability, which undermines the flat price business model. Cost-cutting may retain margins but businesses with revenue gap are shrinking. A general question is if this is a probable outlook for mobile network operators?

In this paper we will focus our analysis and discussion on the following research questions:

- To what extent will mobile broadband improve the mobile operator business?
- Is there a revenue gap in the combined operation going forward?
- IF that is the case - how significant is that gap?
- What is needed to obtain reasonable long term growth?

IV. Methodology and Assumptions

Our approach to analyze the revenue gap phenomena is to model the development of mobile communications in a country called North. We will analyze the relationship between traffic, revenues and network cost for a generic operator by applying two scenarios: one base case and one high traffic growth case. The exercise aims to explore the development of the voice business together with the mobile broadband development up to 2015. This enables us to examine the impact of two different levels of traffic demand on revenues and network cost, i.e. the profit margin. Before we conduct the analysis we will in this section present the working assumptions and the framework for our analysis.

A. Market and Country data

Country North has 13 million inhabitants, divided into four different geotypes: Rural, Suburban, Urban and SuperUrban, determined by the level of population density in each geotype.

We assume that there are four mobile operators competing on the market assuming that each operator has a 25% market share. We will focus on one them: Operator Altel that launched a mobile network in the year 2000 with very good coverage. Cell sites in the rural geotype have cell ranges in average of 7.0 km, while the ranges in the other three geotypes are 2.0 km in Suburban, 0.7 km in Urban and 0.2 km in SuperUrban. This gives a network with 4 600 sites, see Table 1.

B. Usage, traffic and revenues

The operation is divided into two parts: voice and mobile broadband data. Based on the historical trend in Sweden we assume that mobile voice penetration (excluding mobile broadband) goes from 72% in 2000 to 127% in 2010, a peak level. The total mobile broadband market base is expected to grow by an average of 38% per year during 2009-2015, reaching a 63% penetration by 2015. This leads to that the mobile (including voice and mobile broadband) penetration rate increase from 134% in 2009 to 190% in 2015.

We conduct two scenarios: one base case and one high traffic case, see Table 2. Based on the development of mobile broadband in Sweden from 2005-2009 we estimate that the mobile broadband usage is gradually increasing from 1.5 GB per user and month in 2009 to 7.5 GB in 2015.[1] The usage is estimated to be spread over 8 hours per day, translating into a busy hour rate of 12.5%. In the high growth traffic case operator Altel becomes more successful on the market and capture a 40% market share on the mobile broadband market, while maintaining a 25% market share on the voice business.

	Rural	Suburban	Urban	Super-Urban	Total
Population	4 000 000	4 000 000	4 000 000	1 000 000	13 000 000
Area km^2	200 000	20 000	2 000	50	222 050
Pop per km^2	20	200	2000	20000	
Cell range km	7	2	0,7	0,2	
Covered area km^2	154	12,6	1,5	0,13	
Number of sites	1 299	1 592	1 299	398	4 589
Spectrum MHz	10	20	20	20	

Table 1: Key data for country North with 4 geotypes

[1]Statistics about the Swedish telecommunications market, see http://www.statistik.pts.se/PTS1H2009E/index.html

	2008	2009	2010	2011	2012	2013	2014	2015
Base case	1,2	1,5	2,5	3,5	4,5	5,5	6,5	7,5
High traffic case	1,2	1,5	4,6	7,7	10,8	13,9	17	20,1

Table 2: Data usage per month, GB per MBB subscriber

The traffic demand from the customers are significantly higher in the high growth traffic case compared to the base case, with an average usage increasing from 1.5 GB per user and month in 2009 to 20 GB in 2015.

The number of voice minutes (Minutes of Usage, MoU) for voice users are estimated to be 200 during the entire period. We assume that voice ARPU will continue the negative growth trend as Figure 2 shows and decline at an average rate of 6% per year from 2009 to 2015. We assume that the ARPU for mobile broadband remains unchanged at EUR 20 during the entire forecast period.

C. Network costs

We make the assumption that Capex for network deployment is estimated to be EUR 100K per site, and EUR 40K for radio equipment per site, including three sectors. This is in line with historical figures in the industry. The site investment, like civil engineering and construction work, is depreciated over 20 years while active radio equipment is depreciated during 5 years. The cost of capital is set to 12.9%. We do not assume any form of network sharing, although almost half of the network deployment in Europe is currently done using network sharing, which could reduce capex with 20-30%. This gives the basis for calculating annualized capex. Operational expenditures, i.e. site rent, license cost for equipment, support cost, operations and maintenance, transmission, power and other costs, is set to 20% of accumulated capex, in line with estimates made by Ofcom [15]. Moreover, there is a direct cost associated with customers, like marketing, sales, subsidies, support, administration and other cost, which we estimate to be EUR 80 per year and customer.

We assume that all sites are upgraded to HSDPA in 2006 with capex amounting to EUR 20K per site. It is radio equipment and therefore depreciated over five years and calculated with a cost of capital of 12.9%. This implies that we have taken the extra cost for backhaul into consideration as price erosion on network equipment is steep.

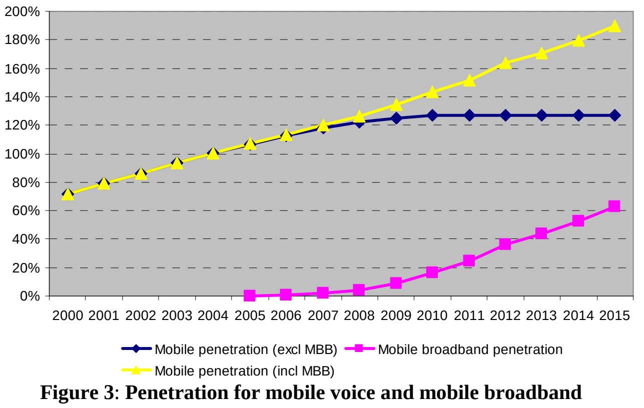

Figure 3: **Penetration for mobile voice and mobile broadband**

D. Spectrum allocation, spectrum efficiency and capacity

We assume that operator Altel is using 10 MHz of spectrum in Rural areas and 20 MHz in the other three geotypes. In rural areas we assume operation in 800s and/or 900 MHz bands which explains the differences between geotypes.

The spectrum efficiency of the radio access technologies is assumed to be low (0.1 bit/Hz) during 2000-07, increasing to 0.7 bit/Hz during the following four years, and subsequently increase from 0.9 bit/Hz in 2011 to 2.0 bit/Hz in 2015 [16]. We assume that the average throughput and average user data rate are considerable lower than the theoretical peak rate (e.g. 170 Mbps) as we expect more active user in each cell and far from optimal receiving conditions for the users.

The improved spectrum efficiency is driven by more advanced modulation techniques in new releases of the standards and our assumptions are in line with what the equipment manufactures are presenting. The spectrum efficiency of 0.7 bit/Hz translates into an average throughput of 14 Mbit/s for 20 MHz, and 2.0 bit/Hz facilitates an average throughput of 40 Mbit/s. However, we are more cautious on spectrum efficiency with the large Rural cells as scheduling with high bitrates can be an issue for the received throughput in very large cells, which also could be the case in Suburban. We therefore assume that spectrum efficiency in Rural will not surpass 1.0 bit/Hz. The site capacity is estimated by multiplying the spectrum efficiency rate with the available spectrum assuming three sector sites. Altogether, this gives a total site capacity of 21 and 30 Mbit/s in rural areas and 42 and 60 Mbit/s in the other geotypes for years 2010 and 2015 respectively. The site capacity is then multiplied with the number of sites. This is then compared with the demand in order to calculate the utilization rate and in case the network needs to be upgraded.

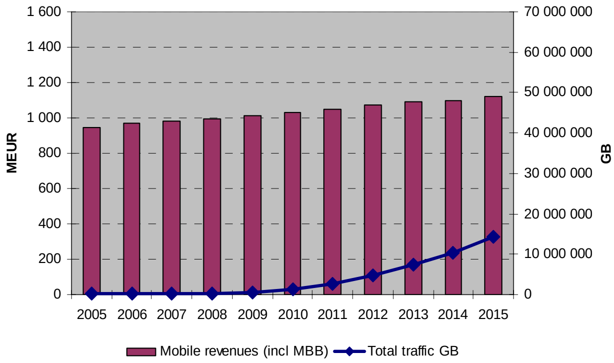

Figure 4: Revenues and traffic growth for the base case

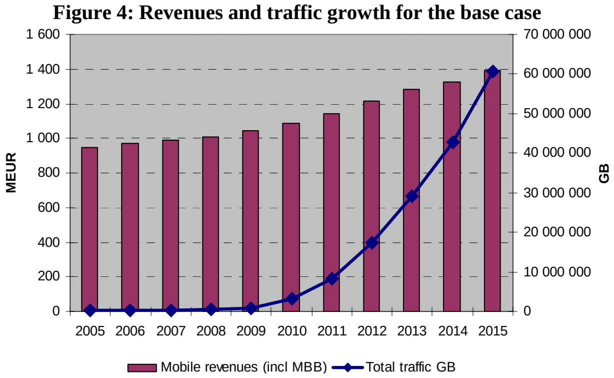

Figure 5: Revenues and traffic growth for the high growth case

V. Analysis and Results

A. Revenues and profit margin for the base case

Based on our assumptions on subscriber growth and ARPU development total revenues is expected to grow an annual compounded rate of 2% during 2005-2015, compared to an average growth rate of 53% for traffic. The voice business is gradually loosing ground to mobile broadband as VoIP is expected to be one application over mobile broadband. On back of the subscriber growth for mobile broadband and stable ARPU it is expected to increase its share of Altels' total revenues from 5% in 2009 to 40% in 2015. Altogether, this gives a revenue and traffic development according to Figure 4.

The traffic growth expectation in our analysis is more cautious than what Cisco present in its Visual Networking Index. Cisco estimate that the global compounded annual growth for mobile data traffic will be 108% compared to our estimated 80% during 2009-2014.[2] The massive traffic growth leads to that the share of mobile broadband traffic in relation towards the total traffic is increasing from 57% in 2009 to 98% in 2015.

In the base case, the voice business carries the corporate opex and network capex, except for direct opex allocated for subscriber acquisition cost and capex derived from the upgrade to HSPA. This leads to a continuously shrinking profit margin for voice, while mobile broadband is generating an improved profit margin, see Figure 6. The total profit margin after annualized capex drops from 40% in 2008 to 32% by 2015. Mobile broadband reach a positive margin in 2010 driven by subscriber intake, but primarily by the fact that the segment is not carrying any corporate Opex, and only covering 10% and 25% of network cost in 2010 and 2015 respectively.

Firstly, the capacity in the modeled network is sufficient to cope with the expected demand up to the latter part of the period. This implies that there is no massive pent up demand for investments in the base case. Secondly, the profit margin is gradually deteriorating which shows that the operator needs to address the cost base in order to grow profitability, or alternatively to increase mobile broadband ARPU. The base case shows that the operator has the means to handle the growing traffic.

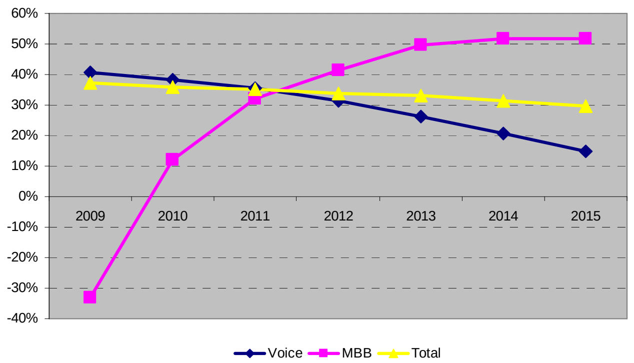

Figure 6: Profit margin after annualized capex for the base case

[2]http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

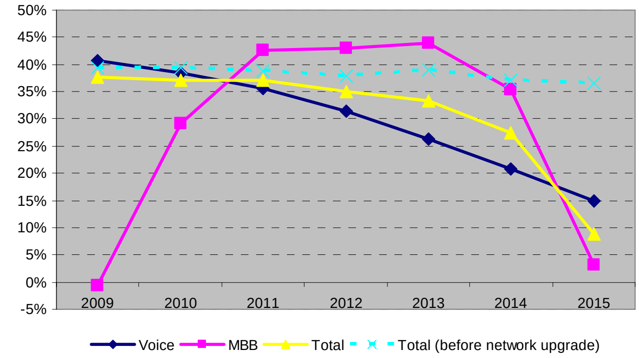

Figure 7: Profit margin after annualized capex for the high traffic case

B. Revenues and profit margin for the high growth case

The outcome of the base case indicates that there is sensitivity on the level of traffic growth. We are therefore stretching the traffic assumption in the high traffic case. The higher usage in combination with higher market share (40 %) has a direct impact on the traffic balance as mobile broadband is generating 99% of the total traffic in 2012, compared to 95% in the base case. Revenues are 6% and 24% higher and the traffic volumes are 1.6 and 3.2 larger compared to the base case in 2010 and 2015 respectively. The deviation is significantly larger for traffic volumes due to higher market share and higher usage, see Figure 5. This adds up to a compounded annual growth rate of 125% for the traffic compared to Cisco's VSI estimate of 108%.

The high traffic growth leads to capacity constraints in the Rural area 2012. The network in Urban becomes congested in 2014, and in the other areas during 2015. We are not assuming any additional spectrum. Consequently, operator Altel has no other option than to increase the number of sites in order to meet the increased demand. It has a direct impact on profit as the profit margin drops to 9% in 2015 compared to 36% before the network upgrade, burden by higher Opex and network cost, Figure 7.

C. Production cost for mobile broadband

Mobile broadband reach a positive margin in 2010 primarily by the fact that the segment is not carrying any corporate Opex, and only covering 10% and 25% of network cost in 2010 and 2025 respectively. The estimated production cost per GB is shown in Figure 8. For the base case, the cost per GB decreases from EUR 7.0 in 2010 to EUR 1.30 in 2015, while the production cost per GB in for the high traffic case decreases from EUR 3.08 in 2010 to EUR 0.96 in 2015

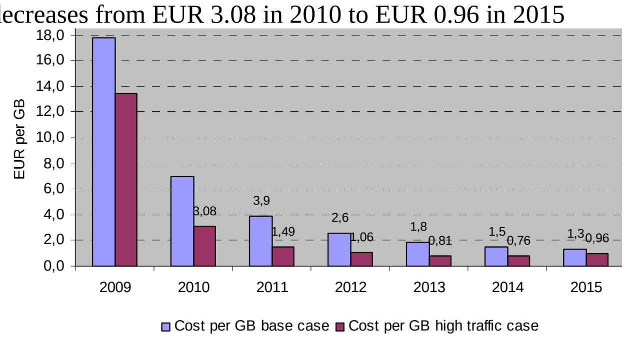

Figure 8: Production costs for the base and high traffic cases

VI. Summary and Conclusions

The outcome of the base case shows that total revenues are generating an annual growth rate of 2% during 2009-2015 driven by an annual growth rate of 44% for mobile broadband, offsetting the declining voice business. Although the pressure on the network is manageable, the network cost is gradually increasing, which reduces profit margin from 39% in 2009 to 32% in 2015. The profit margin in the base case is gradually shrinking but it is not exhibiting an obvious revenue gap. The high traffic case carry up to three times higher traffic volumes compared to the base case. This calls for network upgrades in the latter part of the forecast period, which pushes up network costs. Despite gaining traction on the market with 5-24% higher revenues compared to the base case the profit margin drops from 39% in 2009 to 9% in 2015, figure 7.

The two cases highlight the outcome of different demand levels and show the sensitivity for significantly increased traffic volumes with capacity utilization rates at critical levels. Figures 9 and 10 indicate that the traffic and revenues are decoupled as long as the there is sufficient capacity in the network. When networks are reaching critical utilization rates network upgrades are inevitable, pushing up network costs and thereby reconnecting the link between revenue growth and profitability. The revenue gap exists when revenue development cannot sustain long term growth and profitability, making the applied business model unsustainable. Cost-cutting may retain margins but businesses with revenue gap are shrinking. Operator North in the base case get 78% of the revenues from 5% of the traffic in 2012, while the equivalent numbers for the high traffic case is 69% of the revenues from 1.4% of the traffic.

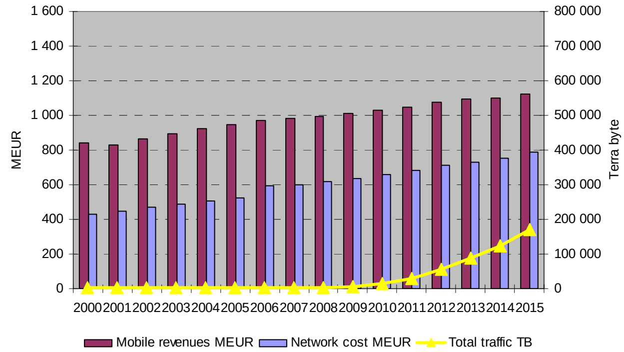

Figure 9: Revenues, network cost and traffic in a base case

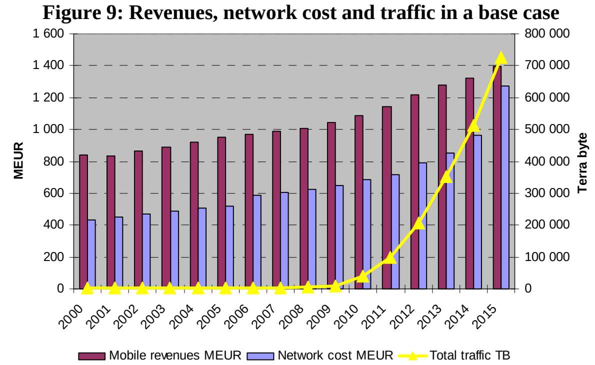

Figure 10: Revenues, network cost and traffic high traffic case

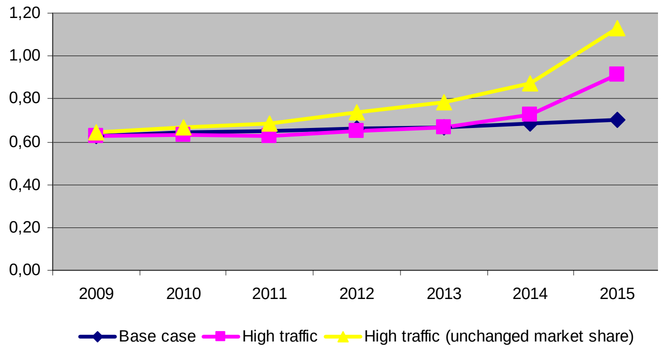

Figure 11: Network cost–to–revenue ratio

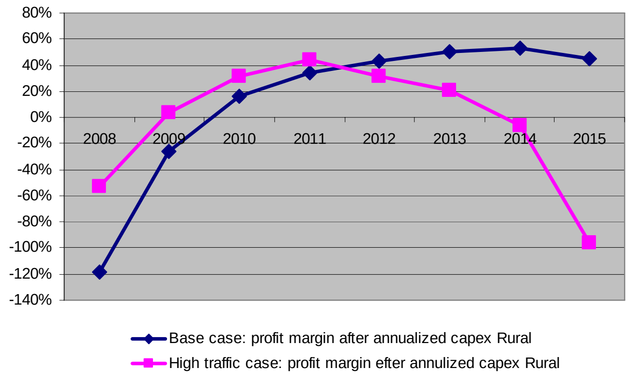

Figure 12: Profit margin Rural

VII. Discussion and Implications

The base case show that operator Altel is able to deliver a modest revenue growth as the decline in the voice business is offset by the mobile broadband business growth. The 5% growth in the high traffic case implies that it is growing above the GDP, but far from a high growth industry. The high traffic case assumes that operator Altel is gaining shares on the market which results in that mobile broadband revenues are 60% higher. This facilitates a network-cost-to-revenue ratio in line with the base case up to 2014, when the network cost is increasing. The ratio would be significantly higher if revenues would be similar as in the base case, see figure 11.

Given that the main focus predominately is on urban areas when the industry is analyzing the profitability and prospect of mobile broadband we regard it as highly relevant to stretch the analysis to Rural areas, as mobile broadband in the long run has the potential to replace the existing PSTN network and xDSL services [14]. The base case shows that the profit margin for mobile broadband is steadily increasing to over 40%. But the impact of higher network cost in the high traffic case shorten the peak margins to one year as the revenue growth is not sufficient to offset the higher network cost.

Mobile broadband operators are facing three options to limit the negative impact of the massive traffic growth as it requires higher network investments. Firstly, by *obtaining additional spectrum* an operator could increase capacity and thereby reduce capex. The value of spectrum is continuously growing with the take off for mobile broadband and the pricing will correspond to its ability to replace network capex. Secondly, to *differentiate and raise prices* operators are able to improve the profitability. We have assumed a stable mobile broadband ARPU of EUR 20 during the entire period. This implies that we have not incorporated any additional revenue streams from value added services (VAS) besides the basic ARPU. The rapid growth for mobile broadband underscores that customers are prepared to pay for ubiquitous access. The path taken by fixed broadband operators and some mobile operators is to launch tiered pricing plans. It is attractive for operators as it facilitates for operators to maintain flat fees, and to differentiate prices according to different usage levels. Thirdly, *offloading strategies* is another measure to ease the pressure on the network by for example femtocell or WiFi. This enables operators to manage traffic flows and utilize existing investments more effectively.

The deteriorating margin for the voice business raises the question of internal cost allocation in order to more accurately reflect the cost generation. In figure 13, we compare the base case production costs for different cost allocation strategies. Rather than voice services taking the majority of opex as well as network costs, we split the cost (consisting of annualized capex and opex besides direct subscriber cost) equally between voice and mobile broadband. The impact is that mobile broadband becomes profitable two years later and the voice business is improving its profitability considerable. The logic behind splitting the cost equally is a compromise as the picture would look significantly worse for mobile broadband if the share of traffic would be used as the cost allocation metric as mobile broadband's share of total traffic is going from 57% in 2009 to 99% in 2015. On the other hand, a cost allocation metric based on the share of revenues would improve the business case for mobile broadband as it goes from generating 5% of revenues in 2009 to 40% in 2015.

The analysis has aimed at give a contribution to the ongoing discussion about the mobile broadband industry and the sustainability of the mobile broadband business. The modeled scenarios show that operators have to take measures in order to maintain profitability margins and that the mobile broadband business calls for more innovative pricing schemes.

The first aim with the paper has been to explore how mobile broadband have the potential to transform the telecommunications industry and, depending upon how operators are managing this transformation, the future development is at stake. The second aim has been to link the ongoing development and research within the industry, and give a contribution to the techno-economic methodology.

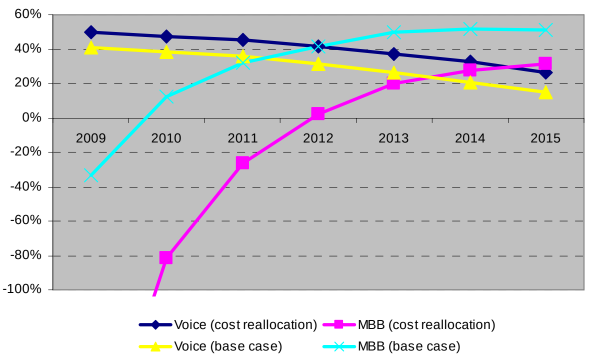

Figure 13: Impact on margin for different cost allocation strategies

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