TELECOM POLICY STATEMENT

2005 – 2010

Report
by the Steering Group appointed by
the Minister of Transport and Communications

1. Preparation of the Policy Statement

Iceland, like other European countries, has experienced major changes in electronic communications in recent years following the harmonisation of electronic communications legislation. This has resulted, for instance, in the elimination of exclusive rights and competition in the electronic communications market. The changes laid the foundation for privatisation of state-operated telephone enterprises; and the sale of Iceland Telecom is naturally the next step in this direction. It is no longer possible for the authorities to implement their electronic communications policy through this enterprise, making it necessary for the government to spell out this policy in clear terms. Due to these changes it is important that the government state its policy for telecommunications services clearly and concisely. With this intention, the Minister of Transport and Communications decided, at the beginning of 2004, to undertake the drafting of a telecom policy statement for 2005-2010, laying out a framework for a comprehensive electronic communications policy. A decision was taken to appoint a special steering group, which has been at work on the project since that time. During the working process, rapid development has taken place on the electronic communications market in Iceland. Electronic communications enterprises, as well as media companies, have merged or been taken over, creating new service providers. The convergence of telecommunications, information technology (IT) and broadcasting is progressing at an unforeseeably rapid speed. This has resulted in a number of changes to the policy during the preparation period.

The Telecom Policy Statement defines the involvement and objectives of public authorities in electronic communications in the near term, and provides an account of the current situation and outlook in electronic communications in Iceland with reference to international trends. By providing a co-ordinated policy framework, the intention is to increase the country's competitiveness, encourage industrial development, and ensure the efficient utilisation of financial resources and co-ordinated prioritisation of projects. Emphasis is also placed on the importance of access to electronic communications for all inhabitants of Iceland and ways to equalise this access for everyone.

2. Vision

Current and future trends

Icelanders have set themselves the objective of being among the leading nations in IT utilisation to ensure progress, opportunities and welfare for individual citizens. Effective and well-developed electronic communications are one way of achieving this objective. The convergence of electronic communications, IT and mass media increases the variety of services on offer, without regard for national boundaries, creating new opportunities for individuals and enterprises. Consumer demands for increased choice, improved access and services, independent of time and place, can best be met through effective competition in an international environment. One aspect of the role of public authorities will be to

set the rules of the game for the market and ensure compliance with them, to the benefit of all citizens.

Definitions

A *fixed network* is an electronic communications network where the user is restricted to a specific location. The connection can be via cable or directional/fixed antenna.

A *mobile network* is an electronic communications network where the user can move about within a certain area (up to a certain speed) without losing connection. Mobile telephone networks fall under this classification, but since they are developing into data networks it is more correct to speak of mobile networks.

The *Internet Protocol (IP)* is a communication protocol where electronic data, images or speech is broken up into packets and transmitted over the Internet.

Use of computers, mobile telephones and the Internet has become an integral part of the daily lives of most Icelanders. It is difficult to imagine modern business without e-mail, websites or mobile phone communications. All of these developments, however, have only a short history:

- 16 years ago (1989) digital connections, including the Internet, were established linking Iceland to other countries. Only two years earlier a data transmission network was installed in the country.
- 11 years ago (1994) the GSM mobile phone system was taken into service in Iceland and the CANTAT submarine fibre optic cable opened.
- Seven years ago (1998) competition in providing GSM service began.
- One year ago (2004) the FARICE submarine fibre optic cable was taken into service.

In recent years, digital technology has gradually been replacing analog technology on the market in various areas of consumer equipment. Compact discs, for instance, have replaced tapes and records, and DVDs are replacing videocassettes. Digital television broadcasting is yet another advance of this type. Older technology is used as long as the equipment lasts, but the supply of services and content is, to a growing extent, directed at digital solutions.

Digital technology has a wide variety of applications and the competition to attract consumers produces many innovations, designed in accordance with varying standards. While it is difficult to predict what solutions will win out, some main developmental trends can be detected.

- The Internet Protocol, or IP, is becoming dominant in electronic communications. - Transmission of audio and visual (television) material and telephone communication is being transferred to IP networks.
- The distribution networks currently in use will be developed and used for many years yet. In the longer term, increased transmission speed will be needed, and optical fibre connections into individual buildings can be expected to be the most

economical way to ensure the bandwidth demanded by the public and business enterprises.[1]

- Services to mobile telephones and via wireless networks will to an increasing extent be harmonised between networks, so that telephone calls and other services can be sent as data independent of the type of mobile network (4G).
- The same types of service should be accessible through fixed networks and mobile networks. Information providers will adapt their service to end-user equipment. The future vision is a *ubiquitous network,* i.e. continual access to services, everywhere, regardless of the type of network.
- The spread of IP systems for telephone and television distribution opens up possibilities of offering services abroad and of international competition. A prerequisite for this is sufficient and secure bandwidth to other countries at a competitive price.

To judge from current developments in telephone technology, all signs indicate that IP will prevail, resulting in lower prices and a greater variety of services. Mobile telephone systems will develop in the same direction.

Electronic communications technology and services have been shown to be of vital significance for economic growth in modern society. The development of information and communications technology (ICT) is predicted to be very rapid and one of the basic pillars of economic growth. Icelanders are already at the leading edge in utilising this technology. It is a position worth maintaining and taking advantage of for industrial growth and progress in new fields.

What speed is enough?

Electronic communications are comprised of voice, data, special services and broadcasting (sound and image). Within a few years, the average user is expected to need between 10 and 20 Mbps for various services of this sort, with usage increasing in line with the increasing supply of interactive products, including that provided by users themselves. In addition, the supply of visual material of higher quality (high resolution) will increase, which in turn requires more bandwidth. In general, providing more bandwidth to users results in new services, which then require additional bandwidth, in a continuous spiral. Demand for bandwidth is thus likely to grow with each passing year. This is offset by progress in data compression technology. As an example, it is now possible to distribute high definition television by 7 Mbps bandwidth instead of 20 Mbps as required only a year or two ago. Table 1 gives a forecast for speed development on

[1] The development of new services involving a steadily increasing incoming and outgoing transmission of visual material, both as a data stream and instantaneous delivery of large files, fuels the demand for more bandwidth.

[2] Cf., for example, UMTS-5, which is IP6 compatible for both voice and data.

fixed and mobile networks.

Table 1. Reference Levels for High Speed.

The concept of high speed is frequently used in this policy statement. There are many definitions of high speed and, in fact, they change constantly as technology races forward. The concept of high speed is used here for speed equal to or greater than the reference level in the table below. High speed is at the upper end of the transmission speed currently offered to the general public in urban areas at a reasonable price.

Year	Mbps in fixed network incoming and outgoing	Kbps in mobile network incoming and outgoing
2002	0.2	8 and 8
2003	0.5 and 0.2	64 and 10
2004	2 and 0.3	64 and 10
2005[3]	5 and 1	64 and 10
2006	20 and 5	300 and 64
2007	50	300 and 64
2008	100	300 and 64
2009	100+	1000 and 300
2010	100+	1000 and 300

The reference level for "high speed" for 2010 is over 100 Mbps incoming and outgoing on a fixed network but only 1 Mbps incoming and 300 kbps outgoing on a mobile network. The supply of optical fibre local loops is predicted to increase. These figures should only be used as a general guideline, since this forecast is subject to a high degree of uncertainty concerning technology, service and use of high-speed networks.

Companies on the electronic communications market have for some time now been laying optical cables in urban areas in parallel with other undertakings. Optical fibre connections to homes will probably become steadily more accessible, at least in urban areas, and are likely to gradually replace other network-access technology. The construction and use of other technology for fixed networks is none the less very important, until the service market has developed and demand for bandwidth increases.

[3] An attempt is made to forecast bandwidth for the period 2005-2010. The forecast is subject to many factors of uncertainty and is intended only as a guideline for drafting electronic communications policy. It is based on an assessment of technological development and forecasts for distribution of high-definition television and other images over high-speed networks, new services and the social changes which this development will bring.

3. POLICY FORMULATION

Policy

Iceland should be ranked among nations enjoying the most efficient, secure, accessible and innovative electronic communications services.

New Approach in a Rapidly Changing Environment

The Telecom Policy Statement discusses primarily the establishment and development of electronic communications networks. It corresponds to the National Transport Programme, to the extent that network systems can be regarded as the highways of the information society. Electronic communications have developed rapidly in recent decades. This applies both to the technological environment, where electronic communications, computer technology and broadcasting are converging and to the regulated electronic communications market, which reflects the harmonised legislation of the European Union (EU). Telecommunications networks of high quality and capacity are not only important for communications and security, but are a major factor in economic progress. [4]

As far back as the beginning of the last century, all electronic communications have been under the auspices of the state. Iceland Telecom (*Landssími Íslands*), which was previously the Post and Telecommunication Administration, was entrusted with implementing government policy and developing electronic communications networks throughout Iceland, which it did very well. The Post and Telecommunication Administration had exclusive right to operate electronic communications, while at the same time it was the public authority and regulator in this field. Harmonised EU legislation has required extensive changes, including increased competition and the elimination of exclusive rights in electronic communications.[5] This laid the foundation for privatisation of state-operated telephone enterprises and the sale of Iceland Telecom is a natural further step in this direction. The government can no longer entrust Iceland Telecom to implement its policy, which makes it necessary for the government to spell out this policy in clear terms.

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[4] See, for instance, *The Economic Impact of ICT: Measurement, Evidence and Implications*, OECD 2004; *One Gigabyte or Bust: A Broadband Vision for California*, Gartner, Inc. 2003. The IT industry now contributes 10% of GDP, see *Upplýsingatækniiðnaður: Helstu þættir framtíðarsýnar og stefnumótunar* (The IT industry: Main aspects of future vision and policy formulation), Federation of Icelandic Industries and Association of Icelandic Software Companies, September 2002, p. 3., *Rethinking the European ICT Agenda*, PriceWaterhouseCoopers, The Hague, August 2004, p. 19.

[5] In 1987 the EU Commission published a Green Paper on electronic communications, laying the foundation for plans for deregulation of the European electronic communications market and the development of an internal market for electronic communications services in Europe. Following the publication of the Green Paper and other subsequent Green Papers, the EU Council and Commission have issued several Directives implementing the policy. These and later EU Directives have resulted in changes to Icelandic electronic communications legislation, first with Act No. 143/1996 (eliminating Landsími's exclusive right), Act No. 107/1999, and most recently Act No. 81/2003.

The technological environment of electronic communications has undergone wide-reaching changes, especially after the advent of the Internet. The convergence of voice telephony, radio and telephone broadcasting, and other data transmission into one distribution system has become a realistic possibility and even an actuality to some extent. This has resulted, for instance, in a drop in the number of subscribers to "normal household telephones". The number of calls through household telephone systems is also dropping steadily.[6] The importance of the household telephone as we know it, however, should not be underestimated and it can be expected to remain in existence for many years to come.

The altered electronic communications environment has completely changed government involvement in this field. It must ensure a legal and operating environment complying with competition rules. Care must be taken to ensure non-discrimination and transparency when decisions are taken concerning electronic communications enterprises required to stimulate competition. At the same time, the government must safeguard consumer interests and rights, encourage price equalisation and ensure universal service. Furthermore, enforcement of the regulatory framework in electronic communications is an important responsibility of the state. At the same time, the government is the largest single purchaser of electronic communications services.

Legislation restricts government intervention in the electronic communications market and also limits its possibilities of imposing obligations on electronic communications enterprises exceeding those already provided for by law.[7]

Measures open to the state in a market economy

The measures available to the government to achieve its objectives are limited by legislation and general considerations of competition. The main measures available are:

1. imposing obligations on electronic communications enterprises; [8]
2. taking the initiative in purchasing and introducing new or innovative electronic communications technology and services;
3. financing projects for the public good, security purposes, environmental reasons or regional development[9] which increase the competitiveness of the society, and which private enterprises can scarcely be expected to undertake. Such projects could be carried out through tendering or contracting out;
4. tendering electronic communications services for public parties.

It is important, however, to emphasis the division of responsibility between private and public parties. Experience has shown that market actors find it advantageous to provide electronic communications service to 90%-98% of Icelanders, depending upon the

[6] See statistical data on the Post- and Telecom Administration website at www.pta.is.
[7] The authorisation in Articles 19 and 20 of the Electronic Communications Act concerning universal service, as well as general provisions on authorisation for electronic communications activities in Article 6 of the Act.
[8] Authorisation in Articles 19 and 20 of the Electronic Communications Act concerning universal service.
[9] Cf. Article 23. of the Electronic Communications Act, No. 81/2003.

type of service. Examples of this are ADSL service, GSM mobile phone services and current television distribution. State involvement in providing electronic communications should be limited to those areas where market actors are not prepared to offer acceptable services and prices.

Extended Universal Service

Where market conditions are such that electronic communications enterprises consider it unprofitable to establish the necessary service, public authorities can apply specifically directed and transparent measures to ensure service of satisfactory quality.

For this purpose, an Icelandic reference will be defined which exceeds that provided for EU regulations (universal service).

Directive 2002/22/EC defines *universal service*[10] as the minimum service, which a certain operator of voice and data transmission services must provide to all users at a reasonable price, regardless of their geographical location. This directive does not authorise imposing obligations on electronic communications enterprises to provide service exceeding universal service. Other means must be sought if the authorities wish to expand this framework.

Access to the information society is one of the premises for settlement in non-urban areas of Iceland. To ensure all Icelanders such access, it has been decided to define a reference level for Iceland exceeding the level of universal service. This new Icelandic reference is called "extended universals service" (*samþjónusta*).

Extended universal service includes service through a fixed network, GSM mobile telephone service and television broadcasting, in particular:

- The general public shall be offered residential high-speed connections corresponding to the current high-speed reference level[11] for transmission of voice, images and data.[12]
- GSM mobile phone services should be accessible on National Route 1 and other principal trunk routes and at main recreation locations.
- Distribution of television programming by Icelandic National Broadcasting (INB), as well as radio programming on INB radio stations 1 and 2, to vessels in Icelandic waters and to remote areas of the country should be by digital satellite transmission.

The reference level for extended universal service must be *reviewed* regularly in paces with general development in technology and service and the common connection speed offered in urban areas.

It should be pointed out that Icelanders are legally entitled to receive the service defined as universal service. Extended universal service, however, defines the

[10] Universal service includes traditional services, such as voice telephony and data transmission at a speed of up to 128 kbps. The requirement of access to universal service is fulfilled everywhere in Iceland with the exception of around 70 farms, which do not have a connection speed of 128 kbps. The cost of connecting them is high, approx. ISK 2 million per connection. In most areas, connections of 2-3 Mbps are now available.

[11] Table 1, References for high-speed.

[12] It is evident that interactive digital television, for instance, will be distributed via a high-speed network.

government's objectives on accessibility to electronic communications services. The implementation of extended universal service depends on various factors, not least the financial resources devoted to these projects in each year's national budget.

By defining a new and ambitious minimum reference level for electronic communications service, the government primarily intends to boost the development of service where it is poorest, i.e. in sparsely populated areas, in the interior highlands, out at sea and in recreation areas. There is concern that non-urban areas may be left behind in the rapid progress of electronic communications, or that development there may be more costly than otherwise. For this reason, harmonized objectives have been set for minimum service which fulfils the demands of modern society.

Handicapped Access

Access to electronic communications by the handicapped is important. Article 19 of the Electronic Communications Act includes services to the handicapped or users with special needs as part of universal service. It is important that everyone, including the handicapped, is able to take advantage of the opportunities created by the development and convergence of electronic communications. The Icelandic government participates in Nordic co-operation to improve handicapped access and know-how in electronic communications. The objective of this co-operation is to disseminate information to handicapped persons on electronic communications and the information society.

Objectives

This is a summary of the factors emphasised by the government with regard to electronic communications and their development. They are discussed in more detail below.

An Opportunity for a Competitive Advantage

Emphasis should be placed on taking advantage of the opportunities offered by good electronic communications, good education and technological progress to create employment and increase prosperity throughout Iceland.

Specific objectives:

- for Icelandic enterprises and institutions to gain an advantage over other countries in utilising electronic communications in manufacturing and service industries;
- to boost the image of Iceland as a country with exemplary electronic communications and, in so doing, strengthen its position in competing for foreign investment;
- to use improved electronic communications to offset the marginal situation of business and industry in non-urban areas and internationally, due to the geographical location of Iceland.

High-speed connections

All Icelanders who so desire should be able to connect to a high-speed network and enjoy cost-effective and secure electronic communications services[13].

Educational institutions should be connected to a powerful high-speed network.

Specific objectives:

- All Icelanders who so desire should have access to a high-speed connection by 2007.
- All upper secondary schools, universities and research institutes should share a joint 2.5 Gbps international connection by 2006.
- All upper secondary schools should be connected to a powerful high-speed network (minimum speed depending upon the size of the school):
  2006 - 100–1,000 Mbps,
  2007/2008 - 1 Gbps.
- All compulsory schools should be connected to a powerful high-speed network (minimum speed depending upon the size of the school):

[13] *Auðlindir í allra þágu* (Resources for the benefit of everyone). Government Policy on the Information Society 2004-2007.

2006 - 10–100 Mbps,
2007/2008 - 100–1,000 Mbps.

- All principal state institutions should be connected to a powerful high-speed network (minimum speed depending upon the size of the institution):
  2006 - 10 Mbps,
  2007 - 100–1,000 Mbps,
  2010 - 1 Gbps.

- Icelandic copyright legislation should be developed in line with international obligations, reflecting the interests of both consumers and rightholders. The objective is to increase the supply of material on high-speed networks.

Mobile connections

The security of travellers should be improved through increased access to mobile telephone services on Iceland's highways and main recreation areas.

High-speed mobile services should be developed in all areas of the country.

A long-range digital mobile phone network should be developed to serve the entire country and offshore waters.

Specific objectives:

- to have GSM mobile phone services accessible on National Route 1 and other principal trunk routes, in main recreation areas, and in smaller population centres, cf. the objectives for extended universal service for 2006;

- to have high-speed mobile service available everywhere in Iceland no later than 2006;

- to have long-range, digital mobile phone service available everywhere in Iceland and in offshore waters upon the termination of NMT service.

Digital broadcasting

All Icelanders should have access to interactive digital television.
Satellite broadcasting should reach all of Iceland and waters around Iceland.

Specific objectives:

- Digital television via high-speed network should be available in 2005.
- Distribution of television programming by Icelandic National Broadcasting (INB), as well as radio programming on INB radio stations 1 and 2, to vessels in Icelandic waters and to remote areas of the country should be by digital satellite transmission.
- UHF television frequencies for digital television should be tendered in 2005.

- Interactive digital television should reach 99.9% of Icelanders by 2007.
- Analog television distribution should be terminated no later than 2010.
- The authorities should ensure television stations, with public service obligations, access to closed distribution systems.

Security and personal data protection

The security of public electronic communications networks within Iceland and internationally should be ensured through satisfactory alternate connections.

The security of the Internet should be improved, so that the public can rely on it in business and everyday life.

Specific objectives:

- to provide guidance to consumers, together with information material on security issues, consumer protection, personal data protection and ethical issues;
- to establish a Computer Emergency Response Team (CERT) to enable more effective response to undesirable activity on the Internet and to fight cyber attacks;
- to define clear security criteria and minimum quality requirements for the functioning of fixed and mobile networks and ensure proper follow up;
- to define the requirements to be made of Internet service providers concerning quality and security of operations;
- to have a risk assessment made of Iceland's international connections to ensure that they are secure from disruption and to define minimum service and response plans in the case of breakdown or threat, e.g. if a submarine cable connection is interrupted;
- to define the role of Civil Protection concerning the functioning of electronic communications networks and take steps to ensure that security of electronic communications installations will comply with government requirements;
- to set out and implement an action plan for defence against spam;
- to inform the public of its rights to protection of privacy in electronic communications, the dangers which electronic communications may involve and responses to them.

Competitiveness

Efforts should be devoted to improve the regulatory framework and reinforce regulation of the electronic communications market to increase competitiveness, transparency and confidence.

Efforts should be made to lower unit costs in international electronic communications.

Efforts should be made to equalise the cost of electronic communications services everywhere in Iceland.

Efforts should be made to improve access to cost-effective and secure electronic communications service everywhere in Iceland.

Efforts should be made to ensure that handicapped persons can take advantage of electronic communications in the information society.

Specific objectives:

- to encourage competition between electronic communications networks where this is cost-effective;
- to ensure that enterprises can easily gain access to existing communications networks in order to offer communications services;
- to ensure transparency in the cost of electronic communications usage and define the obligations of service providers concerning fee calculation;
- to lower the price of electronic communications connections to and from Iceland;
- to analyse the special needs of the handicapped for electronic communications in the information society and encourage a supply of services and equipment to suit them;
- to alter construction regulations so that
    - property owners are obliged to ensure the laying of conduits for optical cables to new construction;
    - all electronic communications enterprises will be authorised to install high-speed connections (e.g. optical cables) using the conduits upon satisfying certain conditions.

4. PREMISES

An Opportunity for a Competitive Advantage

Convergence

The increase in transmission speed over data networks to households, together with rapid developments in mass communications, is opening new possibilities for transmitting voice, sound and images. [14] New types of service are more dependent upon a high and even transmission speed (stream) than other data, such as e-mails and websites. Up until now, separate networks have been used to distribute these services. As things now stand, the convergence of these systems is becoming a reality and it will be possible to use the same system to transmit voice, sound, images and other data. A data network will transmit all types of services. This applies to both fixed and mobile networks. Users will demand *ubiquitous networks,* i.e. continually available service – everywhere, independent of location and type of service.

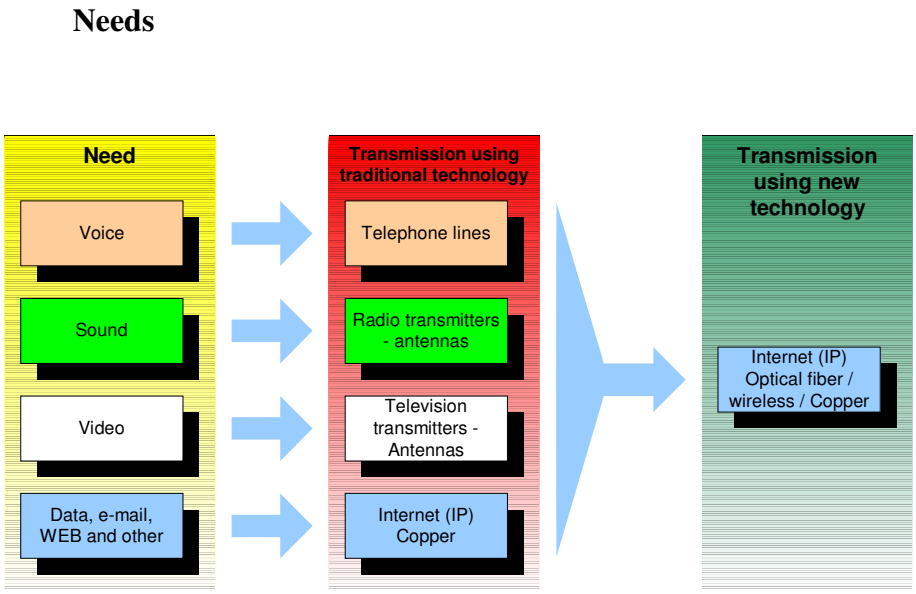

Figure 1. Convergence

[14] The words voice, sound and images here represent low-quality sound transmission (telephone calls), high-quality music transmission (radio) and film material (television).

Networks for telephony and broadcasting, which are now separate, will converge. They will be replaced by transmission via fixed and mobile networks. A great number of users will nonetheless probably avail themselves of radio transmission for television and radio distribution.

Development in coming years will, however, result in radical changes in distribution of all electronic material, including that which until now has not been distributed electronically. Already traditional mail has to a great extent been transferred to the Internet, where it will be joined by newsletters, periodicals, libraries, film rentals, e-trade and many other activities. This has the effect of considerably reducing the division of the market into television companies, telephone companies, radio companies, Internet service providers and daily newspapers. Clear signs of this are already visible in Iceland.

The convergence offers innumerable new opportunities for restructuring, but also in the supply, innovation and development of services. Few examples:

- Everyone, regardless of where they live, will be able to transmit television from their homes using simple equipment, if sufficient bandwidth is available.
- The supply of Internet television stations will be international; stations could number in the tens of thousands.
- It will be possible to purchase telephone service from anyone in the world.[15]

It is important to keep these developments in mind when undertaking the establishment of distribution systems, e.g. for digital television.[16] The aim should be to enable all Icelanders to benefit from this development and it would be a suitable task for researchers to investigate the impact of these changes on Icelandic society.

An Opportunity to Improve Living Standards

Many of the countries, which reaped benefits from ICT at the end of the last century, were able to do so because of previous actions taken, e.g. deregulation of the communications industry, or by generally improving their business environment. [17]

Many studies have shown a correlation between ICT and economic growth.[18] High-quality electronic communications networks are not enough, however, to achieve an

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[15] In Japan, the Ministry of Public Management, Home Affairs, Post and Telecommunications (MPHPT) decided to allocate telephone numbers expressly for IP equipment (starting with the prefix 050). This makes it possible to phone to Japanese computers from normal telephones. It is already possible to use the service of Internet providers to phone from computers to telephones and naturally possible to make voice connections between computers without the intermediation of a telephone company.

16 It is said that "killer applications" (i.e. demanding high bandwidth) drive the convergence of data networks forward. There has been extensive discussions of visual applications, such as TV over IP (TvoIP), video-on-demand (VoD) Pay-per-View (PpV), etc., but the supply of content has been limited by copyright disputes. In Japan, Voice over IP (VoIP), which actually includes image and voice transmission, is referred to as a "killer application". In Iceland, the supply of television programming, e.g. via ADSL, seems to be important in this connection.

[17] *ICT and Economic Growth*, OECD 2003. Pp. 93–94.

[18] *Igniting the next broadband revolution*. Accenture, Outlook 2003; *One Gigabit or Bust*, Gartner Consulting for CENIC, 2003; *The Economic Impact of ICT*, OECD 2004; *Seizing the Benefits of ICT in a Digital Economy*, OECD 2003; *True Broadband, Exploring the Economic Impacts*, Allen Consulting for Ericsson 2003; *Measuring Economic Impacts of Community Broadband Investments*, CISCO, 2001.

increase in productivity in a country, which also requires the effective use and application of the technology.[19] OECD statistics for 1995-2001 show 0.3%-0.8% higher GDP growth as a result of ICT.[20] There is no comparable economic research for Iceland, but it would be helpful if such studies were undertaken.

Providing high-speed communications everywhere in the country would be of great advantage to Icelanders. There are a number of reasons for this, including:

1. The country's distance from markets hinders the development of trade and industry. Foreign trade, for instance, as a percentage of GDP is less than could be expected if markets were closer.[21] On the Internet, distance makes little difference.[22]
2. In Iceland, competition is restricted to only a few parties in many areas, while on the Internet there is global competition in services.

The countries which are leading the way in utilising electronic communications and developing new services can obtain a head start on others and serve as an example to be followed. Many countries are endeavouring to improve their position, with South Korea, Japan and the Nordic countries examples of those who have progressed farthest. The reason for this emphasis on improved data communications is the growing importance of such systems for economic growth and productivity. International comparisons show that the data transmission network in Iceland is among the best in the world and every effort should be made to maintain this position.[23]

Iceland has a unique opportunity to maintain its advantage on other nations by utilising ICT still better and thus boosting the country's GDP growth. The country has all the premises to become an example for others to follow and an exporter of electronic communications expertise and services.

The following reason for this could be mentioned:

1. The infrastructure of high-speed networks in Iceland is among the best in the world. High-speed connections are very common[24] and the installation of optical cables is already well advanced.
    a. There are two separate optical fibre networks (optical fibre networks owned by Iceland Telecom and Reykjavík Energy).
    b. An optical fibre network has been installed encircling the country (Iceland Telecom) as well as another (Fjarski) from Reykjavík to Akureyri, in North Iceland.
    c. Laying optical cables to individual residential buildings has already begun

[19] The distribution system is the C in ICT. The application is the I in ICT.
[20] *The Economic Impact of ICT*, OECD 2004, p. 11. The US has profited the most from ICT, while countries such as Finland, Ireland, Korea and Sweden are also leading the way.
[21] *Determinants of Exports and Foreign Direct Investment in a Small Open Economy*. Doctoral dissertation by Helga Kristjánsdóttir, Faculty of Economics and Business Administration, University of Iceland, 2004.
[22] *The Death of Distance*, Frances Cairncross, Harvard Business School Press, Boston, 1997, 2001. P. 37.
[23] *The Networked Readiness Index (NRI) 2003-2004*, INSEAD-World Bank-World Economic Forum. NRI is calculated as an average of nine sub-classes. One of these is infrastructure. Here Iceland ranks first, as
[24] 54% of Icelandic households have XDSL connections. This figure is 62% in the capital area. See: Hagtíðindi – Upplýsingatækni, Statistics Iceland, 2004:5.

in several locations.

2. The general public is very open and positive towards new technology. Internet usage is more widespread in Iceland than in most other countries.[25]
3. The general educational level in Iceland is high.
4. The economy is robust and stable.

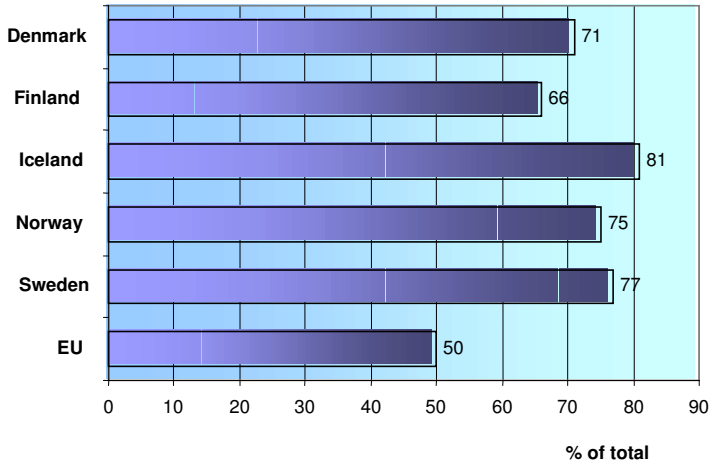

Figure 2. Internet usage by individuals in the EU and the Nordic countries
Source: *Hagtíðindi – Upplýsingatækni*, Statistics Iceland 2004.

An Opportunity to Gain a Competitive Advantage

Objectives

Emphasis should be placed on taking advantage of the opportunities offered by good electronic communications, good education and technological progress to create employment and increase prosperity throughout Iceland.

High-speed connections

Status in Iceland

Use of high-speed connections by the general public and enterprises is very widespread in Iceland; the country is among the world leaders in this respect. Iceland Telecom has installed an optical fibre system around the entire perimeter of the country, together with access networks linking it to individual households. Reykjavík Energy and other enterprises have also laid optical fibre networks. These networks, high purchasing power, a high technical and educational level, and the nation's openness for innovations create unique circumstances to maintain and increase the head start which Iceland has. A powerful high-speed network and its general utilisation will result in economic benefit.

[25] OECD *Communications Outlook*, París 2003, p. 123. See also *Hagtíðindi – Upplýsingatækni*, Statistics Iceland, 2004:5.

Almost all companies in Iceland are connected to the Internet, according to data from Statistics Iceland, although this is not always a high-speed connection.[26]

At year-end 2004, around 95% of Icelanders could take advantage of high-speed, always-on connectivity of 1 Mbps or more, primarily ADSL connections through their local loop (copper cable). Because of the cost, ADSL service is provided almost only to population centres of 500 people or more. Since autumn 2004, Iceland Telecom has distributed digital television via ADSL connections in several locations in Iceland. The company plans to expand this service further. This could encourage the installation of ADSL connections in smaller population centres. Other electronic communications enterprises also offer high-speed connections, e.g. via microwave.

One of the restraints on the expansion of high-speed networks is the lack of content material, such as movies, for distribution. One of the reasons for this shortage is that copyright holders are concerned about unauthorised distribution and reluctant to distribute material on communications networks where it can easily be copied illegally. It is important to develop technical solutions and legislation on copyright, to ensure sufficient supply on future high-speed networks and the rights of both consumers and copyrightholders.

Access networks

Major advances have been made and more are foreseen in the technology and connection speeds of households and enterprises. Access to optical fibre connections is now better in the southwest region of Iceland than in most other countries. The demand for high-speed connections will to a considerable extent keep pace with the development and supply of services and content material.

[26] Almost all enterprises in Iceland (99%) use computers. Of these, 97% have an Internet connection, with high-speed connections by far the most common (81%). 70% of all companies have their own websites, an increase from 2002. One out of every five companies sold goods or services on their website in 2002 and 37% of companies purchased goods or services on the Internet that same year. Source: *Hagtíðindi – Upplýsingatækni*, Statistics Iceland, 2004:5.

Technical notes			
Connection options	**Max. incoming speed**	**Max. outgoing speed**	
	user [Mbps]	**user [Mbps]**	**Comments**
ISDN	0.128	0.128	0.064 if used for telephony as well as data
ADSL	8	0.640	Incoming transmission speed drops rapidly beyond 2000 m
ADSL2	12	1	
ADSL2+	24	1–3	Different versions have different transmission speeds
READSL2+	12	1	Reaches somewhat farther than ADSL2
SDSL	1.5	1.5	
SHDSL	5.7	5.7	
VDSL	52	3	Also available 16 Mbps from user
VDSL2	100	100	Technology expected soon. Possibly 100 Mbps to 400 m
Optical fibre	10,000	10,000	Many 10 Gbps connections can be used via the same optical cable

As DSL technology is developing rapidly, the figures in the table are thus subject to change. DSL technology works to good advantage, as the fixed network in Iceland is in fairly good condition and the distance from the connection box to user is short (250 m on average). By choosing solutions which suit the fixed network in each location, it is possible to achieve considerable speeds, even in both directions. On the other hand, it becomes steadily more complicated and more expensive to achieve higher speeds via copper cable and the DSL systems cannot equal the transmission capacity of optical fibre.

For the general public, access to a high-speed connection is the equivalent of access to and active participation in the information society. This fact is an important aspect of modern lifestyle and a factor in decisions on where families choose to live. By 2010, we can expect the convergence of telephony, data transmission and broadcasting to mean that access to high-speed connections will be regarded as a basic quality of life. This makes it of prime importance to ensure that all Icelanders have access to such a connection so everyone can benefit optimally from the advantages of the information society.

Development

The Internet Protocol (IP) will most likely become dominant in electronic communications. This development encourages a fairly rapid and simple convergence of electronic communications and information technology, as well as broadcasting, since the

transmission speed is sufficient to provide a wide variety of digital services to the great majority of Icelanders. This also facilitates enterprises and institutions in offering Internet services and utilising centralised information systems to improve customer service, while at the same time cutting operating costs.

In the short term, transmission speed via copper local loops can be expected to suffice for the digital services currently offered to the public. In the longer term, residential connections will likely have to be upgraded to at least a transmission speed of 100 Mbps in both directions with new DSL technology, optical fibre networks, wireless technology, or other technology which is not yet known. It is normal for market players on an open electronic communications market to lead this development, as competition is the most favourable method of ensuring the rapid and cost-effective spread of high-speed connections.

Some Icelanders live outside the area in which it is considered feasible, on a commercial basis, to develop high-speed networks on current technological premises. This could apply to up to 5% of Icelandic households. A long-term solution for this group, based on the reference level for extended universal service, can only be achieved through the participation of or support from public authorities.

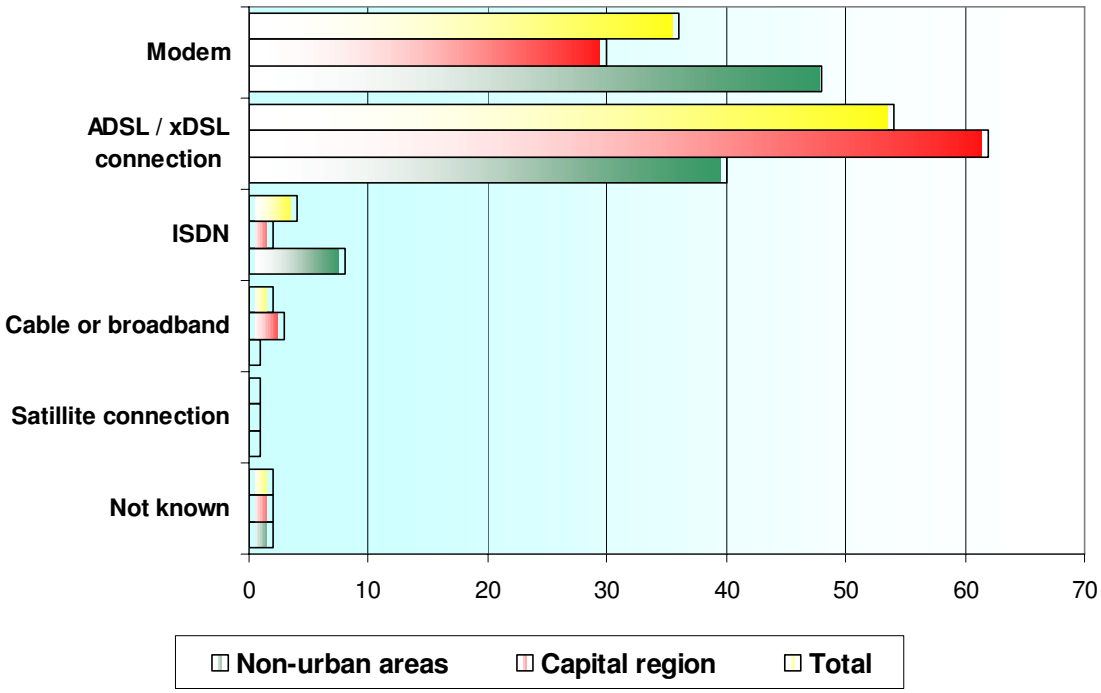

Figure 3. Type of residential Internet connection by location in 2004, percentage of all households. Source: ***Hagtíðindi – Upplýsingatækni*, Statistics Iceland, 2004.**

In Iceland, the entrepreneurial efforts of several enterprises have resulted in data connections in regions ignored by larger market actors, e.g. in sparsely populated areas and summer cottage districts. It would be highly desirable for such efforts to flourish and continue, while at the same time the main high-speed networks expand to cover a wider

area.

Public authorities have made a concentrated effort to expand eGovernment and take advantage of IT, although much more remains to be done in this regard. It is important that all public institutions have good internal and external Internet connections. An evaluation of the network connections of public authorities shows that a major effort is needed to improve this situation, cf. Table 2.

Schools are large workplaces where ICT plays a growing role. Increasing electronic services and digital distribution of instructional material demands continually more bandwidth. Electronic communications between educational levels will also increase and it is important for all the country's schools to have satisfactory access to high-speed connections. The future vision is to have the Icelandic school system at the leading edge.

The FS Network is a high-speed data transmission network linking all upper secondary schools and continuing education locations in Iceland with a transmission speed of 100 Mbps, while continuing education branches are linked to the network via 2 Mbps connections. Currently the FS Network includes 28 upper secondary schools, 9 continuing education locations and 25 branches of the latter.

The Icelandic research and university network, now links 16 universities and research institutes with a transmission speed of up to 1 Gbps. Scientific research and development lead both the advance of technology and its use – they blaze the trail for other users. Modern research requires powerful computer equipment and processing capacity to handle the ever-more extensive and complex measurement and research data gathered through international projects. In order for Icelandic scientists and students to be able to participate in distributed data processing, which is now becoming the practice in the international research and university environment, they need to have access to a minimum speed of 2.5 Gbps for international connections.[27]

[27] This bandwidth is used as a reference level for electronic communications between European universities and research institutes. See also *Auðlindir í allra þágu* (Resources for the benefit of everyone). Government Policy and the Information Society 2004-2007.

	128 Kb/s or less	>128Kb/s to 512Kb/s	512Kb/s to 2Mb/s	>2Mb/s to 10Mb/s	>10Mb/s up to and including 100Mb/s	>100Mb/s
Alþingi (parliament) & public administration	0%		0%		92%	8%
Courts	29%		71%		0%	0%
Financial institutions	0%		9%		91%	0%
Educational inst.	31%		9%		29%	31%
Health care	7%		52%		41%	0%
Law enforcement	43%		43%		14%	0%

Table 2. Breakdown of Institutions by Type and Connection Capacity.
Source: Analysis by Admon of the institutional connection situation, November 2004.

Class A
.
Electronic communications are unsatisfactory and the technical arrangements cannot support current services and the demands of external users.

Class B .

Electronic communications connections are acceptable and the technical arrangements can support current services. The potential of the available connections for electronic services to external users via electronic communications are not utilised, however, electronic communications are acceptable and the technical arrangements can support current services and the demands of external users.

Class C
.
Electronic communications connections are acceptable and the technical arrangements can support current services. Service provided to external users via electronic communications is innovative and takes advantage of technological potential.

Class D .

Electronic communications are very high quality and the technical arrangements will be capable of supporting upcoming development of service and demands of external users in the future.

Table 2 shows the varying quality of connections of public bodies. Institutions in the classification *Parliament and public administration* and *Financial institutions* are thus well situated with regard to their connections and the services provided through them. Institutions in the class *Courts* and *Law Enforcement* have connections which neither fulfil the requirements for service provision nor the demands of consumers.

High-speed connections

The Icelandic government emphasises having high-speed electronic communications throughout the country. It wishes to support and accelerate the positive impact derived from providing a variety of interactive service to all Icelanders. *In the estimation of the government, it is important to enable every household and enterprise in the country to connect with a high-speed network.*

There is no doubt that Icelanders are well placed with their high-speed networks. Access to high-speed connections is now among the best in the world. Iceland Telecom has laid an optical fibre system encircling the country which reaches most settled areas. An additional powerful microwave network links smaller locations. Iceland Telecom has installed optical cable in most urban areas, either right into individual buildings or to the curb. Other enterprises have also laid optical cables and other electronic communications links. Reykjavík Energy has laid an optical cable from Reykjavík to Akranes in West Iceland and south to the Westman Islands. In addition, Reykjavík Energy has in many parts of its energy distribution area laid optical cable, either into buildings or to the curb. The Fjarski network links the capital region with Akureyri, in North Iceland, via an optical cable. The communications company Og Fjarskipti controls a wireless access network in the capital region. eMax has a network offering wireless connections, primarily in the southwest of Iceland.

There has been extensive discussion of the necessity of laying optical cables in other areas of the country to provide high-speed connections. A rough estimate has been compiled of the initial cost of laying optical cable, without terminal equipment, into homes and businesses throughout Iceland. The results are shown in Table 3. The median cost is around ISK 34 billion, from which at least ISK 6.6-8.8 billion could be deducted for the existing optical fibre network. This cost estimate has less than 20% uncertainty. The median cost per household is ISK *409,000* and around ISK *118,000* for each resident. No consideration was given to probable synergies with the installation or maintenance of other types of utilities, such as water lines or electricity lines, although at least 3/4 of the cost of laying optical cable is for excavation.

Table 3. Initial cost of laying optical fibre cable to households, ISK billions

Billion-ISK								
	Urban areas		Non-urban areas		Very sparsely pop. areas		Total	
Region	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
West Iceland	1.4	2.0	0.8	1.0	0.7	1.0	2.9	3.9
West Fjords	1.4	1.9	0.4	0.5	0.2	0.2	2.0	2.6
Northwest Iceland	1.1	1.4	0.6	0.7	0.8	1.1	2.4	3.2
Northeast Iceland	2.6	3.6	0.6	0.8	0.6	0.8	3.8	5.2
East Iceland	2.0	2.7	0.6	0.7	0.4	0.5	2.9	3.9
South Iceland	2.1	2.9	1.2	1.5	1.1	1.4	4.4	5.8
Suðurnes peninsula	1.7	2.4	0.1	0.1	0.1	0.1	1.8	2.5
Capital Region	8.6	12.0	0.2	0.3	0.1	0.1	8.9	12.4
Total	**20.9**	**28.8**	**4.4**	**5.5**	**3.9**	**5.1**	**29.2**	**39.4**

Table 3. Rough estimate of initial cost based on a model for providing optical fibre connections to all residences in Iceland starting from scratch. The median cost is around ISK 34 billion, of which at least ¾ is excavation costs. If the current optical fibre installations were used, the total cost could be reduced by ISK 6.6-8.8 billion. **The uncertainty of the assessment is less than** 20%. **See the report by Rafhönnun of August 2004.**

It is important to point out that providing high-speed transmission throughout Iceland is a long-term project driven by telecom operators, who have led the way and will evidently continue to do so in developing and expanding the electronic communications market. The role of the state involves supporting the establishment of high-speed networks, in co-operation with local authorities and other interest groups, in regions were telecom operators do not consider it commercially viable to provide services. Local authorities in many areas of the country have shown interest in making access to high-speed networks available to residents, as good electronic communications are a prerequisite in the competition for industry and residents. Such projects are already underway and in part based on examples from other Nordic countries.

Optical fibre lines can be laid as part of other utility projects. It is important that local authorities and utility companies consider this and they are encouraged to consult with electronic communications operators on their installations.

Provision of high-speed connections - Objectives

All Icelanders who so desire should be able to connect to a high-speed network and enjoy cost-effective and secure electronic communications services.
Educational institutions should be connected to a powerful high-speed network.

Mobile connections

Mobile connections where required

Use of mobile phones is extremely high in Iceland[28] and among the highest in the world. Both the general public and businesses have taken advantage of this new technology, which has had a widespread social impact, increasing mobility, improving access and providing greater security.[29]

Table 4. Estimated initial cost of GSM provision along main national routes.	
National Route 1, a total of 400 km out of range	Initial cost ISK 215 million
Other main routes, a total of 1,100 to 1,320 km out of range	Initial cost ISK 582-698 million
Total	**Initial cost ISK 797-914 million**
A rough estimate of the initial cost of establishing at least 80% coverage on the main routes in Iceland lacking a mobile phone connection. See Report by Sess ehf., September, 2004.	

Despite the widespread use of mobile services in Iceland, gaps exist in many locations along national routes, in recreational locations, in small communities and throughout most of the highland regions. This causes inconvenience and jeopardises security. GSM mobile phone service has up until now not been made available in these locations since it has not been considered profitable by operators.

It is important to fill in the gaps in the GSM network. Although it was not designed as a security system, it does perform an important public safety function, especially in less frequently travelled locations. Furthermore, it is important that always-on connectivity is available to the public everywhere. The government wishes to effectively contribute to the establishment of such service throughout Iceland. Where telecom operators do not provide such service, the government will seek ways to initiate its development in accordance with the extended universal service objectives.

Long-range mobile telephone system

Iceland Telecom's NMT mobile network is long-range and covers almost all of Iceland and its surrounding waters to distances of 50-150 km from the shore. Operation of the NMT system will be terminated within few years. It is outdated and production of NMT equipment have practically ceased. A successor to the NMT system will have to be found in the coming years, since it is used extensively where other mobile systems are not available.

[28] Around 97% of all Icelandic households have one or more mobile phones. Source: *Hagtíðindi – Upplýsingatækni*, Statistics Iceland, 2004:5.

[29] Electronic communications systems for search-and-rescue teams or security purposes, e.g. the Tetra or VHF systems are not included in the scope of this programme.

Tetra is a mobile phone and radio communications system used by search-and-rescue teams, police and fire departments. It has not been widely accepted and its use is currently primarily limited to the southwest of Iceland. Experience has shown that Tetra is primarily a radio and security system for public and semi-public bodies, as well as contractors.

The CDMA450 digital system has competed with GSM to replace the NMT system at a frequency of 450 MHz in several countries of Eastern Europe and Asia. CDMA450 has a range of 50-150 km, depending upon the location of transmitters, and can provide data transmission speeds exceeding 2 Mbps, which is similar to common ADSL speed at present. The CDMA450 system could be a feasible option when the NMT system is terminated.

Wireless data connections

Data transmission via mobile phone has not been widely used, with the exception of SMS short messages. There are indications, however, that this may change with increasing use of GPRS data connections via GSM phones. The advent of wireless "hot spots" is also an indication that wireless data service will increase. Even greater speed can be achieved by modifying the software in GSM systems.

Technical standards for mobile phones and wireless data connection.
Note that the transmission speed for mobile connections is a common resource, shared among users in the same region. The conditions are often such that the specified transmission speed cannot be achieved. Outgoing transmission speed is commonly less than incoming.

Some connection possibilities	**Maximum incoming speed [Mbps]**	**Range of transmitter [km]**	**Comments and types of electronic communications technology involved in the connection possibilities in question.**
1G		50-150	NMT
2G	0,0144		GSM, HSCSD
2,5G			GPRS, EDGE
3G	1,6		UMTS, WCDMA
3,5G			HSDPA
4G	20-100		IP system for both voice and data Ready at the earliest after 2010
802.11	2		WiFi (LAN)
802.11b	11		WiFi (LAN)
802.11a,g	54	0,1	WiFi (LAN)
802.11n	320		
802.15.1			Bluetooth (PAN)
802.15.3a	110	0.01	UWB (PAN)
802.15.4	0,25	0,03	ZigBee. For measuring instruments
802.16	134		WiMax (MAN). Actually a 4G system
802.16a	70	50	WiMax (MAN). Actually a 4G system.
802.16e	70		WiMax (MAN). Actually a 4G system. Standard ready 9/2004. User may travel at a speed of up to 120 kmph.

802.20	1++	15++	Still on the drawing board. Designed from scratch. (WAN). User may travel at a speed of up to 250 kmh. Connection easily transferred between 802.11, 802.16 and 802.20. This is actually a 4G system.

Licenses for third-generation (3G) mobile phones,[30] offering fast data transmission, have not been allocated yet in Iceland, although the Icelandic parliament has recently passed legislation authorising this. Use of 3G mobile services abroad has been very slow in getting started, but appears to be progressing.

Fourth generation (4G) mobile systems differ from 3G in two aspects: In the first place, they are designed for higher data speeds, but are also intended to transfer voice, data and images over networks as data packets. The development of wireless networks[31] (hot spots) fits in well with 4G functioning. Both 3G and 4G are concepts which are covered by more than one technical standard[32] and varying applications exist or are under development. 4G mobile systems will likely not be ready until after 2010.

One of the main innovations used in 3G/4G mobile phones is transmission of shorter or longer video clips. Television can, for example, be distributed via such systems, although the quality of the picture is limited by the screen resolution. Mobile phones can also be used for wireless reception of images which are subsequently displayed on a larger screen, e.g. on a laptop. There are also new possibilities for communication through images instead of sound, e.g. for the hearing impaired.

It is natural to demand that the digital high-speed mobile network used in Iceland in the future offer the following functions:

- voice transmission,
- high-speed data transmission,
- technical compatibility with fixed networks with regard to data access (generally based on the IP standard),
- long-range,
- possibilities of roaming to and from the country,
- good supply of end-user equipment at favourable prices.

[30] **1G** is used to refer to analog telephone systems, such as NMT. **2G** is used for digital GSM mobile systems (HSCSD, GPRS, EDGE go up to **2.5 G**), and also CDMA, PDC and IS-95, where one or more *voice channels* are reserved when data is to be transmitted. Data transmission speeds vary from 9.6 kbps to 384 kbps in both directions. Dialling-in is required to establish a data connection. **3G** (defined in the framework definition IMT-2000 from ITU) transfers data in packets, and thus does not require reserving voice channels to achieve high data speeds. Data transmission speed is, however, dependent on how many users are concurrently connected to a transmitter. The incoming data transmission speed is 1.6 Mbps and outgoing 384 kbps. The user is always connected. **4G** transmits both voice and data in packets (pure IP system). The concept of voice channel thus does not apply to 4G transmitters. Data transmission speed will be at least as good as in 3G, and as high as 20 Mbps or even 100 Mbps. 4G systems will likely not be ready until after 2010. The Japanese, Koreans and Chinese (30% of the mobile market) have joined forces in developing 4G mobile systems. India has decided to move directly to 4G, omitting 3G.

[31] IEEE standards 802.11, 802.16 and 802.20 cover wireless networks in residences, outdoors and travelling. They are at various stages of development; the first is in general use, 802.16 has recently been published and 802.20 is expected.

[32] There are at least 17 different standards for 3G phone systems, 6 of them via satellite.

There may be no existing mobile systems which fulfil all the above requirements. The 3G systems which neighbouring countries have introduced do not do so. Their main shortcoming is long-range capacity, without which it will be expensive to develop the system in Iceland due to low population numbers and sparse settlement. This will result in limited service to sparsely populated areas, the interior highlands and offshore vessels. No doubt one or more mobile phone systems could be developed which combined would fulfil all of the above requirements, but the cost of doing so would have to be evaluated against the advantages gained. This makes it important to take special care in planning and selecting a system to make sure that the system developed in Iceland as part of the international community will suit local conditions. Some uncertainty still surrounds 3G, and development of other mobile solutions is still in its infancy. Convergence will result in all services being accessible all the time (ubiquitous networks and always-on connectivity). The government will endeavour to ensure that the legislative framework reflects this development in order that high-speed mobile service will be available in Iceland no later than 2006. Suitable measures will be applied, e.g. tendering frequencies and providing information on the current situation, both in Iceland and abroad, to stimulate this development.

Mobile connections - objectives

The security of travellers should be improved through increased access to mobile telephone services on Iceland's highways and main recreational areas.

High-speed mobile services should be developed throughout Iceland.

A long-range digital mobile phone network should be developed to serve the entire country and offshore waters.

Digital television and radio

From analog to digital

Digital television technology opens up various new communication possibilities which were not possible in an analog system. These include an increased number of programmes, improved picture quality, interactivity, high-definition television and new distribution routes.

Broadcasting on a digital system makes it possible to transmit with the same quality 4-5 programmes on a single channel instead of one in an analog distribution system. This multiplies television broadcasting options. All the viewer has to do is to convert the digital signal to analog using soft- or hardware (a set-top box) in order to use a traditional television set.

The principal advantage of television distribution by radio transmission is the possibility of reaching a large number of users at low cost. The cost is still somewhat lower than transmission via high-speed networks. In most cases, broadcasts also cover a rather large area, reaching travellers or people who do not have access to a high-speed network.

In the longer term, distribution via high-speed connections offers more options for television programming, high-definition and interactivity, in addition to which such distribution is part of the convergence of electronic communications technology, IT and media distribution. Television will probably be distributed both via a high-speed network and through the air, in order to meet the needs of different user groups, with high-speed network distribution becoming more widespread as time passes.

Major changes in television user equipment are foreseeable. The television screen as we know it today will likely be replaced by a high-definition screen or projector connected to a digital set-top box or in-house information system. This information system, in turn, will be connected to an access network via an optical cable, xDSL or other means. Reception of television programming, data and telephony will, for instance, be controlled by the in-house information system, which will be comprised of a personal computer, receiver for various types of network services, as well as a residential network. The first signs of this development are already visible in the greatly increased use of ADSL equipment for wireless household Internet.

The introduction of digital television is well underway in many countries. It has proceeded most rapidly where television signals are distributed via satellite to large markets, or where there were pre-existing cable systems, which can be very suitable for digital distribution.

The current distribution system of Icelandic television stations, which is based primarily on analog transmitters, is becoming outdated and in need of renewal. Digital broadcasting through the air or via ADSL have already begun.

As a result, consumers are offered access to a large number of digital programmes on the new distribution networks. This technology can involve considerable cost. Since not necessarily everyone will wish to or be able to take advantage of this technology, it may be desirable to offer a simple, accessible and inexpensive way to receive digital television, e.g. via UHF distribution.[33]

Once digital distribution by radio transmission has been developed and is in common use, analog broadcasts will be discontinued.

Radio broadcasting will follow a course similar to that of television. The difference here is that a large number of radio stations are already accessible on the Internet. Radio reception while travelling, for instance, by automobile, is also considerably more common than television reception. Provisional digital radio broadcasts through the air using the Digital Audio Broadcasting (DAB) standard have begun in Iceland. Listeners who wish to enjoy digital broadcasts will have to invest in new digital receivers.

Increased supply of television content

The service providers who transmit television or offer Icelanders visual services via high-speed networks or via the Internet will in coming years increase significantly in number. This development has already begun, offering the possibility of purchasing services from anywhere in the world. With high-speed residential connections, users can also make their own visual material available on the Internet.

The general public will have easy access to a wide variety of international entertain-

[33] UHF stands for Ultra High Frequency, which together with VHF (Very High Frequency) is a common television distribution method in Iceland.

ment and cultural programming. The supply of Icelandic broadcasting content should be increased, both through new production and by converting older material to digital format. Some older products and programmes of Icelandic National Broadcasting and other parties, e.g. the Icelandic Film Archive, have been converted to digital format, which is a prerequisite for making it accessible.

Special consideration must be given to copyright issues in this connection and to how older material may be reused in consultation with rightholders.

It should be pointed out that the public can already see Icelandic television news on the Internet, although the image quality on a computer screen is not as high as on the television screen.

The Market

Television and radio broadcasting were included as part of the Icelandic electronic communications market for the first time in the Electronic Communications Act of 2003. As a result, the market for such broadcasting will be analysed with regard to competition and conditions imposed on those enterprises which have significant market power and operate distribution systems for such services. These conditions may include, for instance, provisions on access, non-discrimination, accounting separation, cost accounting and price control and making public information on technical systems interfaces.

It would be preferable if radio and television broadcasting were to develop into a horizontal arrangement, i.e. with a clear distinction between activities involving distribution of signals, on the one hand, and production and sale of visual material, on the other. This would facilitate the entry of new actors into the market and prevent larger companies from monopolising distribution systems. In the long term it is important that consumer access to television content is not limited to high-speed connections or distribution networks from a specific operator. Such an arrangement would distort the competitive position of parties producing and distributing material.

To keep costs down and make things easier for consumers, it would be useful not to increase the number of set-top boxes needed to receive digital transmissions from various service providers.

Digital television has to reach all Icelanders.[34]. To reach vessels at sea and sparsely populated areas, INB's television programming, as well as radio Stations 1 and 2, must be transmitted via satellite.

Digital television and radio - Objectives

All Icelanders should have access to interactive digital television.
Satellite broadcasting should be available throughout Iceland and adjacent waters.

[34] According to Article 4 of Act No. 122/2000, on Icelandic National Broadcasting, it must transmit at least one television channel programme to the entire country and offshore waters all year round.

Safety and personal data security

New technology

New telephone technology, based on IP communications, is acquiring a growing share of the market at the cost of traditional residential telephones. The security and dependability of the new telephones may be less than desirable while the technology is developing, but efforts are underway to make them as secure as the older phones.[35] The new telephones also may not work in an electrical failure. If they are to completely replace the previous telephones as a security device, consumers must be made aware of these disadvantages and informed of solutions.

It is important for everyone to be able to use electronic communications in an emergency. The handicapped and other persons with special needs must be able to continue to use security services, e.g. the 112 emergency number, with new and changing technology.

Wireless networks are very common. There have been instances of unauthorised use by third parties. It is important for sellers of such services to impress on consumers that they close their networks for unauthorised access and deliver equipment which is configured so that it prevents unauthorized access.

Operating reliability

Secure connections to the outside world are a key factor in communicating and doing business with other countries. Such connections must be so secure that the possibility of complete interruption is negligible. No reliable research is available on the resistance of these networks to breakdown, and it is important to rectify this.

Today, there are two submarine fibre optic cables serving Iceland with international high speed connections. When the FARICE submarine fibre optic cable was taken into service in 2004, satellite connection via Skyggnir was terminated. The capacity of FARICE is more than 100 times that of the older submarine cable, CANTAT III. The CANTAT III cable can still handle transmission needs if connections through FARICE are severed. Increased use of the bandwidth of FARICE will mean that CANTAT III will no longer suffice as a back-up. A back-up satellite connection can handle telephone traffic, but it would be unrealistic to expect that a sizeable increase in bandwidth use of FARICE could be directed through CANTAT III. This makes electronic communications between Iceland and other countries vulnerable to unexpected occurrences/events, such as system failure or vandalism, and is unacceptable in the longer term both due to commercial interests and concerns of national security. This situation can clearly deter both domestic and international corporations from developing operations which require secure connections with the outside world. Preparation needs to begin immediately for the installation of a new submarine cable.

Security criteria need to be set for the operations of public electronic communications networks and their connections with other countries, with the aim of ensuring the security

[35] In some instances, information on the location of callers to the emergency number 112 is lacking.

of electronic communications both

within the country and between Iceland and other countries. *The minimum requirement should be that two submarine cables should always connect Iceland to the outside world, with a back-up satellite connection.*[36]

Personal data protection

It is important to ensure the integrity of electronic communications with regard to personal data protection and to ensure individual welfare in a democratic state. Care should be taken to ensure that the actions of public authorities, private enterprises or the general public do not violate the individual's right to privacy. In this connection it is important that the public be informed of its rights and aware of potential threats.

Internet Security

There has been extensive discussion of various types of Internet "pests", such as computer viruses, spam, spyware, etc. It is urgent to control this through the co-ordinated efforts of the public authorities, private enterprises and the general public. Both the public and enterprises must be able to feel confident that doing business via electronic communications, e.g. on the Internet, is secure and safe.

Public Education

Instructions and information material on security issues, consumer protection, personal data protection and ethical questions connected with the growing use of ICT should be distributed to the general public. Icelandic participation in international consultations on security and data protection, aimed at ensuring the unobstructed functioning of the Internet and IT systems, should be increased.[37]

Security and personal data protection - Objectives

The security of public electronic communications within Iceland and internationally should be ensured through satisfactory alternate connections.

The security of the Internet should be improved, so that the public can rely on it in business and everyday life.

Competitiveness

Providing a supply of and access to electronic communications services equal to the best in other countries at a competitive price is a prerequisite for

[36] *Auðlindir í allra þágu* (Resources for the benefit of everyone). Government Policy and the Information Society 2004-2007, p. 18.
[37] *Auðlindir í allra þágu* (Resources for the benefit of everyone). Government Policy and the Information Society 2004-2007, p. 18.

Iceland's competitiveness. Effective competition on the Icelandic electronic communications market is a central premise for increased international competitiveness.

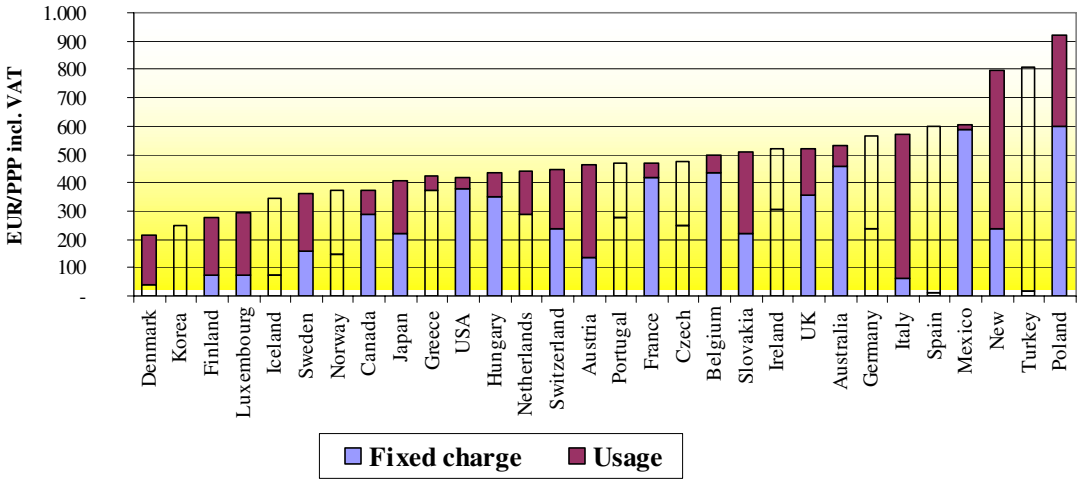

Figure 4. Postpaid Mobile Phone Subscriptions: Cost based on purchasing power and average use. **Source: Telegen T-basket, August 2004.**

The central principle of current legislation on electronic communication is to ensure that electronic communication is cost-effective and secure. The legislation is also intended to stimulate effective competition on the market. This is done by creating an environment where new communications enterprises can enter the market to compete with those who already have significant market power.

The competitiveness of countries and regions is to a large extent determined by the vitality of the local industry; in modern society this is steadily more dependent upon electronic communications technology. Citizens' conceptions of whether they feel they are a part of the cultural and industrial stream, both domestically and internationally is of major significance in determining where they choose to live. The variety of services available thus makes a great difference to the development of settlement in the country and electronic communications play a key role in making both information and entertainment accessible at a reasonable price. It is of great importance for the competitiveness of rural vs. urban areas that consumers outside of the capital area pay the same price for electronic communications services as consumers in urban areas.

The same applies to people in Iceland as compared to people elsewhere in the world. The competitiveness of the country as compared to other countries is determined to a large extent by the ready and secure access to electronic communications to and from the country.

Competition

Where one or only a few parties own or control distribution channels, e.g. to end users, access of new enterprises to the communications infrastructure must be ensured. This is done, for instance, with effective regulation.

Competition can be increased by separating wholesale services from value-added services provided by electronic communications enterprises with significant market power. This facilitates new operators offering services in the market and encourages new entrants to the market and innovation.

Access to electronic communications networks is of prime importance for competition and services in this market. On the one hand, operators can develop new electronic communications networks (network competition) and, on the other hand, can compete by providing services on established electronic communications networks (service competition). Generally, network competition is considered to better ensure competition on the electronic communications market in the long term, but service competition is also necessary, especially where the market is small.

Service competition is only possible if equal access to the communication system is ensured. This can be done by regulation and by imposing remedies on enterprises which have been designated as having significant market power in a specific market. The aim is to ensure that enterprises dominating a market do not prevent access by competitors to limited resources. The owners of an electronic communications network thus may not prevent normal, value-added access by service providers to the network.

It may be necessary to prevent service providers from abusing their position and "starving" a certain distribution network, thus forcing consumers to change network operators if they wish to receive a certain service or programme. It is important to examine consumers' situation in this connection and adopt rules to safeguard their interests.

Pricing and Consumer Protection

The price of electronic communications services in Iceland is among the lowest in the world, according to OECD data.

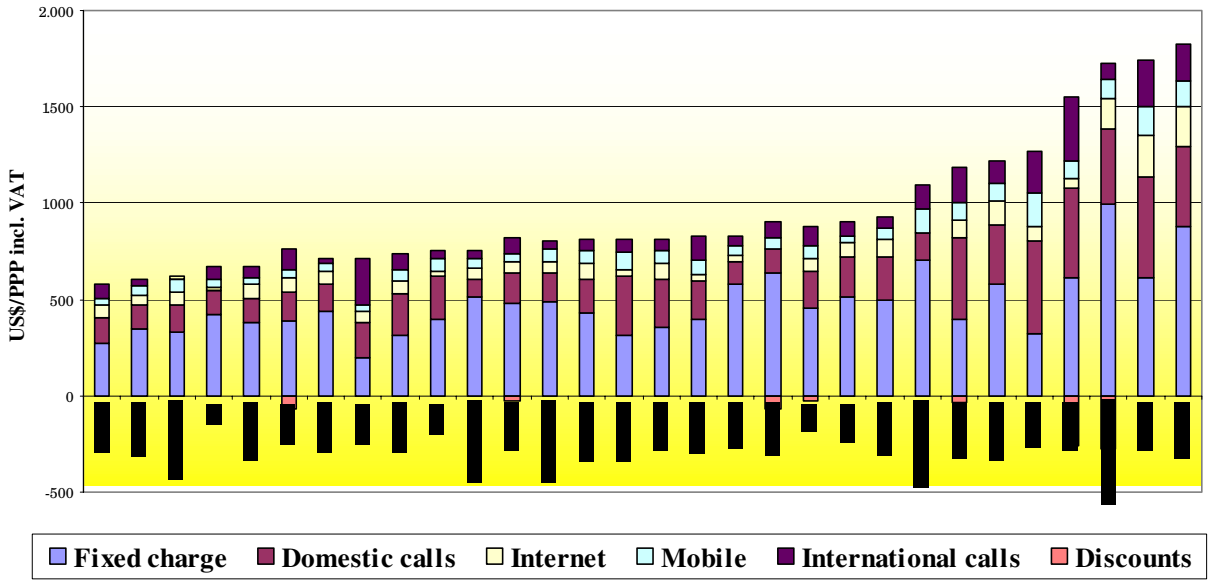

Figure 5. Annual average household cost for fixed-line telephone. Source: Telegen T-basket, August 2004.

The total cost paid by Icelandic households for electronic communications has, however, increased considerably in recent years as a result of new services, such as GSM phones and the Internet. Average household cost of electronic communications was around 1.4% of total expenses in 1995[38] and 3.1% in 2003. It is difficult for both individuals and enterprises to distinguish the most favourable overall terms for electronic communications services and the cost of use is not always transparent or comprehensible to the layman. The responsibility of service providers in this respect needs to be defined to safeguard consumer interests.

Due to Iceland's geographical situation, it is expensive to lay electronic communications cables to connect it with neighbouring countries. The cost of installing the FARICE submarine cable linking Iceland, the Faroes and Scotland, was high and as a result Icelanders have paid a special fee for international communication (e.g. for downloading material). This has served to restrict the use of electronic communications between Iceland and other countries and reduced its growth in Iceland. The capacity of modern electronic communications cables using optical fibre technology is enormous, making it natural to substantially lower the cost of bandwidth for such service. The price paid by users must be moderate and measurement of material downloaded from abroad should be terminated, as this does not accord with electronic communications development and restricts its progress in Iceland.

The important point is to have secure electronic communications connections to and

[38] Statistics Iceland. Research on Household Expense, 2004:4, and Information Technology, 2004:4.

from Iceland and at favourable prices. Actions to reduce the disadvantage caused by the country's geographical situation must be considered in order to eliminate the potential advantage of other countries in this regard.

It is important to effectively monitor the quality and terms of electronic communications, so that consumers will always be offered good services and correct and transparent price information. The Post- and Telecom Administration of Iceland is responsible by law for providing such regulation and ensuring consumers' disputes are resolved promptly.

Access

Access to electronic communications in Iceland is considered good by international comparison. All Icelanders can obtain a residential telephone, over 92% have access to ADSL and GSM mobile service reaches 99% of households.

Extended universal service is aimed at equalising still further the provision of electronic communications service upon which the information society is based.

Competitiveness - Objectives

Efforts should be devoted to improving the regulatory framework and reinforcing electronic communications market regulation to increase competition, transparency and confidence.

Efforts should be made to lower unit costs in international electronic communications.

Efforts should be made to equalise the cost of electronic communications services everywhere in Iceland.

Efforts should be made to improve access to cost-effective and secure electronic communications service everywhere in Iceland.

Efforts should be made to ensure that handicapped persons can take advantage of electronic communications in the information society.

The Ministry of Transport and Communications in Iceland in June 2005