General Distribution **OCDE/GD(96)73**

COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY

INFORMATION INFRASTRUCTURE CONVERGENCE AND PRICING: THE INTERNET

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Paris 1996

FOREWORD

This report was presented to the Telecommunications and Information Services Working Party meeting in January 1996 and was recommended to be made available to the public by the Information, Computer and Communications Policy (ICCP) Committee in March 1996.

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MAIN POINTS

There is growing recognition of the importance of the efficient provision of information infrastructure for economic and social development. OECD governments are increasingly articulating policies aimed at harnessing the potential of the convergence of communication and information technologies to improve services in areas such as health, education and boost national competitiveness. A central tenet of most government policies in these areas is ensuring the widest possible access to information infrastructure for business and residential users. If this goal is to be realised, this paper concludes that governments need to adopt policy frameworks that encourage innovation in pricing and responsiveness to the needs of users. Without such changes significant barriers to developing widespread access to information infrastructure, and the new applications made possible by very rapid technological change, will remain in place.

One of the highest profile developments in this process of convergence has been the Internet. Indeed, for some, the Internet has become the harbinger of an 'information superhighway'.[1] There are two reasons why this view is gaining increasing currency. First is the convergence of service possibilities over the Internet including increasing potential for interactivity between users and the audio/video capabilities that can be built into applications. Accordingly an increasing number of hardware, software and information companies are basing future plans on Internet developments. The second reason is the growing economic and social activity that is taking place based on expanded access to the Internet.

The aim of this report is to document the current state of development of the Internet in the OECD area and focus on the pricing of access and usage. These are important issues for governments for a number of reasons. First, and foremost, is that while there is increasing commercialisation of the Internet much of the underlying infrastructure in many countries remains under monopoly control. From this simple premise stems an enormous range of issues ranging from the level of pricing, availability of service and the potential for anti-competitive behaviour. For example the pricing of infrastructure has a fundamental relationship with the competitiveness of markets and the affordability of services for residential users. The available evidence indicates that competitive markets are delivering best practice pricing (for business and residential users) and providing infrastructure that is not available in monopoly markets.

If the Internet, or like services, are to play a core role in information infrastructure the evidence indicates that new pricing structures for use of communication networks are needed. Pricing structures built around voice telephony use of networks are in many cases not suitable for the new environment. Indeed, many of the aims outlined by OECD Governments could only be implemented at very high cost given current pricing structures. Monopolies may present severe problems in this area and there is growing evidence they do not encourage pricing innovation and responsiveness to new demands as quickly as markets with infrastructure competition. Moreover, it has been suggested by some users that the incentives for monopoly public telecommunication operators (PTOs) in Europe may be such that the required infrastructure will not be developed in a timely fashion or, if it already exists, may not be made available at cost oriented rates because it could provide a platform for alternative service provision in competition with PTOs. This is because of the potential for users to take advantage of new technologies to

meet their needs while circumventing public switched telecommunication network (PSTN) charging practices, the foundations for which were laid in a world of monopoly PTOs. Nevertheless a number of new initiatives have been reported by leading European PTOs in monopoly markets aimed at improving available infrastructure for the Internet. At the same time regulation needs to be modified to reflect current technological capabilities and market realities or PTOs and other service suppliers will face greater hardships in restructuring to take advantage of opportunities, and meet the challenges posed by the changes brought about by converging markets.

This document provides information for policy makers on convergence and pricing issues using the Internet as an example. The first section presents some selected policy highlights for OECD governments considering the implications of these developments for information infrastructure. The second section describes the development of the Internet and provides analysis on market growth and new applications. The third and fourth sections respectively contain data and analysis of the current pricing of information infrastructure in relation to the Internet. The final section contains information and analysis on the implications of convergence, in respect to Internet developments, in the areas of telecommunication and broadcasting. The Information, Computer and Communications Policy (ICCP) Committee home page on the OECD world wide web site is at http://www.oecd.org/dsti/sti_ict.html.

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POLICY HIGHLIGHTS FOR INFORMATION INFRASTRUCTURE

PTO pricing of network access and capacity, which in certain cases is far in excess of cost, is a major challenge to OECD governments achieving the goals they have set out in information infrastructure policies. The following bullet points show a summary of the findings of this study:

-- If countries wish to take advantage of the enabling capabilities of networks such as the Internet, to implement information infrastructure initiatives, they need to urgently address the extent to which the underlying communication policies influence current growth rates.

-- The penetration of Internet hosts is five times greater in competitive than monopoly markets, and if allowance is made for the date of service commencement, Internet access in countries with telecommunication infrastructure competition has grown six times faster than monopoly markets.

-- The average price for leased line access to the Internet in countries with monopoly telecommunication infrastructure provision in 1995 was 44 per cent more expensive than countries with competitive provision of infrastructure.

-- In most OECD countries there are restrictions on who can supply telecommunication infrastructure for Internet access, because of monopoly or duopoly policies. As an increasing number of these PTOs enter the Internet access business policy makers will have to be vigilant against potential abuses of bottleneck control of infrastructure.

-- In countries without telecommunication infrastructure competition the need for policy reform is pressing because when Internet Access Providers pay steep charges to PTOs they must pass these costs on to business and residential users.

-- On average Internet Access Provider's prices for 'dial-up services' were nearly three times less expensive in countries with telecommunication infrastructure competition than those with monopoly markets in 1995.

-- For a basket of 30 hours per month of 'dial-up' Internet access (*i.e.* public switched telecommunication networks plus Internet Access Provider charges) seven of the eight countries with infrastructure competition are below the OECD average while 12 of the 17 countries without infrastructure competition are above the OECD average.

-- A major reason that a sufficient amount of local content is not available in some countries is because domestic producers and users do not have efficient access to networks. Those countries that do not provide efficient access for users will not develop a market attractive to national suppliers.

-- Users in the OECD area would, on average, have to pay more than three times the average OECD residential PSTN basket to access the Internet for 240 hours per year (at standard rates) and more than four times for access to 360 hours per year (at standard rates).

-- While many 'dial-up' users would take advantage of off-peak PSTN rates, to reduce their total bill, several categories of users would need to pay standard rates. This would impact heavily on government policies in areas such as education and small business development.

-- Even at off-peak rates a basket of Internet access is several times more expensive than the OECD residential basket of PSTN services in most OECD countries.

-- Whereas traditional use of telecommunication networks for telephony does not produce widespread differences in the OECD area, based on different charging practices for local calls, users of on-line services differ in the amounts they pay to PTOs by up to ten times for 20 hours per month and 20 times the price for 40 hours of local calls of per month. To put this into perspective the normal difference between the most and least expensive countries for an OECD basket of residential services is between two to three times the cost.

-- The current trend of rebalancing call tariffs, by lowering long distance charges and raising local charges, is increasing the cost of a basket of on-line services with users in monopoly markets being worst affected. The additional price paid on average by users in monopoly countries, although already far greater than the average for competitive markets, is growing.

-- The provision of second residential telecommunication mainlines appears to be an area of growth for PTOs in those countries where Internet access is rapidly expanding, but rebalancing is also increasing this cost in several countries.

-- While users will undoubtedly be prepared to pay higher charges for services they value it is also true that a major examination of charging practices will need to be undertaken by many PTOs if they are to foster efficient use of information infrastructure. Markets can be used by policy makers to assist in this process and eight of the 13 least expensive countries for dial-up services are applying competition policy to encourage further structural adjustment.

-- In monopoly markets there does not appear to be any innovation or structural adjustment to address new growth areas. Instead, the tariff rebalancing that is occurring is making the local charges in these countries even more expensive relative to those with competitive markets. Unless these countries implement policies to address this situation the economic and social benefits governments envisage for information infrastructure will be very slow to eventuate.

-- The real key to meeting the challenge posed by new network patterns of use, in terms of rebalancing prices, is to increase PTO efficiency. However it is important to recognise that even if the rebalancing process was halted in many countries new ways of pricing networks are going to be needed.

-- Traditional telecommunication charging practices might discourage business from locating outside urban centres, employees from opting for tele-work, or rural communities and residences from benefiting from services available to users in cities at more affordable prices.

-- Currently the most innovative solutions for expanding universal service, and other aspects of Internet access pricing for information infrastructure policies, are being developed in competitive markets. One example is an Internet Access Provider in the UK providing

virtual points of presence so that callers in all parts of the country can reach the Internet at the cost of a local call.

-- A key outcome of the new environment is that infrastructure competition is the best policy to assist in the tariff rebalancing process because it encourages greater efficiency and innovation.

-- There is a danger that monopoly PTOs, by maintaining high underlying charges for capacity, could restrict the growth of 'dial-up' and leased line Internet access services until they are ready to enter the market or because they view some new Internet services as threats to traditional sources of revenue.

-- It may or may not be more efficient to use existing or upgraded cable communication infrastructure to provide some new information infrastructure services but many OECD countries restrict the telecommunication services which can be offered by suppliers other than PTOs.

-- Initiatives to lift restrictions on the provision of infrastructure for services which have been liberalised in the EU area (July 1996), such as data services, are very positive for Internet access expansion and will be complemented by the liberalisation of voice services.

-- Regulation needs to be modified to reflect current technological capabilities and market realities, or PTOs and other service suppliers will face greater hardships in restructuring to take advantage of opportunities, and meet the challenges posed by the changes, brought about by converging markets.

-- The key policy message is that while no one is certain which technologies will provide the mix of building blocks for the future, liberal markets are best placed to capture the benefits made possible by convergence of different industry sectors.

DEVELOPMENT OF THE INTERNET

Internet Origins and Growth

The Internet is an interconnection of more than 50 000 public and private networks world-wide that use a common communication protocol **(Table 1)** . Some 92 per cent of these networks are in the OECD area. The Internet has been grafted onto the world's public and private telecommunication networks via a myriad of leased lines and, increasingly, capacity internally allocated by PTOs as they become direct Internet access providers. Internet backbone networks are overwhelmingly made up of capacity owned by the world's PTOs.

The communication protocol which provides a common language for inter-operation between networks is called TCP/IP (Transmission Control Protocol/ Internet Protocol).[ii] The origins of the Internet began with the US Department of Defence's Advanced Research Projects Administration (ARPA) in the late 1960s. The TCP/IP technology was developed to provide a standard protocol for ARPAnet users to communicate and share computing resources.[iii] In 1969 ARPAnet connected four computers at different sites and this grew to around 2 000 connections by 1985.[iv]

In the mid 1980s the US National Science Foundation (NSF) adopted the same protocol when it created the NSFNET in order to provide high speed communication between supercomputer centres. At this time interest was growing among other US government agencies, the wider educational community and business. In addition a number of equipment companies started to build and market 'routers', that act as gateways to the Internet. As the controls were relaxed over who could join the Internet a growing number of universities, research laboratories and commercial enterprises from around the world were connected **(Table 2)**.

The relaxation of the so-called 'acceptable use policy' encouraged many organisations operating as not-for-profit providers of Internet connections to make the transition to providing links for commercial enterprises and access for residential users.[v] These organisations became the first commercial Internet Access Providers (IAPs) by leasing capacity from PTOs to provide transmission services from their facilities to Internet backbone networks such as NSFNET. Business customers who require leased line access to the Internet, via IAP facilities, generally buy this capacity from PTOs.[vi] This enables, for example, a dedicated link for a service provider to create 'home pages' that can be accessed by users. Residential and small business customers mostly use a personal computer (PC) equipped with a modem and access services via the PSTN. This is called 'dial-up' Internet access.

In July 1991 there were 535 000 computers (Internet hosts) connected to the Internet.[vii] Around 430 000 of these hosts were in the US of which 48 per cent were registered under an educational domain name and 34 per cent in a commercial domain name.[viii] In 1994 the number of commercial domain names exceeded the number of educational domain names for the first time. By July 1995 more than 40 per cent of US domain names were commercial and 33 per cent educational, with other domain name categories including sectors such as "organisations" and the "military". At this time there were 6.6 million Internet

hosts in the world, of which 6.4 million were in the OECD area, and just under 4.3 million in the US. By January 1996 there were more than 9.1 million Internet hosts in OECD countries **(Table 3)**.

A major turning point in the development of the Internet came with the creation of user friendly navigational tools over the 'World Wide Web' (WWW). The WWW was developed at the CERN's European Laboratory for Particle Physics and was first used in experimental form in 1989.[ix] These tools, sometimes known as 'browsers', enable users to treat data on Internet as a cohesive whole by fetching data, determining what it is and configuring it for display.[x] In 1993 the first such tool to have a major impact on the growth of the Internet, named Mosaic, was developed by the National Center for Supercomputing Applications at the University of Illinois.[xi] Mosaic created a graphical interface for users that simplified Internet navigation and the research prototype -- distributed free over the Internet -- gained an estimated two million users in the following year. In April 1994 the principal architect of Mosaic was one of the founders of a commercial company, Mosaic Communications (renamed Netscape Communications in November 1994), which is now said to provide the navigational software for 70 per cent of Internet hosts.[xii]

With the growing use of the Internet, and the increasing number of commercial users, the pricing for access and use of the Internet needed to be reformed. By 1995 some two thirds of Internet traffic was estimated to be internal data transfers within corporations as they recognised the potential for applying the technology to increase efficiency and create new business opportunities.[xiii] Anthony Rutkowski, the Executive Director of the Internet Society says the Internet is made up of a public Internet and a private enterprise Internet, with the latter having four to five times the number of registered Internet addresses.[xiv] At the same time a number of commercial alternative backbones had emerged in the US including Alternet, PSINet and SprintLink. Accordingly NSF seed funding for backbone networks was gradually reduced and the NSFNET backbone was shut down on 30 April, 1995. By this time there were at least 14 national and super regional high speed TPC/IP networks in the US.[xv] By October 1995, for all practical purposes, 99 per cent of the Internet was being paid for by the people who use it.[xvi]

While defence, academic and research institutions played an important role in the development of the Internet, they were not well placed nor did they have the skills and incentives to create widespread access to Internet services. Yet expansion of access to the Internet, or like services, is fundamental to the information infrastructure policies of OECD governments. Even with the impressive growth rate of Internet users only a small percentage of people in the OECD area can access the available services. By July 1995 there were 6.7 Internet hosts per 1 000 people in the OECD area **(Table 4)**. If these hosts provided access to an average of 7 people each, it is possible that only 1 in 20 inhabitants in Member countries could access some part of the Internet. Showing OECD averages, however, tends to obscure the very uneven speed of development throughout different Member countries.

The OECD countries leading the development of expanded access to the Internet include Finland, Iceland, Norway and the US. In these countries the ratio of access to the Internet exceeds one in 10 inhabitants. Several other countries including Australia, New Zealand, and Sweden are approaching this benchmark. On the other hand for the ten OECD countries with the lowest penetration of Internet hosts, the ratio is greater than one in 50 inhabitants. If these countries wish to take advantage of the enabling capabilities of networks such as the Internet, to implement information infrastructure initiatives, they need to urgently address the extent to which the underlying communication policies influence current growth rates. This raises the question of market structure and the relative performance of those countries where there is competition or monopoly control of the PSTN.

Here lies the major barrier for Governments wishing to exploit the capabilities of information infrastructure networks. Access to the Internet is being increasingly commercialised but in most OECD

countries there is still monopoly control of the facilities through which Internet Access Providers (IAPs) and customers connect. Of the 25 Member countries of the OECD only eight allow telecommunication infrastructure competition in fixed network facilities.[xvii] In the other 17 OECD countries IAPs, and their customers, have no choice in who provides the telecommunication network facilities. This fact is critical because, on average, the penetration of Internet hosts is five times greater in competitive than monopoly markets. When the rate of growth is compared, weighted by the time since service commenced, Internet access in countries with telecommunication infrastructure competition has grown six times faster than monopoly markets. Accordingly six of the nine countries with the highest penetration of Internet hosts have competitive provision of infrastructure.

To the extent that IAPs are classed as value added services suppliers, under the existing communication regulation in all OECD countries, the market is technically open. Already more than 2 000 entrepreneurial and innovative IAPs have emerged to develop the Internet access market.[xviii] In some OECD countries there is evidence that competition amongst IAPs is lowering prices. For example, one study of prices in the US found that the average price of a 56 kbit/s access from IAPs had a monthly price of $550 in 1995, some 30 per cent less expensive than 1994.[xix] In other words competition amongst IAPs is driving their prices toward costs, much of which is made up by payments to PTOs. Yet it is also necessary to remember that, in this instance, the price mentioned excludes the direct payment by a user to the PTO for a leased line between the customer's premises and the IAPs facilities. This cost to users has not witnessed similar price reductions because competition is more intense at the national level than the local level in the US. An increasing number of US States are acting to open local markets and by November 1995 some 35 States allowed some form of competition compared to 17 States two years previous.[xx] In countries without infrastructure competition the need for policy reform is even more pressing because when IAPs pay higher charges to PTOs they must pass these costs on to business and residential users.

As with any communication service there may be many reasons why growth rates vary from one country to another. These may include, among others, demographic, economic, geographic and historical factors. For example, if there are large differences in the level of basic literacy (and at another level basic IT literacy) between Members countries this could be an important factor in Internet penetration. Similarly if large differences existed between the age of populations, or in sectoral employment, in Member countries this may also contribute to the pace of take up of Internet or other on-line services. On the other hand rapidly growing gaps are emerging between OECD Member countries with high Internet penetration rates and those with very low rates. In Finland a user is four times as likely to have access to the Internet as the OECD average and eight times the EU area average. In respect to the Internet two additional factors have been forwarded to explain different growth rates, namely the penetration of personal computers and the relevance of content.

Impact of Terminal Equipment on Internet Growth

The influence of PC availability would seem intuitively obvious with the argument being that if there are more PCs the opportunities for connection to the Internet are higher. In practice this is difficult to prove because the available data for the penetration of PCs are mostly estimates and there are no reliable data available on the number of PCs with modems or connected to local area networks.

Despite the high level of caution which must be used in interpreting these data **Table 5** provides one indication of the impact PC penetration may be having on Internet expansion **(Box 1).** For some the penetration rate of PCs is only one of many factors to be taken into consideration. Anthony Rutkowski

has stated, "Minimal regulatory constraints on Internet service providers, low cost private leased lines, low cost local access lines, reasonably priced computers, individuals and institutions skilled in designing and operating Internets, individuals capable of effectively using Internets and time of entry into the Internet world, all modulate the rate of diffusion."[xxi]

Irrespective of what influence the penetration rate of PCs has had in the past, it is the efficiency of networking that is the fundamental premise for future growth. A range of new customer premise equipment ranging from Compact Disc Players, 'Set Top Boxes' (both using televisions as display screens) and Computer Game Machines are being developed with Internet access capabilities.[xxii] In November 1995, it was reported that Sony Corporation, Sega Enterprises, NTT and other partners would develop a joint venture to enable video games, karaoke and other entertainment services to be accessed on-line using computer game machines as terminals.[xxiii] At the beginning of 1996, ViewCall Europe plans to launch a 'set top box' for Internet access priced at US$250.[xxiv] ViewCall's 'set top box' can be connected to both a television and a telephone line to display broadcast quality images on screen. Users can navigate the system by using a handset not unlike a remote control for a television. Moreover telephones capable of Internet e-mail applications will soon make their debut. What all these technologies share is the potential to dramatically reduce the cost of terminal equipment necessary to access the Internet for particular services. In the longer term, mobile modems, currently being tested in a number of US universities, could allow access to the Internet via radio waves.[xxv]

In the face of such developments some information technology manufacturers believe the PC has a limited future because less expensive and simplified 'computer like' terminals will take advantage of the improved capabilities of networks to provide Internet access. One such network capability would be higher access speeds enabling users to download the software required to run applications as necessary using programs such as Sun Microsystem's "Hot Java" (discussed later).[xxvi] Louis Gerstner, the CEO of IBM has stated,

> "...we've come to understand that client server is, in fact, not a full-blown phase of computing. It's really the leading edge of what will be the next phase: network-centric computing. There are a lot of forces propelling us to this phase ... If you look at microprocessors, memory, software, storage ... the laggard of the technology family has been communications technology. PCs and servers have become enormously powerful, but they communicate through the equivalent of soda straws. Well, all of that is changing. Very powerful networking technologies -- principally ATM -- will be to the next phase of computing what the microprocessor was to the current phase. But I think the most profound implication of this new technology is that it will change the nature of computing itself. If the communications link between the PC and the network is cheap enough, fast enough and has virtually unlimited bandwidth, why not migrate a lot of the functions that currently reside inside the PC to the network -- the applications, the data, the storage, and even some of the processing?"[xxvii]

On the other hand it is the relative inefficiency of current networks, and the potential for new applications to consume greater bandwidth, the expense of using PTO networks, and concerns about security which convinces a number of industry leaders of the ongoing need for computing power to be provided on the desktop rather than via telecommunication mainlines.

Where intelligence and functionality should best reside in networks, between the core (telecommunication exchanges) and the extremities (in all types of user equipment) is not a new debate in the communication and information technology industry. In the past it has typically been a matter of dispute between PTOs that owned core network facilities and the 'computer industry'. Yet today the focus has shifted to whether intelligence and functionality will reside at the end of networks in networking

technologies, such as those made by the Oracle Corporation, or in personal computers with software and hardware supplied by firms such as Microsoft and Intel.[xxviii]

One reason for the dynamism surrounding the Internet, and the enabling software being developed to harness its potential, is that all the specifications and technical information have been made freely available. Vinton Cerf, a pioneer of the Internet from MCI, has pointed out that:

> "...because software is readily available to people in universities, we find a great deal of experimentation with new ideas for using the network simply because so much of this material is available. It's quite different from the telephone system where not very many people have access to the insides of the programming of telephone switches. And so there is a major distinction here because the Internet system is being driven by forces outside of the network. Its driven by people writing software in the computers that sit on the outside. Just as examples, the World Wide Web, IP telephone from VocalTec, the CU-SeeMe software from Cornell University for video conferencing, the Java software from Sun Microsystems all emerge from the outside of the network..."[xxix]

Whichever direction these developments take, it is the efficiency of networks that will determine the ability of business and residential users to take advantage of less expensive terminal equipment and the new capabilities of PCs. Telecommunication infrastructure competition is a tool available to policy makers to take advantage of this situation.[xxx] This is true both of efficiency in terms of technological capabilities such as high speed access and in the pricing of existing and future network capabilities. For example competition from alternative infrastructure providers, such as cable television operators (hereafter cable communication) racing to develop and deliver cable modems to the market, could increase the capacity available for users and spur innovation in PTO networks. At the same time the discipline and innovation cable communication companies can bring to the pricing of access to the Internet, and like services, will force PTOs to be more responsive to customer demands.

Encouraging Internet Content and Applications

In times past content questions have arisen more in terms of broadcasting than telecommunication policy making. How the Internet should be defined, given the trend of technological convergence, is a moot point and is discussed later in this document. While it would be expected that relevant content will promote the attractiveness of the Internet, it is often overlooked that a major reason that a sufficient amount of local content is not available in some countries is because domestic producers and users do not have efficient access to networks.

If Member countries do not provide efficient access for information and service suppliers then consumers will increasingly meet their needs from foreign producers. The policy choice is between a vicious and a virtuous circle with efficient information infrastructure access as a key premise. Potentially, this choice will impact on the whole range of information infrastructure initiatives. For example the potential for information infrastructure to improve education will not occur if educational institutions, businesses wanting to upgrade employee skills and individuals do not have efficient access to networks. As Apple Computer's Doug McLean has pointed out:

> "In the US alone there are 3 000+ medical and scientific journals, many of which have struggled for years with the costs required to publish on a regular basis. As the cost of paper has doubled in the last twelve months, many of these journals can not afford to publish at all. There is very

> little doubt that many, if not most, of these journals will soon be available only on the Web; fully indexed with links to previous editions and to other journals and sources that deal with similar subjects."[xxxi]

Simply put those countries that do not provide efficient access for users will not develop a market attractive to national suppliers. FCC Commissioner Susan Ness has noted:

> "Internet service is relatively inexpensive in the US, in part because there is robust competition between service providers and carriers. Lower prices from the carriers directly translates into lower prices for consumers. For example, users in one European country pay almost four times the price for access that US users pay. In fact, US prices are so much lower that users in some countries are putting their home pages on US service providers. To browsers it looks as though the home page is located in their country, but in fact it is based thousands of miles away in the US."[xxxii]

Similarly if businesses in some OECD countries can not access the Internet at competitive prices they will be at a disadvantage in trying to sell products to a global market. For example, it has been reported that 30 per cent of the Internet Shopping Network's customer base lies outside the US.[xxxiii] This raises the question of whether consumers are turning to offshore web pages because merchants in their own country, for whatever reason, do not have efficient access to the Internet.

Both Iceland and Finland have demonstrated, by their high penetration rates, that providing efficient infrastructure access for national content providers can assist in the attractiveness of the Internet for domestic users **(Table 6)** . At the same time the content question, particularly in relation to language, may be a distraction in terms of initial growth rates. If most data transferred over the Internet occurs within individual business enterprises, and assuming the vast majority of this traffic does not cross national borders, the question of language is of lesser importance. Certainly in terms of the initial use of American Standard Code for Information Exchange (ASCII) formats, some countries were at an obvious disadvantage since part of their alphabet, language characters or even the ability to write from left to right were not supported. It is only now that technology is catching up with demand. For example, in November 1995, Accent Software released a multilingual browser with full support for browsing Japanese Web pages under any language version of Microsoft Windows. Nevertheless some countries have delivered efficient access to business for enterprise networking, even in the face of all elements of their language not being supported. Scandinavian countries are leaders in expanding access to the Internet.

Some of the main business applications of the Internet are shown in **Table 7**. Over time the Internet may evolve into a widely used electronic marketplace, and if so suppliers of goods and services, and their customers (*e.g.* residential users), will depend crucially on efficient access. Leading edge businesses are already embracing the Internet to enhance the services they can offer customers. For example the Internet pages of Federal Express allow customers to monitor where parcels are throughout the entire process of delivery.[xxxiv] Instead of seeing new communication capabilities as a threat to the market for the 521 million document sized packages people in the US send every year (or perhaps because of the increased competition that may be provided), companies such as Federal Express are using the Internet to add value to their services.[xxxv] Another example is provided by the insurance industry. In the UK, an Internet user can obtain quotes for motor vehicle insurance within seconds, from five different companies, by inputting data on the type of car and driver history.[xxxvi] In short, the Internet has tremendous potential for increasing the efficiency of markets by improving the information available to buyers and sellers.

A survey conducted by CommerceNet/Nielson, released in October 1995, found more than 2.5 million people in the US and Canada had purchased products and services over the WWW.[xxxvii] While still relatively small, compared to other applications for individuals and business users, the percentage of people to have used the Internet for purchasing is significant and growing. AT&T has stated that it wants to make the Internet as widely used for commerce as 800-services are today.[xxxviii] The company handles 15 billion toll free service number calls per year (*i.e.* 800 numbers). AT&T says that in 1994, US$350 million in goods and services changed hands over the Internet compared to US$100 billion in the '800 commerce market' and US$2.7 billion in the home television shopping industry. Competitive markets can best abet such developments and encourage PTOs to find new sources of revenue. In fact, by April 1994, AT&T's free phone traffic exceeded the paid business telephone usage and because of a shortage of 800 numbers, '888' has been introduced as an additional prefix.[xxxix]

At the present time business is using the Internet more to gather information, including home page based surveys, internal communication and as a tool to collaborate and communicate with others. It is this function of enterprise to enterprise network that has prompted calls for Electronic Data Interchange (EDI) to evolve in a more Internet oriented direction.[xl] According to IBM "...most of the Internet investments and spending today is actually done within enterprises and institutions and that by such they are enabling employees within an organisation to communicate and work together as well as joining up with outside organisations and customers."[xli] The corollary is that communication networks are increasingly forming a fundamental platform for national competitiveness. In this environment no one company has all the best ideas, skills and solutions to meet national requirements.

For this very reason the growth of the Internet has in many ways astonished leading communication, information services and technology, software, media and entertainment companies. AT&T openly admits "Frankly, we at AT&T were surprised by this development. We knew that on-line services have the potential for revolutionising the way people work, play and interact with each other. But we didn't recognise just how enthusiastically computer users would respond to the World Wide Web and the new graphical interfaces for browsing the Web."[xlii] Bill Gates, the chairman of Microsoft, has stated "The Internet is kind of like a gold rush, the amount of excitement, the number of companies, it's really unbelievable".[xliii] Gates added the Internet is growing faster than any phenomenon he has seen and says it is his company's number one priority.[xliv] According to Microsoft Corporation, "We do believe the Internet is the most important phenomenon in the computer industry for the last 15 years ... We believe application development on the Internet, whether it is reaching out to an end customer or whether it is between business -- is going to be the next great wave of PC and computer industry applications. We believe, therefore, for Microsoft all our applications and all our services must embrace the Internet."[xlv] IBM says they: "... fundamentally believe that the Internet will become the future network of networks and, maybe more substantially, we believe IP is emerging as the common architecture that will connect governments, institutions, private enterprise and individuals."[xlvi] Sun Microsystems have an interesting perspective on how software development and presentation may evolve because of the Internet. Geoffrey Baehr, Sun's Chief Networking Officer, has stated:

> "...World Wide Web browsers like Netscape and Mosaic and such have become the universal graphical user interface for the next 20 years. Every commercial system that I have seen in the last six months, are rewriting their system to use a World Wide Web browser to control the application, and to present the data -- Network management systems, Telco managements ...."[xlvii]

Just as many industry leaders have been caught by surprise by the pace of developments, in which an entire industry direction can change in a six month period, public policy is inevitably lagging some way behind. In a growing number of areas, such as intellectual property, defamation, security, privacy, law enforcement and the regulation of activities such as gambling and pornography, Internet

developments are raising many concerns. All these issues raise important questions for governments but go far beyond the scope of this document. Still it is worth noting that many of the same issues have been raised by other technologies, which are used to communicate information, and despite the best efforts to minimise the harm which may arise, problems continue to exist.

On the other hand it is possible that some of the concerns that have been raised as problems will, as technologies are developed to deal with them, turn out to as strengths of the Internet. One example, in the area of security, is concerns about the potential for fraud over the Internet. The potential for the theft of credit card numbers over the Internet has been described as "phenomenal at this point", by a member of the US Federal Bureau of Investigation's new Computer Intrusions unit.[xlviii] A recent survey by Ernst and Young highlighted a growing awareness of this problem amongst business when it found that 80 per cent of the companies surveyed -- including Amoco, Boeing, Exxon, IBM and Motorola -- had appointed at least one full-time information security director.[xlix] Unless business and consumers are confident about the security of transactions over the Internet it will be a significant barrier to the development of on-line commerce. Several new forms of payment and encryption systems are being developed, which proponents say will meet these concerns.[l] With these developments in mind Internet fraud, when the Internet commerce market reaches sizeable proportions, is optimistically projected by Forrester Research to total US$1 per US$1 000 of transactions. This compares to current rates of US$1.41 per US$1 000 for credit cards, US$16 per US$1 000 for toll call fraud and US$20 per US$1 000 for cellular telecommunication fraud.[li]

Similarly concerns have been raised about children accessing undesirable content through the Internet. In response a number of software companies have developed products which shield what can be accessed by individual PCs by blocking particular words or phrases. A list of words or phrases can be entered and edited by parents or educators. One such product -- 'Net Nanny' -- made by Trove, a Canadian software security company, has the ability to refuse access or shut down the system if it detects undesirable traffic. In this sense an Internet product may enable parents or educators to have greater control over what children are accessing than many other communication systems.

Despite the attention many of these issues receive in the media, because of the high profile of the Internet, sometimes justifiably, in most cases the immediate challenges for communication policy makers are the underlying telecommunication regulatory regimes. Perhaps this is why, Vinton Cerf, widely credited as the 'father of the Internet' has stated:

> "....the Internet, despite all the cyberspace hype, is embedded in the real world, and I quite agree that there are many laws and conventions that we observe, both nationally and internationally, that still apply to the interactions that take place through the Net ... most of the difficulties and complaints that you hear about regulation are related to regulatory impact on telecommunications as opposed to the other legal frameworks ... Here I think is probably the biggest sensitivity -- it is not so much towards other kinds of libel and so forth, but it's a question of regulatory reform in the telecommunications environment and the maintenance of a high degree of competitiveness in all of these various domains."[lii]

Table 1. **History of NSFNET Growth by Networks (1988-1995)**

	Jul-88	Jul-89	Jul-90	Jul-91	Jul-92	Jul-93	Jul-94	May-95
US Nets	208	551	1291	2074	3898	8294	20521	28470
US (per cent)	96	85	75	67	65	59	57	56
Total Non-US Nets	9	99	436	1012	2133	5827	15632	22296
Non-US (per cent)	4	15	25	33	35	41	43	44

Total Nets	217	650	1727	3086	6031	14121	36153	50766

Source: Merit

Table 2. **NSFNET Network Growth By OECD Country**

	Initial NSF Connection	Sep-91	Jun-92	Jun-93	Jun-94	Jan-95	May-95
Australia	May-89	96	120	189	401	569	1875
Austria	Jun-90	14	31	84	143	213	408
Belgium	May-90	3	7	14	55	70	138
Canada	Jul-88	144	197	429	859	1578	4795
Denmark	Nov-88	3	6	8	22	35	48
Finland	Nov-88	12	18	102	210	360	643
France	Jul-88	95	160	453	805	1078	2003
Germany	Sep-89	144	215	445	777	884	1750
Greece	Jul-90	3	6	11	36	46	105
Iceland	Nov-88	1	1	13	29	29	31
Ireland	Jul-90	3	10	24	56	86	168
Italy	Aug-89	30	80	169	270	306	506
Japan	Aug-89	73	105	257	601	868	1847
Luxembourg	Apr-92	0	1	4	9	19	59
Mexico	Feb-89	5	9	34	64	96	126
Netherlands	Jan-89	52	68	131	207	251	406
New Zealand	Apr-89	15	18	50	119	181	356
Norway	Nov-88	8	21	52	132	141	214
Portugal	Oct-91	0	12	35	66	71	92
Spain	Jul-90	7	18	39	96	128	257
Sweden	Nov-88	25	37	87	164	230	415
Switzerland	Mar-90	35	50	87	155	190	324
Turkey	Jan-93	0	0	9	33	53	97
UK	Apr-89	44	128	420	730	769	1436
US	Jul-88(1)	1758	2485	5571	11732	15920	28470
OECD Total		2570	3803	8717	17771	24171	46569
World Total		2958	4356	9239	19214	26274	50766
OECD/World (per cent)		87	87	94	92	92	92

1. This is the date Merit began managing the NSFNET backbone.

Source: Merit

Table 3. **Internet Hosts in the OECD Area**

	Jul-91	Jul-92	Jul-93	Jul-94	Jan-95	Jul-95	Jan-96
Australia	21774	48639	82157	127514	161166	207426	309562
Austria	2148	6489	11741	20130	29705	40696	52728
Belgium	343	1532	4361	12107	18699	23706	30535
Canada	18582	38929	70977	127516	186722	262644	372891
Denmark	1559	2733	6160	12107	25935	36964	51827
Finland	8761	15718	27033	49598	71372	111861	208502
France	9290	19192	39860	71899	93041	113974	137217
Germany	21109	43907	91987	149193	207717	350707	452997
Greece	216	616	1317	2958	4000	5575	8787
Iceland	194	400	1259	3268	4735	6800	8719
Ireland(1)	100	624	1728	3308	6219	9941	15036
Italy	1656	5147	14746	23616	30697	46143	73364
Japan	6657	15757	35639	72409	96632	159776	269327
Luxembourg	0	80	186	420	614	1516	1756
Mexico	220	789	2093	5164	6656	8382	13787
Netherlands	7382	21105	35629	59729	89227	135462	174888
New Zealand	1193	1831	3165	14830	31215	43863	53610
Norway	8264	14354	25151	38759	49725	66608	88356
Portugal	0	1318	1956	4518	5999	8748	9359
Spain	979	3603	8773	21147	28446	39919	53707
Sweden	11800	21021	31449	53294	77594	106725	149877
Switzerland	9918	17188	30697	47401	51512	63795	85844
Turkey	0	0	415	1204	2643	2790	5345
UK	6990	37776	89788	155706	241191	291258	451750
US	427817	733117	1257408	2044716	3178266	4268648	6053402
OECD Total	566952	1051865	1875675	3122511	4699728	6413927	9133173

1. Data for Ireland in July 1991 is an estimate.

Source: Network Wizards

Table 4. **Internet Hosts per 1000 inhabitants**

	Jul-91	Jul-92	Jul-93	Jul-94	Jan-95	Jul-95	Jan-96(1)	Internet Hosts weighted by time since first connection to NSFNet(2)
Australia	1.2	2.8	4.7	7.2	9.1	11.7	17.5	0.52
Austria	0.3	0.8	1.5	2.5	3.7	5.1	6.6	0.27
Belgium	0.0	0.2	0.4	1.2	1.9	2.4	3.1	0.13
Canada	0.7	1.4	2.5	4.4	6.5	9.1	13.0	0.36
Denmark	0.3	0.5	1.2	2.3	5.0	7.1	10.0	0.29
Finland	1.7	3.1	5.3	9.8	14.1	22.1	41.2	0.91
France	0.2	0.3	0.7	1.2	1.6	2.0	2.4	0.08
Germany	0.3	0.5	1.1	1.8	2.6	4.3	5.6	0.20
Greece	0.0	0.1	0.1	0.3	0.4	0.5	0.8	0.03
Iceland	0.7	1.5	4.8	12.6	18.2	26.2	33.5	1.07
Ireland	0.0	0.2	0.5	0.9	1.7	2.8	4.2	0.15
Italy	0.0	0.1	0.3	0.4	0.5	0.8	1.3	0.04
Japan	0.1	0.1	0.3	0.6	0.8	1.3	2.2	0.06
Luxembourg	0.0	0.2	0.5	1.1	1.6	4.0	4.6	0.34
Mexico	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.004
Netherlands	0.5	1.4	2.3	3.9	5.8	8.9	11.4	0.37
New Zealand	0.3	0.5	0.9	4.3	9.0	12.6	15.4	0.55
Norway	1.9	3.3	5.8	9.0	11.5	15.5	20.5	0.64
Portugal	0.0	0.1	0.2	0.5	0.6	0.9	0.9	0.06
Spain	0.0	0.1	0.2	0.5	0.7	1.0	1.4	0.06
Sweden	1.4	2.4	3.6	6.1	8.9	12.2	17.2	0.50
Switzerland	1.4	2.5	4.4	6.8	7.4	9.2	12.4	0.47
Turkey	0.0	0.0	0.01	0.02	0.04	0.05	0.1	0.01
UK	0.1	0.7	1.6	2.7	4.2	5.0	7.8	0.22
US (3)	1.7	2.9	4.9	7.9	12.3	16.6	23.5	0.65
OECD	0.6	1.1	1.9	3.2	4.9	6.7	9.5	0.01
EU Area	0.2	0.5	1.0	1.7	2.5	3.6	5.1	0.01
Infrastructure Competition	1.0	1.8	3.2	5.2	8.0	10.8	15.6	0.06
Infrastructure Monopoly	0.1	0.3	0.6	1.0	1.4	2.1	2.7	0.01

1. Weighted by 1993 population
2. Internet hosts divided by the number of days since the first connection per 1000 inhabitants (growth to July 1995).
3. For the US the date Merit began managing the NSFNET backbone is used as a proxy to determine growth over time.

Source: Network Wizards, OECD

Table 5. **Internet Hosts and Personal Computer Penetration**

	ITU Estimated PCs, 1994	PCs per 100 inhabitants	Hosts per 100 PCs (1)	Internet Hosts per 100 Inhabitants
Australia	3870000	21.92	5.36	1.17
Austria	850000	10.64	4.79	0.51
Belgium	1300000	12.99	1.82	0.24
Canada	5100000	17.74	5.15	0.91
Denmark	1000000	19.27	3.70	0.71
Finland	810000	15.99	13.81	2.21
France	8060000	13.98	1.41	0.20
Germany	11650000	14.35	3.01	0.43
Greece	300000	2.89	1.86	0.05
Iceland	n.a.	n.a.	n.a.	2.62
Ireland	490000	13.76	2.03	0.28
Italy	4121000	7.22	1.12	0.08
Japan	15000000	12.03	1.07	0.13
Luxembourg	n.a.	n.a.	n.a.	0.43
Mexico	2100000	2.30	0.40	0.01
Netherlands	2400000	15.69	5.64	0.89
New Zealand	669000	19.22	6.56	1.26
Norway	820000	19.03	8.12	1.55
Portugal	490000	4.96	1.79	0.09
Spain	2750000	7.04	1.45	0.10
Sweden	1500000	17.21	7.12	1.22
Switzerland	2050000	21.61	3.11	0.92
Turkey	530000	3.45	0.53	0.00
UK	8800000	15.22	3.31	0.50
US	77500000	30.05	5.51	1.66
OECD	152490000	15.82	4.21	0.67

1. Using host data for July 1995.

Source: ITU, Network Wizards, OECD

Table 6. **Internet Host Penetration Ranking of OECD Countries**

	Jul-91	Jul-92	Jul-93	Jul-94	Jan-95	Jul-95	Jan-96	
1	Norway	Norway	Norway	Iceland	Iceland	Iceland	Finland	41.2
2	Finland	Finland	Finland	Finland	Finland	Finland	Iceland	33.5
3	US	US	US	Norway	US	US	US	23.5
4	Switzerland	Australia	Iceland	US	Norway	Norway	Norway	20.5
5	Sweden	Switzerland	Australia	Australia	Australia	New Zealand	Australia	17.5
6	Australia	Sweden	Switzerland	Switzerland	New Zealand	Sweden	Sweden	17.2
7	Iceland	Iceland	Sweden	Sweden	Sweden	Australia	New Zealand	15.4
8	Canada	Netherlands	Canada	Canada	Switzerland	Switzerland	Canada	13.0
9	Netherlands	Canada	Netherlands	New Zealand	Canada	Canada	Switzerland	12.4
10	New Zealand	Austria	UK	Netherlands	Netherlands	Netherlands	Netherlands	11.4
11	Denmark	UK	Austria	UK	Denmark	Denmark	Denmark	10.0
12	Austria	Germany	Denmark	Austria	UK	Austria	UK	7.8
13	Germany	New Zealand	Germany	Denmark	Austria	UK	Austria	6.6
14	France	Denmark	New Zealand	Germany	Germany	Germany	Germany	5.6
15	UK	France	France	France	Belgium	Luxembourg	Luxembourg	4.6
16	Japan	Luxembourg	Luxembourg	Belgium	Ireland	Ireland	Ireland	4.2
17	Belgium	Ireland	Ireland	Luxembourg	Luxembourg	Belgium	Belgium	3.1
18	Ireland	Belgium	Belgium	Ireland	France	France	France	2.4
19	Italy	Portugal	Japan	Japan	Japan	Japan	Japan	2.2
20	Spain	Japan	Italy	Spain	Spain	Spain	Spain	1.4
21	Greece	Spain	Spain	Portugal	Portugal	Portugal	Italy	1.3
22	Mexico	Italy	Portugal	Italy	Italy	Italy	Portugal	0.9
23	Luxembourg	Greece	Greece	Greece	Greece	Greece	Greece	0.8
24	Portugal	Mexico	Mexico	Mexico	Mexico	Mexico	Mexico	0.2
25	Turkey	Turkey	Turkey	Turkey	Turkey	Turkey	Turkey	0.1

Source: OECD, Network Wizards

Table 7. **Internet Applications in the US and Canada**

Total WWW Use (Application)	Per cent of Individual respondents aged over 16 to ever used the WWW	Business WWW Use (Application)	Per cent of Business Respondents to ever use the WWW
Search for information on products/services	55	Collaborating with others	54
Search for information on companies/organisations	60	Publishing information	33
Search for other information	73	Gathering information	77
Purchase products or services	14	Researching competitors	46
Browse or explore	90	Selling products or services	13
		Purchasing products or services	23
		Providing customer service and support	38
		Communicating internally	44
		Providing vendor support and communications	50

Source: CommerceNet/Nielsen

Box 1: PC Penetration and the development of the Internet

There does seem to be some correlation between the number of PCs per 100 inhabitants, if it is taken to be a rough proxy for computerisation at a national level, and the number of Internet Hosts per 100 inhabitants **(Figure 1)** . Broadly speaking there would appear to be two groups within the OECD area. Those countries with a high penetration of PCs generally have a relatively high Internet host penetration and the opposite holds true for those countries with a low PC penetration rate. However of those countries with a leading PC penetration rate, Switzerland and Denmark have a lower penetration of hosts than might be expected while Norway and Finland have a higher penetration rate.

In those countries with mid range PC penetration rates France and Japan are doing less well than might be expected but Austria has a relatively high Host penetration rate relative to the number of PCs per 100 inhabitants. In France the impact of the Minitel system, acting as a substitute for some PC applications, may be one factor influencing growth rates. In Japan the limited ability of leading browsers to initially support Japanese language characters could also have been influential.

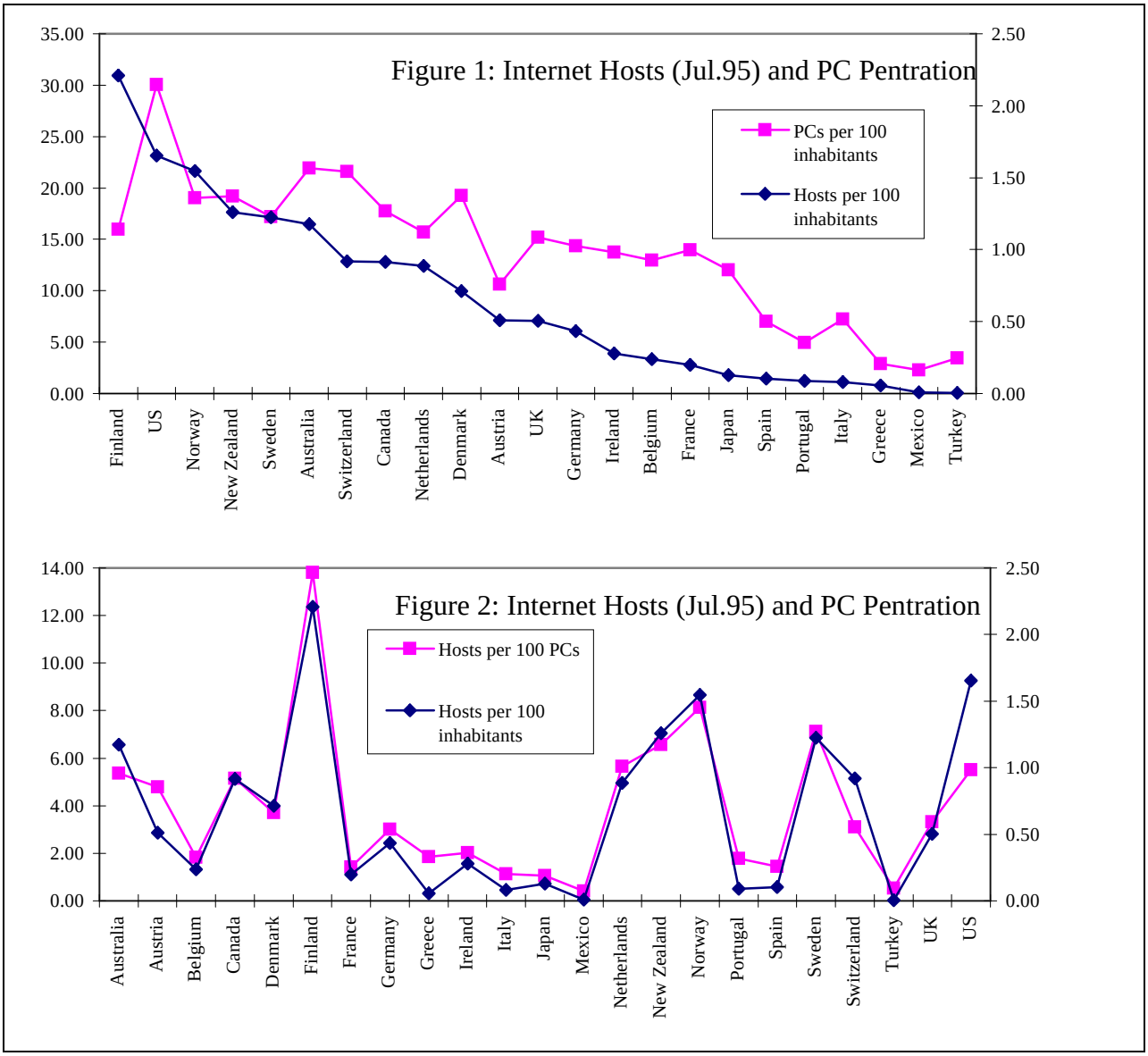
In times past the penetration of PCs has had little to do with communication because of the relatively low rate of PCs with modems. Of more interest today is the proportion of PCs that are connected to the Internet because this has a more likely relationship with a country's communication policy. For policy makers the key question is whether the existing regulatory framework encourages efficient networking for Internet users. One possible indicator of such developments is to compare the penetration of Internet hosts

per 100 PCs to the penetration of hosts per 100 inhabitants **(Figure 2)** . Another is to compare the penetration of PCs per 100 inhabitants to the number of hosts per 100 PCs **(Figure 3)** . **Figure 2**, as might be expected, reveals a fairly strong correlation with major interest being why the two lines diverge such as in the case of Austria, Greece, Switzerland and the US. **Figure 3** goes some way to providing suggested answers to these questions and hints at the way Internet access may develop as telecommunication markets are increasingly liberalised.

For those countries with telecommunication facilities competition Finland, Sweden and New Zealand appear be networking computers at a relatively high rate, with Finland providing the outstanding example. All these countries have among the highest relative rates of Internet access. The US, has a leading Internet access penetration rate and the highest number of PCs per 100 inhabitants. However a lower proportion of them were connected to the Internet by July 1995 than Finland, Sweden and NZ **(Figure 3)**. One reason for this is that the US led developments in the personal computer market, at a time when few PCs had modems.

The US Electronic Industries Association say that, in January 1995, 10 per cent of US households owned a modem while more than 30 percent of households owned a PC. A better comparison may be with those countries with the next highest rate of PC penetration such as Australia (2nd), Switzerland (3rd) and Denmark (4th). Here an interesting correlation emerges between infrastructure competition and networking computers at a higher rate, with the US and Australia ahead of Denmark and Switzerland. Indeed markets with telecommunication infrastructure competition would seem to be capable of sustaining extremely high rates of growth in the future as the local market for Internet Access becomes more competitive and innovative services make it more attractive for users to purchase new PCs (with modems) or other Internet access devices. In November 1995, a Dataquest survey found that 15 per cent of US households plan to buy a PC within one year, with slightly more than half being first time buyers.[liii]

In countries with PSTN monopolies Norway is the only country, amongst the leaders in Internet penetration, to have a relatively high proportion of available PCs connected (although data is unavailable for Iceland), with the next best performer being the Netherlands. In the case of Greece it would appear that the relatively low number of PCs per 100 inhabitants, and a flat rate for local PSTN access, has resulted in a relatively high percentage of Internet Hosts being connected. On the other hand the available evidence suggests that Belgium, Denmark, France, Germany and Switzerland have not taken advantage of their installed base of PCs and may have are large networking gap. The main point is that having a relatively large installed base of PCs is no guarantee of early take off of Internet access. If it was Denmark and Switzerland should be outperforming Finland and New Zealand.



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i For example Anthony Bay, General Manager of Microsoft Network Systems Group has stated that his company believes the Internet has become or is becoming, the Information Superhighway. Refer to his "Keynote Address given at Internet@Telecom 95", ITU, Geneva,7 - 8 October 1995.

ii Jeffrey K. Mackie-Mason, "What is the Internet", Telecommunication Information Resources on the Internet, http://www.spp.umich.edu/telecom/telecom-info.html, 11 July, 1995.

iii "The Accidental Superhighway: The Economist Survey of the Internet", *The Economist*, 1 July, 1995. p 9

iv Vinton Cerf, "Computer Networking: Global Infrastructure for the 21st Century", MCI, 1995.

v Sharon Gillet, "Public Policies to Encourage Cable and ISDN Residential Internet Access", INET 95, Hawaii, 1995.

vi A number of IAPs bundle the PTO charges for leased lines between the IAP and the customer's premises.

vii Mark Lottor, "Internet Growth (1981-1991), SRI International, January 1992.

viii US data is not precise because it includes a mix of 3 letter global domains in addition to the US domain.

ix Cerf, "Computer Networking: Global Infrastructure for the 21st Century", *Op.cit.*

x Sun Microsystems, "The Hot Java Browser: A White Paper", Sun Microsystems Homepage, The Internet 1995.

[xi] Netscape Communications, "Netscape Communications Corporation", Netscape Communications Homepage, Internet, 1995.

[xii] Kenneth Hart, "Netscape widens web", *Communications Week International*, 18 September 1995. p 82

[xiii] Refer "The Web as a corporate tool", *Communications Week International*, 18 September, 1995. p 14 and Hart, Op. cit. Interview with Anthony Rutkowski, Executive Director of the Internet Society, October 1995.

[xiv] Anthony Rutkowski, "Keynote Address given at Internet@Telecom 95", Geneva, 7 October, 1995.

[xv] Mackie-Mason, "What are backbone networks", *Op.cit.*

[xvi] Remark made by Vinton Cerf, "Session 1: State of the Internet", Panel Discussion, Internet@Telecom 95, Geneva, 7 October 1995.

[xvii] Some concerns have been expressed about the capacity of the Internet to deal with the growing number of users and the resulting increase in traffic. Paradoxically, the majority of OECD governments still restrict the number of infrastructure providers through monopoly or duopoly policies.

[xviii] See, for example a directory of IAP's entitled "The Lists" at http://thelist.com

[xix] Maloff Company, "1994-1995 Internet Service Provider Marketplace Analysis", Executive Summary, Malhoff Homepage, The Internet, January 1995.

[xx] "State Competition Moving Despite Federal Debates", Telecommunication Reports, 6 November 1995.

[xxi] Rutkowski, "Keynote address at Internet@Telecom 95" Op.cit.

[xxii] "Set top boxes bring home on-line services", The Sunday Times, 24th September, 1995. "Dutch giant stamps on to the Net: Philips offers on-line access to the World Wide Web through CD-i", . *net : the internet magazine*, Issue 12, November 1995. p 8.

[xxiii] "Sony, Sega, NTT to join in on-line entertainment venture", Nikkei English News, Nihon Keizai Shimbun, 9 November 1995 via the 'News Page' service.

[xxiv] "New $250 "Information Appliance" brings low-cost interactive TV and Internet access to consumers' homes through TV Set-Top box", Business Wire via NewsPage, 13 November 1995.

[xxv] "Mobem offers mobile access to Internet", *The Sunday Times*, 5 November 1995. p 6.13.

[xxvi] "Will your next computer be a tin can and a wire", *The Economist*, 14 October 1995. pp 85-86.

[xxvii] Lou Gerstner, "Keynote Address", Comdex/Fall'95, 13 November 1995.

[xxviii] Oracle, "Oracle embeds Adobe Acrobat "Amber" Technology into Oracle Websystem via Network Loadable Objects", *Press Release*, 30 October 1995.

[xxix] Vinton Cerf, "Keynote Address given at Internet@Telecom95", Geneva, 7 October 1995. Refer ITU home page at http://www.itu.ch

[xxx] "Telecommunication Infrastructure: The Benefits of Competition", ICCP No. 35, Paris, 1995. Refer also to the ICCP statement on the benefits of telecommunication infrastructure competition on the OECD/ICCP home page -- http://www.oecd.org

[xxxi] Doug Mclean, "The Internet: This Changes Everything", Keynote address given at Internet@Telecom 95, ITU, Geneva, 8 October 1995.

[xxxii] Remarks by Susan Ness at "Internet@Telecom 95: Session1: State of the Internet Panel Discussion", 7 October, 1995. Refer ITU home page at http:www.itu.ch

[xxxiii] Fred Hapgood, "Iphone: The Hype and Hope of Internet Telephony", *Wired Magazine*, October 1995. p 196.

[xxxiv] Gerstner, Op.cit.

[xxxv] "Overnight Shipping", *Wired Magazine*, October 1995. p 70.

[xxxvi] "Webwatch", *Sunday Times*, 19 November 1995. p 6.11.

[xxxvii] CommerceNet/Nielsen, "The CommerceNet/Nielsen Internet Demographics Survey: Executive Summary", 31 October 1995.

[xxxviii] AT&T, "An Online Strategy for the Age of the Internet", AT&T Home Page, August 1995.

[xxxix] John Petrillo, "Keynote Address given at Internet@Telecom 95" ITU, Geneva, 8 October 1995.

[xl] EDI News, "EDI Needs to Embrace Internet to Fulfil Commercial Promise", News Page, 30 October 1995.

[xli] Christian Thommessen, IBM, "Internet@Telecom 95 - Session 2: Internet Strategies of On-line Services", ITU, Geneva, 8 October 1995.

[xlii] Petrillo, Op.cit.

[xliii] Bill Gates, "Keynote Address at Comdex Fall 1995", 14 November 1995. Refer Microsoft Home Page. http://www.microsoft.com

[xliv] "Gates Sees 'Gold Rush" As Internet Takes Hold", *International Herald Tribune*, 13 November, 1995. p 13

[xlv] Bay, Op.cit.

[xlvi] Thommessen, Op.cit.

[xlvii] Geoffrey Baehr, "Keynote Address given at Internet@Telecom 95", ITU, Geneva, 8 October 1995.

[xlviii] Jim Erickson, "Crime on the Net a growing concern", *San Jose Mercury Centre*, 17 November 1995, http://www.sjmercury.com

[xlix] "Corporate America Wakes up to Importance of Computer Security", *PR Newswire via NewsPage*, 17 November 1995.

[l] For example the approaches of First Virtual Holdings or DigiCash are described by Lee Stein, CEO First Virtual Holdings Inc., and David Chaum, Managing Director of DigiCash, in their respective "Keynote Address given at Internet@Telecom95", ITU Geneva, 8 October 1995. Indeed use of the Internet is making possible payment to be made instantaneously by check. Under the 'OnLine Check' system customers input information from their cheque book, which is then encrypted and processed by OnLine and an actual cheque is delivered, ready for deposit, to the vendor overnight. The main advantage of this system is that there are 140 million cheque accounts in the US compared to 75 million credit card holders. Refer, "The first System for paying by check on the Internet developed by Denver Firm", PR Newswire via NewsPage, 13 November, 1995.

[li] McLean, Op.cit.

[lii] Remarks made by Vinton Cerf, "Internet@Telecom 95 - Session 2: Internet Strategies of On-line Services", ITU, Geneva, 8 October 1995.

[liii] "Dataquest Study Reveals 15 per cent of US Households Plan to Buy a PC within One Year", Dataquest Press release, 20 November 1995. refer http://www.dataquest.com