
CHAPTER 5

FINLAND

Executive Summary

While many European Union nations are faced with the task of upgrading their communications infrastructure and struggling with deregulation of the telecommunication sector, Finland is on the leading edge of these developments. In the past few years, Finland has come to be recognized worldwide as something of a “communications superpower.” Finland ranks highly in several key per capita measures, notably Internet hosts and mobile phone subscribers, and the country has been a forerunner in dismantling telecommunications monopolies.

Since 1987, Finland has progressively opened its telecommunications markets to competition, and today serves as a model for other European countries working to implement the World Trade Organization telecommunications trade pact and European Commission rules that went into effect this year. Finland is also frequently held up as a prototype of the future “information society,” with currently the highest per capita percentage of cellular subscribers (40 percent) and Internet hosts (9.6 percent) recorded in the world.

Along with high cellular penetration rates and Internet hosts per capita, Finland also ranks highly in such measures as the per capita percentage of fixed telephone lines and personal computers. Due to the deregulated telecommunications sector, Finland places near the top in various price comparisons with other Organization for Economic Cooperation and Development (OECD) nations for the lowest telecommunications charges.

Since outlining a National Information Society strategy in 1994, Finland has moved quickly to develop its domestic data networks and provide high speed Internet access throughout the country for both businesses and residential customers. Finland is home to one of the first nationwide, commercial Asynchronous Transfer Mode (ATM) networks and several firms are in the process of extending broadband services to the home.

Last year, an article in *The New York Times*¹³⁵ attempted to answer the question many are still asking: How did this country, once a buffer between the old Soviet Union and the capitalist centers of northern Europe, become a microcosm of an electronic future? The article concluded that although the reasons are not immediately clear, some possible suggestions include the high educational level, public spending on basic research, and even the long winter nights.

This chapter considers such reasons and provides others that could account for Finland’s emerging strengths in telecommunications and the Internet. Based on the framework for analysis employed in this study, Finland’s balanced development and rapid pace of Internet diffusion is determined primarily by these factors:

- The relatively long history of Internet presence in the country (Finland first connected to the NSFnet in 1988).
- The Finnish government’s coordinated efforts in planning and executing a national information society strategy (begun in 1994).

¹³⁵ “As Most Wired Nation, Finland Has Jump on 21st Century,” *CyberTimes, The New York Times* (20 January 1997).

- The availability of and experience with open and competitive telecommunications markets.
- A major domestic, worldwide leader in telecommunications equipment manufacturing and digital telephony expertise (Nokia).
- A stable democracy with a modern economy and relatively open-minded culture which continues to embrace the Internet and not restrict its use.

Table 42 provides a summary of the current dimensional analysis for Finland. The country ranks highly in nearly all aspects of the framework, and achieves top ratings for half of all the dimensions.

Dimension	Level	Explanation
Pervasiveness	(4) <i>Pervasive</i>	The Internet is pervasive. The ratio of Internet users per capita is currently the highest in the world. Internet access is sufficiently available as a commodity service to the general public for widespread use.
Geographic Dispersion	(3) <i>Highly Dispersed</i>	Internet points-of-presence are located in all of the first-tier political sub-divisions of the country; however, all international IP links run through Helsinki.
Sectoral Absorption	(3) <i>Common</i>	All universities have full-time Internet connections, while over half of the primary schools and the majority of organizations in the commercial, health, and public sectors are connected.
Connectivity Infrastructure	(3)	The aggregate domestic and international bandwidth exceeds the measurements for Level 4; however, there is only one Internet exchange, FICIX. Access to the Internet is via dial-up, ISDN, or leased lines.
Organizational Infrastructure	(4) <i>Robust</i>	There are many ISPs in Finland, and the market is one of the most highly deregulated and intensely competitive in the world. ISP associations and Computer Emergency Response Teams exist.
Sophistication of Use	(4) <i>Innovating</i>	Finland claims a number of world firsts in both the development and application of Internet-related technologies. Thus, the national user community is regularly applying the Internet in innovative ways that push the capabilities of the technology.

Table 42. Internet Dimensions for Finland

When plotted graphically over time (Figure 16), these indicators provide a comprehensive picture of the pace and extent to which Finland has embraced the Internet. The current ratings reveal a country that is one of the most highly developed and well-balanced with respect to these key aspects of Internet development. No other countries in this study exhibit the range and depth of growth that has taken place in Finland, and few in the world could rival their national achievements.

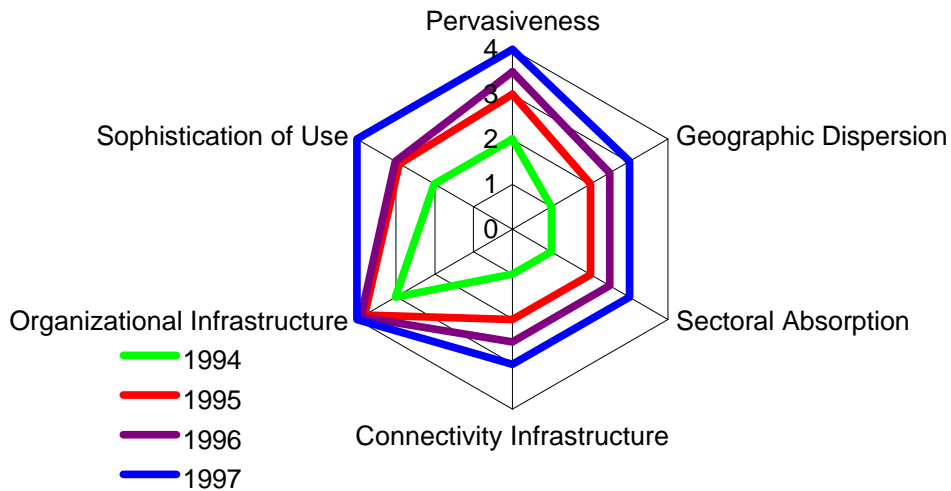


Figure 16. Internet Dimensions for Finland, 1994-1997

Although Finland is a world leader in Internet diffusion, there are several policy concerns that the country is in various stages of addressing that may affect the future growth of the Internet there. The primary issues that Finland remains concerned with are infrastructure development, economic renewal, and social progress towards an enlightened information society.

- The expansion and maintenance of Internet infrastructures is a continual challenge. As in the United States and other Internet-intensive countries, on-going problems include keeping up with the demand for increased network bandwidth, dealing with the pace of technological change, and extending service to more rural areas.
- Finland has rebounded economically from a recession earlier this decade, but it is still troubled by high unemployment. Adapting to the European single currency could put a strain on its investments in IT and research and development. Also, Nokia has become such an integral part of the economy and national identity that if the company were to falter, the negative effects on Finland could be widespread.
- Surveys reveal Finns are more optimistic about the benefits of increased use of technologies like the Internet when compared with other European Union (EU) countries. However, they also appear keenly aware of the potential risks involved in establishing a society based around information technology. Following the country's traditionally careful, measured approach in dealing with social issues, various groups in Finland are involved with studying and implementing trial solutions to alternative work, learning, and social interaction problems brought on by the increased use of networks and technology.

Finland is also actively involved in various EU and international cooperation efforts dealing with these subjects and has been developing a national reputation for being an exporter of specialized knowledge pertaining to such issues. Given the character of the Nordic welfare state in Finland, the government and citizens are concerned about equitable access to information resources in

Finnish society. Perhaps their efforts to develop a solution for preventing a nation of digital “haves” vs. “have-nots” will be another model for the world.

Finland’s notable accomplishments in a relatively short time are indicative of the strong national desire to improve their economic and social well being through technology. It seems the country is no longer content being the quiet “Finlandized” neighbor to Russia or the “poor man” of the Nordic countries.

Introduction

Finland is a highly-developed, stable democracy with a modern economy. It belongs to the European Union, which it joined in 1995. The country is home to 5.1 million people, and it is the fifth largest European country, although it has one of the lowest population densities in Europe (Table 43). Its 188,000 lakes occupy one tenth of its area, while 69 percent of its territory is covered by forests, and about a quarter of Finland is north of the Arctic Circle (Figure 17).

With a highly educated population and modern infrastructures, Finland is making great strides to improve its economy and establish itself as a force in advanced technology. Although its population is smaller than that of several American cities, Finland continues to make substantial investments in research and development effort,



Figure 17. Map of Finland

Table 43. Finland in Statistics		
Metric	Value ¹³⁶	Remarks
Population	5.11	millions, 1995
Population density	14	per km ² , 1995
GDP	97.5	US\$billions, 1994
GDP per capita	19,176	US\$, 1994
Telephones	2,813	thousands, 1996
Teledensity	54.8	per 100 inhabitants, 1996
Teledensity in largest city	143.92	per 100 inhabitants, 1995
Cellular subscribers	1,017.6	thousands, 1995
Cellular density	19.92	per 100 inhabitants, 1995
PCs	930	thousands, 199?
PC density	18.21	per 100 inhabitants, 199?
Television sets (receivers)	2,650	thousands, 1995
Television density	51.9	per 100 inhabitants, 1995
Literacy rate	100 ¹³⁷	per 100 inhabitants older than 15 years, 1980
Infant mortality	5.2 ¹³⁸	per 1000 inhabitants, 1995 estimate

totaling about 2.4 percent of its GDP, or over 11 billion Finnish Markka (FIM) (US\$2.5 billion) last year.

The average growth estimates of GDP for 1997 vary between 4 and 5 percent, which is one of the highest in EU-area. In spite of the fast growth of production and private consumption there are no signs of inflation. Consumer prices are expected to increase by only one percent, and the interest rates have come down by 3 percent since autumn 1995 while the exchange rate against the German DM has been stable for a number of years.¹³⁹

Although unemployment has dropped steadily from a high of 17.2 percent in 1995 to a projected 13.8 percent this year, this continues to be a weak spot for the Finnish economy. Nonetheless, Finland has already fulfilled all the European Monetary Union (EMU) criteria last year and the economic condition of the country continues to strengthen this year. The aim of the Finnish

¹³⁶ Source: *World Telecommunication Development Report*, 3rd ed., 1996/97 (Geneva: International Telecommunications Union, March 1997), unless otherwise noted.

¹³⁷ *The World Factbook 1996*, <<http://www.odci.gov/cia/publications/nsolo/factbook/ir.htm>>.

¹³⁸ *ibid.*

¹³⁹ The Research Institute of the Finnish Economy (ETLA), *The ReseSource*, <<http://www.tat.fi/finnfact/outlook.htm>>.

government is to join EMU from the beginning and industry is strongly supporting this target.

The Nordic welfare state model, which had its birthplace in Sweden, still figures prominently in Finland. The model is characterized by three basic features. First, it includes a comprehensive system of social welfare. The basic principle is the provision of assistance to everyone, without means testing. Second, it is based on a historical compromise between labor and capital, to ensure industrial peace. Both employers and employees have strong organizations in a type of corporate system. Third, there is a cooperative approach to day-to-day policy based on negotiation. Expansion of the public sector has been the result of extensive, long-term planning.¹⁴⁰

This planning extends directly to the telecommunications sector where the Finnish national government has developed and continues to work on programs promoting the information society and related infrastructures. During the first half of the 1990s, extensive studies were carried out with the intent of establishing a national information infrastructure, similar to that of the United States. This was seen by the government as essential to helping relieve the recession of the early 1990's and ensuring Finland's future economic prosperity.

Networks in Finland

The Internet came to Finland in 1988 when it connected to the NSFnet through Stockholm, Sweden along with the other Nordic countries Norway, Sweden, Denmark and Iceland. These were some of the first nations outside of the United States to join the network, and that same year Canada and France were also added.¹⁴¹ The Internet has since followed a path of diffusion common to many countries, with initial use being primarily in the academic and research sectors and then spreading out to the government, commercial and public sectors.

Finland's history with TCP/IP networking goes back to 1984 with the founding of the Finnish University and Research Network (FUNET). At that time the other Nordic countries were also building research networks using various different technologies. In the second half of the 1980's NORDUnet was formed as a result of a Nordic collaboration program financed by the Nordic Council of Ministers. The goal of the project was to unite these networks into a single common infrastructure to serve research and education in these countries.¹⁴²

The TCP/IP protocol was adopted as the primary service to interconnect the country's national research networks (NRN), although a multi-protocol structure was established. This decision was arrived at after a difficult period of network protocol evaluation, and is noteworthy because at the time many others in Europe were implementing OSI networks. The choice was also auspicious since it laid the groundwork for Finland and its Nordic neighbors to become some of the leading countries in the world in Internet use.

NORDUnet was completed in 1989 with interconnections between all Nordic countries and direct circuits to the NSFnet in the United States, and EUnet and the European Laboratory for Particle Physics (CERN) in Europe. That year the network was turned over to the Nordic NRNs, who

¹⁴⁰ Martti Häikiö, *Facts*, University of Helsinki FINFO, <<http://www.vn.fi/vn/um/finfo/findeng.html>>.

¹⁴¹ *Hobbe's Internet Timeline*, <<http://www.isoc.org/guest/zakon/Internet/History/HIT.html>>.

¹⁴² Peter Villemoes, *NORDUnet - a successful collaboration*, <<http://www.nordu.net/info/articles/article1/text.html>>. Mr. Villemoes is the NORDUnet General Manager.

have set up and funded the NORDUnet organization to operate the network. The network infrastructure at that time was based on 64 Kbps links.¹⁴³

Current Connections

While Finland has been called the “cellular telephone capital of the world” because of the country’s high rate of cellular usage, it could also be considered the “Internet capital of the world.” Currently, Finland is more plugged-in per capita than any other country and nearly twice as wired as the United States (per 1000 inhabitants).¹⁴⁴ Although the methodologies and accuracy of tracking Internet hosts are not without flaws, the various estimates from several established authorities over the past several years all place Finland clearly at the top of their charts for host counts per capita.

According to the latest RIPE (*Réseaux IP Européens*) Network Coordination Center (NCC) host count, from December of 1997,¹⁴⁵ Finland has 486,811 hosts or 96.55 per 1000 inhabitants. This is by far the highest percentage in the world, since the next closest countries are Iceland with 71.23 hosts per 1000 and Norway with 68.22 per 1000. The most recent figures from Network Wizards (NW), published in February 1998, show Finland with 450,044 hosts or 88 per 1000 inhabitants.¹⁴⁶ Within Finland, comparable data (to RIPE and NW) is monitored and analyzed by the Telmo Association.¹⁴⁷ Extensive surveys about the state of the Internet in Finland have also been carried out by Taloustutkimus Oy on a quarterly basis since November of 1994.¹⁴⁸

The network infrastructure in the country and the region has undergone major changes to support this increased growth in hosts and users. For example, from 1990 to 1995 NORDUnet bandwidth has increased 170 percent per year. Currently NORDUnet’s international links to and from Finland support 34 Mbps capacity. Internally, the primary backbone is the FUNET ATM network (see map at Tab E), which serves Finland’s universities and research centers. The backbone is mainly based on ATM connections provided by Telecom Finland and connection speeds range from 10 to 34 Mbps. Other connections are based on Ethernet, Frame Relay or modem connections with the speed ranging from 64 Kbps to 10 Mbps. Some connections are also leased from local telephone companies throughout the country. The network is based on TCP/IP, and the FUNET member organizations are connected to the backbone through Cisco Systems routers. The ATM connections have been implemented with Fore Systems ATM switches.

¹⁴³ *ibid.*

¹⁴⁴ *On the Road to the Finnish Information Society*, Statistics Finland, Table 2.3.1, p.35.

¹⁴⁵ RIPE statistics mirrored at TELMO, <<http://www.sty.fi/telmo/tilasto/ripehpa.htm>>.

¹⁴⁶ Network Wizards, *Internet Domain Survey*, January 1998, <www.nw.com/zone/www/report.html> (23 February 1998).

¹⁴⁷ Telmo, The Finnish Association for Interactive Network Services, was established in 1992 to promote the development of telematic services in Finland. Members of Telmo include several ministries and other representatives of the public sector, large and small to medium size enterprises representing various business sectors and other organisations active in network services production and usage. <http://www.sty.fi/telmo/telmoeng.htm>.

¹⁴⁸ E-mail correspondence with Ismo Tenkanen (ismo.tenkanen@toy.fi) (3 October 1997). Taloustutkimus Oy is the second largest full service market research company in Finland and it is commonly accepted that they offer the most detailed study about Internet penetration and usage available anywhere in Finland. This fall the Ministry of Transport and Communications became a regular subscriber. Unfortunately access to these potentially more accurate domestic sources has been limited because they are prohibitively expensive. The report is available in English at a cost of FIM 7,900 (US\$1,425).

In addition to FUNET, there are numerous commercial Internet service providers. The largest are Telecom Finland and EUnet Finland, but many of the regional telephone companies affiliated in the Finnet group¹⁴⁹ and various private firms also offer these services.

Internet Dimensions

The Internet capability of Finland, when examined using the dimensional analysis of this study's framework, is revealed to be both strong and well-balanced. Table 44 summarizes the values arrived at for each of the six dimensions. The advanced development of Finland's Internet

Dimension	Level	Explanation
Pervasiveness	(4) <i>Pervasive</i>	The Internet is pervasive. The ratio of Internet users per capita is currently the highest in the world. Internet access is sufficiently available as a commodity service to the general public for widespread use.
Geographic Dispersion	(3) <i>Highly Dispersed</i>	Internet points-of-presence are located in nearly all of the first-tier political sub-divisions of the country, however the only international IP links are through Helsinki.
Sectoral Absorption	(3) <i>Common</i>	All universities have full-time Internet connections, while over half of the primary schools and the majority of organizations in the commercial, health and public sectors are connected.
Connectivity Infrastructure	(3)	The aggregate domestic and international bandwidth exceeds the measurements for Level 4; however, there is only one Internet exchange, FICIX. Access to the Internet is via dial-up, ISDN, or leased lines.
Organizational Infrastructure	(4) <i>Robust</i>	There are many ISPs in Finland, and the market is one of the most highly deregulated and intensely competitive in the world. ISP associations and Computer Emergency Response Teams exist.
Sophistication of Use	(4) <i>Innovating</i>	Finland claims a number of world firsts in both the development and application of the Internet-related technologies. Thus, the national user community is regularly applying the Internet in innovative ways that push the capabilities of the technology..

Table 44. Internet Dimensions for Finland

capability is evidenced by it having achieved three ratings of 4, the highest score available. In addition, for the remaining three dimensions Finland's lowest rating was a 3, indicating a well-established foundation in all areas for continued growth. The development of the Internet dimensions in Finland is depicted in Figure 18. Further discussion and justification for these ratings is provided in the text that follows.

¹⁴⁹ The Finnet Group is a consortium that comprises 45 private local telephone companies in Finland, <<http://www.finnet.fi/inenglish/index.html>>.

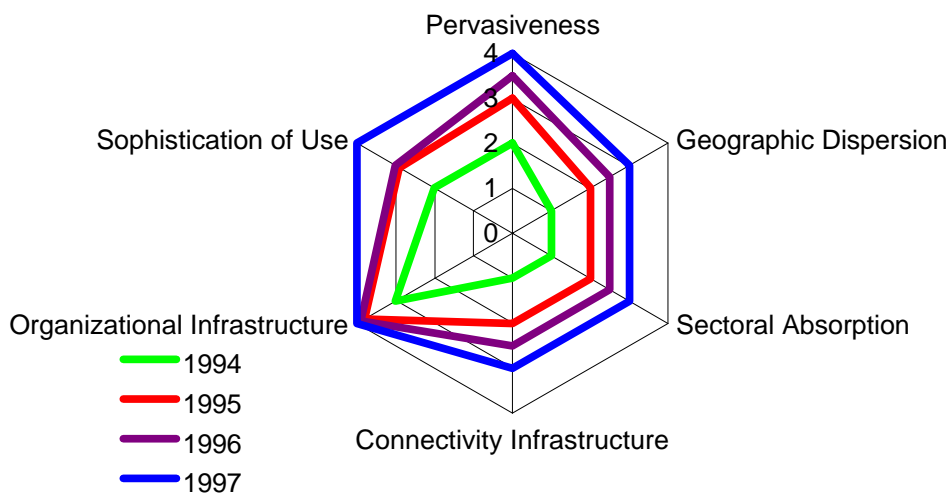


Figure 18. Internet Dimensions for Finland, 1994-1997

Pervasiveness Finland currently has the highest number of Internet hosts per capita in the world. The trend has been generally strong continuous growth with sharp increases occurring during 1994 and 1995, the years during the formulation and adoption of the national information infrastructure plan.¹⁵⁰

The number of hosts per capita receives a lot of attention in part due to the number of reports produced on it by groups like NW and MIDS, but also because of the relative ease of mechanically calculating this when compared to counting numbers of actual users. This generally can only be accomplished by survey and in Finland the most authoritative report tracking Internet users is produced by Taloustutkimus Oy. They have surveyed users four times a year since late 1994 and provide the most accurate picture of Internet usage in the country (Table 45).

According to Taloustutkimus Oy, there were a total of 1,344,000 people between the ages of 15 and 74 years who were using the Internet in Finland during October-November 1996 (Figure 19). This was up 105 percent from the same period in 1995 when 656,000 people were using the net.¹⁵¹ This represents approximately 27 percent of the population in 1996 as compared with 13 percent in 1995. In both cases the ratio of users per capita is at least one in ten. More recent figures from the same period this past year (1997) are not available however it can be reasonably assumed that the growth rate has continued to be strong since the net's popularity continues to expand and there are few factors in Finland to inhibit this expansion.

¹⁵⁰ "Finland's way to the Information Society—the National Strategy" was drawn up under the auspices of the Finnish Ministry of Finance during 1994 and approved by the Council of State in January of 1995.

¹⁵¹ This is the most current, publicly available data from Taloustutkimus Oy. Their complete survey reports are prohibitively expensive and attempts to obtain excerpts from paying subscribers have been unsuccessful. Source: "On the Road to the Finnish Information Society" (1997) Statistics Finland, p.146-7.

Date	12/92	12/93	12/94	12/95	12/96	12/97
Hosts	18,569	33,085	68,262	215,704	314,141	486,811
Hosts/1000	3.68	6.56	13.54	42.78	62.30	96.55
Annual Growth		78 percent	106 percent	216 percent	46 percent	55 percent

Table 45. Internet Hosts in Finland (.fi domain)¹⁵²

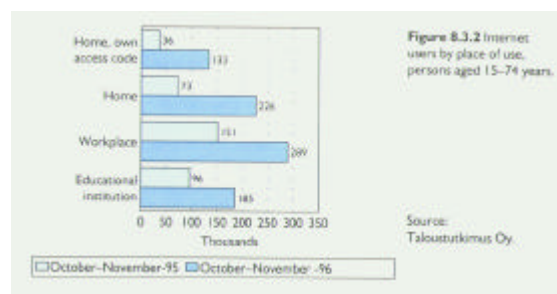
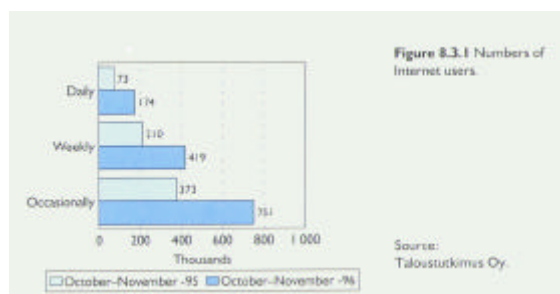


Figure 19. Internet Use Figures, 1995-1996

What is also clear from the Taloustutkimus data is that during 1996 the Internet expanded out significantly from the traditional areas of work and school and into the home. This clearly reflects a change in Internet use from a core group of technical experimenters and “early adopters” to the general public. The fact that the number of private home users had more than tripled to 226,000 in the period of a year is indicative of the relative ease with which the population can obtain Internet service in any local area.

Geographic Dispersion The level of dispersion of Internet services throughout Finland is somewhat unique in that all 12 Finnish provinces have network points-of-presence, however due to country’s relatively isolated geographical position all international IP links are concentrated in the capital Helsinki. Although approximately 60 percent of Finland’s population is urban and lives in the coastal areas, rural access to the Internet is not uncommon. Even the remote Lapland region in the Arctic Circle is served by a 10 Mbps link from Oulu to Rovaniemi and is designated its own Telecommunications Service Area. However, since the average Internet user is male, under age 30, living in the vicinity of Helsinki,¹⁵³ the large majority of the network infrastructure and service provision resides along the southern coast.

For example, Uusimaa is a region in southern Finland, around the metropolitan area of Helsinki. The region consists of 27 municipalities, most of them either small cities or countryside villages.

¹⁵² RIPE DNS host count history, <ftp://ftp.ripe.net/ripe/hostcount/RIPE-Hostcount>.

¹⁵³ “On the Road...,” *op. cit.*, p.148.

The coverage of publicly available Internet services for the municipalities is 100 percent, and the quality of the service is rated very good in most cases. Although this is not uniformly the case for second tier municipalities in the rest of the country, this level of service demonstrates well the high penetration of Internet use in public administration in general throughout Finland.¹⁵⁴

Another unique feature of the country is the rugged coastline dotted with many small islands, a number of them inhabited, which poses a problem in connecting them all via land lines. Cellular data access is available but is still not reliable and cost effective enough to use on a regular basis for the average home user. Nonetheless, many small cities located along the coast line of the Finnish Gulf of the Baltic Sea attract tourists and it is important to distribute travel information on the Internet. Thus the motivation for using web services ranges from visibility to cost savings and public image for the municipalities.

Sectoral Absorption When looking at the degree to which four major Internet-using sectors of Finnish society have taken up the technology, the country employs the Internet moderately (approximately 10-90 percent) in all areas (academic, commercial, health, and public/government). While none of these areas is homogeneous, the public top-tier government entities and academic universities stand out as the most common users with absorption rates greater than 90 percent. As is true in the US, almost without exception every university or technical/trade school has Internet access and provides such services at little or no cost to their students. In addition, every national government office and agency has a web presence, along with all provinces and a large majority of municipalities. Given the strong drive by the national government to carry out its business on-line, this has brought many towns and villages on-line to maintain their resources.

Connectivity Infrastructure In analyzing the four components comprising the connectivity infrastructure dimension: aggregate domestic bandwidth, aggregate international IP bandwidth, interconnection exchanges, and local access methods used, Finland again finds itself in a unique position. It satisfies the requirements for Level 4 in all categories except for Internet exchanges, where it rates a Level 2. This is due to the Finnish Commercial Internet Exchange (FICIX) being the only traffic exchange point in the country. Given the relatively small size of the country, and the concentration of infrastructure in one area, it is not surprising that FICIX is the only Internet exchange. In addition, this is also understandable given the openly competitive nature of the Finnish telecommunications markets and the collaborative nature of many firms and government.

Table 46 summarizes the aggregate bandwidth available on the domestic backbone and international IP links. This information is derived from the FUNET network map of Finland (see Tab E). However, much has happened in the year since this map was put together as significant bandwidth upgrades have been put in place both domestically and internationally.

Organizational Infrastructure The number of Internet Service Providers (ISP) and the competitive environment for access to the Internet in Finland is indicative of the rich service provision infrastructure that exists. The market for these value added data services has been unregulated since their inception in Finland. This, in concert with the country's open, competitive market for other major, traditional services (local, international calling, and fixed line or mobile), has provided one of the foundations for the high subscriber take-up rates.

¹⁵⁴ Helsingin Sanomat, < <http://www.tagish.co.uk/ethosub/lit13/da6a.htm>>.

Table 46. Summary of Finland's Connectivity Infrastructure				
	Domestic Backbone	International Links	Internet Exchanges	Access Methods
<i>Level 2</i>			1	
<i>Level 4</i>	≥ 100 Gbps	≥ 10 Gbps		< 90 percent modem > 64 Kbps leased lines

Figure 20 represents the major players in the Internet service space in Finland during the past year.

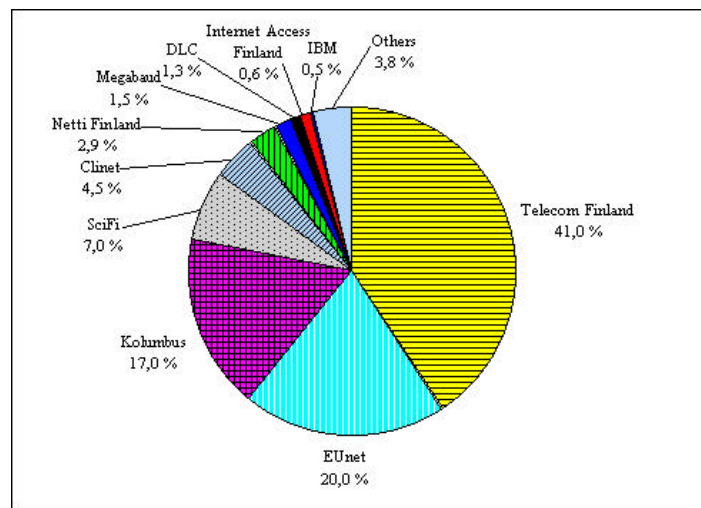


Figure 20.¹⁵⁵ ISP Market Shares

Although Telecom Finland, the government owned but privately run PTT, maintains a dominant position, this is largely attributed to their strong service record, competitive rates and to a lesser extent a sort of “halo” effect (similar to AT&T in the United States). Given the highly deregulated state of telecommunications affairs in Finland, the barriers to market entry are low and limited mainly to initiative, know-how and relatively small amounts of capital. In all, there are currently more than 30 ISPs, many serving small local constituencies.

There are several important collaborative organizations: NORDUnet, FUNET, and FICIX. NORDUnet's mission is to provide international connectivity to the Nordic NRNs by interconnecting them to each other and connecting them to the rest of the world. NORDUnet is organized as a limited company (A/S) in Denmark. The shareholders are the Nordic ministries of education and research, or institutions belonging to them. The Nordic NRNs collaboration within NORDUnet gives them more influence in international negotiations than they would have individually. It also coordinates Computer Emergency Response Team (CERT) services for the national networks.

FUNET Center for Scientific Computing (CSC) was founded in 1993 with the Finnish Ministry of Education accounting for 52 percent and the VTKK Group Ltd. for 48 percent of the original

¹⁵⁵ Source: Omnitele Ltd., <<http://www.vn.fi/vn/lm/vho/tu/internet.htm>>.

capital. In March 1997, the Ministry of Education acquired the entire CSC stock of shares. FUNET/CSC is the Finnish national service center specializing in scientific computing and communications. CSC provides Finland's universities, research institutes and industry with modeling, computing and networking services. The computing for Finnish weather forecasts is done on a Cray supercomputer administered by CSC. They also maintain a clickable map of all Internet servers in Finland (www.funet.fi/resources/clickable-Suomi.html).

The Finnish Commercial Internet Exchange (FICIX) is a consortium of Finnish Internet technology-based data communication providers designed to provide smooth and low-overhead interconnection and a cooperative forum for the operator's networks. All the major Finnish academic and commercial public data network operators are connected to the FICIX. Until 1 June 1997, the FICIX consortium also managed the *.fi* national domain registry. Since then, the *.fi* registry has been managed by Telecommunications Administration Center (www.thk.fi).

FICIX interconnects the major domestic IP networks (Clinet, DataNet, EUnet, FUNET, GlobalOne, IBM Global Network, LanLink, Telia Finland) using 155 Mbps ATM technology. The FICIX exchange is neutral and policy-free interconnection point and each member network has defined its own policy for the traffic. The usage of FICIX has grown steadily and it has reached a major commercial value to all the member networks and their customers. FICIX is located in Otaniemi, Espoo nearby Helsinki. At present, EUnet Finland is in charge of the administrative issues. The operators meet a few times every year to decide on gateway-related issues.¹⁵⁶

Sophistication of Use When looking at how the Internet is employed in Finland, it seems clear that the service is mature enough to attract wide interest, and the user community has transitioned from only using the Internet to developing new applications. Evidence abounds that the Finnish user community is discriminating and highly demanding while regularly applying, or seeking to apply the Internet in innovative ways that push the capabilities of the technology. There are a number of examples which illustrate how the user community has played a significant role in driving the Internet state-of-the-art in Finland and the world beyond.

The popular freeware UNIX operating system, Linux, was originally developed by Finnish computer science student Linus Torvalds at Helsinki University and then refined by thousands of programmers over the Internet. Version 1.0 was released in March of 1994 and this paved the way for many people to set up inexpensive servers as Internet hosts. Finland is also home to the first library in the world offering public Internet facilities, which was Kirjakaapeli in Helsinki in 1994.¹⁵⁷ That same year Telecom Finland boasts having developed the first nationwide, commercial ATM network in the world. Today, Finland continues to be on the cutting edge of developments in IP telephony, broadband Internet access alternatives to the home, and alternative networks (e.g., power, rail) providing IP services.

In summary, the picture of the Internet that evolves out of this analysis is one of rapid, but balanced and measured progress in the last four years since the country embarked on its national information society plan. The various determinants which enabled the swift transformation will be discussed in the next section. However, it should be noted that moving outwards on any dimension represented in Figure 18 (p. 95) is a non-trivial task.

¹⁵⁶ <<http://www.ficix.fi/>>.

¹⁵⁷ <<http://kirjakaapeli.lib.hel.fi/index-en.html>> and <<http://www.kaapeli.fi/~book/vineart.html>>.

Determinants

There are several major determining factors which have contributed to the rapid diffusion of the Internet in Finland. Table 47 summarizes these determinants and the effects that they have on the various dimensions discussed in the previous section.

Determinant Quality	Affected Dimension
Long history of Internet presence in the country	Allows for greater pervasiveness, geographic dispersion, more robust connectivity infrastructure and further sophistication of use
Government coordination and cooperative planning with private sector on NII	Increases pervasiveness, sectoral absorption, and organizational infrastructure
Open and competitive telecommunication markets	Provides a foundation for higher levels of pervasiveness, sectoral absorption, and connectivity infrastructure due to lower costs
Nokia's domestic telecommunications expertise and worldwide sales success	Improves the connectivity infrastructure and sophistication of use
Stable democracy with a modern economy	Allows for greater pervasiveness, sectoral absorption, and organizational infrastructure
Highly educated population	Provides a foundation for higher levels of pervasiveness, sectoral absorption, and sophistication of use
Tolerant, open-minded culture	Increases the pervasiveness and sectoral absorption by keeping net regulation to a minimum.

Experience with the Internet The relatively long history that Finland has had with the Internet has already been mentioned. The fact that FUNET committed early on to the TCP/IP protocol and Finland has had over ten years of experience working with Internet technologies is partly responsible for the country having more Internet hosts per capita than any other nation in the world.

A National Plan: Finland's Way to the Information Society The Finnish government's coordinated efforts in planning and executing a national information society strategy began in 1994. This galvanized support for the concept as it was gaining momentum in the US and the EC, and provided a national vision for achieving "Professional expertise in information and communications technology to be maintained at a high overall level, with selected peaks."¹⁵⁸ Finland's national strategy is far reaching in many of its goals and is expected to have an impact on all aspects of administrative and private sectors reaching all the way to homes and individual citizens.

In Finland, the information society strategy concept dates back to the work of the Information Technology Advisory Board (1976 to 1991) and a country review of Finland's IT and telecommunications policies performed by the OECD in 1990 to 1992. The OECD country review, the first of its kind in the world, concluded that while Finland had reached an very high

¹⁵⁸ "Finland's way to the information society," Ministry of Finance (1996), <<http://www.tieke.fi/tieke/tikas/indexeng.htm>>.

level of IT and telecommunications penetration and expertise, the country lacked a clear statement of strategy in these areas. Consequently, by a Government decision, the Ministry of Finance was given the task of preparing one. The report was researched and written during 1994.

In early January 1995, there were significant developments towards realizing the Information Society in Finland. The Ministry of Finance report which outlined the Finnish national strategy was completed and approved. On the basis of this document and on inputs from other ministries, the Cabinet Office drew up a position paper on measures for the development of the Information Society. The position paper was officially approved by the government on 18 January 1995. These strategy documents have been followed up by concrete action plans in all the government departments and agencies concerned.

The high level goals of the plan were designed to broadly support Finland's renewal by enabling the country to cope successfully with three challenges of vital significance for Finland's future:

- The external challenge of integration into the open global economy.
- The internal challenge of societal renewal to overcome an economic depression of unprecedented proportions, with concomitant mass unemployment and an expansion of the public debt.
- The increased pressures for change brought on by the new technologies.

The Finnish government believed firmly that the following economic and societal goals could be satisfied by an accelerated development towards the information society:

Overall Economic goals:

- successful adaptation to the world economy
- high employment
- vibrant entrepreneurship
- a competitive public sector

Relevant societal goals:

- balanced social development
- better opportunities for individual advancement
- a participatory citizen society
- a civilization based on knowledge

In general, the objective of the information society strategy was to gain and maintain a competitive edge within the world economy as well as to help solve domestic economic problems. And to achieve this in Finland, it was seen as necessary to equal, and in some areas to exceed in sophistication, the best practices of IT applications in competing countries.

The following outlines the five key elements of the national strategy as set forth in the Ministry of Finance report "Finland's way to the information society":

- Information technology and information networks to serve as tools in private and public sector renewal;
- Information industry to become an important sector of economic activity;
- Professional expertise in information and communications technology to be maintained at a high overall level, with selected peaks;
- Everyone to have the opportunity and basic skills for using the services of the information society; and
- Finland's information infrastructure to perform in all aspects as competitive and capable of providing high quality services.

In the complete report, each action line encompasses a number of specific recommendations, 46 in all. This carefully considered and detailed strategy, along with the government's coordination and cooperative planning with a private sector, has been the most important factor contributing to the rapid diffusion of the Internet in Finland.

Open and competitive telecommunications markets Since the mid-1980's Finland has embarked on a progressive program to liberalize their telecommunications markets. Today, Finland has one of the most open and competitive telecommunications markets in the world. There is already significant competition and collaboration among the over 70 telecommunications operators for voice, data and mobile services. However the country continually strives to enhance the field of Finnish telecommunications. The recent Telecommunications Market Act which went into effect in June 1997 aimed to further accelerate competition for local calls and with this act Finland became the first country in Europe to issue decisions applying the principle of a "significant market force."

The liberalization process has not been as difficult in Finland as other countries because many of the telecommunications operators have always been privately owned. Since the first telephone company, Helsinki Telephone Company (HTC), was established in 1882 the number of local telephone companies began to grow rapidly until it reached a peak in the 1930s of over 800 companies. Through mergers and acquisitions this number has been reduced substantially and currently there are some 70 telecommunications operators in Finland. Historically the lack of a central telecommunications monopoly has been seen as a defensive move to prevent a neighboring power like Russia from easily gaining control of the communications networks in the country.

Table 48, from the Ministry of Transport and Communications, outlines the major steps in the deregulation of the Finnish telecommunications market. This sector was first opened up to competition in the late 1987 when data communication and business networks were liberalized. In 1990, competition was widened to cellular networks. In 1994 the telecommunications market was fully liberalized and every segment of the telecommunications market has since been subject to competition.

Evidence of the success Finland has had opening their telecommunications markets can be seen in the domestic cellular market. In January of 1997 there were a total of 1.5 million mobile phones in Finland—29.2 per 100 inhabitants—making it the leading country in the world in this respect for the first time. Following Finland closely were the other Nordic countries: Sweden (28.8), Norway (28.6), and Denmark (25.7). Comparable data shows the United States with approximately 17 percent penetration followed by Japan with 15 percent.¹⁵⁹ In the past year, Finland has continued to add approximately 42,000 subscribers per month. Currently, Finland has over 2 million mobile subscribers and leads the world with a per capita cellular adoption rate of over 40 percent.



¹⁵⁹ "On the Road to the Finnish Information Society," *Statistics Finland* (February 1997), pp. 31-32.

Table 48.¹⁶⁰ Finnish Telecommunications Liberalization Process Since 1987

1987

- Telecommunications Act entered into force, telecommunications administration was shifted under the auspices of the Ministry of Transport and Communications

1988

- Competition in corporate networks and data transmission was partially liberalized
- The new Radio Act created conditions for efficient radio administration and use of frequencies

1990

- With amended Telecommunications Act, the special rights of the National Board of Post and Telecommunications were abolished
- Telecommunications became subject to free competition in data networks and GSM networks

1990-1991

- Licenses were granted to regional radio telecommunications networks
- Corporate networks became subject to free competition

1992

- Switched data transfer did not require licenses any longer
- Competitive licenses were granted to long-distance and local telecommunications

1993

- Restricted competition in long-distance telecommunication and international telecommunication began

1994

- Local, long-distance and international telecommunications became subject to free competition
- The first licenses were granted for so-called service operators

1995

- Competing licenses were granted for DCS-networks

1996

- The amendment to the Telecommunications Act:
 - obliged telecommunications operators to lease telecommunications connections to each other
 - the whole field of telecommunications was no longer subject to licenses granted on the basis of discretion
 - freed customer fees from regulation

1997

- the Telecommunication Act was repealed by the Telecommunications Market Act according to which:
 - the opportunities of telecommunications operators to profitably lease each others telecommunications connections were improved
 - license is needed only in constructing mobile communication networks
 - telecommunications operators have to separate network and service operations

Nokia—the third leg of Finland’s economy Finland has traditionally had two clusters of strength in its national economy: Wood and paper, and metals. More recently they have developed a third: Nokia. Many know Nokia as the number two leader in worldwide sales of cellular phone hand sets behind Motorola. However the company, once known for its paper-processing mills along the Nokia River, is involved in many other aspects of telecommunications and is largely responsible for the modern telecommunications infrastructure in Finland.

In the early 1970s, Nokia became a shareholder in Televa, a government-controlled company that developed digital telephone exchanges. With this investment the design, manufacture and

¹⁶⁰ Ministry of Transport and Communications, <<http://www.vn.fi/vn/lm/vho/tu/market2.htm>>.

marketing of digital exchanges developed in Finland received a considerable boost. From this humble beginning, a strong domestic industry grew which facilitated the decision of Finnish telecommunications companies to start modernizing their telecommunications networks with modern digital technology at an early stage.¹⁶¹

In addition to digital exchanges for stationary networks, Nokia also developed various wireless technologies. Their product development concentrated on both the base stations and the cordless phones themselves. Together with the other Nordic countries, two cellular phone networks based on analogue technology, the NMT450 and the NMT900, and the European digital GSM network were developed.

Today Nokia is one of the world's leading telecommunications groups and a source of Finland national pride. Along the way, it has also helped to transform the Finnish national economy. In 1996, Nokia's turnover was nearly FIM 40 billion, with more than half of sales generated by telecommunications and cellular telephone systems. Last year revenues were US\$8.5 billion, and Nokia's share price went from US\$35 in January 1996 to US\$56 a year later and it currently trades above US\$80.¹⁶²

Nokia's success has had an important impact on a number of areas in the Finnish economy. The company's ever-growing staff of 34,000 scientists, researchers, salespeople and other employees spread around 45 countries (6,000 of whom joined last year alone) has contributed to helping alleviate some of Finland's high unemployment. Nokia has also forged strong ties with many of Finland's 20 universities. For example in Tampere, about 100 miles north of Helsinki, Nokia's research laboratories are next to Tampere University's media lab, and professors regularly share ideas with researchers. Nokia also is a major financial sponsor or contributor to many government and university programs dealing with various aspects of technology and the information society.

Within Finland there have been a number of legislative initiatives brought about by the Internet. However, where other countries, including the United States, have sought to place strict content regulations and other constraints (e.g., on encryption) on the Internet, Finland has taken a less restrictive approach. Table 49 list several areas where Finland has seen it necessary to pursue legislation that would affect the Internet.

However, none of these efforts has sought to target the Internet specifically. Finland employs a "media neutrality policy" with regard to content regulations in the country. That is, any law passed must apply equally to any form of communications medium, whether it be traditional broadcast, print publishing, or the Internet. Figure 21 and Table 50 illustrate the regulatory scheme for telecommunications in Finland.

¹⁶¹ *Nokia—Flagship of Finnish communications*, <<http://www.vn.fi/vn/um/finfo/english/ahoneng.html>>.

¹⁶² Youssef M. Ibrahim, "Nokia: Made in Finland and Sold Just About Everywhere," *CyberTimes*, *The New York Times*, (13 August 1997).

Table 49. Overview of Finnish Legislative Initiatives Related to the Internet

- Drafted legislation allowing the use of electronic media for transactions by citizens and firms with government agencies.
- Developed private law to take account of the implications of electronic networking for business; for example, in payments, with due regard for international harmonization.
- Promoted international or internationally compatible solutions to problems related to protected material, particularly copyright.
- Developed and unified legislation on confidentiality and business secrets.
- Renewed privacy legislation.
- Increased input to national and international standardization efforts to ensure compatible, open markets.
- Drew up a plan for a statistical system to measure information society development.

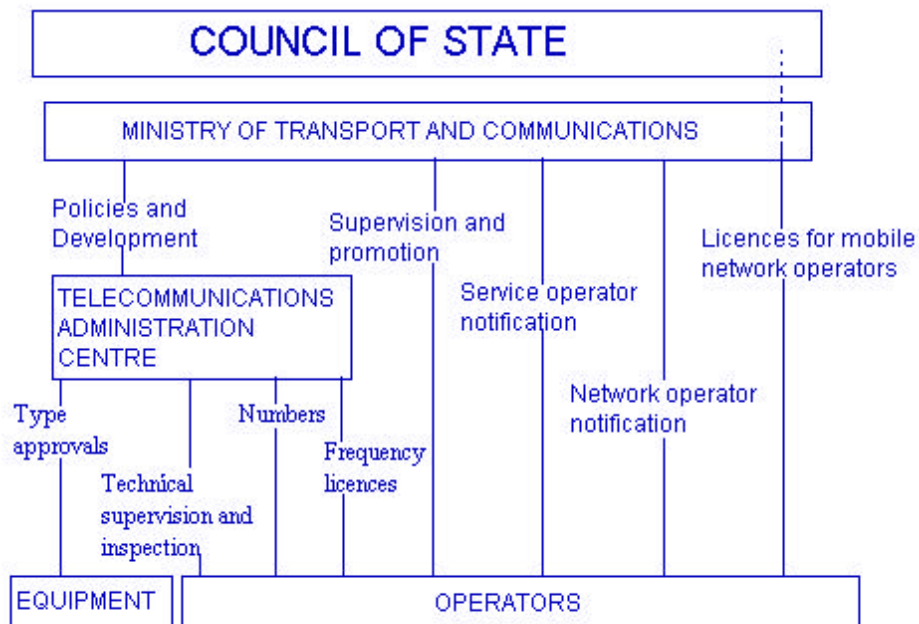


Figure 21. Finnish Telecommunications Regulatory Structure

In general, Finland's policies in this area can be characterized as reflective of the generally open and tolerant culture of the Finnish people. For example, encryption technologies such as PGP (Pretty Good Privacy) and secure web servers (SSL) are permitted and used throughout Finland. Furthermore, the Finnish military has a detailed web site (www.mil.fi/) available in several languages dedicated to promoting information about country's armed forces. While it is doubtful that anything constituting a possible threat to national security would be published here, there are links to information on the country's national defense policy, readiness strategy and command structure. Figure 22 illustrates just one example of the type of information that the Finns evidently feel comfortable making available to the world. This emphasizes how Finland's open approach to the Internet has helped it spread rapidly throughout their society.

Table 50. Finnish Regulatory Responsibilities

EU Regulation and Supervision

regulations, directives, decisions, recommendations and aid

COUNCIL OF STATE

Presents law proposals to Parliament

Grants operating license for:

- broadcasting
- cable TV

Determines TV license fees

MINISTRY OF TRANSPORT AND COMMUNICATION

telecommunications and radio

administration (technical infrastructure)

international contacts in cooperation with the Ministry of Education

supervision of operating licenses

drafting legislation, licenses, etc.:

- broadcasting
- cable transmissions (including satellite TV)
- press
- posts
- telecommunications

Telecommunications Administration Center

subordinate to the Ministry of Transport and Communications

inspection of telecommunications equipment

technical licenses

radio frequencies

inspection of TV licenses and collection of fees

MINISTRY OF TRADE AND INDUSTRY

space and communications technology (satellite)

MINISTRY OF EDUCATION

promotion of cinema, TV and video program production

training, archiving etc. in the communications field

copyright matters

international contacts in cooperation with the Ministry of

Transport and Communications

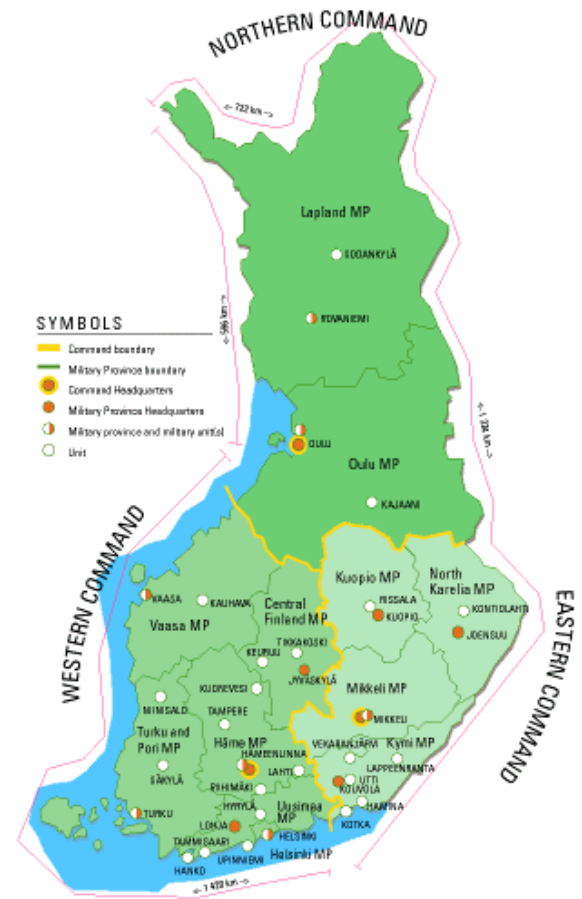


Figure 22. From a Finnish Military Web Site

Problems and Prospects

Although Finland is a world leader in Internet diffusion, there are several policy concerns that the country is in various stages of addressing which may affect the future growth of the Internet there. The primary issues that Finland remains concerned with are infrastructure development, economic renewal, and social progress towards an enlightened information society.

The expansion and maintenance of Internet infrastructures is a continual challenge. As in the United States and other Internet-intensive countries, ongoing problems include keeping up with the demand for increased network bandwidth, dealing with the pace of technological change, and extending service to more rural areas.

Finland has rebounded economically from the recession earlier this decade, but they are still troubled by high unemployment. Adapting to the European single currency could put a strain on their investments in IT and R&D. Also, Nokia has become such an integral part of the economy and national identity that if the company were to falter, the negative effects on Finland could be widespread.

Surveys reveal Finns are more optimistic about the benefits of increased use of technologies like the Internet when compared with other European Union (EU) countries. However, they also appear keenly aware of the potential risks involved in establishing a society based around information technology.

Following the country's traditionally careful, measured approach in dealing with social issues, various groups in Finland are involved with studying and implementing trial solutions to alternative work, learning, and social interaction problems brought on by the increased use of networks and technology. Finland is also actively involved in various EU and international cooperation efforts dealing with these subjects and has been developing a national reputation for being an exporter of specialized knowledge pertaining to such issues.

Given the nature of the Nordic welfare state in Finland, the government and citizens are concerned about equitable access to information resources in Finnish society. Perhaps their efforts to develop a solution preventing a nation of digital "haves" vs. "have-nots" will be another model for the world.

In conclusion, Finland's notable accomplishments in a relatively short time are indicative of the strong national desire to improve their economic and social well being through technology. It seems the country is no longer content being the quiet "Finlandized" neighbor to Russia or the "poor man" of the Nordic countries.

- CSC** Center for Scientific Computing—A Finnish national service center specializing in scientific computing and communications. CSC provides universities, research institutes and industry with modeling, computing and information services. The computing for Finnish weather forecasts is made by a Cray supercomputer administered by CSC. CSC's network support staff is responsible for administering FUNET network operations. <<http://www.csc.fi/>>
- ETLA** The Research Institute of the Finnish Economy—A private institute founded in 1946 to conduct research in the fields of economics, business and social policy designed to serve financial and economic-policy decision making. ETLA has two major activities: macro economic forecasting and project studies. <<http://www.etla.fi/>>
- FICIX** Finnish Commercial Internet Exchange—A consortium of Finnish Internet technology-based data communication providers designed to provide smooth and low-overhead interconnection and a cooperative forum for the operator's networks. FICIX interconnects the major domestic IP networks (Clinet, DataNet, EUnet, FUNET, GlobalOne, IBM Global Network, LanLink, Telia Finland) using 155 Mbps ATM technology. The FICIX exchange is neutral and policy-free interconnection point and each member network has defined its own policy for the traffic. <<http://www.ficix.fi/>>
- FIM** Finnish Markka
- FUNET** Finnish University and Research Network—The Internet Service Provider for Finnish Universities, Government and research centers. FUNET-network services are provided by CSC's network support staff. The FUNET network relies primarily on Telecom Finland's ATM backbone. Connection speeds range from 10 to 34 Mbps with plans to upgrade to 155Mbps this year. Connections to the outside world go via the NORDUnet network of which FUNET is a member. The FUNET network is funded in part by membership fees, and in part by direct budgetary payment from the Ministry of Education. <<http://www.funet.fi/>>
- HTC** Helsinki Telephone Corporation—Helsinki Telephone (also abbreviated HPY) is the largest local, private, telephone company in Finland and is the cornerstone of the Finnet Group. This group was formed in partnership with the other 45 local telephone companies of Finland. The company offers a full range of communication services to customers in the Finnish capital, Helsinki, and its adjoining areas. Through the Finnet Group the company can offer services anywhere in Finland and, through international alliances, even abroad. <<http://www.hpy.fi/>>
- NMT** Nordic Mobile Telephone—NMT-450 and NMT-900 are cellular air interface standards for mobile communications specified jointly by the telecommunications bodies of Denmark, Finland, Norway, and Sweden.

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- NORDUnet Nordic University Network—NORDUnet A/S is a Danish-based limited liability company in charge of the communications network between all Nordic countries. It also provides network connections to other European countries and the USA, as well as to other parts of the Internet. Established for the organization of international network connections, its shareholders are the following research network organizations in the five Nordic countries: DENet Denmark, FUNET Finland, ISnet Iceland, SUNET Sweden, UNINETT Norway, or the corresponding ministries (e.g., Ministry of Education in Finland). <<http://www.nordu.net/>>
- NRN National Research Network—A term used to refer to the national research network organizations in the five Nordic countries: DENet Denmark, FUNET Finland, ISnet Iceland, SUNET Sweden, and UNINETT Norway.

