



# Broadband prices in the Nordic countries in 2006



**National IT and Telecom Agency**  
Ministry of Science  
Technology and Innovation



**Viestintävirasto  
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Finnish Communications  
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**POST & TELESTYRELSEN**

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## Foreword

The task of Nordic regulatory authorities is to promote effective competition that benefits consumers in the electronic communications sector. This is mainly carried out through regulation and supervision of the markets. This report has been produced to facilitate comparisons between similarities and differences in Nordic broadband markets, with an emphasis on prices, regulation and barriers. The intention of this report is to contribute to increased awareness of the Nordic markets and to serve as a basis for continued work with the public authorities' regulation and supervision in the area.

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## Summary

The four Nordic broadband markets – in Denmark, Finland, Norway and Sweden – have all shown similar developments in recent years: increased use of the Internet, there is a clear transition from modem to broadband access and there is an ongoing consolidation process through corporate acquisitions. At the same time, the countries' political objectives all state that the entire population of each country should have access to the digital information society and that no one should be excluded. This means that from a consumer perspective, the accessibility to and use of infrastructure is of particular importance. Consequently, Nordic governments are very interested in monitoring the situation.

Among the various forms of broadband access, xDSL is the most widespread one and which is showing the strongest growth in all countries. The second most common form is broadband access through cable television networks. With the upgrade of cable television networks and the rollout of fibre LAN, certain residential and non-residential customers have received several alternative connection possibilities to the Internet besides the copper access network. However, many people do not have the freedom of choice between different infrastructures, and for some, there is no possibility of obtaining access to broadband at all. Copper access networks are undergoing continual upgrades in the Nordic countries with an increased focus on end users in less densely populated areas also being offered broadband through the copper network. WiMAX, an example of wireless broadband, is growing in the Nordic countries and can serve as a complement to network-bound technology.

Many customers regardless of Nordic country pay a connection charge, that is, an installation charge, in conjunction with their becoming broadband customers. The charge regardless of speed can be as high as EUR 129. Most customers can nevertheless expect to be offered free installation.

The price of a broadband subscription varies considerably between the Nordic countries. For example, the price of a broadband subscription at 8 Mbps varies between EUR 31 and EUR 107. For Nordic consumers, the price of a broadband subscription at 2 Mbps is a monthly charge of between EUR 22 and EUR 75. Sweden generally has the lowest prices and Denmark the highest. Denmark also has the largest interval between the highest and lowest price for the same speed, whereas Norway has the smallest interval. Sweden has smaller price differences between various speeds compared to the other countries. Finland has greater differences in prices than Sweden, but smaller differences than compared with Norway and Denmark.

Operators have two main ways of gaining access to the copper access network in order to offer broadband to their customers, through either LLU (local loop unbundling) or through bitstream access. In the past year, the price per month for leasing LLU access has dropped to a varying extent in all of the Nordic countries. The price is the lowest in Denmark and the highest in Norway, with a difference corresponding to EUR 4.4 per month.

There are a number of competition problems in the market, and which the regulatory authorities are trying to reduce or eliminate in various ways. Examples of such barriers include limited access to infrastructure, long lead times, discriminatory information and changed assumptions in conjunction with the rollout and conversion of access networks.

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# **1 Introduction**

## **1.1 Background**

In November 2005, the Director-Generals of the Nordic regulatory authorities for the electronic communications market resolved at a meeting to initiate collaboration between the Nordic countries in respect of broadband and broadband prices. The National Post and Telecom Agency (PTS) was appointed as the authority responsible for the project.

## **1.2 Objective and aim**

The objective of the project is to compile a report comparing broadband prices for consumers in the Nordic countries. The report is also intended to analyse existing differences in market prerequisites and any differences in current regulations, which could help to explain the differences between the countries as regards current markets and their development.

At the Nordic meeting of the Director-Generals in May 2006, the project was supplemented by an additional two items to be covered by the report:

1. A comparison between the countries in terms of the regulation of access to the fixed network (wholesale regulation), above all local loop unbundling (LLU) and bitstream.
2. A comparison of national strategies and objectives in the field of IT. The strategies and objectives for the rollout of infrastructure with higher transmission capacity (i.e. accessibility) should be the main focus. The report shall also describe how each regulatory authority is to act in terms of its national strategies and objectives.

The aim of the project is to enhance awareness of the broadband markets in the Nordic countries and, by illustrating the similarities and differences, help to further the authorities' continued work on regulation and supervision within the field.

## **1.3 Method**

Denmark, Finland, Norway and Sweden were the countries that participated in the study. Despite the fact that Iceland is not included, these countries will be referred to as the Nordic countries for the purposes of this study. The project was staffed by one or more persons from the regulatory authorities of the various countries.

Following a survey of the availability of existing quantitative data in each country, in addition to the data that is relevant, a decision was then made on the country parameters to be compiled by each project staff member. The purpose of this was to achieve comparable data for later compilation in report form.

Experts within the field in the different countries read the draft to the report and it was gradually disseminated for approval in each country.

#### **1.4 Delimitations**

The price comparisons are limited to end user prices for residential customers. End user prices for businesses and organisations will not be discussed in this report. The only wholesale prices compared are those for leasing LLU access and bitstream access.

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## 2 IT policy in the Nordic countries: broadband for all

The Internet is one of the most important innovations of our era. It has major advantages for economies and societies. The impact of broadband is beginning to become visible only now. Although it is difficult to measure its exact influence, it is obvious that the ability to transmit data at a high speed and through different platforms is of crucial importance for the development of new products and services. This is why it is important for all countries to have a strategy in the field, as is the case for all Nordic countries and also the entire European Union. The digital society should be available to all and no one should be excluded. Over the past few years, there has been a major focus on the digital divide in order to include those who have been excluded and also those who risk being excluded. This section discusses the vision of the European Union and the IT policy of each country.

### 2.1 i2010: The vision of the EU

In i2010, the European Union's vision, widespread broadband access is a key prerequisite for the development of modern economies and is also an important part of the Lisbon Agenda<sup>1</sup>. The European Union shall increase its efforts to promote the use of broadband services and encourage further rollout, particularly in the less developed regions of the Union.

The aim of the European Commission is to give all citizens in the Union the same access to employment and development via the Internet under the slogan 'Broadband for all by 2010'. The focus is on two main initiatives, one is broadband rollout and the other is to ensure that citizens have Internet connections. It is considered that developed areas manage this very well on their own account, for which reason the focus of the EU is to close the existing digital divides between EU citizens in different parts of the Union<sup>2</sup>. The Commission has three priorities:

- To achieve an all-European information space that promotes an open and competitive inner market for the information society and for the mass media. The objective of a single all-European information space is to offer secure electronic communications with high bandwidth at a reasonable price as well as digital services with broad and varied content.
- To stimulate innovation and investments in research within the area of information and communication technologies in order to promote growth and to create more and better job opportunities. The objective is world-class research and innovation for information and communication technologies in order to close the distance to Europe's main competitors.
- To achieve a European information society with a level of participation that furthers growth and job creation in a way that agrees with sustainable development and which means the prioritisation of improved public

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<sup>1</sup> <http://www.regeringen.se/sb/d/2504>

<sup>2</sup> [http://www.realtid.se/ArticlePages/200603/21/20060321154150\\_Realtid613/20060321154150\\_Realtid613.dbp.asp](http://www.realtid.se/ArticlePages/200603/21/20060321154150_Realtid613/20060321154150_Realtid613.dbp.asp)

services and quality of life. The objective here is an information society based on participation, which offers public services of a high standard and which promotes quality of life.

Member States are urged to update their national broadband strategies so that all interested parties receive additional guidelines. Their strategies should include targets, both in terms of coverage and usage, as the basis of an active partnership with regional authorities, and the Member States should utilise the potential for synergy effects between alternative sources of financing (financing from national sources, structural funds and rural development funds). The national broadband strategies should also include concrete targets for the connection of schools, public administrations and health centres.<sup>3</sup>

## **2.2 Denmark – high transmission capacity for all**

The existing strategy for the rollout and use of broadband in Denmark is based on the 2001 broadband plan 'From hardware to content'. The Danish Government follows up this strategy annually. According to a hearing in 2005, Denmark will continue to follow the main principles of the strategy.

The political objective of the Danish Government is high transmission capacity for all, and strategies such as a national infrastructure that is rapid, inexpensive and secure<sup>4</sup>, are needed to achieve this objective. The rollout of the IT infrastructure shall be developed by the private market with the Danish public sector serving as the driving force. For example, own IT investments by the public sector are intended to boost the demand for a digital infrastructure.

According to this strategy, IT should ease the everyday life of Danish citizens and should be relevant and available to everyone. The latter means that the technology should be user-friendly, otherwise broadband will not be of any use to Danish citizens. Danish residents should also have the competence to use the technology for lifelong learning and Denmark is investing in training for this reason.

Broadband with higher transmission capacity means:

- That it will become easier and more advantageous for Danish citizens to use the Internet. For example, this includes searching for information, training, communication, accessibility to cultural life, access to public services and also that citizens will find it more convenient to participate in the digital society.
- Access to information will increase: the business sector, new products emerge, improved contact between consumers and businesses, and improved prerequisites for research and development

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<sup>3</sup> The European Commission, Bridging the Broadband Gap, M(2006) 129 final.

<sup>4</sup> *Fra isenkram til indhold - Strategi for hurtigt, billigt og sikkert internet til hele Danmark* [From hardware to content: Strategy for a rapid, inexpensive and secure Internet for all of Denmark], <http://www.itst.dk/wimpdoc.asp?page=tema&objno=175908069>

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- That the public sector is able to enhance its level of service and offer new forms of payment. At the same time, the digitalisation of public administration can contribute to the improvements that are necessary for the efficiency and transformation of the public sector.

### **2.3 Finland – all citizens should have access to broadband**

Finland's broadband strategy<sup>5</sup> was decided in early 2004. According to this strategy, the Government's objective is for all citizens to have access to rapid, regionally comprehensive and reasonably priced Internet connections before the end of 2005.<sup>6</sup>

Broadband rollout is to be encouraged through a large number of measures, and competition is to be promoted in and between all communications networks. The use of new broadband technology should also be encouraged and the range of services and content in networks enhanced. The information security of users and their skills in using broadband services will be developed.

In February 2005, the Government made a new resolution concerning more exact targets in the national broadband strategy. The emphasis of the broadband policy is to increase the quality of the connections, create content and develop wireless connections.

The range of broadband should be based on commercial operations on the open market, where different services compete with each other. The task of society is to encourage businesses to invest in the development of broadband connections. However, in sparsely populated areas, there are limitations in the commercial range of broadband connections. Even today, the most common broadband technologies require demand to be greater than is the case at the present time. Offering connections at a reasonable price to users is not profitable in all parts of the country for this very reason.

Society is continuing to develop special measures for areas where the demand for broadband services is not sufficient to make a commercial offering possible. Sparsely populated and rural areas play an important role in regional development. The rollout of the broadband network to all parts of Finland is supported by planned and well coordinated development work. A better allocation of existing societal resources may also help to support broadband rollout in sparsely populated areas. Regional development also takes the new possibilities to use the structural funds offered by the European Union into consideration. Government support stipulates special requirements to guarantee that the support does not prevent or delay a commercial rollout of broadband or distort competition and market conditions. One way of increasing access to the services of the information society is to provide locations offering Internet services. These are to

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<sup>5</sup> <http://www.vnk.fi>

<sup>6</sup> *Statsrådets principbeslut om en nationell bredbandsstrategi*. [The Government Resolution on Finland's national broadband strategy], <http://www.mintc.fi/oliver/upl616-Principbeslut.pdf>

be open to the public and use Internet connections with a high transmission capacity.

The objectives of the Finnish broadband strategy are to:

- to promote the all competition within and between the different communications networks,
- to promote the provision of electronic services and the various types of content,
- to stimulate the demand for broadband, and
- to enhance special measures for areas where demand is not sufficient to enable broadband rollout on commercial terms.

The effect of the strategy includes a target of 90 per cent of all broadband connections to be equipped with high transmission capacity by the end of 2007.

## **2.4 Norway – access to broadband at approximately the same price, throughout the country**

According to the statement of the political platform for the parties in Government<sup>7</sup> dated 13 October 2005, the level of ambition for broadband rollout is to rise. The rollout of broadband throughout the entire country offers great potential to the business sector in the form of development and the setting up of more businesses, while reducing the difficulties of great distances. The tangible objectives of Government policy include:

- Broadband should be available throughout Norway by the end of 2007,
- Unreasonable geographical price differences for broadband connection should not exist, and
- Government funding will contribute to broadband rollout in those areas where rollout is not ensured by market players.

According to the Minister of Transport and Communications<sup>8</sup> the following shall, inter alia, promote broadband rollout:

The Minister of Transport and Communications<sup>9</sup> has, inter alia, emphasised that the following shall promote broadband rollout:

- Competition, as supported by the Electronic Communications Act and other regulations,
- General government demand, through the Høykom programme<sup>10</sup> (see below) and from municipalities, county councils and central government operations, and

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<sup>7</sup> "The Soria Moria declaration"

<sup>8</sup> Minister of Transport and Communications Liv Signe Navarsete, speech 10 May 2006

<sup>9</sup> Minister of Transport and Communications Liv Signe Navarsete, speech 10 May 2006

<sup>10</sup> [www.hoykom.no](http://www.hoykom.no)

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- Guidance, through Høyvis (see below) as well as from municipalities and central government operations.

Høykom is an innovation programme aimed at testing, adapting and introducing broadband use. Høykom is financed by the Ministry of Government Administration and Reform. The programme is intended to enhance broadband usage in the public sector and to increase public sector demand for broadband, since, as in other Nordic countries, the public sector is meant to be a catalyst for demand. The programme was founded in 1999 and is currently in its third period, which covers 2005 to 2007. During this period, over NOK 500m has been granted to more than 450 projects. The Høykom programme is described in eNorway2009, 'a strategy for the digital society', which is Norway's vision within the field.

Høyvis is a national competence centre for the use of broadband in the public sector. It provides details of the experiences of and expertise developed by both national and international government broadband projects. Høyvis is to contribute to realising the objectives of Høykom concerning the increased and innovative use of broadband in Norway.

In the revised Norwegian budget for 2006, which was adopted by the Storting [Norwegian Parliament] on 16 June 2006, the allocation to broadband rollout rose by NOK 50m, with the total programme budget amounting to more than NOK 119m<sup>11</sup> for broadband in 2006. The increased amount is being distributed through Høykom in a programme called Høykom District. Funds in this programme can be utilised to establish infrastructure and for broadband projects in areas of Norway with below average coverage. The purpose of the extra funds is to help achieve the objectives in the statement of Government policy on access to broadband for all by the end of 2007.

The Government has allocated a total of NOK 122m (EUR 16.35m) to Høykom in the budget for 2007, which is the largest grant it has ever received. NOK 100m of these funds is earmarked for those areas of Norway that lack broadband coverage.

Preliminary figures show that the latest grant from Høykom District (NOK 80m), together with local grants, have contributed approximately NOK 200m, with the entire amount going to broadband rollout. This is estimated to generate nearly 30 000 new broadband lines.

## **2.5 Sweden – high transmission capacity throughout the country**

Swedish IT policy emphasises the availability of efficient and secure physical IT infrastructure with high transmission capacity throughout Sweden, e.g. to give people access to interactive public e-services. An efficient IT infrastructure means infrastructure with a higher transmission capacity than the traditional fixed telephone network.

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<sup>11</sup> EUR 15.95m in accordance with exchange rate from the European Central Bank as at 24 August 2006

The accessibility objective basically means that residential and non-residential customers in all parts of Sweden should have access to IT infrastructure with high transmission capacity and that this in the first instance should be managed by the market, but that central government has an overall responsibility to ensure that such an infrastructure is available throughout the country. This means that the market should be the main driving force behind development. The role of the public sector is mainly to serve as a regulator, purchaser and role model.

Sweden has many sparsely populated areas where rollout is not expected to take place without central government support. In the Budget Bill for 2007, the Swedish Government proposes that the period for broadband support should be extended by one year to include 2007. The support is intended to promote the rollout of IT infrastructure with high transmission capacity in rural areas, including sparsely populated areas. At the same time, property owners and businesses have been offered more time to take advantage of tax reductions for certain connection costs to telecommunications and computer networks. The main reason for this extension is that rollout in several parts of the country is proceeding under strong time constraints. This may jeopardise the quality and financing of the rollout. The extension provides stakeholders with an opportunity to conclude ongoing rollout projects in a suitable manner.<sup>12</sup>

It is apparent that access to broadband is still unsatisfactory in certain regions in Sweden. For this reason, PTS feels that it is important to have an overall strategy for the continued rollout of broadband. Therefore, no later than 1 March 2007, PTS will propose a broadband strategy for accessibility and competition. The aim of this strategy is for all Swedish residential and non-residential customers to have access to broadband by 2010 and for as many as possible to be able to choose between several operators.

## **2.6 The work of the regulatory authorities**

In 2003, all EU Member States implemented the directives on electronic communications, i.e. telecommunications services in the telecommunications market, broadband and Internet connections, in addition to the distribution of radio and television broadcasts. The new regulatory framework contains requirements for the provisions in the directives to be applied in a similar way in the various European countries.

By supervising the market, the authorities are to ensure that financial competition is effective and that companies are following the statutory obligations on pricing and operations. Through functioning and effective competition, consumers can also be guaranteed more freedom of choice. Regulatory authorities in the Nordic countries are ensuring that the directives are being followed and are assessing the markets in three steps:

1. First, 'relevant markets' are defined, as the law does not define any markets. This means that each country independently determines which

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<sup>12</sup> Government Budget Bill 2007, *Faktablad budgetpropositionen* [Budget Bill fact sheet] 2007, [www.regeringen.se/content/1/c6/07/13/43/68eda493.pdf](http://www.regeringen.se/content/1/c6/07/13/43/68eda493.pdf)

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markets are relevant. There is nevertheless a Recommendation from the European Commission concerning which markets should be analysed.<sup>13</sup>

2. When the markets have been defined,<sup>14</sup> the prevalence of effective competition is investigated by the regulatory authorities and, if the competition is not effective, at least one dominant operator is identified and the regulatory authority must decide upon its or their obligations (see item 3). This regulation will be removed when competition is found to be effective. This means that if the operator was previously dominant, the obligations to which the company was subject to, due to its dominant status, are removed.
3. The third step in the assessment is to make a decision on particular obligations for the dominant operator(s) which may be present in each market. Such obligations may, for example, include allowing access to the network, providing transparency in the form of reference offers, working towards non-discrimination or introducing of price regulation.

Also under the directive,<sup>15</sup> the various European regulatory authorities should consult with the Commission regarding their proposed regulation. On the part of Norway, which is an EFTA member, they consult with the independent monitoring body ESA (EFTA Surveillance Authority). When it comes to the definition of various relevant markets or SMP status, the Commission or ESA may veto and thus oppose an authority having defined a market in a way that deviates from the Recommendation of the Commission or ESA.

Also, the obligations implemented in the different countries may not in practice deviate a great deal from each other, even if the regulatory authorities may take certain national circumstances into consideration justifying a certain degree of deviation. The Commission verifies that similar problems relating to competition are treated equally in all Member States. A regulatory authority must send its proposals for consideration to the Commission or ESA as well as to sister authorities in Europe, and which are entitled to issue a written statement to be taken into consideration by the regulatory authority in its ongoing examinations.

As is the case throughout the European Union, the Nordic countries enable the supervisory authorities to make a decision on frameworks and rules for the markets in advance in order to prevent problems related to competition. This report will describe regulation for two of the eighteen relevant markets: the wholesale market for LLU and the wholesale market for bitstream. The supervisory authorities are also working to ensure that electronic communications, which society is becoming increasingly dependent on, are working efficiently and securely.

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<sup>13</sup> The provision of networks and services for electronic communications is ultimately regulated by the directives adopted by the European Union in the field. 2002/21/EC is a joint regulatory framework for electronic communications networks. Recommendation 2003/311/EC also applies concerning relevant product and service markets. The list encompasses wholesale terminating segments of leased lines and wholesale trunk segments of leased lines.

<sup>14</sup> According to the Directives: Article 7 Framework Directive (2992/21/EC)

<sup>15</sup> See footnote 13

In Finland, the Finnish Communications Regulatory Authority (FICORA) is in charge of issues concerning electronic communications and services for the information society. FICORA works to ensure a functioning and effective Finnish market, with the objective of consumers having access to competitive and technically advanced communications services that are reasonably priced and of good quality. FICORA provides market studies and information about prices and competitive conditions, e.g. broadband markets (see [www.ficora.fi](http://www.ficora.fi)).

In Norway, the Norwegian Post and Telecommunications Authority (NPT), with the help of regulation, is in charge of ensuring competition in terms of broadband rollout. In order to further promote competition, the supervisory body publishes regular information regarding prices and competition in the market, and is in charge of various portals, such as [www.telepriser.no](http://www.telepriser.no), which compiles prices and describes market conditions for electronic communications, [www.bredbandsporten.no](http://www.bredbandsporten.no), which provides consumers, service providers and network owners with information concerning broadband, and [www.nettvett.no](http://www.nettvett.no), which provides information, advice and guidance concerning the secure use of the Internet.

The National IT and Telecom Agency (ITST) is the supervisory authority in Denmark that monitors that competition and the development of the electronic communications infrastructure are ensured. This body compiles statistics on corporate market shares, the development of different technologies and their use, aimed at monitoring the competitive situation in the market. In addition, the National IT and Telecom Agency offers a price guide for telephony and broadband products, which enables price comparisons from a given level of consumption at [www.teleprisguiden.dk](http://www.teleprisguiden.dk). There is also a portal providing information and advice about Internet use, for example about Internet security, [www.it-borgerportalen.dk](http://www.it-borgerportalen.dk), and a portal enabling consumers to compare different Internet subscriptions, at [www.internetkvalitetsguide.dk](http://www.internetkvalitetsguide.dk). The aim of the portals is to increase awareness of the options on the end user market and thus promote competition. It is expected that the portals will be consolidated during 2007 at [www.it-borger.dk](http://www.it-borger.dk), which is a subject portal with IT and telecommunications.

In Sweden, the National Post and Telecom Agency (PTS) monitors the fields of electronic communications and postal services. PTS works within four main areas: consumer and competition issues, efficient utilisation of resources, and secure communications. The vision is that everyone in Sweden shall have access to efficient, affordable and secure communications services. PTS compiles data about the market, which is published both as a printed version and on its website. PTS also provides information directed at consumers and end users with the intention of increasing awareness about the market and, in the long term, promoting competition. In conjunction with this, PTS and the Swedish Consumer Agency launched a web service (Telepriskollen),<sup>16</sup> which is a price database. Its purpose is to help private consumers to calculate and compare offerings of the various operators in a similar way, based on their own needs. PTS's website also provides information about the Internet and security at [www.pts.se/internetsakerhet](http://www.pts.se/internetsakerhet), where users are informed about how they can surf

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<sup>16</sup> [www.telepriskollen.se](http://www.telepriskollen.se)

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more safely. The website also offers a test to show whether one's computer is open to intrusion, and which looks for weaknesses in the security of users' computers.

## **2.7 Common denominators in IT policy**

There is a risk of the gap widening between groups in society and regions as well as between generations when making the transition to an information and knowledge society. The lack of access to broadband connections is part of a more general problem known as the 'digital divide', which describes the gap between individuals, undertakings and territories in terms of gaining access to and being able to use information and communications technology. The focus of all of the Nordic countries is on users and all citizens are meant to keep up to date on digital developments, with no one being left behind.

The objective of these countries is also for high transmission capacity 'for all'. This is also the objective of the European Union. Rollout in the Nordic countries is to take place through the market and the governments of Sweden and Norway have set aside funds so that rollout can also take place in areas where the market cannot meet this need.

In the Nordic countries, broadband benefits economic growth by creating new services and opening up new investment and employment opportunities. Broadband also increases the productivity of many existing processes, which leads to higher pay and increased returns on investment.

### **3 Accessibility and use of broadband in the Nordic countries**

Over the past ten years, the majority of people in the Nordic countries have made increased use of information and communications technology. Use of the Internet has increased during this period and is now a part of daily life for many people. The political message is that the digital society should be available to all and that no one should be excluded. For this reason, accessibility is a prerequisite, which means that governments in the Nordic countries are interested in monitoring developments pertaining to broadband availability.

All Nordic regulatory authorities report on broadband developments annually to the respective national governments by compiling information from operators.

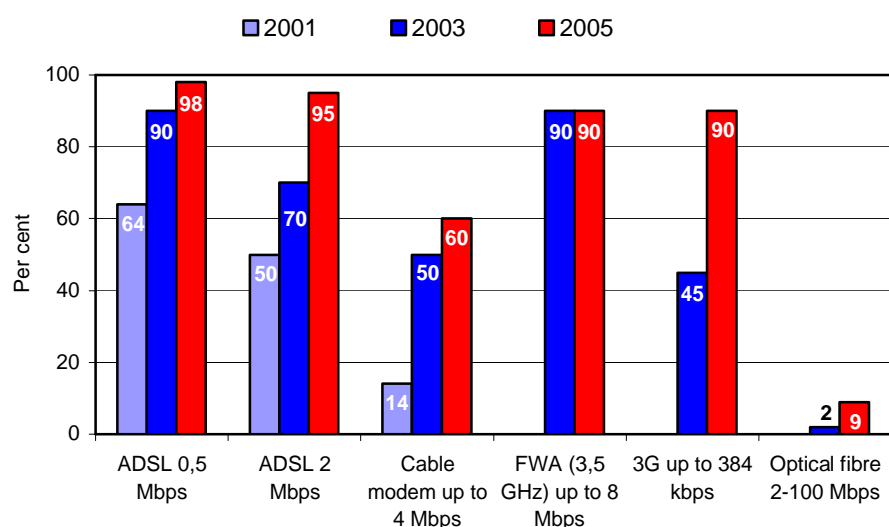
#### **3.1 Broadband over copper access lines**

Accessibility for end users can be defined in several different ways, such as level of coverage, the number of broadband access lines ready for delivery, in addition to actual subscriptions. The level of coverage refers to the proportion of residential customers within an area that theoretically can be offered a broadband subscription. Although there may be coverage, there may, for technical reasons, be practical barriers for customers wanting broadband connections. Thus coverage in an area does not mean that everyone who lives there can obtain broadband at the same time. The number of customers in an area that can be connected to broadband at the same time can be assessed when these practical barriers are taken into consideration. This concept is known as broadband access lines ready for delivery. The number of actual subscriptions shows how many subscribers there really are in an area.

The copper network is the network offering the greatest number of connections in the Nordic countries. Today's access network is mainly designed to provide telephony services, but has gradually been supplemented to meet the new requirements for broadband services.

Figure 1 shows that 98 per cent of the Danish population were able to obtain ADSL with a capacity corresponding to 512 kbits per second in 2005, and 95 per cent could receive a higher speed of 2 Mbps on broadband. According to TDC, 75 per cent of the population should be able to receive broadband at a speed of up to 20 Mbps by 2007.

**Figure 1 Accessibility to broadband in Denmark in 2001, 2003 and 2005**



Source: National IT and Telecom Agency, Denmark

In contrast to the other Nordic countries, Finland has a number of local markets that include some 40 local network operators having a considerable influence on each market segment. This means that Finland has considerable regional differences regarding the quality, speed and price of broadband offerings. In practice, however, the last mile network covers the whole population. Despite regional differences, xDSL is the technology that is most commonly used for broadband in Finland and, according to the National Broadband Strategy,<sup>17</sup> 96 per cent of the population were able to obtain broadband connections through fixed access networks in September 2006. The main part of the population unable to obtain broadband are those living in the more sparsely populated parts of Finland.

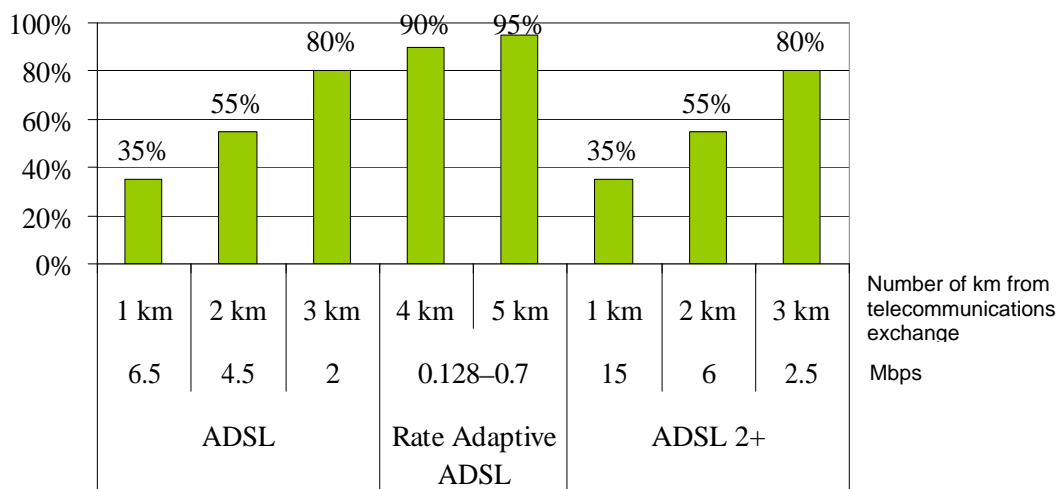
In Norway, Telenor's access network basically covers all residential customers in the country and the level of coverage for ADSL is approximately 91 per cent,<sup>18</sup> i.e. the proportion of residential customers who have access to ADSL. The operator has carried out certain upgrades of the last mile network and, according to calculations, a maximum of 95 per cent of residential customers should theoretically have access to broadband if all of Telenor's telecommunications exchanges were fully upgraded. Telenor has rolled out fibre cable between the telecommunications exchanges and to the connection points, which means shorter subscriber lines and thus an increased potential to provide broadband to Norwegian consumers. The upgrades mainly pertain to the largest communities and metropolitan areas. In addition to these upgrades, Telenor has also rolled out fibre cable to large corporate customers.

<sup>17</sup> *Den nationella bredbandsstrategin, mellanrapport III* [the national broadband strategy, interim report III] <http://www.laajakaistainfo.fi/english/report271005.php>: "In September 2006, there was 96 per cent accessibility."

<sup>18</sup> End of 2006 according to Telenor

Figure 2 illustrates the distribution of end user accessibility to Telenor's copper-based access network, taking consideration of the distance from the telecommunications exchange and the maximum capacity that can be delivered. The bottom of the figure illustrates accessibility to Telenor's access network. Approximately 80 per cent of all Norwegians live no more than three kilometres from the telecommunications exchange and can receive ADSL at a speed corresponding to 2 Mbps. Approximately 35 per cent of end users live within 1 kilometre of a telecommunications exchange and can receive ADSL at a speed of 6.5 Mbps. Limitations to the provision of broadband are, for example, the result of a lack of available copper pairs in the telecommunications exchanges and that not all copper pairs can be used for xDSL, in addition to customers having overly long subscriber lines. However, Telenor has announced that it intends to continue upgrading some of the small telecommunications exchanges with DSLAM equipment. This nevertheless means that there will be a large number of small exchanges that neither Telenor nor any other operator will find profitable to upgrade using DSLAM equipment.

**Figure 2 Telenor's broadband coverage via the copper access network, January 2006. Distributed by form of access (ADSL variants), number of kilometres from the telecommunications exchange and Mbps**



Source: Assessment of broadband coverage: technical possibilities and limitations, Norwegian Post and Telecommunications Authority, 9 January 2006

By the end of 2005, up to 93 per cent<sup>19</sup> of residential customers in Sweden with fixed telephony were connected to exchanges equipped with broadband nodes (DSLAM). The number of broadband access lines in the copper network ready for delivery depend on the DSLAM capacity that is installed and the quality of the telephone line. In the spring of 2006, 2.2 million residential customers in Sweden had connections ready for delivery, corresponding to 49 per cent of Swedish households. Compared with the previous year, this was an increase of some 700 000 connections.

<sup>19</sup> Source: TeliaSonera AB

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## 3.2 Cable television

The second most common form of access in the Nordic countries is broadband access through the cable television network. These connections must be upgraded in order to supply broadband using routers and return-activated sockets.

The Danish cable television network has been upgraded and, by the end of 2005, more than half (60 per cent) of Danish residential customers could receive broadband through either of the two main operators: through TDC's cable television network or through Telia Stofa's network. TDC's network has been fully upgraded with return-activated sockets, whereas Telia Stofa has only upgraded half of its cable television network.

More than half (58 per cent<sup>20</sup>) of Finnish residential customers could receive cable television in 2005. There are a total of 35 local cable television operators in Finland, and 17 cable companies have announced that they also offer broadband access through the cable television network. Of all cable television connections in Finland, 84 per cent had been upgraded with bidirectional sockets by 2006.

Many people in Norway also have access to cable television, where there are two large networks. These networks are owned by Get (previously UPC Norge) and Canal Digital; the latter is in turn owned by Telenor. The cable television network covers approximately 50 per cent of Norwegian households. However, not all households with cable television have had their connections upgraded and can receive broadband.

By 2006, over 2.5 million<sup>21</sup> Swedish residential customers had access to cable television reception in their homes, which corresponds to just over half of all households in Sweden.<sup>22</sup> However, not all of these households have connections that are upgraded by both a router and a return-activated socket, which are needed for broadband to be supplied. Regardless of operator, one-third of Swedish residential customers have connections ready for delivery according to a PTS report, which corresponds to almost 1.5 million customers. Work to upgrade the cable television network is in progress and the number of connections ready for delivery to residential customers is increasing.

## 3.3 Fibre LAN and FWA

Besides copper access networks and cable television networks, other technologies can supply broadband in the Nordic market, such as fibre LAN and FWA, with the latter being a wireless connection.

In Denmark, FWA, fibre (FTTH<sup>23</sup>) and LAN (FTTB<sup>24</sup>) jointly constitute 10 per cent of the market. When it comes to fibre, the most recent and most important

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<sup>20</sup> In 2004, the total number of residential customers in Finland amounted to approximately 2 415 000 (Statistics Finland). The number of Finnish households with cable television is 1 402 569, i.e. 58% of all households in Finland.

<sup>21</sup> Broadband in Sweden 2006 - *Utbyggnaden av IT-infrastruktur med hög överföringskapacitet* [Rollout of IT infrastructure with high transmission capacity] - PTS-ER-2006:22. Adjusted figure.

<sup>22</sup> According to Statistics Sweden's income classification survey, the number of residential customers in Sweden was 4.4 million in 2004.

<sup>23</sup> Fiber to the home.

development in terms of accessibility on the Danish market is the power companies' rollout plans for optical fibre (FTTH), which cover great parts of Denmark. Next year, these will be able to cover half a million residential and non-residential customers in Denmark and 1.2 million residential and non-residential customers in the long term. The wireless broadband FWA is progressing rapidly in Denmark; rollout began in 2005 with WiMAX services. FWA (WiMAX) is an important infrastructure, mainly in urban areas. In 2007, the Danish National IT and Telecom Agency will auction off frequencies between 3400 and 3800 in the MHz band. According to the requirements, the winner must offer broadband with FWA to the 2 per cent of residential customers in Denmark without access to any other broadband infrastructure, such as DSL or cable television network. Beyond this, there were approximately 1 000 hotspots in Denmark in 2005 based on wireless WiFi technology. This technology is also used to an increasing extent to establish wireless broadband networks in both small and large communities.

As in other countries, wireless connections (FWA/WLL<sup>25</sup>) have also begun to show a more rapid development in Finland. WiMAX is the most common technology for these. Wireless broadband access is, for example, being offered in sparsely populated areas where there is no financial interest in offering broadband through copper or cable television networks. However, the market for end user terminal and network equipment for WiMAX is at an early stage of development. The increased interest in wireless broadband is nevertheless also apparent since FICORA has in 2006 received 30 applications for radio licences, which are to be used to offer wireless broadband. By the end of August 2006, nearly 50 radio licences were granted for wireless broadband networks. In early 2006, the proportion of fibre and wireless connections was still marginal in Finland, as approximately one per cent of all broadband connections used alternative technology. In Finland, a wireless broadband network operating at 450 MHz frequencies is being set up. Digita Oy has been authorised as a network operator. The intention is for the network to have a nationwide coverage and to be operational by April 2007.

There are few customers using wireless broadband in Norway, and fibre LAN is not a major form of access in this country. The largest operator offering fibre LAN is Lyse Tele in Rogaland. WiMAX technology has only recently started to be used commercially in Norway, which means that most customers have the older forms of wireless access, such as LMDS. WiMAX is expected to become an important technology in areas that are unable to receive ADSL via the copper network. This is also the case for wireless broadband based on CDMA 450 technology, which the operator Nordisk Mobiltelefon Norway AS launched in the summer of 2006.

In Sweden, one-fifth of residential customers have access to broadband access lines ready for delivery via fibre LAN. Incidentally, this form of access is the third most common, and the number of technically possible connections ready for

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<sup>24</sup> Fiber to the building. An estimated 80 per cent of all LAN lines are based on FTTB and 20 per cent are copper based.

<sup>25</sup> FWA = Fixed Wireless Access, WLL = Wireless Local Loop

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delivery amounts to approximately 900 000.<sup>26</sup> The number of fibre connections ready for delivery rose by eleven per cent compared to the previous year. The rollout of wireless broadband is taking place in Sweden to a limited extent. None of the operators have a national network. In Sweden, WiMAX is also expected to become an important technology in sparsely populated areas where broadband is not available and where there is no commercial interest in, for example, rolling out ADSL.

### **3.3.1 In summary**

Most residential customers in the Nordic countries can obtain broadband through the copper access network. Some residential customers can even choose between two or more different forms of connection. The extent of this overlap is difficult to assess. What is most common is that residential customers, in addition to xDSL, can also be offered broadband through a cable television network. The number of residential customers who are able to choose between different forms of access will increase when cable television networks and other technologies are upgraded in the different countries.

The copper access networks will continue to be upgraded with DSLAM nodes and more telecommunications exchanges, which will enable shorter subscriber lines and higher transmission capacity for end users. This development work has taken place in major cities and urban areas in the Nordic countries. There is now an increased focus on upgrading the network so that end users in small towns can also be offered broadband through the copper network.

WiMAX, which is an example of wireless broadband, is rapidly developing in the Nordic countries. In Finland and Norway, wireless technology serves as a complement to network bound technology, which is more expensive to both roll out and upgrade in areas that are relatively sparsely populated. Wireless technology will also serve as a complement in Denmark. To a greater extent than in the other Nordic countries, Danish power companies are investing heavily in fibre infrastructure, an infrastructure in which Sweden invested at an early stage. This investment in Denmark is expected to have a major impact on competition, particularly in relation to TDC's copper access network.

### **3.4 Use of broadband**

Internet use, both at home and at work, is more common in the Nordic countries than the average for the European Union. In 2006, 80 per cent of the residents of Denmark and Sweden used the Internet, whereas this percentage was higher in Norway and somewhat lower in Finland. Internet use in all countries rose during the period 2002 to 2006 with the exception of Sweden<sup>27</sup>, where the level seems to have stabilised in the past three years. The Internet is mainly used for e-mail, which residential customers use regularly. Otherwise, the Internet is used when searching for information, for Internet banking, e-commerce, contacts with authorities, chatting and discussion fora.

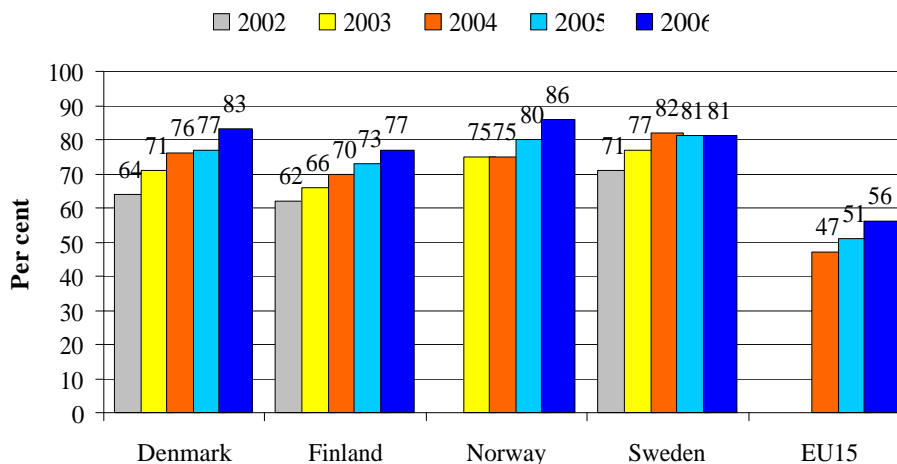
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<sup>26</sup> Broadband in Sweden 2006 - *Utbyggnaden av IT-infrastruktur med hög överföringskapacitet* [Rollout of IT infrastructure with high transmission capacity] - PTS-ER-2006:22

<sup>27</sup> PTS's survey, 'Our demand for electronic communications – a Survey of Individuals', nevertheless shows that Internet use has increased in Sweden (October 2006).

However, parts of the Nordic population do not use the Internet. Reasons vary, but some of the reasons often given in surveys are that residential customers do not feel that they have any need for the Internet or they feel that it is just too expensive.

**Figure 3 The proportion of people between the ages of 16 and 74 who used the Internet at some point during the past three months, 2002-2006**



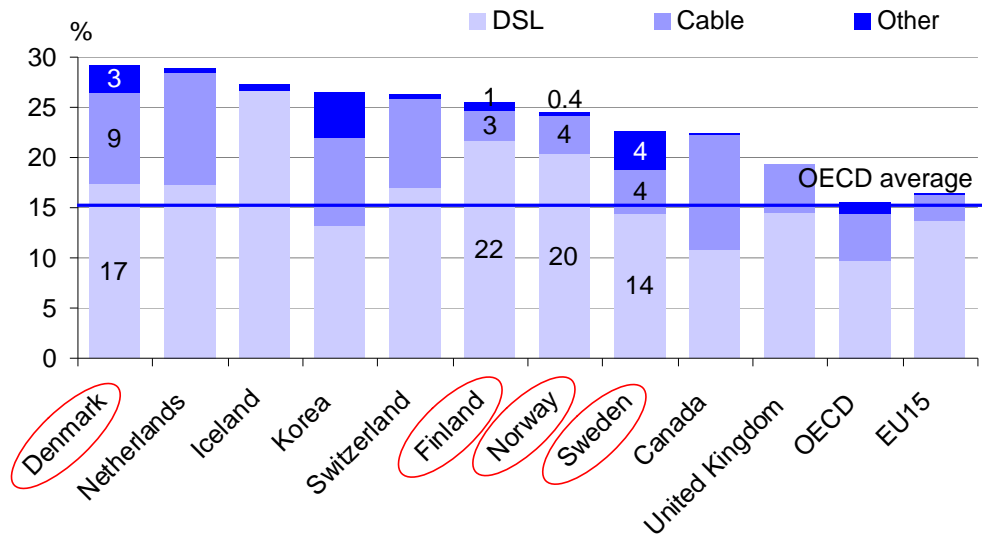
Source: Eurostat

### 3.4.1 Broadband use is rising in the Nordic countries

The trend in the Nordic countries is for most Internet users to either obtain new broadband subscriptions or change from an ordinary PSTN modem or from an ISDN connection to a broadband subscription corresponding to at least the speed of ADSL. In most cases, broadband is chosen so that users can surf faster and because they feel that broadband is less expensive. Other reasons given for replacing the PSTN modem and obtaining broadband instead are related to the functions that the connection is to have. Studies show that broadband is slowly but surely becoming a natural part of a home, as telephones and television have been over the past 40 years.

The percentage of broadband subscriptions in the four Nordic countries amounts to 23-29 per 100 inhabitants, which is significantly higher than the OECD average, where the corresponding figure is 16 per 100 inhabitants. In OECD's comparison from June 2006, all four Nordic countries were among the top ten, with Denmark in first place. The most common type of broadband subscription in the Nordic countries is some form of xDSL technology. Thanks to the considerable coverage in the four countries, xDSL is currently the most important and strongest growing form of access. The second most common form is broadband access through the cable television network. In Sweden, fibre LAN is slightly more common than in the other Nordic countries.

**Figure 4 Broadband subscriptions per 100 inhabitants, distributed by form of access, June 2006**



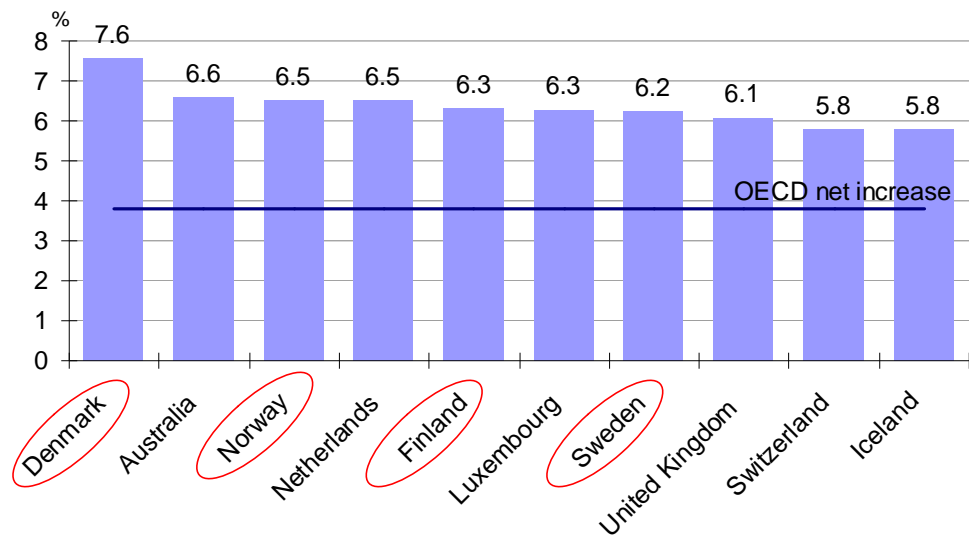
Source: OECD, Broadband subscribers per 100 inhabitants, by technology, June 2006

In the past few years, the number of home PCs and Internet connections used by Nordic residential customers has gradually increased, while dial-up subscriptions are increasingly being cancelled by them to be replaced by fixed subscriptions (e.g. xDSL). Between 2005 and 2006, the number of broadband connections in the Nordic countries rose by 6.7 per cent, which is significantly higher than the OECD average, which was 3.8 per cent.

Out of the four Nordic countries, Denmark has shown the highest rate of growth in broadband connections, at nearly 8 per cent between 2005 and 2006. Sweden showed the lowest growth, at 6 per cent.

One of the reasons behind the increased rate of growth in the Nordic countries is obviously the increased interest in the Internet among the population, but also the development of the existing infrastructure. With xDSL technology, the copper network can be used more efficiently and more customers can be offered broadband. Cable television networks have also been developed. They have been digitalised and return activated, thus enabling broadband and telephony.

**Figure 5 Growth of broadband penetration in OECD per 100 inhabitants, second quarter of 2005 and 2006**



Source: OECD, Broadband penetration (per 100 inhabitants) net increase Q2 2005-Q2 2006, by country

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## 4 Trends in the broadband market

The Nordic broadband markets represent relatively young markets where many operators (ISPs) compete for customers. Here, operators largely focus on different segments of the market and offer different forms of access. Over the past few years, the market for Internet access has been characterised by considerable change, which is clearly linked to the transition from dial-up connection to fixed connection. With the upgrade of cable television networks and the rollout of fibre LAN, certain residential and non-residential customers have received alternative connection possibilities to the Internet besides the copper access network. However, large groups of people lack the freedom of choice between the different infrastructures and for some there is no possibility of obtaining access to broadband at all.

In recent times, there has been a consolidation trend for operators on the electronic communications market. Many operators are attempting to grow through corporate acquisitions and by being able to provide customers with mobile telephony, fixed telephony and broadband. The aim of the acquisitions is often to enlarge their customer base in addition to more efficient use of infrastructure. For example, in Sweden, the Norwegian company Telenor has purchased the Swedish broadband provider Bredbandsbolaget, much of Glocalnet (a fixed network operator), and the Swedish operations of Vodafone, a mobile operator. This means that Telenor has both broadband capacity and mobile capacity in Sweden. This has also been achieved through corporate acquisitions in Denmark.

### 4.1 Former government monopolies

All four countries had a government monopoly for fixed telephony: TDC in Denmark, Telenor in Norway, Telia in Sweden and Sonera in Finland. These operators have been privatised in all of the countries, either partially or entirely, but they have nevertheless continued to own the fixed copper access network in the respective country. However, Sonera's fixed copper access network has never been a national network, but only covers parts of northern and eastern Finland. Instead, Finland has had a large number of local telephone networks; there are currently 37 local network operators besides Sonera. In addition to the copper access network, both TDC and Telenor also own cable television networks. Telia Sonera owns fibre networks in Sweden. Telenor has also been allocated licences for wireless transmission in the 3.5 GHz band; these are known as WiMAX licences.

The former government-owned monopolies are the largest broadband operators in each country. In all four countries, these operators have significant market power on the wholesale market and are thus subject to special obligations. A corresponding situation also applies to the local Finnish network operators.

In all of the Nordic countries, the operators that own copper access networks are subject to obligations concerning the provision of access to alternative operators, either through LLU or bitstream. This is one of the reasons why their market shares within xDSL have shrunk. For example, TDC's share in Denmark on the xDSL market dropped from 81 to 70 per cent during the period 2002 to 2005.

During the same period, TeliaSonera's market share in Sweden pertaining to xDSL dropped from 71 to 48 per cent<sup>28</sup> according to the Survey of Individuals. Similarly, Telenor's market share in xDSL dropped from 65 per cent in 2002 to 58 per cent in 2005.

## 4.2 Operators leading the market

Table 1 shows the largest operators in each country and their market share in the private broadband market in 2005 and for the previous two years. Denmark and Finland's market shares also include the corporate market.

Information on market shares for fixed Internet connections in Sweden is taken from PTS's annual Survey of Individuals<sup>29</sup>, as the Swedish authority's operator statistics for market shares at a residential customer level have not been published. For this reason, the statistics on Swedish market shares are accounted for at an individual level and not at a residential customer level.

The four largest operators cover between 75 and 90 per cent of the broadband market in each of the four countries. Denmark and Norway have a higher degree of concentration than Sweden. Finland's market share is explained by the Finnet Group in this case being presented as one entity. However, in reality it is a loose organisation consisting of 35 operators<sup>30</sup> with their own local telephone networks spread in separate geographical markets.

**Table 1 Market shares for the largest operators in each country, in per cent**

	2003	2004	2005
<b>Denmark</b>			
TDC (incl. Dansk Kabel-TV)	61	59	57
TeliaSonera (incl. Telia Stofa)	15	13	11
Cybercity	6	8	9
Tele2	-	4	5
Tiscali*	3	-	-
<b>Total market share</b>	<b>86</b>	<b>85</b>	<b>82</b>

<b>Finland</b>			
TeliaSonera	30	32	30
Elisa	30	29	33
Finnet Group	20	23	23
Welho	11	7	6
<b>Total market share</b>	<b>91</b>	<b>91</b>	<b>92</b>

<sup>28</sup> Source: Our demand for electronic communications – a Survey of Individuals

<sup>29</sup> The Survey of Individuals is an annual survey of 3 000 randomly selected individuals between the ages of 16 and 75 and who fill out a questionnaire about their telephony and Internet use.

<sup>30</sup> In 2005-2006

<b>Norway</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>
Telenor (incl. Canal Digital)	53	53	53
NextGenTel	16	14	14
Get	10	8	7
Tele2	5	5	6
<b>Total market share</b>	<b>84</b>	<b>81</b>	<b>81</b>

<b>Sweden</b>			
TeliaSonera	46	40	35
Bredbandsbolaget	11	17	22
Com Hem	8	9	11
Glocalnet			7
Bostream*	8	7	
<b>Total market share</b>	<b>73</b>	<b>73</b>	<b>75</b>

Note: Denmark and Finland's market shares also include the corporate market.

\* Tiscali was acquired by Tele2.

\*\* Bostream has been acquired by Bredbandsbolaget.

Source: Finland, Finnish Communications Regulatory Authority (FICORA); Denmark, National IT and Telecom Agency; Norway, Norwegian Post and Telecommunications Authority; and Sweden, National Post and Telecom Agency.

#### 4.2.1 Revenues

Broadband to residential customers generates relatively large revenues in all four countries with a substantial increase having taken place over the past five years. Revenues have increased more than twenty-fold in Sweden, and in Norway, revenues have increased from nearly nothing to EUR 338m in 2005 (see Table 2). On average, revenues per Norwegian residential customer amount to EUR 168, which is substantially more than Sweden's EUR 108 per residential customer. This difference can be partly explained by the greater degree of broadband penetration in Norway, but especially by the higher prices in Norway (see Section 5.2).

In Denmark and Finland, revenues from the corporate market cannot be separated from the revenues arising from the private broadband market. These amounts also include other types of Internet revenues. For this reason, it is not possible to make a fully objective comparison between the Nordic countries' revenues in the private broadband market.

**Table 2 Revenues for fixed Internet connection as at 31 December for the years 2000 to 2005 in millions of Euro (excluding VAT)**

	<b>Denmark*</b>	<b>Finland**</b>	<b>Norway</b>	<b>Sweden</b>
2000	373	123	0	22
2001	513	160	0	84
2002	623	180	69	207
2003	770	232	157	270
2004	830	360	239	363
2005	894		338	473

Note: Exchange rate from the European Central Bank as at 24 August 2006.

\* Denmark's figures include residential and non-residential customers. The companies' accounting information has been compiled. As a result of the companies' exchanges of interconnections, some payments are registered as revenue with one operator, while being registered as an expenditure with another operator. The latter invoices the customer and thus also generates income. Therefore, some revenues are counted twice, leading to overall turnover being exaggerated.

\*\* Revenues include both residential and non-residential customers.

Source: National IT and Telecom Agency (Denmark), Ministry of Transport and Communications (Finland), Norwegian Post and Telecommunications Authority (Norway), and the National Post and Telecom Agency (Sweden).

### 4.3 The biggest challengers

In Denmark, Cybercity is the largest competitor to TDC on the ADSL market. The company is mainly based on LLU from TDC (77 per cent of all Cybercity lines are based on LLU with the rest being based on bitstream access lines). Telenor has owned Cybercity since 2005. Cybercity's share of the ADSL market increased from 10 to 15 per cent during the period 2002 to 2005. Cybercity has also launched broadband in collaboration with power companies through fibre infrastructure.

In Finland, Elisa has superseded TeliaSonera as the largest private broadband operator. However, it should be borne in mind that TeliaSonera is still the largest within its traditional geographical market, which does not cover all of Finland. The markets overlap to some extent, as some operators, TeliaSonera and Elisa in particular, are developing xDSL networks in the traditional areas of other network operators. Elisa's original fixed access network was located in the Helsinki area, but the operator has expanded to other regions in Finland by way of corporate acquisitions. Elisa mainly offers broadband through its fixed access network, but it also has a cable television network in the Helsinki area enabled to offer broadband.

The 30 local operators in Finland belonging to the Finnet Group, own their local access networks themselves and offer xDSL through their membership in the Finnet Group under the Finnet brand, DNA.

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NextGenTel is Telenor's largest competitor in the private broadband market in Norway. The company offers xDSL on Telenor's copper network. In sparsely populated areas, where investments in DSLAM are not seen as profitable, NextGenTel operates as a distributor of bitstream products to Telenor. NextGenTel has also purchased national licences for wireless transmission in the 2.3 and 3.5 GHz bands. In the spring of 2006, NextGenTel was acquired by TeliaSonera.

In Sweden, TeliaSonera's most obvious challenger is Bredbandsbolaget, which is Sweden's largest fibre operator with 47 per cent of that market.<sup>31</sup> Through the purchase of Bostream, which offered xDSL through TeliaSonera's copper network, Bredbandsbolaget also became Sweden's second largest operator within xDSL with 23 per cent of that market.

#### **4.3.1 Cable television networks**

TDC's cable television network reaches 42 per cent of Danish residential customers and is return activated so that all of its customers can have access to broadband. In addition, the TDC Group owns Dansk Kabel-TV, which has four per cent of the Danish broadband market and 11 per cent of the cable television market. This means that TDC is the largest operator in the Danish market for broadband access through cable television. From 2002 to 2005, the TDC Group's market share for broadband access through cable television rose from 31 to 54 per cent.

In Norway, Telenor owns several cable television networks through its subsidiary Canal Digital Norge AS. The numbers of broadband customers using these networks, on the other hand, constitute a relatively small proportion of Telenor's broadband customers.

##### *Specialised cable television operators*

There is a specialised cable television operator in each of the Nordic countries among the four largest broadband operators on the private market: Get in Norway, Telia Stofa in Denmark, Welho in Finland and Com Hem in Sweden.

Of the four largest broadband operators in Norway, only Get offers broadband on a large scale outside Telenor's copper access network. The cable television network has mainly been rolled out in Oslo and other major cities. Through its acquisition of small companies, Get also has a small number of private customers with both fibre LAN and xDSL access lines, which are independent from Telenor. Get has also purchased licences for wireless transmission in the 3.5 GHz band.

Since 1995, TeliaSonera has owned Telia Stofa in Denmark, which covers some 600 000 residential customers through its cable television network, 350 000 of whom are able to obtain broadband. However, between 2002 and 2005, Telia Stofa lost a considerable market share of broadband access through cable television, from 61 to 32 per cent in 2005. Telia Stofa has provided broadband

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<sup>31</sup> Market shares taken from 'Our demand for electronic communications – a Survey of Individuals 2005', PTS.

through ADSL to residential customers in Greater Copenhagen since 2005.<sup>32</sup> Telia Stofa also took over a number of ADSL customers in connection with its acquisition of Orange in 2004.

In the Helsinki area, the cable television operator Welho is so large in terms of broadband that the company is for this reason alone now Finland's fourth largest private broadband operator, with six per cent of the overall market in January 2006. In Sweden, Com Hem has 65 per cent of the market for broadband access through cable television.

#### *Other operators*

Tele2 is one of the four largest private broadband operators in both Norway and Denmark. The company utilises the national copper network in both countries; in Norway almost exclusively through the resale of Telenor's bitstream product rather than using LLU, whereas Tele2's Danish operation uses both LLU (one out of three broadband lines) and bitstream access lines (two-thirds of all lines). However, Tele2 has announced that it also will mainly invest in LLU in Norway in the future.<sup>33</sup> In Denmark, Tele2 acquired Tiscali's Danish operation in 2005, which up until 2003 was one of the four largest Internet service providers in Denmark.

The majorities of Finland's cable television operators are also DSL operators or belong to the same group. In Sweden, the third largest xDSL operator is Glocalnet, which has 10 per cent of the market. Glocalnet provides xDSL on TeliaSonera's copper network.

#### **4.4 Increase in residential customers' use of broadband**

This section discusses broadband penetration in each country over time as based on the proportion of residential customers connected and the number of overall residential customers. The statistics are then broken down by various forms of access, such as xDSL, cable television and fibre LAN.

According to OECD, which studies the proportion of people with broadband connections per 100 inhabitants, broadband penetration is the highest in Denmark and Finland (see figure 4). According to Eurostat, broadband penetration is highest in Denmark and Norway, where 63 and 57 per cent respectively of residential customers have broadband connections, compared with 53 per cent in Finland and 51 per cent in Sweden (see Figure 6). The spread of broadband has been substantial over the past three years. This rate of increase has been greatest in Norway and Finland, where the number of connections has increased nearly five-fold. Denmark has always been at the forefront, whereas Finland has shown somewhat lower growth than the other countries for most of the period. At the same time, broadband penetration in Sweden has shown a reverse trend compared with Norway, from representing the highest penetration of the four Nordic countries to the lowest. However, from an international perspective, all four countries have a relatively high level of broadband penetration.

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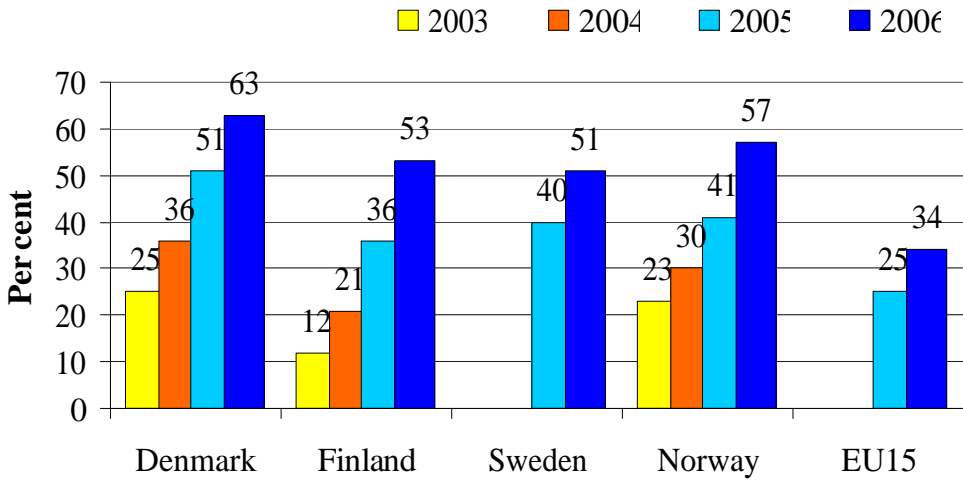
<sup>32</sup> <http://www.stofa.dk/showpage.php?mid=61>

<sup>33</sup> Source: [www.tele2.no](http://www.tele2.no)

The EU Member States with the greatest degree of penetration (more than 15 per cent) all have a high degree of cable television rollout, but often advanced access regulation as well, e.g. involving the leasing of access networks or bitstream access.<sup>34</sup> It is apparent that an effective implementation of access regulation in the Nordic countries may have contributed to a high degree of penetration in terms of broadband. For example, in Denmark and Finland, access regulation concerning the copper access network had already entered into force under the former EU regulatory framework, as early as 1996 in Finland and as early as 1998 in Denmark. In early 2006, Denmark and Finland were among the five countries with the highest degree of broadband penetration in Europe.

Norway's rapid growth can partly be explained by the fact that Telenor had a late start when it came to offering broadband to residential customers.<sup>35</sup> The fact that Sweden has fallen behind is more difficult to explain. The level of broadband coverage is actually slightly lower in Sweden than in the other countries. In 2006, the theoretical level of coverage in Sweden was 93 per cent compared with approximately 95 per cent in both Norway and Finland and 98 per cent in Denmark. The differences in the level of coverage are nevertheless too small to explain most of the difference between the countries in terms of residential customer broadband penetration.

**Figure 6 Proportion of residential customers in the Nordic countries using a broadband connection to the Internet, spring 2003-2006**



Source: Eurostat

It is interesting to note that Sweden currently has significantly more residential customers subscribing to dial-up Internet connections than the other three countries, which indicates that Swedish Internet users may be less inclined to

<sup>34</sup> European electronic communications regulation and markets 2005 (11th report) [SEC (2006)193]. Brussels, 20 February 2006, COM (2006) 68

<sup>35</sup> Telenor started to provide ADSL to the private market in 2000.

change over from dial-up Internet connections to broadband.<sup>36</sup> Nevertheless, a quick comparison between Sweden and Norway shows that broadband is relatively less expensive in Sweden than in Norway compared to dial-up Internet connections. This means that the Swedish pricing structure should encourage a changeover to broadband. The reason for the lower number of broadband customers in Sweden may be a lack of bitstream access.

It is a fact that low prices cannot explain the greater degree of broadband penetration in Denmark and Norway, as suggested by the price comparison in this report (discussed in Section 5.2). It shows that broadband is less expensive in Sweden and Finland than in Denmark and Norway. Since neither the rollout of broadband nor their prices can explain why Denmark and Norway have a greater degree of broadband penetration, the answer should be found in circumstances related to demand rather than supply.

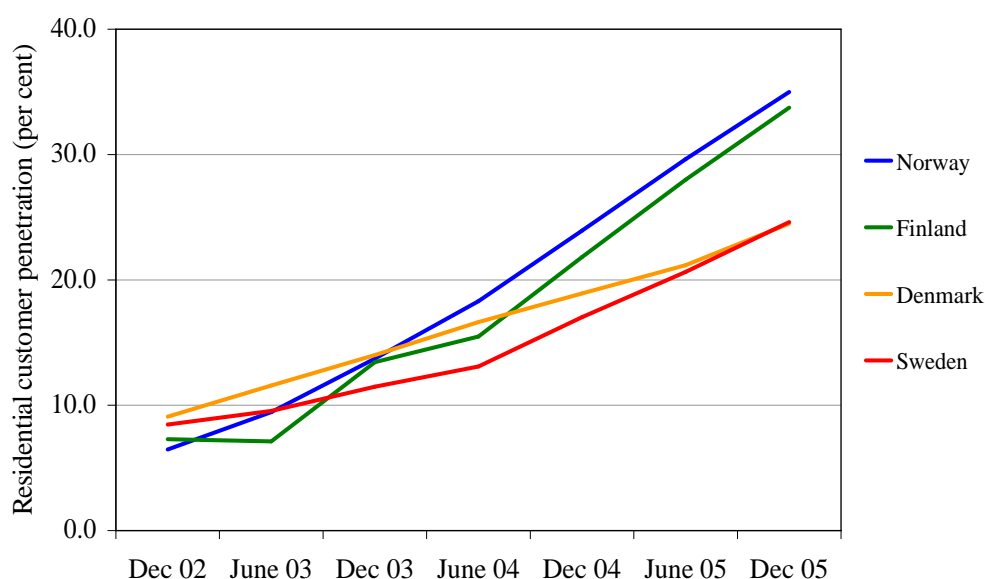
Thus, the demand for broadband from residential customers appears to be greater in Denmark and Norway. Figure 10 later in this section shows whether the demand in both countries is greater at high speeds or only for fixed connections. It compares the percentage of types of broadband in the different countries at speeds of at least 2 Mbits per second.

When it comes to xDSL connections in the four countries, Norway and Finland have increased their distance from Sweden and Denmark over the past three years (see Figure 7). It is likely that this is a result of many people having obtained access to broadband through cable television in Denmark and through fibre LAN in Sweden, which has reduced the demand for xDSL in both countries. However, it should be borne in mind that during the same period, xDSL has been the most common technology in all of the countries, with this form of access representing the largest proportion of new subscribers each year.

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<sup>36</sup> These statistics must be interpreted with caution, as many people in Sweden have free Internet subscriptions that are not always used.

**Figure 7 Penetration, active residential customers with xDSL connections, 2002-2005**



Note: Denmark's figures are based on the National IT and Telecom Agency's estimate that 74% of xDSL subscriptions comprised residential customer subscriptions as at 31 December 2005.

Finland's figures are based on FICORA's estimate that 80% of xDSL subscriptions comprised residential customer subscriptions as at 1 April 2006.

Source: National IT and Telecom Agency (Denmark), FICORA (Finland), Norwegian Post and Telecommunications Authority (Norway), and the National Post and Telecom Agency (Sweden).

Denmark is the leader in respect of Internet access through cable television and has shown greater progress than the other countries over the past three years. (See Figure 8.) One of the reasons may be that operators in Denmark have, as mentioned previously, return-activated their cable television networks to a greater extent than those of Swedish and Finnish operators.

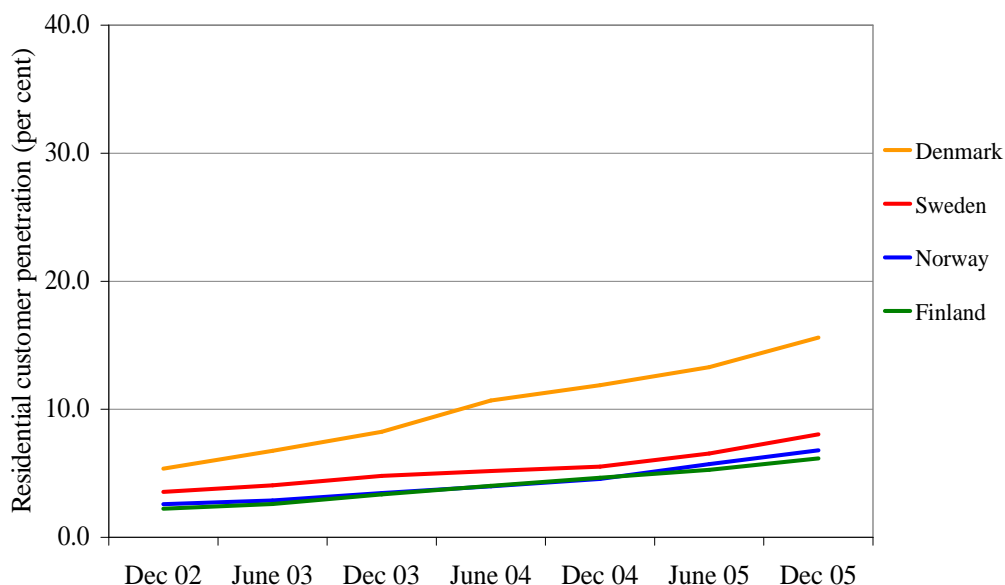
In Sweden, the largest cable television network, Com Hem, was also previously owned by the operator that owned the copper access network, i.e. Telia. Telia was forced to sell its cable television company for reasons of competition law in conjunction with its merger with the Finnish company, Sonera, in April 2004. On 31 December 2004, only 400 000 residential customers in Sweden had access to return-activated cable television, which was less than one-sixth of all households with cable television in Sweden.<sup>37</sup> The new owner of Com Hem has now increased its focus on the return activation of Com Hem's network.

In July 2006, approximately 155 000 customers in Norway had broadband access through the cable television network. However, there is still a lack of information about the degree of return activation in Norway.

<sup>37</sup> Source: Broadband in Sweden 2005

Most of Finland's 38 xDSL operators are also cable television operators. Some operators are investing more in return activation than others, but, as a whole, the percentage of return-activated cable lines in Finland was 84 per cent in June 2006. The number of customers who receive broadband through the cable television network in Finland has increased from 81 000 in 2003 to 150 000 in 2005. Infrastructure competition between the cable television and xDSL networks is most prevalent in the Helsinki region, since Welho (formerly Helsinki Television) is independent from those operators, who owns the bidirectional cable TV access network.

**Figure 8 Penetration, active residential customers with Internet access through cable television, 2002-2005**



Source: National IT and Telecom Agency (Denmark), FICORA (Finland), Norwegian Post and Telecommunications Authority (Norway), and National Post and Telecom Agency (Sweden)

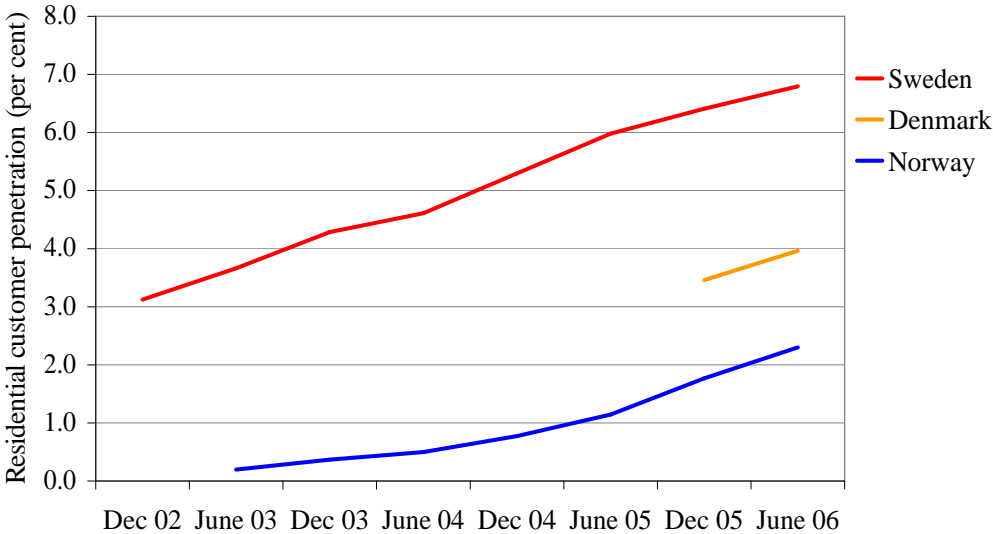
Sweden is the Nordic country with the largest percentage of broadband customers via fibre LAN, followed by Denmark and Norway. Finland was unable to report on residential customers with fibre LAN separately, as this market share is marginal.

In July 2006, over 45 000 Norwegian residential customers received broadband through fibre LAN, which is just under 5 per cent of the broadband market and corresponds to 2 per cent of all residential customers. Denmark has a few more, at 110 000 fibre LAN customers, corresponding to 4 per cent of Danish residential customers. In June 2006, just under 7 per cent of Swedish residential

customers had fibre LAN, which corresponds to 303 000 Swedish residential customers.<sup>38</sup>

Sweden's greater focus on fibre LAN is the result of active commercial interest as well as political interest. The Swedish Government set up a special infrastructure programme in conjunction with the IT Bill 'An information society for all'<sup>39</sup> to provide guidance and facilitate the rollout of IT infrastructure by the market. The central government nevertheless has an overall responsibility to ensure that IT infrastructure with high transmission capacity is available throughout the country. The central government's responsibility has, for example, been expressed through municipalities being able to receive support for rollout which would be unlikely to take place on purely commercial grounds. The support that was available and to some extent is still available for the municipalities is mainly to be used for procuring networks. In the event that no acceptable offers are received, the municipalities can decide to set up, own and operate the networks themselves.

**Figure 9 Penetration, active residential customers with Internet connections via fibre LAN in Denmark, Norway and Sweden, 2002-2006**



Note: Denmark: no data available for the period December 2002 to June 2005. No data is available for Finland.

Source: National IT and Telecom Agency (Denmark), Norwegian Post and Telecommunications Authority (Norway), and the National Post and Telecom Agency (Sweden)

Broadband penetration is greater in Denmark, Finland and Norway than in Sweden, but Sweden nevertheless has a much higher percentage of broadband subscribers with rapid connections than the other countries (see Figure 10). In Sweden, more than half of all fixed connections have a connection speed of at

<sup>38</sup> The Swedish Telecommunications Market – first half year 2006, PTS

<sup>39</sup> 1999/2000:86, www.regeringen.se

least 2 Mbits per second. In Norway, less than one in five residential customers has fixed connections that can achieve these speeds, whereas in Denmark, this figure is one-third of residential customers. As discussed in Chapter 5, Swedish prices are much lower than those in Denmark and Norway, particularly for broadband with higher transmission capacity, which could be one reason why the percentage of users is higher in Sweden than in the other two countries.

The fact that Sweden has a larger percentage of residential customers with rapid connections is largely thanks to the rollout of the fibre networks in Sweden. The high transmission rates offered by fibre networks have increased the competition and have also led to higher rates being offered through cable television and xDSL.

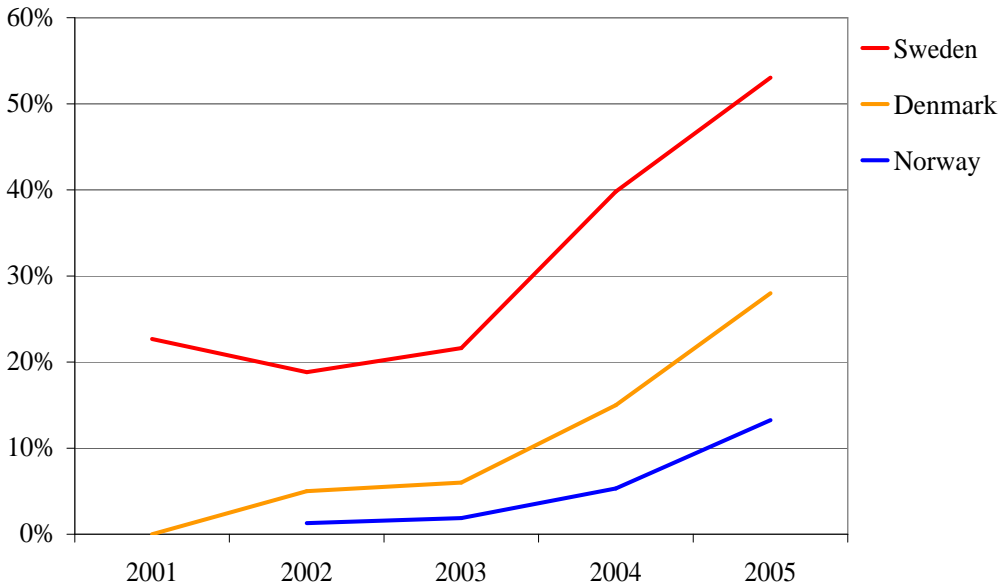
In Denmark, several different technologies, such as FWA, LAN, fibre and cable television networks, have contributed to the infrastructure competition, with the cable television network contributing the most. Another important reason behind the lack of supply and demand for high transmission capacity in Denmark is possibly the fact that the cable television network does not have the same transmission capacities as fibre LAN.

One way competition for lines with a high transmission capacity can increase is the presence of operators offering broadband only in densely populated areas and using only LLUB rather than bitstream access. This can be done at relative low costs even for high transmission rates. Until recently most operators in Denmark has been supplying every single home (98 percent) using bitstream access in sparsely populated areas.

Nevertheless, during the last six months of 2005, a number of new operators entered the Danish market and have been offering broadband to residential customers in urban areas. Broadband from these operators is offered via LLU, fibre LAN or WiMAX/FWA. The result of this can now be seen on the Danish market where also the bigger nationwide companies has been forced to supply high capacity broadband at more reasonable prices. The situation on the Danish market has so to speak become more similar to the Swedish.

Traditionally, cable television access lines contribute in particular to infrastructure competition in Finland, Norway and Denmark. However, in the future, it is expected that the fibre infrastructure of power companies and FWA and other wireless technologies will particularly contribute to increased infrastructure competition in Denmark. In the case of Norway, infrastructure competition is limited, inter alia, by the fact that the cable television network has not been fully rolled out. As in Denmark, Finnish infrastructure competition is limited by most cable television operators being owned jointly by operators utilising the copper access network.

**Figure 10 Percentage of broadband connections at 2 Mbps or more in Denmark, Norway and Sweden, 2001-2005**



Note: Broadbandconnections: xDSL, PLC, cable television, radio, satellite and other fixed access.  
The Danish statistics also include the corporate market.  
In Finland, the percentage of fixed DSL connections at 2 Mbps or more was approximately 30% in 2005.

Source: National IT and Telecom Agency (Denmark), Statistics Norway (Norway), and National Post and Telecom Agency (Sweden)

## **5 Broadband price trends in the consumer market**

All four Nordic countries have seen similar developments in the broadband market: the Internet is used extensively, there is a clear transition from modem to broadband access and there is an ongoing consolidation process through corporate acquisitions. At the same time, the countries' political objectives all state that the entire population of each country should have access to the digital information society and that no one should be excluded. As discussed in the previous chapter of this report, this means that from a consumer perspective, the accessibility to and use of the infrastructure are of particular importance. Another important matter from a consumer perspective is the price that the consumer has to pay for broadband services.

This chapter compares broadband prices in the four Nordic countries. For the sake of comparability, only three different speeds have been chosen: 0.5 Mbps, 2 Mbps and 8 Mbps. These speeds are offered in most of the four countries.

### **5.1 Prices and costs for a broadband subscriber**

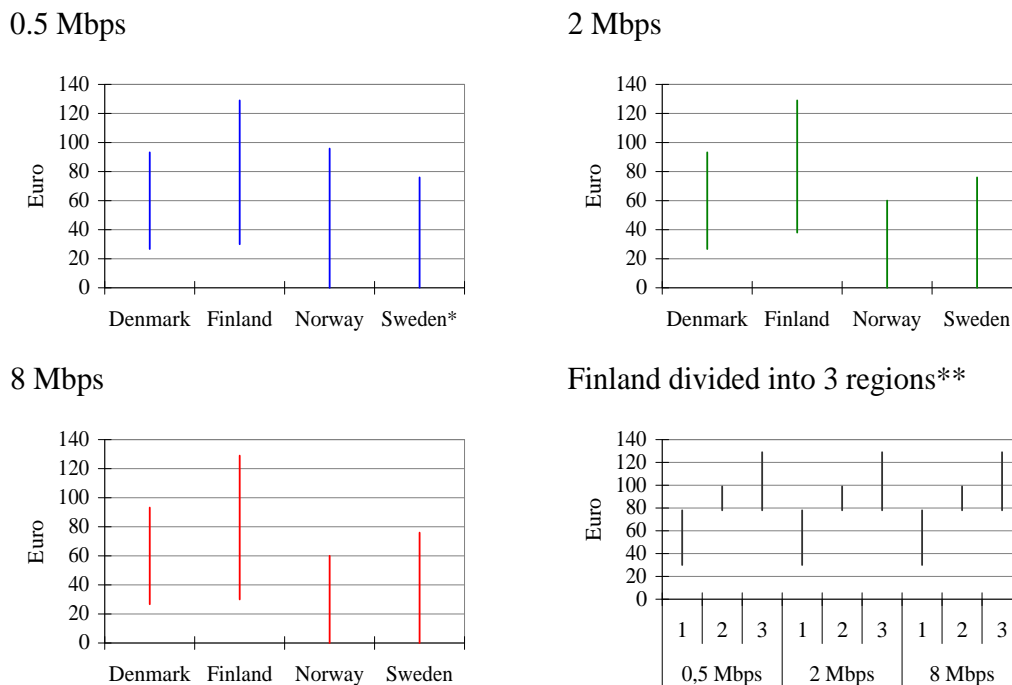
Figure 11 shows the lowest and highest installation costs that the consumer needs to pay for a broadband subscription in the different countries. The cost of installation also includes customer services accessible by telephone, but does not cover support from a technician.

The installation cost for customers in Denmark is within the interval EUR 27-93. Consumers can nevertheless expect free installation, as broadband subscriptions are usually offered together with free installation. The large interval is due to the variation in operators' prices. One of the operators has the same installation charge regardless of transmission capacity. Sweden and Finland have the same interval for such costs, regardless of the speed.

The study covers the price intervals from three different communities in Finland: the capital, Helsinki, the mid-sized city of Oulu and the small town of Sotkamo. The reason for this is that, unlike Norway, Sweden and Denmark, there is not just one fixed access network in Finland, but 38 local access networks. This is why Finland actually comprises several local xDSL markets with price variations. The figure shows all three regions of Finland in addition to a diagram showing the price interval for each region. Finland nevertheless has the highest installation costs, with mainly Oulu and Sotkamo boosting the costs in the country. The highest installation costs in the Helsinki region are still lower than the lowest installation costs of the other two regions.

Regardless of speed, consumers in Norway and Sweden can obtain a broadband subscription at no installation cost whatsoever (i.e. as the lowest cost). In Norway, the highest installation cost for 2 Mbps and 8 Mbps is lower than the highest costs of the other countries for the installation of a broadband subscription.

**Figure 11 Installation costs for broadband, lowest and highest price in Euro, distributed by speed, November 2006**



Note: Exchange rate from the European Central Bank as at 9 November 2006.

Norwegian prices refer to 0.7 Mbps, 3 Mbps and 6 Mbps. The first two speeds are much more common in Norway and are also less expensive compared to 0.5 and 2 Mbps. The 8 Mbps speed is rarely available in Norway and for this reason the price for 6 Mbps is compared, as this speed is offered by the major operators.

\* The price in Sweden refers to the cost of 0.25 Mbps, since none of the four operators offer 0.5 Mbps.

\*\* Finnish prices are divided into three regions. The monthly cost per region is presented in the figure, with region 1= Helsinki, 2= Oulu and 3= Sotkamo.

Source: National IT and Telecom Agency (Denmark), FICORA (Finland), Norwegian Post and Telecommunications Authority (Norway), and National Post and Telecom Agency (Sweden).

Figure 12 shows the interval for the lowest and highest monthly cost for broadband subscriptions offered by the four largest broadband operators in October 2006. This study covers price intervals from three different communities in Finland.

The figure shows that the four largest operators in Sweden have consistently lower monthly prices, with the exception of 0.5 Mbps, where Finland has a lower monthly cost than the other countries. After Sweden, Helsinki has the second lowest prices regardless of speed, see region 1 in the figure. This is despite the fact that broadband prices for low capacities in the Helsinki region have gone up in the past few months. Other parts of Finland also have lower monthly costs for 0.5 Mbps than both Norway and Denmark. The four Swedish operators do not offer 0.5 Mbps, which is why information on Swedish prices for 0.25 Mbps is shown instead, making them difficult to compare with other countries.

It is clearly seen from the table that Denmark has a greater price difference in broadband subscriptions than the other countries. In Denmark, a broadband subscription for 2 Mbps can cost between EUR 40 and EUR 75 depending on which operator is chosen, which is a price difference of EUR 35. The lowest price in Denmark is EUR 40, which is a higher lowest price than the other countries. One reason for this price difference and the higher price is that in Denmark, many different uplink rates are offered for a given downlink rate and the rates that are symmetric (up- and downlink) are more expensive. The relatively high price level in Denmark can also be explained by the fact that operators cannot offer subscriptions to end users with a lock-in period that is longer than six months. The monthly cost for 2 Mbps is EUR 34-47 in Finland, but the difference between the highest and lowest price in the three different regions is only EUR 3.

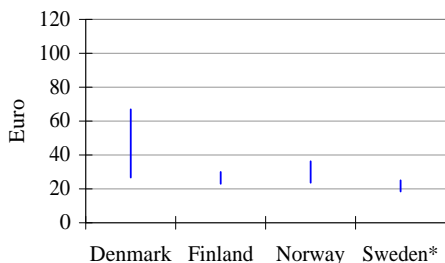
Sweden has the second highest price difference at EUR 10, but, on the other hand, has the lowest price, meaning that a broadband subscription for 2 Mbps costs EUR 22-30, depending on which operator is chosen. In Norway, a corresponding subscription costs EUR 42-48, resulting in a narrow price interval, but a high price level compared with the other countries.

Nordic consumers pay EUR 31-107 for a broadband subscription for 8 Mbps depending on which operator is chosen and the country of residency. Sweden has the lowest price and Denmark the highest. Once again, Denmark has a larger price interval than the other countries, which results in a difference of EUR 54 depending on which operator is chosen. In Norway, users pay between EUR 57 and EUR 60, which is the narrowest price interval; but the lowest price in Norway is also the second highest one after Denmark. In Finland and Sweden, the price difference is EUR 15 and EUR 10 respectively, with Sweden's highest price of EUR 40 being lower than the lowest price of any of the other countries.

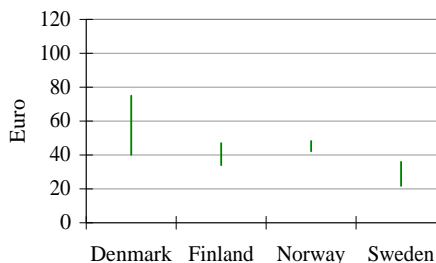
One interesting aspect when analysing the differences in price is that the Danish prices, which were high in the first quarter of 2006, have dropped considerably since then. This is because several xDSL operators have appeared since the second half of 2005, which similarly to operators in Sweden, focus on urban areas through for example LLU and have skipped the more expensive bitstream access lines. Operators that only offer broadband in urban areas through LLU (or FWA) have lower expenses, which has kept broadband prices considerably lower in Denmark and the prices are expected to continue to fall. The reason why competing xDSL operators on TeliaSonera's network in Sweden do not guarantee complete coverage is that bitstream is not yet available.

**Figure 12 Monthly cost for broadband, lowest and highest price in Euro, distributed by speed, November 2006**

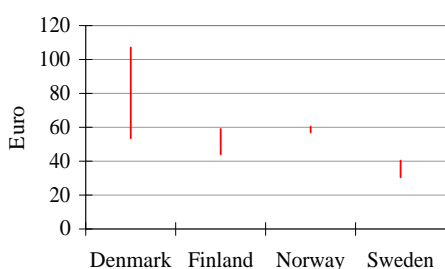
0.5 Mbps



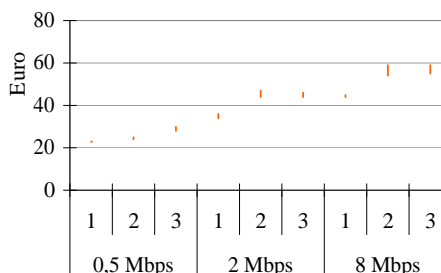
2 Mbps



8 Mbps



Finland divided into 3 regions\*\*



Note: Exchange rate from the European Central Bank as at 9 November 2006. Norwegian prices refer to 0.7 Mbps, 3 Mbps and 6 Mbps. The first two speeds are much more common in Norway and also less expensive compared with 0.5 and 2 Mbps. The 8 Mbps speed is rarely available in Norway and for this reason the price for 6 Mbps is compared, as this speed is offered by the major operators.

\* The price in Sweden refers to the cost of 0.25 Mbps, since none of the four operators offer 0.5 Mbps.

\*\* Finland's prices are divided into three regions. The monthly cost per region is presented in the figure, with region 1= Helsinki, 2= Oulu and 3= Sothkamo.

Source: National IT and Telecom Agency (Denmark), FICORA (Finland), Norwegian Post and Telecommunications Authority (Norway), and the National Post and Telecom Agency (Sweden).

Sweden is characterised by a relatively extensive infrastructure consisting of fibre networks; there is no equivalent infrastructure in the other Nordic countries. The fibre networks enable parallel establishment of infrastructure that competes directly with both the copper and cable television networks. In the majority of cases, the fibre networks are accessible to the same residential customers who already have broadband potential through copper access lines, and often through cable television access as well.

The largest cable television operator in Sweden, Com Hem, is also independent from the owner of the copper network, which is TeliaSonera. Here, there is clear competition between three different types of infrastructure, namely fibre, cable television and xDSL.

In Denmark the largest cable television operator is TDC, the company which also owns the copper infrastructure. This is limiting the infrastructure competition from the cable television network. However a number of other technologies have

appeared in the market and they have all had some impact on prices, which historically have been very high in Denmark compared with other countries. In particular, the rollout of fibre planned by energy companies may exert downward pressure on the price level in Denmark so that it comes close to the level of other Nordic countries for broadband with high transmission capacity.

Broadband prices for end users have dropped sharply in Finland in recent years. In 2005, end user prices dropped by an average of more than 13 per cent, and in the year before, they dropped by 45 per cent.<sup>40</sup> In 2006, the price trend began to stabilise and several major service providers have even raised their prices for low capacities. Some Finnish operators have also cut their prices for subscriptions for high speeds (8-100 Mbps). In its analysis, FICORA has concluded that there is a positive correlation between regional concentration and pricing in Finland, which applies to both end user prices and wholesale prices (LLU and bitstream access lines). The lowest level of concentration is in those regional retail markets with the most infrastructure competition.

There are a number of competing technologies besides xDSL and the cable television network in the countries. In Finland and Norway, there are some areas where operators provide broadband services in a fixed wireless access network through WiMAX technology. Wireless broadband, using 450 MHz frequencies, is also progressing rapidly. In Finland and Sweden, the UMTS networks are being updated with HSDPA, a transmission rate that is approaching the rate for broadband lines in fixed networks. Prices for connections using wireless technologies nevertheless remain higher compared to xDSL. Wireless technologies also mean that end users will need to acquire suitable terminal equipment, such as a plug-in card or a PC and a 3G telephone with Bluetooth.

The prices offered by national operators in Sweden, Norway and Denmark are ordinarily the same throughout the country. However, there are a couple of exceptions. In Sweden, Glocalnet charges EUR 11 more for 8 Mbps if TeliaSonera is the sole broadband provider in the local telecommunications exchange, and in Norway customers of NextGenTel receive a somewhat lower speed at the same price in communities where the company resells Telenor's bitstream product instead of LLU. Obviously, those network operators covering smaller geographical areas in urban areas can have lower costs and thus offer lower prices. For this reason, broadband prices can nevertheless differ substantially between different regions within the same country.

In Finland on the other hand, there are major regional price differences for all broadband speeds. One of the reasons for these differences is the fact that around forty local operators provide broadband services within their own areas. Service providers with operations in a wider area have different prices in different areas. A regional study shows that it is common for all stakeholders within a certain area to price broadband connections at similar speeds in a virtually symmetrical manner. For example, in Sotkamo and Oulu, where the lowest price for 2 Mbps is EUR 44

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<sup>40</sup> Source: *Prisnivån för teleavgifter i Finland 2005* [Price level for telecommunications charges in Finland in 2005], Publication 19/2006 from the Ministry of Transport and Communications

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per month, there is only a difference in the highest and lowest price corresponding to EUR 2 and EUR 3 respectively.

During a comparison of prices, it may be important to bear in mind that there is often no installation charge in any of the Nordic countries during special campaigns. There are also differences in what is included as part of the broadband offerings. The four largest operators in all four countries include e-mail in their offerings, but do not, however, include security packages and paper invoices. In Norway, Telenor and Get offer free antivirus protection and NextGenTel includes a firewall, as this is built into the company's routers. Tele2 in Norway offers its customers a firewall through an additional security package which costs EUR 2.3 per month. In Sweden, however, only TeliaSonera includes a firewall, but with the other three operators charging an additional EUR 4 per month for this. In Denmark, the security package costs between EUR 1 and EUR 3, depending on the operator, and in Finland, between EUR 4 and EUR 7.

TeliaSonera in Sweden includes paper invoices, whereas the other three operators charge an additional EUR 2 per paper invoice. In Norway, end users usually pay extra for paper invoices. In some cases, a discount is provided to customers paying in advance for an extended period of time. Most subscribers in Denmark must pay an administration charge unless they pay through PBS, a payment service, i.e. autogiro. A charge is payable for each paper invoice to the customer.

#### **5.1.1 Private broadband subscription: speed and price**

To clearly illustrate the price situation in the Nordic countries, Figure 13 below shows all subscriptions from the four largest operators in each country. One axis represents the speed and the other the monthly cost. The installation cost is not included here.

The diagrams clearly show that the lowest monthly charges for private broadband subscriptions can be found in Sweden and that Denmark generally has the highest monthly charges. It is also apparent that Sweden has smaller price differences between the various speeds compared to the other countries. This could be explained by the fact that Sweden has rolled out a relatively extensive fibre infrastructure, which in turn leads to more characteristic infrastructure competition for the faster transmission rates.

Finland has greater differences in prices than Sweden, but much smaller differences than Norway and Denmark. As mentioned previously, the cable television operator Welho represents clear infrastructure competition in Helsinki. However, this type of clear competition is not present in most of the country. Prices are also relatively low in many smaller communities, with the first and foremost reason for this being the competition between service providers.

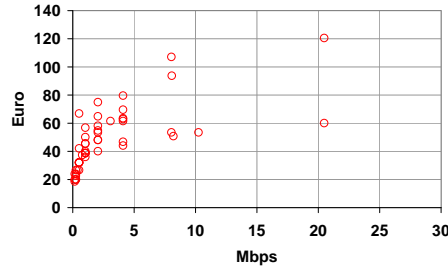
The price comparison between the Nordic countries leads to the conclusion that there is currently no clear correlation between infrastructure competition and price formation. It cannot be ruled out that effective implementation of access regulation has also contributed to increased competition.<sup>41</sup>

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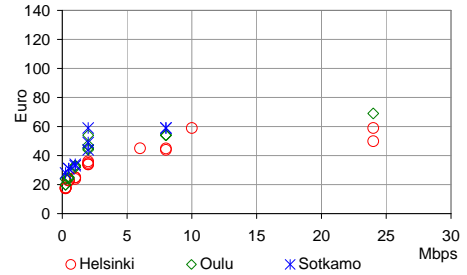
<sup>41</sup> European electronic communications regulation and markets 2005 (11th report) [SEC (2006) 193]. Brussels, 20 February 2006, COM (2006) 68.

**Figure 13 Operators' broadband subscriptions distributed by speed and monthly cost, November 2006**

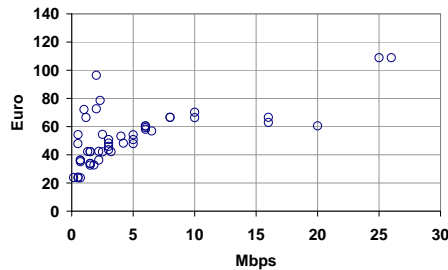
**Denmark**



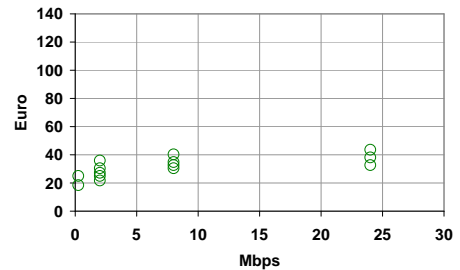
**Finland**



**Norway**



**Sweden**



Note: Exchange rate from the European Central Bank as at 9 November 2006. Prices refer to November 2006. Bredbandsbolaget is offering a subscription in Sweden at 100 Mbps for EUR 35 per month, but this has not been included in the diagram.

Source: Finland, The Finnish Communications Regulatory Authority (FICORA); Denmark, National IT and Telecom Agency; Norway, Norwegian Post and Telecommunications Authority; and Sweden, National Post and Telecom Agency.

**5.2 Recent price trends**

Price competition in Finland has declined in the past twelve months following considerable price cuts in 2004 and 2005. Recent price competition in Finland mainly involves campaigns and other special offers where consumers are offered free installation. The monthly costs in the lowest capacities even rose in 2006. For higher capacities, however, the monthly costs continued to fall in 2006.

In Denmark, the price of broadband installation, at EUR 54-80, has remained relatively constant since 2004, whereas subscription prices have fallen by 25-30 per cent during the same period. As mentioned previously, it was mainly in the first quarter of 2006 that prices dropped considerably, most clearly for the high speeds. For example, the least expensive subscription, with a speed of 8 Mbps, was offered at a monthly charge of EUR 107 at the end of the first quarter of 2006, which dropped by half by the time of the price study from November 2006.

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In Sweden, the monthly cost for all speeds has dropped since the first quarter of 2004. The most marked drops were for 2 Mbps, from EUR 40-50 down to EUR 25-35, and for 100 Mbps (fibre LAN), which Bredbandsbolaget offered on 30 June 2004 for EUR 97, but eighteen months later for only EUR 35. The monthly cost for the other speeds dropped by approximately EUR 5.

The drop in installation costs was even clearer in Sweden. For the four largest operators' subscriptions on 31 March 2004, it was generally EUR 50-160 for installation without a modem, and EUR 150-270 including a modem. Two years later, installation was free without a modem with a few exceptions at EUR 54; in general, the cost was EUR 54-76 including a modem.

In Norway, monthly costs over the past few years have also fallen for most speeds. For example, 3 Mbps cost approximately EUR 80 in the second quarter of 2004, whereas prices during the second quarter of 2006 were within the price interval of EUR 42-48. Installation costs have also fallen and several Norwegian stakeholders are also offering free installation as standard. Previously, free installation was mainly offered during campaigns.

In Finland, broadband prices dropped sharply for end users in 2004-2005. According to the Ministry of Transport and Communications, for example, the average monthly price for 512 Kbit subscriptions dropped from EUR 38 in 2004 to EUR 21 in 2005.<sup>42</sup> During the corresponding period, the price trend for a 2 Mbps subscription fell from EUR 47 to EUR 35. In 2006, the price trend began to stabilise and several major service providers have even raised their prices for low capacities.

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<sup>42</sup> Ministry of Transport and Communications reports (2/2006 and 26/2006).

## 6 Consumers in the broadband market

There are several different types of barrier that have a negative impact on the competition situation in the market. Such barriers may include combination offers, consumers not having the correct information about the market and its stakeholders, or consumers being unaware that they can change operator. The task of the regulatory authorities is to focus on consumer interests. One way is by identifying barriers in the market and informing consumers about the prerequisites on the market.

One clear trend in the Nordic countries and the rest of Europe is that operators are choosing to offer different services as a package. The services that are normally packaged by operators are broadband together with different combinations of fixed telephony, digital television and also mobile telephony. Operators who have access to all of the services in the group or through collaboration with other operators can make attractive combination offers for their customers relatively easily and thus gain advantages in a competition situation. However, operators without the same prerequisites may find it difficult to compete on equal terms.

### 6.1 Market mobility

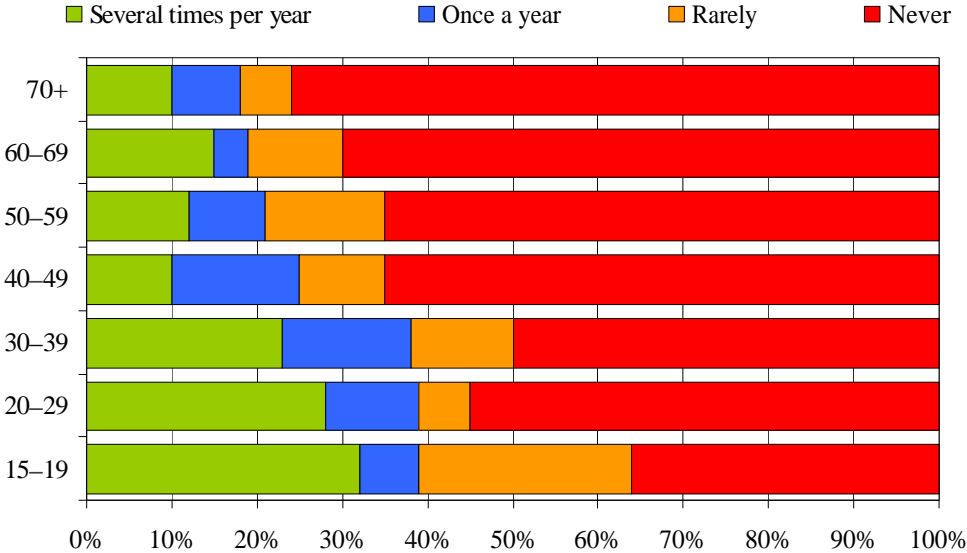
In the market for electronic communications, a lock-in effect may exist in the end user market, which may reduce mobility and thus have an impact on competition. One example of a lock-in effect is known as a transfer cost, which operators generate through various discount and bonus schemes. Discount schemes may be designed so that loyalty over time is attributed particular value or that discounts are associated with the purchase of products from several market segments. A replacement cost may also consist of certain equipment being adapted to a specific provider, so that it cannot be used if the customer should change to a different operator. Another example of a barrier is a lock-in period, which indirectly constitutes a replacement cost. In other words, there are different levels of risk that may limit mobility within the market.

Market mobility is affected by the behaviour of consumers, and this behaviour is in turn affected by the information and awareness that consumers have of the market. Public authorities providing consumers with the opportunity of comparing the services of different operators may be one way of improving market mobility.

The National IT and Telecom Agency in Denmark issues a quarterly price report entitled '*Hallo, hallo – Ved du hvad det koster?*' [Hello, hello – Do you know what this costs?]. The aim of the publication is to generate better price comparisons in the telecommunications market. The National IT and Telecom Agency also provides a price guide on the Internet, [www.teleprisguide.dk](http://www.teleprisguide.dk), which is an interactive tool. This price guide is intended to help consumers calculate the costs for services themselves by estimating their use and then receiving proposals for the least expensive subscriptions based on this use. The price guide is updated continually. This, together with [www.internetkvalitetsguide.dk](http://www.internetkvalitetsguide.dk) and [www.it-borgerportalen.dk](http://www.it-borgerportalen.dk), provides consumers with the opportunity to compare different services.

In September 2005, the National IT and Telecom Agency conducted a user survey in which users were asked how often they consider changing their Internet service provider. Figure 14 suggests the price sensitivity on the market and reflects one aspect of how well competition is functioning. However, the figure does not show how many users actually changed service provider, and consequently how mobile consumers are within the market. Many people actually consider changing service provider one or more times per year, regardless of age. However, younger people consider this more often than older people. Individuals over the age of 39 are less likely to consider changing service provider.

**Figure 14 How often do Danish consumers consider changing broadband operator? September 2006**



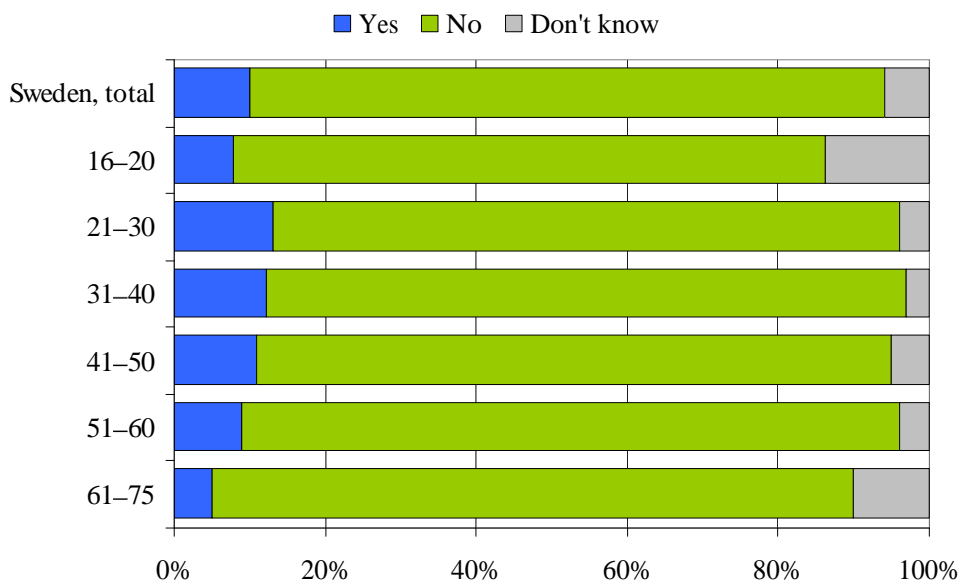
Source: ITST, May 2006: *Undersøgelse af danskernes forbrug af kommunikationsydelser* [investigation of Danish use of communications services]

The Swedish National Post and Telecom Agency (PTS) provides information directed at consumers and end users with the aim of increasing their awareness of the market and promoting competition in the long term. One barrier in the Swedish market is the difficulty that consumers have to compare prices in the telecommunications and broadband markets. PTS and the Swedish Consumer Agency have launched a website called Telepriskollen for this very reason. This website compares prices, lock-in periods and periods of notice. Telepriskollen is updated regularly by the operators.

An end user survey is conducted annually so that PTS can find out about the market from a consumer perspective. The survey, for example, illustrates consumer knowledge of the various phenomena, the services that they use, what they are satisfied or dissatisfied with and customer mobility on the market. Figure 15 shows that 10 per cent of Swedish Internet users changed service provider during the summer and autumn of 2006. This indicated very little change compared with previous years. It was primarily people between the ages of 21 and

50 who changed Internet service provider, with the prime reason for the change being broadband access. The second most common reason for a change is to cut the cost of an Internet subscription.

**Figure 15 Proportion of Swedish Internet users who changed Internet service provider during the summer and autumn of 2006**



Source: Our demand for electronic communications 2006, National Post and Telecom Agency.

A recent consumer survey contracted out by FICORA<sup>43</sup> indicates that only 11 per cent of users had ever changed their broadband service provider. Within the past year about 6 per cent of users had changed service provider. Approximately 40 per cent of customer mobility was related to a move into another house or apartment.

The Norwegian public authority does not have any information on customer mobility within the market.

All four Nordic countries strive to regularly provide information concerning competition in the market. Like Denmark and Sweden, Norway also provides information about market conditions and prices, compiled on [www.telepriser.no](http://www.telepriser.no). The Finnish public authority has a website for consumer information, which includes price comparisons for broadband and other services: [www.ficora.fi](http://www.ficora.fi).

<sup>43</sup> The study was conducted by Suomen Kyselytutkimus Oy with a sample of 1 500 15-79 Finnish-speaking inhabitants (aged 15-79??).

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## 6.2 Lock-in periods and periods of notice

Many subscriptions have a lock-in period. The lock-in period limits the subscriber's ability to change broadband operator. The lock-in period, especially if it is long, leads to lock-in effects within the market. When there are several operators to choose from, shorter lock-in periods can result in increased mobility within the market, and thus contribute to more competition. There is usually a relationship between connection charges and lock-in periods in that the connection charge is higher for a shorter lock-in period and vice versa. The reason for this is that operators want to cover the initial costs that have arisen in respect of the consumer.

In Denmark, operators are not permitted to utilise lock-in periods for private end users for periods exceeding six months. The period of notice for a subscription in Denmark is limited to one month. This is legally binding and thus prevents companies from having long periods of notice that impede competition and mobility within the market. The Danish National IT and Telecom Agency is of the opinion that relatively short lock-in periods are an important assumption for mobility within the market and thus for efficient competition. The duration of lock-in periods has been discussed on several occasions with the aim of this being changed, but there are political reasons for wanting to retain a lock-in period of a maximum of six months. Operators usually require a lock-in period, but there are examples of campaigns in Denmark where customers are not subject to a lock-in period. Compared with the other three countries, which usually have longer lock-in periods, the shorter period in Denmark may be reflected in higher installation costs or fewer campaigns offering free installation.

In Finland, general consumer legislation regulates the lock-in periods of broadband subscriptions and, for example, stipulates that the terms of consumer agreements may not be unreasonable. FICORA has received only few complaints from consumers concerning lock-in periods for DSL.

In Norway, lock-in periods are normally 12 months and the period of notice for broadband subscriptions is one month. This is, however, a matter of contract law and may vary for this reason. Consumers can find information on [www.telepriser.no](http://www.telepriser.no) about the lock-in periods of various subscriptions.

In Sweden, lock-in periods are also a matter of contract law concerning whether they are an unreasonable condition of the contract or not, as per the Consumer Contracts Act. According to regulations, the use of contract conditions that solely benefit the seller at the expense of the consumer are not permitted. Lengthy lock-in periods may be seen as unreasonable, as determined by the Market Court. Lock-in periods for broadband subscriptions nevertheless vary from one month to three years. However, 12 months is the most common lock-in period whereas the period of notice usually varies between one to three months. Consumers can find information on [www.telepriskollen.se](http://www.telepriskollen.se) about the lock-in periods and periods of notice of various forms of subscriptions.

PTS, the Swedish Consumer Agency and KTIB (a consumer agency for telecommunications and Internet matters) provide Swedish consumers with

information about lock-in periods.<sup>44</sup> The websites of PTS, the Swedish Consumer Agency and KTIB provide advice and information, and questions and complaints can be submitted directly to them.

However, it should be borne in mind that the lock-in periods of most Nordic countries are a matter of contract law. The most common operator lock-in period is 6-12 months, although it can be up to 36 months in some cases. The period of notice in the countries often varies between one and three months. So far, the regulatory authorities have only received a few complaints about the term of contracts.

### **6.3 Subscriptions: package solutions or bundling of services**

Traditionally, discussions concerning bundled services pertain to stakeholders with monopolies, who either through their influence or price discrimination have limited consumers' freedom of choice and have attempted to achieve an even more dominant position in the market. Some people also claim that product bundling can also be used on duopoly markets<sup>45</sup>, where leading stakeholders can collude and utilise bundling in order to achieve a dominant position.

The concept of triple play means that one and the same provider, in its own infrastructure, offers all of the three services of telephony, television and the Internet. There are several advantages to bundling. The total cost for customers can be lower than if the same services are purchased from three autonomous operators. Costs are accounted for on the same invoice and the same customer service can be used in the event of any problems. Gains for the provider include economies of scale, since administrative procedures, customer service and existing network infrastructure can be used more efficiently. New services can be launched without the need for much new investment. Another important advantage from the perspective of the provider is the lock-in effect. This means that the more services a customer purchases from the same provider, the less likely the customer is to change provider.

TDC in Denmark offered triple play during 2006 in a package solution combining broadband, telephony and television. In early 2006, all of the operators in Denmark that were studied for this report (with the exception of Telia Stofa) offered IP-based telephony in addition to a broadband line. However, the savings for consumers were relatively limited compared to a traditional PSTN subscription. On the other hand, the price for IP telephony included free telephony to fixed telephones. Package solutions that include broadband, television and fixed telephony are uncommon in Finland, and only a few broadband operators offer bundled services. One of them is Maxisat, which offers a triple play product. Another example is Welho, which offers a bundled broadband and IP telephony service. Finnish consumers are usually offered better agreements for their mobile or fixed telephony subscriptions if they also choose the same operator's broadband service.

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<sup>44</sup> The Swedish Consumer Agency is a government agency aimed at protecting consumer interests in Sweden. For example, it works with consumer issues pertaining to contract terms. KTIB is an autonomous organisation founded in the autumn of 2006.

<sup>45</sup> A market with only two sellers competing with each other.

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In Norway, discounts in connection with package solutions are not common. Telenor offers its customers a package customer discount of five per cent if they opt for fixed telephony, the Internet and mobile telephony. Bundling without discounts is more common, in particular the combination of broadband and fixed broadband telephony. Get and NextGenTel of the four major operators offer triple play.

All four of the Swedish operators studied had package solutions for broadband and fixed telephony during the spring of 2006. TeliaSonera and Glocalnet offered discounted broadband to their pre-selection customers. Com Hem also offered its customers combinations of broadband, fixed telephony and television. During the same period, TeliaSonera also offered digital television for three months on a trial basis combined with broadband during the period in which the study took place. According to PTS's Survey of Individuals, more than half of the Swedes who bought fixed telephony in 2005 bought mobile telephony, television and/or broadband services as well.

## 7 The wholesale market – LLU and bitstream

Broadband is mainly offered through the traditional copper access network in the Nordic countries. As in many other countries, the traditional copper access network is owned by the former government monopolies; in Finland, the network is owned by several local operators. This means that in order to reach their customers, telecom companies wanting to offer broadband to consumers and which do not have their own networks either need to roll out their own access network infrastructure or gain access to and be able to use the existing fixed telecommunications network. The possibility of gaining access to the copper access network is crucial for operators other than the former monopolies to achieve effective competition in the end user broadband market, as a large proportion of consumers do not have access to alternative access networks.

Operators have two main ways of gaining access to the telecommunications network in order to offer broadband to their customers, through either LLU (local loop unbundling) or bitstream access lines.

LLU means that telecom operators lease the copper lines that connect the telecommunications exchange with the customers and lease a location in the telecommunications exchange or in connection to the telecommunications exchange for their equipment, for example their modem equipment. According to the operators themselves, this means that a large number of customers must be connected to each telecommunications exchange for the operators to make a profit from LLU.

Bitstream access is a more refined product than LLU and requires less investment by the operator or service business buying the product. Bitstream access enables small operators to provide their services to customers connected to telecommunications exchanges having fewer customers. The reason for this is that operators can utilise the equipment set up by the dominant operator in the telecommunications exchange instead of investing in their own exchange equipment. Therefore, bitstream access lines enable small operators to offer broadband products where there would otherwise be little potential for competition as a result of a lack of space in the telecommunications exchange or a lack of customers.<sup>46</sup>

In Finland, the market definition of bitstream (and corresponding products) deviates from the definition in the other Nordic countries.<sup>47</sup> The market for bitstream access has followed demand and supply so that it constitutes a separate product from LLU, compared to subscriber lines not including connectivity to the end customer. Operators needing access to the last mile network may, depending on their own needs, either lease both LLU access and bitstream access, or just the last mile subscriber line product. The choice also depends on the competition between the networks, in particular the ADSL backbone network.

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<sup>46</sup> Preconditions for sustainable competition in the broadband sector. PTS-ER-2005:39

<sup>47</sup> See also Appendix 3

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## 7.1 Regulation of the wholesale market

In December 2000, the LLU Regulation, (EC) No 2887/2000, entered into force. The aim of the Regulation was to ensure that operators that did not own the copper access network were given access to the local loop, either through shared or full access. Full access means that an operator leases a copper pair connecting the telecommunications exchange of the network-owning operator. The leasing operator can then have full use of the copper pair and offer telephony, Internet connections or another service within the framework of the pair's physical capacity. DSLAM and switching equipment are needed to connect the copper pairs in the concentration point. The leasing operator can choose to place this equipment in the telephone exchange or in a nearby location.

Shared access means that an operator shares a copper pair with the cable-owning operator in terms of frequency. The leasing operator generally leases the part of the transmission capacity that is not being used for telephony and can thus offer broadband access or another service within the framework of the physical capacity of the copper pair. Normally, the operator leasing out continues to provide telephony in the part of the frequency spectrum that is intended for this purpose. Separation of operators' services takes place through a filter, which is known as a splitter and is often integrated into the broadband transmission equipment. This type of equipment is referred to as DSLAM in a telecommunications exchange.

Denmark had a standard agreement or reference offer as early as 1998, after TDC was obligated to provide other operators with access to the copper access network and to draw up a standard agreement. In Finland, all operators with significant market power as of 1996 were obliged to lease access networks for other telecom operators at a cost-orientated price. In early 2000, TeliaSonera also offered access to the local loop in Sweden prior to the Regulation entering into force. TDC in Denmark, Telia in Sweden, Telenor in Norway and all of the local operators with significant market power in Finland were obligated to adhere to the Regulation once the Regulation entered into force.

The 2002 framework for the regulation of electronic communications services has gradually replaced the LLU Regulation in each Member State. The regulatory authorities are to analyse a number of relevant markets in accordance with this framework and, when necessary, determine one or more operators as having significant market power (SMP). Operators with significant market power should be subject to at least one obligation.

When the national regulatory authority imposes obligations on an operator, it is crucial that these are formulated in such a way that the incentives for companies in the sector to invest in new technology and infrastructure are not undermined in the long term. In addition, the obligations may not impede the companies' innovative capacity or product development. As stipulated by the Commission's and ESA's Recommendation, the Nordic regulatory authorities have analysed 18 various 'relevant markets', including the markets for access to subscriber lines (LLU) and for broadband access at a wholesale level.

In the market for access to subscriber lines, all Nordic telecom operators with significant market power in national or local markets are obligated to lease out

subscriber lines, communications capacity in a subscriber line and room for co-location in telecommunications exchanges. The companies have also been obligated to apply cost-orientated pricing and non-discriminatory contractual terms, as well as to publish their prices and contractual terms.

In the case of broadband access at a wholesale level, Norway and Denmark had already imposed obligations on the dominant operators prior to the new regulatory framework entering into force. In the autumn of 2001, it was decided in Denmark that TDC should make public its standard agreement for bitstream, and TDC published its standard agreement in February 2002. Telenor was obligated to offer bitstream in Norway following an amendment to the Public Telecommunications Network and Services Regulations dated 6 February 2001. When the new regulatory framework entered into force, the supervisory authorities in both countries considered that these operators still had significant market power and were, for this reason, obligated to provide bitstream access as per the new regulatory framework.

Since the local copper access networks in Finland are owned by several local operators, there are 38 operators with significant market power in the Finnish market for access to subscriber lines (LLU) and broadband access at a wholesale level. An obligation has been imposed on all of these operators to publish their delivery terms and price lists, in addition to obligations related to pricing. All of the operators with significant market power in both markets have been obligated to use non-discriminatory contract terms. FICORA has begun the second round of SMP analyses, both for LLU and for bitstream access lines, aimed at adjusting the regulations to current market conditions. The new SMP decisions are expected to be ready by the beginning of 2007. According to the latest market analysis, FICORA issued a proposal in September 2006 regarding the harmonisation of obligations on the LLU market. According to the draft SMP assessment, all operators with significant market power are to continue to be obligated to use non-discriminatory contract terms and to apply cost-orientated pricing together with a transparent account of their costs.

In 2004, determined to be an operator with significant power in the Swedish market, TeliaSonera was ordered to use margin-based pricing (retail minus) to meet all reasonable requests from other operators concerning bitstream access and associated installations. TeliaSonera appealed to the County Administrative Court against this decision. In April 2006, the County Administrative Court ruled in PTS's favour, which led to TeliaSonera seeking leave to appeal from the Administrative Court of Appeal, which in early July 2006 announced that this leave would not be granted. In turn, an appeal was made against the decision of the Administrative Court of Appeal to the Supreme Administrative Court, which granted leave to appeal. The Supreme Administrative Court intends to examine the decision of the Administrative Court of Appeal, and PTS's decision and the decision of the County Administrative Court have been suspended for the time being, which means that the decision regarding obligations does not apply for the time being.

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## 7.2 Price regulation of LLU

With the exception of Finland, the former government monopolies in each country control access to the metallic access networks for telephony. This comprises a structural problem, as the dominant operators, in their capacity of controlling access and in the absence of *ex-ante* regulation, are able to act independently of their competitors, their customers and consumers. There is a risk of operators charging excessive prices or squeezing margins in a way that disfavours competing market stakeholders, and consequently end users. Price regulation is therefore justified.

Price regulation in the form of cost orientation means that the wholesale price is determined on the basis of the expenses of the dominant operator, e.g. based on an FDC model<sup>48</sup>, which is in turn based on historic costs, or on the basis of an LRIC method<sup>49</sup>, which is the long run incremental cost based on the current cost or replacement cost.

### 7.2.1 Sweden and Denmark

As regards LLU, the regulatory authorities in Sweden and Denmark have decided that a cost-orientated price should be calculated according to the LRIC method, as this method best weighs the short- and long-term considerations that are to be made on the basis of the impact on investment, competition and the interests of end users. The LRIC models are updated annually in both countries and a revision or review of the models takes place every three years.

In the beginning, when the LRIC model was used to calculate the prices of LLU, both countries had a price based on the LRIC model and a maximum permitted price that was lower than the LRIC price. A ladder of investment principle was used to cushion the transition to the higher LRIC price, which meant that the highest price was gradually allowed to rise to the LRIC price. Sweden utilises a four-year transition period, whereas Denmark utilised an eight-year transition period.

In Denmark, the LRIC price rose between 2004 and 2005, which was due, among other things, to increased payroll and excavation costs. The model was reviewed in Denmark in 2005, when the capital cost interest was adjusted mainly due to a decline in the risk-free interest rate. This adjustment meant that the LRIC price fell in 2006. In addition to this, the ladder of investment principle was abolished, which means that the price in Denmark is now the cost calculated according to the LRIC model.

The prices calculated according to the Swedish LRIC model remained the same during 2004 and 2005, but fell in 2006. The reason for the difference between 2005 and 2006 is the difference in capital cost interest. In 2005, PTS utilised a

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<sup>48</sup> Fully Distributed Cost Model

<sup>49</sup> The Long Run Incremental Cost (LRIC) method leads to the operator who is ordered to apply cost-orientated pricing for a certain service receiving coverage for relevant costs, assuming that the operation is run efficiently. The fact that the model is based on current costs or replacement costs is justified by the fact that an operator in a competitive world would not price its services on the basis of historic costs, but rather would adapt its prices to the price level applied by competing operators using up-to-date and efficient equipment.

capital cost interest of 12 per cent, whereas in 2006 the authority utilised an interest rate corresponding to 10.5 per cent. The change in the capital cost interest was due to a drop in the risk-free interest rate.<sup>50</sup> In Sweden, the LRIC price is to come into full force in 2007, when the ladder of investment principle is no longer applied (see Table 3 for more details about highest price).

**Table 3 LRIC price in Euro per month for leasing a whole line, 2004 - 2006**

	2004	2005	2006
<b>Denmark</b>	10.6	11.2	8.6
<b>Sweden</b>	12.3	12.3	11.4

Note: Exchange rate from the European Central Bank as at 24 August 2006.  
Source: PTS and NITA

### 7.2.2 Finland and Norway

Neither Finland nor Norway uses the LRIC model; instead, they use the FDC model, which is based on the historic costs of the operators.

In Finland, present value computation is used for each operator's infrastructure assets, while taking operational efficiency into account. This means that the pricing of network operators may not be higher than the corresponding costs arising in an efficient operation. In Finland, cost-orientated pricing is mainly based on proven performance costs. In addition to an obligation to apply cost-orientated pricing, operators can also be obligated to account for their costs. The operator then decides which cost accounting system should be used, with the system subsequently being examined annually by auditors, who send FICORA an auditors' report.

FICORA supervises the market through the authority initiating supervision itself, as well as through disputes and complaints from operators. Like sister authorities in other Nordic countries, FICORA has announced several decisions in conjunction with operators applying charges that were not cost-oriented. The decisions were directed at excessive price levels in terms of both monthly charges and installation charges for LLU. Many price adjustments have also been carried out without FICORA having taken a final decision on a maximum price or other price adjustment. The median price for leasing of a whole line is EUR 11.23 per month,<sup>51</sup> which was unchanged compared to the previous year.

The regulated maximum price in Norway corresponds to EUR 13 per month. Although this is the highest price of all of the Nordic countries, this is considerably less than the previous price of EUR 16 per month.<sup>52</sup>

<sup>50</sup> 10-year treasury bond

<sup>51</sup> This is the median cost, since there are variations between different regions.

<sup>52</sup> NOK 135 as at 24 August 2006. EUR 1 = NOK 8.0755

In the past year, the price of leasing LLU access has dropped in varying degrees in all of the Nordic countries. Prices are lowest in Denmark and highest in Norway, with a difference corresponding to EUR 4.4 per month.

It should be borne in mind that the cost of a shared line corresponds to approximately half the cost of a whole line.

**Table 4 Highest price in Euro per month for leasing a whole line, 2004 - 2006 (median price for Finland)**

	2004	2005	2006
<b>Denmark</b>	8.6	9	8.6
<b>Finland</b>	11.29	11.23	11.23
<b>Norway</b>	16	16	13
<b>Sweden</b>	11.6	11.9	11.4

Note: Exchange rate from the European Central Bank as at 24 August 2006.

Finland: The monthly cost is a median of the 38 operators with significant market power located in the country.

Norway: The prices during 2004 and 2005 are not the highest prices, but a price set by Telenor and accepted by NPT.

Source: Finland, The Finnish Communications Regulatory Authority (FICORA); Denmark, National IT and Telecom Agency; Norway, Norwegian Post and Telecommunications Authority, and Sweden, National Post and Telecom Agency.

In 2006, the estimated average<sup>53</sup> one-off charge for installation when leasing a whole line in Finland was EUR 136.70, which is the highest cost of any of the countries. The estimated cost is based on the 38 operators with significant market power in the Finnish market, but there are major variations between them. In Norway, the corresponding charge is EUR 131. The Finnish and Norwegian charges are approximately EUR 30 more expensive than the charges in Denmark and Sweden.

Between 2005 and 2006, the one-off charge dropped in all countries, with the exception of Norway and Sweden. In Denmark, the charge dropped by EUR 10, whereas there were no considerable cuts in Finland during the same period. However, the Finnish one-off charge has dropped by 20 per cent since 2004, which corresponds to EUR 31.7. In Norway the one-off charge has been the same during the period. PTS's price for 2006 has been appealed by Telia Sonera, and until a decision has been announced, TeliaSonera's price – EUR 158 – is to apply in Sweden.

The price level of connection charges in the Nordic countries is considerably higher than the average price level in EU member states. The average one off

<sup>53</sup> A weighted average of the 39 SMP operators present in the Finnish market

charge for full unbundled local loop was EUR 52.11 in 2005 according to the Commission's 11th implementation report<sup>54</sup>.

**Table 5 One-off charge in Euro when leasing a whole line, 2004 - 2006**

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Denmark</b>	115.1	116.5	106.0
<b>Finland</b>	168.4	138.7	136.70
<b>Norway</b>	130.8	130.8	130.8
<b>Sweden</b>		98.0	115.0*

Note: Exchange rate from the European Central Bank as at 24 August 2006.

Finland: The installation cost is a mean value.

\* TeliaSonera has appealed against PTS's prices; TeliaSonera's price will apply in Sweden until the court has announced a decision.

Source: Finland, The Finnish Communications Regulatory Authority (FICORA); Denmark, National IT and Telecom Agency; Norway, Norwegian Post and Telecommunications Authority; and Sweden, National Post and Telecom Agency.

### 7.3 Pricing of bitstream

In Denmark, prices for bitstream are regulated in accordance with the MHCA method.<sup>55</sup> Prices have remained largely stable since bitstream access was introduced in Denmark. From January 2007, prices for bitstream access will nevertheless be determined using the LRIC method.

In Finland, all of the 38 telecom companies with significant market power have been obligated to apply non-discriminatory pricing for bitstream access. The network operator cannot charge competitors a price that is higher than the price it charges its own service businesses.

In Norway, bitstream access is not regulated in terms of price, but Telenor provides three different categories of bitstream products, Jara ADSL Proff, Jara ADSL Premium and Jara ADSL Basis. The price varies depending on the rate of data transmission offered by the bitstream product, in addition to whether or not a telephony service is supplied on the access. On 1 June 2006, Telenor decided to reduce the price of bitstream and at the same time the price for LLU was cut due to price regulation. In Sweden, margin-based pricing, or 'retail minus', is to be used when pricing bitstream access.

<sup>54</sup> SEC(2006) volume II, page 68. (Commission's 11th implementation report)

<sup>55</sup> Modified historic cost accounting method]

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## **8 Competition problems in the wholesale market**

There are a number of competition problems in the market, and which the regulatory authorities are attempting to reduce or eliminate in various ways. Examples of such barriers include limited access to infrastructure (and the resulting investment costs), established stakeholders' strategic business actions that prevent new operators becoming established, or regulatory barriers. This chapter highlights different competition problems.

### **8.1 Bundling and combination offers**

Bundling and combination offers or various forms of tying<sup>56</sup> can reinforce a company's market power in relation to companies only offering certain products. If products in 'relevant markets' are combined and sold through tying or bundled, it may lead to a company's more widespread market power. For this reason, the supervisory authorities in the different countries are analysing the importance of combination offers and the extent to which these are influencing market power in each individual case.

Until recently, the operator TDC in Denmark bundled telephony and broadband, which meant that TDC required payment for both telephony and broadband even when customers just wanted broadband and not telephony. In connection with the decision on market 12, the Danish National IT and Telecom Agency ordered that TDC may not require telephony at the same time as broadband when customers do not want both products. On the other hand, TDC can charge an amount that covers its expenses. Before this decision was announced, TDC started to offer a product that met the requirements of the National IT and Telecom Agency. There is no longer any bundling of telephony and broadband in the Danish market.

Bundling of telephony and broadband has also taken place in Sweden. PTS has nevertheless ordered TeliaSonera to stop requiring end users to have a telephone subscription for the provision of a broadband access line. TeliaSonera appealed to the County Administrative Court against this order, which announced in a judgment on 24 October 2006 that PTS had grounds for its order.

### **8.2 No room for equipment in telecommunications exchanges**

When operators lease LLU access, the leasing operator must install its equipment in telecommunications exchanges or in a nearby location. Therefore operators with significant market power have to meet reasonable requirements from operators to provide access to telecommunications exchanges. It should also be possible for those operators leasing space to be able to carry out repairs and maintenance to their equipment.

All of the operators in the Nordic countries with significant power in the market for access to subscriber lines are obligated to lease out space in telecommunications exchanges.

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<sup>56</sup> Tying can, for example, mean that a provider, in order to supply a particular product, demands that the purchaser also buys another product or service with no link to the original product or service.

In many cases, problems have arisen for other operators with regard to gaining access to telecommunications exchanges in Finland and Sweden. Supervisory authorities in Finland and Sweden have received different levels of complaints from competing operators. However, in Norway and Denmark, there have only been a few complaints regarding denied access to telecommunications exchanges.

The supervisory authorities in the different countries have noted this problem, and the Finnish authority has clarified that the obligation regarding leased space for the installation of small amounts of equipment refers to DSLAM or the like. They have also determined that operators with significant market power may only refer to non-proportionality in those cases where the positioning of other operators' equipment requires major changes (rebuilding work) in the telecommunications exchange.

PTS visited selected telecommunications exchanges with expert consultants with the aim of making an independent assessment of the possibility of freeing up and offering additional space at telecommunications exchanges. Thereafter, the authority decided that operators should state the reasons behind denied access, and give other operators the opportunity to request an in-depth investigation regarding possible measures for freeing up space.

NPT has imposed a non-discrimination obligation on the SMP operator Telenor, which means that Telenor must retrieve information about the need that other operators have for LLU at the telecommunications exchange well before the rollout of new network centres. In the event of a lack of space at telecommunications exchanges, the non-discrimination obligation requires Telenor's internal network operation to compete for available capacity or space with other operators. In the event that co-location is denied, Telenor is required to document and account for the reason behind this.

A Danish law has been in force since 1998 concerning 'virtual co-location'. If there is no available space in a telecommunications exchange, an operator may require the operator with significant market power to provide space without charge in close proximity to the exchange where the operator wants access. This is why Danish operators do not experience any problems related to a lack of space during co-location.

### **8.3 Long lead times**

Long lead times, i.e. the length of time between a request, order and the delivery of a measure, may be anti-competitive, as long lead times at a wholesale level have a direct impact on the end user. Supervisory authorities have tried to prevent this by obliging all SMP companies to apply non-discriminatory terms, which also include lead times. There are recommendations in a few of the Nordic countries for the lead times that SMP operators should not exceed.

In Denmark, the maximum delivery time for bitstream access lines and LLU in accordance with standard agreements has been determined at 20 working days. The Danish supervisory authority, ITST, has not received any complaints that TDC has not complied with the agreed delivery period. On the other hand, operators have requested a shorter guaranteed delivery period, since they assess that TDC's actual delivery period is, on average, shorter than 20 days.

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According to recommendations in Finland, installations should be carried out without prejudice, and equally rapidly for both lessees and own service providers. One's own service operator may not be favoured so that its own installations are carried out before an order from an other operator having been received at an earlier point in time. Express provision should only occur in special cases and must apply equally for all orders, as rapid provision tends to boost the overall price level. An order confirmation should be sent no later than five working days following the receipt of an order. Unless otherwise agreed, the subscriber line or the transmission capacity in a subscriber line – in accordance with FICORA's recommendation – must be available two weeks following receipt of an order.

Since the Spring of 2004, FICORA has regularly compiled information about lead times and has carried out technical inspections on site at operators to monitor that lead times are non-discriminatory and comply with legislation. In seven decisions taken in 2004 and 2005, FICORA determined that the delivery terms of operators and their procedures were discriminatory during installations for other operators and all operators were obligated to change their procedures.

NPT has imposed on Telenor an obligation that other operators' access to LLU and bitstream be given without unreasonable delays to prevent unnecessarily lengthy lead times. Telenor was also ordered to include compensation in those cases where the company deviated from the agreed delivery time indicated in the standard agreement for LLU, and to apply non-discriminatory terms in order to prevent Telenor having shorter delivery times internally within the company than those applying to competitors.<sup>57</sup>

In Sweden, operators have also complained that TeliaSonera has had overly long lead times and has not provided access to copper access lines on non-discriminatory terms. PTS has ordered TeliaSonera to not discriminate against other operators in terms of delivery times and lead times. TeliaSonera has subsequently introduced new procedures and PTS is continuing supervision within this area.

#### **8.4 Discriminatory information**

Discriminatory information, i.e. access to the same technical and market information concerning the access network, may constitute an impediment to competition. For example, this includes information about rollout plans, the telecommunications exchanges that are to be upgraded for xDSL delivery and the subscribers that may receive broadband. This information is crucial to an operator's efficient management of prospective and existing customers, and thus functioning competition. These problems can to some extent be resolved through an obligation to apply non-discriminatory terms, which applies to all operators with significant market power.

Discriminatory information mainly appears to be a problem in Sweden. Here, operators have notified PTS of deficiencies in quality concerning the information that TeliaSonera has provided in terms of capacity, accessibility and the frequency of updates. Following an order from PTS, TeliaSonera has made information

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<sup>57</sup> Regulation dated 20 February 2006, market 11, Regulation dated 20 February 2006, market 12

concerning the number of active copper access lines per telecommunications exchange available to all operators. PTS continues to supervise the information that TeliaSonera provides and the manner in which it is provided.

In its efforts to change the Danish telecommunications network, TDC has received criticism from other operators concerning the dissemination of information. It is crucial that information about changes during network rollout and the development of the existing network is correct and timely. When new technical facilities or new telecommunications exchanges are being planned, the operators affected must be provided with information within a reasonable period of time, as they need plenty of time to make their own investment decisions.

## **8.5 Squeeze effects**

Squeeze effects arise when the difference in price between an end user service and the wholesale service on which the end user service is based is so small that there is no scope for other operators to compete with the dominant operator in the end user market. Squeeze effects can be prevented by operators with significant market power being obliged to apply non-discriminatory terms by being required to account for costs separately, and by being obliged to apply cost-orientated pricing.

FICORA has compared the price level for subscriber line installation charges for operators with significant market power in Finland and has found that it is considerably higher than the average price level in the European Union.<sup>58</sup> The installation charges impede the operations of competing service providers. FICORA has consequently decided to investigate the extent to which operator charges for connection on a subscriber line and shared access agree with current legislation. In 2005, FICORA investigated all operators with significant market power who were obliged to apply cost-orientated pricing and discovered that the installation charge paid by other operators was almost without exception higher than the charge paid by consumers. In fourteen cases in 2005, FICORA resolved the maximum charge allowed for installation. FICORA is continuing its supervisory work and, in the latest comparison, charges in Finland were still high in relation to other countries.<sup>59</sup>

In Denmark the wholesale price for leasing LLU access is relatively low compared with other countries. In addition, end user prices are relatively high, which may indicate a high margin for Danish telecom operators. It is, however, worth noting that most Danish operators leasing LLU access must also make use of bitstream access lines in order to maintain a national offering. This increases average costs. TDC, the Danish operator, had a geographically differentiated wholesale price for bitstream access lines, whereas end user prices were the same throughout the country. TDC's higher wholesale price in the more sparsely populated parts of Denmark, and where operators consequently would rather lease bitstream access lines than LLU access, may result in squeeze effects, which may have a negative

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<sup>58</sup> The installation charge for a subscriber line in Finland in 2004 was approx. EUR 156, the maximum charge approx. EUR 220 and the minimum charge EUR 84; in 2004, the charge was EUR 75.67 throughout the EU (prices for a whole line).

<sup>59</sup> On 1 May 2006, the average installation charge (weighted average value) for a subscriber line was approx. EUR 137, the maximum charge approx. EUR 202 and the minimum charge EUR 80.

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impact on competition. Following a market analysis in the area, ITST has obligated TDC to apply the same price structure at the wholesale and end user levels. However, following an appeal, The Telecom Appeals Board has revoked the decision of the regulatory authority.

In recent years, NPT has received several complaints that Telenor's bitstream offering contains discriminatory terms which may give rise to squeeze effects in the long term. For example, it involves discounts, which according to some of Telenor's competitors favour Telenor's own internal end user operations in a manner that discriminates against other operators. NPT did not following these complaints find that Telenor had breached its non-discrimination obligation, though Telenor nevertheless amended its terms in some instances following dialogue with NPT.

Like many other operators with significant market power, TeliaSonera is a vertically integrated company and there is a clear risk that squeeze effects may arise. The Swedish Competition Authority filed a lawsuit against TeliaSonera in December 2004 for damages of SEK 144m in a competition impairment penalty. This was due to the company's long misuse of its dominant position in the market by applying a margin between the wholesale price for resale products for ADSL and the retail price for ADSL services offered to consumers by TeliaSonera, and which was not sufficient to cover TeliaSonera's additional costs at the retail level.

## **8.6 Rolling out or rebuilding the copper access network**

TDC, the Danish network operator, has begun to roll out the telecommunications network. Rollout is a natural part of development and is necessary if more rapid transmission rates are to be offered for broadband in the copper access network. Rollout means that new telecommunications exchanges must be set up more closely and in closer proximity to end users. In the long term, this means that other operators must invest in equipment in more cities closer to customers if they wish to continue leasing LLU access from TDC, and this results in higher investment costs. This may mean that it is unprofitable for operators to utilise LLU and they will instead be forced to use TDC's bitstream products. This is a step in the wrong direction in relation to the transition toward infrastructure competition, which is a political ambition in Denmark. This development has also been seen in Norway. Network changes are seen by the regulatory authority in Norway to be a part of technical progress. At the same time, however, it may have unfortunate consequences for infrastructure competition.

In Finland, it has been seen that bitstream may have increased importance in the future as a consequence of changes in the structure of the access networks. Network owners are developing their networks so that fibre links and DSLAM equipment are set up closer to end users, e.g. up to the street and building distribution point. With the help of its renewed network infrastructure, a network operator could, for example, then provide more rapid transmission rates to end users. However, it will become more difficult for other operators to enter the market by leasing LLU access, as there will be insufficient space for their DSLAM equipment. In this kind of situation, leasing bitstream access from the local SMP company may be the only way in which other service providers can keep up with competition in the end user market.

Some Finnish operators with significant market power offer end users a DSL solution that can be installed within 24 hours from the date of the order. To make this possible, the network company has connected all subscriber lines in the area to its own DSL network. For this reason, setting up an end user's connection only requires customer information to be entered into the database. Another telecommunications company that wishes to lease subscriber lines to provide broadband in the same area must, on the other hand, connect the subscriber lines to the other telecommunications company's DSL network. This means a competitive advantage for the network company and a disadvantage for those newcomers who have set up their own DSL networks and provided their own equipment with the intention of only leasing the subscriber lines of the 'last mile' from the local network company. Some of the competing telecom companies have requested the Finnish Communications Regulatory Authority to investigate whether these DSL solutions contravene the regulations. The solutions nevertheless enable a rapid offering of broadband to end users, which is why they are viewed as agreeing with current regulations. Network companies must, however, comply with non-discriminatory contract terms in the wholesale market.

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## Appendix 1 – Data pertaining to Chapter 4

**Table 1** Number of households in the Nordic countries as at 31 December 2004

Country	Number of households	Source
Norway	2 011 000	Statistics Norway
Finland	2 415 000	Statistics Finland
Denmark	2 499 000	Statistics Denmark
Sweden	4 400 000	Statistics Sweden (estimate)

**Table 2** Data for figure 6: Proportion of residential customers in the Nordic countries using a broadband connection to the Internet, spring 2003-2006

	2003	2004	2005	2006
<b>Denmark</b>	25	36	51	63
<b>Finland</b>	12	21	36	53
<b>Sweden</b>	:	:	40	51
<b>Norway</b>	23	30	41	57
<b>EU15</b>	:	:	25	34

Source: Eurostat

**Table 3 Data for figure 7, Number of active residential customers with DSL connections, in thousands**

Half year	Denmark	Finland	Norway	Sweden
31 Dec. 2002	307 *	220 *	130	372
30 June 2003	391 *	215 *	190	420
31 Dec. 2003	473 *	406 *	276	505
30 June 2004	562 *	467 *	368	576
31 Dec. 2004	639 *	659 *	481	749
30 June 2005	715 *	845 *	596	908
31 Dec. 2005	827 *	1019 *	704	1083

\*Danish and Finnish figures also include undertakings. According to the estimate of the Danish National IT and Telecom Agency, 74 per cent of DSL subscriptions were private, whereas 26 per cent were used for corporate purposes as at 31 December 2005. According to FICORA's market review of 1 April 2006, 80 per cent of xDSL subscriptions in Finland were for residential customers and 20 per cent were for non-residential customers.

**Table 4 Data for Figure 8, Number of active residential customers with broadband access through cable television, in thousands**

Half year	Denmark	Finland	Norway	Sweden
31 Dec. 2002	134	54	52	156
30 June 2003	169	63	58	179
31 Dec. 2003	206	81	70	211
30 June 2004	267	97	80	228
31 Dec. 2004	297	112	92	243
30 June 2005	332	127	115	288
31 Dec. 2005	390	149	137	354

Source: National IT and Telecom Agency (Denmark), FICORA (Finland), Norwegian Post and Telecommunications Authority (Norway), and National Post and Telecom Agency (Sweden)

**Table 5 Data for Figure 9, Number of active residential customers with fibre or fibre LAN in the Nordic countries, 2002-2005 (in thousands)**

Half year	Denmark	Finland	Norway	Sweden
31 Dec. 2002			1	137
30 June 2003				161
31 Dec. 2003			7	189
30 June 2004		3 **	10	203
31 Dec. 2004		3 **	16	233
30 June 2005	9 +101 *	2 **	23	263
31 Dec. 2005	12 +105 *	3 **	36	282

\*The first figure pertains to fibre directly to homes. The second figure is LAN networks, which do not need to be fibre in Denmark. These statistics include undertakings.

\*\*Finnish figures include undertakings. Fibre is also not reported separately in Finland, but constitutes part of the 'other' item, as accounted for in the table.

**Table 6a** Data for Figure 10, Percentage of broadband connections at 2 Mbps or more in Denmark, Norway and Sweden, 2001-2005

	2001	2002	2003	2004	2005
<b>Denmark</b>	0	5	6	15	28
<b>Norway</b>		1	2	5	13
<b>Sweden</b>	23	19	22	40	53

Note: Broadband connections: xDSL, PLC, cable television, radio, satellite and other fixed access.

The Danish statistics also include the corporate market.

In Finland, the percentage of fixed DSL connections at 2 Mbps or more was approximately 30% in 2005.

Source: National IT and Telecom Agency (Denmark), Statistics Norway (Norway), and National Post and Telecom Agency (Sweden)

**Table 6b** Number of customers with broadband connections 31/12 (thousands)

	2001	2002	2003	2004	2005
<b>Sweden – Fixed access</b>	<b>432</b>	<b>668</b>	<b>911</b>	<b>1 231</b>	<b>1 727</b>
transmission capacity of 2 Mbps or more	98	126	197	490	916
transmission capacity of 10 Mbps or more			167	258	389
<b>Denmark - Fixed access</b>	<b>152</b>	<b>307</b>	<b>473</b>	<b>633</b>	<b>827</b>
transmission capacity of 2 Mbps or more	0	0.6	6.0	32	143

Note: Fixed access includes: xDSL, PLC, cable television, radio, satellite and other fixed access.

The Danish statistics also include the corporate market.

In Finland, the percentage of fixed DSL connections at 2 Mbps or more was approximately 30% in 2005.

Source: National IT and Telecom Agency (Denmark), Statistics Norway (Norway), and National Post and Telecom Agency (Sweden)

## Appendix 2 – Data pertaining to Chapter 5

This appendix provides data relating to Chapter 5. The prices refer to broadband subscriptions in April 2006.

**Table 1 Data for Figures 11 and 12, monthly and installation costs in Euro for broadband subscriptions, November 2006**

	Denmark		Norway		Sweden*	
	lowest	highest	lowest	highest	lowest	highest
<b>Monthly cost</b>						
Mbps 0.5	27	67	24	36	18	25
Mbps 2	40	75	42	48	22	36
Mbps 8	54	107	57	60	31	40
<b>Installation</b>						
Mbps 0.5	27	93	0	96	0	76
Mbps 2	27	93	0	60	0	76
Mbps 8	27	93	0	60	0	76

	Finland					
	Helsinki		Oulu		Sotkamo	
	lowest	highest	lowest	highest	lowest	highest
<b>Monthly cost</b>						
.5 Mbps 0	23	23	24	25	28	30
Mbps 2	34	36	44	47	44	46
Mbps 8	44	45	54	59	55	59
<b>Installation</b>						
.5 Mbps 0	30	78	78	99	78	129
Mbps 2	30	78	78	99	78	129
Mbps 8	30	78	78	99	78	129

Note: Exchange rate from the European Central Bank as at 9 November 2006.

Norwegian prices refer to 0.7 Mbps, 3 Mbps and 6 Mbps. The first two speeds are much more common in Norway and also less expensive compared with 0.5 and 2 Mbps. The 8

Mbps speed is rarely available in Norway and for this reason the price for 6 Mbps is compared, as this speed is offered by the major operators.

- \* The price in Sweden refers to the cost of 0.25 Mbps, since none of the four operators offer 0.5 Mbps.

Source: Finland, The Finnish Communications Regulatory Authority (FICORA); Denmark, National IT and Telecom Agency; Norway, Norwegian Post and Telecommunications Authority; and Sweden, National Post and Telecom Agency.

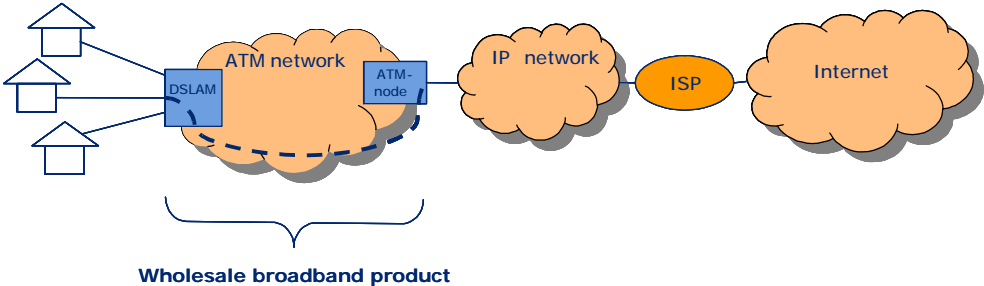
### Appendix 3 – The Finnish market definition, market 12

The Finnish Communications Regulatory Authority has analysed relevant markets in accordance with the Commission's Recommendation and has observed that broadband access at a wholesale level (bitstream or the equivalent, market 12 in the Recommendation) has developed in pace with supply and demand in the relevant geographical markets, so that it constitutes an own product clearly provided separately from subscriber lines. Those requiring access can either lease both wholesale products or only the subscriber line product depending on their needs. The choice also depends on the competition for the network, in particular for the ADSL backbone network.

During leasing, it is crucial that telecommunications service providers that acquire broadband access at a wholesale level are independent service businesses and not distributors. Simple resale is not regulated in Finland. Broadband services at the wholesale level are, however, not tied to a certain network technology. The DSL technology and cable modem technology of the fixed telephone network are the most common broadband technologies used in Finland at the present time. Wholesale-level broadband services are currently being offered in Finland solely through these two technologies. However, the provision of corresponding services through other network technologies is already technically possible.

According to FICORA's market definition, market 12 includes all corresponding broadband services at a wholesale level, regardless of technology. For example, broadband access at a wholesale level provided in the fixed telephone network is usually implemented with a connection from a subscriber line in what is known as the broadband concentrator to the node in the ATM access network. The procurer of the service uses the equipment installed by the network company in the equipment area, e.g. DSLAM. This solution is presented in the following figure:

**Figure 1 Broadband access at a wholesale level in the fixed telephone network**



Source: FICORA

## Appendix 4: Exchange rate

The exchange rates below have been used in this report. The exchange rates are from the European Central Bank as at 24 August 2006.

Table 1 Exchange rate as at 24 August 2006

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100 SEK	=	EUR 9.1906
100 DKK	=	EUR 7.4607
100 NOK	=	EUR 8.0755

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Source: [www.ecb.int](http://www.ecb.int)

