Report from the Nordic competition authorities No. 1/2004

Telecompetition

Towards a single Nordic market for telecommunication services?

norden
Nordisk Ministerråd

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16 September 2004

Table of Contents

Table of Contents 2

Preface 4

Summary and recommendations 5

Chapter 1 The Nordic telecommunication markets 12
- Introduction 12
- The markets for fixed line telephony 14
- The markets for mobile telephony 22
- The markets for broadband access 28

Chapter 2 Sector specific or general competition legislation 33
- Introduction 33
- The need for sector specific regulation 33
- Vertical and horizontal regulators 37
- Principles for and extent of sector specific telecommunications regulation 41
- Regulating access on markets undergoing rapid technological development 50
- Nordic competition case law 52

Chapter 3 Welfare, competition and market structure on Nordic telecom markets 58
- Competition and social welfare 58
- Market structure and social welfare 60

Chapter 4 Competition between and within networks 62
- Competition between and within networks in the Nordic countries 64
- The new network technologies 68
- Promotion of competition between and within networks 72

Chapter 5 Call termination – Pockets of monopoly power 78
- Unilateral setting of domestic call termination rates 81
- Coordinated setting of domestic call termination rates 83
- Pricing of international calls 85

Chapter 6 Technological convergence and competition 90
- What is convergence? 90
- Market and policy implications of technology convergence 92
- Economic theory on horizontal and vertical integration 93
- Market developments in the Nordic countries 95

Appendix 1: One way access 105
Introduction 105
Optimal Prices 107
Calculation methods 114
Implementation 117
Conclusion 120

Appendix 2: Two way access 122
Preliminaries 123
Non-Rival Networks, Bottlenecks and Competition for Subscribers 124
Rival Network Interconnection and Two-Way Access Pricing 133
Concluding Remarks 146

References 147

Preface

International liberalisation and rapid technological development has lead to increased competition in the Nordic telecommunication industry. Increased competition on the telecommunication markets reduces the need for regulation. But will increased competition make Nordic telecommunication markets work efficiently? To answer this question it was decided to establish a working group on the Nordic telecommunication markets at the meeting between the Nordic competition authorities in August 2003.

The working group was given the task to describe the Nordic telecommunication markets, analyse the effects of competition in this particular sector, analyse the effect of horizontal and vertical integration on competition in a context of oligopoly, identify barriers to a common Nordic market for telecommunication services, analyse the interplay between competition authorities and regulatory authorities, and consider sector specific regulations' influence on markets undergoing rapid technological development.

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The working group has relied on Copenhagen Economics for the chapters 3-6 and appendixes 1 and 2. The involvement of Copenhagen Economics was only made possible by virtue of financial assistance from the Nordic Council of Ministers. The working group wishes to use this opportunity to thank the Nordic Council of Ministers for their help and cooperation.

Summary and recommendations

Telecommunication markets in rapid development

The Nordic Working Group on "Competition in the Nordic telecom sector" has examined the telecom markets in Denmark, Finland, Norway, Sweden and Iceland. The purpose of the analysis is to provide recommendations on how to promote competition in the Nordic telecom sector and point at some of the most important problems in a Nordic perspective.

The European regulation to promote competition in the European telecom sector has changed the sector dramatically since the beginning of the 1990ies. Public monopolies have been replaced by demand driven markets. Liberalisation combined with fast technological progress has brought considerable welfare benefits.

Telecommunication is of increasing importance to society. Telecommunication revenue as a percentage of GDP has increased considerably across the Nordic countries. In some countries it has doubled during the last decade. Telecommunication revenue constituted from 2.6 percent of GDP in Denmark to 3.4 percent of GDP in Sweden in 2001.

But the telecommunication industry is not only important by virtue of its direct contribution to GDP. The industry is also an important supplier to most other sectors and essential for communication between people. Telecommunication services are thus essential for interaction both between individuals and enterprises within countries and, to an increasing extent, across borders. In a wider perspective, telecommunication facilitates exchange of ideas and culture. And the number of individuals that can benefit from the possibilities offered through telecommunication is increasing as competition pushes down prices for customer equipment and end-user services.

Price comparisons across the Nordic countries indicate that there is room for further price reductions. Average fixed line spending (subscription + usage) for a comparable consumption profile is approximately 40 percent higher in Norway than in Iceland. And Danish high usage mobile customers pay 60 percent less than Swedish customers with a comparable consumption profile. Only part of these price differences is attributable to cost differences.

Penetration rates indicate the availability of telecommunication services. Measured by penetration rates, the Nordic countries are among the top performers internationally for fixed line and mobile telephony as well as Internet access, particularly through broadband technologies. Mobile and broadband services have experienced strong growth in recent years. Market liberalisation has been a crucial driver of this development.

Market liberalisation was initiated in the early 1990ies when markets for data transmission and mobile telephony were opened for competition. Liberalisation picked up speed by the end of the last century as fixed line access and voice services were liberalised as well. The current

market status is impressive considering the relatively short period of time markets have had to develop on open market conditions. As markets have matured so have consumers. Today, telecommunication services are in many aspects similar to other services or consumer goods.

Sector specific regulation – how much is necessary?

Due to different starting points when markets were opened for fixed line, mobile telephony and Internet access the needs for sector specific regulation have differed across the countries. Competition in mobile telephony has evolved as competing networks have been built and incumbents have had no significant first mover advantage. But fixed line penetration was already high when fixed line markets were opened for competition giving incumbents a significant first mover advantage. Broadband services likewise depend heavily on existing infrastructure.

Building new fixed line networks for telephony or broadband is costly but marginal costs of providing calls are very low. Once entrants have built networks with sufficient coverage to engage in serious price competition with incumbents prices are thus likely to fall to levels that do not permit entrants to recoup their investment. As part of a common European initiative in the 1990ies to promote competition in telecommunication markets, fixed line entrants have therefore been granted access to the incumbents' networks at regulated terms.

Generally, two categories of problems require regulatory intervention: one-way and two-way access. Currently, fixed line retail suppliers need access to incumbent operators' networks to be able to offer services at retail markets. This is called "one-way access" because entrants depend on access to incumbents' networks but not vice versa. One-way access will require regulation as long as absence of wholesale network competition enables incumbents to foreclose competitors at retail markets. The need for regulation of one-way access is likely to diminish as new network technologies are developed.

Two-way access concerns incumbents' and entrants' reciprocal need to terminate calls in each others' networks. Each network has a monopoly on termination of calls to its subscribers. Only countervailing buying power between operators can prevent the individual operators from monopolistic pricing practices. But even in that case, operators have an incentive to keep termination rate above costs. Two-way access may thus require continued regulation.

Telecommunications is among the most regulated sectors of all. This implies a risk of regulatory failures and of too much regulation distorting investment incentives and market development. Consumers and society in general will therefore be better off if sector specific regulation is introduced and maintained only when strictly necessary. Sector specific regulation shall be the exception rather than the rule.

As competition is gaining foothold across markets and countries, the need for regulation that better adapts to market developments has increased. By mid 2003, a new EU-regulatory framework has been implemented in national legislation in most European countries.

Under the previous framework, operators with a market share in excess of 25 percent for a given product (not to be confused with a given product market) were to be regulated. The new regulatory framework secures a greater coherence between sector specific regulation and general competition regulation. Only companies who hold a dominant position (which usually requires a market share in excess of 40 percent) on a product market as defined in competition jurisprudence can be subject to sector specific regulation in the future. In other words, only companies who are potential candidates for regulatory intervention according to general competition regulation can be subject to sector specific regulation.

Even though the new regulatory framework raises the threshold for when a company can be subject to regulation (from 25 percent to at least 40 percent market share), the Nordic competition authorities do not expect the new regulatory framework to significantly bring down the number of regulated companies and markets in the short run as the new regulatory framework paves the way for regulation of markets that have so far have been exempted from regulation (markets for international roaming, fixed line termination in entrants' networks, and wholesale broadcasting).

One market that is particularly likely to become subject to increased regulation is the market for termination of calls to mobile phones. Each mobile network has a monopoly on terminating calls to their own subscribers. In Norway, both operators' termination rates are regulated. In Sweden, Finland and Iceland mobile termination rates for some but not all operators are already regulated while all operators in Denmark have full commercial freedom to determine their termination rates. This is one reason why call termination charges for mobile is 8 - 15 times the price for terminating call on the fixed network.

When evaluating the need for regulation of mobile call termination the positive effects from high earnings on this particular service need to be taken into account. High profits on call termination increase operators' incentives to attract consumers through low prices for outgoing calls. Moreover, profits from call termination have helped build network coverage and retail market penetration. But as mobile markets mature, artificially high termination rates can do more harm than good as they distort competition because of too low prices for mobile originated calls and too high prices for calls from fixed line to mobile telephones.

Whether the new regulatory framework represents a step forward or backwards for liberalisation and deregulation depends on the remedies employed by regulatory authorities to redress current market failures. The new regulatory framework orders regulators to impose at least one remedy on any operator having significant market power (SMP), corresponding to a dominant position according to competition jurisprudence. It is important to keep in mind that, generally, holding a dominant position does not per se constitute a competition problem that calls for intervention. Regulatory authorities need to demonstrate that remedies imposed on regulated operators do not exceed what is strictly necessary to redress the problems detected on the markets in question.

More international cooperation between authorities

Increased cooperation between the Nordic competition authorities can facilitate deregulation. As competition authorities' experience builds in this and other infrastructure sectors so does the scope for better and better use of general competition regulation. Increased cooperation between competition authorities will ensure that valuable experience in one country is put to work against similar kinds of abuses in other countries. As sector specific regulatory intervention may only be used in cases where ordinary competition regulation is insufficient to adequately address the market failures concerned, increased scope for intervention using horizontal competition regulation will reduce the need for sector specific regulatory intervention in the future.

The new regulatory framework also calls for close cooperation between sector specific regulators and competition authorities at both national and international level. Closer cooperation between all authorities can lead to better understanding of the market and more appropriate use of remedies imposed on regulated companies. This objective can be achieved through closer cooperation between competition authorities and regulators at national level and by competition authorities establishing a new international forum to influence future regulation of the industry.

But uniform implementation of common regulation does not lead to a common market. Despite the progress achieved in introducing competition, markets remain national rather than international.

A common Nordic market – a long way from vision to reality

The most obvious sign of absence of a common market for telecommunication services is differences in tariffs for national and international calls. Even though prices for fixed line international calls have fallen considerably retail prices for inter-Nordic calls remain 2 - 8 times higher than prices for domestic calls.

For residential consumers, significant extra costs for cross-border calls compared to national calls imply an additional impediment to keeping in touch with Nordic friends and family members. For enterprises, separate national markets for telecommunication services make cross-border cooperation more difficult and increases costs for cross-border trade. Labour markets are affected as well, as high telecommunication costs are yet another hindrance to living in one country and working abroad or to moving to another country to find work. In all respects, Nordic integration is thus impeded by retail price structures where cross-border calls between locations only a few kilometres apart are much more expensive than long distance national calls.

The vision for a single Nordic telecommunication market where cross-border calls are more or less priced as domestic calls is thus an integral part of ambitions to further Nordic integration in business and culture, and relations between people. Internationalisation may naturally include even more countries. The creation of a single Nordic telecommunication market should therefore not bring price increases for other international calls – on the contrary, international call tariffs should generally be reduced.

Current price differences seem largely unjustified by costs. For mobile telephony, differences in mobile termination rates may to a certain degree justify price differences but not of the magnitude experienced by consumers today. This is particularly evident in the case of roaming. Norwegian customers visiting Sweden pay more than twice as much as Swedish customers for calling another Swedish customer. And Danes visiting Sweden pay more than three times as much as the Norwegians for exactly the same call. The significant price differences illustrate that even though suppliers operate in several bordering countries they still treat each country as a distinct market.

As national markets for national call origination, transit and call termination are already regulated according to sector specific regulation and markets for international transit are relatively competitive, high end-user prices do not appear attributable to problems at wholesale level. Consumers may spur competition and thereby lower prices by using opportunities already present in the market (e.g. various types of low cost carriers). It is therefore important that national competition authorities as well as regulators cooperate with national consumer authorities to find ways to encourage consumers to find and use these opportunities.

Introduction of IP-telephony to residential customers may lead to lower prices for international calls as some providers of IP-telephony already offer free calls between their end-users irrespective of call destination. There are strong positive network effects in this pricing policy. If these operators achieve a sufficient number of consumers this will in itself induce new users to join. It may therefore suffice to add momentum to a development already on the way.

The Nordic competition authorities will monitor the development closely and give priority to removing obstacles to increased internationalisation. But the creation of a single Nordic telecommunication market, where geographical borders become irrelevant and where fixed and mobile technologies compete to an ever greater extent, depends both on consumer and

supplier behaviour and may therefore take years to achieve. The competition authorities will therefore also strengthen their contact to the sector regulators to keep cheaper international calls on the agenda. Finally, the authorities will strengthen cooperation with the European Commission/the EFTA Surveillance Authority in order to increase European efforts to step up internationalisation.

Problems are even worse for international termination of mobile calls than for fixed line calls. Retail providers of mobile services relying on third party access to mobile networks depend completely on their network provider to supply international access. Network operators can therefore limit competition on mobile originated international calls by keeping wholesale prices high.

For mobile telephony there is an additional problem. A basic prerequisite for trans-national markets is low-cost access to mobile networks in areas where the individual operator's own network does not provide coverage. Such network access is called roaming. Prices for roaming in foreign countries (international roaming) are determined in commercially negotiated contracts between mobile operators. Wholesale as well as retail prices have so far been high. National regulatory authorities are currently analysing national wholesale markets for international roaming. Regulatory authorities are obliged pursuant to common European legislation to impose one or more remedies on operators if they are found to hold a dominant position on the markets.

In most countries there are several mobile networks with national coverage. But until recently, techniques directing roaming consumers' handsets to connect to a preferred network have not been available to an extent allowing buyers of roaming to direct an appreciable proportion of consumers onto the cheapest network. Since buyers of roaming were unable to respond to high prices by changing supplier, all suppliers had an incentive to keep wholesale prices high. This may be the primary reason for the high roaming prices experienced so far.

Techniques used to direct consumers onto a preferred network when roaming in foreign countries are gaining ground. But operators buying roaming may still need to enter roaming agreements with several local suppliers to secure the desired quality of service. It is therefore uncertain how strong competition will become at wholesale level in the short to medium term. And even if competition at wholesale level does lead to lower wholesale prices it is not certain that retail customers will benefit from this. Caution and further analysis is therefore warranted when potential regulation of roaming markets is considered. Particularly because price regulation unduly can distort market development while technical development in itself might lead to effective competition on the markets.

Challenges for fixed network competition

Providers of telecommunication services depend on network access to be able to compete at retail level. Telecommunication networks are characterised by significant fixed costs and low marginal costs creating considerable economies of scale and scope. This is one of the most important reasons for the ongoing consolidation in the telecom sector. But benefits of increased concentration in the form of increased economies of scale may be offset by the effects of weaker competition.

Economic analyses show that even few market players may be sufficient to secure workable competition. In contrast to mobile markets, network competition on fixed line markets is relatively weak. Cable-TV networks are due to their geographical roll-out the most likely source of network competition.

In most Nordic countries (except Sweden and Helsinki metropolitan area) incumbent operators still own and control the largest cable-TV providers. This reduces competition between cable-

TV networks and PSTN (fixed line telephone) networks significantly. Forced divestiture of incumbents' cable-TV operations is not practically feasible except as when considered an appropriate remedy in a merger case.

Absence of fixed line network competition makes non-discriminatory access to incumbents' infrastructure a key issue for entrants. Discrimination may come in many forms; e.g. discounts favouring large operators or particularly cumbersome procedures when entrants order technical assistance at incumbents' exchanges. Non-price discrimination is often as detrimental to competition as non-cost based price discrimination and as the quality of price regulation increases more cases addressing discriminatory practices can be expected.

Entrants' dependence on access to incumbents' networks does not only call for intervention by regulatory authorities. Competition law has been a powerful tool for combating abusive behaviour by dominant companies in this sector as well and competition authorities have been called upon several times to intervene against potentially abusive practices like margin squeeze and predatory pricing exercised by incumbents. Most Nordic countries are currently dealing with such cases and case law is developing rapidly. As experience increases, so does awareness of other kinds of abuses preventing entrants from competing on a level playing field.

But despite all efforts, incumbents' markets shares for fixed line subscriptions remain relatively high. End-user prices for subscriptions have increased considerably in all Nordic countries. Part of the reason for this relatively poor performance is absence of profitable ways for entrants to offer fixed line subscriptions. In some countries, entrants have no choice but to rely on access to the local loop. But margins between retail prices for fixed line subscriptions and wholesale access to the local loop are often insufficient to allow efficient entrants to profitably undercut incumbents' retail prices. Only in Norway and Denmark do entrants have access to resale of incumbents' fixed line subscriptions. But even in those countries competition remains relatively weak on the markets for fixed line subscriptions.

Recommendations

On this background the competition authorities present the following recommendations. The recommendations are based on experiences from all countries and some countries may therefore already fulfil some of them. The recommendations are made without prejudice to the market analysis currently being carried out by regulatory authorities and future regulation based hereupon.

The Nordic competition authorities recommend:

To promote common Nordic markets by

- Monitoring market development closely and give priority to eliminating obstacles to increased internationalisation.
- Recommending suppliers of wholesale mobile access to allow retail providers to buy international call interconnection from third parties.
- Informing consumers about possibilities for low cost international calls.
- Contributing to the regulatory authorities' ongoing analyses of the need for regulation of markets for international roaming. The competition authorities recommend that the analyses take into account that price regulation can unduly distort market development and that technological development in itself might lead to effective competition on the markets shortly.

To promote dynamic market driven price and product development through deregulation by

- Reducing and phasing out sector specific regulation as soon as the competitive situation permits markets to develop dynamically and balanced. Regulation should both promote investment in replicable infrastructure and make it easier for new companies to establish themselves and expand in the market.
- Reviewing the need for sector specific regulation restrictively. Regulation according to the new regulatory framework is already subject to periodic review. An essential element in the reviews is whether general competition regulation is regarded as sufficient to achieve effective competition. To ensure a strong focus on deregulation, NCAs should have a central role in assessing the need for regulation in each specific market. Sunset clauses should be introduced in sector regulation not already subject to periodic review.

To secure a level playing field across markets, incumbents and entrants by

- Intervening swiftly against abusive behaviour by incumbents; particularly in cases of margin squeeze, discriminatory business practices (including non-price discrimination) and other abuses directly attributable to incumbent operators' vertical integration. Introduction of interim measures shall be considered.
- Eliminating possible distortions to competition created by too high mobile termination rates. Possible intervention shall take due account of the individual networks' unique characteristics, overall market position, and intervention's effects on competition on mobile access to avoid overregulation.
- Promoting service provision or resale of fixed line access and broadband delivered by incumbents via PSTN or cable-TV networks in all Nordic countries. Prices shall be set so as to ensure viable entry and yet maintain entrants' incentives to invest in new infrastructure.
- Focusing on limiting detrimental effects of horizontal and vertical integration of dominant telecom networks and cable-TV networks in case of mergers or joint ventures.

To push for less and better regulation through increased international cooperation by

- Increasing effectiveness of competition law enforcement. Increased cooperation between the Nordic competition authorities will allow authorities to draw on each others' experiences making competition law an even more powerful instrument to address at times complex issues in the sector thereby decreasing reliance on sector specific regulation.
- Seeking closer cooperation with regulatory authorities. Closer cooperation between all authorities can lead to better understanding of markets and more appropriate use of remedies imposed on regulated companies. This objective can be achieved through closer cooperation between competition authorities and regulators at national level and by competition authorities establishing a new international forum to influence future regulation of the industry.

Chapter 1 The Nordic telecommunication markets

Introduction

In this chapter, general trends and developments on the markets for telecommunication services in Denmark, Iceland, Norway, Sweden and Finland are described. First, markets for fixed line telephony are described. Then, focus turns to markets for mobile telephony and, at last, Internet services.

Telecommunication markets have generally been very dynamic and any comparison of prices, usage, penetration and market shares will thus only provide snapshots of the market situation at a given time. The data used in this analysis have the following features:

- Wholesale and retail prices are from June 2004. Only the incumbent operators' prices are reported. Actual prices experienced by customers in general depend on the price development of entrants as well. But competition from entrants will induce incumbents to respond by lowering their prices as well. A comparison of incumbents' prices alone will therefore to a certain extent reflect overall market conditions. All prices are exclusive VAT[1] to best reflect market conditions.
- Usage, penetration and market shares are calculated as of the end of 2003. For broader international comparisons the most recent available data is used.

All national Nordic telecommunication markets have been liberalised in order to introduce competition. In all the countries, mobile telephony was the first market exposed to competition followed by data, fixed line minutes and eventually fixed line access. Empirical studies by Boylard and Nicoletti[2] indicate that liberalisation in itself, even before competition actually emerges, has positive effects for consumers and society as such. An interesting parameter for market development is penetration rates for different services measured as customer relationships per 100 inhabitants.

[1] VAT rates range from 22 in Finland over 24 percent in Norway, 24½ in Iceland to 25 in Sweden and Denmark.

[2] Olivier Boylard and Giuseppe Nicoletti (2001), "Regulation, Market Structure and Performance in Telecommunications", *OECD Economic Studies* No. 32.

Table 1.1: Penetration overview (2003)

	DK	FIN	IS	N	S	EU 15	OECD
Main telephone lines	67	49	66	73	74	56	51
Mobile	89	90	97	91	89	84	63
Internet access	51	51	67	50	57	39	39
Broadband	13	10	15	8	11	6	7

Source: ITU at http://www.itu.int/ITU-D/ict/statistics/ (Main telephone lines, Mobile and Internet) and OECD at http://www.oecd.org/document/31/0,2340,en_2649_34223_32248351_1_1_1_1,00.html
Note 1: Penetration is measured as customer relationships per 100 inhabitants.

Mobile penetration and penetration of main telephone lines have apparently reached saturation levels in all the five countries. In some countries, penetration of main telephone lines has even stagnated lately.

In all the Nordic countries[3], mobile penetration soared during the 1990es and is at present slightly higher than in the rest of Europe. As to broadband, all the countries have penetration rates above OECD and EU15 averages. During the last six months of 2003 the number of broadband users rose between 18 percent (in Denmark and Sweden) and 56 percent (in Finland). High growth rates in Finland and Norway reflect that these countries have been catching up with the other countries. Iceland experienced an increase in broadband penetration of almost 30 percent during the same period and has thus been increasing its lead among the Nordic countries.

To better explain the Nordic countries' different starting points for fixed line and mobile penetration, the countries' individual demographic and geographic characteristics are taken into account. Higher population density and degree of urbanisation decrease network construction costs reflecting the economies of scale inherent in telecommunication networks. Network construction costs depend to a greater degree of geographical roll-out of the network than of number of customers served. This in turn influences the possibilities to reap the benefits of economies of scope as well because it can prove difficult to achieve a sufficient customer basis for add-on products in scarcely populated areas to profitably exploit economies of scope.

As illustrated in table 1.2, there are large differences in population density and degree of urbanisation across the Nordic countries.

Table 1.2: Population density and urbanisation (2002)

Country	Inhabitants per km^2	Urban population (percent of total population)	GDP per capita (2003 estimates)
DK	125	85	31,200 $
FIN	14	59	27,300 $
IS	3	93	30,900 $
N	14	75	37,700 $
S	20	83	26,800 $

Source: ITU at http://www.itu.int/ITU-D/ict/statistics/ (inhabitants per km) and Development data Group, World Bank http://www.worldbank.org/data/countrydata/ictglance.htm (urbanisation), CIA http://www.cia.gov/cia/publications/factbook/rankorder/2004rank.html (GDP)

Denmark has by far the highest population density and a relatively high degree of urbanisation. Theoretically, Denmark should therefore have the best preconditions for roll-out of competing networks. GDP per capita varied approx. +/- 8 percent around an average of 29.000 $ pro

[3] In this report the term "the Nordic countries" refers to Denmark, Finland, Iceland, Norway and Sweden.

annum in 2003 for all countries but Norway, whose GDP per capita exceeds average GDP for the other countries by 30 percent.

The importance of population density and urbanisation depends of the relevant service and the level of penetration. National coverage is e.g. often a crucial feature for buyers of mobile services. Since population density affects the potential profitability of covering a particular geographic area, it affects the economic basis for competing networks and thereby entry barriers. The degree of urbanisation influences primarily how fast and at what costs entrants can cover a significant part of the population with their own network, thereby gaining independence of the incumbent operator's network. The degree of urbanisation also provides an indication of the proportion of customers operators can cover without having to invest in less densely populated areas, where investments may be more difficult to recoup.

Price comparisons are made in Euros, the national currency in Finland. All the other countries have different national currencies. All price comparisons carried out in chapter one are based on average exchange rates from the period 1 July 2003 to 30 June 2004. The maximum deviation from the average exchange rate was in Norway, where the highest price for a Euro has deviated slightly more than 6 percent from the average exchange rate. All in all, exchange rates have been fairly stable and cross-country comparisons can be carried out with only a minimum of caution on this account[4].

The markets for fixed line telephony

Fixed line markets (for subscriptions and traffic) were the last markets to be liberalised in the Nordic countries. In Sweden, there has never been legislation preventing potential competitors from entering the market. But no competitors actually did enter the market before carrier selection was introduced by law for international calls (1993) and national long distance calls (1994). The development in Sweden thus illustrates that merely opening the market for competitors without securing them access to the incumbent's network does not suffice to create competition.

Different starting points for the liberalisation have yielded different results. Before the liberalisation, customers in Finland were served by a range of local monopolies as well as a state owned operator (presently TeliaSonera), which mainly operated in sparsely populated areas but also was the sole provider of long-distance and international calls until 1993. The market opening has resulted in joint ventures as well as competition between the different local incumbents. Denmark, Sweden, Norway and Iceland all had national monopolies prior to liberalising of their markets[5]. These different market structures may have had an impact on the development of competition.

The introduction of call-by-call carrier selection[6] and carrier pre-selection[7] has enabled entrants to specifically target profitable market segments for fixed line traffic. Prices for fixed to mobile and international calls have generally been reduced. National calls to fixed line telephones,

[4] Exchange rates vis-à-vis Euro (1 July 2003 to 30 June 2004)

	Denmark	Iceland	Norway	Sweden
Low	7.4253	86.1214	8.0441	8.8850
Average	7.4388	88.1205	8.3418	9.1262
High	7.4524	90.3098	8.8602	9.3142
Difference high/low (percent)	0.36	4.86	10.15	4.83

Source: Danmarks Nationalbank (Danish Central Bank) daily observations. The average exchange rate is calculated as a simple average of all daily observations.

[5] In Denmark regional carriers were merged into one national monopoly before markets were liberalised.

[6] Customers can choose which operator to use for each call by dialling an access code/prefix before dialling the called party's phone number.

[7] Instead of dialling a prefix at the beginning of every call customers can choose to have the prefix of their operator of choice programmed into the network. Customers then use this operator for all calls.

particularly regional and long-distance calls, have seen at times dramatic price reductions. In some countries (Sweden and Finland) local call prices have increased, which can reflect both a rebalancing of prices towards more cost-oriented prices (which eventually will facilitate entry) as well as incumbents' market power. In Finland, the incumbents generally have market shares of almost 100 percent on local calls.

Iceland has had uniform tariffs during the entire period in question. But in Denmark, Sweden and Norway, differentiated tariffs for local, regional and long distance calls have been rebalanced into uniform national tariffs. The rise in Swedish local tariffs is therefore an integral part of the price reductions for long distance calls and average prices have fallen significantly in Sweden.

For all the Nordic countries, international call charges have been reduced significantly since markets were opened. The Finnish market for international calls was opened already in 1993. Since 1995, average prices for international calls have fallen 42 percent in Finland. The same applies for long distance calls in Finland where recent price increases in part reflect a recovery in prices after fierce competition pushed down prices dramatically after the market was liberalised.

Even though international calls have seen dramatic price reductions there are still significant differences in the pricing of national and international calls. Even in countries bordering each other prices for calls from a border town to just the other side of the border far exceed prices for a national long-distance call. Differences in minute prices for local calls and a call to a bordering country range from 57 to more than 500 percent; cf. table 1.3. A common Nordic market for fixed line traffic apparently has not arisen so far.

Table 1.3: Indexed price comparison for a 3 minute peak hour fixed line call (2004)

		Call destination				
		DK	FIN	IS	N	S
Call originating in	DK	100	325	775	190	190
	FIN	338	100	678	338	338
	IS	764	837	100	764	764
	N	179	267	493	100	179
	S	171	171	289	171	100

Source: Incumbent operators' official price lists.

General increases in subscription fees and reductions in minute charges illustrate the so-called rebalancing between the two revenue components putting an end to previous cross-subsidisation of subscription fees from minute charges. Previously, such pricing regimes were intended to make fixed line telephony available to low-income users. But this artificial pricing regime had to be changed as markets were opened for competition and access and traffic were separated into individual markets through introduction of carrier selection and carrier pre-selection. Otherwise, entrants would have been unable to enter the cross-subsidised segments and, on the other hand, would have eroded the incumbents' revenues, which otherwise should have covered the costs of providing universal services. Cross-subsidies between rural and urban customers still prevail. The risk of cream-skimming is kept at bay though through uniform national wholesale prices. Current end-user prices across the Nordic countries are compared in table 1.4.

Table 1.4: PSTN tariffs excl. VAT (2004)

Country	Monthly rental (€)	Fixed – fixed		Fixed – mobile	
		Peak	Off-peak	Peak	Off-peak
DK	12.80	3.70	2.04	19.28	10.31
FIN	10.20	5.18	3.72	23.49	17.78
IS	10.35	2.64	1.72	15.97	15.14
N	15.37	4.17	2.82	15.60	15.60
S	10.96	3.50	2.03	26.06	17.29

Note 1: Average call tariffs are calculated as €-cent per minute for call pattern as defined in the OECD PSTN residential composite basket.
Note 2: The definition of peak hours differs between the five countries: Denmark: Monday - Saturday 0800 – 1930; Finland: Monday - Friday 0800 – 1700; Iceland: Monday – Friday 0800-1900; Norway: Monday – Friday 0800-1700 and Sweden: Monday – Friday 0800 – 1800.
Source: Prices calculated by Nordic competition authorities on the basis of incumbent operators' price lists.
Note: Finnish prices are for Elisa Communication's basic home line subscription.

Norway has, by far, the highest subscription fee. Norwegian minute charges are in the high end as well leading to the highest monthly spending for the OECD fixed line composite basket (see box 1.1 for further details on composite basket comparisons).

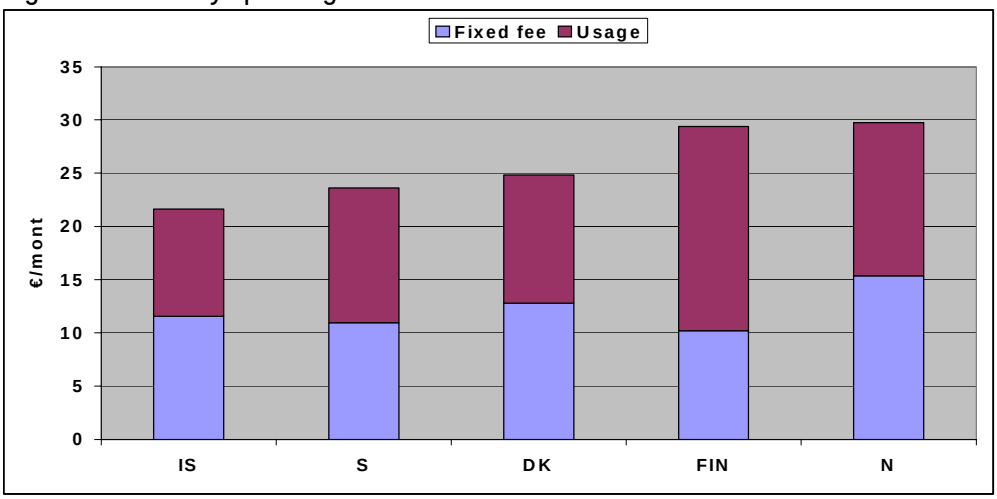
Box 1.1: OECD composite basket

In order to compare end-user prices across borders, total costs are calculated for different user profiles where call duration, call destination and the number of calls are assumed to be identical in all countries. The OECD composite baskets include subscription fee, national and international fixed line calls and calls to mobile networks. The baskets are defined for fixed line and mobile for both business and residential users. The present report focuses exclusively on residential customers and national calls. Price comparisons for business users may yield a different result as business users often are able to achieve more favourable terms.

Differences in underlying costs and regulation as well as in terms for competition can be the reason for the apparent differences in overall prices and the distributions between the fixed and the variable components of total end-user expenditure. Monthly expenditures for a domestic fixed line basket are compared in figure 1.1.

Before turning to the results of the cross-country comparison, a word of caution is necessary. When comparing prices for a consumption basket, potential national differences in calling patterns are neglected. Prices quoted for a consumption basket therefore do not necessarily reflect actual spending for an average consumer in the respective countries. In the following, the prices indicated show what a consumer with *one particular call pattern* would pay if he bought the cheapest possible fixed line subscription of the incumbent operator in each country.

Figure 1.1: Monthly spending for a residential fixed line basket excl. VAT



Source: Prices calculated by Nordic competition authorities on the basis of incumbent operators' price lists.

Customer expenditures in Sweden and Denmark are approximately in line with one another as is the case for Finland and Norway. The balances between fixed fee and usage are slightly different in both cases with a greater proportion of revenue generated from usage in Sweden than in Denmark and in Finland than in Norway. Differences in overall expenditure between the cheapest country (Iceland) and the most expensive country (Norway) are significant. Average spending in Norway is approx. 40 percent higher than in Iceland for a comparable consumer profile. These differences can be the result of different degrees of competition as well as differences in underlying costs and terms for competition.

The actual intensity of competition is difficult to measure. One of the most tangible measures for competition is competitors' ability to acquire market shares. Concentration is relatively high in all the countries compared to other sectors. In all the countries, concentration is higher on the market for fixed line subscriptions than on the market for fixed line minutes, cf. table 1.5. This can in part be a reflection of the fact that markets for minutes in practice were opened for competition before markets for subscriptions. Another, maybe even more important, explanation can be a far stricter regulation of wholesale inputs for minutes than for subscriptions as illustrated later in this report.

Table 1.5: Fixed line market shares as of December 2003

Country	Number of operators	Subscribers				Minutes sold			
		CR1	CR2	CR4	HHI	CR1	CR2	CR4	HHI
DK	17	84	90	97	7042	63	76	85	4166
FIN	47	95	N.A.	N.A.	9025	38	70	100	3118
IS	3	92	98	100	8594	83	94	100	7208
N	24	92	94	98	8400	69	82	88	4900
S	30	~100	N.A.	N.A.	8836	54	68 (est.)	75 (est.)	3248

Note 1: "CR" refers to concentration rates. CR1 is the market share of the biggest company on the market. CR2 is the sum of the two biggest companies' market share etc.
Note 2: HHI refers to the Hirschman-Herfindahl index. The index is calculated by adding up all suppliers' markets shares squared.
Note 3: Due to Finland's particular market structure, market shares for subscriptions are determined as an average of incumbents' local market shares. Market shares for minutes are estimates based on long distance traffic.
Note 4: For residential customers, the Swedish competition authority estimates that TeliaSonera's market share is close to 100 percent. CR1 in Sweden for subscribers can be estimated on total industry revenue minus traffic and "Other" revenues as quoted in "The Swedish Telecommunications Market 2003". CR1 will then be no less than 94.
Note 5: Swedish market shares for minutes are calculated on the basis of traffic revenues rather than volume. CR2 and CR4 are estimates based on 2002 market shares.
Note 6: CR1 and HHI for Iceland are from 2003 whereas CR2 and CR4 are estimates based on 2002.
Source: Nordic competition authorities' calculations based on data from the Nordic regulatory authorities.

Disregarding Finland, the incumbents' market shares range from 54 percent in Sweden to 87 percent in Iceland measured by minutes sold. For subscriptions, the incumbents' market shares span from 83 percent in Denmark to approximately 100 percent in Sweden. So even though entrants have been somewhat successful in obtaining viable market shares on the markets for minutes, they are still struggling to gain foothold on the markets for subscriptions. The apparently weak competition on subscriptions is particularly worrying because not even general increases in subscription fees during the past 5 years seem to have permitted entrants to gain market shares to an appreciable extent. This may both reflect that wholesale terms have worsened as prices have increased and entrants therefore have been unable to benefit from the price increases or just indicate that even though terms for entry have improved they are still not good enough.

Finland is a particular case because of the many local monopolies prior to the liberalisation. Market data gathered at a national level therefore does not necessarily reflect the true market situation because the former monopolies still may hold strong positions on their former "home markets". In fact, in a decision taken by the Finnish regulatory authority March 1st 2004 concerning the market for local calls, 41 operators have been found to possess significant market power on their home market, which corresponds to a dominant position. An indication of customers' propensity to switch operator can be found in the European Commission's 9th implementation report. In 2003, the Commission found that 5 pct. of Finnish customers used an alternative operator for access. 5 pct. of the customers used carrier selection for local calls compared to 65 pct. for long-distance or international calls.

In all the countries, incumbents are subject to universal service obligations (USO). Incumbents are thus required to provide basic telephony services to anyone requiring such services. Only in Denmark can the incumbent apply for financial compensation for the costs of USO. In Denmark and Sweden, USOs have been coupled with price-caps on subscription fees thereby implicitly cross-subsidising customers in scarcely populated areas with revenues from densely populated areas. Competition therefore implies a risk of cream-skimming since entrants can choose only to focus on the profitable market segments.

Box 1.2: Local loop unbundling

Local loop unbundling means that incumbents are required to lease access to the access line (the local loop) connecting end-users to the telephone network. The local loop is "unbundled" because incumbents are not allowed to condition lease of the local loop on purchase or lease of additional services. Entrants can use access to the local loop to provide e.g. fixed line subscriptions and broadband Internet access.

So far, problems of cream-skimming have not arisen since competition on access products is ailing and local loop unbundling (see box 1.2) in general has been unsuccessful in providing competition on PSTN[8] access. By the end of 2003, Iceland performed best of all the Nordic countries with 12 percent of the local loops unbundled. Finland lead the rest of the countries with merely 3.9 percent of the local loops unbundled followed by Norway that has experienced an impressive growth in the number of unbundled lines so that 2.5 percent of the total stock of loops were unbundled by the end of 2003. Denmark trails Norway with 2.1 percent of the local loops unbundled cf. table 1.6.

[8] PSTN is an abbreviation of Public Switched Telephone Network and refers to what has become the standard subscription type for residential customers.

Table 1.6: Deployment of local loop unbundling (2003)

	Total local loops	Full access	Shared access	Total unbundled	Unbundled ratio (percent)
IS	192,552	12,074	10,953	23,027	12.0
FIN	2,600,000	78,600	22,000	100,600	3.9
N	3,244,500	NA	NA	79,614	2.5
DK	2,990,849	50,791	15,888	66,679	2.2
S	5,500,000	6,214	45,699	51,913	0.9

Source: Broadband access in the EU: situation at January 2004 plus statistics from Nordic regulatory authorities.

Most of the loops unbundled are used for providing broadband access alone. Data from March 2003[9] suggests that only 0.6 percent of the total loops in Finland were unbundled with the aim of providing telephony at that time. In Denmark, the corresponding figure was 0.01 percent. In Sweden all the unbundled loops were used for broadband. So far, broadband thus seems to be the primary beneficiary of local loop unbundling whereas competition on markets for PSTN seems largely unaffected.

IP-telephony[10] has already been introduced in Norway to residential users and is expected in Denmark and Sweden shortly. This may change the otherwise gloomy outlook for competition on fixed line access through local loop unbundling. IP-telephony as an add-on to broadband access may spur demand for broadband while providing a more solid revenue basis for alternative providers of telephony than PSTN has done so far.

It is indisputable that local loop unbundling so far has failed to create competition on PSTN subscriptions. One may argue that the original intention of local loop unbundling was to create the prerequisites for broadband competition rather than competition on PSTN subscriptions. Such argument does not take at least one essential feature into account. First of all, in many countries there are no alternatives to using local loop unbundling for an entrant wishing to provide PSTN subscriptions. If local loop unbundling fails to promote competition on PSTN subscriptions competition thus cannot arise at all as entrants are unlikely to achieve lower costs, at least in the short to medium run, by building their own networks.

Part of the reason for the difficulties in making local loop unbundling promote competition on fixed line telephony is the margin between the incumbents' retail PSTN price and the wholesale price for access to the local loop. Gross margins for the Nordic countries are shown in table 1.7.

Table 1.7: Contribution margin for PSTN using LLU (June 2004)

Country	Retail monthly rental (residential) excl. VAT	Access to the local loop			Average monthly gross margin
		Connection setup fee	Monthly rental	Monthly average access charge	
DK	12.80	46.38	8.61	9.39	3.41
IS	11.57	23.88	9.24	9.63	1.94
S	10.96	74.51	7.78	9.02	1.94
N	15.37	126.59	11.99	14.10	1.27
FIN	10.20	200.00	9.60	12.93	-2.73

[9] "Remedies for Broadband Services"; Paper prepared for DG InfoSoc by Martin Cave. September 2003.

[10] IP refers to Internet Protocol. IP-telephony is telephony via the Internet build. IP-telephony is feasible even at low bandwidth but to deliver a quality of service comparable to PSTN it would usually take a broadband connection.

Note 1: Customer relationships are assumed to last for 60 month.
Source: Calculations performed by Nordic competition authorities on the basis of data from incumbents' official price lists and standard offers for wholesale network access.

In Denmark, Sweden, Norway and Iceland there are positive gross contribution margins for competitors using the unbundled local loop to offer PSTN subscriptions. But even in those cases there is a long way to profitability since an operator using the local loop also has to pay for collocation[11], technical equipment, maintenance, and customer services etc.

Only in Sweden and Norway is it possible for entrants to get access to the local loop at reduced rates when providing PSTN/ISDN subscriptions. In all the other countries an entrant that wishes to supply only PSTN telephony to a customer still needs to buy traditional full access to the local loop even though the full potential of the connection is not used.

Margins improve considerably if entrants sell both PSTN and ADSL to the same customer. But the group of customers that entrants profitably can compete for is restricted considerably if entrants rely on this possibility alone as only customers that buy ADSL and PSTN from the same supplier are commercially interesting for entrants. Even though ADSL penetration is relatively high in the Nordic countries, this group of customers remains limited. As a more general consideration it is questionable whether it is desirable that entrants have to bundle two products (ADSL and PSTN) in order to be able to compete on the market for one of the products (PSTN).

Entrants' only incentive to invest in local loop unbundling is thus expected additional income from traffic or the possibility to exploit the economies of scope associated with offering PSTN and ADSL to the same customer using the same access-loop.

In Denmark and Norway entrants can also buy the incumbents' PSTN end-user products with a wholesale discount and resell the product at retail level. Wholesale discounts to resellers range from 18 percent in Norway to 21 percent in Denmark thereby enabling entrants to compete on prices. Resale of incumbent subscriptions is the main reason for the relative success for entrants in Denmark and Norway in gaining market shares compared to entrants in other Nordic (or European) countries.

Resale of incumbent products has the drawback that it may discourage investments in independent production platforms for entrants. Too favourable terms for resellers may therefore prevent emergence of network competition.

The absence of positive contribution margins for competitors offering PSTN via the local loop is either attributable to too low retail prices or too high access prices. Price differences are biggest at the wholesale level. Average monthly access charges in Norway are more than 50 percent higher than charges in Sweden. Price differences might actually reflect different costs of granting access across the region. It is much more expensive to build fixed line networks in Norway than e.g. in Denmark because of Norway's lower population density and more rugged terrain. It is beyond the scope of this report to evaluate whether prices reflect actual costs but it seems surprising if cost differences can justify that access prices in the Helsinki metropolitan area are more than 30 percent higher than access prices in Danish urban areas.

Similar differences in wholesale prices prevail for traffic charges as illustrated in table 1.8.

[11] Location of entrants' network equipment at incumbents' exchanges

Table 1.8: Peak hour fixed line access and interconnection charges (per minute)

	Access			Termination		
	Local	Single transit	Double transit	Local	Single transit	Double transit
DK	0.49	0.66	0.84	0.43	0.66	0.84
FIN	0.96	1.18	2.64	0.96	1.18	2.64
IS	0.49	0.49		0.49	0.49	
N	0.71	0.84	1.05	0.71	0.84	1.05
S	0.68	0.91	0.97	0.68	0.91	0.97

Note 1: Double transit access and termination does not exist in Iceland.
Note 2: Prices are calculated for a 3 min. peak hour fixed line call
Source: Calculations performed by Nordic competition authorities on the basis of data from incumbents' standard offers for wholesale network access + the European Commission's ninth implementation report.

As an illustration of the consequences of the different wholesale prices, contribution margins for a three minute local call in the Nordic countries are calculated in table 1.9. New operators are not always present at local level. In some cases, entrants therefore have to buy single or, in rare cases, double transit access and termination to provide a local call. This influences entrants' contribution margins significantly, cf. table 1.9.

In Norway local exchanges cover relatively vast areas. Changes currently being implemented to the Norwegian network architecture will lead to only 12 local exchanges across the country. In comparison, there are 111 local exchanges in Denmark.

Table 1.9: Peak hour avg. contribution margin in €-cents

Level for access and termination:	DK	FIN	IS	N	S
- Local	2.67	2.18	1.52	2.52	1.98
- Single transit	2.25	1.74	1.52	2.26	1.52
- Double transit	1.90	-1.18		1.83	1.40

Note: Prices are calculated for a 3 min. peak hour fixed line call
Source: Calculations performed by Nordic competition authorities on the basis of data from incumbents' official price lists and standard offers for wholesale network access + the European Commission's ninth implementation report.

The higher the contribution margin, the better the possibility for an entrant to undercut incumbents' prices and still make a profit. Denmark and Norway present the highest contribution margins followed by Finland and Sweden where contribution margins are 13-26 percent lower. Lower margins may be attributable to more fierce competition, less strict wholesale price regulation or historical reasons (e.g. end-user price regulation) that has led to relatively low end-user prices.

In all countries but Iceland, gross contribution margins fall by 10-23 percent if operators buy access and termination at single transit level instead of local level. The price differences in part reflect greater investment requirements for operators present also at lower levels in the network hierarchy. In all countries but Finland, entrants achieve positive gross contribution margins even when producing a local call implies buying double transit access and double transit termination. This reduces entry barriers as entrants who are only present at a limited number of collocation sites still profitably can offer local telephony.

Gross margins constitute from 53 to 74 percent of minute retail prices if access and termination are bought at local level. Gross margins for subscriptions based on access to the local loop range from -27 to 27 percent. One has to be careful making such comparisons but it does seem to be easier to enter the markets for traffic than the markets for subscriptions.

Price differences at retail level are in part attributable to different balances between subscription fee and minutes (illustrated by positive and negative contribution margins for traffic and access respectively). Whereas network construction costs are determined by exogenous factors, retail prices do not face similar constraints. Current imbalances in retail pricing are thus to a certain extent the result of political objectives such as a high penetration of fixed line services, which in general means setting subscription charges low and usage dependent charges high. The countries' different regulatory regimes for retail prices are summarised in table 1.10.

Table 1.10: Price regulation of PSTN

Country	Nature of price regulation	
	Subscriptions	Traffic
DK	Price cap prevents price increases	No regulation
IS	No regulation	No regulation
N	No regulation	No regulation
S	No regulation	No regulation
FIN	No regulation	No regulation

Source: Nordic competition authorities.

Only in Denmark do remnants of end-user price regulation remain in place. The incumbent is subject to a price cap on subscriptions in Denmark. Regulation of minute prices was repealed in 2003.

In Sweden, the incumbent, Telia, was subject to a price cap between 1993 and 2000. Since then, prices regarding PSTN have been regulated solely pursuant to the Telecommunications Act and in Telia's licensing conditions. According to the Act, the tariffs for the use of telephony services between fixed network termination points within a public telecommunications network were to be based on costs, if the service was provided by a telecommunications operator that had SMP-status. According to transitional provisions, this price regulation has been in force until 24th July this year. The regulatory authority will, however, take new decisions regarding PSTN prices in accordance with the Electronic Communications Act.

In Finland, local incumbents were required to demonstrate that prices for local calls were cost oriented until price regulation was abandoned by April 2004.

In Norway, the SMP-operator was subject to end-user price regulation until 2002. Telenor was subject to a price cap regulation on a basket of end user products (subscription, traffic and leased lines) until the end of 2002. In addition, under the previous Norwegian Telecommunications Act, SMP operators were required to provide services at cost oriented prices, also for end user products. Today, no such requirements are applied and regulation is focused on securing cost oriented prices at wholesale level.

The markets for mobile telephony

Mobile telephony is of increasing importance in the Nordic countries for customers as well as operators. All the countries have mobile penetration rates above the EU average (81 percent) and presumably close to saturation levels. For the telecommunication sector in general, revenues from mobile telephony constitute an increasing share of annual turnover, cf. table 1.11.

Table 1.11: Mobile telecommunication revenue as percentage of total revenue

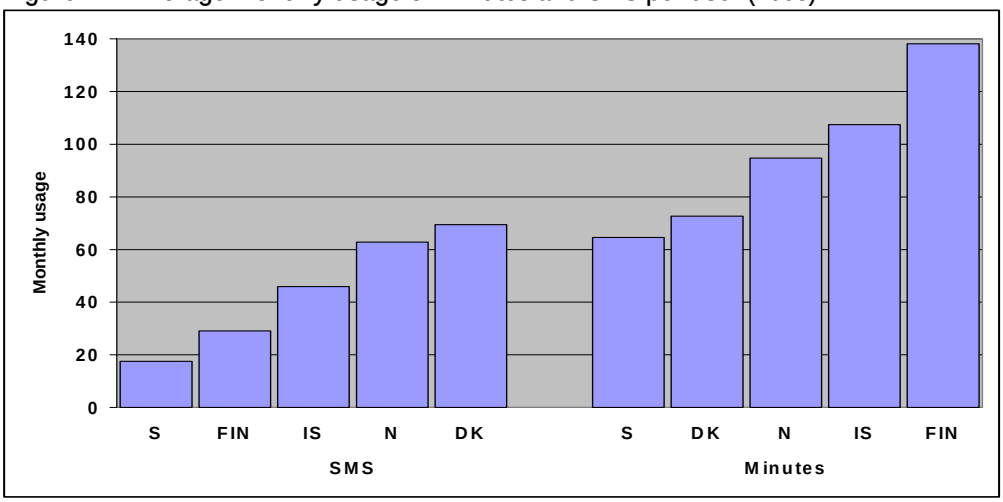
	1995	1998	1999	2000	2001
IS	13	21	24	44	48
FIN	20	36	39	42	42
N	15	25	27	27	25
S	12	18	21	23	25
DK	8	22	24	24	24

Source: OECD Communications Outlook 2003

Revenues generated by mobile telephony constitute an increasing share of total revenues. In most countries, the share has more than doubled from 1995 until 2001. Iceland tops the list with almost half of total revenue generated by mobile services. Finland trails Iceland by a narrow margin. In Norway, Sweden and Denmark, mobile revenue account for approximately 25 percent of total revenue.

As prices for mobile services have generally decreased, it is increasing consumption that drives mobile telephony's increased proportion of total turnover. Usage of minutes and SMS has increased dramatically over the past years. Monthly usage across the Nordic countries in 2003 is illustrated in figure 1.2:

Figure 1.2: Average monthly usage of minutes and SMS per user (2003)



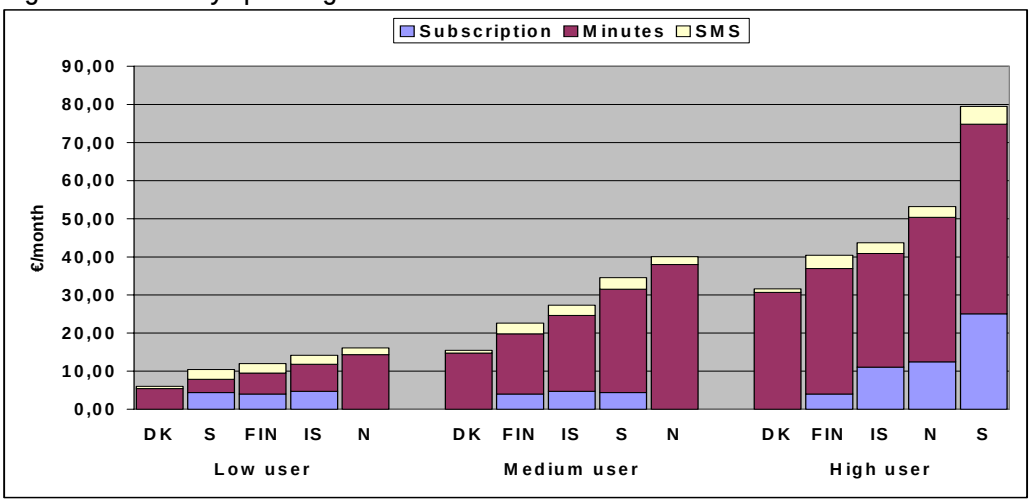
Source: National regulatory authorities' statistics.

Denmark toppled Norway as top performer measured by usage of SMS in 2003 as Danish SMS usage per customer almost doubled from 2002 to 2003. Norway had first place for at least four years. Finland has a solid lead on usage of minutes as consumption per user is almost 30 percent higher in Finland than in Iceland, who has the second highest usage per customer. MMS usage is still relatively low compared to SMS across the region. Norway has taken the lead in 2003 with an average usage of approx. 4.7 MMS per mobile customer per year. In Sweden and Finland usage was 0.8 and 0.7 respectively whereas usage in Denmark is at 0.5 MMS per user per year.

Norway's high mobile usage is followed by leadership in price-levels as shown in figure 1.3. It is difficult to compare prices on such a dynamic market. The following comparison of monthly expenditure for three categories of customers thus only provides a snapshot of the prices in June 2004. Three different composite baskets as defined by OECD are considered in order to compare prices across countries but with the same reservations as in the comparison of fixed line prices. One additional concern needs to be taken into account when comparing prices for mobile composite baskets. In Denmark, Norway and Sweden operators often subsidise

customers' handsets. High spending on subscription and usage in these countries may therefore be offset by lower handset prices for consumers. Handset subsidies are not included in figure 1.3.

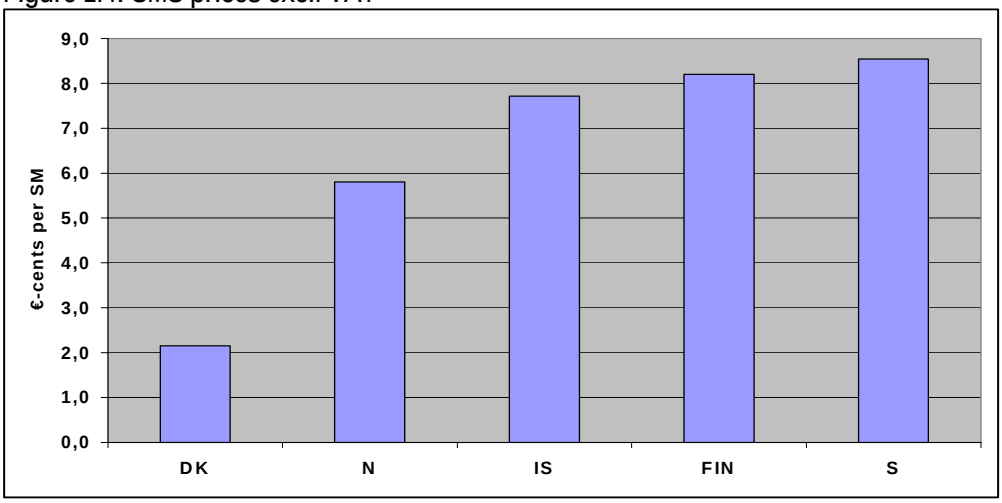
Figure 1.3: Monthly spending for mobile baskets



Source: Calculations made by Nordic competition authorities on the basis of incumbents' public price lists.

Prices as well as the balances between subscription fee, minute charges and SMS prices vary significantly across the countries. End-user prices vary between peak-time and off-peak in some countries, on-net and off-net in others while uniform prices during the day are standard in yet other countries. There seems to be a tendency towards uniform pricing independent of receiving network and time of the day. Average monthly spending is approx. 60 percent lower in Denmark than in Sweden when comparing the incumbents' best offers for high-using customers. The greatest price differences are found for SMS. The Danish price per SMS is only 15 percent of the corresponding price in Sweden as indicated in figure 1.4:

Figure 1.4: SMS prices excl. VAT



Note: The Swedish SMS price is calculated as an average between on-net and off-net prices.
Source: SMS prices are chosen from the cheapest subscription for a low user as defined in the OECD mobile consumption basket.

The SMS prices compared in figure 1.4 are taken from the subscriptions compared in figure 1.3. For heavy users of SMS flat-rate subscriptions are available in several of the Nordic countries. Other kinds of subscriptions include a given number of free SMS (e.g. 100 SMS per month). SMS prices are therefore difficult to compare for customers with high SMS usage.

The price differences for voice and SMS can reflect differences in competition intensity as well as in network costs. The magnitude of price differences across borders seems to exclude the idea of a pan-Nordic common market for mobile services so far. The prerequisites for a common Nordic market ought to be in place with companies such as Telenor, TeliaSonera and Tele2 present in more than one of the countries in question. But roaming prices remain high compared to prices for calls between local customers, cf. table 1.12.

Table 1.12: Total costs for 3 min. call during peak hour (mobile to mobile)

Prices quoted in €-cent		Receiving party's nationality and both parties' geographical location				
		DK	FIN	IS	N	S
Calling party's nationality	DK	28	100	92	197	200
	FIN	189	32	234	189	189
	IS	132	139	21	132	132
	N	66	86	79	32	160
	S	156	156	321	156	36

Source: Prices calculated by Nordic competition authorities on the basis of incumbent operators' price lists.

Total costs for a three minute call to a local customer are in many cases more than several hundred percent higher for a foreigner roaming in the same national network than for a local customer. The price comparison in table 1.12 is made for calls that can be routed using the same network elements similarly. Variable production costs should therefore be equal for a call between two national customers and between a national and a roaming customer. Some price differences may be attributable to higher average total costs for roaming customers as the setup costs for the roaming agreement can only be distributed over a relatively small number of minutes compared to e.g. a national service provider. But it appears improbable that the whole price difference should be attributable to higher costs.

The existence of at times very high roaming prices is by no means unknown to regulators. Consequently, national markets for international roaming have been designated by the European Commission for market analysis under the new European regulatory regime for markets for electronic communication. High prices do not per se call for regulatory intervention though. There are competing mobile networks in all the Nordic countries and the prerequisites for competition at wholesale level for roaming are therefore in place. High roaming prices may therefore simply indicate an immature market as customers focus primarily on prices for national traffic. But as prices for national calls are driven down by at times fierce competition, roaming prices becomes an ever more likely future battleground for operators as the spreading gap between prices for national and international calls may spur customer awareness.

Prices for mobile originated cross-border calls (e.g. a Swede calling from Sweden to Finland) are relatively high as well. As is the case for fixed line, the costs for providing international calls are unlikely to exceed costs for national off-net calls considerably. Retail margins thus remain high. Part of the reason for this is that e.g. service providers in some countries only can buy international interconnection from their network provider. Network providers can thus limit competition on international calls by keeping wholesale prices for international interconnection high.

So far, is seems fairly obvious that the Nordic region is divided into separate national markets. To shed light on the state of competition in the individual countries, focus is turned to market structures across the region.

Measured by market share, entrants have generally performed better in mobile markets than in fixed line markets. In Sweden, the second biggest operator is only trailing the incumbent's

market share by 4 percentage points. Concentration rates remain high across the board as shown in table 1.13.

Table 1.13: Market concentration as of end of 2003

Country	Number of:			Market share				Customers per GSM MNO
	MNOs	MVNOs	SPs	CR 1	CR 2	CR 4	HHI	
DK	4 (5)	1	12	33	55	77	1966	1,196,250
FIN	3	0	6	51	80	99	3723	1,586,800
IS	3	0	1	67	91	100	5553	93,223
N	2 (3)	1	12	56	85	95	4080	2,081,691
S	3 (5)	1	~15	43	82	98	3600	2,889,667

Note 1: Market share is measured by number of subscribers.
Note 2: A Mobile Network Operator (MNO) owns and operates a mobile network.
Note 3: A Mobile Virtual Network Operator (MVNO) runs the intelligent part of the network and leases access to transmission by an MNO.
Note 4: A Service Provider leases access to a mobile network by a MNO.
Note 5: In Denmark, "3" launched 3G services in 2003 using own infrastructure. "3" does not offer national coverage for 3G services and attracted less than one percent of the customers in 2003.
Note 6: In Norway, the third operator (Teletopia) only covers the Oslo-area.
Note 7: In Sweden, "3" launched 3G services in 2003 using own infrastructure, but does not offer national coverage for 3G services. A fourth GSM operator (Swefour) only covers its customers' premises and covers the remaining part of the country through roaming. "3" and Swefour are not included in the calculation of customers per GSM-operator.
Note 8: CR1 and HHI for Iceland are from 2003 whereas CR2 and CR4 are estimates based on 2002.
Source: National regulatory authorities' statistics.

Concentration rates and HHI indicate that Denmark had the least concentrated market by the end of 2003. But 2004 has brought a rapid consolidation of the Danish market. TDC completed its takeover of the biggest serviceprovider thereby increasing its market share to 42 percent. The second biggest MNO bought another successful serviceprovider increasing its market share to 24 percent and, in July, the third and fourth biggest MNO's announced their intention to merge achieving a total market share of 22 percent. CR4 thereby increases to 98 and HHI is increased by 50 percent to 3011. Denmark remains one of the least concentrated markets though.

In Finland, introduction of number portability[12] has increased customer mobility considerably. By mid 2004 HHI is thus reduced to approx. 2900.

There can be several reasons for the seemingly more level playing field that has allowed entrants to achieve significant market shares in the mobile market. First of all, it is far easier to build competing infrastructure for mobile than for fixed line telephony. This has allowed entrants to develop independently of incumbents. Second, markets have grown rapidly in all countries pursuant to the entry of new competitors allowing entrants to gain market share without actually conquering the incumbent's customers. Third, constant development of new technology and shorter, relative to fixed line, customer equipment lifetime provide additional incentives and occasions for customers to change mobile provider. Mobile markets are therefore inherently more dynamic than fixed line markets.

Denmark and Finland have relatively smaller average customer base per operator than Sweden and Norway. Iceland is in a league of its own with the smallest customer basis per network operator. Fewer customers per operator exert two opposing effects on prices: tougher competition between operators to obtain economies of scale, which increases downward pressure on prices, and diminished possibilities to actually obtain economies of scale, which increases the level to which prices can actually fall.

[12] Customer can retain their telephone number when changing telecom operator.

The significant geographic differences between the Nordic countries influence costs, which ultimately determine how low prices can get. Accordingly, it is difficult to rank the countries according to the intensity of competition by comparing prices. Neither are differences in market concentration at a level that allows for conclusions about differences in competition intensity. Mobile markets in all the Nordic countries appear dynamic and prices are following a downward trend all across the region.

Competition between fixed line and mobile telephony

Prices for mobile telephony still exceed fixed line prices for an average customer as defined by the OECD. Despite significant price reductions on mobile telephony, mobile prices have thus not yet reached levels where an average customer would consider giving up his or hers fixed line telephone and rely completely on mobile telephony. But for customers with modest fixed line usage or with high demand for calls to mobile phones, substituting fixed line telephony with mobile telephony has become attractive in many cases.

One way to illustrate how close substitutes fixed line and mobile telephony are, is to compare prices for different levels of consumption. Because of differences in price structures (high subscription fee and low minute charges for fixed line and vice versa for mobile), customers with sufficiently low demand for fixed line minutes will be better off giving up their fixed line subscription and use mobile instead.

In table 1.14 it is calculated how low a consumer's usage needs to be before it pays to give up a fixed line subscription and use mobile instead. The threshold is indicated as number of minutes with a call distribution as defined in OECD's domestic fixed line composite basket. The higher the number of minutes indicated the more customers will find it advantageous to change.

Table 1.14: Threshold for fixed line and mobile substitution (minutes)

Country	Monthly fixed line usage below which customers will find it advantageous to switch from fixed line to mobile	
	For user who only use fixed line	For users who also have high usage of mobile telephony
DK	210	210
FIN	110	180
S	93	139
IS	60	220
N	51	233

Source: Calculations performed by Nordic competition authorities on the basis of incumbents' public price lists.

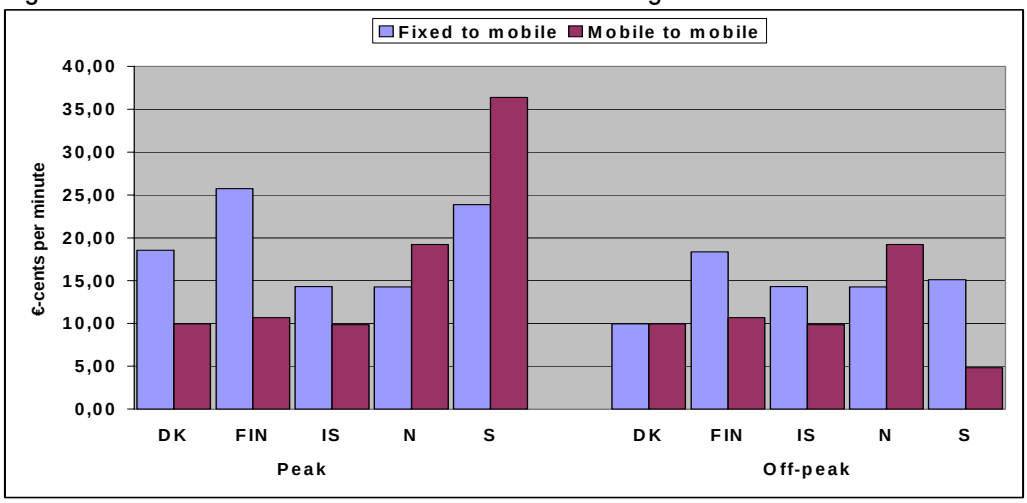
As indicated in the first column, users in Denmark who do not otherwise use a mobile phone will find it advantageous to give up their fixed line subscription if their monthly usage of fixed line is less than 210 minutes. The corresponding usage in Norway is 51 minutes.

The picture changes somewhat if the customer instead is assumed to be a heavy user of mobile telephony considering giving up his fixed line phone. In that case, the customer already pays possible subscription fees for his mobile phone and is in some cases able to get lower minute charges than mobile customers with low or medium usage. In that case Norway tops the list with break even between the two types of telephony at a monthly usage of fixed line telephony of 233 minutes.

Continued downward pressure on mobile minute charges is likely to make it attractive for even more customers to give up fixed line telephony in the future. But there are at least two countervailing developments on the market.

In countries where mobile call termination is not already regulated (as it is in e.g. Norway), likely future regulation of mobile termination charges will lower prices for fixed line customers calling mobile phones and inflict losses on mobile operators. Mobile prices are thus not likely to continue to fall at the same rate as today. In Denmark, Finland and Iceland, it is cheaper to call a mobile phone using a mobile phone during peak-hours than using a fixed line. These price differences are undoubtedly part of the reason for the relatively high substitutability between fixed line and mobile in those two countries. During off-peak hours, only Norway has higher mobile-to-mobile than fixed-to-mobile prices as illustrated in figure 1.5.

Figure 1.5: Fixed to mobile versus mobile to mobile charges



Note 1: The price comparison is made for incumbent customers calling incumbent customers.
Note 2: Swedish prices reflect a particular price structure that benefits off-peak users. Other subscriptions have price structures more similar to the other Nordic countries.
Source: Incumbents' public price lists for ordinary fixed line subscriptions and mobile subscriptions that minimise costs for low user as defined in the OECD mobile consumption basket.

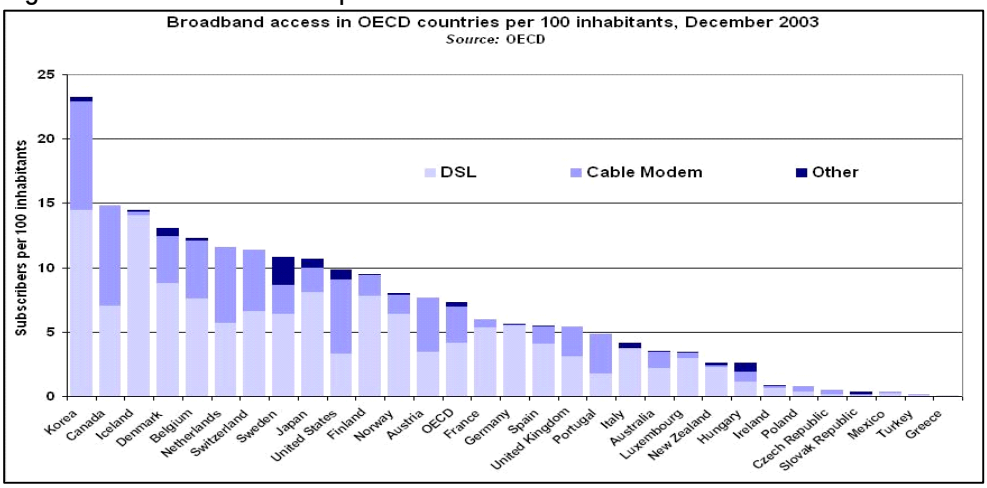
With a growing proportion of calls going to mobile phones, prices for that particular call-direction become an ever more important parameter in the competition. Whether mobile telephony is a competitor for fixed line operators depends thus to a certain degree on the individual customer's consumption.

Second, increased penetration of broadband lowers average costs for supplying PSTN and paves the way for IP-telephony. Lower costs and tougher competition on fixed line subscriptions is likely to push down prices and thus tip the balance in favour of having both fixed line and mobile for many customers. The market for broadband Internet access may therefore influence potential competition between fixed and mobile telephony.

The markets for broadband access

The Nordic countries are performing relatively well in the field of broadband Internet access measured by penetration rates compared to other OECD countries as indicated in figure 1.6.

Figure 1.6: OECD broadband penetration



Source: http://www.oecd.org/document/60/0,2340,en_2649_34225_2496764_1_1_1_1,00.html

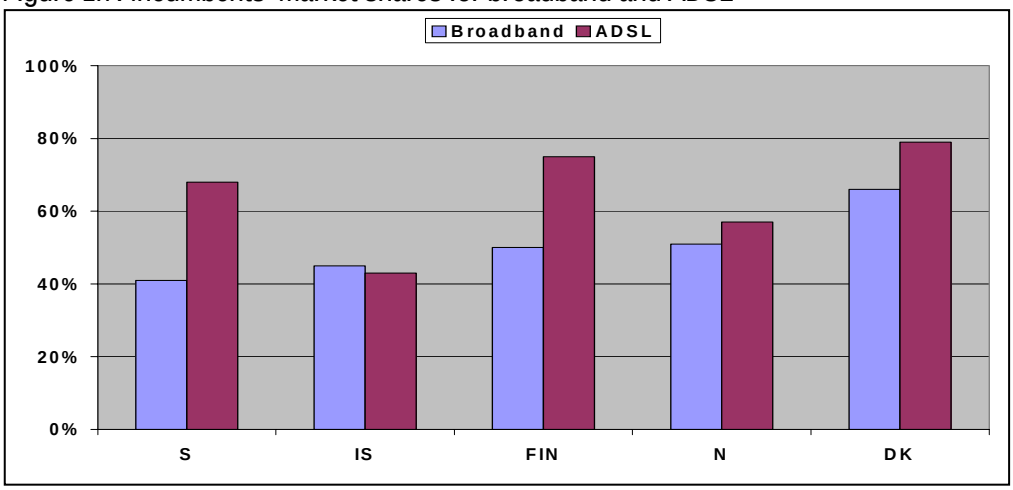
By the end of 2003, all the Nordic countries performed better than both the EU and the OECD countries on average. Iceland leads Denmark by a narrow margin followed by Sweden. OECD statistics indicate that penetration in Iceland has more than doubled from June 2002 to June 2003.

Broadband markets are growing rapidly and annual growth-rates above 50 percent are not unusual. Unbundling of the local loop is completed in all the Nordic countries and has acted as a spark that set off an explosion in demand. Access to the local loop has given entrants the chance to move first on the market for broadband services. Incumbents have in turn had no choice but to enter the market as well.

Different access products have been developed. Shared access to the local loop and bit stream access have made it cheaper and easier to enter the retail-market as entrants are given the possibility to provide broadband services to end-users buying PSTN subscriptions from other providers. In addition, bit stream access lowers the barriers to entry by diminishing investment requirements for potential entrants, who, by relying on bit stream access, do not have to invest in their own access infrastructure.

Incumbent operators have entered the broadband market aggressively and have succeeded in acquiring the lion's share of the booming market, cf. figure 1.7.

Figure 1.7: Incumbents' market shares for broadband and ADSL

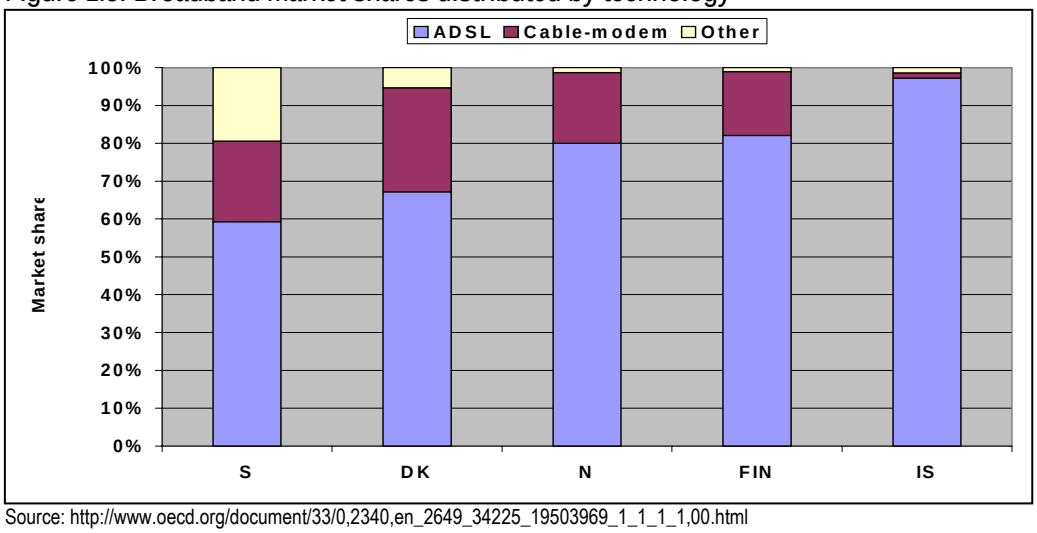


Note: Finnish market shares are for Elisa Corporation in the Helsinki metropolitan area.

Source: National regulatory authorities' statistics

Incumbents are generally performing better on the distribution of ADSL-products than on the overall market. This is due to one major difference between competition on PSTN and competition on broadband which is the existence of competing infrastructure and vertically integrated competitors. In all countries but Iceland, cable-TV providers have entered the market for broadband services. The cable-TV providers' networks only cover limited areas, typically densely populated areas, and will probably never attain national network coverage. Whether cable-TV providers will develop into a real threat to the telephony incumbents will thus depend on how the markets for broadband services develop. So far, cable-TV providers have achieved even significant market shares in many countries as indicated in figure 1.6 and further illustrated in figure 1.8.

Figure 1.8: Broadband market shares distributed by technology



Source: http://www.oecd.org/document/33/0,2340,en_2649_34225_19503969_1_1_1_1,00.html

In neither of the countries do cable-TV-operators grant access to their networks to independent ISPs. ISPs thus rely solely on access to the incumbents' networks either through full access, shared access[13] or bit stream access[14].

Prices as well as upload and download speeds diverge across the countries as illustrated in table 1.15.

Table 1.15: ADSL products and prices

	DK	FIN	IS	N	S
Download/upload speed	512/128	512/256	256/128	704/128	500/400
€/month	38.72	40.16	43.35	35.86	29.72

Note 1: Customer relationships are assumed to last 36 months.
Source: Incumbents' official price lists

It is difficult to compare prices across the five countries because of different standards for upload and download speeds. Yet Sweden and Norway seem to stand apart from the other countries by offering higher transmission speeds at significantly lower prices. Cost analysis in the Danish investigation into possible predatory pricing of ADSL services showed that production costs are largely independent of bandwidth as far as network equipment is concerned. Higher bandwidth may lead to higher consumption which in turn leads to higher

[13] Entrants pay a reduced fee for leasing an access line if the line also is used for e.g. PSTN.
[14] Bit stream access gives entrants a possibility to lease access to an access line and the incumbents' equipment at the exchange.

expenditure for IP connectivity though. With some caution, it is therefore meaningful to compare contribution margins across countries.

Table 1.16: Monthly ADSL gross contribution margins (June 2004)

Country	Contribution margin		
	Full access	Shared access	Bit stream access
DK	28.81	33.39	22.57
FIN	25.00	32.58	12.09
IS	33.45	39.57	
N	21.96	25.14	6.56
S	15.81	22.26	

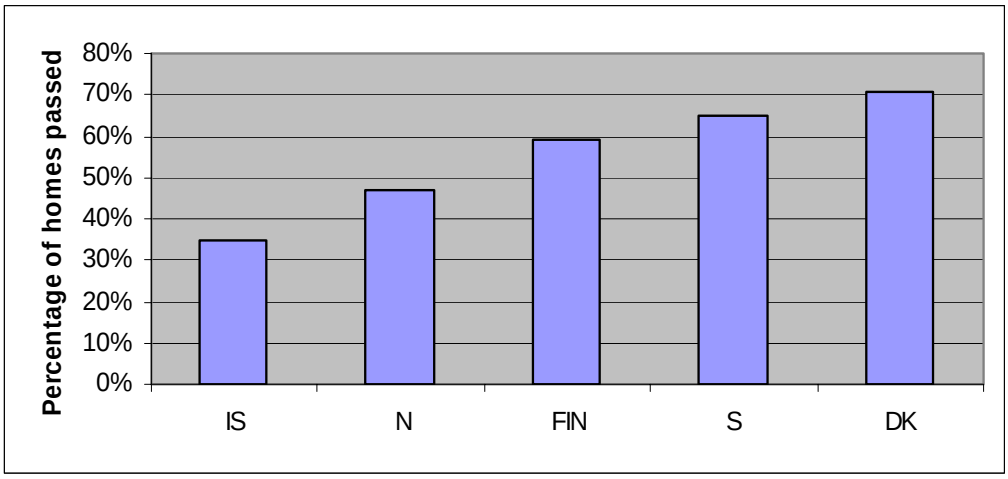
Source: Calculations performed by Nordic competition authorities on the basis of data from incumbents' official price lists and standard offers for wholesale network access.

The apparently lower prices in Sweden and Norway are accompanied by equally low gross contribution margins. Low prices and contribution margins can indicate fierce competition but may also lead to problems in the longer term as markets develop, market growth slows down and market shares therefore become more and more entrenched. Low retail margins on the incumbents' product implies a greater financial strain on entrants, who often do not have the incumbents' strong financial backing. Low prices and strong growth in the short term may therefore come at the cost of less competition in the future if competitors fail to achieve a sufficient customer basis when markets are booming.

In Denmark and Finland, entrants have accused the incumbents of engaging in predatory pricing in the ADSL markets. In Finland, the competition authority intervened in favour of the entrants. In the Danish case, the competition authority did not find sufficient proof to substantiate the allegations of predatory pricing. Similar complaints are currently being investigated in Sweden. In Norway, predatory pricing allegations were under investigation by public authorities but possible problems were solved without regulatory intervention.

Successful creation of competition that may pave the way for deregulation of the markets depend to a large extent on creation of infrastructure competition since that is the only way to reduce the competitors' dependence of the incumbent. Cable-TV networks have so far proven to be the most viable substitute. Cable-TV networks (and power utility companies) enjoy at least two major advantages compared to other types of alternative infrastructure. The first advantage is that the companies already have well-established customer relationships with potential broadband customers. The second major advantage is that these companies do not have to rely solely on income from their broadband business because revenues from cable-TV content cover a significant part of operating costs. The potential for competition from cable-TV operators depend on the coverage of their networks. The percentage of homes passed by a cable-TV network (homes that are either connected to cable-TV infrastructure or where cable-TV infrastructure is available in the immediate vicinity) in the Nordic countries is illustrated in figure 1.9.

Figure 1.9: Percentage of homes passed by cable-TV network. (2001)



Source: Broadband and telephony services over cable television networks (DSTI/ICCP/TISP(2003)1/FINAL

Not all homes passed by a cable-TV network can actually use the network for Internet access because not all parts of the networks have been equipped for two-way communication. But at least in Finland, Sweden and Denmark, cable-TV networks have reached a sufficient proportion of potential customers to exert significant competitive pressure on DSL providers using the telephone network. Iceland has seen strong growth in cable-TV penetration in recent years. And recent Norwegian figures suggest that the OECD-figures reported in figure 1.9 may underestimate Norwegian availability of cable-TV networks that could be as high as 56 percent.

The incumbent telecommunication carriers are also significant cable operators in Denmark, Finland, Iceland and Norway. As long as a significant proportion of cable-TV customers are served by the incumbents, competition can be expected to be limited between cable-TV networks and telephone networks. The biggest cable-TV operator in Sweden (ComHem) was divested from the incumbent carrier (TeliaSonera) in 2003. It is therefore too early to expect notable effects from the divestiture at the present time. But the potential for competition between cable-TV operators and fixed line carriers is clearly illustrated by experiences in Belgium where cable-TV is available to 100 percent the households. The largest Belgian cable-TV operator (Telenet) delivers cable modem services to 17 percent of the homes passed. Belgium has one of the highest penetration rates and download speeds of minimum 3 Mbps.

Use of power-lines for data transmission has so far only to a limited extent been introduced commercially in the Nordic countries. But power companies in several countries currently test equipment that later can lead their way into the broadband markets. At least one Norwegian and two Finnish suppliers seem to have overcome initial technical difficulties. Successful use of power lines has at least one significant advantage compared to the possibilities currently offered by cable-TV operators: Power companies can reach every household. If current research into use of power lines for telecommunication is successful it may therefore bring a dramatic push towards fierce competition at wholesale as well as retail level for all fixed line services.

Chapter 2 Sector specific or general competition legislation

Introduction

The telecommunications sector is covered by general competition regulation like any other sector. But certain matters are subject to sector specific competition regulation as well. The need for sector specific regulation is closely tied to incumbents' control over infrastructure of key importance to entrants'/competitors' ability to offer services on retail markets. In absence of regulated access to the incumbents' infrastructure entrants would only be able to enter markets by building new infrastructure, which would raise entry barriers to almost insurmountable levels.

This chapter addresses the need for and scope of necessary sector specific regulation in the Nordic countries and describes the different institutional setups. The chapter begins with an explanation for why regulatory intervention is needed in order to create competition on services in infrastructure industries. Then, the telecommunication sector's structure is compared to that of other infrastructure sectors. This is followed by a description of major similarities and differences in regulatory setup and regulation across the five countries in the working group. Then, the previous and present principles for regulation of the sector are described and their effect on the nature and extent of regulation is evaluated. This includes a description of the issue of access price regulation and its relationship with investment incentives. Finally, the most prominent cases handled by the Nordic competition authorities according to competition law are described.

The need for sector specific regulation

Large fixed (often sunk) costs and low marginal costs are common features for infrastructure sectors. Such cost structure creates a risk of market failures and thereby obstacles for successful introduction of competition. Competition based on separate infrastructures faces a powerful opponent in significant economies of scale giving incumbents a seemingly natural monopoly. Historically, this has been the reason for placing infrastructure companies under public ownership. Liberalisation and full or partial privatisation of infrastructure sectors has thus created new challenges.

So far, experience has taught regulators that privatised incumbents in a liberalised market often are unwilling to provide third party access (TPA) to their infrastructure to downstream competitors and will do so only at prices that effectively prevent entrants from competing on a level playing field. Hence, in absence of regulation that ensures entrants' access to incumbents' networks at reasonable terms, the only way to enter an infrastructure based market would be by constructing new independent infrastructure. But the magnitude of necessary investments and long depreciation periods are likely to result in a financial strain on entrants that ultimately will deter entry.

In addition, new infrastructure will in many cases just replicate existing infrastructure. Depending on the retail market structure, this may lead to monopoly pricing in geographical areas only covered by the incumbent and unsustainably low prices in areas with double coverage of infrastructure as every operator will prefer a modest contribution margin from serving a customer rather than no margin at all by leaving the customer to a competitor. Consequently, prices will fall to levels about marginal costs and entrants will be unable to recoup their investment costs.

In cases where prices cover variable costs (however miniscule) but are insufficient to cover depreciation and amortisation of sunk investments, it is difficult for competition authorities to determine whether the low prices are the result of fierce competition or a part of a strategy employed by the incumbents to drive entrants out of the market. Consequently, competition law and jurisprudence are in many cases inadequate to secure emerging infrastructure competition.

Hence, the special characteristics of the infrastructure sectors have created a need for sector specific regulation. Sector specific regulation is ex ante in nature - contrary to competition law[15] - and has been introduced to open markets for competition. Regulation has e.g. been used to secure non-discriminatory access to the incumbents' infrastructure. Incumbents are thus required to legally or virtually split up their wholesale and retail operations and act as if their retail departments were entrants.

Even if sector specific regulation may be used to promote competition and efficiency on markets opened up to competition, there are a number of arguments against the use of special legislation in general and against legislation regulating prices in particular. Specific sector regulation leads to higher administrative costs as the legislation is implemented, markets are monitored and infringements are sanctioned. Sector regulation can also distort incentives on the market. It may become profitable for companies to focus on non-desirable activities. The converse can also apply in the sense that activities desirable in themselves are no longer profitable due to sector regulation. Regulated operators are also likely to allocate resources to circumvent regulation.

In the case of telecommunications, sector specific regulation has been used not only to address specific problems or prevent them from arising. Regulation has also been used to create new markets. One prominent example is the division of fixed line services and fixed line access. Originally, services and access were bought from the same supplier (as is still the case on markets for mobile services). Opening the market for competition would thus imply enabling competitors to supply a similar product. But to facilitate entry and to create competitive pressure on profits as quickly as possible, services and access were unbundled thereby creating separate markets.

Is the telecommunications sector different from other infrastructure sectors?
It has often been argued that telecommunication markets are particularly complex compared to other infrastructure markets such as railways, electricity, gas supply or postal services. Advocates of telecommunication sector's alleged unique complexity thus argue that the need for regulatory intervention in the telecommunication sectors is incomparable with the regulatory regimes in place to secure competition in the other sectors. The telecommunication sector is admittedly different in one important aspect. An impressive technological development during

[15] The European Commission's directorate general for competition's (DG Comp) application of common European competition regulation is a notable exception. DG Comp has issued a number of recommendations and guidelines describing on a pre-emptive basis how the European Commission intends to interpret community competition law. But these recommendations are not binding and an infringement of recommendations and guidelines therefore has to be followed by a formal decision. Possible entrants thus cannot rely completely on being protected against abusive behaviour as described in the guidelines.

the past 10-15 years has reduced network construction costs significantly. Moreover, development of new wireless technologies has created better opportunities for network competition where natural monopolies previously prevailed. Similar opportunities are unlikely to arise in the markets for e.g. electricity, gas or railways. However, wireless technologies have not proven viable alternatives to existing fixed wire networks so far and network competition only appears financially feasible in geographically restricted areas.

So while the nature of services provided and the techniques used to provide them differ across the sectors; many characteristics are common seen from a regulatory point of view. Despite a unique technological development on telecommunication markets compared to other infrastructure sectors they all share the same feature: only one company has a distribution network that permits it to service the whole national market and competition is not feasible in absence of some kind of third party access.

Different approaches are possible to address a situation where a dominant infrastructure-owner can prevent sustainable competition from arising through its control over essential infrastructure. The most drastic solution is to split up the incumbent into two legally and financially independent companies: an upstream network operator and a downstream service provider. The downstream service provider then has to buy access to the network on equal terms with entrants and downstream competition can emerge at a completely level playing field.

An alternative to actual separation of the incumbent is accounting separation, which – in theory – can yield similar results. The incumbents thus remain vertically integrated but "buy" access to their own infrastructure on equal terms with entrants. Public regulators then rely on balance sheets provided by the vertically integrated operator to verify that the company actually acts as if it had been vertically separated. But discrimination between a vertically integrated network operator's own retail department and independent retail operators comes in many forms. Accounting separation therefore has to be supplemented by supervision of all other terms for access to the relevant network as well.

Accounting separation is the dominant paradigm for access regulation across the Nordic countries in the field of telecommunication. The vertically integrated incumbents are subject to a number of obligations including TPA, price control, service provision etc. This regulatory regime has to a large degree facilitated the emergence of new and vibrant competitive markets. The market setup for various infrastructure sectors is described in table 2.1:

Table 2.1: Sector overview of vertical separation and third party access

	Vertical separation					Third party access				
	Telecom	Railways	Postal services	Gas	Electricity	Telecom	Railways	Postal services	Gas	Electricity
DK	÷	√	÷	√	√	√	√	÷	√	√
FIN	÷	√	÷	÷	÷	√	√	÷	√	√
IS	÷	NA	÷	NA	NA	√	NA	÷	NA	NA
N	÷	√	÷	÷	÷	√	√	÷	√	√
S	÷	√	÷	NA	√	√	√	√	NA	√

Postal services are only completely liberalised in Sweden and concerns about vertical separation and TPA are therefore purely academic for the remaining countries. In Sweden, third party access is given to a limited part of the network namely public mailboxes.

With regards to the other sectors, incumbent railway operators have generally been vertically separated as required in common EU legislation. So far, TPA has only been modestly successful in the railway sector. One has to be careful however not to judge vertical separation too harshly on these grounds since railways have experienced general decline in business and still encounter serious technical barriers to cross-border operations. Railway operators' ability to compete with e.g. trucks is thus seriously hampered on long distances where railways otherwise could enjoy a relative advantage. The liberalisation of the railway sector has so far led to a limited part of passenger traffic put out to tender.

In Norway and Finland, vertically integrated electricity suppliers are subject to requirements of accounting separation[16] whereas in Denmark and Sweden, distribution networks for electricity are run by independent entities. Vertical separation is currently being considered in Finland for operators currently supplying 85 percent of the electricity consumed. In Norway, where liberalisation was completed already in the early nineties, consumers seem to have benefited from the market opening. Electricity markets in Sweden were liberalised in 1996 and consumers can now choose from a range of suppliers. In Denmark, retail markets for electricity have only been liberalised recently so it is still too early to conclude on the outcome of liberalisation. A pan-Nordic cross-border market for electricity has taken off in a modest scale. But transmission capacity between the countries is still too limited to really put local national suppliers to the test when consumption peaks during the day. It therefore appears to be too early to draw conclusions on advantages and drawbacks from the various structural setups chosen in the various countries.

Distribution networks for natural gas have been separated from downstream suppliers into a publicly owned company in Denmark. For offshore transmission, vertical separation has been implemented in Norway as well. For inland distribution vertically integrated gas companies in Norway are required to establish accounting separation of network and retail services. In either country, markets are too immature to evaluate the effects of liberalisation and choice of structural setup.

Experience from other infrastructure industries shows that several ways to promote TPA are practically applicable. Vertical separation is thus certainly a feasible alternative to accounting separation in some cases. But even though vertical separation provides the best prerequisites for retail market competition at equal terms for entrants and incumbents neither of the countries in the working group has opted for this solution.

One of the reasons why policy makers across Europe have refrained from vertically separating incumbents when markets were liberalised is that vertical separation can have serious drawbacks. One argument against vertical separation of incumbents is the presence of economies of scope. A vertically integrated company has much better information than a stand-alone network operator about the need for investments in infrastructure to satisfy end-user demand and can thus respond more quickly and appropriately to changes in market conditions. This is a particularly valid argument in the telecommunication sector because of the rapid technological development experienced during the past 10-15 years and the plurality of new products being introduced as a consequence thereof.

[16] In Norway, the government chose to split up the government-owned companies Statnett SF (Norwegian power-grid company) and Statkraft (power generation company). Several other companies have chosen legal separation of generation and transmission companies.

However, the importance of economies of scope depends on the level at which vertical separation is carried out. Economies of scope are modest if e.g. only collocation facilities and the local loop are administered by a vertically disintegrated operator. Investments in those two parts of the network only constitute an insignificant part of overall investments, and investment concerns could therefore only have carried little weight if regulators had opted for this solution.

Today, the discussion of possible vertical separation of incumbent telecommunication operators is in many cases merely of academic interest. As governments have sold part of or all their stocks in the incumbent operators, structural changes to promote public welfare to the detriment of stockholders will be tantamount to expropriation. Vertical separation of the incumbents is therefore difficult to implement even in cases when one or more governments hold a controlling interest. In none of the five countries do governments have complete ownership of the incumbent operator, cf. table 2.2.

Table 2.2: Government ownership of shares in incumbent operators as of June 2004

Country	DK	FIN	S	N	IS
Proportion of shares owned by government. (percent)	0	19	46	53	95

Governments in Norway and Iceland hold controlling interest in the incumbent operators. The Swedish and Finnish governments hold a controlling interest in TeliaSonera together. Only in Denmark does the government no longer hold any stocks in the incumbent operator.

All the Nordic countries have thus implemented third party access to fixed line telecommunication networks but have maintained vertical integration. As vertically integrated operators seldom are inclined to grant access to their networks at prices and terms that permit entrants to compete away the network providers' retail profits, government intervention is required to secure a level playing field at retail level. Designated government authorities have therefore been instituted across Europe to handle this task.

Vertical and horizontal regulators

Independent regulatory authorities

In all five countries, independent regulators are responsible for promoting competition on telecommunication markets through regulation of access to the incumbent operators' networks. As some governments still have significant financial interests, at times even controlling shares, in some incumbent operators, it is important that an institutional setup that not only works impartially but also is perceived as impartial by current and potential entrants is in place.

Keeping regulators isolated from political pressure is thus an obvious concern and establishing independent regulators to regulate and monitor the terms for access to the incumbents' networks is consequently an essential feature for successful liberalisation. The institutional setup in the five countries is shown in table 2.3.

Table 2.3: Regulatory institutions and ability to appeal

	Regulator	Policy maker	Organisations that can overturn NRA's decisions (other than court)
Denmark	The National IT- and Telecom agency	Ministry of Science, Technology and Innovation	Telecommunications complaints board; Telecommunications consumers board
Finland	Finnish Communications Regulatory Authority	Ministry of Transport and Communication	Ministry of Transport and Communication
Iceland	Post and Telecommunication Administration	Ministry of Transport and Communication	Post- & telecoms appeals board
Norway	Norwegian Post and Telecommunications Authority	Ministry of Transport and Communication	Ministry of Transport and Communication
Sweden	National Post and Telecom Agency	Ministry of Industry, Employment and Communication	None

In all the five countries, regulators are independent of policy makers represented by government ministries. In Denmark and Iceland decisions by the NRA's can either be appealed to designated appeals bodies or directly to the courts of justice. In Sweden the first instance of appeal is the courts of law whereas in Norway and Finland government ministries have powers to overturn a decision taken by the regulatory body.

In Sweden, Norway, Iceland and Finland, political responsibility for the sector specific regulation is vested in ministries also responsible for other infrastructure related issues such as transport. Only in Denmark is the policy maker a ministry without similar cross-sector responsibilities.

Some operators have argued that government control over the incumbent operator leads to lessened regulatory pressure on the incumbent from the NRA. The comparisons of retail margins in chapter one contradict such assumptions however. A high gross margin implies better possibilities for entrants to profitably enter a market and undercut the incumbent's prices. In Sweden and Norway gross margins on PSTN offered on the basis of access to the local loop are among the highest in the region and Norway has the second highest gross margin on local calls. Claims of favouritism are thus not supported by price comparisons.

In neither of the countries in this working group have competition authorities and regulatory authorities been merged or regulatory authorities been given competition powers as e.g. in Great Britain. There are several arguments in favour of and against vesting sector specific regulation and general competition regulation in one public authority.

Telecommunication markets are in many aspects different from other markets regulated solely by competition authorities. Competition authorities usually address market failures or abusive behaviour on markets where basic prerequisites for competition are present. In the case of telecommunication markets, the task was (and to some degree remains) to dismantle public or private monopolies, i.e. to create a market rather than address a specific abusive behaviour.

The nature of interventions carried out by regulatory authorities and competition authorities is also a key issue. Sector specific regulation often implies detailed regulation of prices and other terms for access to essential infrastructure. Such types of regulation are not common within

competition jurisprudence. General competition regulation and sector specific telecommunications regulation thus build on quite different paradigms. This may favour establishment of separate authorities.

But the institution of two authorities who both regulate competition in a given sector may give rise to difficulties. In small countries, the number of employees possessing the relevant skills is likely to be modest making authorities vulnerable to employee turnover. Such problems are diminished if one single authority is responsible for both sector specific and general competition regulation.

The new regulatory framework[17] has accentuated this problem. The market analysis employed by NRAs to appoint SMP-operators are to be carried out according to principles normally employed when defining relevant markets and determining whether a supplier holds a dominant position according to competition law. This may favour a strengthening of the NRA's competencies in this field. Likewise, regulation of for instance access often requires technical knowledge. In this regard NRAs can benefit from their other technical tasks. But competition law and jurisprudence is in constant development as experience builds from all sectors covered by general competition regulation handled by general competition authorities. It is therefore first and foremost imperative that both authorities take part in the analysis benefiting from the authorities' complementary strengths.

Other types of relevant regulation and regulators

Other kinds of regulation with other objectives than to promote competition also affect market development. Regulation of consumer rights and rules protecting intellectual property can have a bearing on the development of competition on e.g. distribution of digital content. Both consumer regulation and regulation of intellectual property can be vertical as well as horizontal.

The telecommunications sector is thus regulated by several authorities applying different sets of legislations. Besides regulatory authorities and competition authorities, agencies regulating e.g. consumer rights also influence policies in this field.

A comparison of the resources spent on regulation is more likely to illustrate the diverse division of responsibilities between the relevant authorities in the different countries than to shed light on the authorities' efficiency. All the regulatory authorities are financed entirely or partially by fees paid by operators. In Denmark, fees charged by the regulatory authority are supplemented by government appropriation. Competition authorities and consumer agencies are financed by government appropriation in all the countries. Budgets and number of employees regulating competition on telecommunication services in relevant government authorities are shown in table 2.4.

Table 2.4: Resources spent on regulation (2003)

	Competition authority		Regulatory authority		Consumer agency	
	Overall budget	Employees doing telecom-cases	Overall budget	Employees doing telecom-cases	Overall budget	Employees doing telecom-cases
DK	11.9 m. €	2-3	29.6 m. €	17	10.3 m. €	~1
FIN	4.6 m. €	2-3	31.9 m. €	15-20	6.4 m. €	~2
N	7.8 m. €	3-4	20.4 m. €	20-25	10.3 m. €	~3
S	9.4 m. €	4-5	56.5 m. €	25	17.1 m. €	4-5

[17] The New regulatory framework is described further in the section "Principles for and extent of sector specific telecommunications regulation"

Note 1: For regulatory authorities telecom cases comprise dispute mediation, imposition of sector specific competition regulation, handling of complaints over incumbent in regulated areas.
Note 2: Number of employees doing telecom cases at the regulatory authority in Denmark is estimated on the basis of the Danish government budget for 2003.

Sector specific private consumer boards have been established in both Denmark and Norway. In both countries, the board's expenses are covered by the industry. The industry is thereby given an extra incentive to address the underlying reasons for the complaints. For the industry, running the board itself implies an additional advantage, since the industry sooner than when public authorities are responsible for the case-handling gets a more accurate impression of which problems are most important and what kind of information consumers demand. It is not possible though to allocate all complaints to private boards since some problems of a general nature (e.g. marketing practices) often are covered by horizontal consumer regulation.

In most cases, cooperation between authorities is of an informal nature where information is exchanged and the specific delineation of responsibility for a given case is determined. There are no examples of cases with joint intervention from both NRA and NCA. If a case touches upon issues covered by different sets of legislation the relevant authorities deal only with the issues within their field of responsibility. So far, no difficulties worth mentioning have arisen in the allocation of cases between the relevant authorities.

Convergence between digital platforms is no longer just a technological opportunity but reality. Cable-TV networks offer Internet access in most Nordic countries and IP-telephony has already been introduced to business customers and in some countries to residential customers as well. Relatively high broadband penetration rates and increasing bandwidth are paving the way for video-on-demand services and even television distributed over PSTN. These developments make it increasingly difficult to define telecommunication and broadcasting as distinct sectors.

The blurring of boundaries between telecommunication and broadcasting raises questions about how the two sectors are regulated. Only in Finland is broadcasting content in part regulated by the same policy maker as telecommunication. In all the other countries, authorities or ministries separate from the telecommunication regulator are responsible for content regulation.

Horizontal integration of previously distinct industries warrants regulatory reforms aimed at more horizontal regulation. Such reforms do not necessarily imply merging of authorities or redistribution of regulatory responsibilities but at the very least an increased awareness from all interested parties.

Self-regulation

Self-regulation is encouraged by regulators in some Nordic countries. The industry thus gets a chance to find suitable ways to regulate issues of common interest without government intervention (often within a framework defined in regulation though). One of the advantages of self-regulation is that the industry may have a better understanding than a regulator of how a particular problem is best tackled, which may lead to more appropriate regulation than otherwise would have been the case. Self-regulation should not be mistaken for laissez-faire. Only cases where the industry unanimously adopts measures to avoid public regulatory intervention can be considered self-regulation. Use of self-regulation varies across the Nordic countries as shown in table 2.5.

Table 2.5: Use of self-regulation in the Nordic countries

	Areas subject to self-regulation
Denmark	– Rules and procedures for carrier pre-selection. – Rules and procedures for number portability (both fixed line and mobile). – Terms for renting of positions on masts for mobile communication. – Certain issues regarding access to the local loop. – Certain issues regarding access to collocation. – Resale of incumbent products.
Norway	– Rules and procedures for number portability (both fixed line and mobile). – Rules and procedures for carrier pre-section – Rules and procedures for fixed telephony subscription resale – Internet-related issues (for instance spam) – Certain issues regarding access to the local loop and collocation.
Sweden	– Practical procedures regarding implementation of number portability (both fixed line and mobile)

The scope for self-regulation is limited though by differences of interests for incumbents and entrants as well as incumbents' relatively strong negotiation positions vis-à-vis entrants. The threat of regulatory intervention in case the industry fails to reach an agreement is therefore necessary to countervail incumbents' superior negotiating power and thereby provide an as level playing field as possible.

Principles for and extent of sector specific telecommunications regulation

Sector specific regulation is only called for, when competition law is inadequate in creating and maintaining effective competition. As sustainable competition gains foothold and as market failures are reduced or eliminated the need for sector specific regulation falls away and superfluous regulation can even be detrimental to effective competition. General competition regulation has been a powerful tool to combat different types of abusive behaviour by the incumbents in the Nordic countries, cf. the section "Nordic competition case law".

The European Commission explains when sector specific regulation is warranted in its explanatory memorandum for the relevant markets (page 11): "*Ex ante regulation would be considered to constitute an appropriate complement to competition law in circumstances where the application of competition law would not adequately address the market failures concerned. Such circumstances would for example include situations where the compliance requirements of an intervention to redress a market failure are extensive (e.g. the need for detailed accounting for regulatory purposes, assessment of costs, monitoring of terms and conditions including technical parameters etc) or where frequent and/or timely intervention is indispensable, or where creating legal certainty is of paramount concern.*"

It can be of great relevance whether a market is regulated according to general competition regulation or sector specific regulation. Some telecommunication markets have proven very dynamic and technological progress has been the driver as well as the result of introduction of competition in the sector. Innovation and digitalisation of content and services are blurring the boundaries of previously sharply separated markets. If different competition legislation is applied on the telecommunication markets compared to e.g. media markets, operators from the two different market segments will not face a level playing field if competition arises between telecommunication and media companies.

Yet another risk is that sector specific regulation of the telecommunication markets might distort incentives for investment and innovation on the regulated markets. Market development may thereby be diverted in another direction than what would have been the case if general

competition regulation had applied. Sector specific regulation should therefore always be kept at a minimum and leave the greatest possible scope for flexible and unhindered development of wholesale as well as retail products. In some cases, this implies a trade-off between maintaining regulation that can promote competition further and repealing regulation in order to lessen distortions. The same applies in cases where sector specific regulation addresses other issues (e.g. consumer protection) otherwise covered by horizontal regulation.

Some of these concerns are addressed in the new regulatory framework currently being implemented across the EEA countries. In the following, the new regulatory framework is briefly described and compared to the regulatory framework it replaces.

The previous and the new regulatory framework
The common European push for competition in the telecommunications sector was initiated in 1984 as the European council decided to promote liberalisation of markets for telecommunication services. The next significant development was in 1990 when it was decided to grant access to national incumbents' networks (open network provision) to entrants to facilitate retail market competition (Council Directive 90/387/EEC). At the same time (in Council Directive 90/388/EEC) a timetable for when different markets were to be liberalised was laid down.

Later amendments of Council Directive 90/388/EEC (particularly Directive 96/19/EC) lead to full competition by 1998 on all retail markets in the European Community and paved the way for convergence between PSTN and cable-TV networks (Directives 95/51/EC and 1999/64/EC). A selection of some of the most important directives is given in table 2.6:

Table 2.6: Liberalisation and harmonisation (98 Regulatory Package)

Council Directive 90/387/EEC of 28 June 1990 - on the establishment of the internal market for telecommunications services through the implementation of open network provision
Commission Directive 90/388/EEC of 28 June 1990 - on competition in the markets for telecommunications services
Council Directive 92/44/EEC, of 5 June 1992 - on the application of open network provision to leased lines
Commission Directive 95/51/EC of 18 October 1995 - amending Directive 90/388/EEC with regard to the abolition of the restrictions on the use of cable television networks for the provision of already liberalised telecommunications services
Commission Directive 96/19/EC of 13 March 1996 - amending Directive 90/388/EEC with regard to the implementation of full competition in telecommunications markets
Directive 97/13/EC of the European Parliament and of the Council of 10 April 1997 - on a common framework for general authorizations and individual licences in the field of telecommunications services
Directive 97/33/EC of the European Parliament and of the Council of 30 June 1997 - on interconnection in Telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network Provision (ONP)
Directive 98/61/EC of the European Parliament and of the Council, of 24 September 1998 - amending Directive 97/33/EC with regard to operator number portability and carrier pre-selection
Commission Directive 1999/64/EC, of 23 June 1999 – amending Directive 90/388/EEC in order to ensure that telecommunications networks and cable TV networks owned by a single operator are separate legal entities
Regulation (EC) No 2887/2000 of the European Parliament and of the Council, of 18 December 2000 - on unbundled access to the local loop

Even though EU initiatives for market liberalisation have been the model for market opening in all the Nordic countries, the liberalisation has followed different trajectories across the region. In Finland, the first steps to liberalise the markets were taken already in 1988 when markets for

data transfer were partially opened for competition. The Finnish process of liberalising the terms for data transfer was finalised in 1990 when the market was completely deregulated. Finland thereby preceded the rest of the Nordic countries. Deregulation and liberalisation milestones are summarised in table 2.7.

Table 2.7: Liberalisation milestones

	DK	FIN	IS	N	S
Introduction of GSM voice services	1992	1991	1994	1993	1992
Competition on data transmission	1993	1990	1999	1993	1993
Call-by-call carrier selection	1996	1994	1998	1998	1994
Number portability (fixed line)	1998	1997	2001	1999	1999
Carrier pre-selection	1999	1999	2000	1999	1999
Local loop unbundling	1999	2001	2000	2001	2000
Number portability (mobile)	2001	2003	2004	2001	2001
Granting of UMTS licenses	2001	1999	-	2000	2000

Source: Nordic competition authorities

The interconnection directive (97/33/EC of 30 June 1997)[18] and the regulation on unbundled access to the local loop (2887/2000/EC of 18 December 2000) are of particular importance. In the interconnection directive the criteria for determining whether companies were to be regarded as having SMP were defined. The regulation prescribing entrants' access to the local loop gave entrants the opportunity to offer fixed line subscriptions and broadband access by using the incumbents' infrastructure but based on different technological platforms than the incumbents'. Entrants' independence of incumbents' technological platforms is essential for their capabilities to compete on product diversification. The best example is broadband access where entrants in many cases introduced broadband access before the incumbents did.

A review of the European regulatory framework for electronic communications began in 1999 with the adoption of the Communication Review. In March 2002 the Parliament and Council adopted a new package of sector specific regulation designed for more competitive markets and converging electronic communications technologies. The changes in regulatory framework are intended to facilitate roll-back of sector specific regulation as soon as competition emerges. A selection of the directives constituting central parts of the regulatory reform is given in table 2.8:

Table 2.8: Central directives in the 1999 Communications Review

Directive 2002/21/EC of the European Parliament and of the Council, of 7 March 2002 - on a common regulatory framework for electronic communications networks and services (Framework Directive)
Directive 2002/19/EC of the European Parliament and of the Council, of 7 March 2002 - on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive)
Directive 2002/20/EC of the European Parliament and of the Council, of 7 March 2002 - on the authorisation of electronic communications networks and services (Authorisation Directive)
Directive 2002/22/EC of the European Parliament and of the Council, of 7 March 2002 - on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive)

[18] The interconnection directive was later amended through the directive 98/61/EC concerning numbering. According to the amended directive, number portability should be possible. In addition, it should be possible for a subscriber to automatically have different types of calls connected by predetermined telecommunications operators (pre-selection). It should also be possible for a subscriber to bypass the pre-selected operator by dialling a prefix before the telephone number (call-by-call carrier-selection).

Commission Decision of 29 July 2002 (2002/627/EC) - establishing the European Regulators Group for Electronic Communications Networks and Services
Commission Directive 2002/77/EC, of 16 September 2002 - on competition in the markets for electronic communications networks and services
Commission Decision 2003/548/EC, of 24 July 2003 - on the minimum set of leased lines with harmonised characteristics and associated standards referred to in Article 18 of the Universal Service Directive

Cross-border coordination is a demanding but necessary task. Only in this way can authorities reap the maximum benefits from each others experiences and create the prerequisites for a common market. Previously, coordination between NRAs was carried out within the Independent Regulators Group (IRG). But to induce a uniform use of the new regulatory framework across Europe a new cross-border network comprising NRAs and the European Commission (European Regulators Group or ERG) has been instituted (2002/627/EC). IRG and ERG now operate in parallel.

The new regulatory regime is only gradually being implemented. All the Nordic countries have implemented the community directives in national legislation within the timeframes envisaged in the regulation (2003 for EC members and 2004 for EEA members). NRAs are responsible for the market delineation and analysis of SMP in all the Nordic countries. This is an ongoing process and it is yet too early to tell whether it will lead to more or less regulation.

The new regulatory framework changes the criteria used to establish who and what to regulate as well as how the companies and markets in question can be regulated. One of the most significant differences between the new regulatory framework and the framework it replaces concerns the underlying principles for market analysis used to determine which companies qualify for regulation; companies with so-called significant market power (SMP).

Previously, companies with a market share in excess of 25 percent for a product defined in the sector specific regulation were to be subject to regulation. Other criteria were the company's turnover in relation to market size and the company's ability to influence market conditions. According to the new regulatory framework, only operators who posses and are expected to retain a dominant position on a relevant market, both as defined in competition law and jurisprudence, can be subject to regulation. It usually takes a market share in excess of 40 percent for a company to hold a dominant position according to competition jurisprudence. This higher threshold for market share will in itself restrict the group of companies qualified for regulation.

Passing from calculating market shares on the basis of single products to calculating them on the basis of product markets potentially encompassing competing products can likewise lead to lower market shares for candidates for regulation and thereby limit the number of cases in which sector specific regulation is applicable. In this way, regulators have to take new technologies and products into consideration when analysing the basis for regulation. The new principles for market analysis in the regulation of markets in the telecommunication sector should thus lead to a more technology neutral regulation as competitive pressure from products based on different/new technologies are taken into consideration when the possible need for regulation of the market for a given product is evaluated. Market dynamics are therefore better reflected in market analysis conducted under the new regulatory regime and a smoother and more rapid deregulation is facilitated as competition, possibly through new products, evolves.

Another major difference between the initial regulatory regime and the regulatory regime currently under implementation across Europe is the way competition problems detected in the

market analysis are sought redressed. Previously, SMP-operators were automatically subjected to a full range of remedies (obligations vis-à-vis competitors). This approach has lead to a high degree of transparency for entrants and incumbents alike and has been easy to administer by regulatory authorities. Technological development, emergence of competing infrastructure and horizontal convergence have made it necessary to change this approach as the problems to be addressed to a much greater extent than before differ across both countries and markets within the industry. The one-size-fits-all approach has therefore been replaced by a requirement that regulatory authorities tailor regulatory intervention so that only remedies that are strictly necessary to redress problems detected are imposed on SMP-operators. This change of approach will add to regulatory uncertainty but is likely to lead to an overall reduction in the extent of remedies employed. On the other hand there is a risk that regulators may impose too many *ex-ante* obligations in order to prevent abuse of market power by SMP-operators. This can lead to an overloaded bureaucracy and high administrative costs.

The ambition with these new principles is to ensure that regulation better reflects market conditions and addresses the entrants' needs while at the same time leaving as much room as possible for the incumbents to compete. The main differences between the two regulatory regimes are summarized in a somewhat simplified manner in table 2.9.

Table 2.9: previous versus current regulatory regime

	Previous regime	New regime
Relevant markets	Relevant markets were determined on the basis of products explicitly defined in the regulation.	Relevant markets are defined using competition law jurisprudence. Markets as defined by the European Commission are used as starting point for market definitions.
SMP	SMP defined as market shares above 25 percent.	SMP defined as dominant position as defined in competition law jurisprudence.
Remedies	One-size-fits-all.	Tailored interventions.

The regulatory reform will thus bring a greater coherence between horizontal competition regulation exercised by competition authorities and vertical competition regulation administered by regulatory authorities as sector specific regulation to a far greater extent than before will rely on general competition regulation.

Will the future bring more or less regulation?

As described above, the new regulatory regime is expected to provide a better basis for a normalisation of regulation of the telecom markets. But in the short run the result may turn out to be more regulation. Use of general competition law analysis, which the new regulatory framework is based upon, is more difficult when applied ex-ante than ex-post and there is no guarantee that a common analytical framework will create consistency. In order to prevent the abuse of market power by SMP-operators, there is thus a risk that national regulators impose too many ex-ante obligations which, in turn, could lead to an overloaded bureaucracy and high administrative costs.[19]

The relevant markets in which ex-ante regulation may be justified have been identified by the European Commission on the basis of three criteria, namely existence of high and non-transitory entry barriers, absence of effective competition and the insufficiency of competition law in achieving or restoring effective competition. Emerging markets should in principle be free from *ex-ante* regulation.

[19] This has been expressed by RBB Economics (2003)

The current regulation of the 18 markets appointed by the European Commission for future regulation is summarized in table 2.10 to shed light on what can be expected as the new regulation is introduced:

Table 2.10: Number of operators subject to regulation prior to the new regulatory framework

	DK	FIN	N	S
Retail markets				
1. Fixed line access (residential)	1*	44	1	1
2. Fixed line access (business)	1*	44	1	1
3. Fixed line national services (residential)	0	3/44	1	1
4. Fixed line international services (residential)	0	3	1	1
5. Fixed line national services (business)	0	3/44	1	1
6. Fixed line international services (business)	0	3	1	1
7. Minimum set of leased lines	1*	44	1	1
Wholesale markets				
8. Fixed line call origination	1	44	1	1
9. Fixed line call termination	1	44	1	1
10. Fixed line transit services	1	44	1	1
11. Unbundled access to local loop	1	44	1	1
12. Broadband access	1	0	1	0
13. Terminating segments of leased lines	1	44	1	0
14. Trunk segments of leased lines	1	0	1	0
15. Access and call origination (mobile)	2	3	2	3
16. Voice call termination (mobile)	0	3	2	1
17. International roaming (mobile)	0	0	0	0
18. Broadcasting transmission services	0	50	0	0
Number of regulated markets	11	15	16	13
Number of unregulated markets	7	3	2	5

Note: *subject to USO which theoretically does not depend of SMP status

Finland is in some aspects a unique case with its history of local monopolies that has brought a plurality in suppliers not seen in other countries. The higher number of SMP-operators in Finland compared to the other countries thus does not mean that competition is relatively poor in Finland but that the country is split up into smaller separate markets instead of having one national market. The challenges remain the same as in other countries because a local monopoly controlling infrastructure necessary to potential competitors has exactly the same possibilities to exclude competition on its “home market” as a national monopoly. When assessing the need for regulation it thus makes perfect sense to compare Finland with the rest of the Nordic countries.

A comparison between the old and the new regulation is never completely accurate as markets delineated according to the new regulation do not always correspond to the products or markets used under the previous regulation. But table 2.10 never the less gives an indication of the potential extent of the new regulation compared to the regime it is replacing.

Most markets designated for possible future SMP-regulation were also regulated under the previous regulatory framework. In most countries, markets for international roaming (market 17) and markets for broadcasting transmission services (market 18) were not regulated

previously. Regulation of markets for mobile voice call termination (market 16) in Sweden and Finland has in part been inspired by the new regulatory framework though they preceded its introduction whereas regulation of mobile call termination in Norway dates back to 1998, i.e. before the new regulatory framework. The enlargement of the scope of regulation is likely to lead to more regulation in the short as well as the long run and Denmark is likely to follow the example set by its Nordic colleagues and regulate market 16.

As regulatory intervention may only be used when general competition legislation is insufficient to redress market failures, future need for regulation of market 17 (international roaming) depends on the development of competition jurisprudence. The European Commission has investigated possible excessive pricing on the wholesale market for international roaming in the UK[20]. If the European Commission successfully intervenes against high wholesale prices using article 82 of the EC-treaty, regulatory intervention against pricing at these markets may therefore be un-called for.

An example of a market that is likely to become subject to less regulation is the market for access and call origination for mobile telephony. The number of SMP-operators appointed according to the old framework range from 2 to 3 across the Nordic countries. Under the future regulation, NRAs can only appoint more than one SMP-operator on a market if two or more operators have collective dominance, which is rather difficult to prove.

Even though the threshold for SMP-operators' market shares has been raised the new regulatory framework is likely to bring more regulation at least in the short term in most countries. Potential additional regulation is attributable to two effects from the new regulation. First, more markets have been appointed as candidates for regulation under the new regulatory framework than under the regulatory framework being phased out (including markets for mobile call termination, international roaming on mobile networks and broadcasting transmission services). Second, whereas the previous regulation primarily focused on the incumbent operators, the new regulation is neutral in its approach. As a consequence, entrants will probably face regulation of e.g. termination rates on fixed line as well as mobile telephony. So far, only the incumbents have been subject to such regulation in most countries.

The extension of regulation to more markets and in some cases more operators is due to a greater awareness of how markets work (see box 2.1) as well as different requirements for regulation as a consequence of more mature markets for e.g. mobile services. In the short term, NRA's will thus face greater responsibilities depending on the remedies NRAs choose to redress the competition problems identified in the market analysis. The more remedies are imposed the fewer cases are likely to arise but at the cost of stiffening market development as remedies implicitly may bring e.g. minimum standards for regulated products and upper limits on prices.

Box 2.1: Entrant squeezes incumbent

In Belgium, an entrant (Telenet) chose to raise the termination rates for calls to its fixed line customers. The price increase was considerable and Belgacom, being subject to regulation as SMP-operator, was unable to retaliate by raising its own termination charges for calls originated by the entrant. Consequently, Belgacom had no choice but to pass on the price increase to its customers. The entrant thus achieved higher earnings on incoming calls and made Belgacom less attractive for customers.

This case illustrates the risk of asymmetric regulation that does not reflect all market participants' possibilities to influence prices and other terms of business. The new regulatory framework mends this disparity as both incumbents and entrants are recognised as monopolists on call termination

[20] Press release at http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/994&format=HTML&aged=0&language=EN&guiLanguage=en

in their respective networks.

The liberalisation of telecommunications markets has thus generally required, and still requires, sector specific regulatory intervention across the Nordic countries as well as in the rest of Europe to secure market participants' access to essential infrastructure.

Remedies imposed on SMP-operators
Possible remedies that a regulator can impose on a SMP-operator include for instance transparency, non-discrimination, accounting separation, third party access, price control. All remedies aim at making incumbents and entrants as equal as possible when they compete at retail level.

In many cases, the remedies are difficult to use for detection of foul play. Both because annual accounts are finished late in relation to the period of time they cover but also because markets often develop and the appropriate delineation of markets used in the accounts therefore may change. Entries used for accounting separation therefore seldom correspond to relevant markets as intended in competition jurisprudence. As accounting separation in many cases is inadequate to discipline incumbents, correct wholesale price regulation becomes even more important because of wholesale prices' influence on incumbents' incentives to/benefits from attempts to foreclose entrants at retail markets.

Price regulation is not only one of the most important tasks; it is also one of the most difficult ones. In all the Nordic countries, access prices shall allow the incumbents to recover costs including a reasonable return on capital. But there are several different approaches as to how to determine costs using various cost bases and cost standards. A selection of different definitions of cost bases and cost standards is given in table 2.11.

Table 2.11: Principles for costs estimation

Cost base	Cost standard
Historic costs Incumbents are allowed to recover costs actually incurred when the infrastructure was build. Incumbents are thus certain to recover costs if network operating costs do not increase.	Fully allocated costs Prices cover costs directly attributable to the supply of the service in question as well as a contribution to the regulated company's common costs. Fully allocated costs thus mimic the costs for offering a service by a stand-alone-supplier that offers just this one service.
Current costs Prices are set allowing incumbents to recover costs as they are at present irrespective of what costs actually were when the infrastructure was build. This leads to lower prices particularly for new services where network equipment prices often drop as economies of scale are achieved.	Incremental costs Prices only cover the fixed and variable costs incurred by the incumbent when offering the service in question taking economies of scope with other services offered by the incumbent into account. Incremental costs are therefore always lower than fully allocated costs. Incremental costs have the advantage of offering entrants prices closer to the incumbents' actual costs thereby securing an as level playing field as possible.
Forward looking costs Prices are calculated on the basis of expectations for future equipment prices and efficient usage. Entrants thus do not risk paying too high prices due to inefficient investment strategies employed by the incumbents. Incumbents on the other hand cannot be certain to recover costs.	Variable/marginal costs Prices cover the variable costs incurred by the incumbent when offering the service in question taking economies of scope with other

	services offered by the incumbent into account. This principle is not employed in the Nordic countries.

Different combinations of cost bases and standards are possible. The different approaches used in the Nordic countries are shown in table 2.12 for fixed line interconnection and local loop unbundling.

Table 2.12: Cost methodologies for calculating interconnection and unbundling charges

	Cost accounting system for interconnection by SMP operators		Cost accounting system for access to the local loop	
	Cost base	Cost standard	Cost base	Cost standard
Denmark	Forward looking	LRAIC	Forward looking	LRAIC
Finland	Historic/current	Fully allocated costs	Historic/current	Fully allocated costs
Norway	Historic	Fully allocated costs	Current costs	Fully allocated costs
Sweden	Current	LRAIC	Current	LRAIC

Source: the ninth implementation report.

Table 2.12 illustrates that setting prices equal to costs involves a range of choices by regulators with more than one possible correct answer as it is important to keep in mind that balanced investment incentives for both entrants and incumbents are just as important as low prices for entrants' access to incumbents' infrastructure.

When deciding how to allocate costs and who should cover them, regulators often turn to the principle of causation: expenditures should be covered by the entity that causes them to arise. This can lead to distortions in cost structures for entrants compared to incumbents and it is indisputable that entrants are handicapped by these practices as indicated in the following examples.

- In some countries, entrants are charged to cover the costs for being monitored by an incumbent employee when entering a collocation site. Allegedly, the surveillance is necessary to protect the incumbent and others using the collocation site from risk of damages to their equipment. Incumbents do not pay entrants for a similar surveillance service when incumbents access collocation sites.

- When entrants wish to exchange traffic with an incumbent, it is necessary to establish a transmission line connecting the two networks. In Denmark, entrants have to cover the total cost for the construction of this connection. This in part reflects that entrants need interconnection with the incumbent far more than the other way around. In Denmark, costs for construction of connections for interconnection between mobile networks are divided according to the volume of traffic sent by either company.

- In some countries, incumbent operators' interconnection rates have so far been regulated allowing incumbents to charge interconnection rates at three different price levels depending on where in the network hierarchy the call is received: local, single transit and double transit. Entrants' interconnection rates have so far been considered a commercial matter. In e.g. Denmark, the incumbent only pays entrants termination charges corresponding to incumbents own *local* termination rate irrespective of the termination service delivered by the entrant. The incumbent argues, supported by legislation, that calls terminating in another network often are routed differently than calls within the incumbent's network thereby creating additional costs for the

incumbent. These costs are covered by only paying for local termination even when single or double transit termination is delivered by the entrants. Even though entrants face similar costs when their customers call customers connected to the incumbent's network entrants still pay full price for termination.

The examples given above illustrate a dilemma for regulators: efficiency at the cost of equal terms or vice versa. By allowing entrants to enter collocation sites a need for surveillance or access control is created. If costs are solely borne by entrants they face an uneven playing field. But to ask incumbents to pay as well is tantamount to asking the incumbent to defray extra expenses because an entrant uses the incumbent's site to compete with the incumbent. An advantage of the current regime for cost distribution between entrants and incumbents is that only entrants who are sufficiently efficient to cover all costs associated with introducing competition will enter the market. In other words: one avoids inefficient entry. A drawback of the current regime is that incumbents have no interest at all in carrying out investments that would reduce overall inefficiencies associated with operating more than one network, as the costs of these inefficiencies are borne by entrants alone. Current inefficiencies will therefore not be redressed.

Regulating access on markets undergoing rapid technological development

Telecommunications markets in Scandinavia and Europe are developing rapidly as technological development and increased demand for new services continuously change market conditions.

Because of the ever-changing market conditions national regulators face difficult tradeoffs particularly concerning access pricing. Access pricing is particularly complex because it is intended to promote several, and at times apparently conflicting, goals. In order to facilitate entry access prices should be as low as possible. But low access prices take away entrants' incentives to invest in new infrastructure. And without competing infrastructure markets will never be able to work unassisted by regulation. At the same time access prices are supposed to reflect incumbents' underlying costs in order to prevent inefficient entry and secure cost recovery for incumbents. Designing access price regulation is thus all about giving both entrants and incumbents the right investment incentives while keeping entry barriers low[21]. This is discussed further in the following with special attention as to how the unbundled local loop should be priced.

How best to promote competition over the local loop has been a controversial topic in telecoms regulation. Ideally, competitors would put an end to the incumbents' local loop monopolies by building their own networks. But building networks with coverage as the incumbents' networks is immensely expensive and time-consuming. Cable-TV networks generally provide coverage only in some areas (mainly the major cities) and mobile networks cannot yet offer broadband Internet access, at least not with full geographical coverage and the same data transmission speed as the fixed line network. Therefore, incumbents have been forced to share their fixed access networks with entrants.[22]

Chang, Koski and Majumdar (2003) have examined access pricing regimes for local exchange carriers in the US and Europe. In addition, the relationship between various aspects of regulatory and institutional policy changes in Europe and access prices has been analyzed. Based on data from US, the authors find that lower access prices have promoted deployment

[21] This important dilemma is also addressed in "ERG common position on the approach to appropriate remedies in the new regulatory framework" section 5.2.2.3. ERG emphasizes that NRAs have to be careful to design the relative prices of the different options in relation to one another and in relation to the retail prices correctly. Too low a price on one level may e.g. inhibit investment on another level, where replication may be desirable.

[22] See the Economist (2003)

of digital technology among US incumbent local exchange carriers. While the results for the EU are not statistically strong, being based on limited data, they suggest that access prices are lower where competition is more developed, where there is an independent regulatory authority and where retail price caps are in place. The study also finds that in countries where the access charges are higher than the EU average, telecommunications operators as a whole allocate more money towards investments. This is somewhat contrary to the findings established for the US. However, the authors underline that the European data are relatively sparse and likely to be insufficient. They also reflect institutional heterogeneity across nations. One therefore has to be careful about drawing too categorical conclusion on the relationship between different approaches to interconnection price regulation and investment behaviour in Europe.

As network costs to a great extent are fixed, it may appear reasonable to have fixed access charges. However, in order not to discriminate between small and large operators different combinations of fixed and variable charges are usually used. According to Peitz (2003) there are five general aims in the design of regulation. Regulation should:

1. Require as little information and data from market participants as possible.
2. Keep costs of regulation low and avoid an overloaded bureaucracy.
3. Ensure that regulatory measures are temporary rather than permanent and that superfluous regulation is repealed.
4. Ensure static economic efficiency with a particular focus on improving consumers' surplus.
5. Ensure dynamic efficiency so that incentives to invest give rise to socially optimal decisions.[23]

As pointed out by Valletti (2003), access pricing regulation has been analysed in a static context but there is no developed analysis of the linkage between access pricing and incentives to invest. However, one can make some conjectures about the factors that should influence the choice of regulatory policy by drawing on literature in related areas, e.g. literature about research & development. One important factor is flexibility: entrants should be allowed to choose from different entry modes with possibly differentiated price structures and incumbents should be allowed to set different access charges subject to average constraints in the form of price caps. Another important factor is that willingness to invest depends on the perceived risk of investment.

Regulation of access prices and terms affects the return facility providers can expect on their investments. The more often regulation is updated to take into account e.g. recent market developments; the less predictable are access prices and terms faced by market participants. Consequently, expectations of the nature of future regulation affect incentives to invest and to upgrade networks. It is therefore, according to Valletti, advantageous to establish a set of (possibly changing) access pricing rules in advance or at least to commit the regulator to follow a set of objectives or criteria in advance.

A regulator can thus reduce investment risks by committing to an access pricing regime. Such a policy can also facilitate the gradual development of entrants' networks. When investing in new networks entrants need to be as certain as possible that future regulatory intervention against the incumbent does not erode the expected benefits from the investment.

One way to address the potentially conflicting objectives when access prices are determined (low prices to promote entry and high prices to promote construction of new infrastructure) is a

[23] Peitz also underlines that regulatory policy should clearly distinguish between two different market phases, namely infancy and maturity. A policy that is optimal in a mature market may not be optimal in an infant market and vice versa.

model of dynamic prices, i.e. prices that change over time following a pre-determined trajectory. A model with dynamic access prices could promote competition in the short term and still provide incentives to invest in telecommunications infrastructure in the medium to long term, i.e. both static and dynamic efficiency would be achieved.

Cave and Vogelsang (2003) question that the best way to stimulate infrastructure investment is to have universally high access prices. According to the authors the matter must be considered in terms of the dynamics of competition not only between the incumbent and entrants but also among entrants. In addition, the dynamic process through which a single entrant progressively establishes itself in business is important. Experience shows that entrants do not immediately emerge as fully fledged facility-based competitors. A policy of high access prices in the early phase of the entrants activity may, according to the authors, "kill the entrants' business model stone dead". Constantly low access prices are, however, not a realistic long term solution as they deny cost recovery to network investors and thereby eliminate incentives to invest. The authors consider how to set access prices to ensure that both incumbents and by entrants are given an incentive to invest. They propose a model with dynamic access prices which rise over time as a solution.[24] Such an approach may even involve access prices which differ between operators according to the date of their entry.[25] This lowers entry barriers both because entrants' operating costs are lower initially when cash-flows usually are most strained and because losses from an early withdrawal from the market are reduced.

The final determination of the development of the rental charge depends on the regulator's preference for network duplication. Stable access prices at cost level are preferable if preferences for network duplication are weak. If, on the other hand, regulators favour local loop duplication and at the same time are concerned about entrants' short-term cash position they might choose to alleviate entrants' difficulties in the early phase of entry by charging a low initial rental charge which would then rise to a level above cost.

Entrants will generally be less concerned about regulated prices for replicable assets than prices for non-replicable assets. As it takes time for entrants to develop their asset base (and customer base) and that they will begin by investing in those assets which are most easy to duplicate, a regulatory policy of prices which rise over time – applied successively to assets in descending order of replicability – will facilitate the gradual development by entrants of their own networks.

This solution leaves open at least a couple of questions though. At what level should prices start, at what level should they end and how long shall it take for prices to reach their maximum level? Yet another question is the risk that incumbents do not recover their costs. Incumbents are burdened with a deficit during the period when access prices are set below costs. But incumbents will not recoup this deficit if entrants, as is the intention, build their own infrastructure when access prices are increased to levels above costs. Nevertheless, dynamic access pricing might offer the solution to the otherwise complex problem of how to promote construction of replicable infrastructure while keeping entry barriers low. Dynamic access pricing is discussed further in Chapter 4.

Nordic competition case law

Telecommunication markets in the Nordic countries are characterized by the strong presence of former monopolists. The incumbent providers thus still have monopoly positions on the local loop and hold dominant positions on most other markets. This is the reason why the majority of

[24] A policy of rising access prices over time has, according to the authors, the further advantage for entrants that the incumbent's incentive for price squeezes is reduced over time.

[25] Cave and Vogelsang emphasize that such discrimination may be impracticable or unlawful in some countries.

important Nordic competition practice on telecommunication focuses on abuse of dominant position.

Despite minor national differences, the Finnish, the Swedish, the Icelandic, the Danish and, as of 1 May 2004, the Norwegian competition regulations contain direct prohibition on abuse of dominant position and there is to a large extent a similar approach to the competition analysis in Nordic practice. Even though it is not possible to totally adopt the competition analysis performed under a different regulatory regime, it is possible to learn from the analytic approach in other cases.

Market definition
Before deciding if certain behaviour constitutes an abuse of dominant position, it is crucial to determine if the company in question is in fact dominant on the relevant market.

Defining the relevant market it could be tempting to use the markets defined by the Commission in Commission's Recommendation 2003/311/EC of 11 of February 2003 on Relevant Product and Service Markets. In this context it must be underlined that in competition cases, the exact relevant market must be defined case by case.

In regulated markets such as telecommunications it is often necessary not only to define the relevant market according to supply and demand substitution. One also has to consider legal demands for public service provision etc.

It is decided through Directive 2002/19/EC, the so-called access directive (cf. table 2.8) that every telecommunication provider is obliged to give other providers access to its net for exchange of traffic. Technically, every provider has an exclusive access to its own customers. Each provider thus has a monopoly position on other providers' access to its customers.

In the above mentioned recommendation from the European Commission it is established that relevant markets in cases on access to other providers' net or customers are to be defined as separate markets for each provider. This guideline has been followed in two Finnish cases – Fixed subscriber lines from May 2001[26] (upheld by the Supreme Administrative Court in April 2002) and Elisa Communication Oyj's Nettitaksa Internet Service from June 2001[27].

Abusive pricing
According to traditional competition practice, abusive pricing can take form as either excessive pricing or predatory pricing.

In 2003, the Danish Competition Authority examined a complaint on high prices for competitors' listing in the incumbent provider's national printed directories.[28] The Competition Authority did not find that the incumbent provider's earnings reached levels that justified allegations of excessive pricing.

There are no decisions in Nordic competition practice on abuse of dominant position by excessive pricing.

[26] Finnish Supreme Administrative Court's decision 150/690/2000, 18.5.2001: Elisa Corporation's fixed subscriber lines.
[27] Finnish Competition Authority's decision 570/61/2000, 26.6.2001: Elisa's Nettitaksa Internet Service.
[28] Danish Competition Council's meeting on 18 June 2003: Telia A/S complaining over TDC Forlag A/S.

Both Icelandic and Danish competition authorities have analysed complaints on predatory pricing.[29] In none of the cases, the competition authorities found sufficient proof of predatory pricing and illegal cross subsidisation according to the *AKZO* test.[30] In the Icelandic case nr. 17/1999, however, the test was never applied as the incumbent refused to give information regarding the effect of high user discounts, which was decided to be to the incumbent's detriment. The Icelandic Competition Authority's decision was upheld through all instances of appeal.

Another way of approaching possible abusive pricing is by analysing the price margin left for competitors purchasing necessary connection services by the incumbent provider.

Danish, Finnish and Swedish competition authorities have investigated complaints on abuse of dominant position by margin squeeze. 28 April 2004, the Danish Competition Council decided that the incumbent provider of fixed line telephony to business customers had abused its dominant position by obtaining an insufficient profit to cover the significant business risks associated with providing the product.[31]

The Finnish Competition Authority is currently investigating if network operators on the ADSL market are applying price squeeze to their wholesale pricing. The Finnish investigations have not yet come to a final conclusion. In the Finnish case on Nettitaksa Internet service, June 2001, investigations on possible margin squeeze were abandoned as Elisa Communication changed its prices and thereby solved a possible problem.

In 1995 and 1996, The Swedish Competition Authority investigated complaints regarding the dominant provider, Telia's, prices for interconnection over the fixed network. The relatively high interconnection prices, especially on regional and long-distance national calls made it impossible for competitors to offer interconnected calls at reasonable prices. The Swedish Competition Authority issued two interim decisions on the subject. The case was closed in 1999.[32] Due to the fact that the interconnection charges had decreased significantly since the interim decisions were taken, no further action was taken by the Competition Authority. Furthermore, the Swedish Competition Authority is investigating a possible margin squeeze on the market for broadband access (ADSL).

In a Danish case from May 2002,[33] the dominant provider (TDC) used its market power to charge high rates for other operators' termination in TDC's network while TDC demanded to pay significantly lower rates for termination in other operators' net. The Competition Council stated that TDC abused its dominant position both on the supply and demand market to obtain lucrative earning on termination.

Exclusivity and loyalty

Exclusivity clauses are a known way of tying customers. As other types of behaviour mentioned in this section, it can only be prohibited for dominant providers. For non-dominant companies it is a fully legal competitive means. For companies with a market share less than 30 pct., exclusivity clauses and other vertical loyalty measures are exempted from competition assessments in the block exemption on vertical agreements.[34]

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[29] Icelandic Competition Authority's decision nr. 17/1999: Iceland Telecom's GSM prices, Icelandic Competition Authority's decision nr. 41/2003: Iceland Telecom's closed user groups, Danish Competition Council's decision of 18 January 2003: Investigation on TDC's ADSL prices.

[30] AKZO Chemie BV v. the Commission, case C-62/86.

[31] Danish Competition Council's decision of 28 April 2004: Song Networks.

[32] Swedish Competition Authority's decision on 26 May 1999 (case No 107/95).

[33] Danish Competition Council's decision of 29 May 2002: Complain against TDC (filed by Consorte).

[34] Commission Regulation (EC) No 1400/2002 of 31 July 2002 on the application of Article 81(3) of the Treaty to categories of vertical agreements and concerted practices in the motor vehicle sector, OJ 2002 L 203/30.

In October 2002, the Norwegian Competition Authority prohibited[35] Telenor Mobil (the dominant provider) from agreeing or demanding sole supplier conditions when concluding contracts with distributors of mobile subscriptions. The Competition Authority decided that the exclusive rights prevented the distributors' ability to sell other mobile companies' products and services in competition with Telenor.

Loyalty rebates is another means for a dominant provider to attract customers – and prevent existing customers from changing to other providers. The leading Community cases on the subject are the *Hoffman-La Roche* case[36] and the *Michelin* case.[37]

The Icelandic Competition Authority has dealt with two cases on loyalty rebates on telecommunication services. In a case from 1999,[38] the incumbent provider lowered retail prices significantly on GSM services for frequent users just shortly before a new competitors entering to the market. The Icelandic Competition Council found that the discount scheme constituted an abuse of dominant position. In its case 34/2001, the Icelandic Competition Council ruled that Iceland Telecom had abused its dominant position on the market for telecom services by signing an exclusive contract and offering non-transparent end excessive discounts only to maintain its business with the Hafnafjörður municipality.

In august 2001, the Finnish Supreme Administrative Court ruled[39] that ownership discount granted by the dominant telephone co-operative was tying, discriminatory and non-cost-accountable and comparable to an abusive loyalty discount.

After intervention[40] by the Norwegian Competition Authority in July 2002, the dominant provider in Norway, Telenor, had to change its so-called Mobilbonus programme. The Mobilbonus programme awarded customers points for using their mobile phones. The value of the points could be exchanged for other services by Telenor Mobil. Among other things, Telenor Mobil was ordered to pay the value of bonus points automatically to customers when they left the bonus programme or closed their mobile subscription. The Competition Authority also prohibited Telenor Mobil from making the financial value of the bonus points dependent on how the bonus points were realised. Furthermore, the Competition Authority prohibited Telenor Mobil from making the accumulation of bonus points depending on who the customer was calling. Finally, it was prohibited to allow bonus members to use bonus points to buy mobile phones.

In May 2003, the Norwegian Competition Authority prohibited[41] the dominant provider (Telenor) from requiring a 70 percent adherence rate for offering discounts to members of the Co-operative Housing Association (NBBL). In addition the Norwegian Competition Authority prohibited the exclusivity clause, which forbade NBBL entering into agreement with competing operators. In the long term the Authority assessed the clauses to be liable to restrict competition, by shutting out current and possible future competitors.

A number of complaints to the Swedish Competition Authority questioned the validity of Telia's combination offers of analogue NMT and digital GSM services. Telia was the only operator able to offer its customers combinations of telecommunications services from NMT and GSM.

[35] Norwegian Competition Authority's decision of 14 October 2002 no 85.
[36] Hoffman-La Roche v. the Commission, case 85/76.
[37] Michelin v. the Commission, case C-322/81.
[38] Icelandic Competition Council's decision nr. 17/1999: Iceland Telecom's GSM prices.
[39] Finnish Supreme Administrative Court's decision 240/2/2001, 15.8.2001: Päijät-Hämeen Puhelinosuuskunta's (telecom co-op.) ownership discounts.
[40] Norwegian Competition Authority's decision of 10 July 2002 no 55
[41] Norwegian Competition Authority's decision of 3 October 2003 no 58.

The Competition Authority made the overall assessment that NMT and GSM from a demand viewpoint possessed limited substitutability and for this reason should be regarded as comprising two different product markets. In 1996, the Swedish Competition Authority made a decision requiring Telia (the incumbent provider) to discontinue offering joint discounts for NMT and GSM subscriptions.[42] The Competition Authority stated that such a discount system made it more difficult for competitors on the GSM market and that it contravened the Competition Act, i.e. the offers were illegal. Telia appealed the decision of the Authority to the Stockholm City Court which in 1998 upheld the Authority's decision. After this Telia appealed the decision of the Stockholm City Court to the Market Court. The decision was later revoked due to changed market conditions.

Discrimination and other abusive behaviour

According to Community/EEA competition regulation and the similar regulation in Sweden, Finland, Norway, Iceland and Denmark, discrimination is abusive if a dominant company applies dissimilar conditions between competitors for equivalent transactions. Most Nordic competition authorities have dealt with cases on discrimination. There are examples of the incumbent provider charging significantly higher prices from new competitors than from older customers,[43] unjust discrimination with regard to payment for termination fees,[44] not providing access to fibre optic infrastructure on equal terms,[45] and discrimination between competitors by unjustified end-user price differences between on-net and off-net calls.[46] The previously mentioned Finnish ADSL investigation is also examining possible discrimination between service operators.

The incumbent provider might also abuse its dominant position by in other ways gaining advantages from its strong market position.

In 2001, the Icelandic Competition Authority received a complaint from the new entrant Halló! on the market for fixed line voice telephony. The incumbent had sent letters to all Halló!'s customers reminding them of Iceland Telecom's services. This was further followed by calls made to Halló!'s customers. The Competition Authority informed Iceland Telecom that it was likely to abuse its dominant position on the market for fixed line telephony by using information from the fixed line division's (wholesale market) database to market services only to those customers that had chosen carrier pre-selection (down stream market). Iceland Telecom agreed to negotiations with Halló!, which settled the case.[47]

In 1999, the Danish Competition Council decided[48] that the dominant provider Tele Danmark (the later TDC) did not perform anticompetitive tying or in other ways abused its dominant position by offering the product "Duet". Duet customers could call at reduced rates from their fixed line to their mobile phone, and calls to the customers' fixed line phones were directed to their mobile phones if they did not answer the call at the fixed line phone. The competitors complained that they were unable to replicate the Duet product and that Tele Danmark used its advantageous market position on fixed line as leverage on the mobile market. The Competition

[42] Swedish Competition Authority's decision of 26 June 1996 (case No 63/94).

[43] Elisa Corporation's fixed subscriber lines, Finnish Competition Council's (FCC) decision 18.5.2001 (150/690/1999), no appeal to Supreme Administrative Court; Salon Seudun Puhelin Corporation's fixed subscriber lines, Finnish Competition Council's (FCC) decision 18.5.2001 (14/690/2000), Supreme Administrative Court's decision 22.4.2002 (1817/2/01); Turun Puhelin Corporation's fixed subscriber lines, Finnish Competition Council's (FCC) decision 18.5.2001 (15/690/2000), Supreme Administrative Court's decision 22.4.2002 (1842/2/01)

[44] Finnish Competition Authority's decision of June 2001: Elisa Communication Oyj's Nettitaksa Internet Service.

[45] Icelandic Competition Authority's decision nr. 21/1998: Iceland Telecom's fiberoptic infrastructure.

[46] Following the Norwegian competition notice of intervention 18 June 2003, the incumbent reduced the price differentials considerably. In the same period the incumbent lost market shares. As a result, on 17 December 2003, the Authority considered an intervention to be redundant.

[47] Icelandic Competition Authority's decision nr. 23/2002: Iceland Telecom's contact with Halló!'s customers.

[48] Danish Competition Council's decision of 26 May 1999: Tele Danmark's Duet service.

Council found that competitors were able to offer similar products. Furthermore, Duet was overall profitable despite the reduced rates for calls from the individual customer's fixed line to his or her mobile phone.

In 1996, the Swedish Competition Authority decided that the dominant provider (Telia) would abuse its dominant position on fixed subscriber lines by introducing asymmetric prices to its own customers. Telia had planned to gradually introduce a new service called "transferred call" which would make it up to SEK 0.50 more expensive per minute for Telia's own customers to call customers or dial-up numbers in the network of other operators. The Competition Authority stated that the pricing which Telia wanted to introduce would have highly negative effects on competition, as customers would have very limited incentives to subscribe to fixed networks other than Telia's. The Competition Authority made an interim decision on May 1996 and a final decision on December 1996.[49] Telia appealed the decision to the Stockholm City Court. On March 2000, the Stockholm City Court upheld the Competition Authority's decision. Telia appealed the decision to the Market Court. The decision was later revoked due to the fact that Telia no longer planned to introduce such a pricing scheme.

[49] Swedish Competition Authority's decision of 12 December 1996, case No. 587/96.

Chapter 3 Welfare, competition and market structure on Nordic telecom markets

In this chapter we, *first,* briefly recapitulate the goals of the competition authorities in each of the Nordic countries and conclude that the goals seem to be similar, if not identical. In the words of the Norwegian Competition Act, the common goal is to promote "…*competition and thereby contribute to the efficient utilisation of the society's resources."* Common goals are clearly a very important precondition for the feasibility of joint policy initiatives. However, we demonstrate that even if overall goals are similar, implementation of these goals in concrete cases may raise difficult questions about weight given to gains and losses that are unequally distributed, either between the individual Nordic countries or between generations.

Second, we note that it is common to condition a high degree of competition on the presence of a large number of competitors. Clearly, this is not the picture emerging from an inspection of the Nordic telecommunication markets. In most markets the number of competitors is limited and the question naturally arises: Is effective competition at all possible with such a limited number of competitors? The answer turns out to be a resounding *YES* and we explain why many competitors are not a necessary - but maybe sufficient - condition for effective competition leading towards efficient utilisation of society's resources.

Competition and social welfare

The overall goals of Nordic competition laws are formulated in slightly different ways, but the essence is the same: Promoting competition as a means to achieve the goal of more efficient utilisation of society's resources, cf. Box 3.1.

What is efficient utilisation of society's resources?

Broadly taken, *efficient utilisation of society's resources* is achieved when enterprises employ technologies and inputs such that profit is maximised and when consumers are able to buy goods and services such that their utility is maximised. We often use an alternative term to describe this state of affairs. We say that social welfare is maximised.

Box 3.1: The objectives of Nordic competition laws

Denmark:
"*…to promote efficient resource allocation by means of workable competition…*"
Norway:
"*…to further competition and thereby contribute to the efficient utilisation of the society's resources*".
Finland:
"*On the protection of sound and effective economic competition from harmful restrictive practices…*"
Sweden:
"…to eliminate and counteract obstacles to effective competition in the field of production of and trade in goods, services and other products"

Sources: Danish Competition Act no. 539 of 28 June 2002; Norwegian Competition Act of 5 March 2004; Finnish Act on Competition Restrictions (480/1992) w/amendments (318/2004); Swedish Competition Act

First, enterprises should maximise profits, and, as a corollary, minimize production costs. As enterprises base their decisions on prices in the market, it is a clear precondition that prices of all investment goods and inputs should reflect their true costs[50]. If not, enterprises base their production decisions on prices that do not reflect the true costs leading to production costs in excess of what is ideally possible.

Assume for example, that an independent service provider competing with the incumbent must buy access to the only existing network owned by the incumbent. Assume furthermore, that the access price for some reason (e.g. regulation) is lower than the true cost of access. The independent service provider is now able to sell access at a price that does not cover the true costs. But the shortfall of costs has to be borne by someone! The low price gives rise to an excessive demand at a level that is not consistent with maximization of social welfare. In addition, the independent service provider may erroneously decide *not* to invest in alternative access networks even though the true costs in the new network is lower than the true costs in the incumbents network. In brief, society's resources are not utilized efficiently.

Secondly, consumers should maximise their welfare. Consumers gain welfare by acquiring goods and services based on a comparison of prices in the market with their own willingness-to-pay. Also in this case, it is important that prices reflect the true costs. If prices are higher than the true costs, consumers may decide not to acquire the goods in question and give up welfare even though their willingness-to-pay is higher than the true costs, but lower than the price.

Assume for example, that the price of calls between two Nordic countries for some reason is above the true costs, while the price of calls within a country is below the true costs. Consequently, consumers erroneously limit the volume of Nordic calls because the price in some cases may be higher than their willingness-to-pay even though the true costs are below the willingness-to-pay. Furthermore, consumers erroneously expand the volume of national calls, as their willingness-to-pay in some cases may be higher than the price, even though the true costs are above the willingness-to-pay. In both cases, society's resources are not utilized efficiently.

Issues of interpretation
Even though the objectives of all Nordic Competition Acts are broadly similar, it may still be difficult in a specific Nordic competition case to agree on the proper interpretation of the concept social welfare. As the maximization of social welfare requires consideration of the

[50] Including overhead and financing costs as well as a standard measure of rent.

interests of both enterprises and consumers, it is clear that in concrete cases the question arises how much weight should be attributed to enterprises and consumers and to different consumer groups.

As a *first* general example, consider a case that increases the benefits of enterprises more than consumer welfare is reduced? Overall social welfare increases, but enterprises gain and consumers loose? Is this acceptable?

The Norwegian Competition Authorities explicitly takes this conflict into account in the new Norwegian Competition Act by requiring competition authorities to pay "*special consideration to the interests of consumers*". If it means that only the benefits of consumers should be considered, then the Norwegian Competition Authorities would turn down the case, while other Nordic competition authorities may tend to approve the case because overall social welfare is increased.

As a *second* example particularly relevant for the telecommunications sector, consider a case that decreases consumer welfare today, but increases consumer welfare - appropriately discounted - tomorrow even more. This is, in particular, an issue in sectors, as telecommunications, with rapid technological innovation, high fixed costs and intrinsic uncertainty. If prices are very low today to the benefit of today's consumers, it may hamper innovation and investment in new capacity and new technologies, lowering the quantity and quality of telecommunication services tomorrow, and in turn harming tomorrow's consumers.

Market structure and social welfare

The standard paradigm of a market structure that maximises social welfare is a market with perfect competition. In a market with perfect competition the number of agents on both sides of the market, the demand side and the supply side, is so large that none of the agents by making own or joint decisions is able to have an impact on the market price or quality. This is clearly not the picture that emerges from an inspection of the Nordic telecom markets.

However, this does *not* imply that workable competition is impossible with a limited number of competitors[51].

According to the *Bertrand* paradigm two firms are sufficient to drive prices down to marginal cost level, i.e. the perfect competitive outcome. When firms with homogeneous products compete on prices, a firm can capture the entire market by undercutting the rival's price. It is profitable to do so when the price is higher than the marginal costs. Therefore, the equilibrium under price competition will be that both firms set price equal to marginal cost.

However, the Bertrand paradox relies on some assumptions that are not always met.

Firstly, if the firms have different marginal cost, the most efficient firm can capture the entire market by setting a price slightly below the rival's marginal cost. This means that only one firm will operate in the market. However, the price charged by this firm is determined by the marginal costs of its rivals. This means that the *potential competition* will discipline the market and prevent monopoly prices.

Secondly, if the firms differentiate their products they will be able to charge a price above marginal costs. In this case, *actual competition* will discipline the market and prevent monopoly prices contingent on the degree of substitutability between products. The lower is the substitutability, the less effective is the threat of competition, the higher is the mark up on marginal costs, and the less competitive is the market outcome.

[51] This text is based on: Luís Cabral, *Introduction to Industrial Organization*, The MIT Press, 2000.

Thirdly, if the firms compete repeatedly they may be able to establish (tacit) collusion and agree to set prices above marginal costs.

Fourthly, if firms are constrained in their ability to expand production, the choice of capacity becomes a strategic decision. This changes the competitive regime to *Cournot competition*, where firms compete in quantities. Under Cournot competition the equilibrium price is between the monopoly price and the price under perfect competition. The crucial question, when determining whether the Bertrand or the Cournot model gives the best description of an industry, is: What can most easily be adjusted, prices or quantities? If capacities are most difficult to adjust, the Cournot model gives the best description of the competition in the industry.

From a social perspective, the optimal number of firms under Cournot competition is determined through a trade-off between obtaining strong competition and minimizing costs by exploiting economies of scale. In fact the number of firms may be *too high* from a social perspective if there is free entry. A new firm will capture market shares from the existing firms. This is a transfer between firms benefiting the entrant, but not the society. Therefore, if entry does not lead to sufficient expansion of the market, entry may reduce social welfare due to entry costs and loss of economies of scale.

Chapter 4 Competition between and within networks

Telecommunication is a network industry as electricity, gas, rail and postal services. Network industries have a range of common features setting it apart from ordinary industries. The prime distinguishing feature is the dependence on a network, for example cables, tracks and pipelines, as a conduit of the services produced in the industry. Networks have been very expensive to build with high fixed costs, but low marginal costs: Adding a new user to an existing network has not been very costly. For this reason, *efficient utilisation of society's resources* has historically been closely associated with monopoly provision of network services.

A second distinguishing feature is the existence of network externalities. Network externalities imply that private and social gains from using a network grow as the number of customers connected to the network increases. It is clearly more beneficial for a person to be connected to a telecom network the more friends and family members can be contacted using the network. A non-trivial consequence of the presence of network externalities is that neither a competitive market, nor a monopolist may by them selves implement the best market outcome assuring an *efficient utilisation of society's resources*. Alone for this reason, the role of regulation is much more outspoken in industries with network externalities than in industries without.

In many network industries there is only a single monopoly network. This is for example the case in electricity, gas and rail. These networks are characterized by significant economies of scale making it socially undesirable to duplicate the networks. In these network industries competition has to take place *within* the same network. The key competitive concern is to assure access to the network for all companies, actually and potentially, in the market. In most cases, governments have chosen to unbundle the network. Unbundling implies that ownership[52] is transferred to a system operator independent of any commercial interest within the industry and rules are designed to assure non-discriminatory and transparent access to the network for all market participants.

However, telecommunications is different. In all Nordic countries, the incumbent still owns and controls the Public Switched Telephone Network (PSTN) even though the incumbent at the same time competes fiercely with other companies in telecom markets that depend on access to the very same network. The dual role of the incumbent raises significant competitive concerns and accentuates the need for regulatory intervention to moderate the obvious conflicts of interest.

The lack of unbundling between network ownership and provision of telecom services may be justified, if there is strong technical interdependence between the services provided on the

[52] Various degrees of unbundling are available: Accounting, legal, management and ownership unbundling. Accounting unbundling is the least radical type of unbundling, ownership the most radical.

network and the network itself. This may be the case if the introduction of new technologies requires significant investments that are sunk in case of failure and are associated with considerable uncertainty. If the ownership of the network is split between two entities, overall risk will be amplified due to the danger of coordination failure and it may limit the incentive to invest in the first place. This argument is supported in a recent report for the European Commission (Ovum, 2003) and even more forcefully by OECD (2003). In telecommunications, the case for unbundling of the entire network seems to be much less convincing than in other network industries.

However, at the same time technological advancement has markedly reduced the costs of transmitting and switching a telephone call and has made the existence of competing networks and competition *between* networks much more realistic than in other network industries: In the mobile market, several competing networks are active in all Nordic countries; In the broadband market, network access - in particular via cable-TV - has already created competitive pressure on network access through PSTN. Furthermore, a range of promising network technologies is on the verge of becoming technologically and commercially viable on a grand scale: Optical Fibre, Fixed Wireless Access (FWA) and Power Line Communication (PLC), the latter exploiting the electricity network as the carrier of telecom signals.

It seems that competition *between* and *within* networks has the potential to be significant and *complementary* means of promoting overall competition and to achieve efficient utilisation of society's resources in the telecom sector. The challenge will be to give the proper priority to the two types of competition and to make sure that policies designed to foster one type of competition does not undermine the other type of competition.

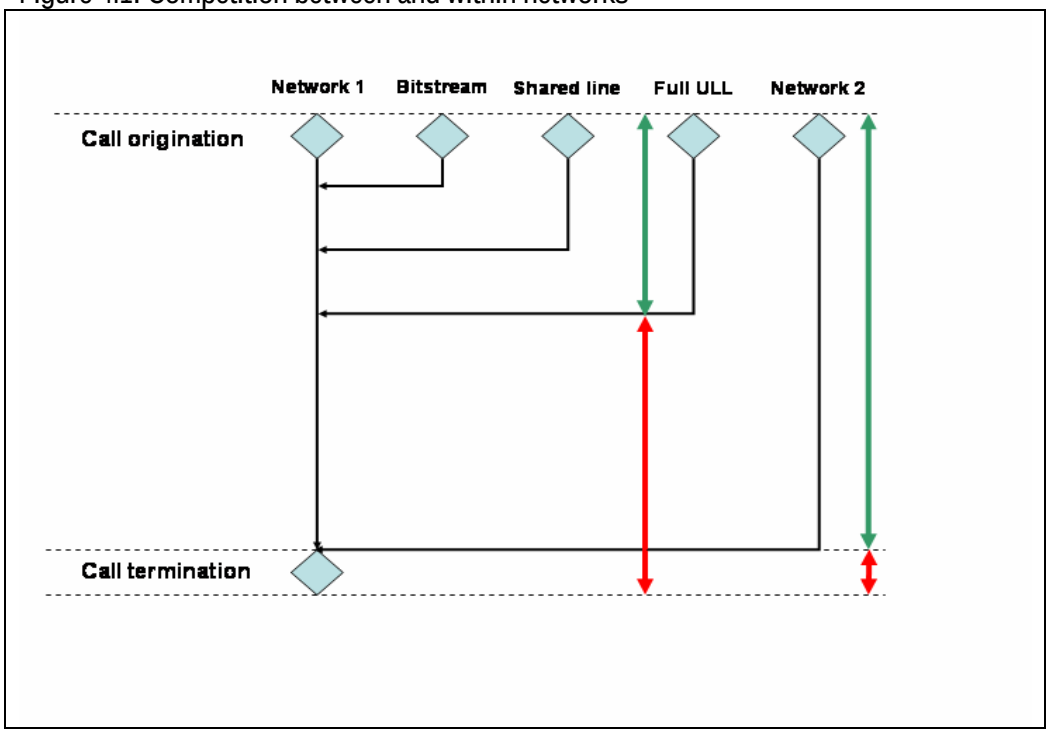
Overall, competition *between* networks seems to be superior to competition *within* networks for the following two reasons:

First, if competition takes place between alternative networks, competition is putting a competitive pressure on all parts of the value chain and generates maximum freedom to create and compete in differentiated products. In contrast, when competition takes place within the same network, some part of the value chain is exempted from the competitive pressure.

In the telecom sector, competition within the (PSTN) network can, in principle, take three different forms: Bit stream access, Shared line and full unbundling of the local loop, cf. Figure 4.1. *Bit stream access* allows a service provider to resell the same retail products as the network owner without requiring significant specific investments. *Shared line* allows him to develop and sell a limited range of own broadband products but requires some specific investments. *Full unbundling of the local loop* implies that he rents the full local loop and can develop a broad range of narrow- and broadband services, but with significant investment costs. In contrast, setting up an alternative network to create competition between networks implies very significant specific investments, but the freedom to operate commercially is also unbounded.

The above examples demonstrate the basic trade-off between entry and scope of competition. The less specific investments needed, the smaller is the risk, the easier is immediate entry, but also the more limited is the scope of competition. On the one hand, promoting access with low investment requirements leads to rapid entry but gives rise only to limited competition. On the other hand, promoting access with high investment requirements makes entry difficult, but may give rise to full competition. Only in the case of investments in alternative networks the entire value chain exposed to competition, except call termination to which we will return in the next chapter.

Figure 4.1: Competition between and within networks



Second, if competition takes place within the same network access to the network must be mandated and strongly regulated (or alternatively the network must be unbundled). This is, in particular, important when the network owner competes on the same downstream market as the service providers who are granted access to the network. The network owner has a strong incentive to obstruct the service providers by raising access prices or otherwise making access problematic, costly and unreliable. In contrast, service providers who own their network owner do not depend on (one-way) access to resources controlled by competitors, although they may have a reciprocal interest in (two-way) access to each others networks.

Consequently, more competition between networks not only extends the competitive pressure in several dimensions, it also reduces the need for regulatory intervention. It follows that any policy aiming at an *efficient utilisation of society's resources* as a prime concern should have to create competition between networks. However, competition between networks is not always superior to competition within networks. Competition between networks requires entry and if entry is difficult and carries high risk, competition within networks may be the only feasible option.

Competition between and within networks in the Nordic countries

We now give a brief overview of the status of and prospects for competition between and within networks in the Nordic countries. We distinguish between the three main telecom markets[53]: Fixed telephony, mobile telephony and broadband Internet services[54].

Fixed telephony

Fixed voice is by far the largest and most mature telecom market. The fixed penetration rate, that is, the number of fixed voice subscriptions per 100 inhabitants, is above 65 in most Nordic countries and the call volume is at least 10 times as large as the call volume for mobile voice.

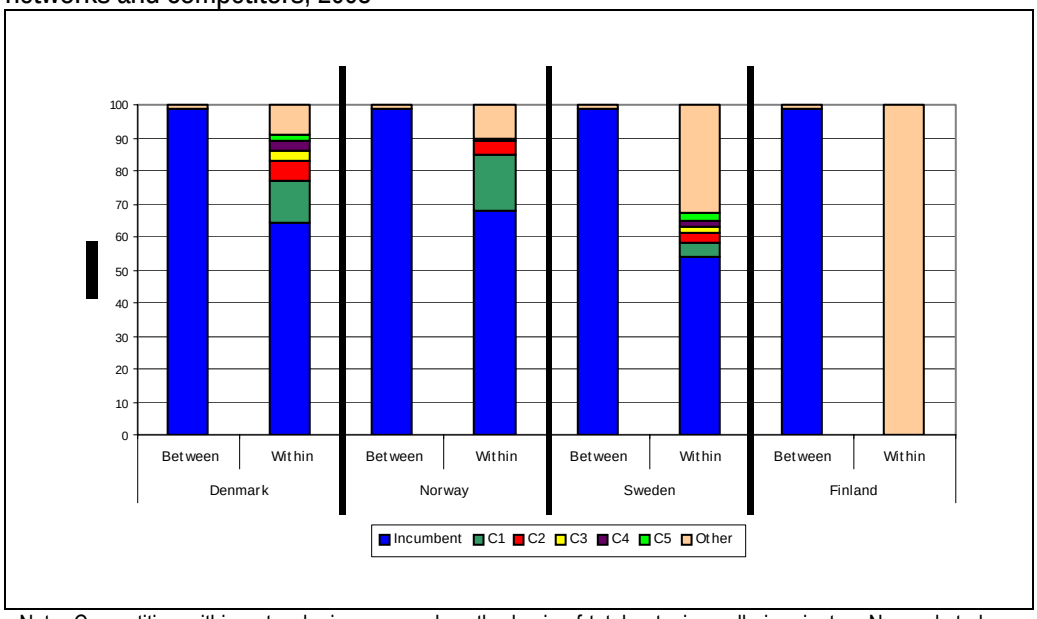
[53] We use the term "market" in a broad sense covering both retail and wholesale aspects and not as a synonym for the relevant market.

[54] Broadband access requires an access line with at least 128 kb/s. Accordingly, access using modem on the PSTN network is not part of the broadband market

However, total revenue for fixed voice and fixed broadband is not more than four times as large as the revenue for mobile voice.

In all Nordic countries, the key network on the fixed voice market is the PSTN network owned by the incumbent operator(s). True competition *between* networks is non-existing as all service providers rely on PSTN-access, cf. Figure 4.2. In contrast, the number of service providers competing *within* the PSTN network is quite significant, in Norway, Denmark and Sweden having a market share between 30 and 50 percent.

Figure 4.2: Fixed voice, competition between and within networks, markets shares for networks and competitors, 2003



Note: Competition within networks is measured on the basis of total outgoing calls in minutes. No market share data available for competition within networks in Finland.
Source: Telestyrelsen, Denmark; Post- og Teletilsynet, Norway; Teleavisen AS, Norway; Kilpailuvirasto, Finland; Post- och Telestyrelsen, Sverige.

However, measured by the share of domestic outgoing calls[55] the market share of the incumbent operator(s) is still very significant, in all Nordic countries above 60 percent. Measured by the share of subscriber lines, competition is less intense as the incumbent's market share is close to 100 percent in all countries except Denmark with about 86 percent[56].

The prospects for attracting investments in new networks on the fixed voice market seem bleak. The number of fixed network subscribers has started to decline slowly and the call volume even faster. In the last three years the number of subscription lines in Sweden has declined by 6 percent while the call volume has slumped by almost 12 percent. The call volume stagnates as Internet traffic moves from ISDN and modems on the PSTN to high speed connections on the broadband market and as mobile voice gradually takes over volume from fixed voice.

IP-telephony, that is, telephony via the Internet seems to be a promising alternative to fixed voice telephony. IP-telephony is a telephony service operated via Internet that requires access to a broadband network. If IP-Telephony succeeds, it is very likely that fixed voice becomes a

[55] Measured by the share of outgoing international calls, competition seems to be even more intense as the incumbent's market share is lower, about 50 percent.

[56] The lower market share for the incumbent in Denmark is not due to the existence of alternative networks, but to Wholesale Line Rentals, that is, service providers' pure resale of subscription services rented from the incumbent. The same possibility exists in Norway.

product bundled with Internet access and Cable TV and provided on a broadband network. As a consequence, the fixed call volume may decline drastically.

New investment in fixed voice is costly, especially in the local loop connecting directly to consumers, and investments are sunk cost in the sense that once investment has taken place, it has no alternative value if the investment fails. Large, sunk costs significantly increases the risk of the investor and deters investment in new networks.

To sum up, the significance of the fixed voice market is already declining. It is not likely that investments in new infrastructure will take place in the market and there does not seem to be a strong role for promoting more competition *between* networks. However, we expect a significant part of the call volume to become integrated on the broadband market where the prospects for competition between networks are much more promising.

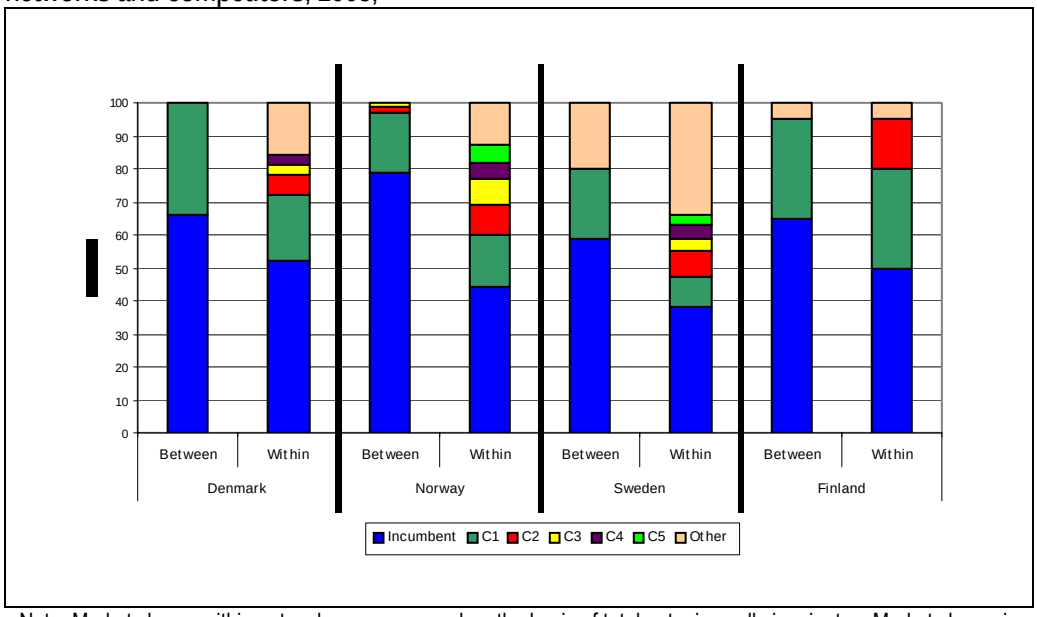
Fixed broadband

The fixed broadband market, in contrast, is still a small market, but rapidly expanding. The penetration rate is just coming above ten in some of the Nordic countries, but the number of broadband subscriptions has more than trebled in Denmark the last two years and the trend is expected to continue. In Norway the number of subscriptions is expected to triple in the next three years.

In all Nordic countries there are already several broadband access networks in place covering significant parts of the population. In addition to the PSTN network, cable TV networks cover 50-70 percent of the population, most significantly in Denmark, least in Norway. In Sweden, networks using the optical fibre technology also have some significance. Thus, compared to fixed voice there seems to be some room for competition *between* networks. Overall, the number of service providers is rather high, but lower than on the fixed voice market. One reason may be that independent service providers have (mandated) access to the PSTN network, but not to cable networks.

However, the competitive pressure on the fixed broadband market is significantly muted due to the incumbent's joint ownership of the PSTN network and the main cable operator in all Nordic countries, except Sweden. Joint ownership of two potentially competing networks reduces the incentive to compete on prices and on creating new innovative services due to the risk of cannibalizing market shares of a sister company. This effect is larger the larger the combined market share of the jointly owned networks is. In Denmark, the incumbent, TDC, owns the PSTN network and the largest cable TV operator giving rise to a combined markets share at more than 70 percent measured in the number of subscription lines, cf. Figure 4.3. Hence, the combined TDC market share is larger on the expanding broadband market than on the declining fixed voice market.

Figure 4.3: Broadband, competition between and within networks, markets shares for networks and competitors, 2003,



Note: Market shares within networks are measured on the basis of total outgoing calls in minutes. Market shares in Finland are for the Helsinki area where Elisa Corporation and TeliaSonera Finland are the two dominating market participants.
Source: Telestyrelsen, Denmark; Post- og Teletilsynet, Norway; Teleavisen AS, Norway; Kilpailuvirasto, Finland; Post- och Telestyrelsen, Sverige.

The same story holds for Norway and Finland and for Sweden until the merger of Telia and Sonera in 2003. As part of the merger approval procedure TeliaSonera accepted to divest their cable TV operations and they now have separate ownership. However, it is still too early to gauge the impact on the market.

The prospects for further investments in alternative networks seem promising on the broadband market. The market is expanding and margins are much larger than on the fixed voice market. Furthermore, a whole range of new technologies is gradually becoming technologically and commercially viable. It is expected that the promotion of new technologies as optical fibre, fixed wireless access and power line communication will have a significant, but still uncertain, potential for strengthening competition.

In sum, there seem to be considerable opportunities for expanding competition *between* networks on the fixed broadband market. However, strict separation of ownership of competing networks, now and in the future, must be enforced. Nordic competition authorities should give high priority to the separation of horizontal ownership in all Nordic countries and to the prevention of ownership concentration across the new and old technologies. In addition, it is important to assure that consumers have real substitution possibilities between alternative networks and service providers. If switching costs are high between networks, due to different standards, need for new converters, switching fees and, possibly, administrative harassment, consumers will be locked in, in small pockets of monopoly power in reality nullifying the benefits of competition between networks.

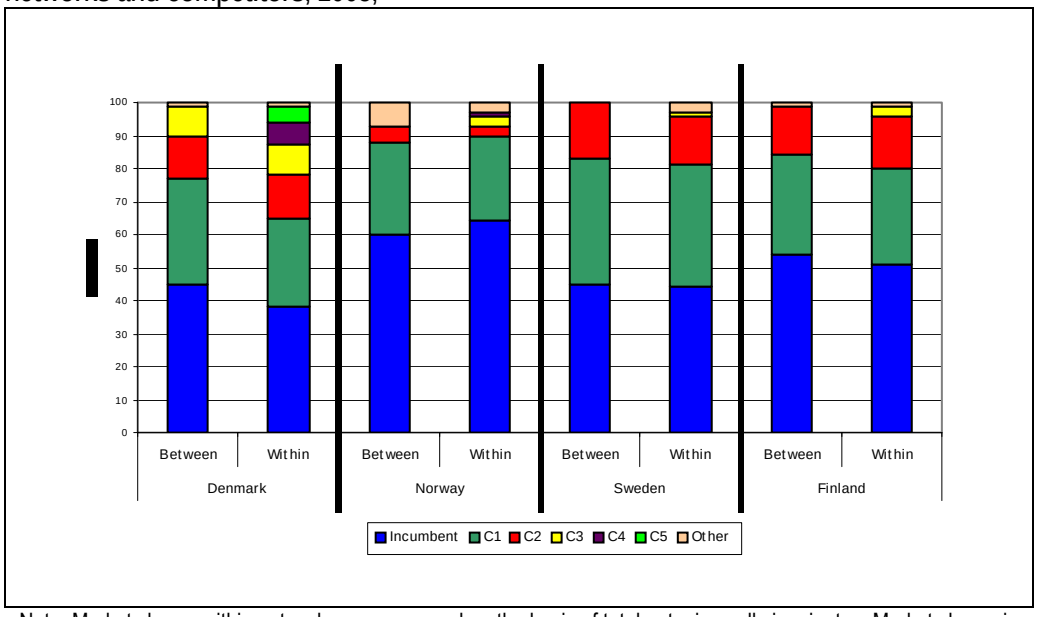
Mobile voice

The mobile voice market is smaller, but with higher margins than the fixed voice market. Penetration is slightly larger, mobile calls represent less than one fifth of all voice calls, but mobile revenue generates one third of the revenue in the telecommunications sector. Penetration has started to level off, but there is still robust growth in the call volume, growing 20 percent annually in Denmark

In all Nordic countries, there are at least two alternative networks on the market giving rise to considerable competition between networks. Furthermore, the number of competing networks is going to increase with the introduction of the third generation of mobile technology, but the speed of penetration is hard to predict (and depends on the choice of regulation).

The incumbent owner of the PSTN networks owns the leading mobile network in all Nordic countries, but its market role is more modest than on the other two markets. In all Nordic countries, the incumbent has market share of between 40 and 60 percent in all Nordic countries, cf. Figure 4.4. However, in some countries the incumbent has started to buy up independent service providers with sizeable market shares, thus increasing the market share controlled by the incumbent.

Figure 4.4: Mobile voice, competition between and within networks, markets shares for networks and competitors, 2003,



Note: Market shares within networks are measured on the basis of total outgoing calls in minutes. Market shares in Finland are for the Helsinki area where Elisa Corporation and TeliaSonera Finland are the two dominating market participants.
Source: Telestyrelsen, Denmark; Post- og Teletilsynet, Norway; Teleavisen AS, Norway; Kilpailuvirasto, Finland; Post- och Telestyrelsen, Sverige.

At this stage, mobile and fixed voice services seem to be complementary services rather than substitutes. For this specific reason, we do not find that joint ownership of fixed and mobile networks needs to be a significant impediment to competition between networks in either of the two markets. However, Nordic competition authorities should be aware of the incumbent's potential for discriminatory treatment of competitors in the market for bundled products covering both mobile and fixed services and should follow the market closely.

The new network technologies

We now briefly discuss the key properties of new network technologies that may play a more significant role for the provision of telecommunication services in the future: Cable-TV, optical fibre, power line communications (PLC) and fixed wireless access (FWA).

Cable-TV

Cable network is, currently, the most promising alternative to the PSTN network for broadband access. Cable-TV was, originally, designed for one-way broadcast of TV and radio signals and needs to be adapted to handle the two-way communication needed for broadband access.

However, the cable network technology is mature and the technological challenges are modest, cf. Box 4.1. Currently, cable networks can handle up to 200 Mbps, but the capacity is expected to increase as TV transmission is digitalized.

Box 4.1: Cable network

Cable network has been designed to transmit TV and radio signals and, therefore, has a purely distributive one-way architecture. When used for broadband access, it is necessary to create a two-way structure by supplementing the downstream path with an upstream path. Typical, one or several 8 MHz frequency channels designed for TV distribution are used for downstream broadband communication. Upstream communication is implemented in the lower part of the spectrum not used for TV. Depending on the modulation technology and the cable TV standard one TV channel corresponds to 27-56 Mbps data. The consumer uses a cable modem to connect to IP devices through USB or Ethernet ports.

Users of cable network share the same physical medium to the network distribution points. It implies that several users must share the allocated capacity, in contrast to the point-to-point fixed telephone network. When the number of users increases, the cable operator has to allocate new channels for IP connectivity to maintain the same average user capacity.

The capacity of a cable network depends on the frequency bandwidth and the bandwidth allocated for TV and radio distribution. The total bandwidth has more than tripled through history. The frequency bandwidth necessary for distribution of one analogue TV channel is just 8 MHz. However, by the conversion from analogue to digital transmission the bandwidth needed for one TV channel will be dramatically reduced, releasing more capacity for IP connectivity.

The adaptation of IP streaming technologies in cable networks is a promising future scenario. Cable TV operators will have a much more flexible and efficient platform for the provision of TV, radio, Internet, IP-telephony and other services.

Source: Ovum, *Barriers to competition in the supply of electronic communications networks and services*, November 2003 and Marilyn Kemper Littman, *Building Broadband Networks*, 2002, CRC Press

Cable network already has a significant coverage and customer base in all Nordic countries, more than 60 percent of the population in Finland, Denmark and Sweden and slightly lower in Norway. On the Nordic market for broadband access, cable networks have market shares in the range between 20 and 30 percent. However, the market share has been declining recently as access through digital subscriber lines (DSL) on the PSTN network has exploded.

The costs of gaining access to a cable network are modest and comparable to the costs of broadband access on the PSTN network. Likewise, the costs of switching between cable and PSTN networks seem to be modest.

Independent service provision on cable TV networks is technically more challenging than service provision on the PSTN networks, as consumers do not have a dedicated line each, but must share a common capacity.

The key problem with the cable networks is the fact that the incumbent owner(s) of the PSTN network also owns the largest cable network in all Nordic countries, except Sweden. In Denmark, TDC owns TDC Kabel TV with 60 percent market share; In Norway, Telenor owns Canal Digital Kabel TV with 55 percent market share; in Finland, the (many) incumbent operators own all providers of cable TV, except in Helsinki. In contrast, Telia had to divest its cable network in Sweden when they merged with Finnish Sonera to create TeliaSonera Sweden.

We find that the positive impact on competition *between* networks will be significantly muted as long as the incumbent owners of the PSTN networks continue to have large ownership shares in cable network.

Optical fibre networks
Optical fibre networks are a promising alternative to broadband access and have already gained some coverage, especially in Sweden. Optical fibre networks use mature and well-known technologies, and the capacity is massive and measured in Giga-, not Megabytes, cf. Box 4.2.

Box 4.2: Optical fibre

Optical fibre network is a promising alternative for broadband access. It has a huge capacity, measured in Gigabytes, and use mature and well-known LAN technologies.

Optical fibre networks suffer from huge installation costs. For this reason, optical fibre is primarily an option for large companies or housing associations. However, there are many "dark" fibres available in the cities and alongside railways and power lines, which can be "lit" and utilised. The coverage of optical fibres is still low in the Nordic countries, except for Sweden.

Optical fibre access can have two different architectures, either Fibre To The Home (FTTH) or Fibre To The Curb (FTTC). The FTTH architecture is a true optical network, where the fibre is connected directly to IP devices like PCs and routers via a converter in the house. The FTTC architecture is a combined fibre/electrical circuit network using optical fibre to a converter in a street cabinet outside the house and the electrical circuit in the house as the last conduit.

Optical fibre networks can offer an integrated service with Internet, IP-telephony, video and broadcast TV over IP (triple play). They may also deliver new broadband services with huge capacity requirements like Video/Audio On Demand (VOD/AOD) services.

Source: Ovum, *Barriers to competition in the supply of electronic communications networks and services*, November 2003 and Marilyn Kemper Littman, *Building Broadband Networks*, 2002, CRC Press

Information about the number of subscriptions on optical fibre networks is hard to find and should not be directly compared to each other. Nevertheless, there is no doubt that fibre access is much more developed in Sweden than in the other Nordic countries. There are about 140,000 fibre users in Sweden, in Denmark and Finland about 30,000 users and In Norway about 14,000 users. These figures correspond to market shares below 5 percent. The number of fibre users in Iceland is not known.

Optical fibre networks suffer from significant installation costs that have to be justified by equivalent traffic volumes. A recent study[57] by OVUM calculated the average cost per subscription line of different network technologies for broadband access and found that the costs of access on optical fibre networks are eight times larger than the similar costs of DSL-access on the PSTN-network. This level will probably restrict the use of optical fibre networks to installations with very high traffic volumes, for example companies or housing associations.

All incumbent operators in the Nordic countries are active in the development of optical fibre networks, but we are not aware of their ownership share of optical fibre networks. However, the same conclusion holds as in the previous section. In order to create or maintain competition

[57] European Commission, 2003, *Barriers to competition in the supply of electronic communications networks and services*, Report prepared by OVUM.

between networks, the incumbent owner of the PSTN network should not be allowed to acquire significant ownership shares in optical fibre networks.

Power line communications (PLC)
Power Line Communication uses the high frequency spectrum of the ordinary electricity network for transmission and has a large potential for increasing competition between networks on the fixed broadband market, primarily as the electricity network has 100 percent penetration, not only to all buildings but also to each and every room.

However, the technological feasibility is still in doubt. Noise and interference in the un-shielded electricity wires is still significant and it is not clear whether these interference problems will be solved in the near future, cf. Box 4.3. The commercial viability can also be questioned, but the on-going liberalisation of electricity sector distribution companies in all Nordic countries render it probable that the commercial viability of the Power Line Communication will be tested.

PLC networks have been tested for a number of years in different countries. However, the actual take-up of the technology is still very low. Norway has about 300 users; Finland about 600 users and Iceland about 700. In Denmark and Sweden public figures are not available.

To our knowledge none of the incumbent operator(s) are currently engaged in testing or operating PLC networks. As in the previous sections, it is essential that the ownership of a future PLC network remains separate from the ownership of the PSTN network.

Box 4.3: Power Line Communication

Power Line Communication (PLC) networks use the high frequency spectrum in the existing electricity network. PLC networks have some obvious advantages. Direct construction costs are very limited as a physical infrastructure with full coverage already exists connecting to each and every room in all buildings.

PLC networks require the installation of Base Station Units in street cabinets. They are connected through a filter to a Service Unit in the home. The filter separates low frequency from high frequency signals, while the Service Unit is akin to a cable modem supplying the IP interface.

The PLC networks use the spectrum above 1 MHz, while electricity is transmitted in the spectrum about 50-60 Hz. PLC networks are still in its infancy and a number of problems remain to be solved. Noise in the power lines makes it difficult to establish error-free high speed broadband data transfer. The high frequency spectrum often interferes with other electrical devices as the power lines are unshielded. The quality of the copper wire varies and limits the reel coverage of the network.

Current technology makes it possible to offer up to 3 Mps broadband connection and 10 Mps technology is not far away. However, as PLC networks are shared networks like cable networks the overall capacity must be much larger to make these networks competitive.

For general access to the Internet, PLC networks are realistic alternatives to other network technologies. However, for other services like Video over IP and IP-telephony the competitiveness of PLC depends on the development of high speed PLC technologies.

Source: Ovum, *Barriers to competition in the supply of electronic communications networks and services*, November 2003 and Marilyn Kemper Littman, *Building Broadband Networks*, 2002, CRC Press

Fixed wireless access
Fixed Wireless Access (FWA) networks are wireless networks using licensed frequency bands.

The term "*Fixed*" refers to the fact that users can only receive signals from stationary positions, FWA networks typically have an omni-directional antenna located at the service provider and a directional antenna at the end-users' premises pointing towards the omni-directional antenna cf. Box 4.4. The typical distance between the two antennas is 5km.

All the Nordic countries have issued and distributed licenses for FWA deployment, but the roll-up is still very limited. Denmark has about 2,000 users, Sweden about 3,500, and Norway about 7,500 users. We have no figures for Finland.

FWA networks are quite expensive to implement and the commercial viability of grand-scale FWA-networks has been questioned. A recent study by OVUM found that the costs of access on FWA networks are likely to be four to eight times larger than the costs of providing DSL-access on the PSTN network. This level will probably restrict the use of FWA-networks to installations with high traffic volumes.

Box 4.4: Fixed Wireless Access

Fixed Wireless Access (FWA) networks are wireless networks using licensed frequency bands. The term Fixed in FWA refers to the fact that the users can only receive the signals in a stationary mode through directional antennas. FWA networks make broadband access available for private households, group of households (e.g. housing associations) and to business users. FWA can also be used as a backbone network technology. Despite its simplicity, FWA networks are quite expensive to implement, especially for single users.

FWA networks typically have an omni directional antenna located at the service provider and a directional antenna at the end-users' premises pointing towards the omni directional antenna. The maximum distances between the transmitter and the receiver vary depending on the surroundings. However, cell sizes of around 5 km are typical for FWA.

FWA networks can be implemented in two different ways: 1) Point-to-Point (PP) where a direct and proprietary signal is transmitted to the end user from the service provider and 2) Point-to-Multi-Point (PMP), where the same non-proprietary signal is transmitted to a number of users. The PP version is mainly used for business users and as backbone technology, while the PMP version is used to offer broadband access to individual households. FWA is a true broadband technology with capacities currently above 100 Mbps.

When FWA came on the market, it was considered an important tool for creating network competition. This was the explicit reason, why the Danish incumbent was not awarded a FWA license. However, FWA networks have spread at a much slower rate than anticipated.

Source: Ovum, *Barriers to competition in the supply of electronic communications networks and services*, November 2003 and Marilyn Kemper Littman, *Building Broadband Networks*, 2002, CRC Press

Promotion of competition between and within networks

We now turn to an examination of how to maintain and stimulate competition between and within networks in the telecom industry. Our starting point is that competition between and within networks is complementary and that both types of competition have an important role on the telecommunications market and both should be encouraged.

However, we tend, generally, to rate competition *between* networks higher than competition *within* networks, as the former but not the latter promote a competitive pressure on the entire value chain and require less regulatory intervention, thus lowering the administrative burden on both regulator and industry. This is an important consideration, because under some circumstances promotion of competition within networks may bring forward more competition in the short run, but may also – by lowering incentives for investment - hold back competition

between networks reducing competition in the long run. Thus, there may be a trade-off between gains from competition in the short and in the long run. It should be noted that competition between networks is harder to bring about than competition within networks due to higher investment needs and risks. Clearly, competition between networks is only superior to competition within networks if competition between networks is feasible.

We now consider the case, where alternative technological network solutions already exist and discuss under which circumstances competition will prevail.

First, from a competition perspective it is imperative to limit horizontal integration, mergers or cooperative agreements involving two or several networks, especially if the merger involves a dominant player in the market. A merger between owners of two potentially competing network technologies, in particular with large market shares, may significantly reduce the incentive to let the networks compete because the success of one network, and higher market shares, may only be achieved at the expense of lower market shares for the other network. Vertical integration, mergers *down the value chain*, may be a cause of worry or not. It depends on the circumstances. If competition is alive on all levels of the value chain, vertical integration may bring about significant benefits by coordinating operations and investments across the value chain. However, if some of the markets are concentrated, vertical integration may be a tool to leverage market power from one level of the value chain to another. In this latter case, vertical integration should cause worry at competition authorities. See also Chapter 6

For this reason, we find that there is a strong case for divesture of companies controlling two or more alternative network technologies, in particular if the company has a dominant position on the market. We also find a strong case for promoting policies that limit the possibility for companies controlling one network technology to gain control over significant shares of alternative, potentially, competing network technologies. One example of such policy was the deliberate decision by the Danish government not to cede a FWA-license to the incumbent operator of the PSTN network.

Second, the mere existence of alternative networks with separate ownership is, however, not sufficient to guarantee that consumers have real choice between networks and that competition prevails. It also requires that the costs of switching between two alternative networks, for example cable network and PSTN network are such that a certain number of consumers views switching supplier of broadband access as a realistic and desirable option when faced with a jump in access prices. By costs of switching we mean all cost incurred by the consumer irrespective of being financial or administrative. They can, among others, include switching fees, the cost of new converters or modems, installation costs and waiting time. Accordingly, it is important to assure a minimum amount of technical compatibility between access to alternative networks and transparent, low-cost rules for switching. If not, lock-in will destroy competition once customers have chosen their network.

Third, regulation of access to the incumbent's network – competition within the fixed network – must be regulated such that it does not destroy the incentives for investing and rolling out alternative networks. The problem is that if service providers are given access to the incumbents fixed network (or any other network) on very favourable terms, it becomes commercially more attractive to be an independent service provider and less attractive to be an investor in an alternative network. It makes service provision within the existing network more attractive than the provision of new networks. It stimulates entry and competition within network today. It drives down prices and margins and it deters investment in new networks and reduces competition between networks tomorrow. In contrast, if conditions for network access become very unattractive, it makes new network provision more profitable than service provision within the existing network, deters competition within network today, but also promotes investment in new networks and increases competition between networks tomorrow.

Thus, the choice of access regulation to the current network carries significant implications, not only for the state of competition *within* networks today, but also for the state of competition *between* networks tomorrow. Optimal access regulation is, basically, an exercise in the efficient monopoly pricing on which an extensive literature exists, at least from a static perspective. The dynamic perspective (that is, access pricing over time) is much less understood (Valletti, 2002). We shall develop some basic principles here, but also refer to Appendix 1: One way access.

Efficient price regulation requires three steps:

- Determination – the price method must be determined
- Calculation – the price must be calculated
- Implementation – the price must implemented

The economic literature gives a rather precise description of how the efficient access price is determined as the sum of three elements:

1. the direct marginal cost of providing access
2. the opportunity value of displaced use; and
3. a financing element

The actual size of the three elements depends on a number of firm and market specific conditions. In principle, therefore, the calculation of efficient prices requires detailed knowledge of the circumstances concerning products, firms and markets.

Many calculation methods exist. There is a fundamental difference between methods that takes as their starting point the costs of the firms in question and those that start from actual prices. Among cost-based methods, a distinction is made between methods using actual costs and methods that aim to establish minimum required costs. And, finally, the cost base may be backward-looking (historic costs) or forward-looking (projected costs).

Cost-based methods (Cost-plus methods) lead to prices that in principle cover the incumbent's costs. If calculations are based on average costs – rather than marginal costs – then the incumbent's fixed costs are covered also. Calculations based on actual costs guarantee, by definition, cost coverage, whereas calculations based on efficient costs involve cost coverage only if the incumbent is as efficient as assumed. Cost-based methods do not, however, take into account the incumbent's opportunity value of displaced use, and may therefore lead to sub-optimal prices. Clearly, if the incumbent could make better use of the same resource, it pays for society to let the access prices rise to reflect the true costs to society.

Price-based methods (Price-minus methods) lead in principle to full cost coverage and also compensate the incumbent for any lost profits of providing access. Basing calculations on the incumbent's prices in the market for consumer services, implies that the method also (implicitly) takes into account possible demand effects. However, it may be that actual profit margins overestimate the incumbent's actual loss from providing access; if so, the method leads to inefficiently high access prices. This could be the case if the incumbent possesses market power and is able to charge retail market prices with a mark-up.

Having determined the best method for calculation the efficient prices, the prices must be calculated. There are basically two choices, depending on what is conceived to be more problematic: too high or too low prices.

Low prices give new competitors a competitive advantage. This stimulates competition and leads to a pressure on consumer prices. Strict regulation will, on the other hand, give the incumbent incentives to limit access by other means. It may also induce less efficient competitors to gain market share at the expense of the incumbent. Low access prices also do

not stimulate investment in infrastructure; the incumbent will refrain from undertaking new investment – especially if it is risky – while other firms will be encouraged to utilise those investments that have already been undertaken by the incumbent rather than invest themselves.

Methods that disentangle prices from underlying costs provide the incumbent with incentives for cost efficiency. Such regulation also reduces incentives for shifting costs between activities and to engage in cross subsidisation. They furthermore allow the regulated firm to adjust prices according to demand conditions. On the other hand, prices that are not directly related to costs expose the regulated firm to risk. Such risk may undermine incentives for investment and for maintaining and improving product quality.

Methods that are based on simple, verifiable rules, and which delegate decisions to the regulated firms themselves, involve relatively light regulatory burdens and low regulator costs for the regulated firms. By restricting the regulator's ability to exercise discretion, one also limits the danger of regulatory capture. On the other hand, such a regulatory regime may leave the regulated firms too much leeway to adjust their activities in ways that undermine competition. It may also lead to high risks of regulatory errors and inadequacies.

Having calculated the efficient prices, the question remains how these prices should be implemented. There are at least three main models: caps on rate of return, price and income, respectively.

The three mechanisms may be distinguished by the incentives to which they give rise. Under rate-of-return regulation (given that the rate is set sufficiently high) the regulated firm has strong incentives to invest and maintain and develop product quality; however, rate-of-return regulation provides poor incentives for cost efficiency. Price-cap regulation has the opposite effects: incentives for investment and quality improvements are poor, while incentives for cost efficiency are correspondingly strong. Revenue-cap regulation has similar effects to price-cap regulation, but in addition provides firms with incentives to restrict supply.

Nevertheless, the differences should not be exaggerated. Even though price caps are not directly related to costs over the period in which they remain fixed, costs will play a role when revisions take place. In practice, therefore, price caps (as well as revenue caps) also have elements of cost-plus regulation. Furthermore, the cap will normally be combined with other regulations. Rate-of-return regulation is typically combined with cost control, to ensure that only those cost increases that are deemed reasonable are allowed to be passed through. Price caps (and revenue caps) are combined with quality requirements and the possibility of passing through costs increases that are out of the regulated firm's control.

The choice of implementation mechanism is therefore to some extent a matter of taste. If the cost structure is relatively easily observed, and it is important to provide incentive for investment and product development, then rate-of-return regulation is preferable. If the major concern is to provide stimulus for increased efficiency, while quality may be regulated directly, then a price cap is more natural. In other cases, it may be necessary to combine elements from various mechanisms, so as to control costs, prices, quality and rate of return.

Fourth, we can combine the above insight with our previous analysis of the potential for competition between networks on the three markets under consideration. First, we can summarize our insight as follows: If we want to stimulate competition *within* networks, choose access regulation giving rise to low access prices, for example methods based on the cost-plus principle. If we want to stimulate competition *between* networks, choose methods giving rise to high access prices, for example methods based on the price-minus principle. Secondly, we

have previously argued that the potential for creating competition between networks in fixed voice is limited, while it is much more promising in mobile voice and fixed broadband.

A straightforward combination of the two lines of arguments would require regulators to go for light access regulation, that is, relatively high access prices in mobile voice and fixed broadband, but tough access regulation, that is, relatively low access prices in the fixed voice market.

Dynamic access pricing has been proposed to achieve a compromise between stimulating competition *within* and *between* networks. Canoy et al. (2003) describe dynamic access pricing as follows:

> "*…an access charge which starts low but rises over time can promote services competition in the short term (enhancing static efficiency), while also providing incentives for entrants and incumbents to invest in infrastructure (enhancing dynamic efficiency).*"

Regulators in Canada and the Netherlands have implemented dynamic access prices for unbundled local loops. Initially, the price of unbundled local loops is set at a level appreciably below cost but then increased step by step over a longer period until it reaches a cost based level. The initiative is a straightforward form of entry assistance that promotes the investments that users of local loop unbundling must make. However, it does so in a manner which makes it clear that prices will rise. As a result, there should be no significant danger that such an offer will encourage inefficient entry.

In general, it has been argued that dynamic access pricing could be a bridge allowing companies to gather experience, customer basis and capital as independent service providers on the PSTN network before transforming themselves into full blown network investors and owners (OPTA, 2003). They distinguish between investments in known and already existing networks, e.g. PSTN, and investments in new networks, e.g. PLC.

In the former case, the incumbent typically has a strong first mover advantage making entrant's investments in complete new networks rather unlikely. Instead complementary investments in local loop network and DSLAMs should be promoted by initially setting low tariffs for access to the unbundled local loop. This is in line with our earlier reasoning. The rate could be increased over time reaching cost-based levels when the market is more mature.

In the latter case, the incumbent has not necessarily a first mover advantage making entrant's investments in new networks more likely. The costs and risk of rolling out new networks are so high, that high tariffs, cost-based tariffs with a mark up, is a necessary requirement for investments to take place. However, if the incumbent with its financial strength and easy customer access decides to invest in the new network technology it may in any case deter new entrants. Also for this reason it may be important to limit the incumbents' possibility to own or control new network technologies that could be a source of potential competition in the future. Alternatively, shared ownership on new technologies could be promoted, even though it creates problems of its own.

It is still too early to gauge whether dynamic access pricing is effective in promoting more entry than would otherwise occur. Empirical evidence from the US seems to indicate that low access prices are not inconsistent with high investment levels (Cave et al., 2001). However, it is not clear whether these investments are complementary or substitutes. Empirical evidence from Europe is very limited. Cave et al. reports some bi-variate results that has the same flavour as the US results, but both the empirical method employed and the quality of data call for caution.

However, the dynamic access pricing seems to be a clever compromise between conflicting goals and as such seems worthwhile investigating further.

Chapter 5 Call termination – Pockets of monopoly power

Networks need to connect to other networks. Fixed networks need to connect to mobile networks. Mobile networks needs to connect to other mobile networks and the fixed network. National networks need to connect to international networks. The reasons are straightforward.

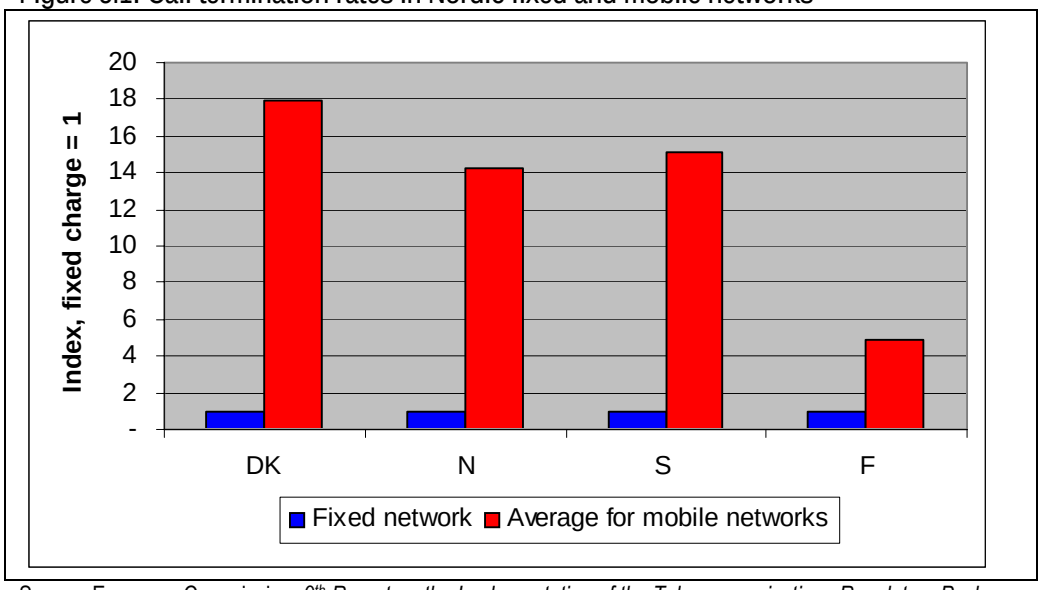
The more people you can reach through a given network, the more valuable the network is. A network can increase its value by attracting more subscribers to the network and it can increase the value of being a member, if members are able to call members of other networks. The latter is achieved through commercially negotiated interconnection agreements.

Interconnection agreements are wholesale agreements between networks regulating the conditions under which members of the two networks can connect to each other. A key part of an interconnection agreement is the *call termination rate*. The call termination rate is the wholesale price a network pays to be able to terminate a call originating from a caller in its own network to a receiver in the other network. An agreement must specify at least two prices for call termination in each of the two networks. These prices are often symmetric (similar).

Call termination rates for fixed networks have long been regulated, because regulators have realised that any entrant to the fixed or mobile voice market needs to connect to the fixed network to be able to compete for customers on the market. Under these circumstances, allowing the fixed network operator freedom to determine the conditions for access to its network can hardly be expected to end up with socially acceptable solutions. Call termination rates for fixed networks in the Nordic countries were in the range 1-3 €-cent per minute in 2002.

In contrast, most mobile networks have commercial freedom to enter into interconnection agreements with other domestic or international networks and agree on mutual call termination rates. Only a limited number of mobile networks with SMP status (Significant Market Power), including the incumbent mobile networks in Sweden and Norway, are required to use cost-based call termination charges. We can observe that the call termination rate for mobile network in the Nordic countries in 2002 were in the range 8-15 times the price of terminating a call on a fixed network, cf. Figure 5.1. Clearly, this drives up the retail price of using all networks, the fixed network in particular, potentially reducing and distorting demand for telephone services.

Figure 5.1: Call termination rates in Nordic fixed and mobile networks



Source: European Commission, *9th Report on the Implementation of the Telecommunications Regulatory Package, 2003*

High call termination rates may be justified if the underlying marginal costs of call termination on a mobile network are significantly larger than for call termination on fixed networks. However, it may also be a consequence of lack of competition as each network in reality has a monopoly on terminating calls to their own subscribers. While any caller can choose alternative networks for call origination if prices become too large, for example by call selection, he has no choice in call termination. If he needs to connect to a specific person, he has no choice but to accept the implicit call termination price on the network to which the person currently belongs.

International interconnection agreements are in principle no different from domestic interconnection agreements. International interconnection agreements are agreements that determine call termination rates between two mobile networks that happen to be of different nationality.

They only appear different because these agreements quote accounting and settlement rates, not call termination rates. We cannot observe accounting and settlement rates directly, but we can infer their relative size by comparing retail prices for domestic and international calls. Indeed, retail prices for international calls, even inter-Nordic calls, on both fixed and mobile networks seem to be disproportionately large compared to domestic calls. Prices for inter-Nordic calls are 2-8 times larger than the price for domestic calls depending on the exact call constellation (fixed-fixed, mobile-to-fixed or mobile-to-mobile). As before, the high prices may be explained by high underlying marginal costs that are proportionately larger than the costs of domestic calls. However, it may also be due to lack of competition as each network in reality has a monopoly on call termination to subscribers in their country or region.

We now investigate in some detail the determination of call termination rates in different competitive settings in order to properly understand whether companies in the market have incentives to charge call termination rates in excess of marginal costs. If this is the case, and if we cannot identify sufficient countervailing arguments, there may be a case for regulation of mobile call termination rates. See also Appendix 2: Two way access for an extended and more theoretical exposition.

First, we consider how a mobile network competing with other mobile networks determine its own call termination rate vis-à-vis a fixed network, knowing that fixed and mobile networks do

not compete for the same customers and that the call termination rate for the fixed network is regulated. Thus, the mobile network does not need to worry about any counter reaction from the fixed network.

We conclude that mobile networks, indeed, have an incentive to price call termination rates at a level (significantly) above marginal costs, even in the case when mobile networks compete fiercely for customers. However, competition indeed drives down profit to zero, as the monopoly profits on call termination rates is used to subsidise entry into the network, for example by subsidising the provision of hand-sets[58].

Interestingly, in markets with many small competing mobile networks call termination rates tend to be larger than in markets with only a few large mobile competing mobile networks. The reason is that large mobile networks tend to take much more into consideration the demand-dampening effect on overall consumption from large call termination rates.

However, in markets with network externalities as telecom markets, the optimal call termination rate is indeed larger than marginal costs. It may be socially desirable to charge a mark-up above costs and use the revenue to subsidise access to the network and expand network penetration. We do not know the level of the optimal mark-up, but in this context it suffices to note that the optimal mark-up must be low in networks with very high penetration rates as the 2G-networks dominating the Nordic countries.

It may be argued that the mark-up does not matter, as all monopoly profits are recycled back to customers as hand-set subsidies. This may be correct, but still leaves the question whether it is socially desirable today to give preferential treatment to mobile services vis-à-vis fixed services financed by subscribers to the fixed network and giving rise to distorted decisions regarding the use of fixed versus mobile networks. Bomsel et al. (2003) has estimated the level of transfers from fixed subscribers to mobile subscribers to 5-10 percent of total mobile revenue in Germany, France and UK. In the Nordic countries this would correspond to about 300-600 m€ per year in Denmark, Finland, Norway and Sweden or about 20€ per year per inhabitant.

Second, we turn to the question how two mobile networks mutually would determine their call termination rate for calls originating from each other, knowing that their networks are rivals and compete for the same subscribers on the retail market. Now, the two mobile networks cannot unilaterally set their call termination rates, but need to agree with the competing network. The question is whether this makes a difference?

We conclude that most of the arguments from the previous section carry over, but some new aspects arise. It turns out that two networks negotiating mutual call termination rates for two reasons modify their rates compared to the unilateral case. First, if the two networks have some market power on the retail market and charge retail prices above costs, they realise that they have a mutual double marginalization problem and prefer to lower their call termination rates somewhat to reinstall an overall monopoly price. Second, the two networks also realise that high termination charges give the rival an incentive to compete more aggressively for subscribers and lower external call termination payments. In order to modify the competitive pressure the two networks prefer to agree on slightly lower rates than in the previous case.

Moreover, large networks may prefer to price discriminate between calls terminating in own network (on-net) and calls terminating in small rivals network (off-net). Price differentiation can

[58] Mobile networks may anyway end up with positive profits, if the services offered from the mobile networks are only partial substitutes.

harm actual entrants and deter potential entry for the same reasons as before. Both arguments level off as the market becomes more symmetric.

Finally, we note that high call termination rates make more sense for society in small networks with socially desirable growth perspectives than in large, mature networks with limited growth prospects. This could be the case for the young, struggling 3G-networks.

Lastly, we consider the special case of international interconnection and roaming agreements, being special not by nature, but because the settlement scheme is different from the one described previously. We conclude that, if there is a case for regulation of domestic interconnection, there is case for regulation of international connection, including roaming.

We also note that inter-Nordic prices on both fixed and mobile networks national are vastly above domestic prices to an extent that hardly can be explained by additional costs. We argue that increased competition in some cases can lower the prices, but it will never solve the fundamental problem of monopoly on call termination. We argue that there may be a case for coordinated Nordic action to regulate call termination in inter-Nordic interconnection agreements.

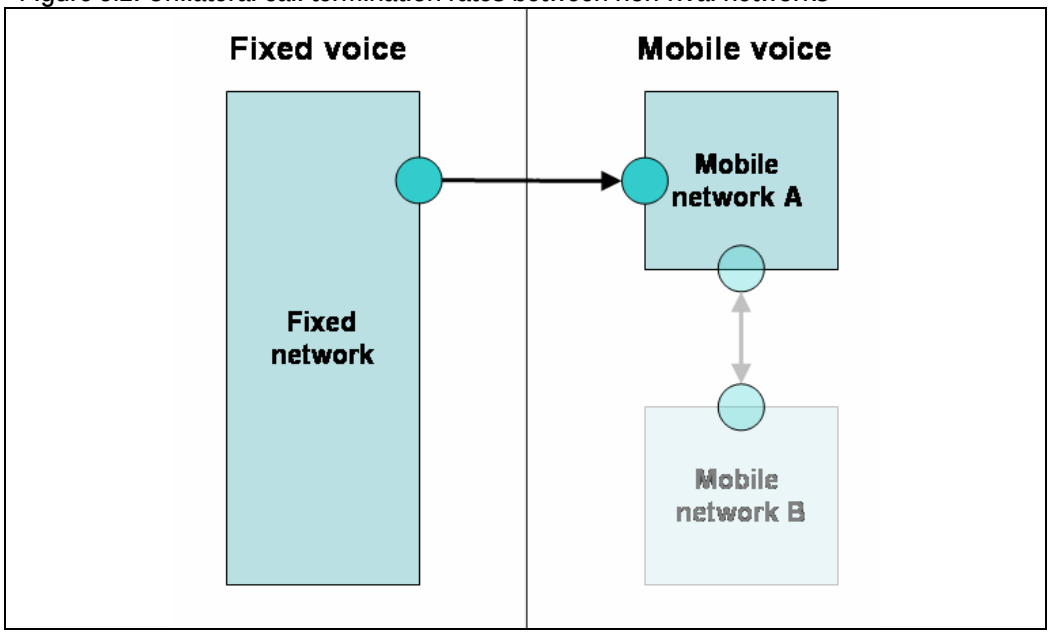
Unilateral setting of domestic call termination rates

We first consider a market with a monopoly provider of fixed voice services and several providers of mobile voice services. Fixed and mobile voice are not on the same market and do not compete for subscribers. In addition, the call termination rate for the fixed voice operator is regulated and determined by regulators.

In contrast, mobile-service provision is highly competitive, in the sense that competition between mobile-service providers for subscribers is intensive, yet each mobile network has a monopoly on termination on its own network. Therefore, potential competition problems arise not so much from lack of inter-brand competition as such, but more from the fact that residual pockets of market power remain. Therefore, pricing of call termination rates is less competitive.

First, we focus on a single mobile network and consider how it unilaterally would determine (wholesale) call termination rates for subscribers to the fixed network requesting access to its network. At this stage, we abstract from other providers of mobile voice services, cf. Figure 5.2.

Figure 5.2: Unilateral call termination rates between non-rival networks



We assume that the mobile network maximises profit from selling outbound mobile calls, covering internal costs of call origination and paying external costs on call termination for calls to the fixed network. In the simplest version, we assume that all calls originating in the mobile network is terminated in the fixed network. However, relaxing this assumption makes no difference to the results that we report below.

Under some simplifying assumptions, the setup implies that the mobile network will maximise termination revenues, irrespective of the intensity of competition between mobile networks (inter-brand rivalry). Profits are separable, in the sense that revenues from call termination are independent of retail revenues from outbound calls.

However, if services provided by the various mobile networks are identical, competition between mobile networks for subscribers drives overall profits to zero. Therefore termination revenues are fully recycled into the mobile subscriber fee. Hence, if we include the cost of the hand-set in the total cost of mobile services, we conclude immediately that termination revenues could potentially be used to subsidize hand-sets.

The main point is that the monopoly on call termination will generally induce even highly competitive mobile service providers to levy termination charges that differ from the marginal cost of termination, potentially far in excess of the socially optimal charges. Essentially, there are many separate relevant markets for termination in which even small and intensely competitive mobile service providers have monopolies. The competitive problem arises due to these residual pockets of monopoly power in markets for call termination, not due to lack of competition on the retail market.

Surprisingly, small mobile networks have larger incentives to raise termination rates than large networks. The reason is that the small network does not take into consideration that a jump in rates also increases the average price on the market and drives down demand. In contrast, a large mobile network is more likely to take into account this countervailing effect, hence, moderating its incentive to drive up call termination rates.

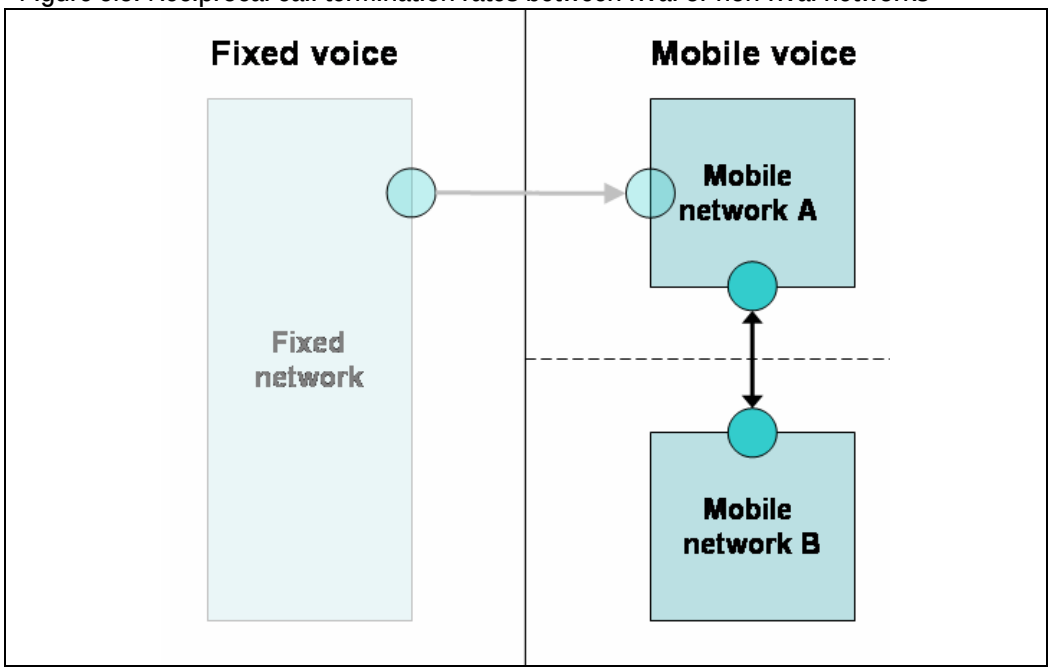
When the mobile network possesses network externalities, it may be privately and socially desirable to cross-subsidise handsets to attract more subscribers. A network externality arises if the value of being member of a network increases in the overall number of network members, or, more generally, members in all associated networks. In this case, it is optimal to impose a mark-up on call termination rates that generate the required revenue for cross-subsidisation. In an otherwise competitive mobile market, this is the main instrument available.

The case for a mark-up on call termination rates is especially strong in immature markets with limited membership and a large potential for further penetration; less so, if at all, in mature markets with high penetration rates. This argument is reinforced even more in the presence of switching costs between old, mature networks and new, immature and technologically advanced networks with high social priority, as e.g. the new 3G-markets.[59]

Coordinated setting of domestic call termination rates

We now turn to considering how mobile voice providers jointly might agree on call termination rates. The mobile voice networks are on the same market and compete fiercely for the same subscribers, but the services they offer may be only partially substitutable leaving some room for mark-up pricing on the retail market. In this case we ignore the fixed network and focus exclusively on two mobile networks, cf. Figure 5.3.

Figure 5.3: Reciprocal call termination rates between rival or non-rival networks



We still assume that the mobile networks maximise profit from selling outbound mobile calls, covering internal costs of call origination and paying external costs on call termination on the other mobile networks. The set up still implies that the mobile networks will maximise termination revenues and tend to set high call termination rates.

Competition between the mobile networks for subscribers again drives down overall profits depending on the degree of substitutability between the mobile services. With full

[59] Add to this that there may be a certain amount of ex post subscriber lock-in. This might push mobile service providers into the red in the short term, despite sizeable termination surpluses. This seems to be broadly consistent with recent empirical observations of the mobile-phone industry in particular. The mobile termination charges are tempered somewhat by network externalities. This, however, does not obviate the need for regulation.

substitutability profit is driven down to zero, while partial substitutability leaves some room for mark-up retail pricing. As before termination revenues are recycled into the mobile subscriber fee, for example subsidizing hand-sets.

However, we now have two monopoly providers of call termination selling inputs to each other and with some latitude for mark-up pricing on the retail market. This is in essence the double marginalization problem, where two monopoly mark-ups are layered upon each other raising the overall price in the market above the monopoly price and reducing demand excessively.

The two mobile networks have a clear own interest in jointly lowering call termination rates to moderate the impact on prices and reinstall joint optimal monopoly pricing. This tendency is in the interest of society, but the two networks still aim to negotiate a joint monopoly termination rate in excess of marginal costs. This rate is still not socially optimal and a case for regulation remains.

We can take this line of argument one step further in mature, symmetric markets with balanced calling pattern. High termination rates clearly increases average costs in the two networks and also increases the incentive to capture market shares from the competitor. Accordingly, very high rates increase the risk of initiating harsher price competition and may lead two networks to agree on slightly lower termination charges to strike the right balance between high termination revenue in the short run and less competitive pressure in the long run[60].

In asymmetric markets, the case is different. Here the large mobile network faces a potential entrant or an actual competitor with a small market share. As the entrant has a very large share of off-net calls, the large mobile network clearly favours high termination rates, as it weakens the financial position of the competitor. With retail price differentiation between on-net and off-net calls it may even be beneficial to agree on taxing off-net calls to increase the pressure on the entrant. However, if the entrant still has limited physical coverage, high termination rates may induce the entrant to build up coverage at a higher speed. This dampens the incumbent's interest in high termination rates.

The dynamic features of mobile termination charges carry over from the last section. If mobile telephony displays network externalities in the sense that fixed subscriber utility is increasing in mobile penetration, then it is socially optimal to let termination charges rise above costs in order to subsidise mobile subscription. Similarly, if mobile markets are immature with few subscribers, and if further market penetration for some reason is deemed socially valuable, but potential subscribers must overcome switching cost given whatever subscription they may currently have, then it is similarly socially valuable to allow termination charges to rise above costs to subsidize mobile subscriptions.

Both of these examples suggest that unregulated termination mark-ups are less of a problem in immature markets as 3G mobile markets than in mature markets. However, since basic 2G-mobile penetration throughout the Nordic countries is close to saturation, arguments for light-handed regulation of mobile termination charges seem to lose weight at considerable pace.

This should induce one to pause to think whether the time is ripe for time-invariant marginal-cost regulation of call termination on mobile networks from the fixed net. At the very least one should think carefully about how to regulate over time. Of course, innovations in the fixed sector might also be desirable, and we are back to some of the reasons to allow the fixed-network incumbent a mark-up.

[60] With retail price differentiation between on-net (calls to own network) and off-net calls (calls to competitor's network) it may even be beneficial to agree on subsidising off-net calls to credibly enter into a collusive agreement.

A proposal has been put forward to let regulated call termination charges follow a sliding scale contingent on the degree of market maturity. In the early stages: Light-handed regulation allowing for some mark-up on call termination charges. In the later stages: Stricter regulation with call termination charges closer to marginal costs. This proposal mirrors the proposal presented in the previous section. So do the comments!

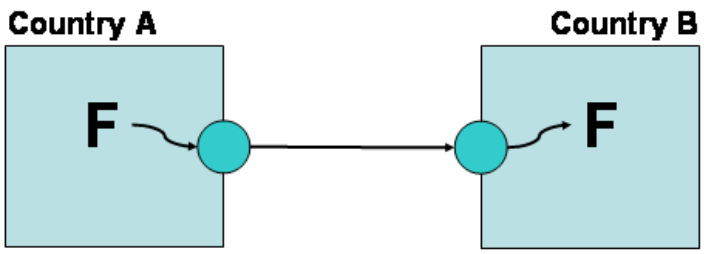
Pricing of international calls

At last, we turn to the pricing of international calls. There is no fundamental difference between interconnection agreements for national and international calls. In both cases, two networks have to negotiate reciprocal conditions for being able to terminate calls in each others network. International prices are settled in international interconnection agreements on the basis of recommendations from International Telecommunications Union (ITU). We distinguish between international calls between fixed networks and international calls between mobile networks.

International fixed calls

An international call between two fixed networks can be illustrated as in Figure 5.4. The call originates in the fixed network of country A and is send to the networks' international gateway. From here the call is transported via cable, satellite or microwave to the international gateway in the terminating country B and further on to the receiver.

Figure 5.4: International fixed-to-fixed calls



International tariffs for fixed voice have traditionally been based on the century old accounting rate system. Accounting rates are wholesale rates, which are negotiated and determined freely in bilateral interconnection agreements between operators in different countries on basis of a number of recommendations from the International Telecommunication Union (ITU). For example ITU recommends that accounting rates should be cost-based.

In a typical agreement, two operators agree on accounting rates for conveyance of calls from origination to termination. Accounting rates can be symmetric (same price in both directions) or asymmetric (different prices in the two directions) depending among others on historic differences in price structure. The accounting rate will mostly be divided equally between the operators[61], although other arrangements have been seen.

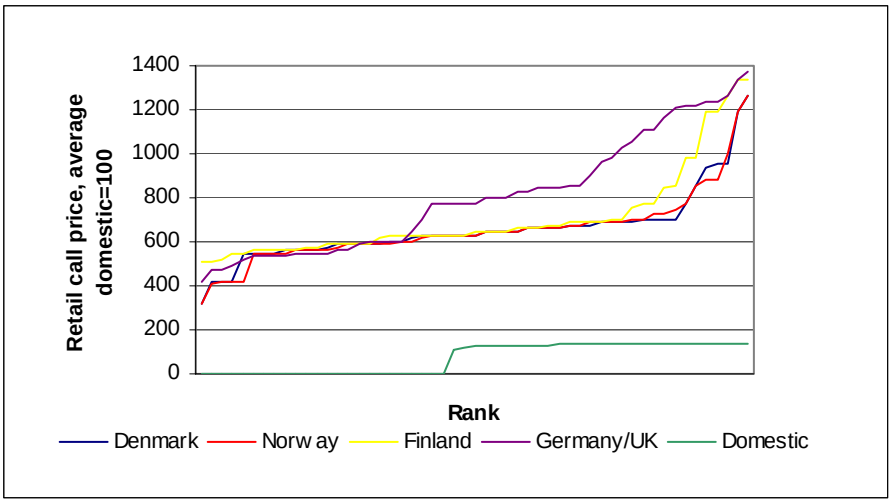
The share of the accounting rate to be paid to the terminating operator is called the settlement rate. The settlement rate corresponds to the call termination rate as discussed above. The caller in the originating country pays the collection rate. This rate is often higher than the accounting rate – though not necessarily.

[61] The accounting rate is split differently, if the call is transmitted by sea cable or satellite or if it requires transit through other countries.

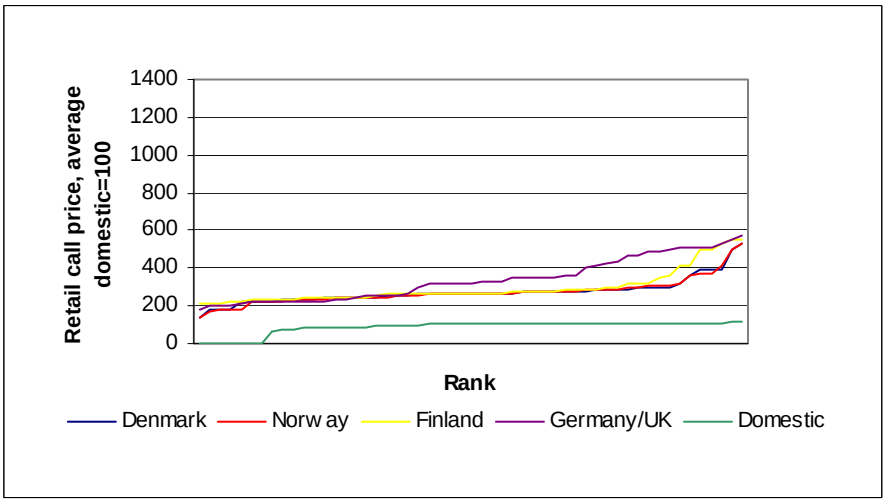
Historically, accounting and collection rates have been far above costs, also in the Nordic countries. However, with liberalization the accounting rate system has come under pressure, but has until now been very resistant to change. One reason could be common interests between networks in keeping up prices. As Figure 5.5 shows, retail rates for calls from the Swedish fixed network to fixed networks in other Nordic countries are still significantly larger than national prices. The same picture holds for the other Nordic countries.

Figure 5.5: Retail rates for fixed-to-fixed calls from Sweden to selected countries, 2004

a: Peak rates



b: Non-peak rates



Notes: All available peak and non-peak rates are collected, grouped according to call destination and ranked from lowest to highest. The overall average domestic price has an index value of 100.
Source: Teleprisguiden, http://www.cint.se/Sweden/asp20/tele_fast.asp

The pressure on the accounting rate system comes from the competition regime established nationally and internationally during the past years. Competing operators have an interest in lowering the international tariffs in order to gain customers and the margins for lowering the tariffs have been - and still are in many parts of the world – considerable.

Some competitors exploit the asymmetries in the international tariff structure. The end user price depends on the country from which the call is originated. This allows some service

providers to offer low cost international rates by using *Call Back Technology*. When using a call back service, one has to dial a number in a country with low international rates. No one answers the call, but the service provider immediately calls back and provides a cheap line, now originating in the low cost country. IP-telephony, known as 'phone card service', is also used extensively by dialling a local number with access and after verification of accounts having the possibility to place an international call via Internet.

For EU member states the principle of equal treatment[62] applies for operators with significant market power (SMP), including all fixed network operators. They are obliged to offer the same call termination rates to both national and international operators. The rates have to be based on national call termination charges plus charges for the international link. The system, however, requires that the calling operator requests SMP charging. Nonetheless, the accounting rate system is still often used.

Even though, inter-Nordic tariffs are relatively low for fixed line telephony, retail prices for inter-Nordic traffic still seem to be significantly above costs. For calls between directly neighbouring Nordic countries, for instance Sweden and Finland, international end user prices are twice as high as national prices. In a survey from the late 1990s the Independent Regulators Group (IRG), concluded that although the accounting rate system was showing some resistance and even though end user prices were still too high, it seemed as if international competition would bring prices down to an acceptable level and therefore no immediate regulatory actions were required.

International mobile calls (GSM)
Routing of international calls from a mobile network to another mobile network is in principle similar to routing of international calls between fixed networks. However, the system must also be designed to keep track of the location of the calling and receiving mobile phones. This is done using directories for locations within own network and guest directories for locations outside own network where roaming is needed.

We can distinguish between four different scenarios, depending on the location of the calling and receiving mobile phone. Here illustrated using Danish and Norwegian phones:

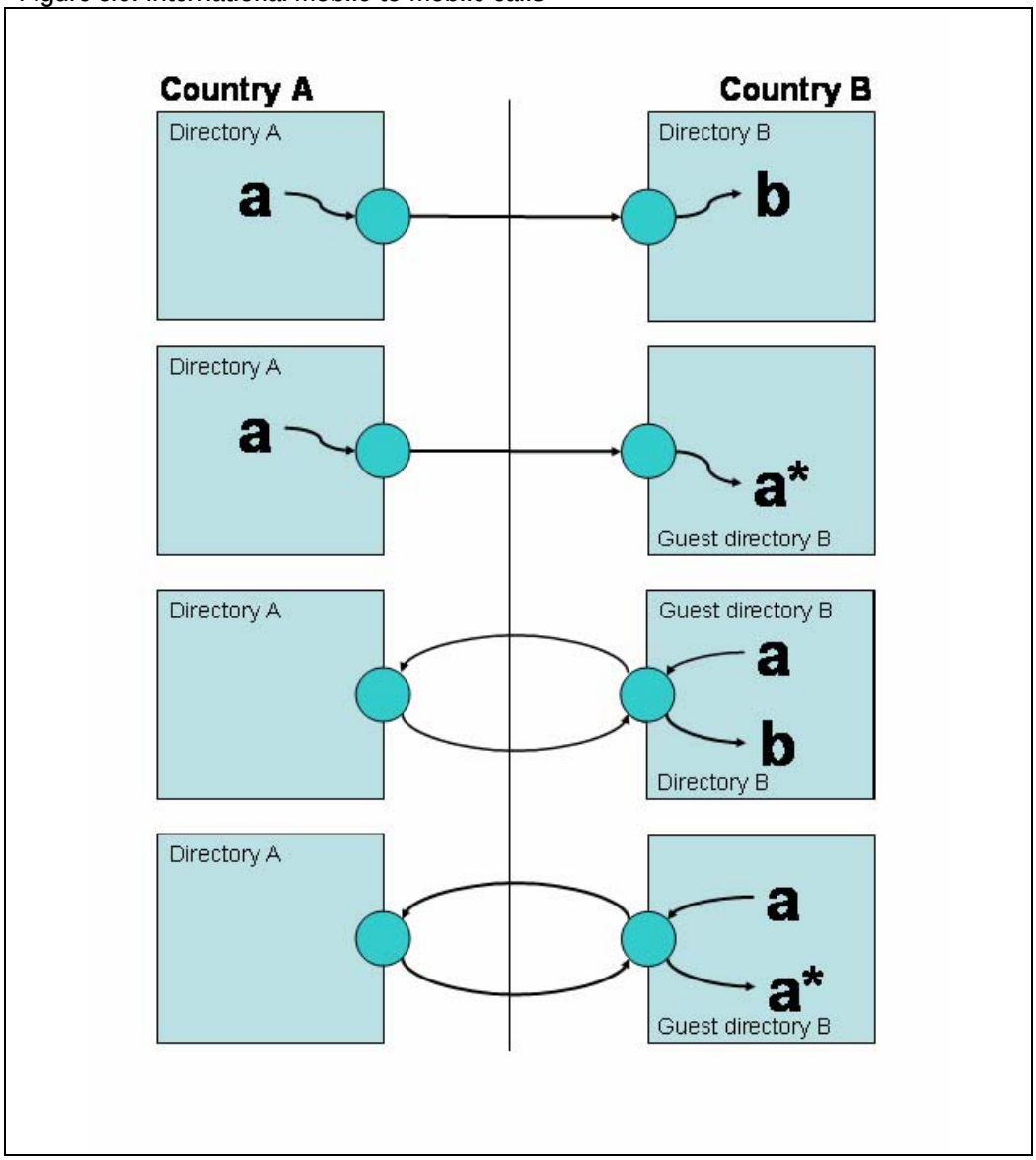
1. Danish mobile in Denmark calls Norwegian mobile in Norway
2. Danish mobile in Denmark calls Danish mobile in Norway
3. Danish mobile in Norway calls Norwegian mobile in Norway
4. Danish mobile in Norway calls Danish mobile in Norway

The four scenarios are illustrated in Figure 5.6. The first scenario corresponds closely to calls between fixed networks. In the second scenario the Danish directory (HLR) contacts the Norwegian guest directory (VLR) to query the exact location of the second mobile (a*) on the foreign network. The second mobile needs access to a foreign network to be able to terminate the call. We say that the second mobile is roaming on a foreign network. When the information is received, the network automatically routes the call to Norway though international gateways. In principle, international roaming can be exposed to competition as the second mobile is not necessarily restricted to roam on a specific network, but can choose between the available networks contingent on the existence of an interconnection agreement.

In the two last scenarios the originating call in Norway is routed back to Denmark, where the query for the location of the second mobile starts. Once the other mobile has been located in Norway, the call is again routed back to Norway. In the last case international roaming is also needed to terminate the call.

[62] WTO rules for interconnection would require that call termination rates should be equal for all operators, national as international. However, it was agreed to defer the issue to the next (i.e. current) round of negotiations.

Figure 5.6: International mobile-to-mobile calls



Note: The first example is an ordinary international connection. The three other examples all include elements of roaming, either roaming for call origination, roaming for call termination or roaming for both call origination and termination.

Optimal routing would avoid sending the call back to Denmark and, instead, send it directly to the mobile phone in Norway. The technology enabling this type of optimal routing has existed for the last decade or so. It has been implemented here and there, but it is not used by operators on a wide scale.

Wholesale prices for terminating calls on mobile networks abroad is also determined in bilateral commercial negotiations between operators. Mobile communication is a much newer market than fixed line communication and there is not the same century-long tradition for price setting. But the basic mechanisms are the same: There is a strong mutual interest among mobile operators for keeping international roaming prices high. For example, revenues from international roaming often constitute 15-25 percent of revenues for mobile network operators. The mechanisms are possibly even stronger than in the fixed line area, as independent service providers are not as aggressive in the international mobile calls as in international fixed calls.

Call termination on foreign networks could in principle be subject to WTO national treatment rules, requiring prices for international call termination to equal rates for national call termination roaming. However, as for fixed voice it has been agreed to defer this question to the next (present) round of WTO negotiations.

Consequently, international wholesale international mobile prices and, therefore, mobile retail prices for using mobile phones in foreign countries are exceedingly high, as is illustrated in Table 5.1 and Table 5.2.

Table 5.1: TDC mobile-to-mobile peak retail minute prices

					DKK/min for	
Type	From a	In	To a	in	caller	receiver
aa*|	TDC mobile	Denmark	TDC mobile	Denmark	1,20	-
A| b			Telia mobile	Sweden	4,45	-
A| a*			TDC mobile		1,20	3,00
| ab		Sweden	Telia mobile		6,13	-
| aa*			TDC mobile		6,13	3,00

Note: TDC Mobile Extra with 'vacation module', all prices paid are in daytime.

Prices paid are with the so-called 'vacation module', which apply automatically for MobilExtra subscriptions without extra subscription fee. With a 'vacation module' foreign countries are gathered into different areas with fixed prices. A call to Denmark from a TDC mobile phone at any time in any of the other Nordic countries costs 5.00 DKK per minute, and receiving a call from Denmark costs the roaming subscriber 3.00 DKK.

Table 5.2: TDC mobile-to-fixed peak retail minute prices, August 2004

					DKK/min for
Type	from a	in	to	in	caller
aF|	TDC mobile	Denmark	fixed net	Denmark	1,20
F| a		Finland			5,00
		Iceland			5,00
		Norway			5,00
		Sweden			5,00
aF|	TDC mobile	Denmark	fixed net	Denmark	1,20
| aF		Finland		Finland	3,10
		Iceland		Iceland	2,85
		Norway		Norway	5,93
		Sweden		Sweden	6,13

Note: TDC Mobile Extra with 'vacation module', all prices paid are in daytime.

Prices differ when roaming on mobile networks of different operators in the individual countries. The operators chosen here are in Finland: FINNET; on Iceland: Siminn; in Norway: Telenor; in Sweden: TeliaSonera.

The issue of excessive roaming charges has been raised many times by the International Telecommunications User Group (INTUG) and has also been examined by the European Commission. DG Competition concluded in 2003 that international roaming suffers from significant competition problems, applying not only to voice services, but also to other services as SMS and GPRS.

Chapter 6 Technological convergence and competition

In conjunction with the intention to shift regulation of telecommunications in direction of less sector-specific and more general competition regulation, convergence with its implications for technology neutral regulation is the prime basis for the new EU communications regulatory package and its implementation in EU and EEA countries. Technological convergence enhances the possibilities for a growing competition between different kinds of network providers, as they increasingly can substitute for one another. At the same time, technological convergence also changes the competitive structure in the communication markets creating new challenges for competition policy.

The focus of attention in most policy oriented work on convergence in the Nordic countries has been on the implications for the media and on relaxing regulatory hindrances for convergence. In the present chapter, emphasis is on the competition related implications of convergence, specifically with respect to telecommunications. Horizontal technology convergence allows, for instance, for cable TV network operators to offer Internet access and Voice over IP telephony. This has positive effects on competition in telecommunications if traditional telecommunication networks and cable TV networks are owned and operated by separate companies. Vertically, i.e. with respect to the different segments/layers in the value chains, the prime competition issue posed by convergence deals with the possibilities for monopoly (or near-monopoly) providers in one segment of a market to leverage their dominance in this segment into other market segments.

What is convergence?

The drivers behind convergence developments are technological as well as economic and political. In the technology area, it is primarily the digitalization and computerization of all communication and media areas, which facilitate convergence. Digitalization and computerization establish a common technological foundation for the different communication and media areas, which formerly were based on diverse analog technologies. However, digitalization and computerization also allow for an increasing separation vertically between, e.g., networks and services. Technology developments, consequently, enable convergence developments horizontally between hitherto separate sectors and, at the same time, disintegration vertically in the service delivery chains in the different sectors. The extent to which such tendencies are realized is, however, dependent on interests and activities of market players and the policy and regulatory incentives.

Box 6.1: Definition of convergence

In 1997, the European Commission issued a 'Green Paper on the Convergence of the Telecommunications, Media and Information Technology Sectors, and the Implications for Regulation', where it is stated that 'the term convergence eludes precise definition, but is mostly commonly expressed as:

- The ability of different network platforms to carry essentially similar kinds of services [for instance telephony not only on traditional telephone networks but also on cable TV networks], or
- The coming together of consumer devises such as the telephone, television and personal computer' [for instance advanced mobile terminals for both telephony, computing and with broadcast receivers][63].

The ongoing developments in technology convergence, in mergers of companies from formerly separate communication and media areas, and the policy focus on convergence has also spurred an interest among public authorities in the Nordic countries resulting in convergence committees and reports on convergence[64]. The focus in these reports is, first and foremost, on the upcoming regulatory changes, necessary for removing the regulatory hindrances for convergence developments, and furthermore on the implications for media policies.

In the Nordic convergence reports, there is a differentiation made between four kinds of convergence:

- Service convergence – when the same content is delivered on different platforms [for instance broadcast on cable TV or via Internet on xDSL]
- Network convergence – when the same network can carry different service types [for instance telephony and Internet via the fixed telephone network]
- Terminal convergence – when the user terminals become multi-functional [for instance PCs used for data communications, telephony and broadcast reception]
- Market convergence – when the companies on the markets merge or enter into partnerships across hitherto separate sectors [for instance Internet service providers and content producers][65]

There is no difference in essence between the definition in the EU document and the above-mentioned Danish report. The definition in the Danish report is, however, more elaborate and includes explicitly the market aspects of convergence.

In a description of the communication and media areas encompassing four sectors - IT, telecommunications, broadcasting, and other media (e.g. newspapers and the music industry) - the potentials for horizontal convergence (and divergence) and vertical integration (and disintegration) can be illustrated by the following table (3) dividing the four sectors up in three layers, content/services, transport/software, and equipment/hardware. It is in essence a process of unbundling and realignment of functions and activities that is underway, and the

[63] COM(97)623, page 1. The examples are included by the authors of the present text.

[64] E.g. the Norwegian report NOU 1999:26, 'Konvergens: Sammensmeltning av tele-, data- og mediesektorene', the Swedish report SOU 1999:55, 'Konvergens och förändring. Samordning av lagstiftningen för media- och telesektorerna', and the Danish report from 2001 'Konvergens i netværkssamfundet', IT- og Forskningsministeriet/Kulturministeriet.

[65] Taken from the Danish 2001 convergence report 'Konvergens i netværkssamfundet', page 35. The examples are included by the authors of the present text.

table illustrates the many new combinations becoming possible horizontally and vertically, but also diagonally.

Table 6.1: Convergence/divergence and integration/disintegration

	IT	Telecom	Broad-casting	Other media
Content / services	Software based content	Telecom based services and content	Broadcast programs	Film, music, newspapers, etc.
Transport / software	Software	Network services	Transmission	Cinemas, video rentals, etc.
Equipment / hardware	IT hardware	Telecom equipment	Broadcast equipment	Reproduction of films, printing, etc.

Source: Anders Henten, Rohan Samarajiva and William Melody: 'Designing Next Generation Telecom Regulation: ICT Convergence or Multisector Utility?', WDR, Lyngby, 2003, page 9.

The table combines a description of the technological as well as market based convergence related development possibilities. It illustrates, for instance, that content like music and film can be distributed on alternative platforms, e.g. telecommunications. It, furthermore, illustrates the possibilities for diagonal integration between telecommunication network and transport service providers and broadcast content providers. The figure also illustrates that the formerly more integrated telecommunication value chain can be split up so that infrastructure provision, transport services and content services do not necessarily have to be provided by an integrated company by can be supplied by specialized companies.

Market and policy implications of technology convergence

Convergence in the communication and media areas is not a new thing. In fact, it is as old as the media and communication industries themselves. The history of these industries is, to a large extent, a case of media innovations evolving out of existing media and, therefore, a process of dissociation and re-combination of different communication and media areas. However, often policy and regulatory authorities have been seeking to limit market convergence and cross-media ownership – not only because of concerns for economic monopolies, but in order to hinder media concentration and the dominance of a limited group of owners over the means of communication. This has mainly affected the content media with their great importance for the political and ideological developments in society, but has also affected the conveyance media such as telecommunications.

There is, however, no doubt that technology convergence based on digitalization and computerization has added a new and powerful quality to the industrial convergence developments in the markets and, furthermore, has put pressure on the policy and regulatory provisions regarding market convergence and cross-media ownership. The history of these developments goes back to the 1970s in the US, where the computer industry started becoming interested in using the telecommunication networks for computer communication and in having a say in the telecommunication area, which was reflected in the different so-called Computer Enquiries[66]. At present, Internet is the prime example of technological

[66] The US Federal Communications Commission held Computer Enquiries in the 1970s and 1980s on the regulation of computer communications.

convergence, first and foremost, between the computer and the telecommunication areas, but also encompassing media from the content areas, lately also including broadcasting.

This already has and will increasingly affect the industrial structures in the communication and media areas. And, in order to reap the benefits of the possible synergies between formerly separate sectors there has been a policy shift away from limiting cross-media ownership. This policy change is partly due to a general change in the policy climate and priorities but is also related to the possibilities for creating new media products and services enabled by technology convergence.

Expectations to that effect were very high, especially in the late 1990s. There were spectacular mergers between giant corporations with the AOL/Time Warner merger in the US as the example most often mentioned, and there were also strategic moves in the same direction in the Nordic countries, for instance, in Denmark, where the incumbent telecommunication operator TDC tried to establish its own TV channel in the mid 1990s. The heading under which many of such initiatives were taken was the slogan 'content is king', implying that the major part of value creation in the media and communication areas in the future will be in the content areas and not in mere conveyance. However, the TDC TV initiative failed and so did many other initiatives of a similar character. But in accordance with the so-called hype curve, there is a stable build up phase after the boom and the bust, and an increasing number of convergence based business initiatives will be seen in the coming years.

Economic theory on horizontal and vertical integration

The political provisions in a number of countries hindering cross-media ownership have been part of a broader set of regulations limiting not only horizontal but also vertical integration if there could be a danger of companies leveraging their dominance in one business area into other business areas. Similarly, the lifting of regulatory barriers to integration in the communication and media areas is also part of a broader trend - inspired primarily by the so-called Chicago school approach but also the transaction cost economics approach – to not necessarily consider vertical integration as a threat to consumers and general social welfare but as a possible efficiency enhancing development. In the present sub-chapter, there is a brief introduction to the theories on horizontal and vertical integration. The reason for the brevity of the introduction in the present report is that a very good introduction has been written lately for the Norwegian competition and post and telecommunication authorities and that an extensive repetition is unnecessary[67].

In this sub-chapter, general statements based on theoretical contributions to the literature on horizontal and vertical integration are presented, followed by cursory discussions of important implications and aspects.

Horizontal technological convergence - where the same services and content can be delivered on different platforms – is potentially beneficial to competition.

An example is telephony via the traditional fixed line telephone system (PSTN) or on cable TV networks by way of Voice over IP. The reason is that providers from different communication areas can enter each others' markets and start competing on what might have been monopoly domains earlier on, and users can substitute between different technology solutions, providing similar services. This statement is quite straightforward but has, now and then, been neglected

[67] Espen Moen and Christian Riis: 'Samtidig deltakelse i flere markeder: Velsignelse eller forbannelse?', Oslo, Eoconomica, August 2003. Another theory overview can be found in Rey, P. and Tirole, J.: 'A primer on foreclosure', forthcoming in Armstrong, M. and Porter, R. eds.: Handbook of Industrial Organization III, 2003.

in the enthusiasm concerning the possibilities for offering and bundling different services and content on the same networks.

The competition enhancing implications of technological horizontal convergence are diminished when individual companies integrate horizontally, increasing their market power across different technology platforms.

This statement is also quite straightforward, as cross-network ownership will limit the competition enhancing implications of the technological possibilities for offering the same services and content on different networks. This can be done by a dominant operator, either by offering the same service across different network platforms or by limiting the possibilities of alternative operators for offering competing services on the alternative network platforms.

There is also the possibility for a dominant operator with control over different network platforms to bundle services in situations where the services offered on the different platforms are not perfect substitutes. This applies, for instance, to traditional fixed line telephony and mobile telephony. These two telephony modes are partly substitutes and partly complements. If an operator owns both kinds of access infrastructures, combined fixed-mobile services can be offered – a possibility which does not exist for operators with only one access infrastructure.

Vertical integration does not in itself hurt competition. However, when vertical integration is combined with horizontal market dominance in one of the market layers, that vertical may be an impediment to competition.

When involving companies with market dominance, there has often in legal provisions and decisions been a sceptical attitude towards not only horizontal integration with its limiting effects on competition between substituting markets but also towards vertical integration between companies in complementary markets. The reason has been a fear of market foreclosure by means of exclusion of competing companies or by means of discriminatory pricing – i.e. there has been a fear of a dominant company; say in an upstream market, leveraging its dominance in this market into the downstream market in which it has acquired a presence, either by ownership or alliances.

However, since the 1970s and 1980s there has been a change in policies and regulations in the area, partly inspired by the criticism from 'Chicago school' economists[68] and from another branch of economics, namely transaction cost economics, which was revived in the 1970s[69]. In brief, Chicago school economists have claimed that in an industrial area with upstream and downstream market layers (for instance network operators and content providers in the communication fields) there is only one monopoly profit to be reaped, and that a company with monopoly on one of the market layers has no interest in leveraging its dominance onto other markets layers. An upstream monopoly company can even have an interest in as strong competition as possible in the downstream market, as competition there will lower prices in this layer, giving the monopoly company the possibility to increase its input prices to the downstream companies, provided that end-users will pay the same price for the final product as in a less competitive situation. According to Chicago school economists, the prime reason for vertical integration is increased efficiency – which is beneficial and not detrimental to the general social welfare. A similar conclusion is reached from a transaction cost economics approach, emphasizing the possible savings in transaction cost as a result of vertical integration.

[68] E.g. Richard Posner: 'Antitrust Law', Chicago, University of Chicago Press, 1976 and Robert Bork: 'Antitrust Paradox', New York, New York Basic Books, 1978.

[69] See Oliver Williamsons piece on antitrust policy in 'The New Palgrave: A Dictionary of Economics', no. 1, page 95-98.

However, the Chicago school conclusions are based on very strict assumptions and have later been criticized by other economists[70], relaxing the different assumptions, for instance, by introducing competition in the upstream market, by reducing the number of companies in the downstream market to an oligopoly market, or by introducing regulation in the relations between the upstream and downstream market. If, for instance, in a market with a monopoly infrastructure provider and competitive service/content providers, the interconnection or access price paid by the service/content providers to the infrastructure provider is regulated and set at a low price limiting or even abolishing the monopoly rent of the infrastructure provider, the monopoly provider can have an interest in integrating vertically with a service/content provider and out-compete its competitors in the service/content market in order to obtain high prices for the integrated product and compensate for the limit on the interconnection/access price. It can also be the case in an infrastructure duopoly market, as the infrastructure providers will have an interest in making exclusive agreements with service/content providers in order to limit infrastructure competition[71].

The outcome of the discussions on the different theoretical approaches and cases is that vertical integration can be an impediment to competition, but that the Chicago school approach constitutes a point of departure and is robust towards many changes in theoretical assumptions. Real world decisions must, therefore, be based on specific evaluations of specific cases, and it is only when companies engage in strategic behaviour – as pointed out by the transaction cost approach – that there is reason to be concerned about vertical integration.

If vertical integration leads to greater efficiency, this will improve the general welfare in society, and there can also be cases where integration will prevent double marginalization, where margins are added to production costs in both the upstream and the downstream markets. In general, competition will improve social welfare but there are cases where more competition does not necessarily lead to increased social welfare. This also means that regulatory interventions focusing solely on competition increasing measures, in specific cases, can hurt general social welfare, including consumer welfare.

Market developments in the Nordic countries

Horizontal integration can take place at different layers in the communication value chain – physical infrastructure, conveyance or content[72]. The present sub-chapter is, however, only concerned with the infrastructure layer and more specifically with the access part of the infrastructure layer. The infrastructure layer also encompasses the backbone infrastructures, but the main focus here is on the access part, as this constitutes the basis for the direct end-user contact in an industry where this is of crucial importance.

In the communication markets, the following access paths are the most important presently:

- Fixed line (twisted copper pairs)
- Mobile
- Cable TV
- Terrestrial broadcast
- Satellite broadcast

[70] See, e.g. Michael Riordan and Steven Salop: 'Evaluating Vertical Mergers: A Post-Chicago Approach', Antitrust Law, 1995.

[71] These two examples are taken from the publication by Oeconomica and ECON Analyse on 'Effektiv og bærekraftig konkurranse i tele- og mediemarkedene – hva skal til?', Oslo, 2003, page 57.

[72] In table 3, the more generalized terms equipment/hardware, transport/software and content/services are used, as the figure encompasses not only the telecommunication sector, but also IT, broadcasting and other media. When dealing specifically with telecommunications, the preferred terminology is physical infrastructure, conveyance services and content.

In addition to this could be mentioned fiber cables (Fiber to the Home/Curb), Fixed Wireless Access (FWA) and Wireless LANs (WLAN, for instance 802.11b). All of these access technologies – and others - may become increasingly important in the years to come, and especially WLAN is diffusing quickly in the markets currently. Primary focus here is, however, on the first-mentioned 5 access technologies and especially twisted copper pairs, mobile and cable TV networks.

In the Nordic countries, the incumbent telecommunication operators are involved in the following horizontal infrastructure access markets (see table 3).

Table 6.2: Involvement of incumbents in infrastructure access markets, 2004

	Twisted copper	Mobile	Cable TV	Terrestrial broadcast	Satellite Broadcast	FTTH/C	FWA	WLAN
DK	X	X	X			X		X
FIN	X	X	X			X	X	X
ICE	X	X	X			X		X
NOR	X	X	X	X	X	X	X	X
SWE	X	X				X	X	X

As shown in table 4, the Norwegian incumbent Telenor is the most 'complete' communication operator among the Nordic telecommunication incumbents. Telenor is not only active in the two-way point-to-point telecommunication markets but also in the wireless (terrestrial and satellite) broadcast markets. Telenor owns Norkring which operates the terrestrial broadcast network in Norway, and Telenor also owns Canal Digital which is one of the two broadcast satellite operators in the Nordic countries – the other one being ViaSat. Furthermore, Telenor owns Canal Digital Kabel TV that has more than half of all cable TV customers in Norway.

Telenor is not the only telecommunication incumbent operating cable TV networks in the Nordic countries. This also applies to Denmark, Finland and Iceland. In Denmark, TDC is the largest cable TV provider. In Finland, the incumbents (including the different local incumbents) are the only cable TV providers except for the capital Helsinki, and on Iceland, Siminn provides cable TV services, however with a relatively small number of customers. The cable TV infrastructure is seen as the most promising alternative network to the traditional PSTN for large scale access provision. The reason is that cable TV networks, which traditionally have been one-way point-to-multipoint distribution networks, can be converted to also encompassing two-way point-to-point network facilities and thus be an alternative access infrastructure to the PSTN.

Apart from the traditional PSTN, which is the original business of telecommunication operators, all incumbents also have mobile networks. Formerly, mobile networks have not been considered as direct substitutes to fixed line access but have been seen as complements to the fixed networks and have not been subject to the same scrutiny with respect to horizontal integration as cable TV networks. However, the present trend is that mobile and fixed networks increasingly are seen as substitutes and may in the future be subject to discussions regarding horizontal integration. But, at the same time, it should be taken into consideration that the mobile area is the most competitive access market in all countries.

Fiber access and WLAN access have not been discussed in light of the problem concerning horizontal integration, but FWA has been seen in this light. In Denmark, a conscious decision by the telecommunication regulator was made not to assign a FWA license to TDC in 1999. As it has happened, FWA has not (yet) turned out to be a success. In Denmark, there were no

more than app. 2,300 customers by the end of 2003, but the explicit reason for not assigning the incumbent in Denmark was to build infrastructure competition and not only rely on service competition. Service competition, where alternative operators use the networks of the incumbents, is much easier to create than infrastructure competition, as the investments in alternative infrastructures are high, especially in the fixed network markets. This fact is evidenced in table 5, which illustrates that the prime Achilles heel for competition in the telecommunication area is the total dominance of the incumbents in the fixed line access market.

Table 6.3: Market shares of incumbent operators in infrastructure access markets, based on number of subscribers, 2003 (percent)

	Twisted copper	Mobile	Cable TV
DEN	84	33	60 (e)
FIN (a)	35 (95)	51	30
ICE	92	67 (c)	100
NOR	95 (b)	56 (d)	53
SWE	~100	43	No activity

Notes:

a. The figures are for TeliaSonera alone. The figure 95 percent under twisted copper includes all the local incumbents in Finland.
b. Figure based on Telenor share of total turnover from subscriptions, movement of subscriptions and installations.
c. This figure includes not only GSM subscribers but also NMT450 subscribers, as there are still a relatively large number of NMT customers on Iceland – 24,240 in September 2003.
d. There are two mobile network providers in Norway, Telenor and NetCom. In addition, there are a number of service providers. The 56 percent represent the Telenor share of subscribers in relation to all mobile providers in Norway, the other network provider and the service providers. When including the subscriptions of service providers, Telenor has 70 percent of the mobile access market.
e. There are 2 major cable TV providers in Denmark, TDC and TeliaStofa. In addition, there are a large number of smaller independent cable TV networks. The 60 percent figure represents the TDC share of the customers being serviced by TDC and TeliaStofa.

Sources: The figures in the table are from a number of different sources and should, therefore, be taken as indicative. Figures are from 2003, either first or second half-year.

In Sweden, the incumbent has an almost total monopoly in the fixed line access market. If including all the local incumbents in Finland, the market shares of the incumbents in Finland, Iceland and Norway are around 95 percent, and in Denmark the corresponding figure is 84 percent. Furthermore, the 16 percent that competitive operators have in Denmark is not for the largest part an expression of ownership of the physical access paths but represents direct customer relationships with respect to subscription – meaning that the physical access paths are still mostly owned by the incumbent but is operated entirely by an alternative operator. This is called wholesale line rental (WLR) and has been part of the requirements on the Danish incumbent since the beginning of the liberalization of the telecommunication infrastructure in Denmark. Alternative operators have the right to rent access lines from the incumbent at a price equaling the retail price minus 21 percent. Similar arrangements in other Nordic countries have come later, which is part of the explanation for the higher degree of fixed access competition in Denmark compared to the other Nordic countries. Fixed line access competition in Denmark is thus primarily service based[73]. However, the fact that an incumbent owns the

[73] The country in Europe with the highest degree of fixed access competition is the UK. In the UK, fixed access competition is, however, mainly infrastructure based, as the main fixed access competitors in the residential market are the cable TV operators, which have deployed fixed telephony cables when deploying their cable TV cables.

physical access lines does not need to be an insurmountable problem for competition if competitors can get access to operating the access lines on terms that are sufficiently profitable for them. But the figures indicate that this kind of competition has not come far – yet, at least.

In addition to competition from cable TV operators, the greatest access infrastructure challenge in the fixed line area, which incumbents are facing in the coming years, will most likely come from local area networks set up by local cooperatives in city districts or by municipalities. Independent cable TV operations can be part of such initiatives, and new high-speed communication technologies can be part of it, allowing for an integration of telephony, broadband data communications (Internet), broadcast, Video-on-Demand, etc.

In the mobile field, there is much more access competition than in fixed line communications. In the Nordic countries, there are in each country 2-4 mobile operators in the GSM area with their own access networks – Mobile Network Operators (MNOs). In addition, there are a larger number of service providers and Virtual Mobile Network Operators (MVNOs). The reasons for the larger degree of competition in the mobile field, as compared to the fixed line field, is that it is cheaper to establish an access infrastructure in mobile communications and that incumbents do not have a century of head start as they have had in the fixed line market.

To the extent that mobile communication is a real substitute for fixed line communications, this has important implications for competition in the access market. In the Nordic countries, the penetration of mobile telephony has been high (above 80 percent of the population) for a number of years and is considerably higher than the fixed line penetration. In Finland, this started affecting the fixed line penetration a decade ago, and in the other Nordic countries similar developments are seen with decreasing numbers of fixed line subscription[74]. The real substitution, presently, is between having a fixed line plus a mobile connection and having a mobile connection only. And, when the prices for mobile and fixed line communication to an increasing degree will converge, and when the quality of mobile connections become comparable to fixed lines, mobile communications and the competing operators offering mobile communications will be a serious threat to the incumbent fixed access line monopolies. With the development of 3G communications and the increasing spread of WLANs, this is a very plausible development.

Finally, in the cable TV market there are duopoly situations in Norway and Denmark with some independent cable TV operations at the fringes. In Finland, the incumbents are the only cable TV network operators except for Helsinki. On Iceland, the incumbent is the only operator on the (presently very small) cable TV market, and in Sweden the incumbent is legally prohibited from providing cable TV access.

The primary focus is now on *vertical integration* and the market shares of incumbent telecommunication operators in the different communication conveyance services markets and the relationships between infrastructures and conveyance services, while content issues only briefly are touched upon.

The market shares of incumbents in the conveyance services markets are, generally, lower than in the infrastructure access markets. This applies, first and foremost, to fixed line communications.

[74] This is, however, also due to increases in private fixed line networks outside the public switched networks – which are measured in statistics on fixed line penetration.

Table 6.4: Market shares of incumbents in communication services markets, 2003 (percent)

	DEN	FIN (b)	ICE	NOR	SWE
Fixed line telephony – outgoing minutes	63	35	83	69	54
Mobile telephony – outgoing minutes	37	51	~65	62	51 (e)
Internet access – subscribers	60 (a)	NA	~55 (d)	62	41
xDSL – subscribers	79	32 (c)	64	57	67
Broadband cable modem – subscribers	35		100	40	No activity
SMS – messages sent	13	~55	55-60	58	39 (e)

Notes

a. The figure 60 percent represents the share of subscribers, which have been active during the past 6 months.

b. Market share of Elisa Corporation.

c. The figures cover broadband subscribers, primarily xDSL but also cable modem and other access modes. In Finland xDSL represents app. ¾ of the total broadband market.

d. Siminn has app. 55 percent of the customers paying for access, which equals app. 35,000 customers. In addition to these customers, there are users not paying for access but only for download per megabit. This is a service started by the banks in order to attract customers to Internet banking.

e. Figure for 2002. The fixed line telephony figures are measured by traffic revenue.

Sources: The figures in the table are from a number of different sources and should, therefore, be taken as indicative. Figures are, generally, from 2003, either first or second half-year, but the estimates from Iceland are from 2004.

The reason for the considerably lower market shares of incumbents in the fixed line traffic markets than in the access markets is that alternative operators can enter the traffic markets by way of interconnection agreements with the incumbents and offer telephony services to customers via carrier selection, either by-call or pre-selection. In Denmark, there were a little more than 3 million registrations to carrier selection codes out of 3.8 million fixed subscriber lines in the first half-year of 2002. The number of registrations has dropped slightly since to app. 2.8 million, but the number of fixed subscriber lines has decreased similarly[75].

It is clearly easier for alternative operators to enter the telephony market by way of carrier selection codes than by taking over the whole customer relationship, e.g., by means of a local loop unbundling (LLUB) agreement. The reason is that the margin between the end-user price and the LLUB price for the 'raw copper' is so small that it is extremely difficult to make a profitable business. This was also the case with carrier selection codes in the beginning after the liberalization of telephony services in the 1990s. However, since then interconnection prices allowing for carrier selection services have been lowered on basis of interventions from the telecommunication regulatory authorities.

The margin for xDSL services is considerably bigger than for telephony services, as the end-user price for xDSL subscriptions are much higher than for telephony subscriptions. In spite of this wider margin, the incumbent operators have a strong dominance on the national xDSL markets. The Danish development is a case in point. The incumbent TDC was not the first operator to introduce xDSL on the Danish market. However, very quickly TDC gained the major share of the market and has approximately 80 percent of the fast growing xDSL market. Alternative providers have claimed that the incumbent is abusing its market dominance and the matter has been examined by both the sector specific telecommunication regulator with respect to installation procedures and by the competition authority with respect to price

[75] The number of carrier selection registration in Denmark, which have been active during the past 6 months, is app. half of the total number of registrations, i.e. 1.4 million, but has maintained at a stable level.

squeezing. But neither the telecommunication regulator nor the competition authority have ruled against the incumbent.

The xDSL development is clearly an example of the advantages that operators with dominance in the access infrastructure market can have with respect to services using this infrastructure. It is a case of leveraging, where the power in an upstream market (access infrastructure) is 'exported' to a downstream market (xDSL). Even if there are no abuses of dominant position, there can still be advantages of the character dealt with by transaction cost economics. By having a vertically integrated business operation, transaction costs are saved as opposed to the competitors buying access to the infrastructure. And, according to theory, even if this is unequal competition, there may still be efficiency gains from a societal point of view in the integrated business operation.

The xDSL case may also be seen as an example of the theoretical possibility of competition problems in a monopoly situation with regulated access prices in the upstream market. In order to clear the way for competitive operators, the LLUB price for the 'raw copper' is regulated, creating an incentive for the access monopoly operator to integrate vertically (or favor their own operation) with the purpose of maintaining higher end-user prices. There is clearly a dilemma here, as the regulation of LLUB prices is important for the competitive operators. However, it requires a strict follow-up regulatory intervention in order to prevent the dominant operator from implementing non-price discriminatory means.

The obvious problem with respect to creating competition in the fixed line infrastructure access market and the corresponding difficulties in promoting competition in the xDSL market has fuelled a continuous discussion concerning the advantages and possible downsides of splitting up the infrastructure market from the services and content markets, i.e. dividing up the incumbent operators and forcing them to divest their physical infrastructures. This would create a more level playing field for competition between service providers, which would all have to buy their access to the physical facilities. Such a proposal has surfaced many times, for instance, in Sweden and in Denmark, where lately Tele2 has promoted the view that the infrastructure of the incumbents should be split off from the service operations of the companies.

There are thus, in fact, competition problems not only in horizontal integration but also in vertical integration, especially in the cases where the downstream services are closely related to the infrastructure access services and are communication conveyance services. With respect to content services and even higher level communication services, the same problems have not arisen[76]. There are different interrelated reasons for this difference between conveyance services and content services. First and foremost, infrastructure provision and conveyance services have traditionally been integrated business areas. There are thus experiences to build on, technologically as well as market-wise, while telecommunication operators have no tradition for activities in the content markets and, therefore, no experience with the technical, organizational and market oriented issues related to content provision. There are economies of scope in the provision of infrastructure and conveyance services and transaction costs involved when splitting up infrastructure and conveyance services. Even if we are dealing with vertical integration in the cases of integration of infrastructure and conveyance services as well as infrastructure and content services, there are thus differences in the competition issues involved.

[76] With content is meant pre-produced data, information or knowledge services, whereas communication services consist of the mere conveyance of signals between the users. Examples of content are music, film or newspaper articles, while examples of communication services are telephony or data communication services. In some cases, however, the borderline is blurred, for instance with respect to electronic games, which are designed and made in advance but may involve communication over networks between users.

Norway is the Nordic country where the issue of vertical integration involving content has been most pronounced. In a recent analysis of the Norwegian telecommunication and media markets[77], it is described how Telenor has integrated vertically into the content market. Telenor has shares in A-pressen and, as mentioned in the sub-section on horizontal integration, Canal Digital, which has made exclusivity agreements with the television station TV2. Telenor has been buying rights to the football world championship in 2002 and the premier football league (Tippeligaen) in Norway. The affiliate Zoniva produces interactive services for digital TV; djuice is active in SMS, MMS and WAP services; and, iCanal delivers game and music services via Internet[78]. In Denmark, the incumbent TDC has been considering being part of a bid for the Danish TV station TV2, when it will be privatized – but has retreated.

The issue of vertical integration into the content markets mostly appears in relation to portals in fixed line communication as well as mobile communications. Most Internet service providers (ISPs) offer portal services, where different kinds of content and more advanced communication services are offered. The purpose of offering portal services is (apart from offering an attractive service package to users) to tie subscribers closer to the ISP in question. However, as there are many ISPs and as the dominance of one or a few provider in this market is weak, and furthermore, as users mostly can access similar or even the same services from other ISPs, there is no competition problem here.

In the mobile area, there has not hitherto been the same structure as in the fixed line area with independent ISPs. This will blossom with the next generation wireless and mobile services, e.g. 3G communications, where Wireless ISPs are foreseen to play a much greater role. However, at present, portal services are closely aligned with the mobile network operators. In Japan, where mobile Internet services have developed much faster than in Europe, the business model used by NTT DoCoMO, but also other mobile operators, has been to construct portal services with easy access to content and service providers with which they have established close relationships. However, content service providers can also use other avenues for their services, and users can also access services outside the portal. There is, therefore, no competition problem involved in this kind of vertical integration.

In the years to come, networks and communication services will not only be based on digital technology but more specifically on IP technology, meaning that the Internet Protocol (IP) will constitute a common basic soft infrastructure for different kinds of services and content. This development comprises both fixed line and mobile communications and is summarized under the heading of Next Generation Networks (NGN). In the broader public, this development has, e.g., been discussed in relation to mobile communications with the deployment of 3G networks, where not only data communications will be based on IP technology but also eventually voice services. Furthermore, a similar development is taking place in the fixed networks, and technologically this will allow for a vertically disintegrated market for communication and content services. The present Internet is an illustration of a far greater vertically disintegrated market for communication and content services than has been seen in the traditional telecommunication area.

This is the vision and has been the vision for a number of years under the slogan of 'networks of networks'. The idea is that independent networks can be integrated horizontally in a seamless way and that many different market players vertically can work together in order to deliver communication and content services to the end-users. This vision was strong around the turn of the century and technology developments will increasingly make it possible. However, traditional communication markets have witnessed a strong tendency to resist this kind of development, and incumbent operators in the telecommunication markets have shown

[77] ECON Analyse: 'De norske tele- og mediemarkedene', Oslo, ECON Analyse.
[78] Information on Norway is based on the abovementioned ECON report, page 4-5.

an ability to retain a dominant position in the telecommunication markets and have even been able to regain market shares during the past couple of years after the losses of market shares just after the liberalization of telecommunications in the 1990s[79]. This leads to the conclusion that technological solutions will not necessarily by themselves open the communication markets to a greater degree of competition. However, the possibilities are there.

Legal cases

The two most internationally known cases in a Nordic context with some relation to the issue of convergence are the two merger cases involving Telia, first with Telenor and later with Sonera[80]. In both cases, the companies involved have been ordered, among other things, to divest their cable operations, as network convergence allows these infrastructures to be used also for telecommunication services and, therefore, could limit a potential for competition. Both cases are mainly related to the issue of horizontal integration, but also, to some extent, to vertical integration, and there have been other cases related to vertical integration, where the xDSL issue has been the most important question, lately, because of the focus on broadband development (see paragraphs on vertical integration).

The Telia/Telenor merger as well as the Telia/Sonera merger would or will have such impact on the telecommunication markets in the countries involved that they were dealt with by EU competition authorities. Under the EU Merger Regulation, a joint venture or merger shall be prohibited if it creates or strengthens dominance in a market, significantly impeding effective competition. This may apply to horizontal integration, where the market share of a dominant company in a specific market exceeds 40 percent, as well as vertical integration, where the possibility of leverage and foreclosure exists.

In the case of the Telia/Telenor merger, which was notified in 1999 but was never realized because of disagreement between the parties involved, the decision of the European Commission was that a merger would strengthen the dominant position of the incumbent operators on several market segments in telecommunications as well as broadcasting. The merger could, consequently, only be approved if the two operators would divest their overlapping activities in the two countries (i.e. the overlapping activities of Telia in Norway and vice versa of Telenor in Sweden), furthermore, divest their cable TV activities, and finally implement local loop unbundling (before the general EU Regulation of 2000 in the field)[81]. Requirements were thus related to horizontal (divestiture of overlapping activities and cable TV operations) as well as vertical (unbundling of the local loop) activities. The Commission decision also illustrated another characteristic feature of many merger decisions, namely the approval of mergers only with strict conditions.

The case of the Telia/Sonera merger was notified in 2002 and the merger between the two operators has actually been realized. The European Commission concluded that the merger would strengthen the dominant position of the merging operators on several telecommunication market segments in the two countries. The merger was, therefore, only cleared when the parties had agreed to divest their overlapping activities and the cable TV operation of Telia in Sweden. Furthermore, fixed and mobile activities in Sweden and Finland were to be legally separated[82]. Again, the focus is mainly on horizontal issues, but vertical issue also arise in connection with the strong position of the merged incumbents and their possibility to leverage the dominance in the infrastructure markets into the services markets.

[79] This issue is discussed, e.g., in Anders Henten and Markus Schneider: 'Has Liberalisation of Telecommunications Failed in Europe?', Communications & Strategies, issue 50, 2nd quarter 2003, pp.19-48.

[80] The description of the two cases is based on a paper by Alexandre De Streel: 'European merger policy in electronic communications markets: Past experience and future prospects', 2002.

[81] See Commission Decision of 29 October 1999.

[82] See Commission Decision of 10 July 2002.

Another important aspect is that the Commission decisions that cable TV operations had to be divested in the Telia/Telenor and Telia/Sonera cases go beyond the sector specific regulation in the field, which only requires telecommunication activities and cable TV activities to be operated in separate legal entities[83]. In Denmark, this is the case, and as cable TV networks are an increasingly important aspect of broadband access, this is a significant issue. TeliaStofa was the first operator in Denmark to offer cable modem services, but TDC has followed suit and has the potentials to become the largest cable modem operator in Denmark, as it is has the largest cable TV network. A noticeable aspect of cable modem services is that there is no competition at present regarding this service on the individual networks. In Denmark, local loop unbundling regulation encompasses all kinds of access infrastructures, however, there are no service providers using the cable TV networks of the two large cable TV network operators to provide cable modem services. The cable TV operations of TDC and TeliaStofa thus, presently, constitute a kind of 'safe havens' in the broadband access market.

Summary and conclusions

Technology convergence between IT, telecommunication, broadcasting and other media allows for formerly dedicated services to be delivered on new platforms. Telephony can, e.g., be delivered on cable TV networks and broadcasting via Internet. This potentially opens the different communication and media markets for increased competition, as the technological possibilities for providers of communication services and content to enter each others' market segments increase. The new technological possibilities, therefore, change the conditions for horizontal and vertical integration market-wise and put new focus on the rules and regulations for horizontal and vertical integration with respect to mergers and joint ventures.

On basis of economic theory, at least two basic rules of thump can be deducted:

- Horizontal joint integration will generally constitute a problem to competition if involving companies with market dominance,
- Vertical integration does not necessarily constitute a problem to competition even if involving companies with market dominance on one of the market layers

However, in both cases there are exceptions to the general rule and specific cases of integration have to be examined thoroughly, and there are also countervailing considerations. The countervailing considerations in the case of horizontal integration are related to potential efficiency gains and the resulting general welfare benefits. This could be the case if there were scale or scope advantages. However, if a company operates different access infrastructures in parallel, there are generally no scale or scope advantages involved, and if this company concentrates all its communication services on one access infrastructure and, therefore, saves maintenance and innovative investments in other access infrastructures, there are certainly scale and scope advantages but no competition problems from horizontal integration, as other operators can use other access infrastructures. With respect to the backbone infrastructures there are advantages of scale and scope even if the operators have different access networks. The backbone networks for fixed line and mobile communications can, for instance, be the same and even cable TV distribution and telecommunication operations can be conducted on hybrid networks.

The countervailing considerations in the case of vertical integration are related to competition problems regarding leveraging or transposition of market power in one layer into other market layers. Especially the discussion in the chapter on the xDSL market has illustrated that serious competition problems can arise in relation to vertical integration. In this case, the incumbent operators are able to build and retain large market shares partly because of dominance in the fixed line access markets. When comparing services that are 'close' to the physical

[83] See Commission Directive 1999/64/EC of 23 June 1999.

infrastructure, e.g. conveyance services, with content services, which are higher up in the hierarchy of protocol layers, there is clearly a difference with respect to the competition issues involved in vertical integration. While the competition problems are small regarding the involvement of telecommunication operators in the content markets, there are competition problems with the integrated access infrastructure and conveyance service providers. It is very difficult for alternative operators not only to build competitive infrastructures but also to compete on services closely related to the access infrastructures. This is the basis for the continuously re-surfacing discussion on a separation of the infrastructure part and the service provision part of the incumbent operators.

In the opposite direction pulls the potential efficiency gains from vertical integration, and in the case of horizontal as well as vertical integration, competition problems have to be weighed against efficiency gains in the policy decisions and case rulings on mergers and joint ventures. However, in the case of horizontal integration, the competition problems are generally grave and the efficiency gains small, and in the case of vertical integration, the competition problems are small and there are potentially efficiency gains. Therefore, the two general rules of thump mentioned provide good initial guidance.

In the chapter, it is briefly discussed to what extent technology developments in connection with Internet technology will diminish the problems of vertical leverage. Internet, which is the prime example of converging communication technologies, is in its existing form, to a large extent, characterized by a layered structure not only technologically but also with respect to ownership. Internet illustrates the point that digital technology allows for layered structures in communications with clear demarcations between the physical, the transport and the content and application layers. Internet is a network of networks horizontally but is also vertically layered technologically and ownership-wise. Internet technology thus has potentials to change significantly the competitive structures on the telecommunication markets. However, as stated in the chapter, operators with market power have shown a significant ability to incorporate new technologies in existing power structures. Convergence will thus continuously change the conditions for competition but will not eliminate competition problems.

Appendix 1: One way access[84]

Introduction

This section contains a brief discussion of one-way access regulation, with reference to telecommunications.[85]

The analysis focuses on the case in which regulation concerns access to some specific economic resource, such as a telecommunications network. The resource is an input to the production of services that are supplied to final consumers.

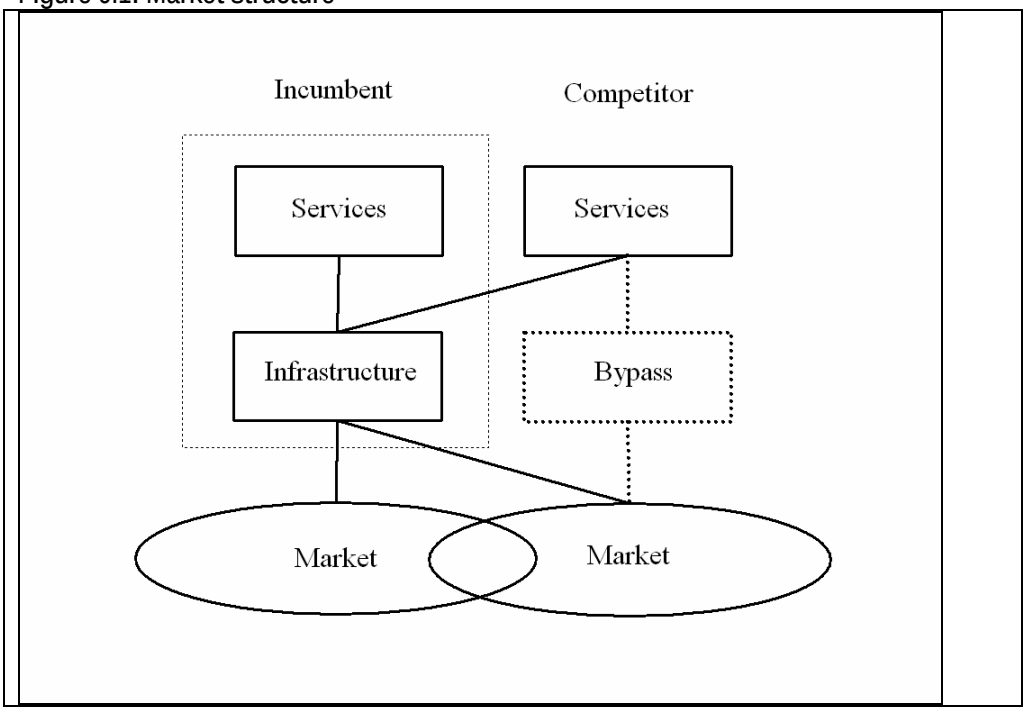
The analysis is illustrated with an example, in which the market consists of two firms. They are the firm that controls the resource – "the incumbent" – and another competing firm – "the competitor". The competitor demands access to the resource in order to supply services to final consumers in competition with the incumbent.

The market structure is illustrated in Figure 0.1. The incumbent produces services that are supplied by means of the resource (infrastructure) to the market. The incumbent faces competition from the competitor, who also utilises the resource controlled by the incumbent to access the market. The services supplied by the two firms are not necessarily identical, as viewed by consumers, and the two markets are therefore not entirely overlapping. The competitor may bypass the resource controlled by the incumbent, by using an alternative infrastructure or by building his own. The terms upon which access to the incumbent's resource is granted – and the quality of access provision – determine whether the competitor takes advantage of the bypass opportunities (if such exist).

[84] Appendix 1 is drafted by Nils-Henrik M. von der Fehr, University of Oslo

[85] There exists a sizeable literature on this topic. Laffont og Tirole (2000) provides a thorough, rigorous and comprehensive analysis. Armstrong (2002) is a shorter overview of the academic literature. Geradin og Kerf (2003) contains an overview of various regulatory methods, in addition to a discussion of experience from various countries. For further references, see the reference list.

Figure 0.1: Market structure



Access provision is a multi-dimensional issue: Firstly, the quality of the resource, and so the gain from obtaining access may vary. The quality is typically under control of the incumbent, and may be varied by choice of technology, investment and maintenance. Furthermore, the gain from obtaining access will depend on the willingness of the incumbent to accommodate the competitor, solve technical and other problems and respond to requests in a timely manner. Secondly, access may be provided at different levels with correspondingly different requirements on the competitor in order to benefit from access to the resource. The level of access also is controlled by the incumbent, who may affect the overall cost of access via technical and other requirements imposed on the competitor. Thirdly, the value of access will depend on the price charged.

Below we mainly concentrate on the pricing issue. This does not mean that we ignore non-price issues. As we will discuss at various points, price regulation must typically be combined with regulation of other aspects, notably the quality of access. Nevertheless, from the point of view of a competitor who desires access to the incumbent's resource, it is the overall terms of access that matter. In particular, we may measure other terms of access by their "price equivalent"; that is, by how much price would have to be reduced in order to compensate for other costs or requirements, detrimental quality and so on. Consequently, when we talk about "price" below, we may think of this as measuring the total costs to the competitor of obtaining access.

The problem of regulating access prices requires answers to three questions:

- What are the principles of optimal pricing?
- How may optimal prices be calculated?
- How can calculated prices be implemented?

Below each of these questions are discussed in turn. Various concerns that may affect how these questions should be answered are presented. The final answer, however, depends on

the purpose of regulation as well as specific features of the market in question. We discuss such trade offs towards the end of the section.

Optimal Prices[86]

The fundamental principle of optimal pricing is that decision makers should meet prices that reflect the opportunity cost of their decisions.[87] The opportunity cost of providing access to a competitor to a resource controlled by the incumbent consists, in general, of three components:

- direct costs incurred by the incumbent when providing access, which could otherwise have been saved;
- the value of the incumbent's own use that is displaced as a consequence of providing access to the competitor; and
- economic consequences (costs or benefits) of changes in the incumbent's financial result.

Below we discuss each of these components.

The marginal-cost rule

In some cases the optimal price depends on the direct costs of providing access only. Suppose the following conditions are satisfied:

- the incumbent has free (unused) resources;
- there are no specific (regulatory) requirements on the financial result achieved by the incumbent.

Under these conditions, the access price t should be set according to the marginal-cost rule; that is,

$$t = mc ,$$

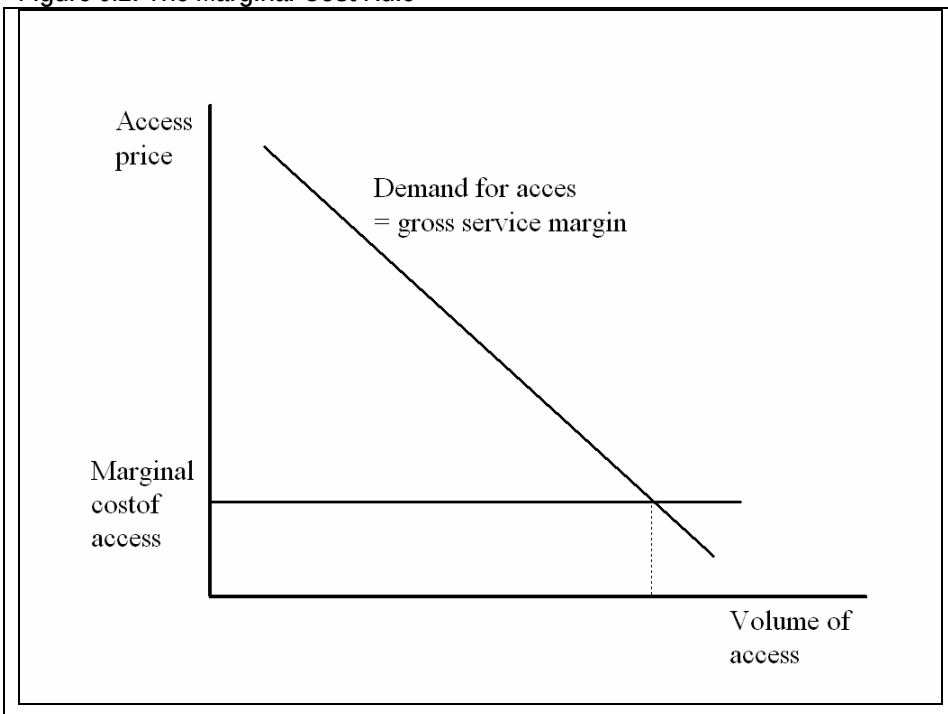
where mc denotes the marginal cost of providing access to the competitor. The marginal cost includes all costs that the incumbent must incur in order to provide access, and which consequently might have been saved if such access had not been provided.

The marginal-cost rule is illustrated i Figure 0.2. The volume of access is measured on the horizontal axis, while the price of access is measured on the vertical axis. The competitor's demand for access – which is derived from his gross earnings on services – is assumed to be decreasing with the price of access. Alternatively, this relationship may be viewed as the competitor's (marginal) willingness to pay for access being decreasing in the amount of access provided. The marginal cost of providing access is assumed to be constant.

[86] This section builds on von der Fehr (1996), which contains formal derivations of the results as well as a discussion of these (with references to the literature).

[87] We refer to optimality in the standard sense of neo-classical welfare economics. Most introductory microeconomics textbooks contain a discussion of this concept; see for instance Varian (2002).

Figure 0.2: The Marginal-Cost Rule



Under these conditions, the optimal provision of access involves letting the competitor obtain access up to the point where his marginal willingness to pay (i.e. gross service margin) equals the marginal cost of providing access. This is facilitated by setting the access price equal to marginal cost.

In other words, if the access price is set equal to the marginal cost of providing access it reflects the true underlying costs of the resource. If competition is effective, prices will be competed down to costs and the resource will be efficiently utilised. All consumers willing to pay the cost of services will be served.

This argument is fairly general, and is valid also in cases in which bypass opportunities exists, in the sense that the incumbent's resource may be wholly or partially substituted by other inputs (such as when telecommunications services are provided over cable-television networks). In order that a firm who does not control access to the resource should be able to make an efficient choice between using the incumbent's resource and using some alternative input (incl. the opportunity of bypassing the network), the firm should face cost-reflecting prices. If other inputs are priced correctly, the access price should be set equal to the marginal cost of access.

However, the Marginal-Cost Rule does not apply to cases in which there are

- imperfect competition in the provision of final services;
- capacity constraints in the provision of access; or
- financial deficits in the operation of the resource that must be financed by other means.

We shall discuss the issues of capacity constraints and financing deficits in some detail below. Before turning to these issues, we briefly comment on the issue of imperfect competition.

If competition in the provision of final services is imperfect, lowering access prices may stimulate competition. A reduction in the access price reduces the costs of firms relying on access to the resource controlled by the incumbent, and hence gives these firms an incentive to reduce prices on services to final consumers in order to gain market shares. A reduction in the access price also stimulates entry of new competitors. However, if the access price is set below the actual cost of providing access then production is no longer cost efficient. In particular, while the incumbent faces the true cost of using the resource, its competitors face a lower cost. The optimal access price balances the gain from more competition and output of services against this cost inefficiency.

Correcting imperfect competition by adjusting the access price is an example of a so-called "second-best solution". If possible, imperfect competition should be attacked at the source of the problem; that is, in the market where the problem originates, namely the market for final services. If both the access price and the price for final services may be regulated, they should both be set at the level of the respective marginal costs. Consequently, it is only when the regulator is unable to regulate the price of final services – or is unable to stimulate competition by other, more direct means – that the access price should be used to correct for imperfect competition in the market for final services.

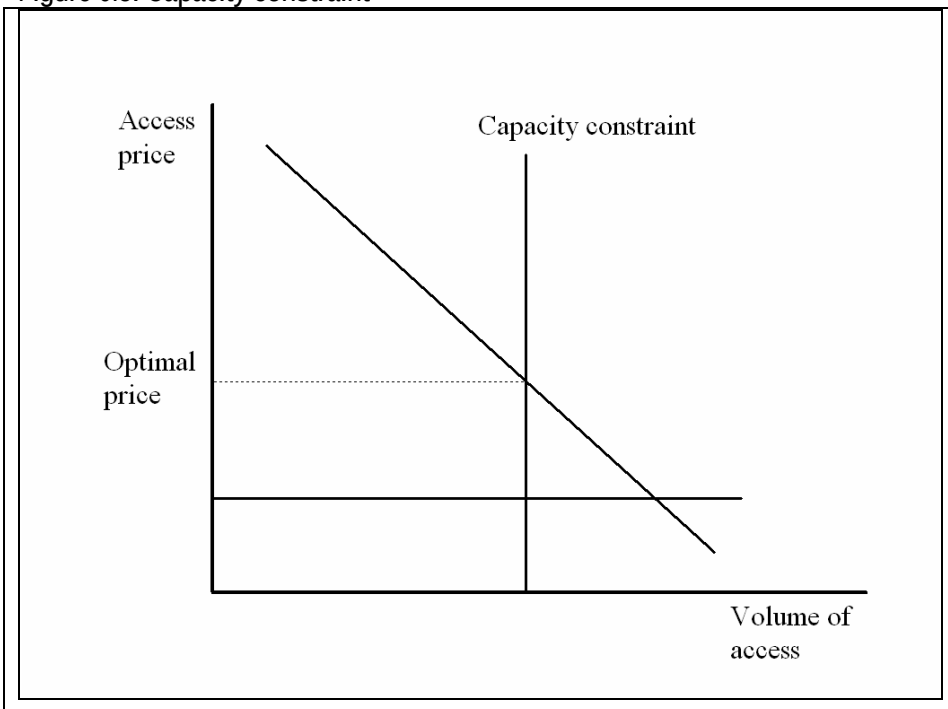
More generally, if regulatory authorities do not have other instruments at their disposal, and there is imperfect competition either in the market for final services or in markets for inputs that are used to provide such services, then the access price may be adjusted so as counteract these imperfections. If, and to what extent, the access price should deviate from marginal costs depends on the extent of market imperfections.

The Baumol-Willig rule

The access price should not be set at marginal cost if the demand for access at this price exceeds the available capacity. In telecommunications, a large fraction of infrastructure costs are fixed and independent of the extent to which the network is utilised. If the access price is set at, or close to, zero, demand for services may well exceed available capacity, at least during peak periods. It will then be optimal to regulate demand by setting the access price above marginal costs.

This idea is illustrated in Figure 0.3, which builds on Figure 0.2. At a price equal to marginal cost total demand for use of the resource exceeds available capacity. In order to restrict demand within available capacity, price must therefore be increased. The optimal access price ensures that capacity is fully utilised.

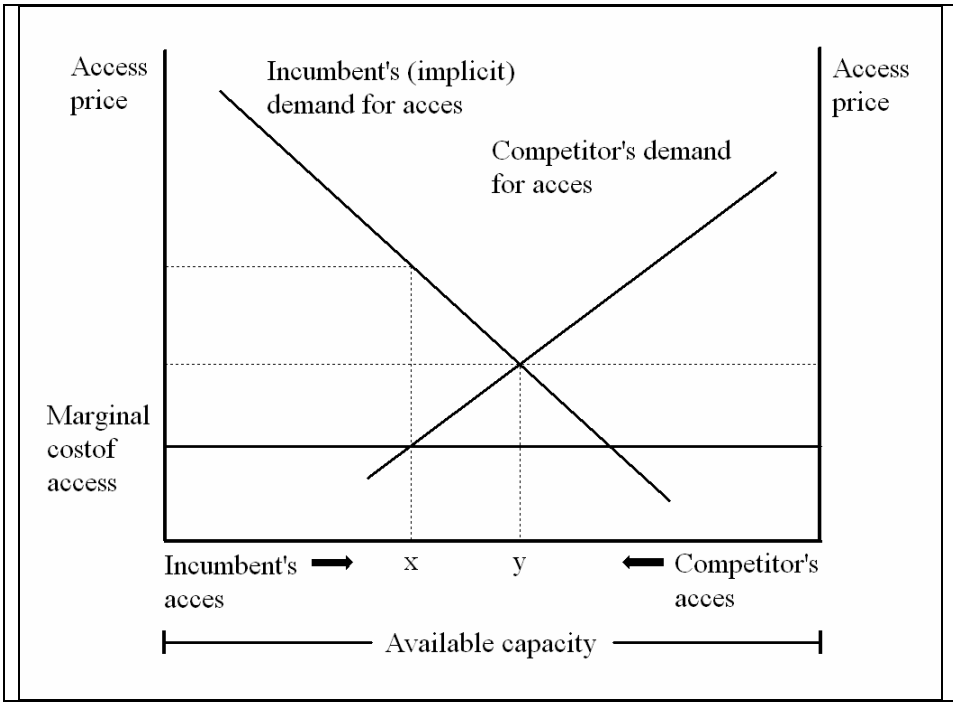
Figure 0.3: Capacity constraint



An alternative way of expressing the above idea is to focus on the opportunity cost of providing access to a particular agent. When the resource is available in limited quantities only – say, due to a capacity constraint – one agent's use of the resource will displace that of another. In such a case the access price should reflect the value of displaced use.

This argument is illustrated in Figure 0.4. The length of the bottom line of the diagram corresponds to available capacity. The incumbent's use of capacity is measured from the left, while the competitor's use is measured from the right. A given point on the horizontal axis (such as "x" or "y") corresponds to a particular allocation of capacity; the length of the line to the left of the point corresponds to the capacity allocated to the incumbent, while the length to the right corresponds to the capacity allocated to the competitor. The marginal value of the resource to the incumbent – or the incumbent's (implicit) demand for the resource – is illustrated by the line sloping downwards from left to right. Correspondingly, the competitor's demand for access – or his (marginal) willingness to pay – is illustrated by the line sloping downwards from right to left.

Figure 0.4



If the price for access were set equal to marginal cost, the competitor would demand an amount of access corresponding to the allocation indicated by "x" in the figure. However, at this allocation the value of the resource to the incumbent exceeds the value of the resource to the competitor. One could therefore increase the overall value of the resource if more was allocated to the incumbent (who values it more) and less to the competitor (who values it less). The optimal allocation is such that the marginal value of the resource is equalised across firms. This allocation is indicated by "y" in the figure.

Alternatively, if the price of the final product is regulated, the quantity of the product will be determined from the demand side and so different suppliers compete for a given volume. This means that an increase in output by the competitor reduces that of the incumbent (and *vice versa*). The value of the reduction in supply – measured by the incumbent's profit margin – should therefore be reflected in the price that the competitor pays for access to the resource. In other words, the profit margin of the incumbent may be considered as an opportunity cost of providing access to competitors; the opportunity cost reflects the reduction in value added at the incumbent when output must be reduced in order to provide room for competitors.

Let p denote the price of the service supplied to consumers and assume that the incumbent's total cost of supplying the service is $mc + sc$, where sc denotes the costs directly related to the service. Then the incumbent's profit margin may be written as $\pi = p - sc - mc$.

The Baumol-Willig Rule – also known as The Efficient Component Pricing Rule (ECPR) – states that the access price should equal the sum of marginal cost of providing access and the profit margin in the supply of the final service:

$$t = mc + \pi \ .$$

From the definition of the profit margin, the access price may alternatively be written

$$t = p - sc \ .$$

In other words, the access price should equal the price the incumbent receives in the market for final services less the direct cost associated with these services. The pricing principle provides a theoretical basis for the calculation method denoted “price minus” (see below).

Note that, if capacity is optimally set, the value of increasing capacity is just equal to the (marginal) cost of investment, that is, $\pi = cc$, where *cc* denotes the investment cost associated with a (marginal) increase in capacity. This means that the access price will equal the long-run cost of making the resource available, or the sum of the short-run marginal cost and the (marginal) capacity cost:

$$t = mc + cc\ .$$

This is sometimes called the Long-Run Incremental Cost (LRIC).

The Baumol-Willig rule presupposes that the competitor needs access to the resource in order to supply the service. If the resource may be supplied from other sources, or the resource may, wholly or partially, be substituted by other inputs, the rule must be modified:

$$t = mc + \sigma\pi\ ,$$

where σ denotes the so-called displacement ratio. The displacement ratio is generally less than 1 and smaller the easier the competitor may circumvent the incumbent or substitute the resource with other inputs.

In the case in which the price of the final product is regulated the access price should also be adjusted for differences between the products of the incumbent and the competitor, respectively. When incumbent’s supply is limited by demand for the final product, on not by the availability of the resource, demand for the firm’s product will fall as the competitor increases supply. The fall will be smaller the more differentiated are the products. The replacement ratio is consequently smaller when products are more differentiated.

To elaborate on this issue, consider a (hypothetical) increase in the access price. This will increase the cost of the competitor. The cost effect is smaller when access to the resource controlled by the incumbent may be substituted by other inputs (possibly by bypassing the incumbent’s resource). The increase in costs reduces the competitor’s competitive position and induces him to raise prices on final services. This will impact on the demand for his services, as well as on those of the incumbent. The demand effect will be smaller the less willing consumers are to switch to the incumbent’s products. Consequently, the overall effect on the incumbent’s profits is smaller the easier it is for the competitor to substitute access with other inputs, and the more differentiated products are.

Note that the opportunity cost of providing access generally depends on characteristics of the competitor, such as his production technology and his products. If there are multiple firms that desire access to the incumbent’s resource, these firms should not necessarily be offered the same access terms. The access price should be lower for firms that have better substitution opportunities and which produce services that differ substantially from those of the incumbent.

The Ramsey-Boiteux rule

Prices determined according to the Baumol-Willig Rule (or, indeed, the Marginal-Cost Rule) may not result in revenues that are sufficient to cover costs. In particular, if there are large, fixed costs, or the incumbent is required to undertake public service obligations, then prices based on variable costs will typically lead to the incumbent running a deficit. An underlying assumption in the above analysis is therefore that any such deficit may be financed (costlessly) in some other way.

One possibility is that the price per unit of the resource is combined with a fixed payment. The competitor will then pay a fixed amount for access, as well as an amount that varies with his utilisation of the resource. A potential disadvantage of such a two-part tariff is that it may discourage users with a low total willingness to pay for access. Two-part tariffs are also difficult to implement when there are opportunities for resale to third parties.

An alternative procedure is to increase the unit price for access. This means that the access price – in addition to reflecting marginal costs and the value of displaced use – must incorporate an element that reflects the need for financing:

$$t = mc + \pi + \phi \ ,$$

where ϕ reflects the financing element.

A raise in the access price will increase the incumbent's revenues in two ways. Firstly, there is the direct effect from competitors paying higher prices for access. Secondly, there is an indirect effect due to the subsequent increase in final-consumer service prices. As the cost of access is raised, competitors will be induced to raise their service prices. This improves the competitive position of the incumbent, who may exploit the consequent shift in demand towards his services, possibly by raising his prices also. Note that this shift of service production – from competitors to the incumbent – involves an inefficiency; as the incumbent faces a lower effective cost of access than his competitors, he will be able to increase his market share even if his production of final services is less efficient, or his product is conceived as less desirable, than that of the competitor. This is the cost of having to finance the deficit of the incumbent by raising the price of access.

If price regulation encompasses a number of products, prices should be set so as to reflect the impact of prices on demand. The aim should be to avoid that demand is affected by more than what is warranted in order to cover costs. In particular, the financing element should be highest on those products for which demand is the least price sensitive.[88]

It is conceivable that the requirement of cost coverage is not absolute, but that parts of the costs may be covered by revenues from other sources. In particular, the government may be willing to provide financial support, drawing on tax revenues. If so, the inefficiency of increasing access prices should be weighed against the distortions cause by alternative means of financing; in particular, the financing element ϕ should reflect the cost of government funds.

Discussion

Optimal access prices reflect three elements: the direct (marginal) cost of providing access; the (opportunity) value of displaced use; and the impact on the overall economic (financial) result of the incumbent. The size of the individual elements depends on a number of firm and market specific conditions. In principle, therefore, calculation of optimal prices requires detailed knowledge of the particular circumstances concerning products, firms and markets. In practice, such information is not always available, and hence methods must be devised that allow for the best possible approximations. This is the topic of the next section.

However, before turning to calculation methods we briefly consider how a firm with market power may distort prices, on access as well as on final consumer services.

From the above analysis, it is clear that an owner of an essential resource, by raising the price of access, may benefit in two distinct ways. First, increasing the access price increases profits from selling access. Second, a higher access price raises competitors' costs of providing

[88] These principles are analysed in detail in Laffont og Tirole (2000).

services to final consumers. As competitors raise prices to compensate for their higher costs demand is shifted towards the incumbent. Consequently, the incumbent benefits from greater profitability on final services as well as on access.

Note that, in general, the incumbent would not necessarily want to raise access prices to a level that drives competitors out of the market. When competitors are more efficient, or provide services that are highly attractive to consumers, the incumbent may have more to gain from allowing competitors on to the market and selling access than to monopolise the market for final services. Nevertheless, it is also conceivable that the incumbent will maximise profits by raising access prices to levels that forecloses the market (in effect adopting a strategy of "refusal to deliver").

Such predatory practices are sometimes called "price squeeze" or "margin squeeze". The idea is that the incumbent prices in such a way that competitors are not able to obtain profitable margins on final services. The incumbent may undertake a price squeeze by raising the access price to a level that effectively reduces the margin on final services to unprofitable levels. Such a strategy is particularly relevant if competitors are unable to raise prices on final services sufficiently to compensate for higher access costs, such as if prices on final services are regulated. Alternatively, the incumbent may combine a high access price with a low price on final services, thereby introducing an element of predatory pricing. Note that a price squeeze requires market power on the market for access only. As such, it is properly seen as a special case of anti-competitive or monopolistic access pricing.

Anti-competitive behaviour – and, more specifically, predatory practices in the form of price squeezes – have relevance for the choice of calculation method; in particular, it implies that actual prices may provide a distorted picture of both profit margins and underlying costs. Such anti-competitive behaviour also has implications for the implementation of price regulation; in particular, prices should be set such that (efficient) competitors are allowed a reasonable profit margin. We analyse such issues below.

Before leaving the optimal pricing issue, however, a final word of caution is warranted. Note that anti-competitive pricing may not be the preferred strategy, even for a firm with market power. Monopolistic access prices induce inefficiencies that may hurt, not only competitors and consumers, but the incumbent also; in particular, if he could, the incumbent would prefer to extract monopoly profits by other means than by distorting prices. For example, and as explained above, by combining fixed payments with a low per unit price the incumbent may be able to extract more revenues than from relying on a high per unit price only. In other words, efficient pricing is fully compatible with exploitation of market power (even though competitors may complain that the incumbent achieves an "unreasonable" level of profitability and such behaviour may be deemed an abuse of dominant position): given sufficient contractual flexibility, profit maximisation may well lead to efficient prices.

Calculation methods

Having established the principles according to which optimal prices should be determined, the next question is how such prices may be calculated.

Many calculation methods exist. There is a fundamental difference between methods that takes as their starting point the costs of the firms in question and those that start from actual prices. Among cost-based methods, a distinction is made between methods using actual costs and methods that aim to establish (minimum) required costs. And, finally, the cost base may be backward-looking (historic costs) or forward-looking (projected costs).

Actual costs
Perhaps the most natural starting point in order to calculate prices is actual costs, as reflected in company accounts. It is common to base calculations on product-specific costs, with an addition for a share of non-specific, or common, costs. Costs are typically evaluated at historic costs, possibly adjusted for inflation and depreciation. Common costs are allocated in proportion either to the volume of outputs or to specific costs (fully-distributed costs).

The main advantages of this method are:

- Accountancy data are normally easily accessible.
- To the extent that accountancy costs reflect actual costs, resulting prices ensure cost coverage.

Among the disadvantages of the method are:

- Historic costs do not necessarily reflect actual costs.
- Cost-based calculations do not take into account the loss of incumbent's profit (cf. the Baumol-Willig Rule).
- Cost-based calculations also do not take into account how demand for final services depends on prices (cf. the discussion above on the price regulation of multiple products).
- The regulated firm will have incentives to distort the cost base. This may be done by shifting costs from unregulated products to products subject to price regulation. For example, an incumbent who both controls essential facilities and competes in the market for consumer services may shift costs from the unregulated downstream activities to the regulated upstream activity.
- In the longer run, incentives to increase efficiency will be affected also. Since the method of calculation is based on actual costs, the regulated firm has limited incentives to improve efficiency.

Modelling costs
Instead of using actual costs, the regulator may attempt to calculate the costs necessary to undertake the activity efficiently. Contrary to the backward-looking, accountancy-based method presented above, this method is forward-looking and based on best practice technologies.[89,90] The aim is usually to estimate the so-called Long-Run Incremental Costs (LRIC).[91]

The main advantages of this method are:

- The method takes account of product-specific costs, including fixed costs that in a long-run perspective are associated with the product. In some cases costs that are not strictly speaking warranted in order to provide access, but are nevertheless necessary in order to sustain production, are also included.

[89] See Europe Economics (2000) and Kennet og Perez-Reyes (2002) for examples of such calculation methods.
[90] Kaserman and Mayo (2002), Lehman (2002), Rosston and Noll (2002) and Weisman (2002) discuss the legal basis for using this method in the US.
[91] Kahn (2001), who is critical of the method, uses the term Total Element Long-Run Incremental Cost – Blank Slate, or TELRIC-BS.

- Since the cost base is not related to actual costs, the regulated firm has no incentives for cross subsidisation or cost manipulation. Incentives to increase efficiency are not affected either.

The disadvantages of the method include:

- It is a very demanding exercise to determine efficient costs, especially in a network industry like telecommunications. One needs information about the equipment required to provide access (in order to estimate investment costs), costs of finance for an efficient firm (which depends on the risk that installed capacity is not fully used), as well as technological developments (which will affect the rate of depreciation).

- Since the method involves considerable discretion on behalf of the regulator, the process may be subject to influence and pressure from involved parties, including the incumbent and its competitors.

- If the incumbent is unable to achieve the assumed efficiency, he will not be able to cover his costs, including the costs of maintaining and expanding capacity. As a consequence, the willingness of the firm to undertake investments may be undermined, especially if projects are risky.

- As with other cost-based methods, this method also does not take into account either the loss of incumbent's profits of providing access or the impact of prices upon demand.

Price minus

While the above methods build the price structure from the cost side, other methods take as their starting point actual prices. As explained above, it follows from the Baumol-Willig Rule (or ECPR) that optimal access prices may be expressed as the difference between the incumbent's price for final services and the direct cost of supplying such services to final consumers. This has lead to the so-called "price-minus" method of calculation.

The advantages of this method include:

- Since the method protects the incumbent's profits, it ensures cost coverage.

- If final-service prices are set optimally, so as to reflect demand conditions, these conditions will impact on access prices as well.

The disadvantages of the method include:

- The method requires constant supervision of the incumbent's prices, costs and profit margins, so as to allow for revisions when changes occur.

- If providing access to other firms does not significantly affect the incumbent's market shares in markets for final services, then the method leads to overcompensation and too high prices.

- The incumbent has incentives to manipulate the basis for calculations, by shifting costs from final consumer products to access provision,

thereby increasing the perceived profit margin for final services and hence access prices.

- If prices for final services are incorrectly set, then the error will spill over to the access price. This means, for example, that if competition in the final service market is imperfect, and consumer prices are consequently too high, then the access price will be set correspondingly high and there will be little pressure on consumer prices. In the opposite case, when consumer prices are too low (say, due to regulation), the access price will not improve the situation.

Discussion

Cost-based methods lead to prices that in principle cover the incumbent's costs. If calculations are based on average costs – rather than marginal costs – then the incumbent's fixed costs are covered also. Calculations based on actual costs guarantee, by definition, cost coverage, whereas calculations based on efficient costs involve cost coverage only if the incumbent is as efficient as assumed. Cost-based methods do not, however, take into account the lost profit of providing access, and may therefore lead to sub-optimal prices (cf. the Baumol-Willig Rule).

The Price-Minus Method leads in principle to full cost coverage and also compensates the incumbent for any lost profits of providing access. Basing calculations on the incumbent's prices in the market for consumer services, implies that the method also (implicitly) takes into account demand effects. As explained above, however, it may be that profit margins overestimate the incumbent's actual loss from providing access; if so, the method leads to inefficiently high access prices.

The choice of calculation method consequently depends on what is conceived to be more problematic: too high or too low prices. Low prices give new competitors a competitive advantage. This stimulates competition and leads to a pressure on consumer prices. Strict regulation will, on the other hand, give the incumbent incentives to limit access by other means. It may also induce less efficient competitors to gain market share at the expense of the incumbent. Low access prices also do not stimulate investment in infrastructure; the incumbent will refrain from undertaking new investment – especially if it is risky – while other firms will be encouraged to utilise those investments that have already been undertaken by the incumbent, rather than invest themselves.

Calculations based on accountancy data – either cost-based methods or price-minus – provide firms with incentives to manipulate the cost basis. This may be done by registering costs in other categories than where they in fact belong (accounting cross-subsidisation), or by moving resources from one activity to another (managerial cross-subsidisation). Such incentives are not present if calculations are removed from the firm's actual costs and based instead on the operations of other firms (bench-marking) or modelled (hypothetical) operations.

Implementation

Having calculated the basis for setting optimal prices, the question remains how these prices should be implemented. There are at least three main models, which caps rate of return, price and income, respectively.

Rate-of-Return regulation

The traditional regulatory mechanism takes at its starting point the rate of return on the regulated firm's investment. Often the actual setting of price is left to the firm itself, while the regulator controls that the rate of return on capital does not exceed a specified limit. Alternatively, rate-of-return regulation is combined with a condition that the structure of prices should be related to the underlying cost structure.

The main advantages of this mechanism are:

- Since the regulated firm is ensured cost recovery and a normal level of profits rate-of return regulation protects investments and hence reduces costs of finance.

- For the same reason, the mechanism provides good incentives for maintaining and developing the quality of the regulated firm's products.

- The mechanism ensures that regulated firms do not obtain excessive profits, which is particularly desirable when such profit levels are deemed politically unacceptable.

- The mechanism leaves little to the discretion of the regulatory authorities, which may make them less exposed to pressure from the regulated firms themselves or from other interested parties.

If the actual setting of prices is delegated to the regulated firms, the work load for the regulatory authorities becomes correspondingly lighter. It will be necessary to determine the capital base (which may be difficult enough), but it is not necessary to calculate prices as such. Delegation of price setting also means that prices may be disentangled from the underlying cost structure so that demand conditions may be taken proper account of.

The main disadvantages of rate-of-return regulation are:

- Rate-of-return regulation provides only weak incentives for cost efficiency, since cost increases may be passed on to prices.

- Unless the cap on rate of return is set appropriately, the mechanism may distort investment incentives. If the cap is set too low underinvestment results, while if the cap is too high the result is overinvestment.

To the extent that the price structure is linked to the cost structure the regulatory task becomes correspondingly complicated. If so, prices also will not reflect demand conditions.

Price cap

Instead of regulating the rate of return, prices may be regulated more directly. This may be done by setting a cap for each individual price. It is more common, however, to set a cap on an index of prices, so as to cover a range of different products with a single cap. A particular variant is the so-called "global price cap", which covers access prices as well as prices on final-consumer services. The price cap is normally fixed for an extended period of time. The price cap may allow regulated firms to pass on costs that are out of their control (such as general inflation). Price-cap regulation is typically combined with efficiency requirements, whereby prices are assumed to fall at a certain rate over time.

Advantages of price-cap regulation are:

- The mechanism provides strong incentives for cost reductions, since the regulated firms keep the entire gain from reduced costs (as long as the cap is fixed).

- A price cap provides firms with flexibility to adjust prices to prevailing demand conditions. If the price cap is related to an average of prices (an

index) then the firm is free to adjust prices on individual products. This is particularly useful if the industry is undergoing rapid changes.

- The complexity of the regulatory task is limited. So long as only averages are regulated the task consists of determining the right price level, as well as the development of this level over time. The regulator does not need to know the underlying cost structure in any great detail, nor does he need to allocate common costs on different products.

Disadvantages of price-cap regulation are:

- The regulated firm is exposed to the entire risk of unforeseen changes in costs and demand conditions.

- The resulting profits of the regulated firm may be very high, something that may be politically unacceptable.

- The incentive to reduce costs may lead to poor quality of products. This is a particular concern in industries in which quality is difficult to observe or where customers do not have access to alternative suppliers.

- The regulated firm may also have incentives to set some prices at very low levels (eg. below marginal cost) and ration supply, in order to be able to set high prices on other products. This may for example be done by setting access prices at low levels but limiting access by other means, so as to achieve correspondingly high prices on consumer services.

- The regulatory authorities need to exercise considerable discretion in setting the price cap, which may make them vulnerable to pressure from interested parties.

Revenue cap
In this case, revenues of the regulated firm are capped. A single cap may be set for total revenues, or, alternatively, different caps may be set for different groups of activities.

Revenue-cap regulation has many of the same characteristics as price-cap regulation. The mechanism provides strong incentives for cost efficiency, with the danger of undermining quality. It also provides opportunities for adjusting the price structure, with the potential result of inefficient prices.

The main advantage of revenue caps, as opposed to price caps, is that it is not necessary to construct a price index, with the associated difficulties of determining weights of individual product prices.

Revenue caps do, however, suffer from the major disadvantage that they do not really restrict prices. Relative to cost-reflecting prices, the regulated firm, by increasing prices, reduces demand and costs, but increases profits. When the revenue cap binds, the firm may in fact set prices that exceed monopoly levels.

Discussion
The different implementation mechanisms may be distinguished by the incentives to which they give rise. Under rate-of-return regulation (if the cap is set at a sufficiently high level) the regulated firm has strong incentives to invest and maintain and develop product quality;

however, rate-of-return regulation provides poor incentives for cost efficiency. Price-cap regulation has the opposite effects: incentives for investment and quality improvements are poor, while incentives for cost efficiency are correspondingly strong. Revenue-cap regulation has similar effects to price-cap regulation, but in addition provides firms with incentives to restrict supply.

Nevertheless, the differences should not be exaggerated. Even though price caps are not directly related to costs over the period in which they remain fixed, costs will play a role when revisions take place. In practice, therefore, price caps (as well as revenue caps) also have elements of cost-plus regulation. Furthermore, the cap will normally be combined with other regulations. Rate-of-return regulation is typically combined with cost control, to ensure that only those cost increases that are deemed reasonable are allowed to be passed through. Price caps (and revenue caps) are combined with quality requirements and the possibility of passing through costs increases that are out of the regulated firm's control.

The choice of implementation mechanism is therefore to some extent a matter of taste. If the cost structure is relatively easily observed, and it is important to provide incentive for investment and product development, then rate-of-return regulation is preferable. If the major concern is to provide stimulus for increased efficiency, while quality may be regulated directly, then a price cap is more natural. In other cases, it may be necessary to combine elements from various mechanisms, so as to control costs, prices, quality and rate of return.

Conclusion

Efficient price regulation requires methods for determining optimal price levels, for establishing a basis for calculating prices, as well as for implementing regulations in ways that provide firms with incentives to undertake their activities efficiently.

All methods have strengths and weaknesses. The choice of methods will therefore depend on the aims of the regulatory authorities. The following criteria may be relevant:

- stimulate competition;
- ensure that regulated firms have incentives for cost efficiency;
- maintain incentives to improve product quality;
- provide incentives to offer access and share infrastructure, as well as to maintain and upgrade this infrastructure;
- design prices that ensure cost recovery; and
- limit administrative costs of regulation (for the regulator as well as for the regulated firms) and minimise the risk of erroneous or inadequate regulation.

Methods that – directly or indirectly – lead to low prices for access to the incumbent's infrastructure favour the competitive position of other operators. As a consequence, competition is stimulated and prices for final services are put under pressure. On the other hand, strict access-price regulation gives the incumbent incentives to restrict access by other means, through forms of exclusionary practices. Low access prices may also allow less efficient competitors to gain market shares at the cost of the incumbent. Low access prices also do not stimulate investment in infrastructure, either by the incumbent or by other firms.

Methods that disentangle prices from underlying costs provide the incumbent with incentives for cost efficiency. Such regulation also reduces incentives for shifting costs between activities and to engage in cross subsidisation. They furthermore allow the regulated firm to adjust prices according to demand conditions. On the other hand, prices that are not directly related to costs

expose the regulated firm to risk. Such risk may undermine incentives for investment and for maintaining and improving product quality.

Methods that are based on simple, verifiable rules, and which delegate decisions to the regulated firms themselves, involve relatively light regulatory burdens and low regulator costs for the regulated firms. By restricting the regulator's ability to exercise discretion, one also limits the danger of regulatory capture. On the other hand, such a regulatory regime may leave the regulated firms too much leeway to adjust their activities in ways that undermine competition. It may also lead to high risks of regulatory errors and inadequacies.

The choice of method – for determining optimal prices, calculating such prices and implementing them – consequently depends critically on the importance given to different criteria.

Appendix 2: Two way access[92]

Introduction

Two-way access issues in telecommunication relate to situations where several phone-service providers require access to each others' networks, in order to build viable business models. More precisely, we deal with issues that arise when customers of any given network require the facility of *terminating* calls to customers of other networks. A core example is that all mobile-phone providers must be able to provide termination of calls in rival mobile networks as well as in the networks of fixed-phone providers. Thus, the discussion below mainly relates to termination charges and market power in termination.

The companion paper (see von der Fehr (2004)) discusses *one-way access*, where the structure is more asymmetric, in the sense that some (potential or actual) entrant requires access to the network of an incumbent, while the incumbent (depending on the details) would simply prefer no entry. The philosophy of the approach to one-way access and the main results draw heavily on the economics literature on *monopoly regulation*. Hence, the natural point of departure is the "ideal" of marginal cost pricing and its various "adaptations" such as the ECPR, LRIC-pricing and Ramsey-pricing. Then, practical issues related to price *calculation*[93] and *implementation*[94] are touched upon. While much of this is clearly still relevant for understanding *two-way access*, the emphasis in the following will be changed slightly from that of *monopoly regulation* to one of *competitive* or *oligopoly interaction and regulation* thereof.

Before continuing, we note that the formal (economics) literature on issues in two-way access is less consolidated than the literature on one-way access-price regulation. Thus, it presents less of a unified approach, and models are (in the best *Industrial Organization* tradition[95] used to illustrate various problems in a more partial manner. That is, a series of (potential) competition problems is outlined, models to study these problems are presented, and (hopefully) sensible approaches to solve the problems are suggested based on the model-results. The following short presentation will be relatively informal. For the underlying theoretical perspectives and models, we rely heavily on the syntheses provided by Armstrong (2002) and Laffont & Tirole (2000, ch. 5)[96]. Practical policy concerns are dealt with in detail by e.g. Canoy, de Bijl & Kemp (2003) and OECD (2004).

The outline is as follows. Section 2 will present some preliminaries on the kinds of structures that we want to understand and a first indication of some key problems. This is meant to motivate the emphasis in the following. Section 3 then presents the first pass through two-way

[92] This appendix is drafted by Per Baltzer Overgaard, Professor, Ph.D. , University of Aarhus
[93] That is, calculation of access prices based on actual costs, modelled costs and "price minus".
[94] Rate-of-return, price cap and revenue cap regulation.
[95] See Tirole (1988).
[96] 4Laffont & Tirole (2000, ch. 5), in turn, rely heavily on Laffont, Rey & Tirole (1998a,b).

access in the form of a discussion of *competing bottlenecks*, where (perfectly) competitive phone-service providers require access to the incumbent's infrastructure, while retaining some market power over termination to their own subscribers. The main driver of results in this section will relate to the potential problems stemming from *market power in call termination*, which have been identified in the theoretical literature as well as by regulators and antitrust practitioners. Section 4 then moves to a discussion of *network interconnection* and *two-way access pricing*, where the setting of termination charges and the subsequent (imperfect) competition for subscribers are interlaced. A selection of problems and regulatory issues will be presented. Finally, Section 5 briefly concludes.

Preliminaries

As mentioned at the beginning, we are concerned with situations where two or more service providers, each with their own network infrastructures, need to be able to link up so that customers can call[97] anyone else, irrespective of whether they subscribe to the same network or a different (rival or non-rival) network. Thus, all firms or networks must buy vital inputs - access - from each other. So, networks must *interconnect*, and we are concerned with cases where reciprocal access or two-way access is required. This access is something that has to be *granted* and *priced*, and since access must be reciprocated, there are at least two prices that must be determined. From the perspective of this presentation, the question is whether any or all of these access prices should and could be regulated, or whether the pricing should simply be left to the various networks to deal with either non-cooperatively or cooperatively through negotiation. As noted, several different problems may arise as a result of the specifics of a given situation. To prevent the analysis from getting out of hand, there is a need to deal with these various problems sequentially.

Most of the recent literature as consolidated in various ways by Laffont & Tirole (2000, ch. 5) and Armstrong (2002) has approached the two-way access problems by starting out from simple models that make a few central points and then gradually introduced new aspects.

Throughout, several networks will be "competing" to some extent for subscribers. If the services offered are highly substitutable, this competition for subscribers is likely to be intensive, while if the services are complementary, then the relationship between networks may be considered as an exercise in coordination rather than competition. However, even if competition for subscribers is intensive, a distinction can still be made between two different settings (following Armstrong (2002)).

The basic structures

As in the case of one-way access considered by von der Fehr (2004), several complementary inputs have to be combined to make up a service. When some of the services are less than perfectly competitively supplied, problems potentially arise. In the one-way access-setting, this is most readily exemplified by an entrant in downstream service provision needing access to the infrastructure of an upstream monopolist, where the upstream monopoly is either "natural" (scale economies and network externalities) or simply historical. In the present setting, a complete service typically consists of *call origination*, *call transportation* and *call termination*. Either of these could in principle be provided non-competitively. That a particular input is non-competitively supplied could, again be for either "natural" or historic reasons, but we add here that it could also be for the simple reason that once a customer has subscribed to a particular network, say mobile-phone network, the firm operating the network has at least some monopoly power over call termination to this customer, despite intensive inter-brand competition for subscribers. Much of the emphasis in the following will be on competition

[97] More generally; communicate with.

problems and regulatory issues related to market power in call termination. To illustrate the issues we briefly describe *two basic structures* that will serve as useful points of reference in the following.

The *first* type of structure essentially includes a monopolist controlling the fixed-telephony (backbone) infrastructure and facing several, competing providers of various services (mobile telephony, Internet access, etc.). The competitive service providers must have access to the fixed infrastructure to terminate calls, and the monopolist must have access to each service provider to terminate calls.[98] Note that this type of structure is well-suited to discuss issues related to fixed-mobile interconnection, and as such it also represents the first natural step from the underlying structure used to discuss one-way access in von der Fehr (2004). In particular, this will be useful in assessing whether mobile termination charges should be regulated, in a setting where fixed termination charges are already regulated.

The *second* type of structure is initially more symmetric. Each of several, similar networks must interface with each other, otherwise they will not be viable (by assumption). Examples include international interconnection to enable long-distance telephony and interconnection between competing mobile-phone or fixed-phone providers. Hence, reciprocal access terms are important. Different cases can be considered, in which termination charges are either *set unilaterally* by networks, are *negotiated* between networks or are *regulated*. In addition, the effect of the intensity and mode of competition in the final service market on unilateral or negotiated termination terms is assessed. The central issue is whether or not the setting of termination charges might dampen service-market competition or facilitate collusion.

The two basic structures will be illustrated by a sequence of simple models, which we subsequently elaborate on. The simple models can be referred to as models of *non-rival* and *rival* networks, respectively. In the first section below we focus on two-way access between non-rival networks, which is meant to capture a simple setting where e.g. the (monopoly) fixed-phone network does not compete with a given mobile-phone network for subscribers, while mobile-phone networks do compete (intensively) with each other. In contrast, the second section below focuses on two-way access between rival networks, which is meant to capture e.g. that several fixed-phone or mobile-phone networks must arrange reciprocal access, while at the same time they compete for the same pool of potential subscribers. This sequence of relatively simple settings allows a focus on different issues in turn, and it prevents the analysis from getting out of hand.

Non-Rival Networks, Bottlenecks and Competition for Subscribers

As noted, this section is motivated mainly by markets for mobile telephony. On the assumption that mobile-phone services are largely competitive, potential competition problems arise not so much from lack of inter-brand competition as such, but more from the fact that residual pockets of market power remain, to the extent that particular providers (networks) have *monopolies on termination* in their nets.

The topic is best illustrated by the relationship between a monopoly provider of fixed-phone services and several providers of mobile-phone services. Mobile-service provision may well be highly competitive, in the sense that the tariff competition between mobile-service providers for subscribers is intensive, yet each mobile network has a monopoly on termination in its net. Therefore, pricing of access (*termination*) is less competitive. The details of the analysis will then depend on various assumptions made about consumer utilities including the valuation of

[98] Whether the competitive providers must also have access to each other depends on the details. We start out by suppressing this, and then re-introduce it subsequently as we move to the second structure.

in-bound calls, on the presence of network externalities, on the substitutability of fixed and mobile services, etc.

Benchmark

In the benchmark model of Armstrong (2002) the key assumptions include that the (downstream) mobile sector is very competitive, in the sense that the tariff competition for subscribers ultimately drives mobile profits to zero. This captures the idealized situation where mobile services offered by different networks are *perfect substitutes*, and there is free entry and no capacity constraints. However, fixed and mobile calls are initially assumed to be non-substitutable, and the upstream monopolist does not provide mobile services.[99] Hence, fixed and mobile networks are *non-rival*, in the sense explained above. In the benchmark case, it is further assumed that only the calling party pays, all mobile calls are terminated on the fixed net, call receivers obtain no utility from incoming calls and receivers are indifferent as to the welfare of callers.

In short, this is a model in which there is intensive competition for mobile subscribers, yet each network has a monopoly on providing access to its subscribers (that is, call termination). Armstrong (2002) refers to this as *competitive bottlenecks* to capture that service providers are in close competition for subscribers, yet (despite the competition for subscribers) they each control the vital facility (bottleneck) of providing access to their subscribers. That mobile and fixed calls are non-substitutable and that the upstream firm is not present in the downstream market imply that the upstream firm and a downstream firm are not competitors. When they are competitors, for either of the two reasons, we move towards the model of the next section, where we discuss rival network interconnection and competition. Despite its partial lack of realism, this model is very useful for analysing one set of issues related to fixed-mobile interconnection, while other issues are best approached by a different formal modelling.[100]

Assume that tariff schemes for mobile subscribers consist of a fixed fee (possibly, a subsidy) and a per-call or per-minute charge, which we can write as

$$s^{mob}(q) = f + pq$$

For simplicity, in the following we shall refer to p as a per-call charge levied on the mobile subscriber and to q as the number of calls made by the subscriber. That the mobile services provided by different networks are *perfectly substitutable* implies that tariff competition between mobile networks for subscribers drives per-call or per-minute prices to variable cost (which include the termination charges set by the upstream monopolist, see below). Had there been product differentiation and/or imperfect competition at the downstream level, this would generally have allowed positive downstream profits. However, this is not central to the qualitative points we want to make. However, it might matter for the level at which regulated termination charges should be pegged. In addition, mobile-service providers generate revenues from terminating calls originating in the fixed net. Competition between the mobile networks for subscribers, however, drives net profits to zero. Therefore termination surpluses

[99] We realize that in this section where reciprocal (two-way) access is required, it may be a little misleading to refer to the mobile sector as downstream and the fixed sector as upstream. Since both sectors buy vital inputs from each other, inputs are not simply and unambiguously moved in one direction while being processed into outputs. However, since the companion paper by von der Fehr (2004) on one-way access deals with one vital input passing from the fixed sector to the service sector, we shall occasionally continue to refer to the fixed sector as upstream and the mobile sector as downstream.

[100] When applied to fixed-mobile interconnection, it is typically unrealistic to assume that the fixed-service provider is not also a competitor for mobile subscribers. Recall, through, that fixed-mobile interconnection is but one application. There might be other areas of service provision, where the fixed service provider is not a competitor either by choice or by regulatory exclusion. Also, by its simplicity the model is highly relevant for capturing the key elements of situations where the fixed-service monopolist is regulated in most of its lines of business, whereas competitive (downstream) service providers are not.

(if they arise) are *fully recycled* into the mobile subscriber fee. Hence, if (as a matter of interpretation) we include the cost of the hand-set in the total cost of mobile services, we conclude immediately that access revenues could potentially be used to subsidize hand-sets (as is frequently observed in practice). This is very useful in assessing issues of dynamic efficiency to which we shall briefly return below.

The assumption that *all mobile calls are terminated in the fixed net* is extreme. It is made for the sake of clarity, since it ensures that the charge from terminating calls in the mobile network does not affect the cost of making mobile calls. So, this assumption fits most accurately a situation where charges for terminating calls in the fixed net are regulated (as is often the case), and where a very large proportion of calls from a given mobile network is terminated in the fixed net.

Mobile-service providers incur a fixed cost per subscriber, F , in addition to a cost of originating a call, c_{orig}, which includes the charge for terminating a mobile call in the fixed net (which may be either regulated or freely set by the upstream monopolist), and a cost of terminating the call from the fixed net, c_{term}. Hence, if a given mobile subscriber makes q calls and receives x calls, then the *total costs* incurred by the network because of this subscriber are

$$C^{mob}(q,x) = F + c_{orig}q + c_{term}x$$

The mobile network sets a charge, t, for terminating a call to its subscribers originating in the fixed net. This is paid by the fixed network. Hence, the *call-termination revenue* associated with a mobile subscriber who receives x calls is

$$T^{mob}(x) = tx$$

and the ultimate *profitability* of this subscriber is

$$\begin{aligned}\pi^{mob}(q,x) &= S^{mob}(q) + T^{mob}(x) - C^{mob}(q,x)\\ &= f + pq + tx - F - c_{orig}q - c_{term}x\\ &= f - F + (p - c_{orig})q + (t - c_{term})x\end{aligned}$$

Now, neither q nor x are constants. The number of out-bound calls from a mobile subscriber depends on the price of out-bound calls, and we write $q = q(p)$. Similarly, the number of in-bound calls to a mobile subscriber depends on the price charged to fixed subscribers for making such calls. We shall refer to the latter as $P(t)$, since the price charged to fixed subscribers for making calls to the mobile network will generally depend on the termination charge, t. Hence, we can rewrite the (per-subscriber) profits of the mobile service provider as

$$\Pi^{mob}(f,p,t) = f - F + (p - c_{orig})q(p) + (t - c_{term})x(P(t))$$

to capture how per-subscriber profits depend on the choice variables of the mobile network: the fixed subscriber fee, f , the price charged to subscribers per out-bound call, p, and the termination charged levied on the fixed network per in-bound call, t.

This formulation of profits also shows immediately that to maximise profits the mobile network will maximise termination revenues, irrespective of the intensity of inter-brand rivalry between mobile networks. Thus, profits are *separable*, in the sense that revenues from termination are independent of the retail-tariff scheme. And, inter-brand competition relates only to the retail-tariff schemes.

Of course, this separability is not general. For example, if c_{orig} is related to the termination charge t through some kind of reciprocity,[101] then there is a link between termination revenues and subscription revenues, and profit maximization will not be consistent with maximization of termination revenues.

However, the point we want to make in this section is that the *monopoly on termination* will generally induce even highly competitive mobile service providers to levy termination charges that differ from the marginal cost of termination. Essentially, there are *many separate relevant markets for termination* in which even small and intensely competitive mobile-service providers have dominant positions (in fact, monopolies). Laffont and Tirole (2000, ch. 5) make this point forcefully by suggesting that small (*mobile-phone*) providers may behave more monopolistically than providers with larger market shares when (*fixed-to-mobile*) retail pricing cannot discriminate according to the identity of the terminating network.[102] The point is simple when made in a setting where there is no competition for subscribers (but it carries wider implications). Suppose that on the access side the fixed network cannot discriminate between the mobile networks and must set uniform access prices depending on some averaging of the termination charges levied by the mobile-service providers. On the retail side, suppose that (due to regulation) the fixed-service provider cannot discriminate according to the identity of the terminating network.[103] Then, if a small mobile-service provider increases its termination charge, it will have a very modest effect on the fixed-sector termination charge and a very small effect on the number of incoming calls. So, a small mobile network essentially has an incentive to maximise termination revenues. A larger mobile service provider is more concerned that raising the termination fee affects the number of incoming calls.

Return to the base case where the profits defined above are driven to zero through tariff competition, that is,

$$f - F + (p - c_{orig})q(p) + (t - c_{term})x(P(t)) = 0$$

Further, we have marginal-cost pricing of out-bound calls, $p = c_{orig}$,[104] and it follows that the fixed charge levied per mobile subscriber is given by

$$f = F - (t - c_{term})x(P(t))$$

which is just the per-subscriber fixed cost minus the per-subscriber termination surplus. Thus, if $t > c_{term}$, we conclude that mobile subscribers are subsidized by the termination surplus. If $t <$

[101] Recall that c_{orig} includes the cost of terminating a mobile call in the fixed net. Therefore, the termination charge levied by the mobile network could well affect the charge levied by the fixed network. For now, let us simply assume that regulation of the upstream monopoly prevents this. In the next section, we return to this issue.

[102] E.g., for reason of regulation of the fixed-service monopolist.

[103] Alternatively, Gans & King (2000) suggest that the demand for fixed-to-mobile calls is some function of average prices across mobile networks, since fixed subscribers may not know which mobile network they are calling. Then the charge of a small mobile network has little effect on the average price and on the demand forthcoming.

[104] This is essentially by standard, Bertrand arguments. If there is a per-call mark-up, some firm would lower the per-call rate slightly, attract all customers and make a positive profit. If there is a mark-down, some firm would increase the per-call rate and decrease the fixed fee by enough to attract customers, yet have enough cost-saving per customer to make it worthwhile.

c_{term}, then in-bound calls are subsidized by the mobile subscribers. However, to *maximise profits* a mobile-service provider will maximise termination revenue per subscriber

$$T^{mob} = (t - c_{term})x(P(t))$$

from which follows that $t > c_{term}$, and we conclude that termination surpluses will always subsidize subscriber fixed payments under the stated assumptions. Let

$$t_{monop} = \arg\max\{(t - c_{term})x(P(t))\} > c_{term}$$

denote the termination charge that maximises termination surplus.[105]

We can now partially formalize the point made above on small and large mobile networks as follows. With several mobile-service providers and no discrimination based on terminating network, we could write the number of in-bound calls to a particular network, say, network i, as a function of a vector of mobile termination charges

$$x_i(P(t_1, t_2, ..., t_n))$$

This service provider maximises

$$T_i^{mob} = (t_i - c_{term})x_i(P(t_1, t_2, ..., t_n))$$

If n is large and all networks are small (symmetry), then changes in t_i will have a modest impact on $x_i(P(t_1, t_2, ..., t_n))$ since the derivative $\frac{\partial x_i(P(t_1, t_2, ..., t_n))}{\partial t_i}$ is small. Firm i effectively faces an *inelastic* demand, and it follows that there will be an incentive to set t_i at a relatively high level. Suppose instead that n is small, in which case the impact of changes in t_i on $x_i(P(t_1, t_2, ..., t_n))$ is substantial. We conclude that demand is effectively *more elastic*, and the mobile service provider will be more moderate in its pricing of termination of fixed-to-mobile calls.

The upshot of the preceding comments is that with imperfect competition in mobile call termination, the unregulated termination charges will be set above the cost of termination, $t > c_{term}$. This deviation from marginal cost pricing suggests that there might be a role for regulation to play.

With this in mind, let us turn to the socially optimal mobile termination charge. This, however, will generally depend on the charge levied on out-bound calls from the fixed net. So suppose for simplicity that $P(t) = C + t$, where C is the marginal cost of the fixed network of originating a call and transporting it to the point of interconnection with the mobile sector. For the sake of clarity, we shall just assume that this determination of $P(t)$ comes from the regulation of the fixed-service monopolist.[106]

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[105] Armstrong (2002) makes the further point that if a mobile subscriber values in-bound calls at some number u_{rec} per call, then it is equivalent to lowering the unit cost of termination from c_{term} to $c_{term} - u_{rec}$. Hence, if (perfect) competition for mobile subscribers is interpreted as maximization of mobile subscriber utility subject to the break-even constraint of the mobile networks, then the outcome (equilibrium) would embody that mobile termination charges solve $max\{(t - (c_{term} - u_{rec}))x(P(t))\}$, which would imply that $t < t_{monop}$. Hence, appreciation of in-bound calls puts a downward pressure on mobile termination charges. We return to this below.

[106] Armstrong (2002) alternatively assumes that fixed-service provision is perfectly competitive. Either way, the point of departure is that fixed subscribers are charged a price for calls to the mobile networks which coincides with the

If the profits are eliminated in both fixed and mobile service provision, welfare per mobile subscriber can be written as[107]

$$W = V^{fix}(C+t) + V^{mob}(c_{orig}) - (F - (t - c_{term})x(C+t))$$

In this expression $V^{fix}(C+t)$ captures the consumers' surplus of the fixed subscribers calling this mobile subscriber when $P(t) = C + t, V^{mob}(c_{orig})$ is the consumer's surplus of the mobile subscriber when the out-bound call charge is $p = c_{orig}$, while the last term is just the subscription fee of the mobile subscriber, $f = F - (t - c_{term})x(C+t)$. Maximizing with respect to the mobile termination charge and noting that $\frac{dV^{fix}(P)}{dP} = -x(P)$, we immediately obtain the optimal termination charge as

$$t_{opt} = c_{term}$$

From this follows that $f_{opt} = F$. Hence, the optimum entails marginal-cost pricing of mobile termination and no subsidization of mobile subscription fees through termination charge surpluses. Since the unregulated price is

$$t_{monop} > c_{term} = t_{opt}$$

with an associated subsidy to mobile subscribers embedded in

$$f_{monop} < F = f_{opt}$$

we conclude that there is a role for regulation to play in setting the proper mobile termination charges. In the particular model under scrutiny, implementation of the optimum is very simple. Regulators should simply set $t = c_{term}$. Then the tariff competition for mobile subscribers will drive mobile profits to zero, that is, $p = c_{orig}$ and $f = F$, and the optimum is implemented. Recall that c_{orig} includes the charge levied on terminating mobile calls in the fixed network. Thus, under constant returns (as we have assumed), and if c_{orig} coincides with the total unit cost of origination, transportation and termination, then the optimum is *first best*.

In contrast, if the break-even constraint of the fixed-service provider is violated (due to joint and common costs of the fixed-phone infrastructure), things are more complicated, which brings us back to the principles of optimal (fixed-net) access charges considered in von der Fehr (2004). At this point we shall not have more to say about this, and instead we turn to a brief discussion of some of the key assumptions made above.

actual marginal costs of the call (which includes the mobile termination charge). We shall subsequently comment on the case where $P(t) > C + t$.

[107] Strictly speaking, this requires some additional assumptions, including that the demand for mobile subscriptions is inelastic over the relevant range of tariffs (e.g. mobile market is covered or fully penetrated) and that mobile termination charges do not affect the profitability of fixed service provision in any other line of business (either because the fixed service provider has no other lines of business or because they are unrelated to (no substitutability or complementarity) fixed and mobile telephony or because these other lines of business are suitably regulated).

Assumptions and extensions

Unregulated fixed-service provider

Suppose first that the fixed network is unregulated, which would most likely imply that $P(t) > C + t$. Hence, the price of fixed-to-mobile calls is the result of a markup on costs. To counteract this mark-up by the fixed network, it is optimal from the perspective of the social interest to subsidize call termination in the mobile net. To see this, note that $P = C + c_{term}$ is still optimal, and to attain this when $P(t) > C + t$, it is clearly necessary to set $t < c_{term}$. Hence,

$$t_{opt} < c_{term}$$

and, under the stated conditions, it is optimal to let the mobile subscribers "subsidize" mobile call termination to counteract the fixed-phone mark-up.

To see what is going on here, let us simply refer to the well-known double marginalization problem in a chain of monopolies.[108] Two monopolies are stacked on top of each other. One supplies a vital input to the other, in the sense that outputs are produced from a fixed proportions technology where both parties supply one unit of complementary inputs.[109] Then the first monopoly will charge a mark-up on its unit cost to equate marginal revenues and marginal costs. This mark-up factors into the costs of the second monopolist who will add another margin to equate its marginal costs and marginal revenue. The ultimate result is that the final price at the end of a chain of monopolies is higher than the price that would ideally be charged by a fully vertically integrated monopolist. In the most simple cases it would be simple to solve this problem by regulation. Regulators could simply require that all prices in the distribution channel coincide with unit costs. However, on the assumption that one of the parties cannot be regulated, partial regulation might still serve a useful purpose. In the particular case, on the assumption that it is impossible to regulate the fixed sector any further, it might be optimal to try to regulate the mobile sector in order to remedy problems arising from the fixed sector. Here, putting a below-cost cap on termination charges in the mobile net restores overall marginal cost pricing.

Network externalities

Suppose next that the number of mobile subscribers is not fixed, and that there are unexploited consumption-scale economies or network externalities. A simple example is one in which the utility of fixed subscribers is increasing in the total number of mobile subscribers. Then the optimal mobile termination charge is of the form

$$t_{opt} = c_{term} + s(n) > c_{term}$$

where *n* is the number of mobile subscribers, and the function *s(n) > 0* is the *sur*charge optimized to attract mobile subscribers. The bottom line is that compared to the case where $t = c_{term}$, it would be socially optimal to attract more mobile subscribers. Given the intensity of competition between mobile-service providers, subscribers can only be further attracted by "subsidies" to the fixed fee (e.g. hand-sets). The available instrument is to allow the competitive mobile-service providers to run a termination surplus, that is $t > c_{term}$. The higher mobile termination charge increases utility of mobile subscription, which in turn induces more to

[108] See, e.g., Tirole (1988, ch. 4). Laffont & Tirole (2000) alternatively refer to this as the *pancaking* problem.

[109] 17Fixed proportions is not critical to making the point, but is makes the presentation much simpler. Without fixed proportions other inefficiencies potentially arise when regulators start twisting relative prices. This latter point is also touched by von der Fehr (2004) in the discussion of one-way access and bottleneck bypass.

subscribe, and this is valuable for fixed subscribers. Therefore some measure of "subsidisation" of mobile subscription is socially optimal.

It would be interesting to speculate (and formally analyse) what might be the likely properties of the *s(n)* function. For example, it might be suggested that *s(n)* is positive but decreasing to zero as mobile penetration increases from 0 to 100 percent. In other words, based on this type of argument and underlying model,[110] it might be sensible to let the competitive mobile-phone providers enjoy their termination monopolies in the early phases of the industry, only to gradually tighten regulation of mobile termination charges as mobile penetration is completed. However, Armstrong (2002) notes that while consumption-scale-effects on the part of fixed subscribers (or all subscribers) may well imply that optimal termination charges are raised above the unit cost of termination, this does not generally imply that unregulated mobile-service providers would pick termination charges anywhere near the optimal ones. Hence, this type of network externality does not generally render regulation obsolete.

Call externalities and internalization of caller welfare

Somewhat similar remarks regarding the need for regulation apply when mobile subscribers value incoming calls (call externalities) or care for the welfare of callers, though for somewhat different reasons.

First, if mobile subscribers value in-bound calls as suggested in footnote 13 above, then we saw that unregulated mobile networks would reduce termination charges from $t_{monop}(c_{term})$ to $t_{monop}(\hat{c}_{term}) = t_{monop}(c_{term} - u_{rec})$ where u_{rec} is the constant value attached to each in-bound call by mobile subscribers. However, the socially optimal termination charge is

$$t_{opt}(\hat{c}_{term}) = c_{term} - u_{rec} < t_{monop}(\hat{c}_{term})$$

So, despite the fact that this type of call externality puts a downward pressure on the unregulated price, the optimal regulated price also falls, and there will still be a gap between the private incentives of mobile-service providers and social values. Thus, this type of call externality does not obviate the need for regulation of mobile termination charges.

Second, if mobile subscribers *fully* internalize the welfare of callers, then unregulated termination charges would coincide with the socially optimal charges. The only case where full internalization of the welfare of callers might be descriptively accurate is if both fixed and mobile subscribers belong to the same legal entity, so that charges levied are paid out of the same budget (e.g., households or firms), or some other type of close-knit organization (clan or club). Except for this limiting case, it makes sense to suggest that there is at most partial internalization of caller welfare on the part of the mobile subscriber, and this generally adjusts unregulated prices in the direction of the social optimum, but it does not close the gap. In this sense, the partial internalization of caller welfare reduces the need for regulation, but, again, it does not obviate the need completely.

Dynamic issues

Even though the modelling framework referred to above is largely static, it is certainly suggestive of a couple of interesting dynamic features of mobile termination charges and their relation to the social optimum.

First, if mobile telephony displays network externalities, in the sense that fixed-subscriber utility is increasing in mobile penetration, then, as already argued above, it is socially optimal to let

[110] Which remains to be worked out.

termination charges rise above costs, in order to "subsidize" mobile subscription. If mobile markets are immature with few subscribers, and if further market penetration is socially valuable, but potential subscribers must *in addition* overcome *switching costs* given whatever technology they currently subscribe to, then *a fortiori* it is socially valuable to allow termination charges to rise above costs to "subsidize" mobile subscriptions. Both of these examples suggest that unregulated termination mark-ups are less of a problem in immature mobile-phone markets than in mature markets. However, since *basic* mobile penetration throughout, e.g., the Nordic countries is arguably close to saturation, these arguments for light-handed regulation of mobile termination charges seem to lose weight at considerable pace.

Second, and relatedly, if it is necessary and socially valuable to subsidize the introduction of *new, advanced* mobile technologies (such as *3G*), then high mobile termination charges may follow more or less directly from *Ramsey*-principles. On this note, casual observation suggests that the zero profit constraints of mobile-service providers are more imminent than that of the fixed-sector incumbent. This should induce regulators to pause to think twice whether the time is yet ripe for time-invariant marginal-cost regulation of access to mobile networks from the fixed net. At the very least one should think carefully about how to regulate over time, that is, in both the mature and immature phases of various mobile-phone technologies. Of course, innovations originating in the fixed sector might also be desirable from the social perspective, and we return to some of the reasons displayed in von der Fehr (2004) for allowing the fixed-network incumbent an access mark-up.

The upshot of these brief comments on the proper dynamics of termination-charge regulation, is that, in the face of network externalities, what is optimal in the short run may differ markedly from what is optimal in the medium-to-long run.[111]

Receiving-party-payments

So far, we have assumed that only the calling party pays (also referred to as *CPP*) in telecommunications. Alternatively, we could allow for the possibility of charging for incoming calls (also referred to as receiving-party-payment or *RPP*). Somewhat generally, it may be argued that *RPP* tends to alleviate the monopoly-on-termination problem by providing "the missing price", since the cost of mobile termination will be *internalized* by mobile subscribers, who have to pay for incoming calls and, therefore, by competitive mobile-service providers. However, this may well be at the expense of other problems, since fixed-to-mobile callers may now pay too little and therefore tend to call to an extent beyond the social optimum. Whether this is balanced by other externalities that work in the opposite direction remains an empirical issue. From the perspective of theory, however, *RPP* is not a general solution.[112]

Summary and conclusions

As is evident from the discussion above, *the Devil is in the detail* when it comes to regulation of the termination charges of competitive mobile-service providers. The main message is that there can be no general presumption that regulation of these termination charges is unnecessary, and that unfettered competition between mobile-service providers will necessarily (or even probably) bring the resulting termination charges closely into line with the social interest.

[111] At this point, we should caution the reader that the formal economics literature on the dynamics of optimal regulation of two-way access in telecommunications is itself very immature, indeed.

[112] A detailed discussion of the *virtues* and *vices* of *RPP* is well beyond the scope of this short note, but see Armstrong (2002) and Laffont & Tirole (2000, ch. 5) for some discussion. In particular, with reference to the US, where the use of *RPP* is widespread in mobile telephony, it has been argued that this has held back mobile penetration significantly, see the comments in Canoy, de Bijl & Kemp (2003).

In the base case we saw that separation of relevant termination "markets" and *de facto* monopolies on call termination will tend to lead to high termination charges, potentially far in excess of the socially optimal charges. It was even suggested that more intensive competition for subscribers would tend to increase mobile termination charges, since small operators view their returns as virtually separable into variable subscriber revenues and termination revenues. Small mobile-service providers perceive of termination charges as having little impact on the demand for fixed-to-mobile call termination. The resulting termination surpluses are then recycled into the competition for subscribers in terms of subsidies to mobile hand-sets and other fixed up-front investments. Both of these are frequently observed in practice.

We can add to this that there may be a certain amount of *ex post* subscriber *lock-in*, which is not captured by the formal modelling above, but probably descriptively accurate. Markets with *switching costs* and *ex post lock-in* tend to generate even fiercer initial competition for subscribers (see e.g. Farrell & Klemperer (2001) for an extensive survey). This might push mobile-service providers further into the *red* in the short term, despite sizeable termination surpluses. This seems to be broadly consistent with recent empirical observations of the mobile-phone industry.

It was argued that mobile termination charges are tempered somewhat by call externalities on the part of mobile subscribers and by the partial internalization of the welfare of callers by mobile subscribers.[113] Neither of these, however, generally obviate the need for regulation completely.

Finally, despite the static nature of the models alluded to, a few points on dynamic issues can be made. Tentatively, the models suggest that efficiency problems stemming from monopoly-on-termination in competitive networks may be less severe in immature than in mature markets, to the extent that either positive network externalities associated with mobile-phone services are significant or the (implicit) subsidization of new mobile technologies or other phone services is assessed as socially desirable.[114] This might call for relatively light-handed regulation of the termination charges of competitive service providers in the immature phases of the service markets. In contrast, termination charges in the (by now) relatively mature markets for *basic* mobile services seem to be obvious candidates for intensified regulatory scrutiny.

Rival Network Interconnection and Two-Way Access Pricing

The analysis above was partial and incomplete, in the sense that it fully separated the setting of termination charges from the competition for subscribers. That is, we considered two-way access between non-rival networks. Generally, however, termination charges affect service-market competition, and as a result the various networks would set their termination charges with a view to how they affect their competitive position and that of their rivals in the service market. Hence, networks are *rivals* with respect to subscribers. Notably, it is of interest to study how termination charges that are set non-cooperatively compare to charges that might be agreed to through negotiation between the networks. Also, it is important to study how negotiated termination charges compare to the social interest. In particular, might termination agreements have *competition-dampening* or *collusive* effects on the service market? This is the main focus of the following.

[113] And, possibly, by receiving-party-payments.

[114] It should be remarked, though, that liberal treatment of such indirect subsidies to competitive services will not generally be *first best*. Conceivably, there might be alternative instruments available to regulators (or, government agencies more generally). For example, as far as providing incentives to introduce new technologies, more effective instruments might be available through adjustments to the corporate tax code.

On the *one hand*, we notice immediately that a slight reinterpretation of the previous remarks on the *monopoly-on-termination* problem serves as a useful point of departure. Recall how we argued that even *highly competitive* mobile-service providers may have a *de facto* monopoly on termination in their nets. On the maintained assumption that fixed and mobile services are non-substitutable,[115] a *single* (monopolistic) mobile-service provider would similarly set termination charges above the cost to maximise termination surplus. If, in addition, we assume that the *single* (monopolistic) fixed-service provider was also unregulated and free to set its termination charge, then it would likewise set a termination charge above costs. Essentially, under linear termination-pricing rules and in the absence of competition for subscribers, we have two monopolies selling vital inputs to each other, and the *double-marginalization problem* reappears. The resulting termination charges will be set too high from the perspective of the joint profits of the fixed and mobile industries and from the perspective of both fixed and mobile subscribers. In short, networks would have a strong incentive to join up and strike a deal over termination charges, and such agreements could well be in the interests of society as a whole.[116] Note well the limitations of this. That an agreement might be in the social interest *merely* says that vertical agreements to internalize the vertical externalities ever-present in a string of uncoordinated monopolies *may lower* the retail price at the end of the distribution channel below the uncoordinated monopoly price. It does *not* say that the resulting price is anywhere near the socially optimal (cost-based) price. Vertical coordination or agreements will not undo the basic monopoly problem.

On the *other hand*, models from the *Industrial Organization* literature suggest that wholesale-price agreements may serve to sustain collusion in output markets and, therefore, be against the social interest.[117] The basic argument may be illustrated as follows. Suppose two firms compete in standard Bertrand fashion in the output market, so that equilibrium output prices coincide with unit costs. Thus, final equilibrium prices are fully cost-determined. Now, if the firms could somehow agree to buy *inputs* at *inflated prices* from a commonly owned supplier, then product-market profits would still be zero, while the upstream supplier would run a surplus which is shared between the owners. In addition, if the linear input price is suitably chosen to coincide with the (hypothetical) output-market monopoly price, then total upstream profits to be shared between the two rivals would coincide with the integrated monopoly profit, and we could say that the wholesale-price agreement implements the fully collusive outcome without there being any *sign* of actual collusion in the output market.[118]

The extent to which these perspectives on coordination and agreements are relevant for two-way access between *rival networks* in telecommunications has been explored by Laffont, Rey & Tirole (1998a,b) and Armstrong (1998), and it is discussed by Laffont & Tirole (2000, ch. 5) and Armstrong (2002). A simple bench-mark model of two-way access between *two* rival networks is considered. This could represent *either* two fixed-phone providers *or* two mobile-

[115] That is, there is no competition between providers of mobile and fixed services.

[116] This, essentially, forms the basis of discussions of termination-charge agreements for international calls when national monopolists serve national markets without any interference from competition for its subscribers. Hence, the national networks are non-rival. Each network would non-cooperatively try to maximise termination surplus from in-bound international calls. Pricing of out-bound international calls would then be based on the monopoly-termination charge of the other network. Thus, another mark-up is added to an already high termination charge and origination cost. Hence, the resulting international call rates could be very high indeed. The joint incentive for international call settlements is therefore strong. For further discussion of international call charges and regulation, see Armstrong (2002).

[117] Note that, from a modelling perspective, access or termination charges are similar to wholesale or input prices in the more familiar *Industrial Organization* context.

[118] This, of course, is the basis for antitrust concerns about wholesale-price agreements. The conditions under which the setting up of a jointly owned input supplier from which firms buy exclusively is part of an equilibrium of a properly specified game remain to be explored, but this is beyond the scope of this presentation. Laffont & Tirole (2000, ch. 5) refer to patent pools. Firms sink their vital patents into a jointly owned company from which output-market rivals license patents at inflated prices. If the license prices are suitably chosen, the patent company may appropriate monopoly profits, which are then distributed between the owners.

phone providers competing for the same potential subscribers. Alternatively, it could capture one fixed-phone provider *and* one mobile-phone provider on the assumption that fixed and mobile subscriptions are highly substitutable as seen from potential subscribers.

Assume that differentiated networks are in place,[119] and that they compete for subscribers using linear retail-tariffs.[120] Access (termination) charges are set in reciprocal fashion either by negotiation or by regulation, and calling patterns are assumed to be balanced. *Reciprocal termination charges* simply mean that both networks levy the *same* per-call or per-minute termination charge on calls originating in the rival network. *Balanced calling patterns* imply that the probability that any given call is terminated on a particular network coincides with the market share of that network measured in term of subscribers. Thus, the fraction of calls from a network which will terminate off-net is proportional to the market share of the rival network.

With this basic structure at hand, we shall, roughly, follow the structure of the previous section by first presenting some key results for the benchmark model, then discuss the assumptions and various extensions and finally provide a summary and some conclusions.

Benchmark

In the benchmark model of Laffont & Tirole (2000, box 5.2) two *symmetric* networks are in place. They each have full coverage in the sense that any consumer can be reached by any of the networks at a fixed cost of *F*. Hence, we shall, initially, refer to the networks as mature. Symmetry has two dimensions. On the one hand costs are symmetric. On the other hand firms are located symmetrically with respect to the space of consumers.[121] Because of this symmetry, we will assume that in their negotiations the networks will agree to charge the same (that is, reciprocal) termination charge, *t*, to each other.[122]

Retail-tariff schemes. Initially, we assume for simplicity that networks are restricted to setting *uniform* and *nondiscriminatory retail tariffs*. Thus, subscribers of network i are charged

$$S_i(q) = p_i q$$

where p_i is the per-call or per-minute retail tariff as above, while *q* is total call volume (including both on-net and off-net calls).

Subsequently, we shall consider two "more realistic" retail-tariff schemes. This includes *two-part tariffs*

$$S_i(q) = f_i + p_i q$$

(as in the preceding section of this note) and *network-based price discrimination*

$$S_i(q^h, q^a) = f_i + p_i^h q^h + p_i^a q^a$$

[119] Implicitly, the base case assumes that the market is mature.

[120] We shall have much more to say about various, more general retail-tariff schemes in the discussion of the model and its assumptions. We start out with the most simple, linear schemes to make a couple of basic points on the potential *competition-dampening* or *collusive* effects termination-charge agreements.

[121] E.g. at opposite ends of the Hotelling line with consumers being uniformly distributed on the line. Thus, if network tariffs coincide, each network will have half the consumers as subscribers. Thus, the services offered by the two networks are differentiated in the usual sense of the Hotelling model.

[122] Compared to the case alluded to above where networks set their termination charges non-cooperatively (double-marginalization), we expect the networks to agree to a lower reciprocal termination charge. In a fully symmetric model, though, non-cooperative termination charges would also coincide.

where p_i^h and q^h are, resp., the tariff for and quantity of on-net calls, while p_i^a and q^a are the tariff for and quantity of off-net calls.[123,124]

Costs. The total cost of completing a call arise from origination, c_{orig}, transportation, c_{trans}, and termination, c_{term}. For simplicity it is assumed that the cost of origination and the cost of termination coincide, $c_{orig} = c_{term}$.[125] Thus, under a reciprocal access charge t, we can make a distinction between *on-net* calls and *off-net* calls. We assume that the originating network carries the costs to the point of interconnection. Then, the perceived (and actual) cost of an on-net call is $c_h = c_{orig} + c_{trans} + c_{term} = 2c_{term} + c_{trans}$, while the perceived cost of an off-net call is $c_a = c_{orig} + c_{trans} + t = c_h + t - c_{term}$. Thus, if the (reciprocal) termination charge, t, exceeds the actual cost of call termination, c_{term}, then $c_a > c_h$ and off-net calls have higher cost than on-net calls. This, ultimately, forms the basis for raising one's rival's costs, but it also spells the (potential) demise of collusion as we shall see in the following.

Based on this setup, two important observations can be made immediately.

Observation 1: Given a balanced calling pattern, more calls originating in a given network terminate in the rival network the larger is the market share of the rival.

Since termination charges have to be paid for off-net calls, this implies that if $t > c_{term}$, then the average[126] marginal costs of a given network are *increasing* in the market share of the rival. For this reason, any given network has an incentive to build market share when there is a mark-up on termination. In contrast, if there is a mark-down on termination costs, $t < c_{term}$, then the average marginal costs of a given network are *decreasing* in the market share of the rival. Laffont & Tirole (2000, ch. 5) refer to these features as the *endogenous-marginal-cost effect*, which plays an important role in the assessment of whether large termination mark-ups (*collusion*) can be part of a stable market outcome. To formalize, consider network i, and assume that the rival network j has a subscriber market share of s_j. Then, the (average) marginal costs of network i are

$$c_i = c_h + s_j(t - c_{term})$$

from which the above remarks follow immediately. In particular, if $t - c_{term}$ is large – high negotiated termination mark-ups – then networks have a very strong incentive to grab market share from the rival to lower costs. This, essentially, is what will undermine large termination mark-ups.

Observation 2: For given market shares, the perceived average marginal costs of a network are increasing in the termination charge.

This follows immediately from the definition of (average) marginal costs above. Thus, when termination charges factor into the equilibrium prices of service-market competition, an increase in termination charges will increase equilibrium prices (for given market shares). This is the *raising-the-rival's-costs effect* of the *Industrial Organization* parable at the beginning of the section, and generally higher unit costs dampen the intensity of the competition for subscribers.

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[123] *h* and *a* are mnemonic for "home" and "away".

[124] In the latter case, it is also possible to make the distinction between $f_i = 0$ and $f_i \neq 0$.

[125] The assumed coincidence of origination and termination costs is without loss of generality. Also, the size of c_{trans} plays little role. In contrast, the symmetry across networks is central.

[126] This means average across all calls originating in the network.

Based on this model structure it is readily shown that to the extent that a unique equilibrium of the *termination-charge-cum-retail-tariff* game exists, it is characterized by a *mark-up* on termination costs, that is,

$$t_{equil} > c_{term}$$

Essentially, the argument is that starting from $t = c_{term}$, it is in the interest of both networks to increase the reciprocal termination charge and thereby dampen the intensity of price competition. Hence, negotiated reciprocal access charges have some competition-dampening or collusive potential as suggested by the reference to wholesale-price agreements.

From the perspective of the social interest, termination charges in excess of the termination costs are clearly wasteful (given the maintained assumption of no joint and common costs of network operations). In contrast, to the extent that the services provided by the two networks are *not* perfect substitutes, the optimal termination charge is below costs,

$$t_{opt} < c_{term}$$

This mark-down on termination costs counter-balances the retail mark-up allowed by the imperfect retail-tariff competition. So, "subsidisation" of a key input restores balance. This is just a different version of the argument presented at the beginning of subsection 3.2. There, the mark-up embedded in fixed-phone calling-rates was optimally counter-balanced by a "subsidy" on termination in mobile networks. Here, the mark-up embedded in retail rates due to imperfect tariff-competition (product differentiation) is optimally re-balanced by a "subsidy" on off-net termination. In contrast, when $t = t_{equil} > c_{term}$, then the networks (sub-optimally) "tax" each other. Note that as the mark-up on retail rates vanish when services become closer substitutes, then the socially optimal termination charge approaches the actual cost of termination from below.

Thus, the discrepancy between t_{equil} and t_{opt} as captured by

$$t_{equil} > c_{term} > t_{opt}$$

suggests a scope for regulation of reciprocal access charges when service providers compete for subscribers using linear tariff-schemes.

However, it should be noted that these result have abstracted from break-even concerns arising out of joint and common costs of network operation. For the usual arguments outlined in von der Fehr (2004) and repeated in the section on competitive bottlenecks, this balances the score-board somewhat. Joint and common costs of the network infrastructures put an upward pressure on the optimal, regulated termination charge, and in the abstract it is unclear whether

$$t_{opt} \gtrless c_{term}$$

Of course, it may just be the case that the need to cover common costs balances the requisite subsidy due to imperfect service-market competition so that

$$t_{opt} = c_{term}$$

But recall that $t_{equil} > c_{term}$, and the potential need to regulate remains even in this case. The upshot is that private incentives and the social interest do not generally coincide under the stated assumptions, where networks compete in non-discriminatory, linear retail tariffs and termination charges are reciprocal.

Assumptions and extensions

Collusion and incentives

We first discuss the collusive potential of termination-charge agreements in more detail. Above, it was noted that the candidate for an agreed, reciprocal termination charge exceeds costs,

$$t_{equil} > c_{term}$$

If the networks aim to maximise joint profits in the negotiations, then some fully collusive retail tariff, *p**, should be attempted. This, in turn, requires some termination charge in excess of costs

$$t^*_{equil} = c_{term} + m^*$$

where *m** solves for the collusive equilibrium price $p^* = p(m^*)$ The profit-maximizing mark-up on the termination costs, *m**, is *positively* related to the substitutability between network services and the maximum potential per-subscriber profits and *inversely* related to the price sensitivity of individual subscriber demands.[127] In particular, we note that when services are non-substitutable,[128] then the profit maximizing mark-up is zero, that is, $t^*_{equil} = c_{term}$. When, services are perfectly substitutable, as in the Bertrand example alluded to above, the profit maximizing mark-up on termination costs is maximal (since no further mark-ups are generated by the retail-tariff competition). Hence, when services become more closely substitutable, the termination mark-up is required to "do more work" to implement the fully collusive price *p**.

To see whether collusion is sustainable (cf. Laffont, Rey and Tirole, 1998a), we first note that with a given pair $(p^*, t^*) = (p^*, c_{term} + m^*)$, the perceived marginal costs of each network are of the form

$$c = c_h + \frac{1}{2}(t^* - c_{term}) = c_h + \frac{1}{2}m^*$$

around the optimum. We recall the symmetry assumed, so that market shares are fifty-fifty, that is, $s_i = s_j = ½$, when networks charge the same price. Further, when retail-tariffs coincide, termination payments balance.

It follows that with product differentiation, there is no incentive for any of the networks to undercut the retail-tariff *p* slightly*, since the increase in revenue resulting from the increase in market share is just balanced by the increase in net termination payments to the rival network. A small downward deviation by one firm from the collusive retail-tariff opens a termination deficit not because of imbalanced calling-patterns, which we have assumed away, but rather because subscribers of the low-price network make more calls both on net and off net.

[127] In the standard Hotelling formulation subscribers are identical except for some location parameter.

[128] As in the example in footnote 24 on international call charges. Similarly, if fixed and mobile services are largely non-substitutable and provided by different networks, the same remark applies.

Therefore, the net effect of a retail-tariff decrease by one network will be that more off-net calls originate in this network than in the rival network.

A *sizable* cut in price below *p** may, however, allow the deviating network to *corner the market* and decrease marginal costs to

$$c' = c_h$$

since no calls are terminated off-net, if one network has a market share of one. Laffont, Rey and Tirole (1998a) show that such a cornering of the market is an optimal response to the fully collusive agreement, if services are sufficiently substitutable - this is the *incentive to build market share* at work. In other words, exactly when sizable termination cost mark-ups are needed to maximise joint profits will collusion be destabilized by opportunistic behavior in retail-tariff competition. A different way of phrasing this is that only moderate mark-ups, $t - c_{term}$, are sustainable. We therefore conclude that the collusive potential of termination charge agreements is somewhat limited.

Note, though, that whether or not termination charge agreements can sustain termination charges far in excess of costs, the social interest requires that termination charges should be *below* cost in the absence of significant joint and common costs of network operations. If substantial joint and common costs have to be factored in to the termination charges, then the socially optimal, reciprocal termination charge may be above costs, and if the substitutability of services only allow modest mark-ups to be sustained, then it might just happen that it is expedient to leave networks to settle reciprocal termination charges.

Two-part retail-tariffs

So far in this section we have entertained the somewhat unrealistic assumption that networks are restricted to simple, linear retail-tariffs to make the point that termination charge agreements between competing networks may have some collusive potential. More generally, what is required for this is that the fixed subscriber fee levied is *not* a free choice variable of the networks. Regulation along the lines of non-discrimination between subscribers would have this effect in a richer model. Hence, the restriction to simple linear retail-tariffs may not be as unrealistic as the first impression suggests. Let us return to the *two-part retail-tariffs* considered in the previous section. Thus, subscribers of network i are charged

$$s_i(q) = f_i + p_i q$$

Retaining the assumption that consumers are identical (except for their locations in the Hotelling space), it is immediate that the per-call charge of each network will be set equal to perceived marginal costs,

$$p_i = c_h + s_j(t - c_{term})$$

while the fixed fee will be used to appropriate consumers' surplus.[129] In symmetric equilibrium, his reduces to

$$p_{equil} = c_h + \frac{1}{2}(t - c_{term})$$

[129] Note that (as above) high termination charges feed into retail tariffs. So, high perceived marginal costs still dampen retail-tariff competition.

which implies that networks make no (marginal) profits on calls. Instead, their entire profits are made from a mark-up on the fixed (monthly or quarterly) subscriber fee over and above the fixed subscriber cost *F*. As shown by Laffont, Rey and Tirole (1998a), competition in the subscriber fee[130] implies that network profits are *independent* of the chosen termination charge. This is referred to as *profit-neutrality* of termination charges. Hence, whatever might be the negotiated reciprocal termination charge is *not determined* in this model. This immediately implies that termination-charge agreements between competing networks have no collusive potential when retail-tariff competition is in two-part tariffs.

To see what is going on here, note that networks now have *two* instruments for subscriber competition given some termination charge *t*. Thus, to attract subscribers network *i* can lower f_i, while keeping p_i fixed. As long as p_i is kept fixed, the balance of termination payments is unaltered. This implies that network *i* is free to use the extra instrument f_i to increase market share without developing a termination deficit. In the base case with simple linear tariffs, the only instrument with which to attract subscribers was the retail tariff. When this was lowered to attract subscribers, a termination deficit arose, and this, of course, tempered the incentive of one network to undercut the retail tariff of the other.

While termination-charge agreements may have no collusive potential in this version of the model, this does not imply that regulation is unnecessary, but it does imply that regulation has become a lot easier. Without regulation, the networks might agree to some reciprocal termination charge either above or below the cost of termination for reasons of habit. One interesting case might be that the firms simply agree not to bill each other ("bill-and-keep"), which is equivalent to $t = 0$. This implies

$$p_{equil} = c_h - \frac{1}{2} c_{term} < c_h$$

which is equivalent to *below-cost* pricing and significant "subsidisation" of off-net termination. This would of course be associated with high fixed subscriber-fees. From the perspective of the social interest, marginal cost pricing is optimal (as usual, in the absence of joint and common costs), that is,

$$p_{opt} = c_h$$

This is easily implemented in the present version of the model by setting a cost-based termination charge,

$$t_{opt} = c_{term}$$

Implementation should be easy, since networks are indifferent between termination charges in a two-part tariff-regime, and they would therefore not object to the regulator's suggestion.

Network-based discrimination

Finally, we shall consider *network-based price discrimination*. This arises when networks charge subscribers *differently* for on-net and off-net calls. Thus, network *i* employs a retail tariff-scheme of the form

$$S_i(q^h, q^a) = f_i + p_i^h q^h + p_i^a q^a$$

[130] In much the same way as in the previous section with competitive mobile-service providers. However, in that model, net profits were driven to zero - not so in the imperfectly competitive Hotelling framework.

where p_i^h is the tariff for on-net calls, while p_i^a is the tariff for off-net calls.[131] If $f_i = 0$ this reduces to third-degree price discrimination.[132]

In line with the preceding framework, networks levy call-charges that coincide with perceived marginal costs in equilibrium if $f_i > 0$. By the symmetry and reciprocity of termination charges, for on-net calls we have

$$p_1^h = p_2^h = p^h = c_h$$

and for off-net calls we have

$$p_1^a = p_2^a = p^a = c_h + (t - c_{term})$$

independently of market shares. The fixed subscriber charges coincide as well

$$f_1 = f_2 = f > 0$$

So, we note that the ratio of off-net to on-net call charges reduces to

$$\frac{p^a}{p^h} = 1 + \frac{t - c_{term}}{c_h} \gtreqless 1 \text{ as } t \gtreqless c_{term}$$

Thus, if the termination charge exceeds costs, then off-net calls are "*taxed*", while if the termination charge falls short of costs, then off-net calls are "*subsidised*". Further, Armstrong (2002) notes that network profits now (again) depend on the termination charge, so that the profit-neutrality result under non-discriminatory two-part retail-tariffs no longer prevails under network-based discrimination. Hence, in principle, the collusive potential of termination-charge agreements is restored.

However, to maximise profits it turns out to be optimal for networks to agree on a reciprocal termination charge of the form

$$t_{equil} = c_{term} - l < c_{term}$$

where l is inversely related to the price sensitivity of individual subscriber demand. Hence, off-net calls are "*subsidised*" in the unregulated equilibrium - and more so when subscriber demand is inelastic.

To understand what is going on here, we refer to the notion of *network-based externalities* suggested by Laffont, Rey & Tirole (1998b). Start by considering the case where subscribers are charged the same price for on-net and off-net calls (that is, $p^a = p^h$, as would be the case in the retail-tariff equilibrium if $t = c_{term}$). Then consumers have no particular preferences over which networks the people they call belong to. However, if $t > c_{term}$ (hence, $p^a > p^h$), then callers would prefer receivers to be on the *same* net, and there is a *positive* network-based externality, since subscribers prefer to belong to a *large* network. In contrast, if $t < c^{term}$ (hence,

[131] To motivate this, note that when the termination charge differs from costs, then a network has different costs of terminating calls on-net and off-net. Thus, based on costs considerations networks would have an incentive to charge subscribers differently for on-net and off-net calls if possible.

[132] Laffont, Rey & Tirole (1998b) consider both cases.

$p^a < p^h$), then callers would prefer receivers to be on the other net, and there is a negative network-based externality, since subscribers prefer to belong to a *small* network.

Thus, network-based price discrimination induces network-based externalities, and the termination-charge agreement determines whether this network-based externality will be positive or negative. Effectively, when setting the reciprocal termination charge, firms decide whether the resulting subscriber competition is set against a background of positive network externalities ($t > c_{term}$), no network externalities ($t = c_{term}$) or negative network externalities ($t < c_{term}$). Since *positive* network externalities intensify the competition for subscribers to the detriment of network profits, in equilibrium the networks choose a structure with negative network externalities, and a termination charge of the form above follows immediately. Thus, to *dampen* competition, off-net calls are "subsidised", $t_{equil} = c_{term} - l < c_{term}$.[133]

Note that private telecom networks aim to maximise profits. Thus, heuristically, at the initial termination-negotiation stage, they will aim to mutually agree to a termination charge which allows maximal profits in the equilibrium of the subsequent non-cooperative retail-tariff competition stage. Since "subsidization" of off-net calls diminishes the individual network gains from grabbing market share from the rival, "subsidization" is exactly what is called for to dampen the subsequent competition for subscribers. In other words, the mutual agreement on below-cost termination charges is like a credible and "soft" competitive posture.[134]

As in the previous case, it is in the social interest to set the termination charge at cost, that is

$$t_{opt} = c_{term}$$

Given the network agreement on a reciprocal termination charge of the form

$$t_{equil} = c_{term} - l < c_{term}$$

there is consequently a potential role for regulators. It is interesting to note, though, that in this more realistic setting, it is the private incentives to "*subsidise*" off-net calls, rather than the collusive effects of *high* termination charges ("taxation" of off-net calls), which seem to be the main problem. In the particular setting considered, a suggested solution would simply be to *ban* termination-based price discrimination, which brings us back to the previous setting (profit-neutrality), where networks would not object to the mere suggestion of cost-based termination charges.[135]

Asymmetric networks

So far, we have assumed a highly symmetric setup to represent a mature industry with, roughly, equal-sized networks. Therefore, we end this discussion with a few comments on the possible effects of asymmetries, which might be particularly relevant for the discussion of less mature phases of the (relatively) recently liberalised telecommunications industry.[136] So, we

[133] Laffont, Rey & Tirole (1998b) also consider the case where $f_i = 0$ (third-degree price discrimination). Then, we are back in a linear-pricing framework as in the benchmark, where competition-dampening is aided by above-cost termination charges. It can be shown that with sufficient network-service differentiation, networks will agree to above-cost termination charges, although the collusive potential of termination-charge agreements is diminished by the on-net/off-net price discrimination.

[134] For analyses of commitment and strategic posture in dynamic games, see the seminal work by Fudenberg & Tirole (1984) and Bulow, Geanakoplos & Klemperer (1985) and as well as the survey by Tirole (1988, ch. 8).

[135] Hence, enforcement costs should be modest.

[136] We repeat our caution that the economics literature on two-way access in telecommunications is, itself, rather immature. Therefore, the following is somewhat tentative.

should have in mind an industry which is asymmetric, either in the sense that there is an incumbent network faced by a potential entrant or in the sense that there is a large, dominant network faced by a smaller actual competitor. Note that the intrinsic asymmetry could relate either to the preference of potential subscribers for the services of a particular network (viz. the old incumbent) or to cost differences in favour of the large firm or incumbent. Emphasizing demand asymmetries, we shall briefly try to assess how this might change some of the conclusions above and the extent to which this is relevant for the role of the regulator.

To set the scene, we first reiterate that when both networks have positive market share, an increase in the termination charge will increase the average cost of calls as above. More interestingly, the average cost of calls from the *small* network increases *more* than that of the *large* network, since a larger fraction of calls from the small network terminate off net. Thus, because termination costs generally feed into retail charges in favour of the large network in the subsequent rate-setting game, this could spell difficulties for reaching an agreement on termination charges. To keep the small network at a permanent disadvantage, the large network might insist on relatively high termination charges. Hence, in the asymmetric setting there is a potential additional role for the regulator, particularly in the early phases of the industry, where the small networks (recent entrants) may be very small, indeed, compared to the established network (the incumbent).

Above, we concluded that with *linear retail-tariffs*, the networks would tend to agree to high termination charges in the symmetric setting. This qualitative result survives in the asymmetric setting (if an agreement on a reciprocal termination charge can be struck), at least to the extent that equilibrium retail-tariffs still coincide across asymmetric networks. The argument is more or less as above. As long as retail-tariffs coincide, net termination revenues are zero. Thus, an increase in the termination charge above costs will merely serve to dampen retail-tariff competition as before, and two asymmetric networks would also agree to an above-cost termination charge, if they can, indeed, agree.

Turning to *two-part retail-tariffs* (without network-based discrimination) conclusions may change somewhat compared to the symmetric case as analysed by Carter & Wright (2003). With two-part tariffs, marginal retail charges are still cost based as above. When termination charges exceed costs, this implies that the average costs of the small network are *larger* than those of the large network.

However, this may work in favour of the small network. When costs are relatively high for the small network, this implies that its resulting retail-tariff is also comparatively high. With comparatively high retail-tariffs, the *small* network generates a termination *surplus*. The reason is that the subscribers of the small network cut back on the number of calls (or call-minutes) compared to the subscribers of the large network. Hence, there is a *net inflow* of calls to the *small* network. As a consequence, the small network makes a positive net profit on termination. Therefore, the small network might be interested in agreeing on a relatively high termination charge.

The large network, in contrast, would be interested in setting reciprocal termination charges at cost. If termination charges are set *above* costs, the subscribers of the small network make fewer calls than subscribers of the large network for the reason just explained. Hence, the *large* network generates a termination *deficit*. In contrast, if termination charges are set *below* cost, the subscribers of the small network tend to make more calls than the subscribers of the large network for similar reasons. Hence, a *net outflow* of calls from the *small* network will result. However, when termination charges are below costs this net inflow of calls to the large network will generate a termination *deficit* to the *large* network. Hence, the large network has an interest in pegging the reciprocal charge at the level of cost. This is the socially optimal level, and, provocatively, Carter & Wright (2003) suggest that the regulator simply *delegate* the

setting of the reciprocal termination charge to the large network (viz., the old incumbent network) in this case.

Intuitively, perhaps the most surprising of all the results above was that with two-part tariffs and *network-based discrimination*, the networks would agree to below-cost termination charges. Note, though, that this result arises in the mature and symmetric setting. However, there is reason to believe that the conclusion might well be sensitive to the symmetry assumption. If instead, the networks are, initially, highly asymmetric, a (very probable) conjecture is that the large, incumbent network would have an interest in high termination charges instead. The reason is that high termination charges increase costs and retail-rates for off-net calls, and since the small network terminates a larger fraction of calls off net, this benefits the competitive position and the profits of the larger network. Roughly similar remarks apply when either the incumbent attempts to limit the market inroads of an actual entrant or it attempts to deter entry altogether. Hence, the main regulatory concern may be high termination charges after all.

Finally, let us make a few comments on *entry* and termination charges. An entrant must ensure access to terminate calls in the network of the incumbent.

First, assume that due to switching cost, the entrant must offer lower fixed subscriber fees and lower call charges to attract subscribers. Then, it seems likely that the incumbent will attempt to insist on reciprocal termination charges at a relatively high level, since high termination charges weaken the competitive position of the entrant. To see this, note that the entrant might be doubly hurt by high termination charges. First, the small network (the entrant) has high unit costs since a larger proportion of calls from the small network terminate of net. Secondly, the fact that the small network has to set a lower price generates a termination deficit, since low retail-tariffs generate more calls per subscriber and a net outflow of calls. Hence, insisting on high termination charges is akin to a “tough” strategic posture by the incumbent, which will serve to limit the competitive position and scale of the entrant.

Secondly, so far we have assumed that the two networks compete for a *fixed pool* of subscribers, and that both networks have full coverage from the outset. In an asymmetric (incumbent vs. entrant) setting neither of these are necessarily sensible assumptions. In particular, the full-coverage assumption is suspect as far as recent entrants are concerned. How this affects the incentives of the incumbent with respect to the level of the reciprocal termination charge is not entirely clear. For a given coverage by the entrant, the incumbent may have an incentive to insist on a high termination charge to weaken the short-run competitive position of the entrant. However, a high charge may also give the entrant a stronger incentive to build market coverage more quickly, which might adversely affect the profit prospects of the incumbent in the longer run.

Summary and conclusions

This section has largely focused on symmetric situations, where two or more networks require two-way access to each other’s subscribers, when they are at the same time competing for these subscribers.

We started by establishing the general point that networks have a private incentive to negotiate termination charges to internalize double-marginalization externalities. If networks act in non-coordinated fashion, the resulting outcome is likely to be one in which termination charges are very high, even too high from the combined private interest of the networks. Thus, networks have an incentive to coordinate on lower termination charges. The associated internalisation of the vertical externality would also generally be in the interest of society as a whole. This is most simply illustrated by the virtues of agreements on international call charges.

However, this does not generally imply that unregulated termination settlements made by competing networks will be fully (or even pre-dominantly) in line with the interests of society as a whole. This was illustrated with reference to a *symmetric* duopoly model where the two networks first agree to a *reciprocal* termination charge and then compete for subscribers by their choice of retail tariff-schemes. Several modes of competition were considered.

With *linear* and *non-discriminatory retail-tariff* schemes, it was argued that networks have an incentive to agree to above-cost termination charges - that is, "taxing" off-net calls. The social interest, in contrast, dictates below-cost termination charges to counter-balance imperfections in service-market competition. Thus, it is optimal to "subsidise" off-net calls. We conclude that there is a general role for regulation of termination-charge settlements.

However, it was also argued that the collusive potential of negotiated termination charges should not be overstated, since it turns out that network incentives to build market share will undermine the stability of high, negotiated termination charges. Thus, whether network-services are highly substitutable or not, relatively modest mark-ups on termination costs are the most likely outcome of private settlements.

When networks are free to employ simple *two-part retail-tariffs*, results differ markedly. First of all, the variable retail rates will coincide with perceived marginal costs of termination. This enables the fixed subscriber-fee to perform the task of competing for subscribers without generating termination deficits. It follows that termination charges are *profit-neutral* and, therefore, do not have any collusive potential. However, this leaves the "problem" that termination charges are not strictly determined. So, we cannot render a verdict on whether private settlements will lead to termination charges that are too high or too low from the perspective of the social interest. However, this leaves the simple role for regulators to suggest cost-based termination charges, since pricing at perceived marginal cost in retail competition will be aligned with the social interest, provided that the perceived costs coincide with actual costs. Networks are indifferent as to the level of the termination charge and would, therefore, not object to such a suggestion. Hence, policing of the regulatory regime should be inexpensive.

This section also considered *network-based tariff discrimination*, which captures that retail call-rates discriminate between on-net and off-net calls. On the assumption that fixed subscriber-fees complete the retail tariff, all retail call-rates coincide with perceived marginal costs. Termination charges are no longer profit-neutral and, thus, have collusive potential, but due to *network-based externalities*, it is optimal for networks to agree to below-cost termination charges - that is, "subsidising" off-net calls. This "subsidisation" dampens the competition for subscribers and maximise network profits. The social interest dictates termination charges at actual marginal costs. Therefore, there is a role for the regulator to eliminate this "subsidy" to off-net calls. Regulation can either directly insist on cost based termination charges *or* it can ban network-based tariff discrimination and merely suggest cost-based termination charges.

Finally, some tentative remarks were made on the sensitivity of the main conclusions to the symmetry assumption. If asymmetry is taken to refer to a situation where a large incumbent firm is facing a small actual or potential entrant, then the weight of the argument indicates that the incumbent might tend to favour higher termination charges, in order to disadvantage the small network. Thus, if the incumbent is able to force high reciprocal termination charges on the entrant, then regulators should certainly be vigilant. However, it was also suggested that cases arise where the incumbent interest as far as termination charges are concerned may be in line with the social interest.

Concluding Remarks

This note has attempted to provide a partial overview of key results from the economics literature on two-way access charges. The discussion was naturally split between settings in which networks are *non-rival* and settings in which networks are *rival* with respect to subscribers. The two sections have each suggested simple modelling frameworks suitable for discussing two-way access problems, and have presented some key insights, which should be useful for regulators. In particular, the note has tried to highlight the necessary changes in regulatory emphasis as telecommunications markets pass from immature to more mature phases.

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