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Conference Paper

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21st European Regional ITS Conference, Copenhagen 2010

Provided in cooperation with:
International Telecommunications Society (ITS)

21st European Regional ITS Conference
Copenhagen, 13-15 September 2010

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Abstract

Mobile broadband data access over cellular networks has been established as a major new service in just a few years. The mobile broadband penetration has risen from almost zero to between 10 and 15 per cent in Western European leading markets from 2007 to the end of 2009. More than 75% of network traffic was broadband data in 2009, and the data volumes are growing rapidly. But the revenue generation is the reverse as the average for operators in Europe in 2009 was around 77 per cent of service revenues from voice, 10 per cent from SMS and 13 per cent from other data.

Voice and broadband data service are built on two quite different business models. Voice pricing is volume based. Revenue depends linearly on the number of voice minutes. Broadband data service on the other hand is mainly flat fee based even if different levels are being introduced as well as tiers. Revenue is decoupled from traffic and therefore also from operating costs and investment requirements. This is what we define as a revenue gap. Earnings as well as internal financing will suffer from increasing traffic per user unless the flat fee can be raised or changed to volume based, other revenue can be obtained and/or operating costs and investments can be reduced accordingly.

Observable trends and common forecasts indicate strong growth of mobile broadband traffic as well as declining revenue from mobile voice in the next five year period. This outlook suggests a prospective revenue gap with weak top-line growth and expanding operating costs and investment requirements. This is not only a profitability and cash flow issue. It may also severely restrict the industryôs revenue and profit growth potential if it is handled mainly by cost-cutting.

In sections 2 ï 4 we describe related work, our contribution, the specific research questions as well as the methodology and its problems. Section 5 is an overview of mobile operatorsô revenue, its sources and development till today. Section 6 presents trends, developments and published forecasts that may be relevant for the future. Section 7 contains our conclusions.

JEL code: L96
Key words: Mobile broadband, mobile operator revenues, revenue requirements, voice revenues, non-voice revenues.

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1. Introduction

Mobile broadband data access over cellular networks has been established as a major new service in just a few years. The mobile broadband penetration has risen from almost zero to between 10 and 15 per cent in Western European leading markets from 2007 to the end of 2009. More than 75% of network traffic was broadband data in 2009, and the data volumes are growing rapidly. But the revenue generation is the reverse as the average for operators in Europe in 2009 was around 77 per cent of service revenues from voice, 10 per cent from SMS and 13 per cent from other data.

Voice and broadband data service are built on two quite different business models. Voice pricing is volume based. Revenue depends linearly on the number of voice minutes. Broadband data service on the other hand is mainly flat fee based even if different levels are being introduced as well as tiers. Revenue is decoupled from traffic and therefore also from operating costs and investment requirements. This is what we define as a revenue gap. Earnings as well as internal financing will suffer from increasing traffic per user unless the flat fee can be raised or changed to volume based, other revenue can be obtained and/or operating costs and investments can be reduced accordingly.

Observable trends and common forecasts indicate strong growth of mobile broadband traffic as well as declining revenue from mobile voice in the next five year period. This outlook suggests a prospective revenue gap with weak top-line growth and expanding operating costs and investment requirements. This is not only a profitability and cash flow issue. It may also severely restrict the industryôs revenue and profit growth potential if it is handled mainly by cost-cutting.

In sections 2 ï 4 we describe related work, our contribution, the specific research questions as well as the methodology and its problems. Section 5 is an overview of mobile operatorsô revenue, its sources and development till today. Section 6 presents trends, developments and published forecasts that may be relevant for the future. Section 7 contains our conclusions.

2. Related work and contributions

Previous work has studied the economic feasibility of 3G business models including mobile broadband operations assuming volume-based pricing [1] or assuming that a flat-rate business model should stimulate revenue from value-added services [2]. Third-party internet service providers have however gained the greater part of revenue from added services. This developmentôs overall influence on the economic feasibility of the mobile operators business has not been studied in the literature. We have explored potential revenue gap situations by different case studies in previous articles [3] [4].

This paper inquires into the revenue growth potential of the mobile operator and its prospective influences on revenue gap threats more in detail. We will contribute by studying if mobile operatorsô core revenue may be sufficient to avoid revenue gaps or if complementary revenue may be necessary to secure balanced financial development.

The subject is about total service revenue. But revenue is driven by several more or less independent factors. We will investigate a number of such factors in order to evaluate potential for growth; if it is a positive or negative influence, if it is important or not and if it has been quantified in other studies. The conclusions will be combined evaluation of all these factors and their influence on service revenue.

3. Research question

The research question focuses on revenue circumstances, which may contribute to develop revenue gaps for mobile operators in a Western European type of mobile communications market.

- **Will core revenue from voice, messaging and data, according to common forecasts for the next five years, be sufficient to avoid revenue gaps?**
- **How much other complementary revenue will otherwise be necessary to secure persistent financial position and earnings growth?**
- **Which other revenue may fill the gap?**

The discussion will include evaluation of high and low figures among published revenue estimates, their background and their influences on revenue gaps. We will also look at examples of other revenue which may fill the gap, as well as the requirements on the operators to take on such complementary operations successfully.

Several operators target revenue growth rates of only a few percentage points for the next five years period. Such figures include new revenue from consumer and enterprise services. This scenario implies almost no real term growth at all even in a low inflation economy. Data traffic volume is however expected to grow in the order of 80 ï 100 per cent per year in the same period. Network quality is in addition put forward as a key competition issue [5]. The research questions inquires into the viability of such a scenario and the consequences for financial performance.

4. Methodology

We will test the sensitivity of a typical operator in Western Europe for different levels of common forecasts of revenue from different sources for the next five years. The sensitivity tests are based on a span of common estimates as communicated from industry sources today. But the viability of different alternatives will be discussed. Sensitivity tests will be based on a model of a typical mobile operator in a Western European market from 2009 to 2014. The core model illustrates financial position and earnings performance. Simplified complementary models are used for calculations of capacity requirements and costs.

This is an empirical investigation so we are dependent on quantitative input on the number of subscribers, revenue, traffic etc. of Western European operators and their markets. Such number are however not readily available. We base our discussion on a multitude of sources: operatorsôreports and presentations, regulator statistics and analysis from consultancy houses. Sparse information from operators and sometimes inconsistent data from other sources make the empirical basis not quite complete for our purpose. We have made our own evaluation and

believe that trends and main conclusions are fairly robust while details may deviate from actual development.

5. Revenue and market developments

The total global telecom services market revenue was around USDbn1440 in 2009. Fixed-line broadband and the mobile sector have driven the total average growth at around 4 per cent per year in the last 5 years. Global mobile service revenue reached USDbn790 or 55 per cent of the total in 2009, after average growth of 7 per cent 2005 - 2009. Western Europe accounted for 25 per cent or almost USDbn200 of global mobile service revenue 2009 [6].

Mobile operatorsô service revenue growth in developed markets has declined gradually after a legible set-back during the early 2000ôs recession. Growth more or less stagnated in 2008/09 in spite of strong expansion of mobile broadband income. National markets have however evolved differently. North American mobile service revenue growth declined fairly linearly down to 3 per cent growth in 2009 [7]. Western European operators saw a more cyclical development with actual revenue decline of 2 ï 4 per cent in 2008/09 [6]. Nordic markets managed better. Swedish mobile operatorsô service revenue increased after decline in 2002/04 to almost 9 per cent growth in 2009 [11].

The operator bill is however just one part of usersô expenditures for mobile communications. Increasing sales of expensive smart-phones in the last few years have contributed to higher user expenditures growth than reported operator revenue figures indicate. Interview studies show that budget restraint is an increasing reality for a number of users [8].

5.1 Mobile voice revenue decline

Weak total mobile service revenue development has been due to declining voice service income, the worst in North America with 5 ï 7 per cent decrease in 2008/09. Western European mobile operators saw a downturn of 2 ï 5 per cent in the same period, while voice revenue in e.g. Sweden remained flat.

Table 1: European mobile operators' service revenue and annual growth 1997 - 2009

EURbn	
Revenue 1997	42
Avg annual growth 1997 - 2002	21 %
Revenue 2002	108
Avg annual growth 2002 - 2007	7 %
Revenue 2007	153
Avg annual growth 2007 ï 2009	- 1 %

Source: OECD

Most mobile operators talked in the 1990ôs about the voice service as a complement to fixed line voice. Usage was supposed to derive from new opportunities to make calls on the move and would not infringe on fixed usage. The service was priced accordingly very high in relation to fixed [9]. New operator entrants, declining cost of new technology etc. however induced price competition. The service became increasingly a substitution for fixed line voice. Today more than 60 per cent of all mobile calls are made in homes, offices and other places where a fixed line phone is readily available. Roughly half of all voice traffic minutes are mobile minutes. The issue of complement vs. substitution has returned in the discussion of wireless data services (see below, section 5.2.2).

Mobile voice minutes volume growth is slowing down in leading markets. Covariance between volume growth rate and price reduction rate is approaching unity or descending below one, indicating declining price elasticity.

The total Western Europe and North American fixed and mobile voice markets in the 1990s and previous decades indicated a volume growth trend of around 2 per cent per year. The growth trend in the last ten years has however been slightly negative including mobile and fixed voice as well as VoIP [7][10]. Other means of communication have increased; not only different one-to-one messaging services but also one-to many social network communications.

5.2 Non-voice services growth

5.2.1 Messaging

Developments of national messaging markets are even more diverse than voice performance. SMS revenue remains an important contribution to Western European mobile operatorsôrevenue although slowly declining to a share of around 10 to 12 per cent in 2008/09 [6]. The stability hides fairly significant trajectories. Swedish SMS volumes increased 67 per cent per year on average from 2005 to 2009 while prices declined 32 per cent per year [11]. North American messaging traffic is gaining even more. MMS remains insignificant in all markets.

5.2.2 Mobile Internet access

Mobile broadband traffic in the last few years has been almost only for general Internet access. Most operatorsôportal-based and other proprietary services have had minor and declining shares [12]

At least four different markets are emerging in the area of mobile Internet access.

- Wide area cellular Internet access for laptops, often referred to as just Mobile Broadband.
- Wide area cellular smart-phone Internet access including access for different types of handheld terminals driven by advanced operating systems.
- Local public access at hot-spots and Wi-Fi zones, mainly with IEEE 802.11x networks.

- Local private access at homes and enterprise facilities, private Wi-Fi or operator controlled femtocells.

These four areas are substitutes to some extent.

Several studies show that more than two thirds of mobile phone calls are sent or received in homes and working places where a fixed line terminal is readily available. We believe it is reasonable to assume the same for mobile data traffic. Usage is nomadic rather than mobile. The use of a laptop outside homes and working places requires a reasonably comfortable working environment such as a hotel room, a restaurant, a conference facility, a train or other means of transport, environments where public Wi-Fi access often is available.

Different types of terminals are substitutes to some extent. A smart-phone with an advanced operating system can perform some of the laptopôs functions in terms of e-mail, access to web pages etc. Both laptops and smart-phones can access Wi-Fi and femtocells.

Mobile Broadband for laptops and smart-phones are sometimes regarded as a unity in statistics of penetration, traffic and revenue. But there are important reasons to differentiate between the markets mentioned above. Laptop and smart-phone access services are priced differently. Average traffic per subscription is quite different with 150 ï 200 kB for smart-phones per month and more than one GB for laptops on average in Western Europe. The laptop can handle much more intense traffic such as up- and downloads of large documents, overheads and HD video as well as many more advanced applications. The laptop is thus more suitable for substitution of fixed-line Internet access. The smart-phone is in practice much less versatile due to restricted processor capacity, memory and input-output facilities. Video is the major potential capacity hog for smart-phones.

Table 2 show estimates of actual Mobile Broadband and smart-phone subscriptions with a data-plan. Less than half of smart-phones in Western Europe are connected with a data-plan and thus used for more regular Internet access.

Table 2: Wide area cellular mobile Internet access in Western Europe – Revenue and traffic 2009

	Mobile Broadband	Smart-phones	Total
Users (m)	20	30	50
Revenue per year (EURbn)	3.1	3.6	6.7
Traffic per user (GB per month)	1.1	0.2	0.5
Total traffic per year (mGB)	210	50	260
Revenue per GB (EUR)	15	70	25

Source: Arthur D.Little, Exane BNP Paribas, elaborated by KTH

Mobile Broadband

Mobile Broadband penetration in Western Europe has increased from around 1.5 per cent in 2007 to almost 5 per cent in 2009. Penetration exceeded 10 per cent 2009 in Finland, Sweden, Austria and Portugal. The mobile broadband penetration in North America is much lower at 1.5 ï 2 per cent [7].

Average operator revenue per Mobile Broadband user in Western Europe has declined from around EUR20 in 2007 to EUR12 in 2009. Total revenue doubled however to EUR3bn in 2009 as the number of user more than tripled in the same period. Mobile Broadband revenue was around 2 per cent of operator service revenue in 2009 [6].

Previous studies have illustrated how this development has been driven by low pricing, cheap dongles, HSPA networks and increasing laptop penetration. Mobile Broadband service prices in leading markets have been flat rate and low in relation to fixed-line Internet access. Dongle prices have come down to the level of EUR50 and even offered for free. HSPA has provided one Mbps or higher throughput in the downlink, enough for a broadband experience. A majority of PCs are now laptops, which are mobile and personal and contain embedded WiFi access cards.

There are however some marked differences between national markets. Mobile broadband penetration has increased briskly 2007 ï 09 in the leading markets while fixed line broadband penetration increase slowed. Mobile broadband penetration increased much more slowly, up to 4 ï 5 per cent, in other markets (such as Italy, Spain, Belgium, UK) and no faster than the fixed penetration. Traffic per user in leading markets has risen to around 1.7 GB while the lower penetration markets remain at around 0.5 GB. The conclusion has been that especially low pricing in Austria, Sweden, Portugal and Finland has driven substitution of fixed line Internet access while higher than average pricing in Belgium, Netherlands, Switzerland, France, UK and Spain has slowed such substitution. Mobile broadband in these markets has been seen as more complementary than substitutionary [14].

Smart-phones

Smart-phone Internet access service is generally a more important market for mobile operators in developed markets than Mobile Broadband. Average penetration in Western Europe is higher at 7 per cent compared to 5 per cent for Mobile Broadband in 2009. User number growth is higher, 110 per cent compared to 55 per cent. Incremental ARPU is similar (excl. voice and SMS revenue for smart-phones) i.e. total revenue is higher. Traffic per user is much lower. The service price per GB is five times higher at around EUR70. (see Table 2)

The smart-phone Internet access market was in practice initiated in late 2007 with the launch of the iPhone. In 2008 smart-phones accounted for 18 per cent of all mobile handsets

sold in Western Europe and in 2009 24 per cent. Around 18 per cent of the customer base in the end of 2009 used a smart-phone and almost half of them subscribed to a data plan.

Table 3: Smartphone ownership and sales numbers

	2007	2008	2009
Mobile subscriptions	440	470	520
Handsets sold	203	191	200
Smartphone share of handsets sold	12 %	19 %	24 %
Smartphones sold	24	36	48
Smartphone users	18	44	66
Share of users with dataplan	20 %	32 %	45 %
Smartphone users with dataplan	**4**	**14**	**30**

Source: Arthur D.Little, Exane BNP Paribas, elaborated by KTH

Smartphone is the major wireless data market in the US. Penetration is 21 per cent and a data plan is compulsory as operators control handset sales. US data traffic figures are obscure. But they indicate average smart-phone traffic at 0,5 ï 0,6 GB per subscription per month in 2009. Reports from leading operators indicate that 42 million users consume on average 0,15 GB and 23 million (iPhone-)users on average 1,2 GB per month. Mobile broadband traffic is lower than one GB per month per subscription on average.

Local public access

Local public WiFi access is provided by specialized operators, by cellular operators as a complement to cellular Internet access and by possessors of suitable public venues. Subscription prices have decreased to the level of cellular Wireless Broadband or below. Complements to cellular access are generally offered for free. Hotels, restaurants, transportation companies etc. are increasingly offering unlimited WiFi service for free. A recent example is Starbucks with 6700 locations in the US. Starbucks even put in some additional items like free access to Wall Street Journal and other subscription services [15].

Local private access

Thirteen mobile operators have launched commercial femtocell offering as of mid 2010. Pioneers include Vodafone, AT&T and DoKoMo. Typical prices are EUR100 ï 200 one-off or around EUR10 per month.

Choice of business model for the service has caused some confusion among operators. AT&T has focused on improvement of indoor cellular coverage, but offer also an USD20 unlimited plan for voice calling over the femto. Data traffic tiers for cellular Mobile

Broadband as well as smart-phones access apply also for traffic over femtos. Vodafoneôs service in the UK has been rebranded to make its marketing message clearer to users. The service has also been bundled with high-end handsets. Softbank in Japan offer both the femtocell and a fixed-line broadband connection for free on the condition that the femto is available for public access. All offerings so far target household customers. But several operators prepare enterprise services.

AT&T state that their femto strategy is partly based on the fact that almost all (96 percent) of its customers have WiFi at home and that all of the smart-phones in AT&T's portfolio have WiFi. But from a consumer's point of view, there are latency benefits to using WiFi, compared to femtocells, because traffic does not have to pass through as many network elements. AT&T is as well very active in offloading data traffic to its own extensive WiFi network. The strategy seems still a bit confusing.

The 802.11n standard has made WiFi competitive to enterprise Ethernet wired networking. Enterprises should probably prefer networks that they control (like WiFi) compared to operator controlled femtos.

5.2.3 Applications, content and other services

Mobile operators are engaged or may engage, besides retail voice, messaging and Internet access, in a number of different services which are more or less related to the core businesses. These services may be structured in the following categories.

Packaging	The offering of combinations of connectivity services with technologically simple add-ons, mainly to enterprise customers. Wholesale of connectivity services. Services to MVNOs. Femtocells with femto apps.
Hosting	Network and computer hosting and support. Cloud services for general processing, security back-ups etc. Network and computer outsourcing.
Content	Multimedia digital content and applications sales and distribution
Internet services	Advertising based on search engines, network communities, localization based services etc. Mobile banking. M2M based services in smart grids, health care etc.

Source: KTH

Packaging

Packaging is really the operatorsô home turf. But actual involvement varies a lot between individual operators. Combined fixed-line and mobile operators should have an advantage in combining offerings for large enterprise customers. A few, such as Eplus in Germany focus on offering services to MVNOs and more or less abandon the retail market. Femtocell is a new market where many operators enter with different business models. Targets include mobile broadband offload and coverage improvement while the customer is supposed to pay for the equipment and the fixed-line internet access. Softbanks initiative to offer publicly available femtocells for free in Japan is maybe an indication of the future development of this

market. The actual size and development of this market is not quite clear. One of the most advanced operators like Verizon, with USDbn108 of revenue, disclose 56 per cent in wireless, 19 per cent in retail fixed-line and 23 per cent in enterprise and wholesale services. Most middle sized and small operators show much lower figures in packaging services.

Hosting

Hosting is an area where you may expect activities from telecom operators. Most of the participants in this market have experiences from their own internal management of networks and computer processing, most often huge operations. Hosting is however dominated by others. Not only IBM and other service oriented IT companies but also Google, Amazon, Yahoo and other Internet service companies with huge processing operations of their own are large players in hosting. Network management and hosting are instead dominated by equipment suppliers like Ericsson, Nokia-Siemens and AlcatelLucent. One exception is BT, which is quite active in mobile network outsourcing.

Content

This area includes books, audio, picture and video content as well as games and other computer software distributed by operators. The mobile applications market has increased considerably after the launch of Apple App Store in mid 2008. Most operators offer content through their proprietary portals. But the new business model introduced by Apple has initiated many new competitors with direct end-user contacts.

Table 4: Digital content markets in EMEA 2009 (EURbn)

		Total market	Of which Mobile
Digital content		63	0.7
	Music	7	0.5
	TV video	56	0.1
	Books	0	0.0
Games		14	1.7
Advertising		101	0.8
Mobile applications		1	0.6
Total		**178**	**3.8**

Source: Arthur D.Little, Exane BNP Paribas, elaborated by KTH

Internet services

The Internet service providersô original core business concept was in advertising. The industry includes Google, Microsoft, Yahoo, AOL and the like as well social networking operations like Facebook and MySpace. Search engines and other services are offered for free to attract Internet users and serve as advertising platforms. Usersô preferences, as revealed by their behavior with the free services, are used to optimize advertising campaigns. Targets in

search engines, discussion subjects in social networking media etc. unveil suitable areas for targeted advertising to specific individuals, i.e. more efficient marketing.

The basic free search engine service has been extended into new areas with the same core business concept. The stride is to create new platforms and collect more information to sell for efficient marketing. Facebook, Twitter, YouTube and Maps exemplify near-by extensions. E-commerce, mobile advertising and IPTV represent new areas which however may require new business models.

Economics of scale, universal reach and agility in product development have provided the Internet service providers dominant positions in their markets. Mobile operators have not been able to follow. They are instead acting as distribution partners e.g. by supplying pre-installed bookmarks to internet services in their customersô handsets.

6. Revenue prospects

Many future scenarios and accompanying new strategies have been proposed for mobile operators. One example from IBM Institute for Business Value [8] focus on changes in industry structure as response to revenue crisis and Internet service provider expansion. There is however quite limited evidence of such developments today. The infrastructure and terminal provider industry has however been subject to consolidation and disaggregation as well as activities in service provisioning. Apple is the most prominent example of entry into Internet service provisioning.

Two-sided business models is another area of strategy development. The idea is for operators to gain revenue from new types of customers rather than exclusively from end-users. Such business includes revenue from suppliers for distribution of digital products and services as well as for Internet service providersô use of the Internet access to the end-user. Many operators have argued that Google, Apple and others should pay for the use of operatorsô Internet access capacity and/or for QoS guarantees. This should e.g. include higher tariffs for higher data rates and availability. Priority for some applications and circumstances could also be an additional revenue source. Uncertainties about net neutrality regulations make this issue unclear today.

The most recent manifestation of operator cooperation is the Wireless Application Community (WAC). This is an effort from operators to establish a common open environment for developers to create new services and applications. Developers will then be able to reach a global market for e.g. mobile apps by one development instead of numerous versions for different operator app stores. Operator cooperation has so far been restricted to such limited areas as WAC.

Different more material strategy approaches have been exposed by several large mobile operators in the last couple of years. Activities have most probably been driven by dwindling growth of voice revenue.

Deutsche Telekom (DT) has published the most stringent strategy in quantitative terms.[16] The target is to double revenues in the core growth areas of Mobile Internet,

Connected Home, Online consumer services, hosting and M2M services. The major potential is seen in 20 per cent average annual growth of Mobile Internet and Online consumer services revenue. DT expects its addressable market in mobile to grow on average 2.5 per cent per year from 2009 to 2014. Mobile voice and messaging would decline 1.7 per cent and Mobile data is expected to grow 20 per cent per year on average. DT of course expects to do better through concerted efforts in mobile and fixed Internet services, bundling and strong gains in IT-Services hosting.

6.1 Voice revenue scenarios

The mobile operator industry in developed countries is generally expected to face continuing decline of voice revenue.

- The fundamental incentives for price competition remain
- Free WiFi access and enterprise WiFi networking substitute cellular
- New messaging services substitute voice
- VoIP goes mobile as well as new voice services from Internet service providers.
- Regulatory action is set to reduce interconnection rates.
- Cost of VoLTE may be too expensive in the long term.

Technological development has been a major driver of price erosion in the mobile voice communication industry in the last couple of decades. New technology has made lower production costs possible and in particular lower marginal costs for operators. The mobile voice service did however not gain wide popularity until its reach/coverage became comparable to the fixed-line. Universal coverage depends on extensive networks with high fixed costs. Such cost structure rewarded high capacity utilization and high market shares. This in combination with low marginal costs and regulatory efforts induced price competition.

Declining prices drove usage and penetration as well as substitution of fixed-line voice. A reasonable coupling of revenue and costs maintained good profitability despite very strong and largely unexpected continuing growth. The traditional price structure with a monthly subscription fee and plus minute charges mirrored the characteristics of the service from usersô point of view - reach ability and talk time. These characteristics in turn were connected to the production parameters coverage and capacity.

It is reasonable to assume that the fundamental incentive for price competition remains.

Voice volumes as well as prices may be increasingly influenced by new competition from in particular VoIP, WiFi and different messaging services.

Skype has already announced cooperation agreements with several mobile operators such as 3 and Verizon [17]. Telefónica will rollout of VoIP-based phone services across its O2 businesses in Europe starting with a web-based international calling service ï óO2 Global Friendsôï offering low cost international calls via a local number, without the need for new software or hardware [18].

Voice over WiFi technologies such as UMA has been around for some time without general success. A major application has been seamless coordination with cellular access e.g. as a basis for in-door service in areas with poor cellular coverage. A possible breakthrough is expected with the recently standardized 802.11n as it offers functionalities comparable to wire-line Ethernet. 802.11n may replace enterprise Ethernet networking not only for data but also for voice. This should reduce demand for cellular voice access widespread in working places.

A number of new messaging and e-mail services are being introduced by operators and by Internet service providers. All of them should contribute to reduce demand for voice minutes. SMS volumes have grown significantly in several markets. The average growth rate in Sweden was 67 per cent per year from 2005 to 2009, a strong acceleration compared to 35 per cent from 2000 to 2005. Chat and instant messaging have been more popular in other markets. Service packages like Hotmail, Gmail, Yahoomail, Facebookmail etc. represent Internet service provider alternatives to operator services. Social networks as such function as communication platforms for one-to-many. They function as more efficient substitutes for the spread of information through voice calls. Many different collaboration tools like Google docs and functionality in Skype have been introduced in the last few years.

Internet service providers including Skype, Google and Facebook are planning or already making forays into the voice market, with a view to offering richer services than the basic voice that operators are used to providing. Such services include contact management, presence, messaging and video calling, services that todayôs mobile voice is just a small part of.

All of these non-circuit-switched and even non-operator services compete with voice by their efficiency in non-relaxed private and business situations. Pricing in addition should of course be much lower in the IP environment.

Regulatory action is set to reduce mobile termination rates (MTR). MTR accounts for around 15 per cent of Western European mobile operator revenue on average. MTR rates have been reduced by around 15 per cent per year in the last few years, with a negative influence of two percentage points of revenue growth rates. MTR reductions are expected to continue at 20 per cent per year on average in the next five years [14]. The two percentage pointôs negative influence remains over the period. MTR revenue decline is of course mirrored in MTR expense reductions. Mobile operators are however net beneficiaries of the interconnect system and will lose out in the bottom line.

A number of estimates point at a continuing decline of mobile voice revenue. Revenue decline will be matched with cost cuts. As cost-cutting proceed increasing focus will be directed towards the expensive circuit-switched core network. This is in line with the All-IP Network SAE core specification for LTE and the interest to reduce costs by managing fewer and preferably only one core network.

The mobile operator industry has (almost) agreed to use IMS and MMTel (Multimedia Telephony) as a standard for voice over LTE. ñSooner or later, operators must decide whether

to invest in voice, or whether to slowly exit the voice segment as GSM networks approach their end of life. Some operators may conclude that LTE voice revenues do not justify the related costs and uncertainties.ò[19] The cost of investing and maintaining the service platforms may not justify a separate solution for voice.

Northstream takes the issue a step further and questions the mobile operatorsô ability to compete with Internet service providers in the area of rich voice services. They propose that mobile operators should eventually exit the voice business.

Alternative scenarios may emphasize that there is still a big volume of fixed line voice traffic left to substitute. Mobile voice prices are already quite low and in some markets even lower than the fixed line. Further price cuts will induce more substitution and moderate revenue decline. New business models with bundling of different services, offers of free femtocells with special femto apps as well as the mobile operatorsômarket brand may delay the revenue decline to manageable levels.

Revenue sensitivity for price and volume – requirements on other revenue

A reasonable growth rate for an infrastructure operator should at least match a comparable bond rate of return i.e. today around 5 per cent. An individual company can of course endure in the short term perspective by downsizing and increased cost efficiency. But that has both its limits and its difficulties in a declining or low growth environment.

Sensitivity analysis for the total Western European mobile operator community show that New Data - incorporating Mobile Broadband and smart-phone revenue (excl. voice and SMS) - need to expand on average at least 40 per cent per year in the next five years in order to reach five per cent revenue growth if voice revenue remains stable and SMS and other data grow at four per cent average annual rate. Many estimates state expected voice revenue decline at 2 ï 4 per cent and expect decline in SMS. This means a required growth of New Data revenues of 50 - 60 per cent per year on average to attain five per cent total service revenue growth.

Table 5: Total service revenue average growth rates 2009 - 14 with alternative Voice and New Data growth (Other data and SMS assumed at 4 per cent decline)

	New data				
Voice	**20%**	**40%**	**60%**	**80%**	**100%**
2,0%	2,3%	5,1%	9,5%	15,4%	22,8%
-2,0%	-0,6%	2,6%	7,3%	13,7%	21,4%
-6,0%	-3,3%	0,2%	5,4%	12,2%	20,3%
-10,0%	-5,8%	-2,0%	3,6%	10,8%	19,2%

Source: KTH

6.2 Wireless data access scenarios

The most frequently cited wireless data traffic forecast is Ciscoôs Visual Networking Index (VNI)[20]. It is a consensus type of scenario based on several independent and quite diverse

estimates from analyst houses. Underlying assumptions in terms of prices and elasticity are not disclosed. The range of published estimates from analyst houses for e.g. Western European traffic is from 2 to 10 GB per subscription per month in 2014. All estimates anticipate in addition that average revenue per subscription will decline significantly.

A typical ARPU forecast would be an accumulated decline of 40 - 50 per cent in the next five years[14]. A consensus forecast based on VNI and 10 ï 15 per cent annual ARPU decline would look like this:

Table 6: Wide area cellular mobile Internet access in Western Europe – Revenue and traffic 2009 and 2014e

	2009	2014e	CAGR
Users (m)	50	240	37 %
ARPU (EUR per month)	15	8	- 11 %
Revenue per year (EURbn)	7	22	26 %
Traffic per user (GB per month)	0.5	3.5	50 %
Total traffic per year (mGB)	260	9800	106 %
Revenue per GB (EUR)	25	2	- 39 %

Source: Cisco VNI, elaborated by KTH

Table 7: Wide area cellular Smart-phone Internet access in Western Europe – Revenue and traffic 2009 and 2014e

	2009	2014e	CAGR
Users (m)	30	150	39 %
ARPU (EUR per month)	14	8	- 10 %
Revenue per year (EURbn)	4	14	31 %
Traffic per user (GB per month)	0.2	1.1	40 %
Total traffic per year (mGB)	50	1800	104 %
Revenue per GB (EUR)	70	8	- 36 %

Source: Cisco VNI, elaborated by KTH

Table 8: Wide area cellular Mobile Broadband Internet access in Western Europe – Revenue and traffic 2009 and 2014e

	2009	2014e	CAGR
Users (m)	20	90	34 %
ARPU (EUR per month)	16	8	- 12 %
Revenue per year (EURbn)	3	8	20 %
Traffic per user (GB per month)	1.1	9	51 %
Total traffic per year (mGB)	210	8000	106 %
Revenue per GB (EUR)	15	1	- 42 %

Source: Cisco VNI, elaborated by KTH

Table 6 shows data for the combined Smart-phone and the lap-top oriented Mobile Broadband markets. The breakdown into separate figures for Smart-phones and Mobile Broadband illustrate the differences in character between these two markets.

This type of scenario is also fairly in line with published market expectations from Deutsche Telekom [16] and indications from other large mobile operators. But some question marks remain.

The scenario obviously assumes a strong position for the fixed line Internet access in the five year period. Mobile Broadband reaches only 21 per cent population penetration in 2014. The same trend is included in VNI estimates where 94 per cent of Internet access traffic in 2014 is expected to be fixed line access. Continuing investments in new xDSL and fiber technology retain the superior capacity and speed in the networks. There may however be more room for pre-paid occasional use of Mobile Broadband in addition to the scenario figures.

New types of terminals may gain popularity and change the market conditions. The smart-phone is not very apt for general Internet access and for comfortable video usage. It is more suitable for pre-installed applications (compare the emerging app store market) and short video sessions. Public dissonance between AT&T and Apple reveal that YouTube video is an important capacity hog on iPhones. The tablet format may contribute new usage with a larger screen with more versatility and better video experience.

The scenario is supported by trends in WiFi and Femtocell use. All laptops and Smart-phones have embedded WiFi modules. WiFi is not subject to operator tiers on data volume. Subscribers are generally price conscious and would certainly prefer free alternatives to cellular if possible [21].

A further breakdown of Mobile Broadband would reveal differences between complementary and substitutionary markets. Traffic per user per month is expected at 18 GB in low pricing markets and 3 GB in high pricing markets where subscriptions are offered more as a complement to fixed line Internet access.

Almost all operators have declared that they have or will impose tiers/monthly usage limits in their tariff structures. AT&Tôs new smart-phone low volume tariff states USD15 for 0.2GB per month and USD15 for each additional bucket of 0.2GB, i.e. at least USD75 (EUR58) per GB. The high volume tariff is USD25 for 2GB and USD10 for each additional bucket of 1GB. If this type pricing gains followers, it will change the business model from flat rate in the direction towards volume based prices.

The most important uncertainty concerns the general price/ARPU development and price elasticities for smart-phones and new terminal types. If price erosion stays at 5 per cent and volumes are the same, then total Internet access revenues growth increases from 26 per cent to 32 per cent.

It is in addition difficult to conduct a discussion based on overall data on Western Europe with such diverse set of markets. The circumstances are different in a market where a basic ADSL connection would cost EUR40 per month (Spain) compared to one where the price is EUR20 per month (Sweden).

6.3 Other non-voice revenue scenarios

Messaging

SMS and legacy data traffic and revenues are generally not expected to increase significantly going forward. New types of messaging services are mostly launched by Internet service providers. They have established a position in fixed line rich messaging including instant messaging, chat etc. Social networking sites offer the possibilities of one-to-many-messages. This existing set of fixed line services is now extended and migrating to the mobile sphere through smart-phones. Traditional mobile value added services in content/multimedia downloads are expected to decline steeply in favour of web-based services.

Packaging and hosting

Only the major mobile operators are significantly engaged in this type of services, such as Deutsche Telekomôs T-System and Verizonôs Global Enterprise and Wholesale. The really big players are able to offer international companies substantial service in communication and IT. Smaller operators have gradually withdrawn from this market. They focus more on standardized packets to SMEs. Even the big suppliers see competition from system integrators like IBM and Accenture. Internet service providers in their role as mega computer processors and trunk network operators compete in areas like cloud networking and processing.

Packaging is important areas for the large integrated fixed-line and mobile operators. For Deutsche Telekom it is around 30 per cent of their addressable market. But for smaller operators it is expected to remain a marginal business. In reports it is regularly accounted for under the fixed-line heading. Generally expected growth going forward is not very high, around 4 per cent per year.

Content and Internet services

Mobile apps, M2M, advertising and LBS are examples of service areas which are expected to grow significantly in the next five years.

Mobile apps

Mobile apps have attracted interest from operators along with the soaring volume of offered applications and billions of used downloads. Although paid apps have increased substantially in volume with the emergence of app stores, free apps have really boomed, creating a potentially serious problem for network operators hoping to create new revenue by selling apps to mobile users, according to a recent report from Pyramid Research. "This is a key trend, and it will drive new revenue streams, namely from advertising," [22]

The development of the typical app cost $35,000 and the median paid app earns $682 dollars per year after Apple has taken its cut. The reason that the average return on an iPhone app is so small is because there are so many apps available due to the extremely low barrier of entry. Advertising through free apps is an increasing phenomenon. It has been estimated that the total download volume (free and paid) will increase by a factor of seven between 2009

and 2014 from 5.7 billion to 41.1 billion. "Although paid apps have increased substantially in volume with the emergence of app stores, free apps have really boomed, revolutionizing the mobile advertising market," [22].

Mobile apps may not be the obvious source of revenue that operators talk about in press releases nowadays. If app downloads reach the expected 41 billion in 2014 with 80 per cent free, revenue will be some 8 EURbn and operator share maybe 3 billion or 0.5 per cent of expected mobile operator revenue in the OECD area or one EURbn in Western Europe. Free apps will gain nothing if rewarded with share of sales revenue. They may instead possibly play a role as advertising revenue for operators.

M2M

Great expectations are tied to M2M applications in smart metering, health-care, mobile payments, automotive surveillance etc. Many operators are engaged in service development projects. These are however areas where the mobile connectivity value-added may be very small. Studies of business models for such services show a number of roles and functions that have to be performed in order to get a functioning eco-system [23]. None of these roles, except connectivity, constitute competence possessed by mobile operators. Besides, fixed line may have an advantage as these systems are to a large extent indoors. Mobile operators meet competition even in the mobile area from specialist wireless network operators as Arqiva supported by BT [24]. The industry is looking for one billion installed modules globally by 2014 and revenue of 1 ï 4 EUR per connection per month. If so, this will be a minor contribution to revenue in the five year perspective.

Advertising

The present business models for Internet advertising and mobile Internet advertising in particular, center on optimized marketing and targeted ads. Operators possess information about users that may be employed for targeting. But Google and the other Internet service providers have significant leads and more sources of information as well as experience as ads agencies. The digital advertising market is still dominated by non-targeted ads, the hopping and blinking things that follow many homepages. They are extensions of traditional ad agency businesses and hardly accessible by telecom operators. Googleôs market may be around USDbn 50 ï 60, of which Google had UDSbn23 in 2009, or 1,5 per cent of global telecom operator revenues.

Location Based Services

Mobile operators may have an advantage in location based services (LBS) as they possess real-time information about subscribersô location. Even if operators cannot provide the services themselves, they may be able to charge for the critical information. LBS service revenue has been forecasted at more than EUR400m in 2015. Local search, navigation services and social networking are believed to become the top applications in terms of number of users. Google and others have however developed other technologies ï based on GPS, WiFi triangulation etc. - to access location information. New services emerge based on

voluntary location check-in from users, thus preserving personal integrity [26]. There are still no widely accepted pricing models for operator location information. The operators are as usual accused of charging too much [25]. Depending on how large a share of service revenue is allotted to supply of location data, European operators may receive up to 0.12 per cent of total revenue from LBS.

7. Conclusions

Expectations of continuing mobile voice and SMS messaging revenue decline in Western Europe are supported by ongoing competitive circumstances and regulatory actions in roaming and interconnect. The downturn in 2008/09 is influenced by the recession and not indicative. But free WiFi, new messaging, mobile VoIP and Internet voice services are new factors with highly uncertain future impact. Published estimates play down these factors in the five year perspective. But risk is on the downside.

Table 5 show that the requirements on new data are considerable in order to fill the gap and retain service revenue and possibly revenue growth. Voice revenue is commonly expected to decline 3 ï 4 per cent per year between 2009 and 2014. This means that The Western European mobile operator industry will lose 16 ï 21 EURbn of revenue per year in 2014 compared to 2009. SMS and other data revenue is commonly expected to decline 2 ï 4 per cent per year producing a revenue loss of 3 ï 6 EURbn. The gap seems to be in the order of 20 ï 25 EURbn in 2014.

New data revenues are income from new data services and from the provision of mobile Internet access.

The new data services that have been given the most attention in operatorsô statements and industry discussions include smart metering and healthcare applications in M2M, mobile advertising, localization based services and mobile apps. We have also reviewed estimates of other data services. The review of potential revenue sources in section 6 shows that we have not found any such sources that may have a significant influence of operatorsô revenue growth 2009 ï 2014.

Packaging and hosting is not a major growth business for the majority of mobile operators. Large operators expect 3 ï 4 per cent growth in operations including both fixed line and mobile offerings.

M2M is commonly expected to contribute around one EURbn increase of new annual revenuie from 2009 to 2014 in Western Europe. That would include health care, car telematics, smart metering, fleet management, payment terminals and security applications.

The targeted advertising market today concerns almost only fixed-line Internet. The mobile global opportunity has been estimated at USDbn 5-8, or EURbn 1 ï 1.5 for Western Europe in 2014.

Localization Based Services may contribute EURbn 0,5 at the most and mobile apps around EURbn 1.

Expected revenue from new data services add up to an annual amount of around EUNbn5 for the Western European operators. Remains EURbn 18 ï 25 to be covered by new revenue from provision of mobile Internet access in 2014 in order to reach stable revenues compared to 2009.

We conclude that sources of revenue growth will have to be found in connectivity services; in less price erosion for Mobile Internet access and possibly mobile voice than presently commonly expected.

There is of course a possibility that common estimates of mobile operator revenue from new services in applications, content and other services may be underestimated. But that would be a break in a stable trend of operator behavior. ñService providers and their system suppliers have demonstrated repeatedly that they are terrible at service innovationé .. The only safe bet is that service providers will continue repeating many of their old mistakes, in particular in their preoccupation with control and with content as opposed to connectivity.ò[29].

Connectivity services however may be much more promising.

A common assumption in inquiry of mobile connectivity services is that the consumer of telecommunication data services of tomorrow will expect to receive the same services in a wireless fashion as he or she receives from a fixed network. These services require high bandwidths. Future users are not expected to be willing to sacrifice functionality for the added value of mobility [28].

The major service we discuss here is wireless connection to the general Internet. The characteristic of this service from the usersô point of view is, in line with the assumption above, access to all the services, applications, content etc. that resides on the Internet irrespective of the bit-rate requirement of each Internet service. These services develop rapidly in terms of bit-rate requirements driven by actual and expected capacities of the competitive fixed-line networks. The human capacity is no longer a restriction for bit consumption. The user can watch HD video as easily as conducting a voice call. Bit consumption per user may run away explosively while revenue per user remains unchanged, if based on unlimited flat rate.

As the mobile data service is access to the Internet, any increase of the bit-rate required for Internet based services will then not necessarily be regarded by users as an increase in data service volume or quality. The readiness to pay for such an increase may be limited.

In the long term perspective there should however be an increasing trend of budget scope for telecommunications expenses driven by general economic growth as well as structural changes of expenditure levels.

The introduction of cellular mobile voice was one such structural issue. Cellular voice revenue increased on average 20 per cent per year in the 1990s and total telecom service

revenue doubled. The major growth push in the 2000s was introduction of fixed-line Internet. Revenue from narrowband and broadband Internet access increased on average 15 per cent per year. That was however not enough to compensate for accelerating decline of fixed-line voice income and moderation of cellular voice revenue growth.[27]

Cellular mobile data is expected to be the next structural change and revenue has started to accelerate in 2008-09. Total mobile operator revenue were however flat or declined, most probably due to the sharp recession in the last two years.

Spending is mirrored in figures of total telecommunications revenue as a percentage of GDP. OECD statistics show that this statistic increased during the 1990s from 2.0 per cent to the peak of 3.3 per cent in 2001. From 2001 till 2007 there was a decline to 3.0 per cent which most probably continued in the recession 2008 ï 2009 [21].

The development in the 2000s was more or less a structural set-back due to lack of new attractive services, while prices of existing services eroded. A core question now is if mobile Internet access is such a new attractive service than may generate a structural increase of spending for mobile operators in the next five years.

The only structural change that really transformed the telecom service markets was introduction of mobility. Fixed line Internet access has been a growth driver in the last ten years, but not to the extent that mobile voice has been. Estimates of future mobile voice price decline along past trends are risky especially as price levels match or approach fixed line voice pricing.

Growth in mobile Internet access appears to be significantly ahead of what technology can support. The race for market shares and overestimation of future contributions from new services may be responsible. This will not be sustainable. In the longer term operators will have strong incentives to closely manage their network traffic, and are likely to try to ration capacity and discriminate among applications and among service providers. Then the market may very well prove to support higher than expected price levels for mobility. Risk is on the upside. Indications are e.g. AT&Tôs pricing of smart-phone traffic and Teliaôs recent statement about ñvalue-based pricingò [30].

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