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**Structural conditions for business model design in
new information and communication services
- A case study of multi-play and MVoIP
in Denmark and Norway**

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“Designing business models for customer value in heterogeneous networks”

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Structural conditions for business model design in new information and communication services – A case study of multi-play and MVoIP in Denmark and Norway

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Summary

The report analyses the structural conditions for the design of business models regarding new information and communication services. The services examined are mobile VoIP (MVoIP) and multi-play – services that already are on the market, however in their infancy, and which represent different kinds of services in terms of structural conditions market-wise and in regulatory terms. As the two service categories are relatively new on the market, dominating business model designs have not yet settled and the strategic choices of companies are very open. Being on the market, the discussion on the business model design, however, transcends the purely speculative stage.

The structural conditions studied are the market conditions including the regulatory conditions. In addition, the different technological solutions are examined, as MVoIP as well as multi-play include different technology solutions for the delivery of services to users. This means that the analysis includes technological as well as market-based and regulatory elements.

The aim of the analysis of the structural conditions is two-fold: On the one hand, to deepen the understanding of the structural condition and, on the other hand, to discuss the conditions for different business model design options. The report examines the regulatory policies and market characteristics in MVoIP and multi-play as a basis for a discussion on how these policies and characteristics affect the business model decisions of service providers in the two areas.

Using empirical material from Norway and Denmark, the report presents a comparative analysis of the structural conditions and the business model choices made by actors in the market.

The basic theoretical framework for the analysis is the Structure-Conduct-Performance (SCP) framework. The strength of this framework is that it stretches all the way from the structural conditions, through the conduct (business models and strategies) of companies seen in connection with these structural conditions, to the actual performance of companies in the market. The focus of the present report is on the structural conditions with a view to the framework that these conditions constitute for the business model design of companies.

The empirical basis of the report consists primarily of interviews with representatives from IT and telecom industry organizations, policy makers and regulators in the telecom area in Norway and Denmark.

1. Introduction

During the 1990s, the Nordic countries emerged with an image of being one of the most advanced and sophisticated regions in terms of ICT, in particular telecommunication services and the proliferation of ICT in society. In this period, the rapid diffusion of the mobile communication system GSM made all of these countries seem ahead of the rest of the world. This image was bolstered by the industrial and technological success of Ericsson and Nokia – their Nordic identity contributed to the image of excellence of the Nordic countries. According to the World Economic Forum's *Global Information Technology Report 2007-2008*¹, all the five Nordic countries are among the “top ten” countries of 127 economies/nations surveyed. Having a rank of number 10, Norway was at the bottom of this “top ten”-list, but Denmark was number 1, closely followed by Sweden as number 2 – and Finland as number 6 and Iceland as number 8. Although one may question the relevance of some of the indicators and assessments used in this report, it seems fair to suggest that the Nordic countries as a region represent a kind of world leadership in ICT. Needless to say, this leadership also reflects the economic wealth and welfare system of these countries, i.e. what is often referred to as the “Nordic model”, hence being on the top of World Economic Forum's list may also be interpreted as an indicator of affluence, i.e. a factor that causes ICT sophistication and level of knowledge and innovation in ICT.

Still, the situation in the Nordic countries is interesting because in many ways this may be viewed as a front runner whose experience may be valuable to other parts of the world. This encompasses a broad range of issues and dynamics, however, we think that a key for understanding this and, perhaps, developmental trends that will become important in the future, will be provided by analyses of structural conditions for business model design in new ICT services. For this purpose, this report examines mobile VoIP (MVoIP) and multi-play – services that already are on the market, however, in their infancy, and which represent different kinds of services in terms of structural conditions market-wise and in regulatory terms. As the two service categories are relatively new on the market, dominating business model designs have not yet settled and the strategic choices of companies are very open. Being on the market, the discussion on the business model design, however, transcends the

¹ Cf.: <http://www.weforum.org/en/initiatives/gcp/Global%20Information%20Technology%20Report/index.htm>

purely speculative stage. The structural conditions studied are the market conditions including the regulatory conditions. In addition, the different technological solutions are examined.

The aim of the analysis of the structural conditions is two-fold: On the one hand, to deepen the understanding of the structural condition and, on the other hand, to discuss the factors that may influence various business model design options. The paper examines the regulatory policies and market characteristics in MVoIP and multi-play, and it discusses how these policies and characteristics may affect the business model decisions of service providers in the two areas. Furthermore, it focuses on the relationships between regulation, competition and innovation in the two service areas.

Using empirical material mainly from Norway and Denmark, but also from other Nordic countries, the paper will present a comparative analysis of the structural conditions and the business model choices made by actors in the market. The paper will also make comparisons with other country cases having different market conditions. The empirical material consists of two different sources:

- in-depth interviews of twelve high level policy makers and analysts in Norway and Denmark,
- analyses of relevant policy documents, business analyses and statistics, in addition also “open sources” on the internet that are relevant for the topics of this paper.

Prior to this data collection, the authors participated in a pre-study which gave a general framework and focus for this study, cf. Pedersen et al. (2007)

The basic theoretical framework for the analysis is the Structure-Conduct-Performance (SCP) framework (Methlie & Gressgård, 2006). The strength of this framework is that it stretches all the way from the structural conditions, through the conduct (business models and strategies) of companies seen in connection with these structural conditions, to the actual performance of companies in the market. The focus of the present paper is on the structural conditions with a view to the framework that these conditions constitute for the business model design of companies.

2. Economies of scope as a structural factor

A salient property of ICT and its evolution towards systems and networks that are completely based on IP technology is a dramatic increase in efficiency and, hence, products and services that have decreasing, nearly zero, marginal costs. Economies of scale are increasingly embedded in technological solutions and standards that have low appropriability, e.g. standardized technology platforms. These tendencies are reinforced by regulations designed to stimulate competitive markets. Increasingly, value creation has become a game of creating economies of scope. This entails various strategies for reducing customer churn while simultaneously obtaining what the industry often euphemistically call “customer loyalty”, or more aptly, that lock-in of customers has become important in order to maximize ARPU (average revenue per user).

If these assumptions are valid, actors will increasingly search for – and develop – business models based on product and service concepts that will promote economies of scope, because the demand-side of the markets has now become essential for value creation. Paradoxically, this dominant game of the industry also may open niches or opportunities for actors who may attempt to develop innovations and business models based on economies of scale, as evident in some actors’ strategies of investing in roll-out of WiMax networks. This makes analysis extremely complex. Either way, both strategies will ultimately depend on the type of value proposition industry actors are capable of offering, and, more crucially, how customers and users perceive, interpret and assess these. This will then enter into their opportunity judgement, however, one may assume that the notion of satisficing (Simon, 1969) is important, and their perception of transaction costs involved in a choice or non-choice (the latter may be important for understanding the mechanism of lock-in) also enters into this. These aspects are increasingly reflected in current thinking on new product development (Robert G. Cooper, 1996; Robert G. Cooper, Scott J. Edgett, & Kleinschmidt, 2000), reflecting the influence of mainstream diffusion theory, i.e. that the customer value proposition should consist of a broad range of benefits. Consequently, the idea of “packages” and “one-stop-shopping” has become a norm, and with this, various strategies for re-bundling services are now being attempted, e.g. multi-play.

Needless to say, some aspects of economies of scope are structurally inconsistent with the aims of competitive markets that most OECD member countries are now attempting to enforce in regulations. These regulations are aimed at obtaining maximum economic efficiency and social welfare by means of competition. In this, lock-in or other attempts at creating de facto monopolies are antithetical. SMP-regulations and consumer rights such as “number portability” are typically designed to counter such tendencies. In obtaining market power, control – usually by means of ownership – of ICT infrastructure plays an important role in lock-in strategies. In the present perspective of 2008, the scene and structure is governed by basically three types of infrastructures, with associated stakeholders controlling these:

- wired networks that have evolved from cable television networks and electric power distribution networks,
- networks that are based on PSTN and its twisted copper wire in the local distribution network,
- wireless networks in which allocation of radio frequencies are fundamental.

All of these infrastructures are now capable of – or have a realistic potential for – providing most of the ICT services that exist now because limitations in transmission bandwidth are increasingly being solved by new technological solutions, standards and configuration of networks. In this, the position of wireless networks and solutions have the advantage of flexibility and potential for rapid deployment, however, this type of infrastructure may have limitations in capacity and QoS that may ultimately demand high investment costs and complex system architecture, hence involve diseconomies of scale – for the competitive benefit of other types of infrastructure. Hence, the various infrastructures have comparative strengths and weakness. In the following sections, we will focus on this, from the perspective of two comparatively new service concepts, multi-play and mobile voice over IP (MVoIP), with a focus on Norway and Denmark.

3. Multi-play

Multi-play² and affiliated terms such as triple play and quad play may at one level be described as various types of marketing driven packages or bundles of ICT-services and subscriptions offered primarily to private, residential customers, i.e. families and households. At present, triple play is most common. Usually, these types of packages have emerged from operators of cable television (CATV) distribution systems. A typical triple play package will consist of these services:

- television broadcasted programs (traditional CATV service)
- high speed data communication for Internet access
- telephony, provided as voice over IP, or VoIP

3.1 Multi-play in Norway

In quad play, mobile communication services are included as the 4th service element in the package. Compared to triple play, the proliferation of quad play is still small. In Norway, only one network operator, Lyse Tele, offers quad play, however, this is still (early 2008) on a trial basis, hence the service is offered only to a limited number of customers. For Lyse Tele, quad play represents a development of its present “Altibox” triple play package, which is offered on Tele Lyse’s advanced FTTH network. The mobile communication service which will be introduced in the transition from triple play to quad play is branded as “iMobil”. In this wireless service, the mobile handset (or any other wireless terminal) will be connected to the network by WiFi-zone at home or in the neighborhood. When and if the user moves out of the WiFi-zone, there will be a seamless handover to GSM or other WiFi-hotspots. Tele Lyse has an ownership in the mobile communication operating company Network Norway; this company will provide the GSM inter-working with Lyse Tele’s quad play service. Hence, Tele Lyse’s quad play users also become users of Network Norway. The “iMobil” service will require users to have WLAN capability in their terminals. According to a press release from Tele Lyse, the company will test “iMobil” until the summer of 2008.³

² Earlier, in the 1990s, the term multiplay was associated with online internet based computer games involving many players, typically such as MUDs, i.e. multi user dungeons.

³ Cf.: <http://www.lyse.no/imobil>

As of early 2008, quad play is still in an infant stage in Norway. Although the addition of “iMobil” in Tele Lyse’s current triple play concept “Altibox” may technically qualify this as quad play, it is still a far cry from what is envisioned in various scenarios of FMC. What constitutes the mass of multi-play in Norway is triple play in some variety; however, because “triple play” is not a category in official statistics in Norway, no exact figures on the dissemination of triple play exist. Below, some facts and figures that may in an indirect way elucidate this will be presented. The status of broadband diffusion is strategic for understand this and the presentation will start with this topic. Following this, issues related to regulations and policy will be presented and discussed.

3.1.1 Broadband in Norway

For all intents and purposes, Norway as a nation now has full broadband coverage, because 99% of all households in the country should be able to connect to some type of broadband service, according to a study done in the summer of 2007, by the consulting firm Teleplan⁴. According to this study of the coverage potential, 93% of household in Norway may potentially be serviced by ADSL, 33% by CATV, 8% by FTTH and 13.5% by radio access broadband solutions. Table 3.1 gives an overview of what kind of broadband solutions are actually used. In Teleplan’s study, broadband is defined as a medium that provides communication transmission equal to, or faster than 640 kbit/s. This speed is considered as the minimum transmission speed required for moving pictures (video) by the Norwegian government, i.e. the client of Teleplan’s study. As shown, approximately 50% of the broadband subscriptions were to services of 2Mbit/s or above, and more that 95% were faster than 704 kbit/s. The term “broadband coverage” is an indicator of a potential. Hence the claim of 99% “broadband coverage” means that 99% of all homes and firms in some way or other have a potential or possibility to be connected to a broadband service, i.e. a measurement of the national broadband infrastructure. Although there has been a rapid increase in the number of households connected to broadband networks in recent years, the level of saturation was still approximately 60% (as of mid-2007). This figure is based on the assumption that there are approximately 2 million households/residential units in Norway and that at this point

⁴ Cf.: *Bredbånd – Dekningsanalyse 2007* [*Broadband – Survey of coverage 2007*] – study commissioned by the Norwegian Ministry of Government Administration and Reform, downloaded from www.teleplan.no.

approximately 1.2 million households/residential units had some type of broadband service, according to Teleplan’s study.

Table x.1: Broadband subscriptions in Norway 2001-2007

Type of subscription	2001	2002	2003	2004	2005	2006	2007
xDSL	7 852	87 629	214 187	413 545	678 968	901 385	1 040 759
CATV broadband	30 800	42 011	58 236	80 497	115 001	155 003	205 256
Radio access		533	2 217	9 032	11 889	16 820	30 669
Optical fiber				11 852	26 127	50 678	83 231
Leased circuit	6 200	5 980	5 471	2 222	3 710	3 035	2 627
Total	44 852	136 153	280 111	517 148	835 695	1 126 921	1 362 542
Annual rate of growth %		204	106	85	62	35	21

Source: Norwegian Post and Telecommunications Authority, cf.: http://www.npt.no/iKnowBase/Content/105175/tallgrunnlag_PTs_ekomstat07H_rev1107.xls

Figures from the Norwegian Post and Telecommunications Authority (NPTA) on broadband diffusion accord well with the figures provided in Teleplan’s study. NPTA’s figures on broadband diffusion in Norway are shown in table 3.1. As indicated in this, there were 1,362,542 broadband subscriptions in total in the middle of 2007. Approximately 10% of the subscribers were business firms and public organizations. Of the total, 76% of the broadband connections were xDSL and 15% were mediated by cable television networks, and only 6% were optical fibers.

Two salient features are evident in these figures:

- Optical fibers and the concept of FTTH still constitute a small portion of the national broadband infrastructure. The number of FTTH will probably increase in the next years because many energy utilities and CATV-operators are now deploying FTTH on large scale.
- The growth, or diffusion of broadband has been rapid. Starting from almost zero in year 2000, the growth in 2001-2002 was twofold. As typical of any successful, rapid initial diffusion dynamic, the rate of growth will gradually slow down: From 2006 to 2007 the rate of growth was “only” 21%.

If we assume that the growth from 2007 to 2008 will slow down further, e.g. to 15%, the total number of broadband subscriptions should now be approximately 1,550,000. Assuming only negligible increase in the business market segment because this was saturated first, the

broadband penetration in Norwegian households should now have reached 80%. Following the theoretical predictions of the S-curve in a diffusion of innovation process (Rogers, 1995), the diffusion of broadband will soon have encompassed the “second majority” of households/residential units. The remaining 20% of this population, i.e. the “laggards”, will adopt broadband in a slow pace, if at all. Hence the rate of annual growth will fall rapidly, maybe to an annual growth rate of a couple of percent.

3.1.2 Multi-play and triple play dominant – not quad play

Apart from Lyse Tele’s upgrading of its “Altibox” triple play offer to quad play, the dominant offer to households/residential units is triple play and dual play. As shown earlier, a substantial part of what constitutes broadband in Norway is mainly xDSL using the PSTN-infrastructure. The statistics from NPTA does not give any figures on the proliferation of VoIP, however, two figures may give an indication: In the first half of 2007, in the statistics on telephone subscriptions, under the category “broadband telephony”, there were 421,190 subscriptions in this category. Of these, 11,819 were provided by the CATV. In general, as the total number of fixed telephone service subscriptions have declined gradually from year 2000 (there were 1,744,285 subscriptions this year) to 2007 (1,605,278 subscriptions), there has been a migration of subscriptions form PSTN/ISDN to broadband telephony. Needless to say, the general, slow decline in PSTN/ISDN-subscriptions is also related to a more massive diffusion and growth in subscriptions of mobile communications. In 2007, the figure for mobile telephone subscriptions was 5,210,608, i.e. 1.1 mobile telephone subscriptions per capita. As evident in telephone directories, many people have two or three mobile telephone subscriptions, but among infants and young children (e.g. under the age of eight years) and among elderly, the rate of diffusion is still low. There are no official figures on the status of 3G mobile communications (UMTS, etc.) in Norway, however, the assumption (or, guesstimation) is that 5-8% of mobile communication is 3G/UMTS. This assumption is based observations of the number of mobile handsets sold with 3G functionality and the traffic volume in 3G mobile networks⁵.

⁵ A common complaint often heard is that the UMTS coverage and reception in Norway is still poor outside downtown areas, e.g. in some suburbs of Oslo, UMTS does not work inside buildings, according to some users. Mobile operators claim the contrary.

3.1.3 Market players and multi-play

It is a well known fact that in Norway, the incumbent telecommunications network operator Telenor has a dominant role in the market for telecommunications. In addition to having hegemony in service provision, the company also owns or controls a substantial part of the country's telecommunication infrastructure. Although the market share of Telenor has declined gradually since liberalization in 1998, the company's dominant position is evident, as shown in table 3.2 on market shares in service provision.

Table 3.2: Market shares (%) in telecommunications service provision in Norway, 2007

Type of service	Telenor	Netcom (TeliaSonera)	Tele2 (Comvig)	Others
Fixed telephony	70	-	9	21
Mobile communications	53	23	-	24
Broadband	50	-	6,4	37

Source: Norwegian Post and Telecommunications Authority, cf.:

http://www.npt.no/iKnowBase/Content/105175/tallgrunnlag_PT_s_ekomstat07H_rev1107.xls

As shown, Telenor's dominance is weakest in broadband, which is due to the role of cable television operators and energy companies in this market. In mobile communications, Telenor is partner to a de facto duopoly, together with Netcom. Although this is not stated explicitly, Telenor's basic strategy is typical for this type of company in that it may be characterized as a "second mover" (Gilbertand & Bormbaum-More, 1996; Nerdrum & Godoe, 2006), hence basically reactive in terms of introducing and promoting new services such as 3G or others services that may require large investments or may cannibalize existing services that provide the company with a comfortable flow of revenues. Telenor's dominant role is reflected in the number and character of complaints⁶ reviewed by Norwegian Post and Telecommunications Authority, which acts as the competition surveillance authority in the telecommunication sector:

⁶ Cf. Post og teletilsynet, *Årsrapport 2007* [Norwegian Post and Telecommunications Authority, *Annual report 2007*], p. 9-13.

- Competitors who claim that Telenor impose unfair prices and terms of business
- Telenor (and in some cases also Netcom and other companies that have a dominant market position in some segments or services, or “significant market power” - SMP) complain that the conditions imposed by authorities are unfair or unreasonable, e.g. imposing price caps on roaming or network inter-working.

Telenor has become a dominant player in the market for broadband service provision by means of xDSL based on the twisted pair copper wire of its traditional PSTN, i.e. its ownership of the local access network. Telenor will probably continue to develop this capability by an evolution towards VDSL, possibly as part of the general trend toward NGN that many other telecommunications incumbent companies are pursuing. In view of this possible scenario, marketing concepts such as “multi-play” and “triple play” or “quad play” may be viewed as rival concepts, however, these being promoted by actors who are still considered as “outsiders” in the telecommunication sector because of their identity as energy utilities or cable television network operators. In this landscape, the potential for radical bypass solutions are also present. Currently, the potential of WiMAX (IEEE 802.16) as a wireless infrastructure represents a real alternative, as evident in USA. Two companies, the gigantic Sprint Nextel of Reston and the startup company Clearwire, have announced that they will construct a large WiMAX-based network using the 2.5 GHz radiofrequencies in 2008. According to their plans, these networks will cover a geographical area of 70 million people at the cost of USD 3 billion. Outside USA, in South Korea, deployment of WiMAX began in 2006 with the brand name of WiBro. In conjunction with this, Samsung developed and launched mobile PC that will work in a WiMAX environment. For this reason, development of complementary technology to the WiMAX system does not constitute barriers.

The WiMAX trajectory of development is, of course, also in rivalry with another trend: LTE, or Long Term Evolution promoted by the 3GPP community affiliated with ETSI, which is envisioned by its protagonists as the 4G successor of GSM/HSPA/UMTS trajectory of development. The latter has currently hegemony in Europe and regions in Asia, South-America and many other parts of the world, but not in USA and Japan. Although 3GPP is expected to complete its work with the specification of LTE in “Release 8” in 2009, LTE is still an idea or a vision; it has not yet been implemented or deployed in any operation, in contrast to WiBro in South Korea or the WiMAX initiatives of Sprint Nextel and Clearwire in

USA. However, given the economic and political strength of the actors represented in the 3GPP-movement and the vested interests they have in a developmental path for the present hegemony of GSM, one may expect that these actors will protect and promote vested interests in a developmental trajectory towards LTE as the desired course of development towards FMC (Fixed Mobile Convergence). The development of LTE resembles the culture of NGN in the sense that both are promoted by the traditional telecommunications network operator community, both spell a “non-disruptive”, smooth and gradual transition from status-quo to something new and innovative, and, finally, both envision an all encompassing, total system. Needless to say, this implies a development that accords well with their interest. However, in this complex environment, there are obviously numerous factors that will shape and catalyze future development, in particular the future of multi-play and MVoIP. Of these, as evident in the WiBro-case of South Korea, political and regulatory aspects will possibly play an important role. In the next sub-section, this will be the topic.

In most countries, there is a switchover from analogue television broadcasting to digital terrestrial television broadcasting (DTTB). The decision for this has been policy driven over a number of years. The switch to DTTB has been justified in terms of improved radio frequency management that will increase the number of television channels and that viewers will receive improved signals, i.e. improved quality. Hence in an age of technological neutrality, this transition, which has been highly top-down, seem paradoxical, although in a technological perspective, the transition to digital technological solutions for television broadcasting seems very rational. The same policy paradox is also evident in the decision to adopt the various MPEG standards.

In the landscape in which the scenario of FMC is prominent, the future role of DTTB is considered a “dark horse” by experts because basically this system, as organized by national operators, may possibly become a competitor to FTTH and other cable based communication networks. Possibly, if DTTB becomes widely diffused, this may favour xDSL or WiMAX based solutions for DTTB customers, hence the diffusion of triple play and quad play may face serious competition.

3.1.4 Regulations, technological neutrality and network neutrality

The mantra among Nordic policy makers and the community of stakeholders in ICT is that policy should adhere to the principle of technological neutrality. This is in accordance with the ideological paradigm that was introduced in the mid-1980s as a result of deregulation and liberalization of economic systems, in particular for the telecommunication sector. Adherence to the principle of technological neutrality is convenient for policy makers because most of them have little ICT-knowledge, i.e. most of them are unable to make expert technological judgments, recommendations or decisions. From a national technology policy perspective, one may suggest that adherence to this principle represents abdication in terms of making national technological strategies. In this perspective, the South Korean decision in 2005 to promote WiBro (WiMAX) and (presumably) encourage Samsung and other Korean companies to develop equipment for this, represents an interesting contrast to this principle because a government “picked a winner”.

However, in redefining their role in ICT-policy adapted to a deregulated and liberalized market, policy makers view their role in terms of promoting the interests and demands of citizens and society to ICT, i.e. specify requirements, not how or by what means (technological solutions) these should be implemented. Basically, these requirements are:

- Robustness and vulnerability of systems and services so that they will function as expected and serve the needs of society in various critical situations (e.g. accidents, war, terrorist attacks, catastrophes, etc.).
- Enable fair competition among service and network providers so that costs are as low as possible and efficient in an economic system perspective. Competition is also considered important for innovations in service development and development of novel technological solutions, according to this tenet.
- Ensure fair access to ICT, e.g. Universal Service Obligation – USO, to all citizens.
- Ensure freedom of expression.
- Promote cultural and national identity (native language) and ethical values (curtail or ban immoral communication and information flow).
- Anticipate the evolution of mass media into two varieties of services: Linear (traditional broadcasting) and non-linear services (e.g. video on demand) – and the regulatory implications of this to the ideals of public broadcasting.

- Define a minimum of QoS-levels and enforce these and other aspects related to consumer rights.

In sum, the policy community shares a broad consensus on the merits and importance that ICT policy should be technology neutral, and that policy makers should not attempt to make decisions that in any way favor one type of technological solution to the detriment of others, i.e. policy should not “pick winners” – this should be done in competitive markets. Still, as in most cases were unanimity rules, there are viewpoints that to some extent contradict these principles. These are related to interests representing national industry suggest that within the framework of technological neutrality, there should be some “flexibility”. Often this translates into the opinion that national strength and advantage related to a particular technology or R&D area should be given some type of priority in terms of R&D funding, or funding of development contracts, demonstration projects, etc. Others, when confronted with decisions made by policy makers that were clearly technologically biased, put on an innocent face, stating that this particular decision was “very sensible and farsighted” – thus in reality redefined as outside the domain of technological neutrality. Hence, the notion of technological neutrality is open for flexible interpretations and, possibly, controversy if conflicts of interest arise.

The last point on QoS and consumer rights is relevant for the concept of network neutrality. This term is more a de facto policy principle, or ideal, and also controversial. Basically, this involves consumer rights and to what extent telecommunication operators may differentiate or impose limitations on the use of internet and broadband, and more important, if they should discriminate (and charge more for) services that require specific QoS-standards. This question is relevant for a number of services, specifically for wireless voice telephony in order to reduce jitter and voice degradation, which is a real problem in all systems based on packet switching. Although this is not a big issue now, in the future this may become a barrier for the diffusion of many wireless services. Apart from policy implications, there are non-trivial technical implications related to how a telecommunications system, which is becoming more and more uniform because of a common IP platform, should manage this type of differentiation. In Norway, the topic of network neutrality became a controversial issue in 2007 because Telenor broke off its contract with NIX – Norway Internet Exchange.⁷ Telenor

⁷ Cf.: <http://forbruker.no/digital/nyheter/data/article1903858.ece>

claimed that many ISPs were free riders to this system, pointing to the company Schibsted that generated 250 times more traffic from its system than from Telenor's, implying that Schibsted reaped substantial commercial benefits from a system that was initially based on reciprocity. This controversy points to potential conflicts between various actors within the system. In a regulatory perspective one may suggest that this is not a big issue for consumers in Europe, because, according to the EUC, consumers are basically free to choose among many different internet service providers. Hence, the problem of lock-in is not perceived as important. On the contrary, some European regulators think that network differentiation may be beneficial because pricing mechanisms may serve as an incentive for increased efficiency and competition.

3.1.5 Diffusion of broadband: Two different strategies

In the zeitgeist of the dotcom period (approximately 1995-2001), the scenario of a future Information Society was prominent. In this, building broadband infrastructure became an important political issue in most OECD member countries. This was seen as an essential prerequisite for an imminent emergence of a new techno-economic paradigm based on the foundation of a "new economy". Usually in political debates, there was broad consensus on this goal: Building a broadband infrastructure was seen as a high priority, for many this was the most important national policy issue. Nevertheless, the topic of *how* this should be done and what type of governance and institutional model should be applied to this became an area of disagreement.

One point of view was that the state, or an agent of the state, should plan, construct and operate this type of national broadband network and infrastructure, as a public good. Advocates of this type strategy argued that because of the risks involved and prospects for market failure, the market would not be capable of doing this type of task, in particular private investors would shy away from constructing networks and provision of services to rural districts and to economically less privileged groups in the population. In addition to this, they pointed to national security, lock-in problems, and issues related to vital cultural values which would be easier to enforce in an infrastructure controlled and operated by the state. The other, opposite strategic direction advocated that the market and private actors would automatically invest in and operate the future broadband infrastructure if the framework conditions were normal. Hence, they claimed, this would be much more efficient and flexible. Although

protagonists of this strategy also recognized the possibility of market failure and the importance of “vital” national interests, they argued that these could be counterbalanced by policy measures that were specifically designed to address these issues. In Norway, the latter strategy was enacted because at the time (1999) a coalition of liberal-conservative political parties held office in the government and had a majority in the parliament, the Storting. Parallel to this, they allocated funds to a demonstration program, HøyKom, for co-funding a number of broadband deployment projects in public schools and institutions. In the period 1999-2007, the government spent NOK 573 million (Euro 71.5 million) on this program. As explained earlier, the broadband infrastructure in Norway now has 99% coverage. Hence the basics of the goals have been attained demonstrating that the market oriented strategy was successful.

The Swedish broadband approach, which was enacted from 2001 with substantial government funding (Euro 588 million), represented the opposite strategy compared to the Norwegian. In 2001, Sweden was ruled by socialists. According to a report⁸ by the Swedish Post and Telecom Agency (SPTA), the broadband coverage in Sweden in 2007 was 99%, i.e. identical to the broadband coverage in Norway. Although the Swedish broadband system has a much larger proliferation of FTTH (29% coverage), which may be an asset in terms of a future potential, Sweden and Norway have obtained its goals by means of two different strategies.

What is perhaps most interesting is the success of Norway’s strategy, which many experts in 1999 feared would fail, suggesting that ideological blinders (liberalism) made these plans unrealistic. The success of this market oriented policy and strategy may explain why policy makers now seem to accept the tenets that policy should be technology neutral. Hence, the role of the state as a leader, coordinator and builder of ICT systems has been delegated to the actors in a market environment. As a consequence of this, the relationship between actors in the market in terms of interconnection and business models that impinge on these will become an area for building new types of institutions and governance models in order to create an environment for efficient competition.

⁸ http://www.pts.se/upload/Rapporter/Internet/2008/Bredbandskartlaggning_2007_2008_5.pdf

3.1.6 Radio frequency allocations and wireless access networks

In 2001 when the first licenses for UMTS were given by governments, these were allocated to operators on “beauty contest” criteria in Norway and Sweden, i.e. those operators who promised to build what was considered the best networks were given licenses. In contrast, in Germany and UK and many other countries, including Denmark, similar licenses were auctioned off and the governments reaped billions of Euros for these. Shortly afterwards, the dotcom bubble burst and the exorbitant prices paid by many of the mobile communications operators created severe economic crisis in these companies. At the time, the Norwegian policy was praised as “sound” and “wise”. Now, seven years afterwards, it is difficult to see if the “beauty contest” policy really was as beneficial as proclaimed because the diffusion of UMTS has been slow and many of the beauty contestants have turned in their licenses.

The radio spectrum is a scarce natural resource and allocation of this should be done in a manner that maximizes this as a public good. This may explain why the principle of auctioning of radio frequencies has now become more interesting. In the period after the dotcom crisis, new technological solutions, specifically WiMAX, have become more mature, hence, there are many contestants to the use of radio frequencies. In particular, the switchover to digital terrestrial television broadcasting has made large blocks in the spectrum vacant. In this perspective, policy makers should consider offering this in auctioning, in order to develop a pricing mechanism for the system. This way of thinking now seems to be implemented in the management of radio frequencies, as evident in the recent auctioning of licenses in the 2,6 GHz band.

3.2 Multi-play in Denmark

Multi-play comes – as mentioned in the section on multi-play in Norway - in different versions: Double play (TV and Internet), triple play (TV, Internet, and VoIP) or quad play (TV, Internet, VoIP, and mobile). In Denmark, no operators offer quadruple-play at the moment in the traditional sense of the term – i.e. all four services in one bundled package. There are operators offering all four services and also packages of services, for instance double or triple play - but no quad play packages in the traditional sense of the concept – although the mobile operator ‘3’ could be said to offer quad play on a mobile platform.

The main physical network technologies used for offering multi-play are in Denmark: Cable, DSL, and fiber. 3G can also be seen as a platform for multi-play services – depending on how multi-play is defined. Furthermore, WiMAX will be an option, but still needs some development. WiFi can also be one of the technologies used in multi-play solutions, e.g. including UMA. However, even though UMA is offered by Telia in Denmark and even though Telia has also recently started offering a double-play solution (TV and Internet) via DSL, these two offers are not combined into one assembled package. They are marketed as different offers.

3.2.1 The market for broadband in Denmark⁹

By end 2007, there were almost 2 million broadband subscriptions in Denmark. This corresponds to 36.1 broadband subscriptions per 100 inhabitants, which is the highest penetration rate in Europe. The speed of broadband connections is, however, only average, and the prices are slightly higher than in the cheapest comparable countries.

The importance of the different technologies (excluding 3G) is listed in table 3.3.

Table 3.3: Broadband subscriptions 2005 – 2007

	2 nd half 2005	2 nd half 2006	2 nd half 2007
xDSL	826,439	1,062,040	1,206,862
Cable modem	389,635	506,734	541,708
FTTH	8,118	21,961	70,253
FTTx	...	7,611	10,956
Satellite	111	149	5
Power line	92	99	96
WLL	4,785	3,761	3,793
WiFi	7,806	5,961	6,095
WiMAX	2,495	12,272	13,109
LAN	104,187	113,644	124,469
Others	186	1,085	19
Total	1,343,855	1,735,317	1,977,365

Source: NITA p. 21

⁹ All figures and tables in the paper are from 'Telecom statistics – second half on 2007', by the Danish NRA, NITA.

With respect to speed, there has clearly been an upward move, especially lately. This is the result of increasing competition in the broadband market, first and foremost in the DSL area. Competition has also affected the prices, which are quickly decreasing. In table 3.4, downstream capacity ultimo 2007 is shown.

Table 3.4: Broadband subscriptions by downstream capacity, ultimo 2007

144 – 512 kbit/s	16.5%
513 – 1,024 kbit/s	12.9%
1,025 – 2,048 kbit/s	26.0%
2,049 – 4,096 kbit/s	24.0%
4,097 – 10,239 kbit/s	11.6%
10,240 kbit/s	3.0%
More than 10,240 kbit/s	4.8%
Unspecified	1.1%
Total	100,0%

Source: NITA p. 25

Although IPTV can be watched at lower speeds, it requires speeds of 10 Mbit/s and above to be able to subscribe to real multi-play services. This means that by the end of 2007, only 7.8% of broadband subscribers were potential multi-play customers. With respect to DSL customers, this would only be 3.5% of the approximately 1.2 million DSL subscribers. In the case of cable modem, the equivalent figure was 3.8% of the approximately 0.5 million cable modem subscribers.

Regarding the companies providing broadband connections, TDC is by far the largest in the DSL area (68.8% by end 2007). The second largest is Cybercity with 17.6%, and thereafter comes Tele2 with 4.9% and Fullrate with 3.2%. In the cable modem area, TDC is also the largest operator with 43.0%. Telia Stofa has 28.7%, Dansk Kabel TV has 11.5% and Arrownet 8.9%. In the FTTH area, the picture is completely different. In this field, the broadband subsidiaries of the electricity companies dominate and TDC is not a player. TDC prefers to go for a combination of fiber and copper in a VDSL solution. There is a wide range of electricity company subsidiaries in this field, and none of them have more than 12,000 broadband customers at the moment, but their ambitions are high.

In the WiMAX area (where there is no more than app. 13,000 subscribers all in all) one company (Danske Telecom) totally dominates with more than 90% of customers. There is, however, not much progression in this area at the moment.

The last area to be mentioned is 3G. After the 3G auction in Denmark, the only company that entered the market forcefully was '3'. They were more or less alone on the 3G market for 3-4 years. However, lately, TDC as well as Sonofon have also entered the 3G market. And, the low-price companies Telmore and CBB have followed suit. This has led to a fast increasing number of 3G subscribers – not only for the 'new' companies in the market, but also for '3'. Ultimo 2007, the number of subscribers was 666,178. Not all 3G subscribers are, however, mobile broadband users (i.e. subscribers having used advanced data services within the last 3 months). Only half of 3G subscribers are mobile broadband users. In the first half of 2008, mobile broadband (broadband modem to PCs) has really taken off. This is an important driver for the 3G development.

3.2.2 The multi-play market in Denmark

The statistics on triple play in Denmark say that by the end of 2007 there were 48,038 subscribers. Of these, half were customers of '3'. This means that in the triple play figures published by the Danish NRA, NITA, the mobile TV subscribers of '3' are included. This is in a sense reasonable, as '3' offers a platform for in-band mobile TV as well as Internet access and telephony (circuit switched as well as IP-based). This could be considered as a quadruple-play offer.

In the more traditional sense of the multi-play concept, the fiber-based solution dominates. This is the area in which the subsidiaries of the electricity companies are active. However, the solutions offered by these subsidiaries are generally not multi-play services in a strict sense. The electricity subsidiaries offer a communication path and cooperate with TV package providers, Internet access providers and VoIP providers, who offer their services on top of the fiber connection. The electricity fiber-subsubsidiaries are thus generally bit pipes. They do not offer a bundled package - although the range of service providers with whom they cooperate is limited.

Among the other initiatives in the multi-play area, the TDC-owned cable company, YouSee, has been offering a triple play solution for the last year. Telia Stofa, which is one of the three large cable TV providers in Denmark, has also for a number of years been offering Internet access for its cable customers. Lately, Telia has come out with a double-play solution based on DSL. They are offering IPTV in combination with Internet access. This is a field where TDC also is planning to offer services via high speed DSL connections.

However, it would be an exaggeration to state that the multi-play market in Denmark is a burgeoning environment. There are potentials and initiatives. However, they seem to be constrained by, on the one hand, that cost effective technology solutions be developed – for instance the fact that TDC is not going for a full rate fiber solution but a combined solutions – and on the other hand that technology solutions and service offers are already available for delivering the services separately, which may be more profitable for the operators and service providers and even preferable for the customers, as they don't get tied into a bundled service offer. However, this may change once fiber has been more widely deployed and once speeds on DSL and cable modems have reached a level, where quality TV can be delivered.

3.2.3 Policy and regulation

Regulation and policy in general do not seem to be major issues in this field – probably as multi-play has not been at the centre stage yet. This is clearly the impression that one gets from interviews with representatives of the Danish IT and telecom associations (ITEK, IT Brancheforeningen and Telekommunikationsindustrien). There are a couple of questions, though, that deserve mentioning. One question relates to the take-up of broadband subscriptions in general and the other question is concerned with a regulatory decision regarding multicast and multi-channel.

With respect to the take-up and establishment of broadband access networks, the policy of the Danish governments for the past decade has been non-interventionist. When compared to the other Scandinavian countries, the broadband policies in Denmark are clearly on the liberal side, just like Norway. Although the establishment and extension of the research and education network in Denmark, at a point of time, was important for the extension of Internet access, there has been very little economic support on the supply side from public authorities at all levels for broadband development. On the demand side, however, there has been and is

an important economic support. The Danish tax laws allow for a large range of fringe benefits for employees. These fringe benefits are deducted from the salaries of the employees. This, however, means that the state pays app. two thirds of the price of the fringe benefits (including broadband access), as the top tax in Denmark is around 65%. In the statistics published by NITA, it is shown that 18% of all broadband connections are sold to and used by business; almost 60% are sold to and used by households, while a little more than 22% of broadband connections are sold to business and used by households. This constitutes a considerable contribution to the take-up of broadband access.

The regulatory question regarding multicast and multi-channel is concerned with third party access to using the networks of network providers for the delivery of IPTV. In late 2006, Cybercity complained to NITA regarding access to bit stream access (BSA) products for multicast and multi-channel. In late 2007, NITA decided that multicast and multi-channel are part of the regulation on BSA. This means that third party providers of IPTV now can use the network of TDC for offering IPTV and multi-play on the basis of a regulated BSA product from TDC.

A last potentially important issue is concerned with the problems for end-users in subscribing to a bundled service. There may be a danger of lock-in of customers. However, this issue is not taken up by the telecoms regulatory authorities in Denmark, as this is not considered to be a problem at the moment.

4. MVoIP

In this section, the structural aspects of the development of mobile voice over Internet Protocol (MVoIP) are examined and two country cases, Denmark and Norway, are briefly presented. The basic structural aspects discussed are 1) technology development, including the development of standards, 2) market developments, and 3) regulatory developments. These three broad areas are examined separately in the text though it is clear that they are strongly interrelated. Such interrelatedness applies in all fields, and the purpose of the section is to examine the specific interrelatedness between the technology, market and regulatory aspects in this potential market segment.

Fixed VoIP solutions have been on the markets for a number of years and have already acquired a sizeable and growing share of the voice markets. MVoIP is a novel service because it delivers VoIP on mobile platforms. At present, the number of users of MVoIP solutions is relatively low, and the aim of the present section is to examine the structural factors that will affect the development of the MVoIP area.

4.1 Technology aspects

There is no dominating technology solution for MVoIP on the market or on the way to the market. Different competing solutions are found, and the market is still so immature that it is not possible to determine whether the market will be dominated by a single solution or whether many different solutions will co-exist. The likelihood is, however, that different solutions will co-exist, as they partly cover different needs of users and market strategies of companies operating in the markets.

To simplify the presentation of the different technology solutions relevant for MVoIP, three different layers should be touched upon. The first layer is concerned with the applications, where three different solutions are often dealt with: The older H.323 ITU protocol, the SIP IETF protocol and the proprietary protocols like Skype and Google Talk. The second layer is concerned with the platform level, where the question is basically whether open IP is used or whether services are delivered on the basis of an IMS platform. The third layer has to do with the more basic network solutions applied, WiFi or WiMAX networks, or the data channels of mobile networks, or a combination as in the case of UMA, which combines a cellular solution and a WiFi solution.

With respect to the application layer, the H.323 solution of the International Telecommunication Union (ITU) was the first (1996) one on the market but has never acquired any large following. Far more successful has been the Internet Engineering Task Force (IETF) Session Initiation Protocol (SIP). This is the protocol used by most VoIP providers and is also likely to have a following among the future MVoIP providers. In addition, there are different proprietary protocols of which Skype is the most successful. This applies in the fixed VoIP area and also seems to be the case in the mobile area. The operator '3', has, for instance, implemented the Skype solution into its X-Series offer and has also launched the mobile 3 Skypephone.

Regarding the platform level, the major issue is whether open IP is used or whether the IMS (IP Multimedia Subsystem) platform is introduced. IMS is the preferred platform of traditional mobile operators. It is a platform, which allows for a control of the level of QoS (Quality of Service) delivered and allows for a differentiation between, for instance, the IP-based services delivered by the mobile operators themselves and the services delivered by independent third parties without QoS assurance. The services delivered on the IMS platforms allows for a differentiation between best-effort third part services and services, which has the QoS assurance of the mobile operators.

Concerning the more basic network solutions, VoIP can be delivered via WiFi networks or via WiMAX. However, far more debated has been the MVoIP solutions delivered via the data channel of mobile networks or via a combination of a circuit switched cellular channel and a WiFi channel. This latter solution is mostly called a UMA (Unlicensed Mobile Access) solution, as it uses unlicensed frequencies when relying on WiFi access. The mode of operation is that when the user is in the vicinity of a WiFi network (for instance at home), the WiFi connection is used, and when outside WiFi reach, the traditional circuit switched cellular network is applied. Furthermore, there is seamless handover between the two networks so that the user will not observe when switching from one network to the other. TeliaSonera, for instance, has been marketing such a solution under the brand name, Home Free.

There are clearly many different combinations of these solutions on the different layers. 'Naked SIP' is, for instance, a term used for a SIP solution delivered on an open IP platform, while the SIP protocol also can be used in a more closed IMS environment. SIP can also be used for a cellular data channel solution, while in the case of X-Series delivered by the operator '3', it is a Skype solution which has been implemented.

The technology solution chosen is primarily determined by the business strategy of the operators in question. The Skype solution implemented by '3' is presumably chosen for its marketing purpose, i.e. for developing the '3' brand and connecting '3' with the strong Skype brand in a situation, where '3' has been fighting just to get the 3G market kick-started. The UMA solution chosen by TeliaSonera is much more determined by be aim of maintaining and

expanding the number of traditional cellular customers in the face of stiff price competition on cellular mobile communications.

4.2 Market aspects

Within a time frame of approximately 5 years, fixed network operators will close down their PSTN (Public Switched Telephone Network) operations, and voice services will be either IP-based or mobile – or a combination. The Danish incumbent, TDC, operates within this time horizon. It is difficult to imagine that the combination of mobile and IP will not play a major role in the coming years, also for voice services. Such a ‘prediction’ is based on the steeply growing capacity of the cellular data channels with HSPA (High-Speed Packet Access) and the LTE (Long Term Evolution) development and the growing diffusion of WiFi and also WiMAX.

It will, however, take some years yet for technology reasons, but primarily for market reasons. The technology reasons are that competitive technology solutions still have to be fully developed. Users have become accustomed to total coverage and seamless handover (service almost everywhere), and services at a lower quality level may have a hard time competing. The market reasons are that most of the existing operators have very small incentives to launch MVoIP, as it cannibalises on their existing mobile voice services.

The basic competitive situation on the Nordic mobile voice market is that penetration is above 100% and that prices have reached a level so low that not only have the number of mobile subscribers long time ago surpassed the number of fixed line subscribers, but the number of minutes generated from mobile terminals have also passed by the number of minutes generated on fixed terminals.

However, in spite of the quickly growing number of minutes generated on mobile terminals, the average revenue per user (ARPU) is decreasing. This illustrates that there is a sharp competitive situation on the mobile voice markets, and that the window of opportunity for MVoIP is relatively narrow, at the moment. New MVoIP operators have to compete on a market where users are accustomed to relatively high quality services at relatively low prices. And, existing mobile operators have very little incentive to undermine their own circuit switched mobile operation, as this is still the cash-cow of mobile services in spite of

decreasing ARPU. In spite of this, expert informants expect a radical decrease in the price level of mobile services in the future. This, they think, will happen partly because of price competition created by new entrants who will offer services at lower prices than incumbents. The incumbents will respond to this by cutting their own costs (which are still high compared to small operators) and lower their own prices. Lower prices will stimulate more use of mobile services, thus ARPU may be maintained or even increased. Needless to say, this type of scenario is conjectural; however, in looking at the development of demand for mobile services, this type of dynamic has been important for growth in mobile communications use since the introduction of GSM in the early 1990s.

MVoIP is a technology which, to a large extent, is an example of a disruptive innovation – in the Christensen sense (Christensen, 1997). The quality of the service is, at present, lower than the dominant existing mobile voice service; there are, however, development potentials, for instance the possibilities for combining voice services with data services on the data channel; and, the costs of delivering the service is potentially lower than for circuit switched services.

In the long run, MVoIP should be able to out-compete traditional circuit switched mobile voice services. It is, however, difficult to see who will forcefully carry this service to the market, at present. Naked SIP delivered by independent third part operators is a possibility, but we still have not seen this forcefully entering the market. We have, however, seen Skype on X-Series of '3' and now also the 3 Skypephone and we have seen the Home Free solution of TeliaSonera, but the launch of these services seems to relate more to specific market strategies in existing markets than to any aim of a full-scale launch of MVoIP. In the case of '3', the purpose has, as mentioned, to a greater extent been to brand '3', and in the case of TeliaSonera the aim has been to increase the competitiveness on the circuit switched market. Although the potentials of MVoIP are very good, operators still seem to be in a phase where the best business models have not yet been found.

We are thus in a phase of trial and error, and, in contrast to what the Christensen theory on disruptive innovations says, the successful models can just as well be developed by existing/incumbent operators as total newcomers. UMA solutions may develop into successful solutions in an intermediate phase between the existing dominant circuit switched phase and a future all-packet switched phase. At the moment, however, there is not any apparent success –

the reason probably being that the prices of circuit switched mobile voice have become so low that a UMA solution does not constitute any decisive move. Third party naked SIP solutions via cellular networks can also become viable and competitive solutions. The actual capacity on the mobile networks is, however, generally not presently sufficiently high to secure a high quality service. SIP solutions on WiFi and/or WiMAX can also develop into successful services in the future, but the coverage of especially WiFi networks but also WiMAX networks is a question to be resolved. Finally, an IMS-based solution presently seems like a potentially successful model. This entails a continued control by the network operators and, therefore, also a control on the revenue. Such a service, however, cannibalises on the circuit switched operations and will only be forcefully launched when a viable business model is found, combining voice and other services, and finding a manner of charging such a service in a profitable way.

4.3 Regulatory aspects

In some areas of the development of telecommunication services, (sector specific) regulation plays an important role. This is not relevant for MVoIP. In this case, technology developments and, first and foremost, market developments are the primary factors. This applies whether looking at regulation from the point of view of hindering service development or promoting service development. There is, presently, no sector specific regulation either hindering or promoting MVoIP developments decisively. However, situations may later arise where regulatory decisions have to be made.

Mostly, traditional sector specific telecommunication regulation includes three major regulatory areas: competition regulation including interconnection, rights of way regulation including access to frequencies, and universal service regulation.

There is sector specific regulation for interconnection in the mobile field. The cellular mobile area is included in the market analyses determining whether there is Significant Market Power (SMP). To the extent that the SMP conditions are not met, alternative operators still have access to the network facilities of the existing network operators. A question that could arise would be the access of alternative operators to the QoS-controlled IMS area. This question could resemble the American discussions on network neutrality, i.e. whether network

operators have the right to offer lower quality services to third parties than to the conveyance of services delivered by the network operator itself.

The frequency question is probably the potentially most important one in connection with MVoIP. If services are delivered on WiFi networks, there is presently no regulatory issue, as WiFi is license exempt. WiMAX, however, requires frequency licenses in some frequency bands, and this could be an issue if WiMAX becomes an important platform for MVoIP. In Denmark, two WiMAX licenses were assigned a few years ago. One of them went to an active WiMAX operator, Danske Telecom, while TDC acquired the other license. It, however, seems that this license was primarily acquired to be used 'in case', i.e. to exclude another operator from starting a WiMAX operation.

Cellular mobile communications is also conditioned on licenses – assigned by means of beauty contests or auctions. This means that a limited number of operators have licenses for operating mobile networks and it means that the business strategies of these companies – as described in the sub-section on market developments – play a crucial role for the development of the MVoIP market. The purpose of the license regulation has not been to affect the development of MVoIP, but there is an indirect effect.

The last sector specific regulatory area is concerned with universal service. Present universal service regulation encompasses fixed telephony services and fixed telephone networks (PSTN). Although a growing number of users rely solely on voice delivered on mobile networks, there is no universal service provision on mobile communications. This issue has, actually been considered by the European Commission, but the conclusion was (in 2005) that mobile communications were already too widely diffused (around 100% of the population) to make a universal service provision relevant. Though unlikely, it may be that universal service in a coming round of universal service reviews will be extended to broadband access. Should this become the case, universal service will be changed from a service (telephony) and its dedicated network (PSTN) towards broadband access, pure and simple. This could strengthen the general VoIP development and subsequently also the MVoIP development. But again, this is a very indirect effect.

The last issue that merits mentioning is general consumer protection. General consumer protection also applies to telecommunication services including MVoIP. This could affect the

development of MVoIP, as some MVoIP solutions most likely will be of a markedly lower quality than existing voice solutions. This could contribute to a limitation on the fast spread of MVoIP solutions.

All in all, however, the regulatory aspects do not seem to be the most important in the case of MVoIP. Technology development is important, but the primary factors affecting MVoIP developments are market factors and company strategies.

4.4. Denmark

MVoIP has not really taken off in Denmark. The two major operations in the field, Skype via X-Series and 3 Skypephone of the operator '3' and the UMA solution by Telia named Home Free, have already been mentioned. The Skype solution '3' started in 2007, but did at first not at first include Skype In or Out – only the Skype-to-Skype solution. Later, Skype Out has been included in the service. In 2008, '3' also launched the 3 Skypephone where telephony via Skype plays a more prominent role in the value proposition of the operator. The Home Free solution by Telia was launched in the autumn of 2006, but has never become a decisive feature in the portfolio of mobile services by Telia. In addition to these larger initiatives, MVoIP can also be executed using, for instance, Fring software. However, all in all, it has to be concluded that MVoIP has not yet any substantial following in Denmark.

The incumbent operator TDC is preparing for the possibility of offering MVoIP, among other services, on an IMS platform. However, at the moment this is in the planning phase.

In connection with the research phase for this report, three representatives of Danish IT industry organisations¹⁰ were interviewed and so was the Danish NRA, IT- og Telestyrelsen. In none of these interviews were any serious current regulatory issues regarding the development of MVoIP pointed at. The issue of MVoIP had not specifically been on the agenda in these organisations. In one of the organisations (Telekommunikationsindustrien), however, VoIP in general has been on the agenda. The concern has mostly centred on the issue of Quality of Service (QoS) and the need for developing standards for the

¹⁰ The IT industry organisations interviewed are ITEK, the IT branch of Dansk Industri (DI), IT Brancheforeningen (ITB), and Telekommunikationsindustrien (TI).

interconnection between different IP based systems. In a managed IP system, QoS can be secured at a high level. However, on the open Internet and in interconnections between different managed systems, there are quality problems. This applies to VoIP in general, and applies even more to MVoIP, as this kind of VoIP, moreover, is transferred via a radio link with the specific problems that this entails – this was the viewpoint expressed by Telekommunikationsindustrien. This also leads to a potential regulatory problem, namely the extent to which third party operators should have access to the QoS control of network operators – as mentioned above.

From the other interviewees, most emphasis was on the market aspects of the development of MVoIP. However, the representative of ITEK also put much emphasis on a ‘past’ regulatory issue, i.e. the high prices charged in the Danish 3G auction. According to ITEK, the high fees have been a serious problem for the development of 3G in Denmark. In a long period after the assignment of 3G licenses, it was only the operator ‘3’ that marketed 3G services. They only have a 3G license and have, therefore, not had the possibility to rely on a 2G license. Only within the latest one to two years, has there been any serious growth in the Danish 3G market. This has contributed to holding MVoIP back – as it has held back all other packet based data services on a 3G platform.

Another issue mentioned by the ITEK representative is the lack of viable business models for the delivery of packet based services. The problem - as they see it – is that the telecommunication operators cannot charge the customers sufficiently in an Internet-like environment. This is the reason why operators are working on IMS or other quality controlled models, where the customers can be charged for services.

The last point to be mentioned here is that the planned strategies of operators involving MVoIP are directed at the business users primarily. MVoIP will be offered to business customers in a package so that voice services can be integrated with data services. This is a strategy for including MVoIP in a quality package product. The primary aim is not to deliver cheap voice services but to deliver an integrated package. It is, of course, also the aim to deliver services at competitive prices to business customers who have high mobile bills from communicating when travelling abroad, etc. But it is not primarily a price-oriented strategy but a service package strategy. This fact points in another direction than the Christensen-

based discussion on disruptive innovations, where the focus is on low-end users and newcomers. The question is whether such a strategy will succeed.

4.5 Norway

The situation in Norway is not substantially different from Denmark. MVoIP has not either taken off in Norway. The small operator Hello has started offering an UMA solution, and the same applies to the company Phonzo. Moreover, Telio launched a MVoIP solution for business customers in the end of 2007. Furthermore, as in Denmark, the Norwegian incumbent Telenor is building an IMS platform which will allow for offering MVoIP services along with other data-based services.

3G services have been relatively slow to take off in Norway – as in Denmark. Lately, however, 3G has started developing fast in Denmark and also in Norway, although Norwegian statistics do not single out 3G as a specific category.

A possible difference between Denmark and Norway could be related to the development of WiMAX. WiMAX does not seem to develop fast in Denmark. The number of WiMAX subscribers has been constant for the past year in Denmark, while WiMAX may have larger potentials in Norway because of the geographic conditions in Norway.

4.6 Summary

The development of MVoIP has vast potentials, as it is based on two technologies, which increasingly have dominant positions in telecommunications, mobile and IP. At present, however, MVoIP has not really taken off. When examining the different aspects that traditionally affect the development of all services, including telecommunication services, i.e. technology aspects, market aspects, and regulatory aspects, it is clearly the market aspects, which are presently the most important for the development of MVoIP. Technology aspects are also important, as MVoIP technologies still are in the development phase. However, the strategies of operators and especially the strategies of incumbent network operators and their concerns regarding the cannibalization of their own circuit switched services are of crucial importance for the MVoIP development.

5. Discussion and conclusion

Economies of scope and the related issue of vertical integration are two of the traditional issues in structural analyses of markets. While the term economies of scale – in the traditional sense of the concept – relates to savings on the production side as a result of increasing size of the production, economies of scope – in most conceptions of the term – relate to the production as well as consumption side. In this context, the report examines the development of multi-play and MVoIP. Multi-play is clearly a case which relates to the issue of economies of scope. MVoIP, on the other hand, is to a larger extent related to the question of technology substitution, but can also be seen in the light of economies of scope, as MVoIP is and will often be part of a larger package of services offered to the users.

Formerly, communication services were produced and delivered in vertically integrated silos: telephony on PSTN and TV on cable networks, for instance. Presently, communications has become much more layered and different services are provided on the same IP network. This should imply that there are lower vertical economies of scope than formerly, while there may possibly be higher economies of scope in integrating different kinds of networks horizontally.

With respect to the vertical dimension, there will still be external transaction costs related to interacting between different players, even when technology allows for a more layered structure. On the other hand, there will also be internal transaction costs in integrating different production cultures, as is the case when integrating telecommunications and content production and delivery. For a number of years, these are issues that communications companies have been struggling with – and it still applies. It is not clear whether there is an optimal industry structure in the area and what that optimal structure would be. There is a high degree of trial-and-error in the area.

In the 1990s, when the big turmoil in the sector really took off with the liberalization of telecommunications and the increasing convergence technologically and market-wise between hitherto separate communications sectors, there was an understanding in the telecommunications sector that ‘content is king’ and that the strategy of operators should be to ‘get up on the value chain’, i.e. to get involved in content production and delivery and to avoid becoming a ‘mere bit-pipe’. In the trial-and-error process at this point of time, the

Danish telecommunications incumbent failed, while Telenor seems to have been more successful.

In the Danish context, presently, the electricity companies, which are active in deploying fiber to the home, have up until now chosen a strategy where they deliver the connection (the bit-pipe) and leave the delivery of television, Internet access, and telephony to (a limited number of) companies with whom they cooperate. This is probably a reflection of a realization that the core competences of electricity companies are not in content and communication – at least presently. They are satisfied with being ‘mere bit-pipes’.

There also seems to be a realization among industrialists in the communications area that money can also be made without being the content provider. While formerly, representatives from industry organizations would support the ‘content is king’ thesis, there seems to be a growing conception that it is in the organization of services and content that money can be made¹¹. Focus is, therefore, on providing platforms for services and content, and the main strategy of incumbent operators is presently to establish IMS (IP Multimedia Subsystem) as the platform for service and content delivery.

Emphasis is thus on being the one that retains the customer contact and being the one that sends the bill. This is the central focus of the traditional communications industry and has been a concern since the growth of Internet (according to the Danish industry organization ITEK). Traditional telecommunications operators have seen Internet as a real threat, as Internet is an open platform with a layered structure with a split between access providers and content and service providers. This has been seen as a model for explaining the decreasing revenues for telecommunications operators. For this reason, operators have struggled to find alternative models, where operators still have a central position. The struggle is, so to say, about being the ‘spider in the net’ – the player that controls the customer access in relation to the other players delivering content and services. This is obtained by being the one that delivers services and content in a controlled environment (with QoS and security) to customers, retaining the customer contact.

¹¹ This applies, e.g., to the Danish industry organization, ITEK, which is one of the organizations interviewed in connection with the preparation of the present report.

It is in this light that many of the initiatives from the traditional players in the telecommunications area regarding multi-play and also MVoIP can be seen. It is difficult to make a clear case that there are economies of scope in the production process. Multi-play is, to a large extent, about locking in customers by offering packages of services where there are switching costs for customers in changing the providers of one or more of the services, which are included in the package. Another expression of the same is that it is all about creating customer loyalty and limiting churn of customers.

In the mobile area, churn is a major problem for operators. There are no new customers to be gained, only customers to be lost to other operators or gained from other operators. And, in the fixed Internet area, this is also increasingly the case (in Denmark and Norway and other countries with high penetration rates). Saturation is about to be reached in the fixed Internet access area, and there is an increasing fight among operators for customers. Communication speeds are going up and prices down.

The bundling strategy, however, presupposes that there are advantages to be gained for customers in buying bundles of services instead of acquiring services separately. Two types of advantages are feasible. One advantage has to do with the ease of buying an arranged bundle of services and not having to worry about subscribing to different providers and setting up different solutions on your own hand. Another advantage is concerned with possible price discounts. On the other hand, customers are also concerned with being dependent on just one provider. This is the reason why we see targeted bundled offers for specific groups of customers with the aim of gaining customers or retaining customers in different fields. General offers may not be accepted by customers, as customers will be reluctant to be locked in to specific company solutions.

In all this, it however seems that the 'game' is on the customer side and not on the production side. It is difficult to make a clear case that there are economies of scope on the production side in multi-play and MVoIP combined with other data services. It can, however, be argued that there are economies of scope for customers (price discounts) and too high transaction costs in buying services from many different providers. The economies of scope thus seem to be on the consumption side. To paraphrase the concept promoted by Shapiro and Varian in their 'Information Rules' book (Shapiro and Varian, 1999) regarding demand side economies of scale, one could say that there are demand side economies of scope in bundled services.

This applies to multi-play but also applies to MVoIP when MVoIP is offered on an IMS platform together with other data services.

According to OECD's *Communications Outlook 2007*, the most fundamental and important driver in ICT development is voice telephony: "Voice has been, and still is, the key driver for the telecommunication business" (2007, p. 18). This, they suggest, may explain why the telecommunications market has attained a worth of over 1 trillion USD in annual revenues. Although this figure is impressive, a closer look at consumer spending provides a different picture. According to the abovementioned OECD study, the percentage of final consumption expenditures that households in OECD member countries spend on communications (which also includes expenditures on equipment and postal services) was 2.3% in 2004. This is not much, however, the share of communication has increased from 1.8% since 1991. The 2004 figure of 2.3% translates into USD 1,054 (OECD, 2007, p. 32). Compared to 1991, consumers now reap a substantial consumer or welfare benefit; one may be tempted to call this a gigantic, historical "free lunch" because they now obtain a broad range of new, high quality services to a comparatively much lower price. Still, the OECD-figures are sobering, because they show that the telecommunication market is an arena of competition and business opportunities where households – on average – are willing to spend only a little bit more than USD 1000 a year. By comparison, a household would probably spend more money on milk or beer. In this perspective, the ICT-market for services seems like a zero-sum game.

As shown, analysis of the present situation of multi-play and MVoIP does not give a clear indication of the direction of future development. The "dark horse" in this may be the development of broadband wireless solutions and the market demand for mobile communication services based on these. In USA and some Asian countries, WiMAX-based services seem to have promising future. In the rest of the world, the evolution towards LTE – in which telecom incumbents have hegemony – seem at present to have most success. The latter has a strong base because of the success and hegemony of GSM and its current evolution to 3G. Outside the domain of GSM, other solutions seem more promising.

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