Unclassified **DSTI/ICCP/TISP(98)8/FINAL**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

OLIS : 04-May-1999
Dist. : 06-May-1999

Or. Eng.

DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY

DSTI/ICCP/TISP(98)8/FINAL
Unclassified

Working Party on Telecommunication and Information Services Policies

THE ROLE OF TELECOMMUNICATIONS AND INFORMATION INFRASTRUCTURES IN ADVANCING ELECTRONIC COMMERCE

77644

Document complet disponible sur OLIS dans son format d'origine
Complete document available on OLIS in its original format

Or. Eng.

FOREWORD

This Background Paper for the OECD Ministerial Conference "A Borderless World: Realising the Potential for Global Electronic Commerce" was discussed by the ICCP Committee and its Working Party on Telecommunication and Information Services Policies at their meetings on 14-17 September 1998, in which they agreed to its declassification through written procedure. The report was submitted to the Executive Committee and to the Council, who noted the intention of the Secretary-General to transmit the document as a background paper to the OECD Ministerial Conference to be held on 7-9 October 1998 in Ottawa, Canada.

This paper was prepared by Mr. Dimitri Ypsilanti and Mr. Jurgen Spaanderman of the OECD's Directorate for Science, Technology and Industry. It is published on the responsibility of the Secretary-General of the OECD.

TABLE OF CONTENTS

Tables

Figures

1. INTRODUCTION

Governments and the private sector have given high priority to the development of electronic commerce and to ensuring that appropriate frameworks are in place to facilitate the development and diffusion of new electronic commerce applications. The OECD in its work on electronic commerce has highlighted the essential requirements for effective international electronic commerce as:

- Building trust for users and consumers.
- Establishing ground rules for the digital marketplace.
- Enhancing the information infrastructure for electronic commerce.
- Maximising the benefits of electronic commerce.

Electronic commerce is concerned with business occurring over open networks[1]. A fundamental requirement for electronic commerce services and applications is the underlying communication infrastructure. Electronic commerce will not flourish without adequate infrastructure platforms that do not meet demand requirements, that are not made available in a timely and cost effective way, and that do not have appropriate conditions for access and use.

There are three main policy areas which governments need to address in the context of the role of information infrastructures in advancing electronic commerce:

- The development and diffusion of information infrastructures, nationally and globally.
- The conditions of access and use of infrastructures.
- Policies related to existing and new services and applications using infrastructures.

The focus of this paper is on the first two areas which relate to how the demand requirements of electronic commerce for communications networks can best be met, and the policies required to ensure the availability of infrastructures for users and suppliers of electronic commerce. The third issue, while playing an important role in electronic commerce, is much wider and is more appropriately dealt with separately.

OECD Ministers have already endorsed policy recommendations on Global Information Infrastructures-Global Information Society[2] which recognised that the development of networked-based information economies requires:

– The availability and diffusion of high speed networks.

– Non-discriminatory access to and use of infrastructure for customers and service providers.

– Interconnection and interoperability of infrastructure and services.

– Appropriate competitive safeguards.

This recognised that the development of infrastructures, and conditions of access are closely linked with the regulatory and policy frameworks presently in place which influence communication investment decisions and access to and use of these infrastructures. As such, their regulation can have an impact, both negative and positive, on the growth and diffusion of electronic commerce applications and services. This paper shows that it is necessary to examine the evolution in communication policies which may need to be put in place to accommodate this growth. The paper also stresses that the developments in technological and service convergence taking place in the communication sector are part of the process which facilitates the development of electronic commerce and new online applications. In this context, OECD countries should recognise the fact that they are now facing the challenges brought about by the development of convergence and that they should be prepared to tackle them. .

The success of electronic commerce will to a large extent depend on applications, services and purchases being more efficient, cost effective, and having greater utility to users than existing commerce applications. This implies that users and service providers must have access to electronic commerce without network delay, without unnecessary restrictions on access, and at prices which encourage network usage. The underlying infrastructure, its interoperability, its costs and subsequent prices charged to network-based services and network users are important in this respect.

2. CHANGING DEMAND STRUCTURES

The infrastructure requirements for electronic commerce are changing rapidly as electronic commerce applications develop and begin to diffuse. Growth in electronic commerce demand, linked with rapid changes in the structural characteristics of demand for communications services and infrastructures, have significant implications for the future supply of communication infrastructures, the usage patterns of communication networks, and their development. Existing networks were engineered for quite different demand structures and usage patterns. Obstacles in effectively meeting demand requirements because of inadequate network infrastructures, access and use conditions, and terminal equipment, will create disincentives to the growth of many of the *new types* of electronic commerce services being offered. It is necessary for policy makers to ensure that there are no obstacles to supply which could constrain effective demand and slow business and residential customers in migrating to these more advanced electronic commerce services which may provide users and suppliers more value-added than existing electronic commerce services.

The fundamental way that electronic commerce, and the digital communication markets that are being created are changing demand characteristics for communications infrastructures, is through altering the one-to-one specificity between services and infrastructures. Broadcast networks have been used in the past specifically for content, and the public switched telecommunication network (PSTN) mainly for voice. Electronic commerce and technology are creating the impetus to transform infrastructures so that they can handle a range of services and applications. This transformation in network infrastructures will result in them becoming the building blocks for a significant change in the market economy and economic structures[3].

The growth in demand for network resources by competing electronic commerce services is expected to be important. Of equal importance, however, is the increasingly strategic role of networks for company competitiveness, both for intra-company organisation, management and production, and for integrating through networks suppliers and markets with enterprises.

Demand considerations for electronic commerce are crucial both in terms of assessing the longer term growth of network capacity, and in the technological structure and configuration of this capacity. Although supply can precede, and to some extent stimulate demand, it can also be extremely costly to invest in network capacity when there are insufficient electronic commerce applications and insufficient effective demand. For this reason it is important that countries have a coherent and all-encompassing policy for electronic commerce which facilitates both demand growth and future policy stability for electronic commerce, as well as the appropriate market structure, and to ensure that investment takes place in the necessary broadband capacity.

It is also important for the success of electronic commerce to rapidly build up a threshold of users necessary to sustain the economic viability of online services. For this reason issues such as building trust for users and consumers and establishing ground rules for the digital marketplace are important in that they help overcome uncertainty and in turn stimulate demand as well as ensure that early entrants remain in the online market. Although these market safeguards are necessary for infrastructure, maximising the number of users requires maximising interconnection and interoperability at the network and service level. Full interconnection and interoperability allows users to engage in commercial transactions via local infrastructures of the user's choice, either fixed or mobile, high or low bandwidth and allows application providers to choose the most optimal infrastructure for providing services.

Demand and infrastructure

Existing infrastructures required for electronic commerce have three main potential platforms: the public switched telecommunication and data network (fixed networks which include wireless in the local loop), the broadcasting infrastructures, and mobile infrastructures (both cellular as well as satellite networks). These infrastructures, both wireline and wireless, despite differences in network topology, bandwidth, performance and reliability, provide the basis for the high speed local loops and backbone infrastructures which customers and service suppliers will rely on for access to electronic commerce services and applications. These networks also offer different means of access which would allow users and service suppliers to choose how they access and use electronic commerce.

Choice is crucial because:

- Electronic commerce, including the underlying infrastructure platforms, must develop in a competitive environment to ensure price efficiency, high quality of service and rapid diffusion of applications and networks.
- Service suppliers can determine which infrastructure platform provides them with the best network architecture for their specific requirements.
- Customer requirements are quite different -- they range from large users to residential customers.
- Customers need flexibility in how they access and participate in electronic commerce, which can only be provided through network choice.

The complementary goals of facilitating user choice and encouraging the build-up of various infrastructure platforms to support electronic commerce applications provides a strong case for ensuring adequate regulatory structures (see below).

For everyday transactions the three infrastructure groups mentioned above can be viewed as *substitutes*. For example ordering a book is possible over all these infrastructures. If the user has to choose between infrastructures, then criteria such as price, log-on time and user interfaces of these infrastructures becomes important. But there is also *complementarity* between some of the infrastructures. For example, when travelling from work to home commercial transactions can be made over a mobile phone. The advantage of mobility which allow transaction to be undertaken at the users convenience probably compensates for the limitation in the user interface resulting from lower bandwidth. For certain groups of users, for example business-to-business, high bandwidth applications will have to be undertaken so that choice may be limited. An indicative comparison on the relative bandwidth potential and the main advantages of different infrastructures is shown in Table 1.

Table 1. Characteristics of the three main infrastructures

Infrastructure vs. characteristic	Bandwidth at present	Bandwidth potential	Main advantage for electronic commerce
Fixed copper	medium	high	high penetration & quality
Mobile (incl. wireless)	low	medium	mobility
Broadcasting (incl. satellite, CATV)	high downstream, low or no upstream	very high downstream medium upstream	high bandwidth

Source: OECD

The networks mentioned above have been engineered for applications other than electronic commerce. The public telecommunications networks based on point-to-point telecommunication infrastructure, while having two-way interactive communication, have been engineered to meet a relatively short peak-load demand with significant spare capacity outside peak hours. Unlike traditional usage, electronic commerce generates more unpredictable traffic flows with longer online times and therefore can have important implications for engineering network capacity requirements. Broadcasting networks have been traditionally point-to-multipoint one way communications and therefore unsuitable, without significant upgrading, for interactive applications necessary for online commerce applications.

Like Internet traffic, most electronic commerce traffic is likely to be based on store and forward data messages, with varying capacity demands and different traffic distribution patterns. This will rapidly change the pattern of usage and occupation time of a network circuit. For example, in the United States Pacific Bell estimates that the average customer uses the telephone for voice traffic 22 minutes per day compared to 62 minutes for Internet per day. It is necessary for public telecommunication operators to converge their networks and network management systems to be able to handle store-and-forward services and circuit-based services over the same flexible network. The trend toward a growing share of services using packet-based techniques, will tend to steer upgrading and expansion of fixed networks towards a communication network that can provide services which traditionally have been delivered over (public) data networks. Internet telephony is a typical example of a service that provides a bridge between those two worlds and is accelerating the convergence between circuit and packet networks and services.

Present growth rates in electronic commerce demand have been significant (see *Impact* paper) The largest part of this growth has taken place through the Internet (i.e. based mainly on packet switched networks, and the world wide Web (WWW). The Internet, a packet-switched network designed for data transfer, delivery and retrieval, is playing a key role in the development of electronic commerce. The competitive environment for the provision of infrastructures for Internet services which is emerging from recent telecommunication liberalisation is stimulating this development by optimising bandwidth, performance, quality and price characteristics of alternative technologies. This is also allowing ISPs, PTOs and others facilitating electronic commerce to choose their preferred infrastructures and provide a choice for customers. ISPs are usually connected to both packet switched networks and through the PSTN to provide local access.

The ongoing improvements in reliability and capacity of the Internet have led to initiatives to build separate IP networks for business services in order to be able to guarantee certain quality, for instance for Internet telephony services. Also many incumbent PTOs have announced plans to provide IP services, including Internet telephony, but using IP infrastructures allowing them to better control the quality. These examples illustrate that the industry believes in a market for business IP-networks providing higher and consistent quality compared to present Internet services using public switched networks.

Estimates are that electronic commerce demand will continue to grow rapidly, and become more demanding on capacity as applications become more complex and include audio, video and complex graphics. The capacity requirements for these types of applications are significant. For example, multicasting applications where there is continuous video streaming generates huge demands on capacity. In addition, video-based applications will require high and much better compression technologies, improved video interactivity and enhanced video delivery. Internet demand has led to a spiral in which bandwidth expansion in networks, driven by services, opens the possibility for higher bit-rate services. As a result technological innovation in infrastructure is now mainly commercially driven and shows a similarity to the spiral relation between computers and software.

The demand for Internet services has had significant implications for infrastructure deployment. It also provides an important example of how technologies can rapidly evolve and diffuse, and markets grow, where demand is buoyant and investment opportunities unrestricted by regulation. Internet deployment in the United States has led to over 40 major backbone networks operating and over 4 500 ISPs, and 23% of households connected to the Internet[4]. It is predicted that in the United States the Internet access market will increase from USD 6 billion in 1997 to USD 38 billion by 2002[5]. Internet traffic over the last few years has been increasing at a significant rate (in certain countries doubling every 4 to 6 months).

On major routes (e.g. transatlantic and across the Pacific), Internet traffic growth (much of it linked to electronic commerce or nascent electronic commerce applications) is also expected to very soon overtake the volume of traffic generated by voice telephony traffic, long the mainstay of the telecommunication service industry in terms of revenues. Although in a number of countries significant investment is taking place to upgrade network infrastructures, this is far from being the case across the OECD. OECD[6] (1998) has assessed what policy initiatives have been undertaken more broadly to facilitate growth in new demand for Internet-based services, and identified successful approaches in Canada, Finland, the Netherlands, the United Kingdom and the United States. In a number of countries, however, there has been very little commitment to electronic commerce, either on the demand or the supply side. Other countries are assisting in technological development. In France, in the context of an action programme for the Information Society adopted in 1998, the growth in demand of Internet services is being encouraged. Enhanced network capabilities are being assisted through government programmes in the United States where the government launched the Next Generation Internet Initiative in 1996. This is a multi-agency Federal government research and development programme with a USD195 million budget over 1998-1999.

Congestion

Growth in Internet traffic has resulted in network congestion becoming an issue, especially in the United States. Congestion is a multifaceted issue in that it can occur at different levels of the network, including at the customer interface (the terminal). At the technical level the determination of congestion is a complex issue since it is difficult to determine where such congestion occurs. The problem could be a computer, server, or network one. On Internet networks the number of interconnected networks and the fact that no single entity has end-to-end responsibility has been cited as a difficulty in allocating responsibility and taking appropriate measures[7]. Different solutions are required for the different types of congestion which may occur. Clearly congestion can have negative impacts on demand growth by reducing the utility of electronic commerce, increasing relative prices where time charges are used for dial-up customers, and increasing the possibility for errors through packet loss. Customers, whether business or residential, will defer full migration to online commerce where congestion becomes a recurrent problem.

Resolution of congestion is both a technical and a strategic/policy issue. Increased bandwidth can clearly help alleviate congestion, but as bandwidth improves, the demand for applications will increase, thus there will be a synergistic process between the growth and diffusion of electronic commerce and the availability of bandwidth, and infrastructure capacity. As bandwidth improves suppliers will tend to use more of it, for example through use of more complex Web pages, streaming video applications etc.

Although bandwidth is growing, in certain cases it cannot keep up with demand growth. Examples of bandwidth growth include such backbone providers as Uunet who are installing on average a new T-3 link every day. A number of large customers are now demanding OC-3 lines (155 Mbps capacity), and OC-12 lines (622 Mbps capacity) are coming on stream. However, as the question of bandwidth shortage is being discussed in the United States, it has been estimated that about 60% of installed fibre optic networks are not being used[8]. This unlit fibre is reportedly being held in reserve by the large telecommunication operators, and therefore tends to slow down capacity availability for Internet usage and electronic commerce applications.

Investment alone in broadband capacity by network service providers is not necessarily in itself the only solution to network congestion. Increased capacity and increased flow-through of traffic may further stimulate demand (in terms of the number of customers and log-on time) leading to further congestion unless traffic management solutions are optimised. Congestion in this sense is a dynamic issue.

The local loop is one particular area where congestion can occur so that service providers need to be assured that local access networks can meet peak traffic loads. Congestion can also occur at the customer level when trying to access ISPs. To avoid this, companies such as AOL have increased their modem ratio from 1 to 100 customers in 1993, to 1 to 50 in 1996, and 1 to 20 by the end of 1997. This reflects an important change in usage patterns of customers. For this reason the perceived bandwidth requirements of today may well be inadequate as applications develop. As electronic commerce expands and develops a number of factors will play a role in stimulating the demand for bandwidth with consequent implications for congestion: for example, interactivity will be in high demand for electronic commerce applications as will advertising which requires continuos streaming of data. Further, as more electronic commerce applications include high capacity features, such as graphics and video, network infrastructures need to be capable of transmitting these data volumes[9].

On the technical side, as bandwidth increases there is more use of techniques such as caching of data by ISPs to reduce the volume of repeated requests for data from popular Internet sites. As well, the use of sites by content providers can also help reduce backbone traffic. Existing capacity is also being improved (e.g. through multiplexing), and the volume of data is being reduced e.g. through compression and reduction techniques (widely available open standards, such as MPEG (Moving Pictures Experts Group) have been important in this context). Traffic control procedures can also be important in reducing the level of congestion. New network routers are under development to increase efficiency and dependability[10].

Inverse Network Technology, a company specialising in measurement and testing of Internet performance recently undertook a survey of dial-up performance of leading ISPs[11] in the United States. Reliability measurements were based on 24-hour call success rate, evening hour call success rate, business hour call success rate, initial modem connect speed and average time to log in. Inverse's recent survey shows overall improvements in call failure rates from 1997 but relatively stable reliability and performance over the last 3 months.

There are a number of possible indicators of Internet infrastructure which could be used by ISPs (ISPs) and others in order to effectively manage day-to-day network quality. Work at the OECD has noted that many of the tools are publicly available on the Internet to measure quality of service, however most ISPs do not collect this information[12]. In this context the importance of sharing operational information among ISPs needs to be stressed.

Company strategy and public policy can help ameliorate problems due to congestion in a number of ways: policy has an important role in stimulating the build-out of infrastructures, policy also has an impact on prices and, if necessary, the pricing structure can be used to influence traffic flows by influencing prices either in terms of structure (peak and off-peak prices) or level (premium prices for guaranteed access speeds). Firm strategies can also help alleviate congestion through pricing which allows customers to choose speeds and classes of service. Service differentiation for different types of traffic would also allow traffic which is sensitive to delay obtaining priority in routing, whereas other traffic such as file traffic would be queued. In many cases large enterprises will rely on dedicated networks for their bandwidth requirements, as many already do for existing data needs.

There have been suggestions that in view of congestion, pricing should be used to provide a market signals to ‘ration’ access. This perspective takes a short-term view of the congestion issue. Potential bandwidth availability is very high so that congestion must not be viewed as a scarce resource issue, rather it is a dynamic issue, which changes with new technology and infrastructure and as new service applications, develop and diffuse. In addition, congestion pricing can have negative impacts on the growth of electronic commerce if relative prices between electronic commerce and traditional (off-line) commerce are changed in favour of the latter.

There is a need for much better data on congestion and a clearer delineation of where congestion occurs in order to determine the best solutions. Congestion cannot be examined in isolation from the developments in Internet pricing in Internet traffic exchange models and peering, and in technological and service development of the Internet.

Demand and technology

The perceived demand for different electronic commerce applications will also play an important role in determining investment in the different type of technologies. For example, if interactivity requires only low capacity signalling from residential customers, ADSL[13] may be sufficient since it can deliver signals at a high rate but allows for return signalling at low rates. In 1998, a number of companies, such as Bell Atlantic and GTE in the United States, began to offer residential customers in major cities ADSL. However, for high degrees of interactivity this technology would be insufficient since it would not support a number of multimedia services that require outgoing and incoming signalling at the same (high) rates. Choice is complicated by the range of different applications that are becoming available for households and for business customers. Each of these applications makes different demands on bandwidth (Box 1). Thus, many existing electronic commerce applications, such as purchasing books, downloading software, or verifying bank accounts, could be carried out efficiently with ADSL, whereas applications requiring video communications (e.g. videoconference services) may require higher bandwidths.

Rapid growth in demand for access to Internet services and business applications requiring reliable data circuits has stimulated the diffusion of higher bandwidth technologies[14] such as Integrated Services Digital Networks (ISDN). This technology has been available for a number of years, but has suffered from extremely slow rates of diffusion because, among other factors, there was no obvious demand. The significant impetus to the growth in the number of ISDN subscriptions (Table 2) is indicative of the symbiosis between demand growth and capacity expansion. In Germany, Deutsche Telekom reported an increase in the number of ISDN channels of more than 40%. In addition, revenue growth for their online service expanded by just over 90% during 1997 with some 2 million customers using their service[15]. Matav, in Hungary, has also reported strong demand for second lines to support e-mail, fax and Internet applications, an experience many operators are having, which provides them with a surge in profits to allow for network upgrading. Many PTOs in the OECD area are also reporting strong growth for digital leased lines.

To respond to faster access by dial-up customers, modem technology has evolved rapidly so that now 56 Kbps modems have become the standard for new PCs. However, an important percentage of new demand growth in the United States has been met through the growth in second lines which in the mid-1990s began to increase rapidly (Table 3). To a large extent this reflects lack of choice of other infrastructures and the inability to obtain high bandwidth capacity at the residential level.

Box 1. **The Need for Bandwidth**

Bandwidth Resolution

90 Mbit/s = 4 700 telephone lines Full motion colour television

2.0 Mbit/s = 104 telephone lines High quality videoconference

1.5 Mbit/s = 78 telephone lines Good quality image for business/industry meetings

384 kbit/s = 20 telephone lines Interviews/Education/Training

64 kbit/s = 1 ISDN bearer channel INDEO (PC-based), ISDN circuit

19.2 kbit/s = 1 4kHz telephone line Freeze frame (slo scan) telephone

Note: INDEO is Intel's ISDN videophone standard.

Source: Lydia Jackson, Intermedia, December/January 1994/95 Volume 22/No. 6.

Table 2. Number of ISDN subscribers in OECD countries, 1995 and 1997

	Total ISDN subscribers			ISDN basic rate subscribers			ISDN basic rate subscribers per 1 000 mainlines		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
Australia	#N/A	#N/A	#N/A	193600	269525	360350	21,3	29,4	38,5
Austria	16813	42018	85683	16308	40642	83083	4,3	10,8	22,3
Belgium	28071	54652	96548	27288	53342	93935	5,9	11,3	19,0
Canada	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Czech Republic	0	0	#N/A	0	0	165	0,0	0,0	0,1
Denmark	14082	29863	#N/A	13599	28797	#N/A	4,2	8,9	#N/A
Finland	6416	27015	#N/A	5962	25922	54168	2,1	9,1	18,9
France	288800	#N/A	#N/A	258800	391200	556400	7,9	11,8	16,5
Germany	881400	1963900	2887200	846400	1918300	2831200	20,2	43,4	62,6
Greece	303	981	#N/A	303	888	2408	0,1	0,2	0,4
Hungary	#N/A	#N/A	#N/A	5000	11000	39600	2,3	4,1	12,4
Iceland	0	#N/A	#N/A	0	1396	6850	0,0	9,1	44,1
Ireland	0	0	#N/A	0	0	#N/A	0,0	0,0	#N/A
Italy	49061	104578	335000	45571	97543	322000	1,8	3,9	12,5
Japan	#N/A	1084950	2364554	529294	1084928	2364520	8,7	17,6	39,3
Korea	4309	8405	#N/A	4309	8405	21110	0,2	0,4	0,9
Luxembourg	4556	10378	24479	1556	3688	9839	6,7	14,3	35,2
Mexico	0	0	0	0	0	0	0,0	0,0	0,0
Netherlands	23700	312000	279000	22000	300000	270000	2,8	35,6	30,5
New Zealand	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Norway	20052	66411	#N/A	14252	47211	146005	5,9	18,5	53,4
Poland	82	238	#N/A	82	238	#N/A	0,0	0,0	#N/A
Portugal	7891	19729	47845	7101	18212	45060	2,0	4,9	11,8
Spain	10828	96941	#N/A	10601	96040	228458	0,7	6,2	14,4
Sweden	19700	#N/A	#N/A	19000	#N/A	#N/A	3,2	#N/A	#N/A
Switzerland	69459	125810	#N/A	65958	120540	200000	15,0	26,4	42,6
Turkey	0	0	0	0	0	0	0,0	0,0	0,0
United Kingdom	132500	#N/A	#N/A	102500	154500	#N/A	3,5	5,0	#N/A
United States	510652	876943	1174583	500702	841662	1108307	3,0	4,9	6,2
OECD	2088675	4824812	#N/A	2690186	5513979	8743458	5,9	11,9	20,0

Source: OECD, ITU

Note: This Table shows the number of subscribers. Other sources sometimes report the number of channels, i.e. 2 channels per ISDN Basic Rate access subscriber and 30 (or 24 in the United States) channels per ISDN Primary rate access subscriber.

Table 3. Demand for second lines in the United States

Additional residential lines for households with telephone service in the United States (data in millions)			
End of year	Total residential lines	Of which additional residential lines	Percentage of additional residential lines
1990	92.2	3.9	4.4%
1991	95.9	6.5	7.3%
1992	99.3	8.3	9.2%
1993	101.9	8.8	9.5%
1994	105.2	11.5	12.3%
1995	108.1	13.9	14.7%
1996	110.8	15.7	16.5%

Source: FCC

Market segments

The two main market segments for electronic commerce will be the business-to-business market[16] and the business-to-residential market (see *Impact* paper) and each of these markets are likely to have different usage patterns, and therefore network configuration preferences as well as possibilities to access applications. However, one of the more serious challenges will be to deliver services to residential customers given that they are more widely dispersed than large business customers, and given the requirement in upgrading local loop technologies to access every household.

Business-to business

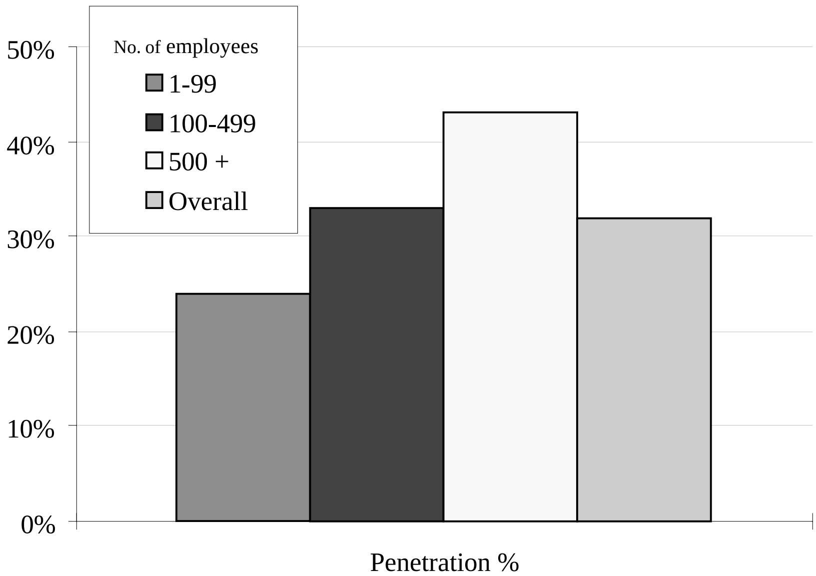
Demand characteristics of larger companies for electronic commerce are based on information sharing, close links between downstream suppliers and upstream distributors of goods and services and the linkage of corporate intranets. An important part of business demand is to make available to partners and other suppliers complex technical information. In a number of cases, for example for CAD/CAM systems, the data requirements are significant and reliability is extremely important.

Networking of companies has traditionally been based on the use of leased circuits or data networks. As liberalisation in the use of leased circuits spread across most OECD countries, widespread inter-company networks were able to be used for voice as well as data communications through so-called “closed-user groups”. Compared to larger enterprises, the small and medium enterprises (SMEs) found it more difficult to use network technology. This has been partly due to high costs of implementing a network strategy for SMEs. The recent significant improvements in communication technologies, in speed, services and applications has accelerated the process of integrating commercial transactions through communication networks as has the Internet. For many smaller companies the development of Internet protocols has allowed them to reach a global market at very little cost and with low training costs. Commonality, arising through digitalisation has also led to convergence by allowing different network platforms to provide a range of different data and become less tied to specific services. In addition there has been a significant change in forms of access. For Internet, for example, dial-up access is easily undertaken by a wide range of customers, both residential as well as smaller business customers.

Internet protocol based networks are allowing for greater interoperability both within as well as between companies which is in turn stimulating demand for access and use of networks. Open standards have thus played an important economic role in stimulating the market compared, for example, to some Electronic Data Interchange standards which, because they were proprietary, tended to restrict market access and growth. Again this has been important for SMEs who no longer need to be tied to a single company because of proprietary standards. Many ISPs are also acting as intermediaries for small and medium business customers providing Web-hosting, training, customer management services, and other services facilitating the entry of these firms into electronic commerce applications. Their ability to handle a large number of customers simultaneously has also given ISPs an important role in intermediation: for example, companies such as AOL support more than 730 000 simultaneous users and more than 18 800 Web hits per second[17].

In the service area as well, a number of applications are one-to-many or many-to-many where services may be sent to multiple recipients (news, stock quotes, etc.). The extent that different US companies of different sizes are using the Internet is shown in **Figure 1**.

Figure 1. Percent of sites (by employee size) using the Internet



Source: http://www.ci.infobeads.com, November 1997.

The World Wide Web (WWW) and Internet Protocol (IP) has emerged as a dominant protocol for applications. The ease of use and adaptability to most PCs, which are the main business terminals for local area networks, and the ease in accommodating Intranet and Internet applications, has played a large part in the rapid take-up of IP and the ability to develop electronic commerce applications. The ability of IP to support a variety of different types of traffic has also been important in facilitating the growth of demand. This growth is depicted in Table 4, showing Internet hosts per 1 000 inhabitants for OECD countries[18]. For the OECD as a whole the average number of Internet hosts per 1 000 population has doubled in 18 months. In the first 6 months of 1998 a number of OECD countries showed significant growth in the number of hosts.

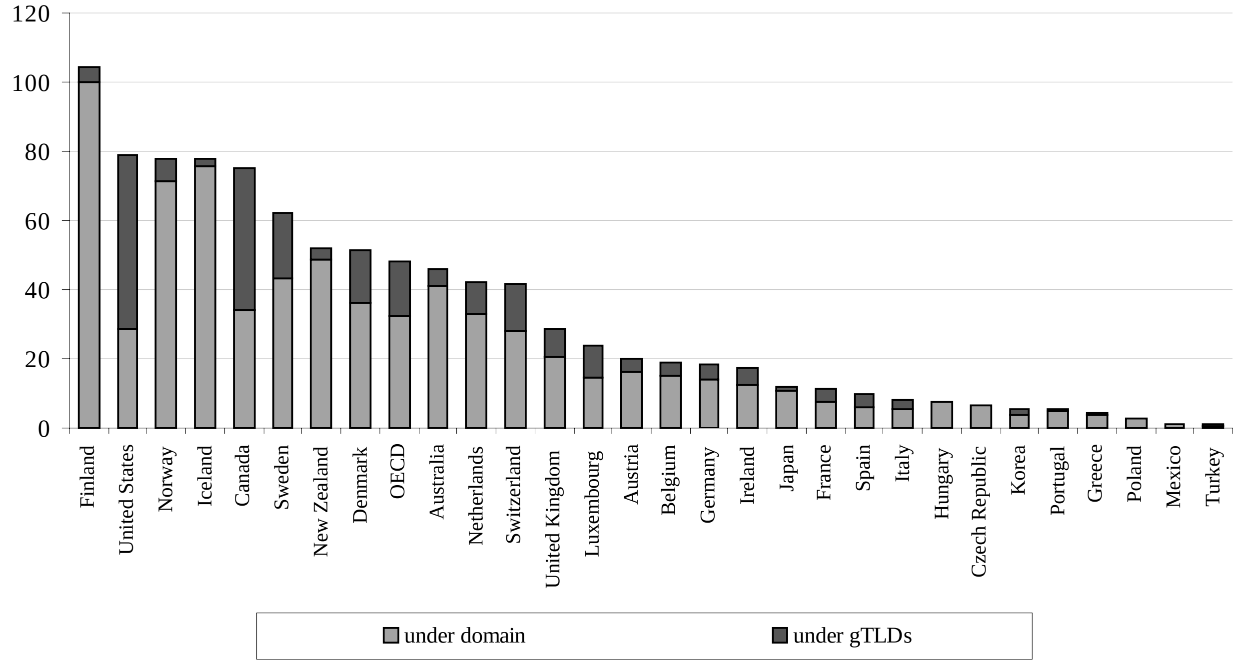
Table 4. Internet Hosts in OECD countries

	Number of hosts under domain		Hosts per 1 000 inhabitants		Growth rate (Jan-July)	% of total gTLD registrations (.com, .net, .org)	Hosts including gTLDs weighted by domain registrations per 1 000 inhabitants
	Jan-98	Jul-98	Jan-98	Jul-98			Jul-98
Australia	665 403	750 327	36.5	41.1	12.8	0.51	46.1
Austria	109 154	132 202	13.4	16.2	21.1	0.18	20.2
Belgium	87 938	153 760	8.6	15.1	74.9	0.22	19.0
Canada	839 141	1 027 571	28.0	34.3	22.5	6.75	74.9
Czech Republic	52 498	65 672	5.1	6.4	25.1	0.02	6.7
Denmark	159 358	190 293	30.4	36.3	19.4	0.44	51.3
Finland	450 044	513 527	87.5	99.9	14.1	0.13	104.3
France	333 306	431 045	5.7	7.4	29.3	1.31	11.4
Germany	994 926	1 154 340	12.1	14.0	16.0	1.96	18.3
Greece	26 917	40 061	2.6	3.8	48.8	0.04	4.4
Hungary	46 082	73 987	4.6	7.4	60.6	0.02	7.8
Iceland	17 450	20 678	63.7	75.5	18.5	0.00	77.7
Ireland	38 406	44 840	10.8	12.6	16.8	0.09	17.2
Italy	243 250	320 725	4.2	5.6	31.8	0.76	8.0
Japan	1 168 956	1 352 200	9.3	10.8	15.7	0.76	11.9
Korea	121 932	174 800	2.7	3.8	43.4	0.42	5.5
Luxembourg	4 273	6 145	10.2	14.7	43.8	0.02	23.8
Mexico	41 659	83 949	0.4	0.9	101.5	0.09	1.1
Netherlands	381 172	514 660	24.3	32.9	35.0	0.80	42.1
New Zealand	169 264	177 753	46.5	48.8	5.0	0.06	51.7
Norway	286 338	312 441	65.6	71.6	9.1	0.16	78.0
Poland	77 594	98 798	2.0	2.6	27.3	0.02	2.6
Portugal	39 533	45 113	4.0	4.6	14.1	0.05	5.4
Spain	168 913	243 436	4.3	6.1	44.1	0.83	9.9
Sweden	319 065	380 634	36.1	43.0	19.3	0.95	62.4
Switzerland	114 816	205 593	15.8	28.3	79.1	0.53	41.4
Turkey	24 786	27 861	0.4	0.4	12.4	0.20	1.0
United Kingdom	987 733	1 190 663	17.0	20.5	20.5	2.57	28.4
United States (.us, .mil, .edu, .gov)	6 618 382	7 738 298	24.4	28.5	16.9	75.90	78.8
.com	8 201 511	10 301 570	..	..	25.6	..	..
.net	5 283 568	7 054 863	..	..	33.5	..	..
.org	519 862	644 971	..	..	24.1	..	..
.int	672	853	..	..	26.9	..	..
.gov	497 646	612 725	..	..	23.1	..	..
.mil	1 099 186	1 359 153	..	..	23.7	..	..
.us	1 076 583	1 302 204	..	..	21.0	..	..
.edu	3 944 967	4 464 216	..	..	13.2	..	..
Total OECD (incl. gTLDs)	28 593 902	35 473 629	26.2	32.5	24.1	95.79	48.3
EU	4 343 988	5 361 444	11.6	14.4	23.4	10.34	19.3
Non-OECD	1 076 098	1 265 371	0.2	0.3	17.6	4.21	0.4
World	29 670 000	36 739 000	5.1	6.3	23.8	100.00	9.3

Source: Network Wizards and OECD.

Despite significant growth the opportunities for electronic commerce are far from being equal across the OECD if Internet access is viewed as a major platform for such commerce. Figure 2 shows starkly the wide dispersion across OECD countries in the number of Internet hosts. The implication in differences in host diffusion is that those countries with a low diffusion rate may also be relatively slow in developing domestic electronic commerce services and applications.

Figure 2. Internet hosts per 1 000 inhabitants (incl. .com, .net, .org), July 1998



Source: OECD

Residential customers

For residential customers, while fast access to network and electronic commerce applications is important, affordability is of prime concern. Analysis by the OECD has shown that where local network usage charges and Internet Service Provider (ISP) charges are low, the growth in the number of users has significantly surpassed the level in high priced markets.[19] Low or flat-rate charges may, however, result in longer connection periods which may aggravate congestion so that pricing structures need careful consideration.

Sufficient bandwidth capacity will be relatively slow to be made available for residential customers. This is because of the relatively high costs of building new local loops or upgrading existing loops. Furthermore, the price of access, especially in countries where public switched telecommunication networks are priced on a timed basis, will retard the full deployment of electronic commerce applications (see section on pricing below). Earlier OECD work[20] has indicated that, 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 online services differ in the amounts they pay to public telecommunication operators by up to ten times for 20 hours per month and 20 times the price for 40 hours of local calls per month.

The user interface is very important for the acceptance and widespread diffusion of electronic commerce. Terminals for electronic commerce applications should be easy to use, inexpensive and interoperable with various networks and protocols. It is evident that those electronic commerce applications that make use of today's commonly available terminals, such as the PC, telephone, and to some extent the TV, will have a head start in reaching the broad public. However, in many cases the existing stock of terminals available to residential customers will need to be upgraded. This applies to PCs as well as TV sets. However, companies embarking on electronic commerce should carefully review their policy of customer access in order to maximise the use of the installed user base. This is because the capital costs for consumers in replacing existing terminals is relatively high: the benefits that consumers can obtain from electronic commerce can play a role in providing incentives for the purchase of new equipment. Consumers would have to perceive important benefits from electronic commerce if they are to invest rapidly in new terminal equipment.

Terminals

The level and rate of growth of demand for electronic commerce will depend on the availability of appropriate terminals to access applications and their diffusion. As the initial interface by users (residential and business) to access electronic commerce, through the different infrastructure platforms, terminals can constitute an important bottleneck. High speed local loops and sophisticated electronic commerce applications are of little value to customers if they have no means of access, if the technical capacity of their terminals is much less than required by applications, and if terminal prices are high. Ease of use of terminals is also an important factor in their diffusion.

The PC has become a potentially important electronic commerce terminal with a relatively high installed base in the OECD area. In 1996 there was an average of 18.6 PCs per 100 inhabitants in all the OECD, of which 27 per 100 in North America, 14.9 in Asia-Pacific and 13.5 in Europe (see Table 5). The PC has become the main terminal for business to access Intranets as well as the Internet.

The PC has undergone significant technological change in the last few years in terms of speed and new features. New features have enhanced the PC, such as video for telephony or conferencing and e-mail. For business the PC is likely to remain the most popular terminal for electronic commerce. For residential customers price and complexity of PCs may however still be a barrier, even though price/performance ratios have recently shown significant improvements.

The ability to access networks has also improved, for example, dial-up modems were operating at 2 400 baud in the early 1990s, increasing to 56 000 baud by 1998. To overcome disadvantages of complexity or price some parts of the industry have heralded Network Computers as a relatively inexpensive way to access online services. However, significant price reductions in personal computers may make it difficult for this market to take off. TV set-top boxes may also provide relatively inexpensive solutions for the residential market, because of the availability and simple user interface of the TV. Digital TV could help this market grow, as it gives a much-improved picture, increased capacity and the possibility of interactivity. Another terminal which is undergoing important changes to allow for Internet access is the telephone set, which also has the advantage of ease of use and an already high penetration rate.

TV set-top boxes, such as WebTV, are devices that can load and store Internet WWW pages. The latest versions can download many Web pages over the cable or terrestrial infrastructure overnight onto an onboard hard drive for viewing during the day. Interactivity is often provided through the telephone networks. In the United States, such set-top boxes are sold typically for USD 300, plus a monthly fee of USD 19.95 for the Internet service, and announced prices for Europe are about the same. Some systems offer high speed open access to the Internet via a cable modem without the need to store the pages. One example is Netchannel in the United Kingdom, where the box is sold for GBP 399 (USD 640) plus a GBP 14.95 (USD 24) monthly subscription. The prices are given only as an indication for the reader, so as to compare the price of the TV terminal with the PC. A 1997 survey predicted that 15.3 million households would be using WebTV and other non-PC Internet devices by the year 2002[21], compared to the existing 80 million PCs connected to the Internet, with forecasts for about 200 million by the year 2002.

The potential of the TV as an interface for electronic commerce for residential customers appears significant, as the penetration worldwide is much higher than that of PCs with an estimated 56.9 TVs per 100 inhabitants (see Table 5). But the TV is a ‘receive-only’ terminal so that interactive applications need terminal adjustments as well. By enhancing the capabilities of television, the shift toward digital television will have positive consequences for the use of TV terminals for electronic commerce. However, penetration of digital TV sets may be slow unless consumers discern significant differences between digital and analogue TV features and quality. The average level of education of the PC users is higher and relatively more technical than that of TV users. The amortisation of the two differs significantly: PC users often buy new equipment every few years, whereas a TV lasts for more than 10 years. WebTVs will probably have to be renewed as often as PCs as computer hardware and software developments of PCs will set the pace of the developments in WebTV-like products.

Access to the Internet can also be undertaken using WebTV. These terminals are now being made available on the market at reasonable prices. France Telecom and Com1 are developing a WebTV system as a replacement for the Minitel and at a targeted price range of around USD 200[22].

In the United Kingdom it has been estimated that the installed base of non-PC access devices for electronic commerce will reach nearly 100 million by the year 2005. TV-based devices will account for more than half the total, i.e. 50 million TVs capable of using the Internet by the end of 2005[23].

Table 5. Communication terminals in the OECD area, 1996

	Access lines per 100 inhabitants	Mobile phones per 100 inhabitants	PCs per 100 inhabitants	TVs per 100 inhabitants
OECD Total	46.8	10.9	18.6	56.9
OECD Europe	43.7	7.2	13.5	48.9
OECD North-Am	50.2	12.3	27.0	65.5
OECD Asia-Pacific	47.8	17.8	14.9	60.5

Source: ITU, OECD (TVs for some countries estimated).

For some services additional terminal equipment may be necessary, for example smart card readers to support secure payment. In addition the infrastructure needs to support services such as electronic mailboxes.

Although the development and distribution of terminal equipment is primarily the responsibility of the supply industry, governments can play a significant role in facilitating terminal diffusion. The most important is to ensure that there are open, competitive market conditions to ensure the lowest prices for terminal equipment. In addition, governments need to encourage industry in ensuring that there are open standards and interoperability. Agreements, such as the Information Technology Agreement in the context of the WTO, can play an important role by improving market conditions and prices for terminal equipment. Education of potential users can also be important to ensure a smooth take-up of equipment. Governments may in some cases facilitate market development by defining government requirements for terminals and through pilot projects (e.g. the Government Network Project in Norway). Governments can also facilitate access to electronic commerce applications by stimulating the availability of terminals in public locations, which can be accessed for government services and other public information services. This helps build up the level of familiarity of the public with the use and acceptance of terminals and electronic commerce.

3. CONNECTING TO INFORMATION INFRASTRUCTURES

Electronic commerce, itself the outcome of technological and service convergence and digitalisation, is taking place simultaneously as the different communication markets integrate through the convergence, and expansion, of previously separate common carrier services (i.e. telephone) and content-based broadcasting (primarily television) market segments. The technical directions of this convergence are many, including prospects for telecommunications companies offering consumer multimedia services; the development of various multi-channel delivery alternatives (cable TV, direct broadcast satellite, multi-channel microwave or "wireless cable" systems); the advent of competitive telecommunications services provided by cable TV and other new operators.

Electronic commerce provides network operators with a potentially wide service base on which to justify network expansion plans. This results in a significant change in the economics of infrastructure development. In the past investment was justified on a limited service portfolio. It is important, as argued in the next section, to allow each of the different infrastructure platforms to try to service the wide market base offered by the potential of electronic commerce.

The underlying infrastructures

Although infrastructures such as the PSTN are presently being used for electronic commerce, bandwidth requirements of new services require upgrading. A brief review of the relative strengths and weaknesses of different infrastructures relevant to electronic commerce is given below.

Alternative local loops

At present, most households or business customers are connected to communication networks by a pair of copper wires, which is part of the PSTN. This local loop also gives access to public and private packet switched data networks, and is used to provide data services, mostly for business subscribers. Other networks are those for broadcasting which include coaxial cable networks, terrestrial wireless networks and satellite networks. These basic infrastructures will, to a large extent, provide the support for electronic commerce. However, they are engineered mainly for short messages with a fairly predictable calling pattern, and do not yet have the capacity to handle the many new applications that require transfers of substantial amounts of data, such as video and graphics, or to meet consistently high demand without loss in quality. The Internet, based on packet switched data technologies but applicable over most of the above networks, has been hailed as the medium for the rapid development and diffusion of electronic commerce. This section describes in more detail the present developments in infrastructures

Existing infrastructure operators in a number of OECD countries are in the process of expanding and upgrading their infrastructure by building upon the existing infrastructure. Examples include public telecommunication operators (PTOs) introducing digital local loops by implementing ISDN and xDSL (see below) and cable operators incorporating upstream paths and adding cable modems for high speed Internet access. As telecommunications markets have opened to competition new entrants are beginning to offer services. Many of these, however, are investing in infrastructure aimed mainly for the business market. This is because the expected return on investment in the business market is viewed as more rapid and more sure than in the residential market.

Competitive high-speed networks, including high-speed local loops, will require substantial investment in upgrading networks. The most widespread type of network, the public switched telecommunication network (PSTN), will be capable of carrying broadband traffic through high speed digital subscriber loops and of switching the traffic through a flatter and more flexible network hierarchy. As well, coaxial cable networks presently used for distributing cable television programming on a one-way basis will be able to carry two-way traffic through modernising the cable distribution points using optical cables. This will allow cable companies to provide a platform for electronic commerce based on their wideband distribution capabilities. Finally, wireless in the local loop offers possibilities to increase competition as well as provide an effective conduit for electronic commerce access (see section below on *Mobile and Wireless Networks*). In order to use electronic commerce applications successfully over various networks, network features and supporting services are necessary to support these applications. Examples of such features are addressing systems to reach electronic commerce users, number portability of these addresses, and number portability for e-mail services.

The following sections give a more detailed description of the various infrastructures.

Circuit Switched Networks

The PSTN will play a key role in the development of electronic commerce as most potential customers are already connected to this network. The PSTN has been engineered for voice telephony services which affects bandwidth, coding techniques and switching capacity. For example, switching capacity is based on the statistical distribution of voice call patterns, that is the distribution of a number of circuits per time and the circuit time, i.e. the duration of a connection. Electronic commerce significantly alters call patterns and duration of connections. In addition, the PSTN has not been completely digitalised in some countries. This means that existing network elements used to improve voice services stop high frequencies and thus hinder digital transmission.

Most residential users use analogue modems to access their ISP for Internet services. Analogue modems, for instance with speeds of 28.8kbit/s or 33.6kbit/s, transform the digital signal between the Internet server and the user's computer temporarily into an analogue signal so it can pass over the local loop. Fast modems with a speed of 56kbit/s use different techniques. Recently, a generic standard has been approved in the ITU: the various supplier specific systems in use are converting to this new standard.

Digitalisation of the PSTN has resulted in data channels with capacities of 56kbit/s or 64kbit/s, forming a common basis for voice and data services, and facilitating new service features and value added services. The ISDN is a standard for circuit switched networks that provides two of these fixed channels for voice or data services, plus an additional data channel for call set-up and user data. Digitalisation of the PSTN has increased rapidly, from an average in the OECD of around 40% of main access lines in 1990 to 83% by 1995[24]. However, additional investments are needed to make the networks capable of handling the changing demand for both capacity and call duration caused by data traffic.

The success of ISDN varies a great deal over the OECD countries. In some countries this technology is being promoted heavily and priced around the same level as two normal fixed lines, whereas in others ISDN installation is much more expensive and can take months to obtain. Usage fees also vary: in some countries the fee per channel is the same as for an analogue line, in others prices are much higher.

In the United States there is a usage charge (time-based calling charge) for ISDN, but not for analogue lines. In some countries it is still difficult to find ISPs (ISPs) who support ISDN, and often where they do customers are required to pay higher monthly charges to them in addition to the line rental charges. Figure 3 shows the number of ISDN basic rate access subscribers in relation to the number of access lines.

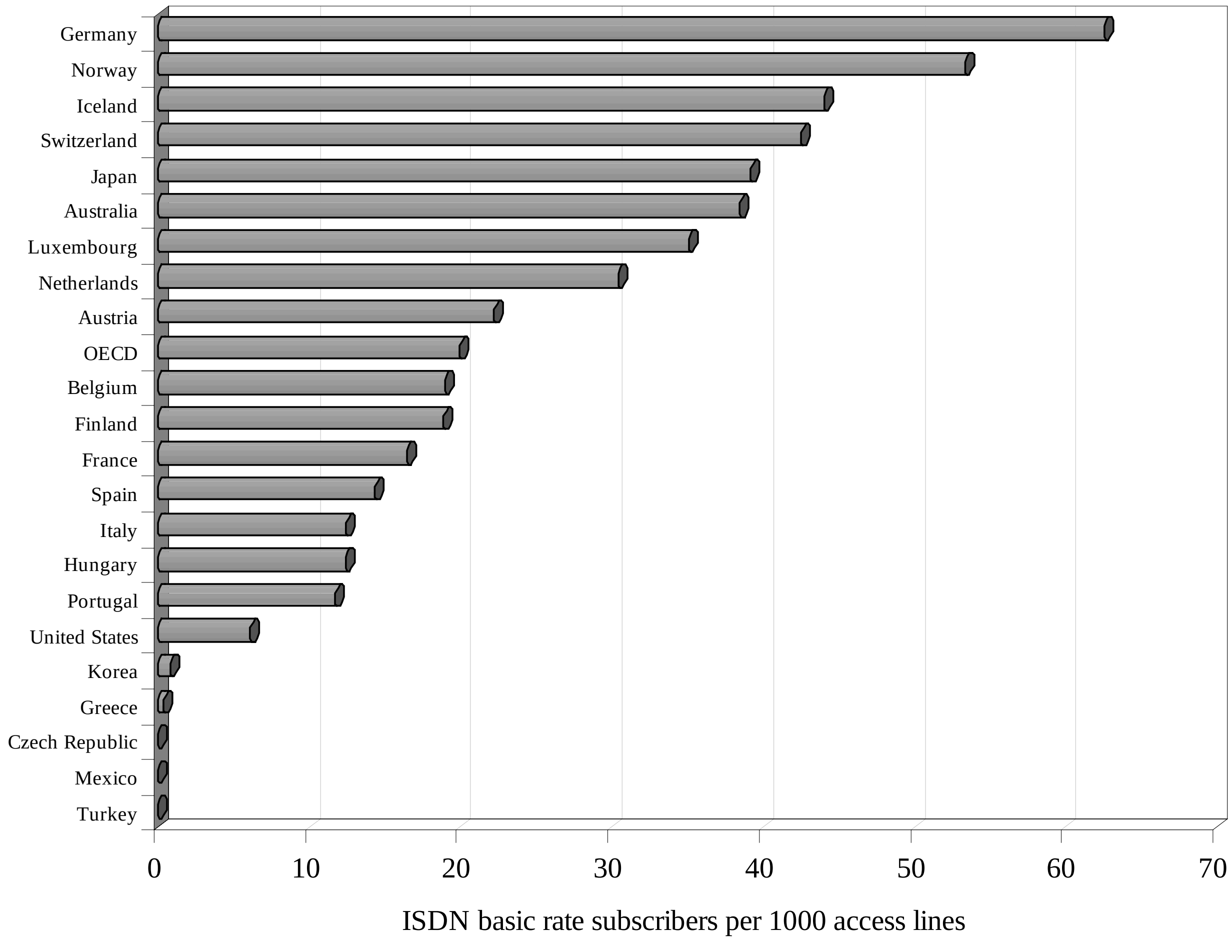
Although ISDN provides more bandwidth for data services and a great deal of flexibility in combining voice and data services, future electronic commerce applications are likely to require even higher bandwidths. These could be provided via the PSTN through a set of high speed access techniques, called "Digital Subscriber Line" (xDSL)[25]. ADSL as an alternative to ISDN has the advantage that consumers can install it themselves, lowering the installation costs for the operator. These techniques optimise the data transmission capability of the existing twisted pair copper wire infrastructure. Many field trials and the operational usage of ADSL and other xDSL show that these techniques can support broadband transmission at data speeds of over 50Mbit/s over copper wired local loop circuits. High capacity lines, presently used by large businesses,[26] such as E1 and T1, are too expensive for the residential market.

The amount of fibre in the local loop is still limited, mainly because of the costs of optical network termination equipment[27]. For example, in the United States overall fibre cable constitutes less than 10% of total cable sheath deployed[28]. In general, however, the share of fibre optics as a physical transport medium in the PSTN is growing. Capacity increase is achieved by higher bit rates over existing optical channels, by employing wavelength division multiplexing techniques and by techniques to have full duplex transmission over the same fibre. However, some promising modem techniques on the copper network, like xDSL, and also the use of broadcasting networks, have resulted in alternatives to fibre in the local loop. Alternatives such as wireless in the local loop, are also providing an opportunity to increase bandwidth at relatively low cost.

At the international level undersea cable system capacities have expanded significantly: for example, between Europe and North America capacity increased from 5.1Gbps in 1994 to 45Gbps by 1997 and is forecast to grow to 165Gbps by the end of 1999[29]. Liberalisation of foreign ownership of undersea cables by WTO signatories of the Basic Telecommunication Agreement is also facilitating the construction of new cables.

The extension to higher levels of transmission capacity and flexibility in circuit switched networks has been underway for a number of years in most OECD countries. More flexibility in the network is needed because emerging services have characteristics different from voice telephony. This has led to a requirement for flexibility in bandwidth assignment per service and flexibility in handling services at virtually the same time, so that a variety of services with various transmission rates can be switched at the same time. This has led to the development of the transmission protocol Synchronous Digital Hierarchy (SDH, ITU standard) and Sonet (Synchronous Optical Network, North America) and the data transfer technique Asynchronous Transfer Mode (ATM). ATM is a cell-based technique with similarities to a packet switched network, but includes the support for circuit oriented connections, in order to provide a wide range of services, including data services. Data transfer via ATM is not limited to the highest network levels, so those consumers with very high bandwidth requirements can be connected straight to ATM.

Figure 3. ISDN basic rate access subscribers per 1 000 access lines, 1997



Source: OECD

Data networks

In contrast to circuit switched PSTN, the Packet Switched (Public) Data Network (PSDN) is a network engineered to transport data via so-called packets. These type of networks are also called X.25 networks. Frame Relay is a packet-based data interface standard that transmits bursts of data over wide area and local area networks, with speeds from 64kbit/s to 45Mbit/s. Frame Relay is more advanced than X.25 and seen as a replacement for these networks. Although popular in the United States over the last few years, Asian and European operators are only recently seeing the advantages as they become more interested in data services. Packet networks are used to transport data between computers, and became popular in the business sector to exchange data. A number of specific packet data systems have been developed, such as SWIFT (Society for Worldwide Interbank Financial Telecommunications) for data exchange between banks, dedicated systems for airline reservation and travel information exchange, and also the French information system Minitel. Both public and private data networks and the circuit oriented ISDN form the basis of the Internet, which in turn is seen as the forerunner of electronic commerce. Through the convergence between infrastructures and services and the competition for Internet access, most infrastructures are transforming into data networks. This is having a positive effect on the speed of innovation in communication networks: the combination of IP networks with computer terminals has innovated much more rapidly than has historically been the case for circuit switched telecommunication networks. At the same time, the competition between the different technologies is also driving innovation as equipment manufacturers and infrastructure operators try to obtain a competitive advantage.

Broadcasting networks

Cable television networks are capable of transporting large volumes of data, but mainly in one direction, i.e. to the consumer. Many of these networks are being upgraded for two-way traffic, and are being modernised using fibre optics. Networks with similar characteristics are terrestrial broadcasting networks and satellite broadcasting networks. These networks form an important alternative to the PSTN infrastructure and have the advantage of having a high bandwidth potential. The broadcasting function links up with the expected characteristic of electronic commerce applications where most data flows from the network towards the consumer. Pay-TV applications are among the first electronic commerce applications on broadcasting networks.

At present many different and vendor-specific cable modem technologies are in use. The lack of a common standard has made it risky for cable operators to make large-scale investments in cable modems because of uncertainty from lack of compatibility. This probably slowed down the diffusion of high-speed telecommunication services over cable, but initiatives to develop common technology standards are promising, and standardisation is estimated to take place over the next 12 months. In Europe there are a number of alternate local loop trials taking place (Table 6).

Data can also be sent via the so-called "vertical blanking interval" of the video signal on a cable network at relatively low cost. Systems have been developed to allow operators to scale download speeds according to the number of TV lines dedicated to carrying data, resulting in speeds of up to 128kbit/s to 300kbit/s at an announced price of USD 5 per month[30]. One implementation is to let set-top boxes decode the data, while supplying an upstream path via a radio frequency channel, satellite or telephone. The use of the vertical blanking interval of the broadcasting signals can be an inexpensive solution, particularly in combination with the TV, as an electronic commerce interface. High bandwidth wireless and satellite are expected to play a more important role in the longer term, especially with the advent of low earth orbit satellites and projects such as Teledesic.

Like terrestrial broadcasting networks, geostationary satellite broadcasting networks have the capacity to transmit large volumes of data towards the user. They already play a role in downloading Internet data to PCs. A modem link over the PSTN provides the return connection for interactivity. The capacity to reach a large area can help give small businesses a potential to reach a wide customer base at no extra cost. At present, upstream information is often sent via the telephone line, but new Low Earth Orbit (LEO) satellite systems can, in combination with cellular mobiles, make the satellite infrastructure interactive for residential use at reasonable prices, and can handle broadband transmission without the typical delay experienced from geostationary satellites [31].

Table 6. Alternative local loop trials in Europe

Infrastructure development in the European Union -- Status March 1997				
	Commercial ATM services	**ADSL**	**Cable network upgrades underway**	**Cable modem trials**
Austria	N/A.	N/A.	some	N/A.
Belgium	yes	trials	yes	yes.
Denmark	yes	trials	yes	yes
Finland	yes	Commercial launch in 1997	yes	yes (limited commercial offer)
France	yes	trials	yes	yes (limited commercial offer)
Germany	yes	trials	yes	yes
Greece	planned in two years	planned	N/A.	N/A.
Ireland	planned	trials	some	N/A.
Italy	yes	trials	N/A.	planned
Netherlands	yes	trials	yes	yes (limited commercial offer)
Norway	yes	planned	yes	planned
Portugal	yes	planned	no	N/A.
Spain	yes	trials.	yes	yes
Sweden	yes	Commercial launch in 1997	yes	N/A.
United Kingdom	yes	Commercial launch in 1997	yes	yes (limited commercial offer)

N/A = information not available
Source: ACTS: The European Information Society at the Crossroads; orig.: Databank Consulting 1997; cable modem trials based on Ovum 1997.

Mobile and wireless networks

The cellular mobile telecommunication market in OECD countries has grown significantly and growth is still strong[32]. About 11% of the population in the OECD has a mobile phone, compared with almost 47% with a fixed connection[33]. Mobile communication for electronic commerce has quite a potential, despite present limitations in the speed of data services. Although the bandwidth restricts the ability to use applications with graphics or video, many applications can have a much simpler interface. Transactions via e-mail and applications such as home banking require limited bandwidth and may become very popular among mobile communication users. Those systems working with smart cards, such as GSM, offer a very good platform for electronic commerce because the standardised smart card interface makes it easy to use and supports a large number of standardised services and features, e.g. for security.

Electronic commerce using mobile telecommunication networks will probably develop in two main directions. On the one hand, electronic commerce applications that communicate directly with mobile phones, and on the other, electronic commerce applications that communicate via mobiles, with a portable computer. The latter particularly will require high bandwidth mobile telecommunications as portable computers will play an important role to support and promote electronic commerce sales.

At present, several developments for a third generation mobile system are under way which will allow network capacity to be enlarged, in order to connect more customers to mobile systems and to offer more bandwidth to customers. Third generation mobile systems are also aimed at integrating mobility in public networks, enterprise networks and home networks.

Local Multipoint Distribution Services (LMDS) also provide a potential for new broadband access. This technology is a radio service which can provide high-speed Internet access at 100 times current modem rates, or carry over 200 video channels simultaneously. In the United States, the FCC has precluded incumbent carriers and cable companies from bidding within their region for the required spectrum for LMDS thus positioning such services as a competitive network technology to existing technologies. LMDS trials have concentrated on residential video services operators (e.g. in Japan, Korea and Europe), however it is expected that North American carriers will provide a mixture of high speed data services, combined with voice services, wireless Internet and multichannel video services.

Electricity distribution networks

The successful transmission of data over electricity distribution networks without interference, developed by Nortel and NorWeb, can play a role for electronic commerce as it would be relatively inexpensive to stay permanently online[34]. The two companies plan to use United Utilities' power lines in the United Kingdom to offer high speed Internet connection (up to 1 megabit per second -- approximately 10 times current ISDN speeds) and launched a commercial trial to 2 000 homes in early 1998. The system uses fibre or radio links between local electricity sub-stations and then sends data over the existing wires to the home. In order to send and receive data over this network, PCs will need to be fitted with additional hardware and software (estimated to cost under USD 326)[35].

4. ACCESS TO INFRASTRUCTURE PLATFORMS

Main policy principles

The economic and strategic importance of information infrastructures, in the economy-wide context, is becoming significant with the development of an electronic marketplace. *These infrastructures will be able to provide directly a range of electronic commerce services to users by bundling together transport, access and market transactions.* They will also provide the platform for other transactions, whether to purchase goods, access entertainment, or interact with government. Given that communications networks and markets are to play an important role in shaping economic exchange in the future[36], it may be opportune to begin a *review* of the policy base applied to communication networks, although the impact of bundling on competition must always be taken into account. Policies for networks may need to increasingly focus on creating *open conditions of access* for users to electronic commerce, ensuring that market conditions provide the correct incentives to *build-up the capacity of networks*, ensuring their *interconnection and interoperability*, and ensuring their *widespread availability at affordable prices*. Neutrality in the regulatory treatment of infrastructures when they are used for similar services, in particular for electronic commerce, may also warrant examination.

A fundamental understanding among OECD countries is that electronic commerce must develop in a competitive environment based on open systems. Governments need to begin reflecting on the implications this may have for the different policy models they apply to the different communication markets. Among the questions policy makers should consider are the following:

- Have the goals of regulations changed and what will be the basis of regulation?
- How will existing laws, regulation and regulatory principles need to change?
- What are the implications for regulatory bodies?
- What are the criteria for abstaining from regulation?
- Will the application of principles, such as non-discrimination, change?

The implication of opening-up networks to electronic commerce would be that many networks could no longer be viewed as service specific. This can have important implications for future regulation in that, historically, the use of some of these networks was regulated on the basis of network/service specific regulation, such as for voice telephony and broadcasting. It may be that certain regulatory frameworks inhibit the use of certain network infrastructures and make it difficult to provide electronic commerce services which integrate voice, audio, video and other data communication services, including functions such as interactivity and broadcasting. Thus, the dynamic opportunities offered by electronic commerce in using infrastructures may require the adaptation of existing sector-specific regulation in order to accommodate the use of infrastructure more broadly and effectively. The changing nature of services, as exemplified by electronic commerce, and of functionality, may place pressure for more open access to the various underlying network technologies for the widest possible range of electronic commerce services. In addition to opening markets to allow for the development of electronic commerce applications, competition will also stimulate the ongoing improvement of existing infrastructures, such as increasing capacity, upgrading to support bi-directional traffic, flexibility and reliability.

The implication for telecommunication policy of developments in electronic commerce is to examine more carefully how policies may need to be changed to support all types of applications, including multimedia, telephony and electronic commerce.

A core structural feature of a networked economy -- that is an economy based on electronic commerce -- is that multiple services on the one hand, and multiple users on the other, share ubiquitous common resources to access each other. Thus, access to and use of these resources -- the communication infrastructures -- for electronic commerce applications and services and for users is clearly necessary for the rapid development and diffusion of electronic commerce. For most OECD countries access to voice telephony provided over public switched networks has opened to competition, in a number of cases only recently. Even though most countries are approaching universal availability of network access, there are still segments of the population that are not connected to telecommunication networks. In many countries as well there are important differences in the availability of access between major cities and rural areas. These factors may constrain the ability of some to participate in electronic commerce. However, all OECD countries place high priority on attaining and maintaining universal service for voice telephone service.

In terms of electronic commerce the necessity is not only to ensure widespread physical connection of residential and business subscribers, but also to encourage the availability of adequate network resources. In addition to physical access, it is crucial to ensure that there is adequate market access by service providers and users to networks.

However, from the perspective of stimulating network and capacity development and meeting the needs of electronic commerce, one can question the role being played by existing regulatory frameworks. Indeed, in this context it should be recalled that telecommunication markets in many OECD countries are in transition from monopoly to competitive markets. As a result these frameworks are based on safeguards which tend to be asymmetric with respect to infrastructure operators with market power, and tend to limit the ability of these market players to take advantage of opportunities which arise from technological and service convergence. While these asymmetric regulations are viewed as necessary to develop competition, it is important for regulators to carefully weigh their benefits and costs in order to ensure that all firms have an economic incentive to invest in upgrading their infrastructures. *In this context, regulators should also take into account the wider economic and social opportunities provided through electronic commerce.*

Extending competition and facilitating convergence

The economic inefficiencies that often occur with limited infrastructure competition can retard the growth of electronic commerce applications and the economic and social benefits which electronic commerce can provide. It is therefore important for regulators to review and examine the possibilities of broadening liberalisation to cover networks in all communication markets and to extend the process of market restructuring already underway for telecommunication infrastructures and services.

As well, as argued in the previous section, each of the different infrastructures available have their own characteristics, perhaps with some relative advantages. But all of them can be used for electronic commerce. There seems to be no need for governments to have preferences or to disadvantage certain of these technologies as infrastructure for the use of electronic commerce. It would also be dangerous to “pick winners” and push one single infrastructure or technology as ideal for electronic commerce, as this will slow down the development of the alternatives and limit the freedom of choice for service providers and users.

The fact that many incumbent public telecommunication operators with a dominant position, especially in Europe, own important alternative infrastructures such as for cable television, is viewed by some countries as an impediment to the development of alternative infrastructures, which could slow down competition in network infrastructure and reduce incentives to improve the capacity of the local loop for electronic commerce. In certain cases this will have an adverse impact on the development of electronic commerce as well. Such restrictions should not apply to non-dominant market entrants. Other countries, consider that the *a priori* possession of a telecommunication and cable television infrastructure is not in itself anti-competitive, indeed arguing that divestiture may go counter to convergence.

Regulatory safeguards applying to the whole communication sector remain important, even in a competitive environment, to ensure that new entrants face a level playing field as they develop their infrastructure and build up their customer base, and that required social goals (such as universal service) can be met. Many of these safeguards have been developed in the process of introducing competition in telecommunication markets. They remain relevant in the broader context of ensuring that there are competitive networks which can be accessed for a range of services, irrespective of whether they are entertainment, content services, the provision of voice services, etc.

Technological convergence, in the context of service digitalisation, is providing a unique opportunity to rapidly facilitate the development of electronic commerce by allowing all infrastructures to provide any type of service (voice, video, audio, text). This is because convergence may stimulate the competition necessary for investment to ensure the deployment of high-speed local loops.

Convergence is also making less and less clear cut the traditionally-defined industry boundaries within the communications sector (telecommunication, cable television, broadcasting satellite and cellular mobile). The same is true for boundaries between the communications industry, information/content industry and information technology industry. There is indeed a wide recognition of the reality of the convergence process at the level of both technology and network infrastructures. But this does not mean that convergence of both markets (in terms of the players involved) and services will automatically follow. The question of how to ensure a balanced horizontal approach to regulation therefore remains unanswered, as well as the issue of ensuring access to networks and digital gateways in an converging environment. The common format that digitalisation provides implies that digital services need no longer be tied to specific platforms for delivery. This proliferation of multiple conduits, and improvements in the performance and cost of technologies is leading to a dramatic expansion in the scope, nature, and cost of delivering communications applications. Convergence may also offer new ways of meeting public interest objectives, such as universal service (both directly and indirectly, as a result of lower cost and greater flexibility). While this may require a review of current regulations, it does not necessarily change the fundamental policy objectives underpinning such regulations.

Insufficient levels of competition can impact adversely on companies in implementing an electronic commerce strategy. For example, most large companies use dedicated networks, built-up through leased lines. Delay in obtaining such circuits can impose significant penalties for competing industries. Thus, reports that in Europe average delivery time delays for leased lines are of 30-40 days should be taken very seriously by policy makers[37].

Many new Internet services are considered as "like" services, which fall into service categories already regulated. Some argue that as "functionally-like" services they should be regulated. An example of a "like" service is Webcasting[38] which, from a user's perspective, may differ little from traditional radio or television services.

Market access

A number of other factors can impede investment in infrastructures for electronic commerce. These are often linked to the general provisions of communication policy. One example is in *licensing*. In telecommunication markets it is necessary in some countries to obtain an individual license which may place specific requirements on the license holder. A number of other countries have implemented a general system of class licensing which does not place service limitations and allows new entrants to benefit from economies of scale and scope. Some countries use a mixture of both licensing systems. A progressive movement to an open system of class licensing, to facilitate open entry to cover communication infrastructures, would need time in order to implement supplementary policies to meet broad government objectives, which are often imposed through the licensing procedure.

Important economies of scale and scope may result from using networks to provide a number of different electronic commerce services. Taking advantage of these economies could strengthen the already significant market power of incumbent operators, given the near universal access they have to all households and most businesses with their existing networks. Care must be taken to ensure that effective competition develops.

In fact asymmetric regulation is viewed by a number of telecommunication regulators as an effective way to stimulate competitive markets. It may, however, be important to review whether such policies can have negative consequences through biasing the investment decisions of firms with market power. For example, asymmetric regulations can provide an incentive to incumbents to shift services to an IP environment which present regulations do not encompass. As well, incumbents will not invest in broadband networks if regulations do not allow them to provide a range of integrated services. If regulators wait until new entrants have a sufficient market share before allowing incumbents into new service areas, they may need to consider whether such policies inadvertently impose a penalty on consumers and potential users of electronic commerce. There is also the possibility that delays in the diffusion of broadband-based electronic commerce applications may create disincentives for new entrants to build-out of their networks. In a number of OECD countries the weight of the arguments have tended to favour allowing incumbents to provide integrated broadband networks and services, putting in place where necessary adequate safeguards to ensure that there is no abuse of dominant position[39].

One example of how asymmetric regulation is presently used is through *line-of-business restrictions* placed on incumbent operators. Their market power is such that if they can use existing networks, including their vast local loop network which is key in accessing customers, to provide telecommunication, entertainment services and other services, there is a danger that new entrants will be unable to compete effectively. This may then require placing short term limitations on incumbent network operators in terms of the services they can bundle on a network.

Certainly, line-of-business restrictions on non-dominant firms should not be imposed. They should be given the incentive to construct broadband networks and thus should be allowed to provide all types of services on their networks. Restrictions would provide few incentives for new service providers to build their own infrastructures.

As technological convergence accelerates between the computing, communications, and broadcasting industries there is a tendency for vertical and horizontal integration. This is occurring as network owners and operators try and increase their service value-added by moving into new applications and services and try to extend their network capacity. Likewise, content service providers are investing in networks as a means of attaining market access. Such vertical integration should not be discouraged as a general rule, although where necessary individual cases would need to be examined on the basis of competition law. What needs to be avoided in the context of network infrastructures is that firms with bottleneck facilities leverage this position to gain unfair advantage when operating in other markets and, for example, obtain market advantage for their upstream services. This requires that policies should ensure a level playing field, so that non-integrated companies face the same conditions of access to facilities as integrated companies.

Operating systems and certain types of software can be viewed as belonging to the extremity of network infrastructures, and provide the intermediary through which users of electronic commerce access different services. Due to convergence, an increasing amount of electronic commerce originates and terminates on such computer supports. These products often play a crucial role in that they may define the way in which commerce takes place and occupy an increasingly important place in the infrastructure chain. It is therefore important to ensure there is no abuse of dominance in such markets. There is the possibility that dominant positions in operating system and software to access networks may result in negative consequences for the growth of electronic commerce.

Interconnection and peering

Another important requirement for market access is interconnection. This was recognised by countries through the inclusion of interconnection as a principle in the WTO Reference Paper. Efficient interconnection and non-discriminatory access encourages greater use and development of infrastructures. In existing market structures for most OECD countries the local loop is dominated by a single carrier. For this reason interconnection at the level of the local loop is perhaps the most significant issue in an interconnection framework. Interconnection is important for the large number of potential electronic commerce companies who want to access users directly. As OECD countries change their communications market structure to a multi-carrier environment, interconnection as an issue increases in importance.

Interconnection is also changing. First, interconnection is becoming international in scope as international markets open. This can change the way public telecommunication operators (PTOs) interconnect with each other. This is also changing the international relations between operators who co-operated with each other in the termination of traffic whereas they now increasingly compete with each other to obtain and to terminate traffic. At the international level a ‘half-circuit’ philosophy was common. That is, each operator provided half of the international circuit to provide an international connection between two countries. Now with end-to-end competition carriers are looking at providing full circuits.

To date most policy discussions on interconnection have focused on the linking of telecommunication networks owned by different public telecommunication operators. In the majority of cases these networks provided the same type of telecommunication services even when this involved different transmission technologies. In other words, interconnection ensured that the customer of one network provider could communicate with the customer of another. Until relatively recently interconnection between networks offering different types of services was not common in OECD countries because most infrastructures and services were reserved for monopoly PTOs. Following the liberalisation of these markets, and the rapid expansion of services such as Internet access, cross-platform interconnection issues are becoming more commonly debated.

Current interconnection discussions in relation to the Internet have been of less concern to policy makers because they are occurring in a sector of the communication industry much less encumbered by regulation than PSTNs. A number of issues arise with the desire of ISPs to interconnect. In a purely competitive environment, equally positioned firms are usually able to reach "unbiased" agreement. However, if firms are asymmetrically positioned it raises the question of whether it is appropriate for governments to intervene in the open market to "level" the playing field. The current trend in a growing number of countries is to allow competition to occur in telecommunication markets, but to create rules to help in the transition in telephony from monopoly suppliers to competitive suppliers, by regulating interconnection.

In the context of ISPs and their relations with public telecommunication operators a number of interconnection issues arise which may need resolution to ensure the development of alternative access to electronic commerce. These issues, which are currently under discussion in many national regulatory authorities, include:

- The question of regulatory designation. That is, whether ISPs need a certain designation before they can obtain certain types of interconnection for services, such as Internet telephony. Some PTOs take the position that ISPs, as opposed to other telecommunication carriers, have no rights in matters such as co-location because these rights have only been conferred by regulators to designated (in some cases licensed) telecommunication carriers.

- The question of what ISPs would include as unfair unbundling of products and services by PTOs. An example could be a PTO bundling a telecommunication and Internet service that cannot be matched by ISPs without non-discriminatory access to the same service components.

- The question of whether ISPs should be able to offer their own highspeed xDSL service via an unbundled copper loop, that is as resellers. This would enable them to compete on a resale basis with ISPs with their own infrastructure on more equal terms.

- The ability of ISPs to co-locate equipment with the PSTN facilities. Apart from the familiar reasons for wanting to co-locate, such as reducing leased line costs, ISPs would be at a disadvantage compared to the subsidiary ISPs if they could not co-locate in relation to the provision of xDSL.

- The ability of ISPs to obtain greater access to "dark fibre" of dominant carriers, that is the capacity which is available but not presently used by these carriers.

- The question of how broadly the non-discrimination concept should be interpreted and whether it should apply to ISPs.

The issue in most countries is that there is not the same legal requirement to provide interconnection to ISPs since they are not licensed public telecommunication entities and, as a result, PTOs may not be obligated to meet their demands. This could negatively impact on wide diffusion of electronic commerce by restricting the growth and development of ISPs. Regulators may need to consider, in the light of electronic commerce developments, the issue of interconnection by ISPs. In addition, as different networks develop offering a range of services outside the traditional telecommunication area, the consideration of interconnection by network providers will take on a much wider scope. Continuing opportunities for ISPs to interconnect with underlying telecommunication networks should not imply that ISPs would be regulated as telecommunication operators if they do not propose to offer commercial telecommunication services.

Traditionally there have been a number of ways in which telecommunication operators have made payments to each other for the termination of traffic. The bilateral accounting rate system has been one form while another has been sender-keeps-all. In the context of the Internet, ISPs have traditionally sent traffic on a sender-keeps-all basis. This agreement between ‘peers’ or ‘peering’ was undertaken on the basis that traffic between ISPs was of a similar amount, which by implication would require very little or no exchange of payments if a payments system was in force. The growth in the number of ISPs and the emergence of smaller ISPs serving smaller markets and resulting in unbalanced traffic flows has led many larger ISPs to refuse to peer on the basis that their costs in handling traffic with small ISPs were higher. While this issue needs to be resolved mainly by industry, it is important to avoid introducing price anomalies. In addition, the increasing dominance in the provision of Internet services by a few large ISPs with their own backbone networks may result in peering becoming more costly for smaller ISPs[40]. Regulatory intervention in ISP relations is unwarranted at this time, given emerging telecommunication liberalisation, new technologies for Internet, and cost effective arrangements which are evolving for Internet traffic. However it may be necessary to maintain this issue under review. The peering structure is changing due to the increasingly competitive marketplace.

Economic importance of open standards

The smooth application and deployment of electronic commerce worldwide requires a minimum set of fundamental standards that need to be timely and designed to guarantee interoperability of systems from multiple suppliers. This also applies to the underlying infrastructure platforms. Interoperability of systems designed by different suppliers is one of the key requirements and, for a standard to be complete, it must include (or be associated with) the necessary international standardised profile(s), conformance statements and test methods. Interoperability is of vital importance in a networked environment. The example of EDI illustrates both the consequences of the lack of a broad coherence in standardisation efforts, and the difficulty of overcoming existing barriers resulting from the proliferation of specialised proprietary solutions. The concept of interoperability, which covers a number of elements, ranging from emission and reception of data to connectivity with peripheral equipment, is a key requirement in the general diffusion of electronic commerce applications and in the ability for market participants to communicate with each other: although competition is important this must be linked with open systems (the Internet provides one example) and, indeed, competition often facilitates the adoption and diffusion of such open systems.

The success of the Internet lies in its definition of the interoperability of networks via gateways and communication via a standard protocol. The interoperability of networks and applications is facilitated through the availability of a number of standards for protocols, such as the Internet Protocol (IP), the Transmission Control Protocol (TCP) and also terminal software. The open standards-based nature of the Internet and the World Wide Web (WWW) are largely responsible for its remarkable growth. A lot of technical work has been carried out by the Internet Engineering Task Force (IETF), which is an open international community of network designers, operators, vendors and researchers, concerned with the evolution of the Internet architecture. Another group, the Global Internet Project (GIP), has recently published a number of recommendations on electronic commerce to the European Union, in response to the calls for the private sector to play a leading role in charting the future of the Internet.

Open interfaces, based on standards from international standards bodies, are essential to an electronic commerce multi-party environment, allowing anyone to easily connect to this environment without the high risks and costs of non-standardised software and equipment. Governments can support interoperability by encouraging industry to develop open standards which are industry and market driven and also by choosing open standards for their own electronic commerce applications. In this regard, the Global standards Conference is an example of business efforts to promote resolution of outstanding standardisation issues[41]. Governments need to be aware of the danger that successful proprietary *de facto* standards may rapidly become a limitation to fair competition and slow down or hinder the use of new technological opportunities and innovation. A reasonable balance needs to be reached between the requirement of Intellectual Property Rights (IPR) for specific technologies and the importance of ensuring the long term advantage for the whole sector when choosing a technology as a standard.

There are a number of initiatives where the open standards process is helping to improve infrastructure and to this access for electronic commerce applications. On the equipment side, for example, the US private sector, recognising the importance of reaching rapid agreements on standards set up the ATM Forum, aimed at accelerating the development and deployment of ATM products and services. This group has also set up a working group to examine issues of interoperability requirements and quality of service for small businesses and residential customers. Other such informal bodies exist (for example, the Digital Audio-Visual Council), usually including the user community, and these bodies have helped speed up the standards. At the formal level the international standardisation bodies, such as the ISO and the ITU, have also been working on a number of relevant broadband and other standards. For example, the ITU is standardising the IMT-2000 System (International Mobile Telecommunications)[42] and is working on Global Information Infrastructure standards[43]. This concept for a worldwide standards aims to provide a flexible third generation mobile system and also to establish the relation between the global market for fixed wireless access and multimedia mobile personal telecommunications[44]. In this context, some national and regional standardisation bodies, such as the European Telecommunication Standardisation Institute[45] (ETSI), are in the process of developing standards for IMTS through international co-operation and co-ordination. These new mobile standards should improve the quality of services, and are likely to become an important tool for both the growth and the development of electronic commerce. START HERE

In the face of rapidly evolving technologies, convergence and new electronic commerce applications, there is a necessity for the private and public sectors to ensure that standardisation processes are rapid. They must also encompass all relevant actors in an open and non-discriminatory way.

Addressing techniques

Addressing in networks and for online services is crucial in allowing for proper identification of customers and companies participating in online transactions: there are different levels of addressing including telephone numbers, the domain name system[46], and Internet Protocol (IP) addresses. Electronic commerce application providers may introduce their own identification systems, but it is likely they will use existing network and service addresses.

The outlined networks have specific addressing techniques, such as telephone numbers, e-mail addresses, IP addresses and related domain names, but also addressing at the service level such as the identification numbers used in pay-TV sets. Some addresses are related to a network link or network termination, such as telephone numbers and IP addresses, some are related to the terminal or to a separate device (smart card or personalised unit), such as addressing in pay-TV, or cellular mobiles. In both cases the addressing is related to the network, although addressing through the smart card in cellular mobiles gives some personal addressing advantages. Other addresses are related to a service, such as e-mail addressing which is related to an ISP. Further reflection is needed on whether policy issues related to telephone numbers, such as number portability, also have to apply to other addresses and numbers such as e-mail addresses.

Because of the topology, conventional broadcasting networks cannot identify individual customers by the access line and therefore identification occurs at the service level. For the correct handling of personalised electronic commerce services and transactions, including payment transactions, an electronic commerce environment needs unambiguous identification. It is likely that telephone numbers and IP addresses, as well as e-mail addresses, will be used for electronic commerce identification purposes, because they are widely in use. However, for certain transactions, such as the use of digital signatures, these may not be sufficient. The guarantee on uniqueness is through the control of these systems, which differ substantially. Uniqueness of telephone numbers is in many OECD countries realised through a national authority, IP addresses are given out through some private international organisations and issuing of e-mail addresses is by the ISPs, who have their own unique address via the domain name system. The various addressing techniques can be used simultaneously as long as customers are guaranteed a unique address for electronic commerce transaction delivery.

The price of access

Competition in the telecommunication sector has already played a significant role in reducing prices and changing price structures. The price levels presently used in most countries for many of the burgeoning electronic commerce applications, such as those available on the Internet, are usually too high for heavy use of network resources. This is because these prices were developed for the world of telephony where the use of networks has often been less than 30 minutes a day for residential customers, and perhaps several hours a day for some business customers[47]. The pricing structure is one which charges customers according to the time spent using a dedicated channel and the capacity of the network. Unlike voice telephony electronic commerce will probably create greater fluctuations in use, and will require much longer log-on periods. The difference in intensity of use in electronic commerce compared to traditional communication services is expected to be important. Customers are expected to remain on the network for long periods throughout the day, shopping, interacting with their bank, sending messages, obtaining information, and accessing entertainment services. However, these changes of network use are not by definition to be met by changing the pricing structure or through increasing the network capacity, but can also be solved by choosing another technology. For example, the various sorts of Digital Subscriber Loop can route the packets sent by a user straight to the packet network, without using the ports of the switches of the circuit switched network. New pricing structures can emerge to take this change of network use into account, and will emerge more rapidly, if necessary, where there is sustainable competition in the provision of network infrastructures and services.

Competition in the telecommunication sector has already played an important role in reducing prices. For example, with the liberalisation of data communication markets in many OECD countries, many new companies began providing data services in competition with leased lines from the incumbent public telecommunication operators (PTOs). This competition led to important reductions in the prices of leased lines. The OECD simple average of the price of a 1.5Mbit/s or 2Mbit/s national leased line basket was in, January 1996, 70% of the January 1994 basket[48]. Despite these price reductions, the price of leased lines across OECD countries varies significantly. For example, it is cheaper to lease circuits across the Atlantic from Europe than it is to lease circuits for direct intra-European connections. This has implications for network configuration and traffic flow, but more importantly it will impact on the location of electronic commerce activities. Different prices for different qualities of service levels may arrive in a competitive market, as users may have different quality demands, as well as because of the differences in communication services and networks.

The withdrawal of price regulation for telecommunications becomes even more important with convergence. Innovative pricing packages should be allowed to play a key role in promoting new convergent services in the Information Society, including the stimulation of a wide take-up and use of online and other services. Another reason why price regulation of telecommunications requires urgent attention is that several areas of communications do not apply price regulation. For instance, the IT and online publishing markets operate almost entirely free from specific price controls. PAY-TV channels including premium services, as well as the commercial activities of free-to-air, are not generally subject to price regulation, but are subject to competition from other market operators. However, in many countries a form of price regulation does seem to occur in the broadcasting sector where price controls (e.g. on the licence fee), seek to keep that service affordable in order that high penetration is achieved for free-to-air channels. In some respects this is not unlike the affordability concern for universal service in telecommunications.

With the development of new multimedia services and the changes these are bringing in terms of the pattern and duration of network usage, there seems to be pressure to consider whether new pricing structures may be necessary. Some believe that the present policies of applying different pricing rules to different networks may no longer be sustainable. At the same time, the existence of competitive delivery channels is likely to restrict the discretion to set prices, for example for network access, independently of other competitors. Although greater pricing flexibility should be allowed to facility-based operators, policy review may be necessary to ensure that proper incentives are in place to facilitate transition from existing to new pricing structures, and to ensure that dominant operators are not using pricing mechanisms to unfair advantage.

Universal access

Convergence by accelerating network diffusion, providing alternate networks, and providing a wide range of services, can be expected to promote those universal and public service considerations which exist in telecommunications, and those which presently exist for broadcasting. There are, however, differences in the culture of universal/public service considerations between the telecommunication and the broadcasting world. There would be broad agreement that, in seeking to maximise the benefits of the information society, universal access would be important for reasons of greater equity and to ensure that all citizens have access to new sources of information. There is, therefore, an important need to assess how such universal access can be achieved without distorting market mechanisms, and to avoid imposing large costs on the community. Universal access may need to be examined in a dynamic way which can change in future and take into account new services.

At the same time, it is important that efficient and cost-effective means of achieving equity are sought. At a time of increasing competition and privatisation, rapid technological change and convergence, it is important that equity-oriented programmes do not result in distortions to *competitive neutrality* not only among telecommunication operators but between telecommunication and other communication suppliers and, indeed, other (non-communication) suppliers as well. In the context of universal access the importance of promoting backbone networks at various levels across countries should also be taken into account.

Policies which enhance greater access to digital markets are also important in terms of enlarging the electronic marketplace and ensuring that there is an adequate threshold of both users and service suppliers in the market. Recognition also must be given to the fact that business requirements and user requirements are different in terms of accessing digital markets. Existing polices aimed at universal service for telecommunications are important in this context as well.

It is important that all members of society can participate in online transactions. Benefits must not be limited to those who can afford terminal equipment, or to pay for monthly access. Consideration needs to be given to public facilities, for example, which would allow wider access to the different online services, and perhaps to a minimum range of services which can be provided through existing means of access to public facilities. Projects which provide Internet access points in public libraries, schools and universities are not only important in a social context, but also help contribute to attaining a critical mass of users which will be important to stimulate the take-off of electronic commerce. However, it is important for governments to ensure that any policies adopted in this context are neutral with respect to technologies, are transparent, no more burdensome than necessary, and do not constitute a barrier to market entry or to market participants.

Global infrastructures and markets

More than 90% of households in high-income countries have network access compared to only 16% in the rest of the world[49]. These data and the fact that 23 developed (OECD) countries account for 62% of all global telephone lines, brings into stark contrast the significant differences in access to telecommunications in the world. Furthermore, much of the investment in the OECD area is going into capital deepening, upgrading network technology so that the real gap is much greater if relative levels of technology are factored into the data. Thus, while high income countries had an ISDN B-channel penetration rate equivalent to 2.67% of main lines, for lower to middle income countries this ratio was 0.04%[50]. Linked with extremely low diffusion of terminal equipment, such as PCs or television sets[51] the opportunities for many countries outside the OECD area to participate in electronic commerce are limited.

Thus, the development of a global electronic commerce environment will require significant investment in developing infrastructures in many non-OECD countries where even basic telephony is lacking or has very low rates of diffusion. There has been increased recognition among the developing economies that the development of such global infrastructures needs to take place in a competitive environment since this will not only ensure economic efficiency but will attract the necessary investment funds to develop networks. In this context, Member countries of the ITU have been urged to adopt the principles in the Reference Paper agreed to by WTO signatories of the Agreement on basic telecommunications[52].

Although limited financial assistance from international agencies (such as the World Bank's Infodev programme) has been forthcoming, the countries themselves must make considerable efforts to restructure their policy frameworks to ensure that they have an open market, encourage foreign investment, and that their regulatory frameworks help stimulate build-out of networks. Initiatives to enhance international co-operation have been attempted, for example, in the context of the 1996 Information Society and Development Conference hosted by South Africa. However, these appear to be insufficient and often do not maintain the necessary momentum to create conditions for sustained growth and infrastructure development.

Convergence is also having important international spillover effects, since many services and information sources, traditionally controlled on a domestic level, are increasingly provided on a global basis. Ensuring a compatible legal and technical framework for cross-border electronic commerce is likely to require international co-operation. Common international principles, for example, may be necessary to support interoperability and interconnection of converging networks.

The globalisation of services is another distinctive feature of the new convergent environment and raises the need to consider whether international regulatory responses are necessary. Satellite television broadcasting across countries is an example. Existing satellite footprints can cover several countries for service provision and can inadvertently provide services to countries where restrictions may be in place limiting service provision. With the imminent arrival of Global Mobile Personal Communication Systems the question of how global services are treated will become of key importance.

Globalisation is increasingly placing pressure for a review of a number of national policies to determine whether they can still serve the purpose for which they were designed. Uncoordinated or fragmented national approaches will undermine the confidence of economic actors in using global networks for trading purposes. The efforts of private sector and governmental organisations should be co-ordinated to ensure compatibility and avoid duplication, confusion and uncertainty.

The recent WTO agreement on basic telecommunications was a significant step in opening global markets to communication infrastructure and service competition. The reference paper, accepted partly or in whole by signatories, provides an important framework of principles for future liberalisation of communication markets. Although initiatives are being taken in the context of the WTO with respect to electronic commerce these need to be extended to include the infrastructure without which electronic commerce could not take place.

5. CONCLUSIONS

The substitutability between communication networks, as well as features of complementarity, imply a policy which allows for bandwidth expansion and technological innovation in infrastructures to take place in a competitive environment which is commercially driven. The emphasis must be placed on business needs, on end user requirements, on how best to stimulate the transformation of existing economic transactions to a network-based model, and on creating an appropriate environment for investment in infrastructure. The implication of these requirements is for less policy influence and attempts at direction with respect to which infrastructures should be available for new electronic commerce applications, and more emphasis on ensuring that: obstacles to demand are eliminated; diffusion of terminal equipment and services take place rapidly; and convergence is facilitated. Only in an environment where electronic commerce application providers can select the most competitive network providers, but also the best service providers, and there be sufficient incentives in undertaking the substantial investment required in upgrading existing networks and providing high speed local loops.

The challenge to governments, if they place high priority on the development and diffusion of electronic commerce and the creation of a large customer base, is no longer to view the different communication network infrastructures as different sectors or markets. As far as electronic commerce and the Internet are concerned, an increasing number of OECD countries are beginning to debate whether policy needs to deal with communication infrastructures as part of a single communication sector where there is no specific relation between services and networks. Placing emphasis on the creation of new electronic commerce services, jobs, and the transformation of economies to an information society is also important.

The reformulation of the specific regulations applicable to broadcasting networks and to telephone and data networks is difficult, but necessary. The economic inefficiencies, which often occur with limited competition in infrastructure, can retard the growth of electronic commerce applications and limit the economic and social benefits which they can provide. Regulators ought therefore to review and examine how the process of market restructuring already underway in telecommunications can be extended and thus allow the development and integration of generic networks that can provide and support all types of services, including entertainment, telephony and electronic commerce. Linked with this is the ongoing debate in some countries to begin considering whether existing telecommunication policy based on asymmetric regulation provides sufficient incentives for rapid upgrading of existing public switched networks and investment in new infrastructures.

While governments have become increasingly aware that they need to dismantle various barriers to electronic commerce and do so in a coherent way so as to create new economic opportunities, they have only begun to review and reflect on how to restructure communication markets. This may mean that it could take several years for change to be implemented.

The process of technological and service convergence within the telecommunications industry, information technology and broadcasting and multimedia industries, is posing a number of significant regulatory challenges. The speed of technological and market change is an element of this challenge because regulatory change moves much slower than market requirements. Another complication is that the ‘old’ regulatory issues have not all been resolved, given the continued dominance of incumbent public telecommunication operators in many markets, and the fact that the transformation to competitive telecommunication markets is only recent in many cases. Thus, ‘new’ issues arising from convergence are likely to continue to coexist with present issues. This adds to the layers of regulatory complexity. The regulatory challenges which policy makers may face include, among others, the following:

- Considering whether and how regulatory frameworks for existing services and networks may need to evolve.

- Considering whether it is timely to eliminate or reduce any existing restrictions on infrastructure operators and service providers.

- Determining where specific provisions in telecommunications regulations can be streamlined.

- Determining where market entry procedures, including licensing, to facilitate market entry and new applications can be streamlined.

- Reviewing the basis for any existing price regulation.

- Examining policies for facilitating wide access to new facilities and services.

- Examining policies for cross-media ownership, and appropriate vertical and horizontal integration.

It is important to remember that regulation is not an end in itself but simply a tool which might be used to achieve policy objectives. In recent years, a primary objective of regulation has been to foster effective competition in order to achieve expected efficiency benefits which include, *inter alia*:

- Lower costs.

- Lower prices.

- Enhanced quality of service.

- Greater responsiveness to and choice for customers.

- Increased innovation.

These objectives are still valid, but must be viewed in terms of the development and diffusion of electronic commerce. In the turbulent, uncertain markets that will be the characteristic of electronic commerce growth and development, it is difficult to predict which infrastructure platform is best for which service, which application will grow the quickest, or which terminal is best suited for access to different services. There must be experimentation by companies, and there will be failures. For these reasons it is crucial that resource allocation decisions are demand-led, and driven by the market.

NOTES

1. See OECD (1998), *The Economic and Social Impact of Electronic Commerce: Preliminary Findings and Research Agenda*. Paris (hereinafter referred to as *Impact Paper*).

2. See OECD (1997), *Towards a Global Information Society*. Paris.

3. See OECD, *The Economic and Social Impact of Electronic Commerce*, op.cit.

4. See, R. Pepper, OECD/OSIPP Workshop on Internet Governance, Osaka, June 1998.

5. Forrester Research Inc., Cambridge, Massachusetts.

6. OECD (1998), *The OECD Jobs Strategy: Technology, Productivity and Job Creation. Best Policy Practices,* Paris.

7. OECD/OSIPP Workshop on Internet Governance, http://www.oecd.org/dsti/sti/it/cm/act/osakaagd.htm#sess7, Paper presented by John Leong, Chief Technical Officer, "Inverse Network Technology, Measuring Internet Performance".

8. See R. Pepper, *OECD/OSIPP Workshop on Internet Governance*, Osaka, June 1998.

9. For example, a multicast video stream of one to four frames per second uses about 128Kbps of bandwidth and has poor quality whereas television-quality video scans at about 24 frames per second and would require, therefore, significantly more capacity.

10. The Internet Engineering Task Force is drafting a standard, Multi-Protocol Label Switching (MPLS), aimed at improving traffic flow.

11. See http://www.inversenet.com/news/pr_05-26-98.html, "Inverse Study Names Top Internet Service Providers for Dial-In Performance and Reliability", 26 May 1998.

12. See DSTI/ICCP/TISP(98)7/FINAL: *Internet Infrastructure Indicators*, OECD (1998), Paris.

13. Asymmetric Digital Subscriber Line. ADSL and xDSLs are modem standards used to achieve high speed transmission at the local loop. The technique is asymmetric as the upstream channel is only narrowband, but recently a symmetric version, called SDSL, was introduced which provides symmetrical 3 Mbit/s channels over a single subscriber loop.

14. Bandwidth is the amount of data that can be transmitted in a fixed amount of time.

15. Http://www.dtag.de/english/company/g_zahl/g_bericht97/index.htm.

16. The business market is far from being homogeneous given that the requirements of large businesses are quite different from small and medium enterprises, and given the range of different applications that business requires.

17. Excite Technology News, 19 August, 1998.

18. A 'host' is a computer connected to the Internet, especially one with its own IP address, that is, the computer on which a Web site is physically located.

19. OECD, *Internet Pricing*.

20. OCDE/GD(96)73: *Information infrastructure convergence and pricing: The Internet*, OECD (1996), Paris.

21. http://jup.com/index.shtml, Newsbytes, Jupiter Communications, 4 April 1997.

22. "Au Revoir Minitel As France Readies National Web-TV Network", *TotalTele*, 24 November 1997.

23. *Reuters* and www.ovum.com.

24. *OECD Communications Outlook 1997*, OECD Paris.

25. xDSL refers to a set of Digital Subscriber Line Standards (which are modem standards). Examples include Asymmetrical, high-bit-rate, Symmetrical, Very-high-bit-rate Digital Subscriber Lines (ADSL, HDSL, SDSL, VDSL.).

26. For example, E-1 circuits in Europe equal 2Mbits/s or T-1 lines in North America equal 1.5Mbits/s.

27. Fibre prices have also increased recently as network construction has accelerated.

28. *Fiber Deployment Update: End of Year 1996*, Jonathan M. Kraushaar, FCC.

29. WRQ Consultants Ltd.

30. Worldgate at http://www.tvol.com/index.html; "General Cable to Test Video-Based Internet Access", TotalTele, Sheridan Nye, 24 October 1997.

31. Examples of LEO satellite systems are: Teledesic ("Internet in the sky"), Celestri, Skybridge, Iridium and GlobalStar.

32. *OECD Communications Outlook 1997*, OECD Paris.

33. *OECD Communications Outlook 1999*, OECD (forthcoming).

34. Nortel (Northern Telecom) and NorWeb Communications, London, 8 October /PRNewswire.

35. GBP 200, see previous note.

36. See OCDE/GD(97)18: "*Information Infrastructures: Their Impact and Regulatory Requirements*", Paris, 1997.

37. See http://www.totaltele.com/cwi, 2 March 1998.

38. See OCDE/GD(97)221 "Webcasting and Convergence", 1997.

39. For example, in Australia and New Zealand.

40. See OECD, "Internet Traffic Exchange: Developments and Policy", DSTI/ICCP/TISP(98)1/FINAL, 1998.

41. See http:www.ispo.cec.be/standards/conf97.

42. IMT-2000 encourages convergence of the many diverse satellite and terrestrial mobile systems towards a third-generation global mobile communications system which is also expected to handle multimedia applications.

43. Study Group 13 of the Telecommunication Standardization Sector is, for example, examining interoperability issues, naming and addressing schemes and integration of ATM and IP networking.

44. http://www.itu.int/imt/.

45. ETSI SMG (www.etsi.fr).

46. The Domain Name System essentially maps Internet addresses and is a necessary element enabling communication routing to function. It works for any Internet service that requires domain names: e-mail, WWW, FTP and so on. To function as part of the Internet a host needs a domain name that has an associated Internet Protocol (IP) address record.

47. For example, on average fewer than four calls a day are made on a Dutch telephone line compared with ten in the United States: See *KPN Annual Report*, 1996.

48. See *OECD Communications Outlook 1995*.

49. ITU, *World Telecommunication Development Report*, 1998.

50. Ibid., Table 13.

51. An average in 1996 of 22.28 PCs per 100 inhabitants for high income countries compared to 2.92 for upper middle income and 0.23 for low income. ITU, op.cit. Table 19.

52. Chairman's Report, ITU Regulatory Forum, March 1998.