Trends in
European Telecommunication:

2002 Status Report of Denmark's Progress in Telecom Reform and Information Infrastructure Development

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Trends in European Telecommunication:

2002 Status Report of Denmark's Progress In Telecom Reform and Information Infrastructure Development[1]

A. INTRODUCTION—TELECOM REFORM

Telecom reform began as a process of restructuring the traditional telecom services sector. It has since been transformed, along with the telecom network, to encompass information infrastructure development and the steps necessary to prepare the network foundations for information economies and societies. The future economy is often referred to as a "network" or a "knowledge" economy. For its first decade, telecom reform in Europe was directed toward market liberalisation and the extension of telecom services. New services, e.g., mobile and Internet, have been complementary extensions of traditional telephone services. National regulatory agencies have been seen as the major vehicle for promoting liberalisation and the extension of network services. Progress has been measured in terms of benchmark indicators such as number of competitors, market shares, universal service penetration, interconnection and consumer service options and prices. Data measuring these indicators have been gathered and published by the EC, ITU, OECD and other organisations. These indicators provide useful comparisons of progress over time in individual countries, and identify the leaders and laggard countries in implementing various telecom reforms. As this process is far from complete in Europe, these benchmark indicators will be needed to identify and stimulate progress for some time yet.

In recent years, leading countries like Denmark, as well as the EC and other organisations have been looking beyond the conventional telecom network and services, and its benchmark indicators. They are developing and applying additional indicators of progress in information infrastructure development, i.e., the establishment of a ubiquitous, high speed telecom network that provides access to an ever widening range of information and communication services. Denmark's commitment to being a leader in developing its information infrastructure and network society is set out in a number of government reports in recent years, including the National Telecom Agency's ***Report on New Access Routes to the Network Society***.[2] In this area, reform is much less a program to achieve a fixed set of targets, and much more a process of continuous stimulation of expansion and growth.

Following the basic structure of last year's report, this 2002 Report on Trends in European Telecommunication provides indicators in two main categories: (1) traditional indicators of telecom reform – market and service development, consumer pricing and competition; (2) information infrastructure and network society development – investment and access technologies; internet market development; e-commerce and e-government readiness and activity. There have been two major developments since the last report that should be noted. Responding to the growing trend toward information technology (IT) and telecommunication

[1] Special thanks to the LIRNE.NET project team members for research, editorial and presentation support: Pearl Barendse, Sujata Gamage, Bruce Girard, Divakar Goswami and Amy Mahan, from Economics of Infrastructures, TU Delft; and Merete Henriksen, Anders Henten, Annette Mørk and Markus Schneider from Center of Tele-Information (CTI), Technical University of Denmark.
[2] The National Telecom Agency, January 2000, www.itst.dk.

convergence, the national telecom regulatory authority (Telestyrelsen) has been assigned significant new responsibilities in the IT area and is now referred to as the National IT and Telecom Agency (*IT – og Telestyrelsen*). The second development is the dramatic stock market collapse in the ICT sector in general and the telecom sector in particular. As the knock-on effects of this financial collapse upon investment, services and other related factors are just now unfolding, they are not reflected in the comparative data gathered for this report.

The purpose of the report is to provide a succinct overview for participants in the International Discussion Forum of the National IT and Telecom Agency, the telecom regulatory authority for Denmark. The countries selected for comparison in this report are the leading reform states in Europe, plus Denmark's larger neighbours that are beginning to accelerate their reform programs after a slow start. The countries are Sweden, Finland, Norway, Netherlands, UK, Germany and France. For some indicators, where comparable data for the US and Canada exists, they are included. Readers are cautioned that the quality of the data varies substantially among the different indicators. The traditional telecom reform indicators have been used for some time and have a reasonably sound foundation for drawing comparative conclusions. The new indicators for information infrastructure and network society development can present only a very incomplete and partial picture in the very early phase of an evolution that will be underway for a long time.

B. TELECOM REFORM

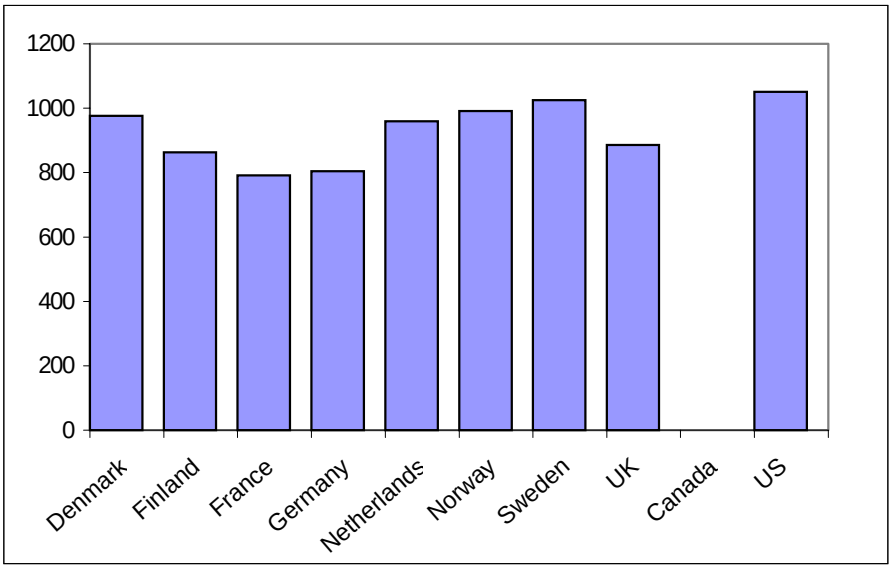
1. TELECOM MARKETS AND SERVICES

1.1 National Telecom Markets

Figure 1.1 shows the telecom revenue per capita for the compared countries for 2001. A high level of development is demonstrated for all countries. Revenue per capita is highest in the US where there has been an historic tendency for people to use fixed network services more intensively than people in other countries, and in Scandinavia where universal service penetration rates are highest.

Figure 1.1 – Telecom Revenue per Capita

(2001, million Euro)

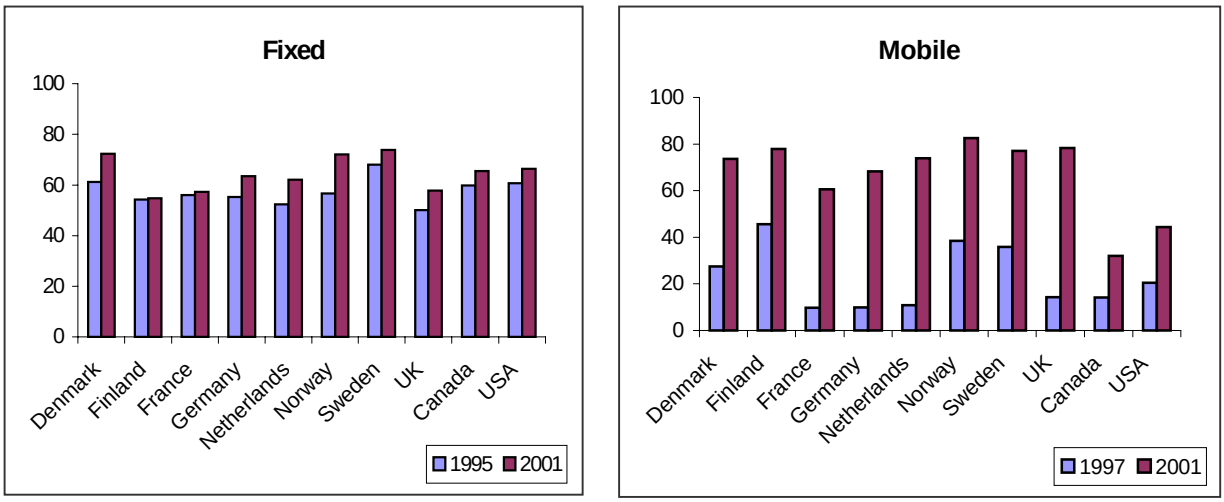


Source: EITO 2001, OECD 2001

1.2 Network Services Coverage

The generally accepted measure for universal telephone service has been the penetration rate of fixed network main telephone lines per 100 inhabitants as shown in Figure 1.2. Although all the countries in this comparison presumably provide a universal service, the main line penetration rates in 2001 range from a low of 54.8 (Finland), to a high of 73.9 (Sweden). The relatively low Finland figure is explained by the fact that many Finns (up to 20% by some estimates) have replaced their main lines with mobile service. The high figures for Denmark, Sweden and Norway are explained by a significant number of ISDN lines, which provide two or more main lines per connection. The data suggests that the Scandinavian countries have a higher standard of universal service coverage than the other countries.

Figure 1.2 – Penetration of Main Telephone Lines and Mobile Subscriptions
(communication channels per 100 inhabitants)



Source: ITU 2002

Figure 1.2 also demonstrates the rapid growth in mobile market penetration. The UK and The Netherlands have caught up to the Nordic countries, as the leaders in Europe, and Europe is a long way ahead of the US and Canada. However it must be noted that mobile penetration rates in Korea and some other Asian countries are approaching the world's highest levels, and there are many indications that world leadership in mobile market development is shifting to Asia.

When fixed and mobile connections are summed, the differences among countries are accentuated further. The number of network access paths per 100 population in the Nordic countries is demonstrably higher than the other European countries, the US and Canada.

2. CONSUMER PRICING

2.1 Public Switched Telephone Network (PSTN)

Based on OECD tariff methodology, comparisons can be made using a basket of different elements needed for a particular telecommunication service. Table 2.1 indicates what residential and business users pay for a basket of services including usage and fixed charges. PSTN network charges for Denmark are relatively low for national services, both for business and residential users. For international services, Denmark's ranking has fallen to a middle ranking in the last two years despite significant price reductions. These developments confirm the increasing competitiveness of the international services market.

These OECD comparisons are based on the tariffs of the incumbent telecom operators. As competition develops and the market shares of incumbents decline, this data is less indicative of prices actually paid by consumers. This undoubtedly has the greatest impact upon the US data, where the majority of these services are sold at actual consumer prices below the incumbent's tariff prices. In Denmark, competitors offer some international services at prices up to 40% below the incumbent Tele Danmark prices.

Table 2.1 – Charges for Call Baskets for Network Services

USD PPP, February 2002 (Business baskets include VAT)

	National Business	National Residential	International Business	International Residential	Mobile Business	Mobile Residential
Denmark	512	309	0.50	0.79	675	180
Finland	639	359	0.78	1.00	766	149
France	813	392	0.39	0.77	568	403
Germany	883	377	0.49	0.72	791	294
Netherlands	617	349	0.38	0.55	599	267
Norway	539	339	0.24	0.37	545	211
Sweden	501	288	0.36	0.57	911	202
UK	940	356	0.89	1.48	608	331
Canada	711	307	0.85	1.16	800	419
USA	826	369	0.54	1.51	492	475

Source: OECD 2002

Notes:

- Previous year comparisons are not given here because call baskets in 2002 are different from those in previous years
- National: Calls to Mobile Networks and International Calls are excluded
- International: Average call charge for one single call, weighted by traffic For UK, BT Choice 1 for Business basket and BT Option 15 for Residential basket.
- Mobile: The business basket includes 300 national minutes and excludes international calls; The residential basket includes 50 national minutes and excludes international calls.
- National and mobile baskets include both fixed and usage charges.

2.2 Mobile Services

The OECD has developed a common methodology for national mobile services.[3] Table 2.1 shows that the Nordic countries continue to enjoy the lowest prices for residential mobile services, but mobile business is a more mixed picture, and prices are continuing to decline in all countries. The data demonstrates dramatically different pricing policies in different countries. In the US, the charges for the representative call baskets for business and residential are about the same, a 1/1 ratio. France is 1.4/1; UK and Canada, almost 2/1; the Nordic countries between 3 and 4/1. The US serves the business market best; the Nordic countries serve the residential market best.

One reason for the higher charges to business in Europe compared to the US is the application of very high mobile call termination prices, especially for roaming calls between countries, which are made possible by the monopoly on the termination call number. Comparative data on mobile call termination prices is unavailable. However, there is increasing evidence that these prices are extremely high, not regulated effectively, if at all, and are providing a bottleneck for continued mobile service development, in particular international roaming. Studies have estimated call termination charges to be 40-70% higher than cost. This could have a major constraining effect on future growth rates.

2.3 Leased Lines

Leased lines allow high volume users to take advantage of lower prices than those offered for the PSTN and, in addition, to have control over their own telecom facilities and traffic. Leased lines facilitate entry to telecom markets for companies interested in providing value-added services, including ISPs concerned with building backbone networks for Internet services and large customers accessing ISP facilities. High tariffs for leased lines have represented an important barrier to entry for these different user groups.

Within the EU, the prices for leased lines have been a major concern for users for a considerable time. Since 1 July 1996, the provision of leased line services has been liberalised, but competition has been slow to develop. Based on the Interconnection Directive (97/33/EC), fixed operators identified as having significant market power have the obligation of providing cost-oriented leased line services to other operators.

Denmark has been at the forefront of liberalising this market segment and providing leased lines on a more competitive basis. Table 2.2 reflects the OECD basket of national leased line charges. Figure 2.1 provides comparisons among specific national leased line prices for services of different distances and bandwidth. In these comparisons, Denmark is the leader in a close race with Sweden, and these two countries are widening the extremely large gap between them and the other countries. The enormously wide variations in leased line rates demonstrate there is still an urgent need for major leased line pricing reforms in most countries.

[3] At present the personal basket includes 568 calls per annum and the business basket 1169 calls per annum.

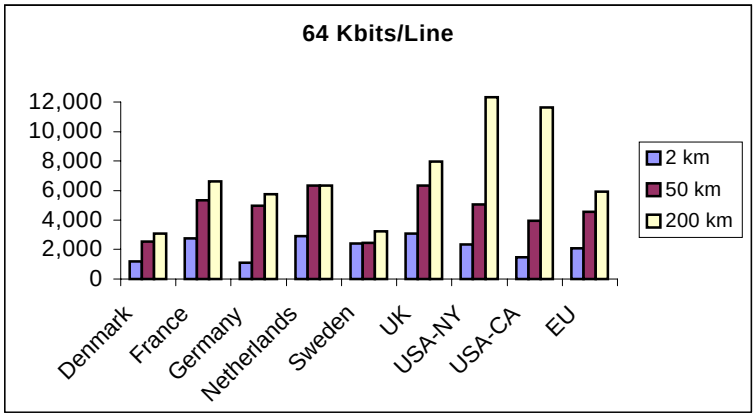
Table 2.2 Charges for Baskets of Leased Lines,
USD PPP, February 2002 (VAT excluded)

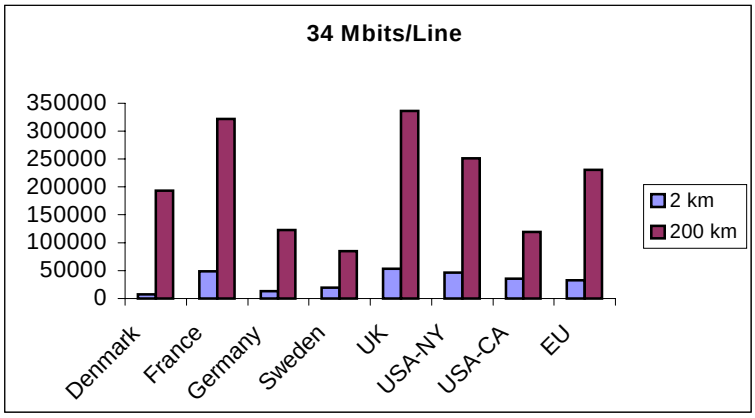
	*M1020	64 k	2 M
Denmark	112,622	178,986	743,945
Finland	n/a	n/a	613,836
France	540,888	455,206	1,998,059
Germany	317,250	355,716	1,689,054
Netherlands	227,390	441,820	2,280,419
Norway	183,558	313,471	1,188,687
Sweden	69,095	245,699	749,993
UK	348,830	481,842	2,025,623
Canada	..	438,340	3,867,571
USA	..	671,386	1,942,800
OECD	257,090	398,052	1,831,795

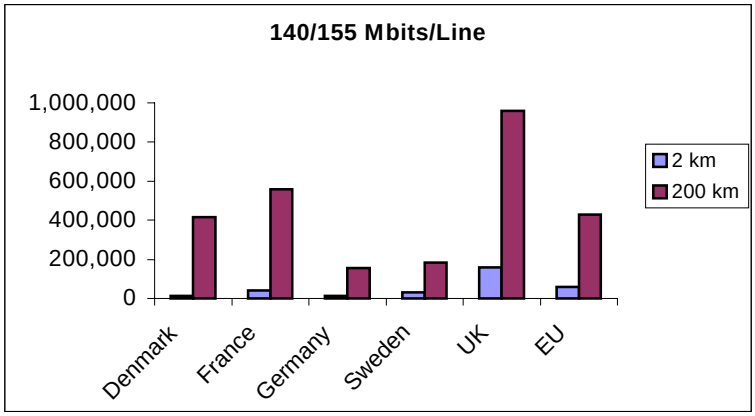
Source: OECD

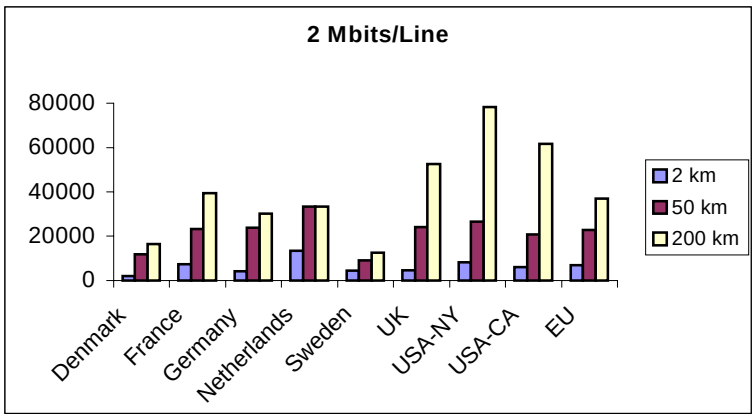
**Analogue leased lines (bi-directional with point-to-point configuration) that covers the voice bandwidth (300 Hz to 3400 Hz) and conforms to ITU-T Recommendation M.1020.*

Figure 2.1 – Annual Leased Line Rentals (Euro, excl. VAT)









Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

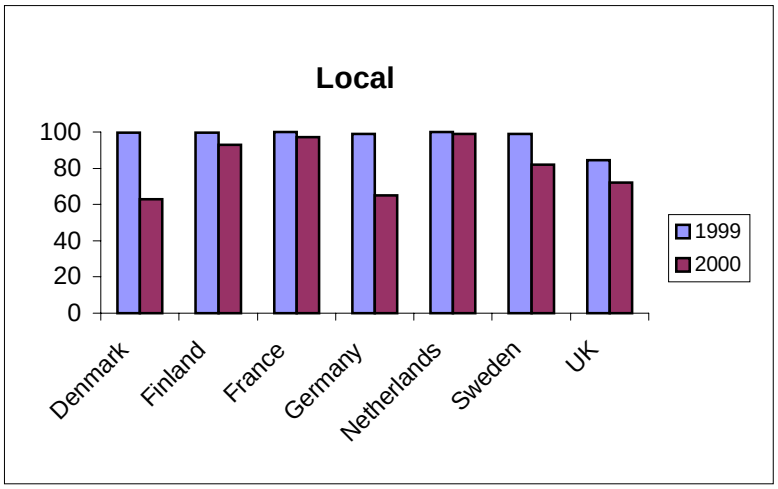
3. COMPETITION

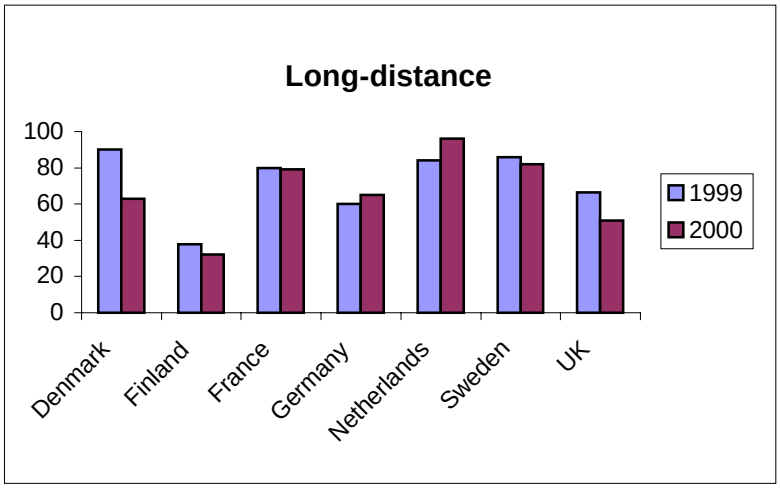
3.1 Public Fixed Voice Telephony

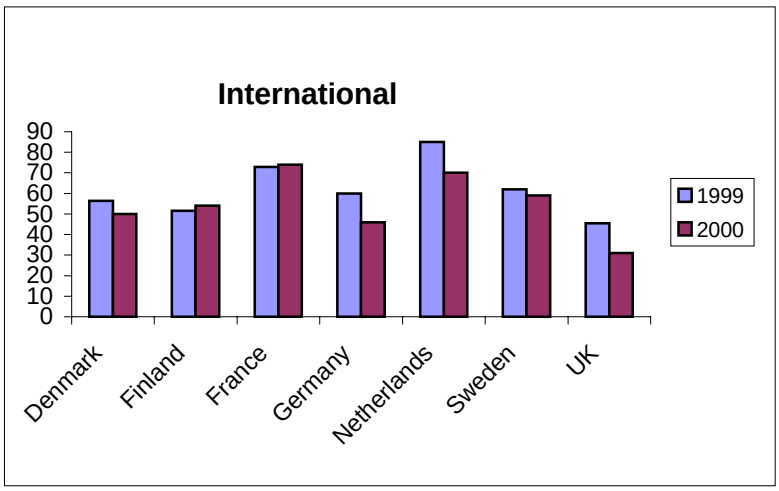
Denmark has been a distinctive leader in liberalising entry to the market, as new entrants are not required to receive authorisation or even make special filings. Denmark has been a leader in reducing barriers to entry by introducing carrier (pre-) selection, number portability, and unbundling the local loop well ahead of EC deadlines.

With respect to the development of actual market competition, at the present stage of market development the incumbent's market share has been demonstrated to be a reasonably good indicator. Comparisons of incumbent market shares for local, long distance and international services are shown in Figure 3.1. By this measure, competition is having a significant impact in all of the compared countries in international services, a more modest impact for national long distance, with only a demonstrable impact in the UK for local services. The local data for Denmark, Germany and Sweden reflect local and national long distance combined and reflect more a high estimate of long distance competition than a low estimate of local competition. Other data suggest that some local service competition is beginning to develop in Denmark and Canada, but is stalled in the US. Overall North American markets are more competitive than Europe, and the UK remains the most competitive market overall within Europe. Although Denmark ranks in the top three countries in the EC country comparisons, it is surprising that more competition has not developed given the long standing policy of open entry and minimal barriers to entry.

Figure 3.1 Incumbent's Market Share in Public Fixed Voice Telephony





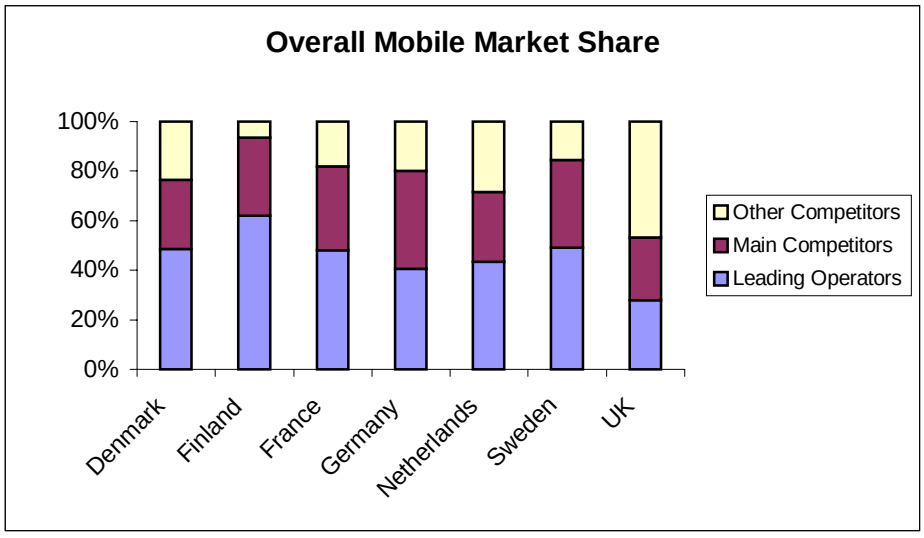


Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

3.2 Public Mobile Services

Competition in mobile services has increased more rapidly than fixed network services. With each generation of mobile, more competitors have been licensed in Denmark and most other countries. Denmark was the first country in Europe to introduce virtual mobile network services (VMNS). An indication of the significance of competition can be seen from the mobile market share data provided in Figure 3.2. Although competition has had a significant impact in all the countries, within Europe it has been greatest in the UK where BT has been displaced by Vodafone as the leading operator. Perhaps the best indicator of the probable effectiveness of competition is the market share held by operators other than the top two. By this indicator, the UK is the clear leader followed by The Netherlands and Denmark. More recent developments include the issuing of additional licenses for 2G, 3G and/or fixed wireless services in many countries, and plans to issue further licenses in the near future. Notable for competition in Denmark is the issuance of seven fixed wireless licenses and the fact that the incumbent Tele Danmark did not win a license.

Figure 3.2 – Mobile Market Share, August 2001



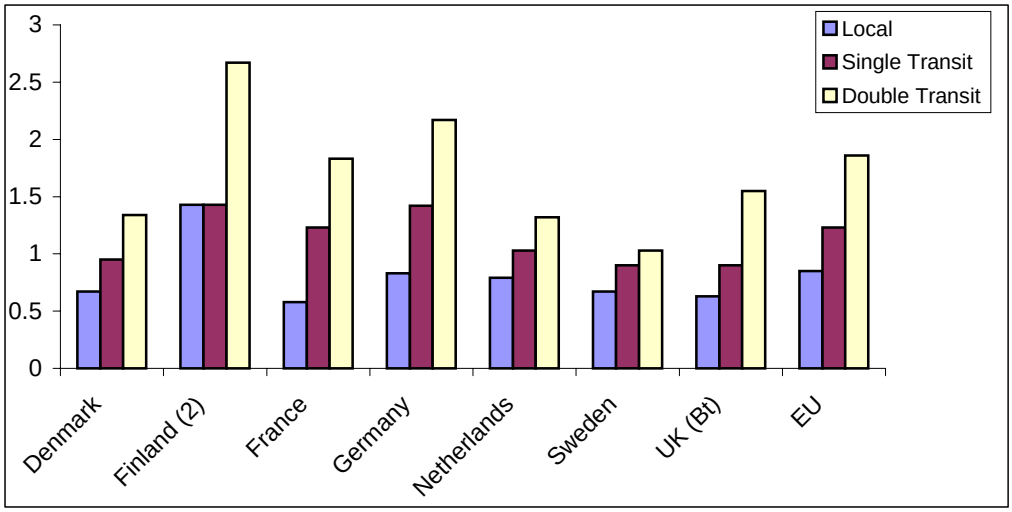
Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

3.3 Interconnect Prices

Reasonable interconnection charges are vital to the development of effective competition. Denmark's interconnection charges have always been among the lowest among EU countries. Figure 3.3 presents the most current EU data on interconnection charges for fixed-to-fixed voice services. Denmark's charges are well below the EU target in all categories. Some other countries have reduced their interconnection charges significantly since the last report so Denmark must now share leadership with Sweden, the UK and the Netherlands.

Figure 3.3 – Interconnect charges for fixed-to-fixed voice

Per minute (Euro cents), August 2001



Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

3.4 Unbundled Access to Local Loops

A fundamental bottleneck restricting the development of public switched network competition has been the difficulty of providing direct access to customers for new service providers. Unbundled access to local loops is a key element not only in the development of the next phase of competition in EU countries, but also in preparing the telecom network for information infrastructure development and the network society services envisioned in Danish government policy documents, and similar policy statements by the EC and other national governments. National regulatory authorities in a few countries, including Denmark, have taken the lead in requiring the incumbent operator to provide unbundled access to local loops.

Table 3.1 provides data on the availability and deployment of local loop unbundling (LLU) as of the end of 2001. Denmark stands alone as the only country with a virtual universal availability of LLU, with about 95% of Danish households able to access ADSL services. Most countries are just beginning the process. Table 3.1 also shows data on the deployment of unbundled local loops. It documents the earlier start in LLU in the US and Canada, and the fact that all countries are at a very early stage of deployment. Given the fact that Denmark has 100% LLU availability, it is in the best prepared of any of the compared countries to increase deployment rapidly.

Table 3.1 – Local Loop Unbundling (end of 2001)

	LLU Availability (% of exchanges)	LLU Deployment (% of loops)
Denmark	100.0	1.0
Finland	n/a	1.5
France	7.9	0.0
Germany	31.6	1.2
Netherlands	n/a	0.1
Norway	n/a	n/a
Sweden	49.2	0.3
UK	4.5	0.0
Canada	n/a	4.0
US	n/a	6.6

Source: OECD, Developments in Local Loop Unbundling, DSTI/ICCP/TISP(2002)5

Table 3.2 provides a summary of LLU prices per voice grade copper pair. The evidence suggests that Denmark prices are the lowest of compared countries for unbundled access to local loops, while its line rental charges are rank about average. This is providing a sufficient margin to attract competitors into the ADSL market, as is demonstrated in Table 3.3. Denmark is the only EU country with a significant market share for alternative ADSL providers, 27%, as opposed to 5% in Germany, 4% in Finland and The Netherlands, and only a bare beginning in the other countries.

Table 3.2 – Unbundled Local Loop: Implementation Date and Rental Prices

	Implementation date	Unbundled Access (Monthly)	Shared Access (Monthly)	Line Rental (Monthly)
Denmark	Jul-98	7.16	3.58	10.46
Finland	1996	10.37-12.96	6.48-9.51	10.16
France	Jan-01	9.94	3.02	10.85
Germany	Jan-98	10.78	4.12	9.45
Netherlands	Jun-00	14.23	9.37	13.39
Norway	n/a	10.79-18.12	13.49	NA
Sweden	Mar-00	10.02	4.75	9.51
UK	Aug-00	13.97	6.05	12.62

Source: OECD, Developments in Local Loop Unbundling, DSTI/ICCP/TISP(2002)5

Table 3.3 – Market Share of Alternative ADSL providers

January 2002 (%)

Denmark	27
Finland	4
France	0
Germany	5
Netherlands	4
Sweden	1
UK	0

Source: ECTA and Cullen International, LLU Scoreboard, January 2002

ASSESSMENT: TELECOM REFORM

By all the standard indicators, Denmark compares extremely well among the leading countries with respect to progress in telecom reform. Its national telecom market development, and the service coverage of its basic telephony and mobile services rank among the best in the world, along with the other Nordic countries. Denmark's prices rank almost as well. Overall its leased line prices are among the lowest of the compared countries. Its PSTN and mobile service prices are in the top group of countries. Its weakest performance has been in international call charges where major reductions in several other countries have been introduced even faster than the significant reductions in Denmark in the last few years.

With respect to competition, all countries still have a long way to go before their telecom services markets are fully competitive. Mobile and international services show evidence that significant competition is developing in all the compared countries. In the mobile market, the incumbent is no longer the leading player in the UK and Germany, and mobile has begun to displace fixed services in Finland. National long distance competition is developing more slowly and local service competition has barely begun. Although Denmark is among the leaders in developing competition in international services, like most other countries, national local and long distance competition has been slow to develop.

Denmark's performance ranks much higher on prices and market development than it does in the development of actual competition. When viewed in the context of Denmark's leadership in minimising barriers to entry, its high ranking on interconnect prices and its leadership position in unbundling access to the local loop, this could indicate that Denmark's good performance is being driven more by the regulator than by competition.

Overall, one does not find a direct correlation between the development of competition and the lower prices and greater market coverage that one would expect. In direct contrast to Denmark, the UK has been the clear leader in the development of competition throughout the entire telecom reform process of the last 14 years. This correlates well with UK leadership in reducing interconnect prices, but UK consumer prices and market penetration rank surprisingly low among the compared countries. A major issue for the EC and the NRAs for the immediate future will be to determine what steps are necessary to ensure the reasonableness of national and international mobile call termination charges.

For the future, Denmark has prepared the ground well for information infrastructure and network society development by establishing the lowest barriers to entry in Europe. The key indicators of preparation for information infrastructure development for the next several years are leased line and interconnect prices, and unbundled access to local loop. As Denmark is the only country in a leadership position in all three areas in Europe, it is well positioned to build on that in the development of the information infrastructure for its network society.

C. INFORMATION INFRASTRUCTURE AND NETWORK SOCIETY DEVELOPMENT

The transformation of national and international telecom networks into information infrastructures capable of providing advanced communication/information services is generally associated with two developments: an increasing variety of Internet services; and the supply of increased bandwidth of varying capacity to carry the newer and more sophisticated Internet services. Insufficient bandwidth can be a constraint limiting the access of residence and business customers to certain more advanced services, e.g., interactive video. But a great many Internet services can be supplied effectively at much lower prices over digital telephone lines. Today the vast majority of Internet use is email and web site access over single or multiple (ISDN) digital telephone lines. But as service opportunities and consumer demand grows, higher bandwidth capacity is needed. The pace of market development is governed by the interaction of these demand and supply factors.

Thus, information infrastructure and network society development involves several interdependent components:

1. Internet services development which helps stimulate demand for new services;

2. preparation for applications of new Internet services throughout the economy and society to business, government, education, entertainment, etc.;

3. an expansion of the bandwidth capacity in national and international networks to reduce unit networking costs and provide for higher capacity services;

4. an expansion of bandwidth for local connections to business and residence users to facilitate the increasing demands for higher speed services.

This evolutionary process of network and market development will proceed faster for certain segments of society than others. The concern of policymakers and regulators is to facilitate the process by preparing a foundation that will promote the development and application of new services. This section of the report provides some preliminary data on, (1) information infrastructure supply, capacity and access; (2) Internet development, uses and users; and (3) applications for network society development – e-commerce and e-government readiness and activity.

4. NETWORK INVESTMENT AND CAPACITY

As the convergence of telecom, computing and media proceeds, increased attention is focused on the capacity of national telecom networks to meet the demands of future multi-media, e-commerce and other Internet services. Capacity requirements concern the bandwidth necessary for local connections to the home, as well as the capacity of national and international networks. National network investments are related to the expansion of traditional telecom services, the growth of relatively new services (e.g. mobile), and preparation for expanding growth in Internet services, both narrowband and broadband.

4.1 National Network Investment Trends

Investment trends in national networks are shown in Table 4.1. For most countries average investment per capita has increased throughout the 1990s, reflecting the increasing need for upgrading and expanding capacity. The US and Norway have the highest investment per capita in the later years. The Netherlands had a major increase in 1999 stimulated by new mobile networks. The pattern for Germany in the early and mid-1990s has been determined by the enormous requirements of rebuilding the former East German network. Investment per capita in Denmark was among the lowest during the early 1990s, but has increased substantially in the later 1990s, reflecting the rollout of mobile networks and the upgrading of local networks for the Internet bandwidth economy. This has continued through 2000 and 2001 in preparing the network for universal access to ADSL.

Table 4.1 – Public telecommunication investment per capita (in USD millions)

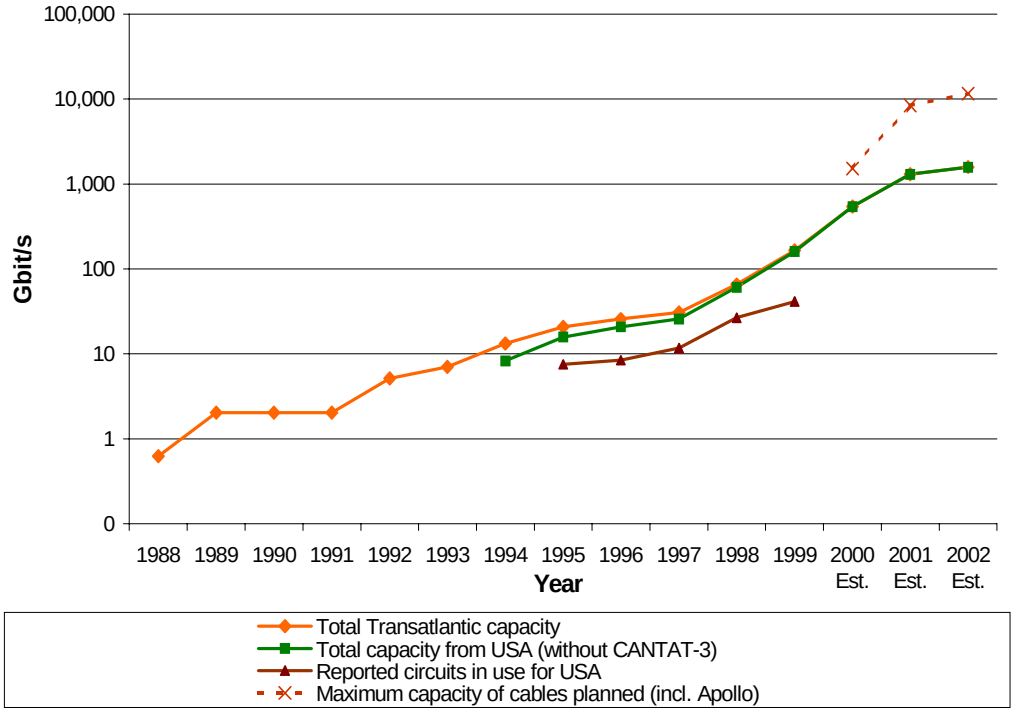
	Average 1988-90	Average 1991-93	Average 994-96	1997	1998	1999	Average 1997-99
Denmark	96	81	106	128	213	166	169
Finland	135	101	124	162	116	111	130
France	81	106	106	110	110	95	105
Germany	118	197	156	145	132	137	138
Netherlands	77	104	98	95	171	299	188
Norway	118	113	139	180	305	229	238
Sweden	127	134	136	109	105	103	106
UK	84	65	84	171	151	216	179
Canada	127	117	95	134	149	171	151
US	93	100	141	200	244	324	256

Source: OECD Communications Outlook 2001

4.2 The Trans-Atlantic Capacity Explosion

Figure 4.1 shows an overview of all fibre optic capacity laid across the Atlantic, compiled from the FCC International Circuit Status Report. The combination of several new high capacity fibre optic cables, and the major capacity enhancement of the existing cables has increased the transmission capability by almost ten times in a few years. As this is far in excess of even a rapidly growing demand, it has contributed to the inevitable bankruptcies and the creation of an enormous amount of excess capacity.

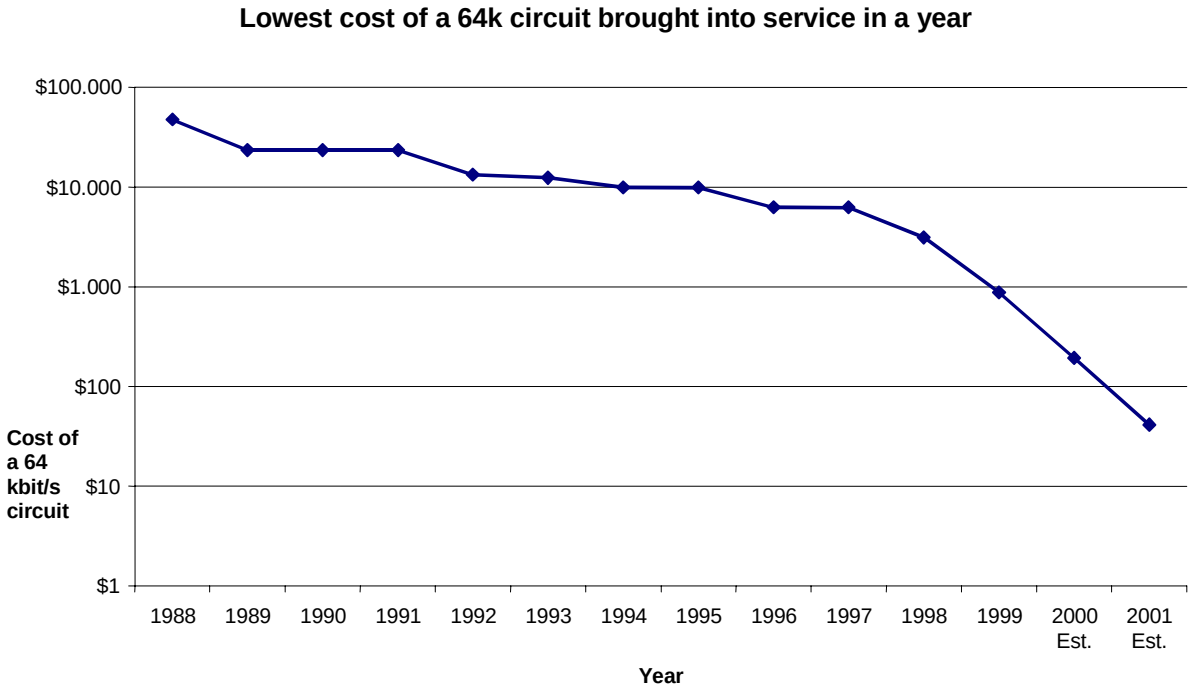
Figure 4.1 – Transatlantic submarine cable capacity 1988 – 2003



Source: Based on 1999 FCC International Circuit Status Report

Figure 4.2 shows the current cost curve for the supply of a 64 kbit/s transatlantic circuit, as estimated from FCC data. It shows that the investment per circuit for a transatlantic cable has fallen from $10,000 in 1995 and $1,000 in 1999 to about $50 in 2001. The current market conditions suggest that we can expect some dramatic price reductions for transatlantic services between Europe and North America. The death of distance may occur here sooner rather than later.

Figure 4.2 – Cost of newly installed transatlantic circuit capacity is declining.



Source: Based on 1999 FCC International Circuit Status Report

5. NEW ACCESS TECHNOLOGIES

5.1 Options and Implementation Horizons

The bottleneck in the development of competition for telecom network services of all kinds is direct access to customers. Unbundling access to local loops permits competitive access opportunities for traditional telecom services, and for higher speed services that can be provided using new technologies applied to existing copper subscriber lines. However, competition for the longer term is centred on alternative “pipes to the home” and the need to supply higher speed access for the more sophisticated Internet services being developed.

The time horizons for the development and application of new access technologies depends in part on the pace of technological improvements, and the achievement of reductions in bandwidth unit costs and other technical service parameters relating to security, privacy, intellectual property protection, e-contracts, etc. And it depends in part on the rate of growth in demand for services that require higher speeds and greater bandwidth. For the near term, new access technologies that are now being made operational in many countries are DSL, upgraded CATV systems and digital TV applications. Fibre to the business is economical in some circumstances, but fibre to the home will require significant cost reductions and demand growth before it becomes competitive beyond special circumstances such as green field high density locations.

Licensing of Fixed Wireless and broadband mobile networks now in process in many countries will open new possibilities. New satellite systems offer medium term possibilities for some users. For the longer term horizon, HIPERACCESS, High Altitude Platform Stations and powerline communication may become possibilities. The unresolved question is whether the competition among the different technologies will tend to supply many pipes to many homes, or one pipe to all homes. Possible options for Denmark and other European countries over the next few years are discussed below.

5.2 Broadband Development by DSL and Cable Modem

DSL provides an upgrading of the capacity of customers’ copper wire connections. It can come in varying sizes, usually from 128 kbits to 2 Mbits, depending on the quality of the copper wire, the distance from the central office, and other factors. If unbundled local loop access is provided, DSL services can be supplied by competitive operators as well as the incumbents. In most countries DSL provides immediate opportunities for enhancing local competition for higher speed access to Internet services. DSL services first became significant in the USA and Canada in 1999. Various European countries began during 2000.

In some countries, the best immediate option for competitive access to higher capacity services is via established cable television (CaTV) operators. In entering the markets for broadband access, CaTV operators in countries with high CaTV penetration rates have a head start over other new access technologies.

Table 5.1 provides recent estimates of early Broadband development by DSL and cable. Canada has a clear lead, while Sweden and Denmark are the leaders in Europe. Table 5.2 provides data relating to DSL/Cable pricing in Europe. Denmark’s prices are the second lowest for both DSL and cable access.

Table 5.1 – Broadband Penetration

ADSL and Cable Modem, 2001

	Connections per 100 Inhabitants (ADSL + Cable)
Denmark	4.14
Finland	1.31
France	1.05
Germany	2.36
Netherlands	3.00
Norway	1.55
Sweden	4.96
UK	0.56
Canada	8.40
USA	4.47

Source: OECD 2002

Table 5.2 – DSL / Cable Pricing

December 2001 (lowest monthly cost of 1 megabit/sec)

	ADSL	Cable
Denmark	29.7	16.79
Finland	43.63	13.83
France	38.65	38.84
Germany	24.09	33.63
Netherlands	37.61	61.55
Sweden	40.45	17.04
UK	67.18	40.3

Source: e-Europe Benchmarking 2002

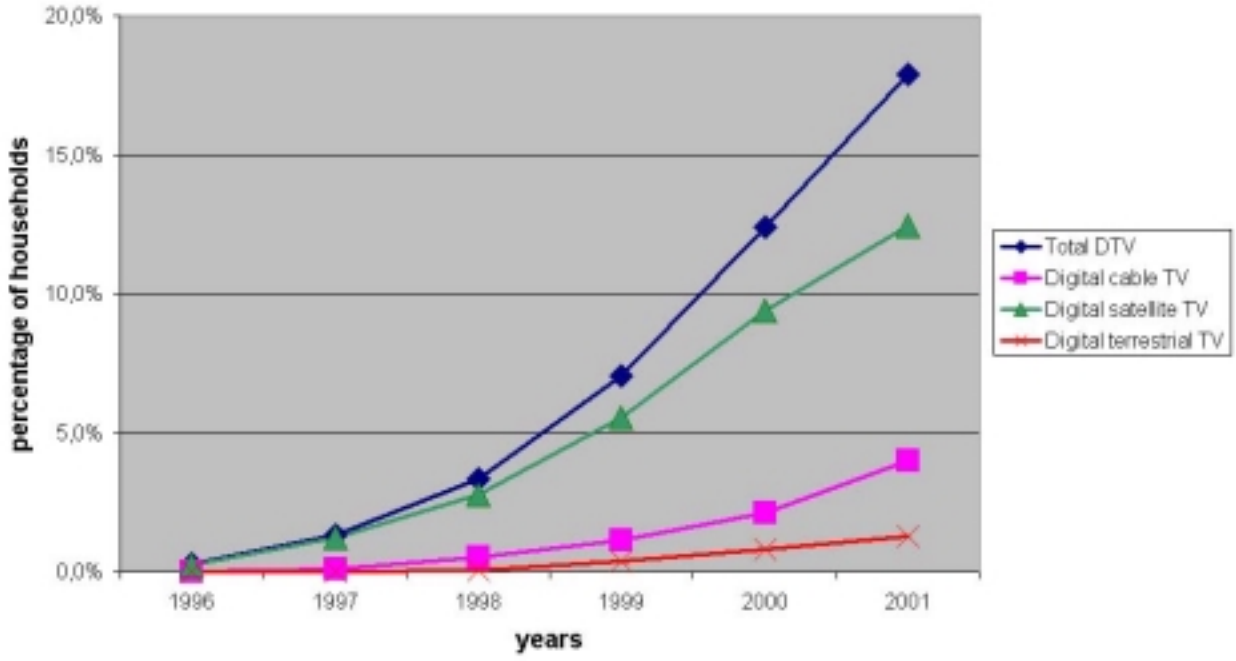
5.3 Digital TV

As Digital TV opens for transmission of data services in addition to the traditional audio and video services, it is one the new high capacity access routes, and because of its coverage and ease of use, a potentially promising one. The new data services can be related to the TV programs or they can be non-TV-related services. The program related data services consist of background information related to the programs including, e.g., sale of books, CDs and other merchandise. The non-TV-related services can be any data services, such as access to the Internet, data cast, etc.

Digital TV can be distributed using cable, satellite and terrestrial networks. In the last few years the number of digital TV subscribers has increased rapidly and digital TV is now promoted vigorously as interactive, I-TV. France has led the way in global I-TV development, but the service is now available in satellite and cable networks in many countries. Regarding terrestrial networks the USA, the UK and Sweden are among the first countries to implement these services.

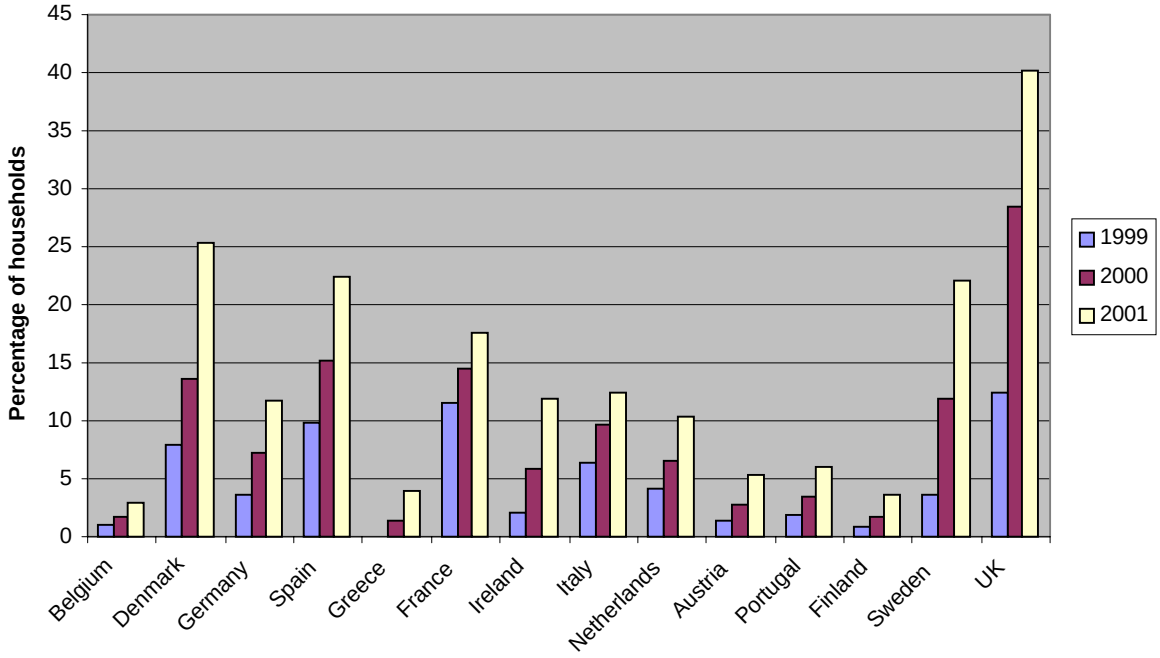
Figure 5.1 shows the rate of deployment of TV subscribers in the EU between 1996 and 2001. Figure 5.2 shows digital TV penetration in selected EU households in 2001. Denmark ranks second with a 25.3% penetration, a near ten-fold increase since 1999. In the US the penetration rate in 2001 was 31.8%, lower than the European leader, UK (40.1%).

Figure 5.1 Evolution of digital TV in the EU (percentage of households)



Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Figure 5.2 – Digital Television Households in EU (1999-2001)



Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

The main difference between traditional telecom networks and TV-networks is that the first are two-way or communicative and the second are one-way or distributional. The lack of a 'built-in' return channel is a weakness in the development of interactive services. The solution has been to use the telecom network as the return channel, which can be built into the systems. There is, however, no standard solution for this, and the complexity and the cost of implementing the return path in the terrestrial and satellite networks, at least at the current technological development, makes such integration unfeasible. Another problem is the capacity available per user as the distributive networks are designed for transmission of the same content to many users. Among different distribution platforms, cable networks are technologically better positioned to integrate the return path inside the network and to optimise the networks to keep the capacity per user on a reasonable level.

5.4 Fibre to the Home

It has been estimated that more than 25 million miles of fibre-optic cable had been laid by the end of 2000, and there will be a 500-fold increase in capacity by 2003. But very little of it will be laid to residential homes. Fibre is now the dominant technology in international and national networks, and the concentrated central core of larger cities. It is increasingly being used to construct fibre rings in local networks in metropolitan areas, and provides direct connections to large firms. For smaller cities and towns, SMEs and residences, to be served by fibre economically they have to be located on the path of fibre links in the larger networks.

The interest in fibre arises from its enormous, and increasing bandwidth carrying capacity and its rapidly declining unit cost as the technology continuously improves. (Some fibre fans claim Moore's Law now applies.) One can project that at some future time, the growth in

demand for high bandwidth services to the home and the decline in fibre costs will make fibre to the home not only the economical choice, but the only choice as DSL, upgraded CaTV cables and new mobile networks would not be able to handle the bandwidth demand. But so far the vast majority of demand can be satisfied on existing networks, and whatever reductions in fibre cost take place, they cannot replace the 70% of the local loop cost associated with installation, e.g. digging ditches. For the immediate future, it will still be very difficult for fibre to compete with already installed copper and coaxial cable. Even the most optimistic telecom operators are not planning to get any closer to the home than "fibre to the curb", and only that in special circumstances.

There is increasing interest by city and town governments in establishing local fibre networks, as important both to retaining and attracting business for the local community economy and supporting major public institutions, e.g., schools. In the USA and Canada, several cities and towns have constructed backbone fibre distribution networks, or are planning to do so. But they are not planning to extend them to homes or even neighbourhoods outside the central core. Other cities are considering special underground ducts to house the cables of competing operators. Some condominium and apartment blocks are establishing internal fibre wiring and connections to the curb as a means of making fibre connections more attractive. It has been suggested that this principle might be extended to residences as a matter of policy.

These approaches would all make fibre to the home more feasible for the operators, but more expensive for residential users. This could promote development for some while restricting it for others and make a universal service more difficult to achieve. It would also bias the competition among alternative "pipes" to the home in favour of a technology that, if it wins, may well end up a monopoly because of its enormous bandwidth and infinitesimal marginal cost.

Stockholm based Bredbandsbolaget is believed to be the leading fibre company in Europe in a very small market with few active players. The firm was started in 1998 for the development of a Fibre to the Home (FttH) service by utilising Local Area Network switching gear that is installed in the basements of apartment blocks. These switches are interconnected by fibre optic cable, while the last 100 meters is realised by installing 4-pair copper data-cabling. With the LAN-switch based design Bredbandsbolaget launched in 2000 a 10/100 Mbit/s Internet access services with a guarantee of 1 Mbit/s at a price of circa $25 per month. This low price is based on the very large scale production of LAN-switches for the general business community and the high amount of dark fibre available in particular in the Stockholm area from municipality owned Stokab.

Bredbandsbolaget announced in 2000 it is expanding its operation area under the name Bredband.com to all Nordic countries and the Benelux area. Its growth so far has been much slower than expected.

5.5 Fixed Wireless Access

Fixed Wireless Access (FWA) has attracted serious interest as an efficient way to stimulate competition in the local loop by creating an alternative infrastructure. The US had an early start by granting licenses in 1998 and US companies are active on this area over most of Europe. Licenses for FWA have been awarded in most European countries. In Denmark seven licenses were awarded in December 2000.

However the FWA markets in many European countries have turned sour during 2000. The auction in the Netherlands for point-to-multipoint microwave links, slated for March 2000, has been deferred and the UK auction, held in November 2000, failed to gain bids on the lots for a substantive number of areas. In addition, the major European players, many of them founded and financed by US FWA entrepreneurs, faltered or did not start their network build outs. Most FWA operators now concentrate on data communications services, filling a niche market rather than attempting to provide any serious local loop alternative for fixed voice telephony service.

Besides the conventional FWA, a new type of semi-fixed FWA has sprung up based on Wireless LAN technology. Jippii deploys a Wireless LAN based public Internet access network service in Helsinki, and Telia provides a similar service in Stockholm. Both operators are utilising the new Wireless LAN standard technology that operates in the license free Industrial, Scientific and Medical band of 2.4 GHz for their outdoor coverage.

Wireless LANs are set up as an indoor public service in airports, hotels and convention centres and outdoor on larger company and university campuses. Wireless LAN technology is also sold with dedicated directional antenna's and operated in a number of European countries by start-up operators as a cheap alternative for microwave FWA to the Internet.

5.6 Broadband Mobile Services

Second and third generation (3G) mobile networks are generally seen as playing a more significant role in future telecom markets than FWA. The licensing of additional competitors in second generation mobile in some countries, including Denmark, has expanded competition in existing mobile markets that will both extend the limits of these markets and speed up the competitive overlap with fixed networks. Denmark licensed additional 2G networks (GSM900/DCS 1800) in January 2001. The role of 2G mobile is enhanced by the introduction of new technologies such as HSCSD (High-Speed Circuit-Switched Data), GPRS (General packet Radio System) and EDGE (Enhanced Data GSM Environment). These "2½ G" technologies will provide bit rates between 4 and 40 times as fast as 2G. The rollout of HSCD and GPRS began in Europe during 2000.

3G networks are expected to be able to provide Internet access at speeds up to 2 Mbits, and open a new competitive alternative "pipe" to the person. In addition, 3G systems will offer the capability of a clear technical and operational separation between network operators and service providers. All the compared countries examined in this report have issued four to six 3G licenses.

The financial fallout from the enormous auction prices paid in the UK and Germany, and significant but lesser amounts in some other countries, and the return to reality of stock prices in the sector, is having a major impact on 3G network rollout plans in most countries. Although Denmark's 3G auction did result in a financial backlash in Denmark, the pace of 3G deployment will be driven by conditions in the larger European and world market. Current expectations suggest a two to four year time horizon for network development and service deployment.

5.7 Satellites

New satellite technologies will play a significant role in future telecom networks, but whether they will be capable of providing a competitive "pipe" to the home for high speed Internet services is at present a speculative question. Direct broadcast satellites have taken a small,

but significant share of the television market in some countries, and this could expand. But the primary role of satellites has been in international and some national (for large countries) networks as a transmission vehicle for a variety of telecom services, with a comparative advantage in television transmission.

Digital TV could open possibilities with the development of advanced technologies for LEO and MEO satellites. But the current expectation is that the Teledesic satellite plan, which focuses on high speed access to Internet services, will connect primarily to local operators, not to homes. As a competitor supplying an alternative “pipe” to the home for high speed access to Internet services, the satellite option remains speculative and long term, and with a comparative advantage only for a small and specialised portion of the market.

6. INTERNET DEVELOPMENT

Indicators of Internet development cannot be as definitive as traditional telecom indicators, but do provide a basis for general comparisons. Internet hosts provide a general indication of services availability. Internet connectivity provides an indication of coverage. Internet prices identify access and competitiveness. The market share of incumbent operators in the ISP market provides another indicator of competitiveness.

6.1 Internet Connectivity

Table 6.1 provides data indicating the extent of Internet development in the compared countries. Data on Internet hosts indicates the US is significantly ahead, with Finland and Canada in the second tier, well ahead of the other countries. However, the category of Internet hosts is not necessarily a very good indicator of connectivity. Other data suggest that Denmark and the UK in particular have a relatively high number of web server sites per host.

Whereas Internet hosts is an indicator from the supply side, Internet users is an indicator from the demand side. On this measure Norway, Sweden and the US lead and Denmark's ranking moves up to fourth. Penetration is growing rapidly in all countries. In Denmark, at least one estimate has user connectivity currently at more than 70%.

It should be noted that the penetration data in Table 6.1 reflects the percentage of people who have Internet access. The Nielsen / Net Ratings' Global Internet Trends Report of June 2001 estimates that actual services to homes in the USA is at 50%, and in Europe at 25%. Given the rapid growth rates in all the countries compared here, comparative rankings at any moment in time are not likely to be indicative of long-term comparative rankings.

Table 6.1 – Internet Hosts and Users, 2001

	Hosts per 100 Inhabitants	Users per 100 Inhabitants
Denmark	10.5	44.7
Finland	17.1	43.0
France	1.3	26.4
Germany	3.0	36.4
Netherlands	16.4	32.9
Norway	6.7	59.6
Sweden	8.3	51.6
UK	3.7	40.0
Canada	9.3	43.5
USA	37.1	50.0

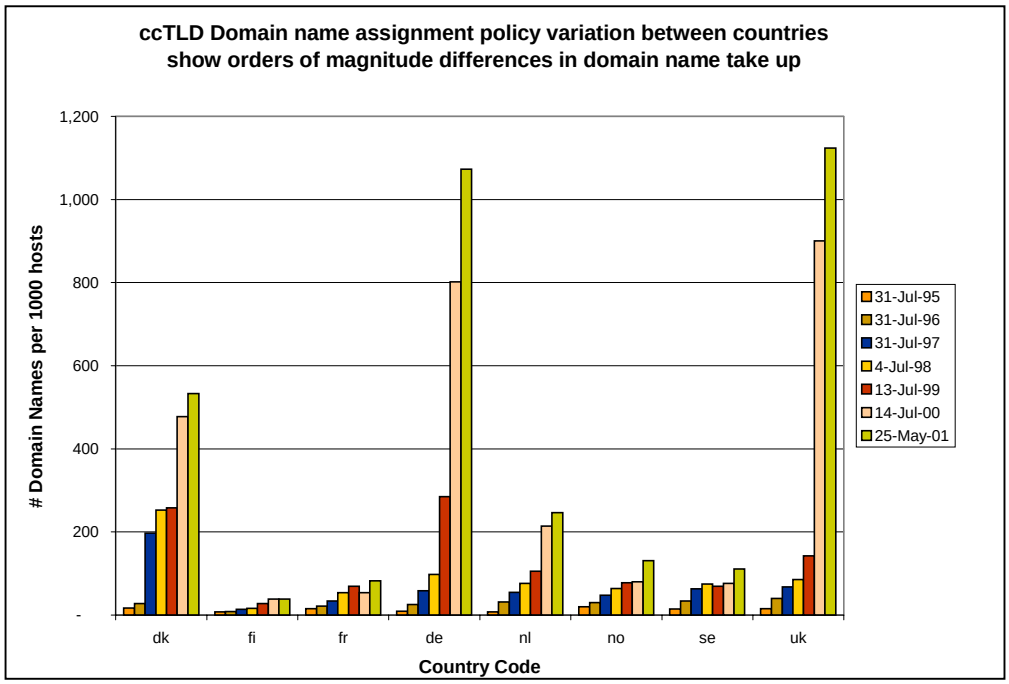
Source: ITU 2002

6.2 Domain Name Registrations

Figure 6.1 shows the strong differences among the various countries when the number of active[4] assigned *country code TLD* domain names are compared with the number of Internet hosts installed under the same ccTLD. The differences are better explained by the variation in ccTLD domain name assignment policy than by other gauges (such as internet penetration level).

The still very strict rules in Finland and France on domain name eligibility and assignment are exemplary. Denmark has introduced far more liberal rules on whom can register what domain name. A similar shift to a very limited set of name assignment rules and wide eligibility as in Denmark has been made during recent years in Germany, the UK and to a lesser extent in the Netherlands.

Figure 6.1 – Domain name take-up



Sources: RIPE NCC Hostcount; UK July-2000 data, OECD; UK May 2001 data Netsizer and Netnames domain name stats

Table 6.2 shows the differences in registrations under generic TLDs (gTLDs – such as .com, .net and .org) and the ccTLDs for July 2000. Denmark, Germany, the Netherlands and the UK have more registrations in their ccTLDs than under gTLDs. The data demonstrates that the United Kingdom, Denmark and the Netherlands attained a higher number of domain names per capita than the United States in 2000.

[4] An active name is a domain name that could be found by a search of the domain name tree on the Internet. Registrations of names that are not implemented on the Net are not counted by RIPE. In some countries these speculation and false implementation names add another 25% domain name registrations.

Table 6.2 – Domain name registrations under top-level domains, July 2000

	Number of gTLDs	Number of ccTLDs	Total	gTLDs per 1000 inhabitants	ccTLDs per 1000 inhabitants	Total domains per 1000 inhabitants
Denmark	49,775	206,454	256,229	9.4	38.8	48.2
Finland	45,650	17,603	63,253	8.8	3.4	12.2
France	445,825	89,097	534,922	7.5	1.5	9.1
Germany	455,125	1,732,994	2,188,119	5.5	21.1	26.7
Netherlands	216,900	399,411	616,311	13.7	25.3	39.0
Norway	72,050	45,541	117,591	16.1	10.2	26.4
Sweden	146,125	45,241	191,366	16.5	5.1	21.6
UK	1,121,850	1,938,740	3,060,590	18.9	32.6	51.4
Canada	678,275	93,330	771,605	22.2	3.1	25.3
USA	10,120,208	6,468	10,126,676	37.1	0.02	37.1

Source: OECD Communications Outlook 2001 based on data of Matthew Zook

6.3 Internet Pricing

In the current phase of Internet development, most consumers still use dial-up connection via modems and telephone lines to access the Internet. As Table 6.3 shows, these Internet access charges vary widely across countries, and in some countries PSTN charges account for most of the cost of access. The OECD has developed a methodology to compare the diverse pricing mechanisms across countries. In its Internet access basket, the OECD included PSTN fixed and usage charges, as well as ISP charges, for 20 hours at off-peak times using discounted PSTN rates. Table 6.3 illustrates Denmark's favourable comparison with the other countries under consideration.

Table 6.3 – OECD Internet Access Basket for 20 Hours at Off-peak Times Using Discounted PSTN rates

2000 (US$ PPP, incl. VAT)

	PSTN fixed charge	PSTN usage charge (discounted)	ISP charge	Total
Canada	20.61	0.00	15.22	35.83
Denmark	12.35	12.58	4.27	29.20
Finland	11.40	5.53	6.95	23.88
France	11.19	0.00	22.81	34.00
Germany	11.94	17.32	9.58	38.84
Netherlands	18.13	14.65	0.00	32.78
Norway	14.52	12.61	8.95	36.09
Sweden	10.14	12.11	2.32	24.57
UK	12.72	0.00	12.59	25.31
USA	14.29	2.33	16.45	33.07
OECD average	13.49	11.97	10.67	36.14

Source: OECD, www.oecd.org/dsti/sti/it/cm/

Note: PSTN fixed charges include monthly rental fee and additional monthly charges related to discount plans, if applicable. The basket includes 20 one-hour calls. Off peak is taken at 20h00. In Canada, France and UK, ISP and PSTN usage charges are bundled and included under the ISP charge.

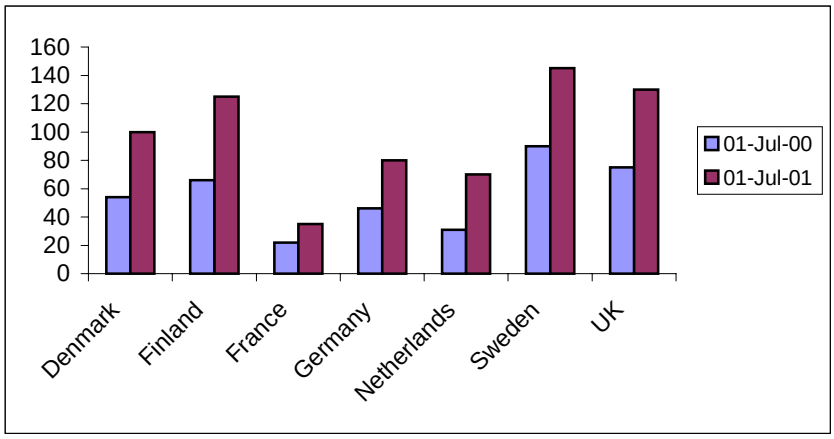
7. Network Society Development

7.1 E-commerce Readiness – *Secure Servers*

Given the current lack of common definitions for surveys, the measurement of e-commerce poses serious problems. One useful measure is the number of "secure servers", which are considered essential to the conduct of e-commerce. A current standard is the use of SSL (secure socket layer), a protocol developed by Netscape for encrypted transmission over TCP/IP networks. It sets up a secure end-to-end link over which http or any other application protocol can operate. The most common application of SSL is https for SSL-encrypted http. Any security system consumes relatively large amounts of bandwidth because of the multiple checks that are being performed (generating chunks of data that go back and forth) but there are large differences between the various systems.

The US and Canada are known to be the leaders in deployment of secure servers, but growth rates are greater than 100% per annum in all of the compared countries at this early stage of development. Figure 7.1 shows recent data for the EU countries. Denmark ranks in the mid-range of the countries compared.

Figure 7.1 – Number of SSL-based Servers per million inhabitants



Source: e-Europe Benchmarking Report, 2002

7.2 Preparedness for the Mobile Internet

The ITU has developed a measure for the preparedness of countries to take advantage of mobile Internet integration. It has developed an Index that measures how each economy is performing in terms of information and communication technologies (ICTs) while also capturing how poised it is to take advantage of future ICT advancements. The Index covers 26 variables sorted into three groups: infrastructure, usage, and market structure. These three components combine for a score between a low of 0 and a high of 100. The rankings of the countries being compared in this report are provided in Table 7.1. Hong Kong was ranked first, Switzerland fourth and Korea seventh.

Table 7.1 – ITU Mobile/Internet Index Rankings

	Mobile/Internet score (/100)	Ranking
Denmark	65.61	2
Sweden	65.42	3
United States	65.04	5
Norway	64.67	6
United Kingdom	63.00	8
Netherlands	62.25	9
Canada	61.97	11
Finland	61.22	12
Germany	55.53	17
France	n/a	> 20

Source: ITU 2002, *Internet for a Mobile Generation* Report. Statistical Annex. ITU: Geneva.

7.3 E-Readiness

The Economist Intelligence Unit/Pyramid Research unit develops E-Readiness assessments of 60 countries. The rankings for 2000 and 2001 are listed in Table 7.2.

Table 7.2 – EIU/Pyramid Research e-readiness rankings

	May 2001		May 2000	
	E-readiness score	Rank	E-readiness score	Rank
Denmark	7.70	9	8.2	12
Finland	7.83	8	8.6	3
France	7.26	15	8.1	14
Germany	7.51	13	8.2	13
Netherlands	7.69	10	8.4	5
Norway	8.07	5	8.5	4
Sweden	7.98	6	8.6	2
UK	8.10	3	8.4	6
Canada	8.09	4	8.3	7
US	8.73	1	8.8	1

Source: The Economist Intelligence Unit

The factors (both of a quantitative and qualitative nature) included in the index are in six categories: connectivity (30%); general business environment (20%); e-commerce consumer and business adoption (20%); legal and regulatory environment (15%); supporting e-services (10%); social and cultural infrastructure (5%).

All the countries being examined in this report are ranked high. The US is well ahead of the others, with France lagging. For the other countries the significant changes in rankings between 2000 and 2001 suggest there are only marginal differences among them. However given Denmark's general higher rankings on other related indicators, the reasons for Denmark's ranking might be worthy of further investigation.

The specific use of e-commerce is in its earliest stages and varies from sector to sector and country to country. In some countries, such as Denmark, EDI has been the base for a relatively high ranking in the business-to-business (B2B) sector. In others, such as Sweden, e-commerce is almost entirely TCP/IP-based. The balance between B2B and business-to-consumer (B2C) also shows large differences. In Denmark, the success of B2C has been much less pronounced than B2B. Overall, the total turnover of e-commerce per capita does not differ a lot among the Nordic countries, with the exception of Sweden that has a slightly higher position.

The public sector relationship to e-commerce has multiple facets. The public sector has importance in providing national strategies for e-commerce, providing the legal framework for

transactions, shaping and promoting market development through effective regulation, applying electronic services, making electronic procurements, providing tele-work etc. It must also invest to upgrade its own networks and services for electronic access and delivery. Specific comparative data among countries at this early stage of development in e-commerce and e-government is too speculative for purposes of this report.

7.4 Preparedness for Network Society Development

Table 7.3 shows the rankings of an Information Society Index that attempts to weight assessments of preparedness for information or network society development in four areas, computing, Internet, telecom/broadcasting and societal capacity. Denmark ranks very high at 5th, and again finds itself in direct competition with the other Nordic countries for the international leadership positions.

Table 7.3 – Information Society Index 2001

	Score	Rank
Sweden	6,496	1
Norway	6,112	2
Finland	5,953	3
USA	5,850	4
Denmark	5,837	5
UK	5,662	6
Netherlands	5,238	10
Canada	5,126	12
Germany	4,937	13
France	4,104	21

Source: IDC (http://www.idc.com)

ASSESSMENT: INFORMATION INFRASTRUCTURE AND NETWORK SOCIETY DEVELOPMENT

Comparative assessments of progress in information infrastructure development are much more difficult than for telecom reform because of the paucity of directly comparable data, or even agreed upon indicators of comparison, for a development process that is still in its earliest stages. Rankings mean less, and may be extremely transitory. What is more important is whether the necessary activities are underway to guide and stimulate information infrastructure development.

With respect to information infrastructure and information society development, the US and Canada started earlier than Europe and are further along the growth curve. Denmark and the other Nordic countries are leading Europe by most indicators, and are moving ahead rapidly to facilitate further growth. Finland has the highest penetration. Sweden is the Internet hub of the Nordic region. With the landing of the TAT-14 transatlantic fibre cable in Denmark in 2000, opportunities for Denmark to play a more active role in the evolution of the Internet may be presented.

Similarly, the Nordic countries are moving ahead at a leadership pace in e-commerce readiness, again with Sweden and Finland as the front runners by most indicators. In Sweden and Denmark in particular, the public sector has been a major driver of growth through its administrative and purchasing activities. Government policy changes relating to digital signatures and related issues should be a stimulus to e-commerce growth in many countries, including Denmark. The current explosion in transatlantic bandwidth capacity will provide a major stimulus for the integration of European and North American e-commerce activity, and could open new opportunities for European firms in North American markets. The Nordic countries, the Netherlands and the UK are well positioned to take advantage of this opportunity.

It is still very early in the process of deploying new local access technologies. The primary driver of Internet growth at this stage is additional subscribers to the currently most popular services, email and web site access, which can be supplied economically on narrowband and enhanced narrowband networks. It appears that the fastest growing access technology in most European countries is ISDN. Although Denmark stands out with its near universal coverage of ADSL capability, in most countries DSL and upgraded CaTV access still have technical, economic and market development challenges to overcome if they are to be capable of providing ubiquitous services, and the 3G mobile initiatives are not likely to be operational for several years. Effective competition in local markets is still primarily a gleam in the eyes of economists, policymakers and regulators. The available information suggests there will be a need for proactive regulation for the foreseeable future, both to drive the competitive process forward and to shape and promote information infrastructure and network society development.

8. CONCLUSIONS

Denmark has set a high standard for its telecom reform process – to offer consumers the "best and cheapest" services. It has established itself as a leader in Europe and internationally and compares itself not to the average EU standard, but rather to international best practice. This report has drawn some comparisons of the progress in Denmark with a selected group of countries that are its competitors for international best practice rankings, or are otherwise important for comparison.

In interpreting the comparative information, it must be kept in mind that the data is not complete and captures only a partial picture of a rapidly changing industry and an evolving process of telecom reform and information infrastructure development for network societies. The available information documents that Denmark is a leader in most aspects of telecom reform, but like all countries, has specific areas of comparative strengths and limitations. Denmark is notable as a leader in opening its markets and minimising barriers to entry, e.g., licensing, interconnection, leased line prices and local loop unbundling. Actual competition has progressed most rapidly in mobile and international services. National and local services remain dominated by the incumbent.

Nevertheless, Denmark, like all other countries, still has a way to go before its markets are effectively competitive. Experience so far with the early deployment of alternative higher speed access via DSL, coaxial cable (CaTV), fibre cable, 3G mobile and other possibilities suggests that significant local competition using different technologies is still more on the longer, rather than the shorter term radar. Although Denmark's interconnection prices are at, or better than the EU best practice standard, continued priority attention to interconnection and access prices and conditions, and the further development of competition in the various network services markets will be necessary.

For the future it is important that NRAs and policymakers in Denmark and other countries prepare themselves for the Internet economy, and a major acceleration in the speed of integration of national and international networks. The activities and priorities of leading NRAs will increasingly shift from issues of traditional telecom reform to issues associated with the continuing rollout of the information infrastructure as the foundation for the development of the e-economy and network societies. NRAs will need to be active in monitoring and guiding this process if the ambitions objectives of government policy in Denmark and other countries are to be achieved.

ANNEX – SUPPORTING TABLES FOR FIGURES

Figure 1.1 – Telecom Market Development
(million EUR)

	1999	2000	2001	Revenue per capita (2001)	Revenue per telecom path[a] (1999)	CAGR (1999-2001) (%)
Denmark	4,362	4,778	5,190	976	696	9.0
Finland	3,939	4,196	4,461	863	634	8.6
France	36,533	42,107	46,751	791	667	12.9
Germany	53,515	59,368	65,964	804	746	10.6
Netherlands	11,662	13,656	15,162	959	711	14.2
Norway	3,753	3,996	4,424	991	637	9.2
Sweden	7,019	8,482	9,081	1,025	603	12.8
UK	40,637	47,113	52,745	886	707	12.6
Canada	19,325	n/a	n/a	n/a	720	n/a
US	254,333	270,356	286,848	1,051	1,149	6.3

Source: EITO 2001; OECD 2001

[a] Fixed plus wireless.

Figure 1.2 – Penetration Rate of Main Telephone Lines and Mobile Subscriptions
(Communication channels per 100 inhabitants)

	Fixed			Mobile		Telecom access paths per 100 inhabitants	
	1995	2001	cagr, %, (1995-2001)	1997	2001	cagr, %, (1997-2001)	2001
Denmark	61.2	72.3	4	27.5	73.67	28	146.0
Finland	54.3	54.8	0	45.6	77.84	14	132.6
France	56.0	57.4	1	9.8	60.53	58	117.9
Germany	55.3	63.5	3	9.9	68.29	62	131.8
Netherlands	52.4	62.1	4	10.8	73.91	62	136.0
Norway	56.7	72.0	6	38.4	82.53	21	154.6
Sweden	68.0	73.9	2	35.8	77.07	21	151.0
UK	50.2	57.8	4	14.3	78.28	53	136.1
Canada	59.9	65.5	2	14.1	32.00	23	97.5
USA	60.7	66.5	2	20.4	44.42	21	110.9

Source: ITU 2002

Figure 2.1 (a) – Annual Leased Line Rentals for 64 Kbit/s line
(Euro, excl. VAT)

	2 km	50 km	200 km
Denmark	1,186	2,529	3,066
France	2,766	5,342	6,632
Germany	1,104	4,985	5,767
Netherlands	2,920	6,344	6,344
Sweden	2,439	2,477	3,254
UK	3,064	6,309	7,959
USA-NY (a)	2,352	5,067	12,314
USA-CA (b)	1,489	3,940	11,645
EU	2,086	4,558	5,915

Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Note: For the USA (a) the prices of Nynex/Verizon (New York) have been used (b) Prices for Pacific Bell (California) have been used. Finland is not included because since 1998 Sonera does not publish the prices for full 64K/bits services.

Figure 2.1 (b) – Annual Leased Line Rentals for 2 Mbit/s line
(Euro, excl. VAT)

	2 km	50 km	200 km
Denmark	1,956	11,884	16,315
France	7,500	23,325	39,515
Germany	4,080	23,749	30,054
Netherlands	13,363	33,489	33,489
Sweden	4,326	9,175	12,737
UK	4,786	24,116	52,722
USA-NY	8,244	26,654	78,315
USA-CA	6,080	20,847	61,676
EU	6,841	22,652	37,055

Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Figure 2.1 (c) – Annual Leased Line Rentals for 34 Mbit/s line
(Euro, excl. VAT)

	2 km	200 km
Denmark	8,112	193,674
France	49,027	321,422
Germany	12,600	122,712
Sweden	19,667	84,820
UK	53,464	335,778
USA-NY	46,870	250,644
USA-CA	36,000	119,230
EU	32,595	230,681

Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Figure 2.1 (d) – Annual Leased Line Rentals for 140/155 Mbit/s line
(Euro, excl. VAT, 2001)

	2 km	200 km
Denmark	12,330	417,525
France	41,161	559,790
Germany	12,300	154,512
Sweden	30,828	181,817
UK	159,817	959,064
EU	59,058	430,003

Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Figure 3.1 – Incumbent Operators' Market Share in Public Fixed Voice Telephony[a]

	All local calls		Long-distance calls		International calls	
	1999[b]	**2000**[c]	**1999**[d]	**2000**[c]	**1999**	**2000**
Denmark	99.7	63.0	90.0[e]	63.0	56.3	50.0
Finland	99.7	93.0	37.9	32.0	51.5	54.0
France	100.0	97.0	80.0	79.0	72.9	740.0
Germany	99.0	65.0	60.0	65.0	60.0	46.0
Netherlands	99.9	99.0	84.0	96.0	85.0	70.0
Sweden	99.0	82.0	86.0	82.0	62.0	59.0
UK	84.6	72.0	66.6	51.0	45.4	31.0

Source: OECD (2001); EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Notes:
a. All figures for 2000 refer to market share of outgoing minutes except for Sweden where figures refer to market share of revenue.
b. Percentage of access lines
c. The 2000 Figures for Denmark, Germany and Sweden include local and long-distance calls
d. Share of switched minutes
e. 1998 figure

Figure 3.2 – Mobile Market Share
(August 2001)

	Leading Operators	Main Competitors	Other Competitors
Denmark	48.5	27.9	23.6
Finland	62.1	31.4	6.5
France	48.0	33.9	18.1
Germany	40.5	39.7	19.8
Netherlands	43.5	28.1	28.4
Sweden	49.2	35.2	15.6
UK	27.9	25.4	46.7

Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

Note: Except for UK, the leading operator is a subsidiary of the incumbent fixed network operator.

Figure 3.3 – Interconnect Charges for Call Termination on Fixed Network
(Per minute, Euro cents – August 2001)

	Local	Single Transit	Double Transit
Denmark	0.67	0.95	1.34
Finland[a]	1.43	1.43	2.67
France	0.58	1.23	1.83
Germany	0.83	1.42	2.17
Netherlands	0.79	1.03	1.32
Sweden	0.67	0.90	1.03
UK (Bt)	0.63	0.90	1.55
EU	0.85	1.23	1.86

Source: EU 7th Report on the Implementation of the Telecommunications Regulatory Package, 2001

[a] In Finland there are about 50 SMP operators that apply different charges. The figures are for the two major operators. Local transit and single transit numbers are for one operator and the double transit numbers are for the second major operator

Figure 7.1 – Number of SSL-based Servers per million Inhabitants
July 2000 – July 2002

	July 2000	July 2001	% Change 2000-2001
Denmark	54	100	84
Finland	66	125	89
France	22	35	60
Germany	46	80	75
Netherlands	31	70	130
Sweden	90	145	61
UK	75	130	73

Source: e-Europe Benchmarking Report, 2002

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