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**COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY**

# INFORMATION INFRASTRUCTURES: THEIR IMPACT AND REGULATORY REQUIREMENTS

**ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT**

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## FOREWORD

This report was presented to the Working Party on Telecommunication and Information Services in January 1996 and was subsequently recommended to be made available to the public by the Committee for Information, Computer and Communications Policy (ICCP) in September 1996.

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## MAIN POINTS

Governments of most OECD countries have in recent years been emphasising the importance of information infrastructures and the opportunities for increased productivity, the creation of new economic activities and jobs that their development is expected to bring. Evidence regarding the development of networks, applications and pricing indicate that existing market structures and therefore policy frameworks in most OECD countries are not conducive to support the rapid and efficient development of information infrastructures and multimedia applications. Some countries have begun to face up to the economic and social challenges as well as opportunities raised by information infrastructures and multimedia applications. In certain cases countries are trying to rapidly consider and apply the appropriate frameworks, while other countries are only at an early stage.

To realise the growth and long-term employment potential of new technologies, this paper argues that it is essential to introduce competitive market structures, allow the process of convergence to take place between communication sectors, and implement appropriate regulatory frameworks for integrated communication infrastructures and new multimedia activities. Only through efficient and competitive infrastructures will applications emerge and diffuse throughout the economy. It is through this process of development and diffusion of applications that economic opportunities will be realised. There are high social costs from inefficiencies of non-competitive markets, in particular lower rates of investment, slower development and diffusion of applications, and higher prices. There is a danger that governments will through policy immobility be responsible for missing these opportunities if they do not allow economic actors to exploit the challenges provided by information infrastructures and multimedia applications to create new economic activities. The challenge for government is to ensure that the private sector, and governments themselves, can efficiently harness these new technologies to increase productivity, to provide new services, and to increase the efficiency of existing service provision. The importance of implementing global regulatory principles and frameworks has also been stressed.

This report has argued that:

- Regulatory policy must be neutral with respect to the development of infrastructure. The role of government as a regulator should be to facilitate the development and diffusion of technologies and ensure the right investment conditions are in place.

- It is necessary to eliminate the traditional regulatory paradigm based on strict communication service boundaries and parallel non-substitutable networks and services. Regulators must allow and provide the proper incentives for the merging and interconnection of networks and merging of services presently based on different technologies and structures. There is also a need to review content regulation, especially in terms of liberalising the provision of transborder flows of information including content.

- The lessons from introducing competition in telecommunication markets have shown that market restructuring and the elimination of entry barriers often require a transition phase to attain a fully competitive market. This can be a relatively long process requiring an effective

regulatory framework with adequate safeguards to ensure fair competition. A number of regulatory requirements will be necessary in particular an effective framework for interconnection and equal access.

- Governments can play a significant role in creating mass markets for information infrastructure applications by adopting their use for public services and general administration.

- Present telecommunication pricing structures are unsuitable for access to and use of multimedia applications. If national operators, service suppliers and governments wish to stimulate the development of on-line multimedia applications then existing telecommunication pricing structures will require fundamental change.

- The policy goal should be to develop a range of applications and an efficient market which requires not only competing fixed-link structures but competing technologies and networks. Policy needs to take into account possible economies of scales and scope, but it should not be necessary for regulators to decide on the number and types of networks excepts where there are clearly defined resource limitations which may require rationing.

- The principle of universal service needs to be maintained for information infrastructures and appropriate services which are viewed as essential need to be defined over time. It is premature to do this at this stage of service development, but rather it should be an evolutionary process.

- In a highly developed information economy interoperability between systems and services, and different services, is important in terms of ensuring the development of services and their diffusion across the economy. Governments need to ensure that their policies in this context do not create disincentives to private investment and the development of applications.

- At the international level it is necessary to have greater harmony between national regulatory concepts and practices. The issue of foreign investment and limitations placed on ownership by foreign entities of domestic network operators is key to the process of international infrastructure competition and liberalisation.

- In addition to national pricing structures, the issue of international communication pricing remains important, and in particular the system for settling accounts for bilateral traffic flows. The rapid introduction of competition would provide the best means to restructure international telecommunication pricing structures.

Governments have also begun to work together on common projects, to share experiences, to try to solve common problems, and to try to achieve open and compatible frameworks. In a number of policy areas there has been an important commonality in the principles countries are contemplating in adopting. Perhaps where the greatest challenge lies is in the details of elaborating and implementing these principles. There is consensus that action is required, however what is lacking perhaps is speed in implementation.

It is also important for OECD countries to be aware of, and take appropriate action to overcome, the significant gap which exists in the present level of infrastructure development between the developed and the developing countries. Without a more concerted international effort the concept of global information infrastructures will be a myth.

# CHAPTER 1 INTRODUCTION

> "The information highway is more than cable and copper wire; it is a metaphor for the promise and uncertainty surrounding the emergence of a world-wide communications network driven by innovation, competition and technology." (Canadian Radio-television and Telecommunication Commission)[1] .

## Background

Underlying the significant interest which has emerged over the last years in information infrastructures is the perspective that industrial economies are at the threshold of potentially radical changes in their economic structures. Information infrastructures, and related applications, are viewed as providing the foundation for the transformation of existing social and economic relationships into an "information society". Such an information society is viewed as resulting in a paradigm shift in industrial structures and social relations, much as the industrial revolution transformed the then agrarian societies. A key feature of such a society is the transformation of the market place; networks will provide the marketplace of the future bundling together transport, access and market transactions[2]. The driving force behind economic growth and development in such a society will not be natural resources or physical goods but information. Based on the premise that communication networks and markets are to play an important role in economic exchange in the future, then their development, structure, price and availability will be important in shaping future social and economic life.

Harnessing the process of change promised by advanced communication infrastructures, and accelerating change, is viewed as important in the present economic context[3]. There are several reasons for this. First, the need to stimulate economic growth, and in particular long term employment growth which the development of information infrastructures (II) is expected to generate. Second, the belief that public policy has a role to ensure that the potential economic gains from II will be realised rapidly. Third, that country differences in market structures and in policy tools to assist the development of information infrastructures can lead to potential frictions between countries and will also act to limit the overall potential economic impact which could result from development of such infrastructures. Fourth, and following the latter point, that in the context of global economic interlinkages it is important to examine the issues and role of II from an international perspective and impact because information infrastructures are global by their nature.

The purpose of this paper is to address a number of key questions being posed with regard to information infrastructures (II):

- What are the challenges in developing information infrastructures?
- What are the issues with respect to the impact of II on economic and employment growth?
- What is government's role in IIs?

- What are the policy requirements to ensure the rapid development of IIs?

- What are the international policy requirements relevant for global information infrastructures?

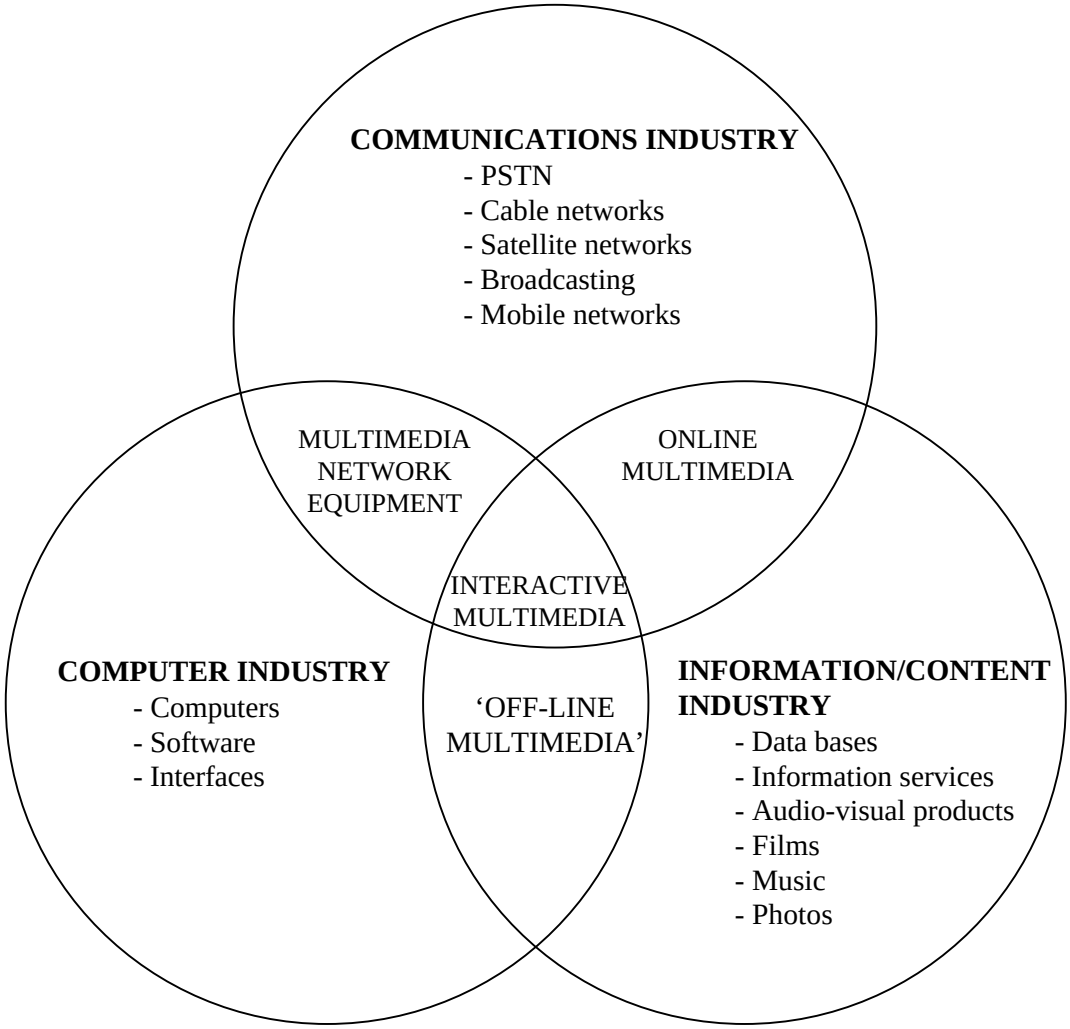
The driving force behind the changes are the commercial opportunities which manufacturing and service industries foresee as arising from the development of information infrastructures and their applications. The basis for these opportunities is the common format that digitalisation is providing allowing for common delivery systems to be used for all types of information, integrating different types of services, and providing the opportunity to develop new services. These developments are also leading to the breakdown of existing industry boundaries not only in the industries traditionally producing and delivering information but also in using industries. The increased role of information in economic activity is also a significant factor in this context. Information differs from other economic outputs in that it is non-exclusive (it can be consumed by many consumers) and it is often non-destructive (that is consumption does not always require an increase in supply)[4]. The development of information infrastructures and applications are also viewed as having longer term impacts on employment, occupational structures, working conditions and social relations.

National developments in information infrastructures have international spillover effects. Networks and the delivery of services on these networks do not respect borders. Already, there is an interconnected global telecommunication network in place based on national public switched telecommunication networks. This has taken place as well through the interconnection of packet switched data networks. Many private networks as well have become global. Increased bandwidth and more sophisticated applications and services will have important implications at the global level for the development of networks.

Governments have a crucial role to play in the development and diffusion of information infrastructures. This is because the main sectors which will be involved in information infrastructure development and development of new services are in most countries heavily regulated, and their existing market structures are not viewed as conducive to the development of information infrastructures and the diffusion of new applications. Second, governments themselves are expected to be significant users of new II services. Third, diffusion of many new II services will depend on having appropriate administrative, legal and commercial frameworks in place to facilitate electronic commerce, transactions and delivery of new services.

The traditional depiction of the convergence taking place between main economic sectors underlying the transformation to an information society can be depicted in simplified terms in Figure 1. Within the communication service industry itself convergence is taking place as once different networks begin to offer a similar range of services; cable television networks now offer telephony and telecommunication networks programming. Mobile networks, although presently being treated as separate from fixed networks will begin to merge offering a package of telephone services to customers. Similarly, the media industries (content) are increasingly converging with software and computer applications; and networks have become important as a means of distribution, accessing customers and providing new applications such as interactivity. However, a one-dimensional diagram is deceptive, showing only the integration and convergence of sectors. Market developments include both horizontal convergence and vertical convergence of enterprises and they are also occurring at the service and equipment level. Above all, the convergence of networks is in itself a key driving force of change both within the telecommunication industry and for the economy at large.

**Figure 1.1**




*Source*: Devotech "Developpement d'un environnement multimedia en Europe"

**Information infrastructures**

There is no accepted international definition of Information Infrastructures, nor is it desirable to have strict or narrow definitions given that technologies and applications are changing rapidly. The terminology used across countries differs but there is a core consistency in the concepts encompassed by information infrastructures. In the United States the term National Information Infrastructures (NII) has become current. In other countries terms such as Information Highway, Integrated Broadband Communications, Electronic Highways, Information Networks, etc., are being used.

What is important is that the term information infrastructures is understood broadly. The United States in its "Agenda for Action"[5] recognises that the term information infrastructure should be interpreted widely to include not only the network itself but the relevant terminal equipment, the information databases and applications and software. This wider definition, therefore, includes both the physical

transmission and switching capacity, peripheral equipment attached to the network, the application software and downstream activities. In Canada the term "information highway" is viewed as describing a global network of networks[6]. The European Commission uses the term Information Society laying stress on the fact that the applications and development of information infrastructures have more than a purely economic impact but also have important social dimensions. However, an analysis of policy proposals, position papers and national reviews which have been undertaken by OECD countries on information infrastructures shows a large degree of consensus with regard to the understanding of the coverage of information infrastructures, the leading principles which should underlie the development of information infrastructures and applications, and on their economic and social potential.

In some analysis it has been viewed useful to differentiate between the infrastructure per se and applications. Although the latter differentiation may have some merit for some analytical purposes it can be difficult in practice to make such a differentiation since in most areas network-based applications are highly dependent on the infrastructure and its capabilities. Such compartmentalisation also tends to ignore the importance of using information infrastructures as a general concept encompassing networks, applications, and the policy and commercial framework binding these developments.

Essentially, information infrastructures are largely based, but not limited to, broadband communication technologies which, through the process of digitalisation of communication infrastructures, the convergence of these technologies with broadcasting technologies, and recent technological developments for switching and transmission, allow rapid transmission of large quantities of information at low cost. Unlike existing networks which are restricted as to the datastreams they can carry, broadband can carry integrated data, video, text and voice traffic. Broadband has therefore multimedia service capabilities. There is commonalty in that the information is in digital form.

It is erroneous to view II as a single network infrastructure, or based on a single technology. On the contrary, the common digital base will allow a number of different technologies to integrate and interoperate. Diversity will be important in terms of user demand and in terms of the economic impact of information infrastructures.

Broadband infrastructures and services are sector independent in that they will serve equally well the data processing sector, the broadcasting and entertainment sectors and the telecommunication sector. By providing a common transmission and switching medium, broadband also facilitates the integration of services. By allowing carriage to be provided at low prices, broadband provides the means for service provision on a personal basis and on demand, that is, to the home or to the office. Through digitalisation there is an opportunity to integrate terminal equipment which can, in turn, provide the integrated services. Because of its capacity, cheap switching and the intelligence which can be built into terminals, broadband allows for interactive applications with customers, which significantly augments the range of applications available.

Interactivity is an important characteristic of information infrastructures from a technological, economic and social aspect. Existing networks are either one way (e.g. broadcasting networks) or do not in general provide sufficient speed and capacity to allow for interactive applications (e.g. the public switched telephone network). Interactivity will require that sufficient capacity and bandwidth is in place for the use of a range of applications; from a technological perspective a high demand for interactivity could have important implications for the technology available to users, and the degree of interactivity may be directly correlated with the economic and social impact.

The broadband market is normally viewed as constituting four main areas: backbone networks, enterprise networks, residential networks and integrated community networks. These four areas also reflect the service areas which will develop as an outcome of the development of information infrastructures. Traditionally most advanced communication services have been viewed as being limited to manufacturing and service industries. II applications are viewed as having an economy-wide impact including directly on the residential market. In fact one of the characteristics of information infrastructures is the potential that is viewed in developing mass markets for residential customers. In the latter context the range of applications is often covered by the term 'multimedia', although this term should not be viewed as being limited to applications only for the consumer market[7].

Many of the concepts and aspirations which are presently being put forward with regard to information infrastructures are not new. They have in a number of cases been put forward in the 1980s. For example, the European Commission's RACE programme (R&D in Advanced Communications-technologies in Europe) dates from the mid 1980s[8] with an objective toward the "introduction of Integrated Broadband Communication (IBC) taking into account the evolving ISDN and national introduction strategies, progressing to Community-wide services by 1995"[9]. France, in the early 1980s, had a vision of the information society and, based on its Biarritz cable project, put forward the (short-lived) Plan Cable. Japan's NTT was already forecasting significant expenditures in the mid-1980s to create its Information Network System. The race to develop and define high definition television following the Dubrovnik ITU's CCIR Plenipotentiary of 1984 was part of the national emphasis to develop information societies. These early visions of change based on emerging technology of the time provide important lessons to policy makers since they attest to the complexity in adopting and diffusing new technologies, but also to the inadequacies of the market mechanisms that were in place in the 1980s to exploit new technologies and services. But there were also a number of pilot projects in some OECD countries launched by the private sector in the late 1970s and in the 1980s which were not commercially successful. In some cases the technology was immature and did not live up to expectations, in other cases user demand was not evident either because prices were too high or the services were not sufficiently innovative to substitute for services existing at that time. These pilot projects covered many of the same services being proposed today for pilot projects (home banking, distance learning, video-on-demand, etc.). Many pilot programmes have suffered from coming onto the market too early. An example of such a service is the introduction of video-telephony in the early 1970s by AT&T which failed, but which according to most analysts is now ripe for market entry (with of course significant improvements in technology since then).

By the mid to late 1980s many OECD countries had put into place (often funded by Governments) interactive videotex services either on a commercial or experimental basis. In some cases these services foundered. In hindsight it is now evident that videotex was a technological possibility that has been superseded by subsequent developments in technology.

Since the mid 1980s when many of the key technologies appeared on the horizon, the new communication technologies have matured. But these new technologies have also evolved significantly during the period and have stimulated the development of a number of other technologies leading to a new cycle of change. In a number of cases new technologies which were diffusing slowly through the economy have been by-passed by other technologies so that the diffusion process has been at times fragmented by competing immature technologies.

If any lessons can be learned from these past experiences, they are that the successful emergence of new services will result mainly from a combination of favourable innovation (the technology-push) and market demand (demand-pull), that vigorous competition is necessary to develop applications and encourage their diffusion, and that government intervention in choosing technologies and in determining development strategies should be untertaken with care.

Perhaps the most important difference in the present context with the renewed emphasis on information infrastructures is that the technology is now much more mature, the required fibre and digital switching backbones are in place, and the fact that the emphasis is now more on applications and implementation than on technology.

The aim of this report is to examine the market and regulatory frameworks required for the development of information infrastructures. Underlying the requirement to develop these infrastructures is the ability to create new services and markets based on networks which may increase productivity and provide new job opportunities. The challenge for governments is to remove the structural impediments which restrict the development of these multimedia services and provide a framework for enterprises and users to develop and meet their requirements.

# CHAPTER 2 THE DEVELOPMENT OF INFORMATION INFRASTRUCTURES

## Introduction

Technological developments are impacting the broadcasting and entertainment industries, software and computer service industries, the information technology and communications equipment industry and the communication service industries in different ways. Each sector has to overcome technical and economic challenges and, increasingly, has to co-operate and integrate technologies and services. For some areas public policies directly impact the development and diffusion of technologies and services, while for others public policy is less important. Nevertheless, trends toward convergence often imply that activities which have not up to now been regulated, are restricted in their development and provision of applications by policy road blocks in other areas of activity. In this paper the stress is placed on communications infrastructure, communications services and related policies since it is here where the most significant restructuring is required from an industry and from a policy perspective. It is also at the level of the infrastructure where the bottleneck occurs in developing the information economy and diffusing services for the information economy. This is not to say that this is the most important policy area: other areas such as the legal frameworks for privacy, issues of network security and intellectual property protection are equally important in order for applications to develop and to be distributed[10].

Convergence is affecting a number of hitherto stand alone sectors and resulting in structural changes. Agreed statistical classifications as to what constitutes the information economy do not exist. Some even doubt, given the pace of change in technologies, products and services, whether such classifications can be meaningfully developed until a certain level of maturity has been reached in these sectors. Nor are consistent data across OECD countries available, but country specific data indicate that the total weight in the economy of the information sector defined broadly is relatively large and growing rapidly. For example, in Canada the information economy accounts for close to 7 per cent of GDP (table 2.1). Employment in IT services in Canada was 318 000 in 1995 representing about 2.5 per cent of total employment and has grown at about twice the rate of total employment (Table 2.2).

For the European Union the relative distribution of activities directly or indirectly concerned with the development and diffusion of information infrastructures and multimedia applications are shown in the Figure 2.1.

In Japan, as well, the market growth in information/communication activities has shown very high growth during the 1985-90 period (Table 2.3). By 1992 the information/communications sector accounted for 9.5 per cent of Japan's GDP and the ratio of employment in this area had attained by 1994 7.5 per cent of the work force.

Although in a number of countries continued high growth is expected in many of the sectors covered by the term information infrastructure, such growth will be contingent on appropriate market structures and frameworks.

**Table 2.1. The Information Economy in Canada, 1995**

| | Revenues in $C | % of GDP in 1996 |
|---|---|---|
| IT Service Revenues | 43.4 billion | 4.8 |
| IT Goods Revenues | 16.9 billion | 2.0 |
| Total ICT | 60.3 billion | 6.8 |

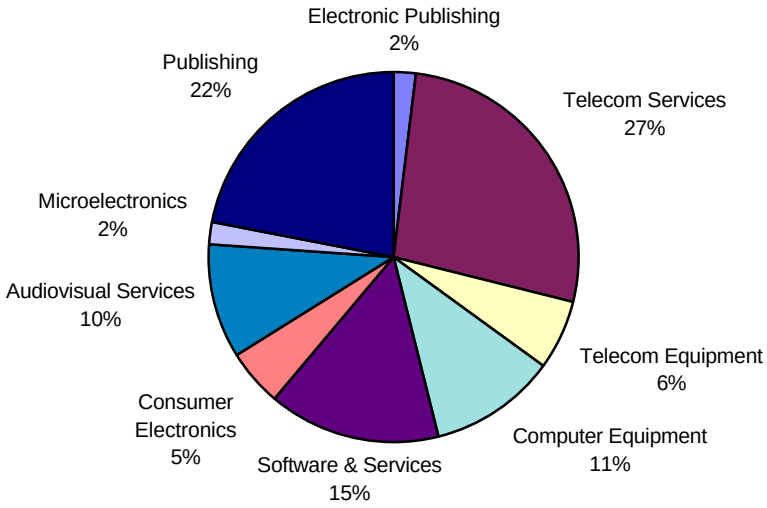
*Source:* STATSCAN

**Table 2.2. IT Employment (000)**

| | IT Services | IT Service Index | Total Economy Index | IT Service Share |
|---|---|---|---|---|
| 1976 | 110 | 100 | 100 | 1.7 % |
| 1995 | 318 | 198.9 | 139.5 | 2.4 % |

*Source:* STATSCAN

**Figure 2.1. Distribution of Activities in the Information Economy by 1993 Revenues: European Union**
(Total Market 414 billion ECU)




*Source*: Devotech, 1995

**Table 2.3. The Market Growth of Information/Communication Activity 1985-90**
Percentages

| | |
|---|---|
| Information/Communications Industry | 5.22 |
| Communications, Broadcasting | 6.88 |
| | |
| Communications | 6.62 |
| Postal | 5.40 |
| Telecommunications | 6.89 |
| Type I | 3.95 |
| Type II | 24.84 |
| International | 3.96 |
| Other Communications | 15.63 |
| | |
| Broadcasting | 8.05 |
| Public | 5.52 |
| Private | 8.37 |
| Cable | 8.05 |
| | |

*Source:* Report for the Study on Communication IO table configuration, Ministry of Posts and Telecommunications, Japan, 1993.

**Network growth and investment**

The underlying basis for information infrastructures are already in place. Some analysts have even argued that the backbone for the information highway is in place and that only the "on" and "off" ramps are missing. Over the last decade telecommunication operators from OECD countries have been undertaking significant investments in infrastructure, both in terms of capital expansion and capital deepening. Total OECD investment by public telecommunication operators totalled US $103 billion in 1993 representing 3 per cent of gross fixed capital formation (GFCF) in the OECD area. Capital expansion has consisted in attaining national coverage of the telecommunication network and meeting new demand so that by 1994 there was an average of 50 telecommunication main lines per 100 inhabitants[11] compared to 35 per 100 in 1982. This figure contrasts with the average main lines per 100 for the world which stood at 11.6 in 1994. In addition to the expansion of the public switched telecommunication network (PSTN), there has been significant investment in public data networks.

Capital deepening has consisted in investment in digital switching, and fibre optic transmission systems so that by 1992 57 per cent of fixed networks had digital mainlines. Between 1990 and 1992 for every one new customer connection to the public switched network there were at least two digital upgrades for the lines of existing customers in a number of OECD countries[12]. Between 1992 and 1994 there was in many countries a significant improvement in the rate of digitalisation. A number of countries with competitive facilities-based telecommunication operators are installing second (or in some cases more) national infrastructures. Further, market opening expected to take place in most European Union countries by 1998 is expected to also result in increased infrastructure investment. Different estimates suggest that the ratio of telecommunication investment in GFCF will be in the region of 10-12 per cent by the end of the present decade[13].

In addition to investment in the fixed communications infrastructure there has also been considerable investment in other communication technologies[14]. For example, the mobile communication market has shown extremely rapid growth and by the end of 1994 there were over 44 million subscribers in the OECD area[15]. Growth in areas such as Very Small Aperture Terminals (V-SAT ) services has also been rapid. Manufacturing and service industries have been investing heavily in communication infrastructure, not only in private branch exchanges (PBXs), but in local area networks (LANs)[16]. In addition to these telecommunication networks some countries have been building up their cable television (CATV) infrastructure. New potential areas of investment include Personal Communication Systems based on low earth orbit satellites to provide mobile voice and data services. There are also proposals to introduce Fixed Satellite Service (non-Geostationary Orbit) to provide global broadband data communications (to contribute to so-called 'fibre in the sky' systems). Other promising technologies include wireless in the local loop which is expected to provide a low cost competitive solution to fixed wire access to the home.

Investment data alone do not capture the significant qualitative improvements that have been taking place in communication infrastructures and in the peripheral equipment attached to these infrastructures. Quality improvements have impacted both switching technology and transmission as well as customer terminal equipment. The rapid diffusion of multimedia computers, for example, is increasing the number of users on the Internet and consequently having implications for communication networks and applications. Packet switched data networks have been playing an important role in national economies and internationally in information exchange including in the development of the Internet which is expected to play a significant role in the economy and society.

The contrast among OECD countries in availability of these means of access is quite stark (Table 2.4) and indicative of the time and investment requirements which are still necessary to adjust to the potentials of an information society. The data also overstate access capabilities in that in many countries cable TV density is relatively low and it this infrastructure which at present provides a promising competitive challenge to telephony rather than the broadcasting medium. As well, modem availability is relatively low in most countries implying that many PC are still not able to access networks and many PCs are not sufficiently powerful to be used as a tool for access to information infrastructures.

Although most PTOs have been investing heavily in fibre-optic, especially for long distance backbone networks[17], there are still important differences between OECD countries in network development and the extent of network digitalisation (Table 2.5). In the context of the development of multimedia applications it is not only network development which is important but the diffusion of other technologies such as multimedia computers, servers, etc. For example, the rate of diffusion of touchtone telephones is important given their necessity in accessing many services (in 1994 for example the UK had a penetration rate of 30 per cent for residential customers and 45 per cent for business customers for touchtone phones).

Between the OECD and the rest of the world the gap in network development is large and although there appears to be some reduction in disparity it has been extremely slow (see Chapter 6). Further comparative data do not bring out the fact that OECD countries have been investing heavily in digital technology so that the measure of mainlines per capita does not bring out the wider gap in disparities in network capability. In terms of the development of global information infrastructures these disparities need to be overcome.

**Table 2.4. Multimedia Access, 1994**
Per 100 inhabitants

| Country | Telephone Density | TV Density | PC Density |
|---|---|---|---|
| United States | 59.5 | 79 | 29.7 |
| Denmark | 60.4 | 55 | 19.3 |
| Canada | 57.5 | 65 | 17.5 |
| Sweden | 68.3 | 48 | 17.2 |
| Australia | 49.6 | 48 | 21.7 |
| France | 54.7 | 58 | 14.0 |
| Switzerland | 59.7 | 41 | 28.8 |
| Netherlands | 50.9 | 48 | 15.6 |
| Germany | 48.3 | 55 | 14.4 |
| Japan | 47.8 | 64 | 12.0 |
| United Kingdom | 48.9 | 45 | 15.1 |
| Austria | 46.5 | 48 | 10.7 |
| Belgium | 44.9 | 47 | 12.9 |
| Italy | 42.9 | 45 | 7.2 |
| Spain | 37.1 | 42 | 7.0 |
| Greece | 47.8 | 22 | 2.9 |
| Portugal | 35.0 | 25 | 5.0 |
| Turkey | 20.1 | 27 | 1.1 |
| Mexico | 9.2 | 20 | 2.2 |

*Source:* ITU World Telecommunication Development Report, Geneva, 1995.

Connecting these national telecommunication infrastructures are a web of international cables, both copper and fibre, around the globe as well as satellite systems (see Box 2.1). This embryonic global information infrastructure has developed rapidly across some routes, in particular across the heavy traffic paths such as the Atlantic. Investments in new cable systems have resulted in extremely high rates of increase in capacity with developments in cable technology and multiplexing (Table 2.6). Thus the cable TAT-12/13 which is expected to come into service across the Atlantic in 1996/97 will add a further 600 000 voice paths, effectively doubling trans-Atlantic capacity. NYNEX's FLAG[18] is expected to add by 1997 a further 600 000 voice paths linking the UK to Japan with 13 landing paths en route. In conjunction with capacity increases, and because of technological change the cost per voice path across major routes has declined from about $9 000 to present levels of about $1 000 a voice path.

**Box 2.1. Fibre-optic Undersea cable:**

| | |
|---|---|
| Atlantic | 75 853 km |
| Caribbean | 14 869 km |
| Mediterranean | 17 116 km |
| Northern Europe | 10 771 km |
| Pacific | 55 500 km |
| Southeast Asia | 36 519 km |
| Inter-regional | 17 790 km |
| Total | 228 058 km |

*Source:* Alcatel

## Table 2.5. Network Development in OECD Countries

| | Fixed Network (% of digital lines) | | | Mobile Network (% of subscribers to digital network) | |
|---|---|---|---|---|---|
| | 1990 | 1991 | 1992 | 1992 | 1994 |
| Australia | 23 | 26 | 40 | 0 | 51 |
| Austria | 11 | 18 | 27 | 0 | 46 |
| Belgium | 37 | 45 | 48 | 0 | 60 |
| Canada | 50 | 69 | 80 | 0 | 88* |
| Denmark | 29 | 33 | 40 | 0 | 53 |
| Finland | 28 | 42 | 51 | 1 | 68 |
| France | 70 | 79 | 83 | 0 | 89 |
| Germany | 12 | 16 | 30 | 20 | 45 |
| Greece | 1 | 4 | 11 | 0 | 31 |
| Iceland | 39 | 42 | 49 | 0 | 85 |
| Ireland | 55 | 63 | 68 | 0 | 67 |
| Italy | 33 | 41 | 48 | >1 | 67 |
| Japan | 39 | 49 | 60 | 0 | 72* |
| Luxembourg | 31 | 50 | 70 | n.a. | 82* |
| Netherlands | 33 | 79 | 86 | 0 | 100 |
| New Zealand | 72 | 92 | 95 | 0 | 98 |
| Norway | 38 | 45 | 51 | 0 | 71 |
| Portugal | 30 | 45 | 54 | 0 | 71 |
| Spain | 28 | 34 | 36 | 0 | 48 |
| Sweden | 38 | 47 | 54 | 1.5 | 67* |
| Switzerland | 28 | 36 | 43 | 0 | 57 |
| Turkey | 48 | 51 | 56 | 0 | 55 |
| U. K. | 47 | 55 | 64 | 0 | 83 |
| US | 43 | 53 | 60 | 0 | 65 |

1. OECD is a weighted average rather than a simple average.
2. Asterisk signifies 1993 data.

*Source:* OECD; Communication Indicators for Major Economies, 1995, Eurostat/OECD/ITU.

## Table 2.6. Capacity and Cost per Voice Path of Selected Trans-Oceanic Cable Systems, 1956-2000

| | Year in Service | Cable system | Cost per voice path | Capacity (Voice paths) |
|---|---|---|---|---|
| Trans -Atlantic | 1956 | TAT-1 | 557 000 | 89 |
| | 1970 | TAT-5 | 49 000 | 1 440 |
| | 1989 | PTAT | 6 000 | 85 000 |
| | 1994 | CANTAT | 1 000 | 302 000 |
| | | | | |
| Trans-Pacific | 1957 | Hawaii 1 | 378 000 | 91 |
| | 1974 | Hawaii 2 | 41 000 | 1 690 |
| | 1992 | TPC-4 | 5 500 | 75 600 |
| | 1996 | TPC-5/6 | 2 000 | 605 000 |
| | | | | |
| Japan/UK | 1997 | FLAG | 1 500 | 605 000 |

1. Costs are capital and construction costs only, stated in US$ to the nearest $500, unadjusted for inflation.

*Source:* TeleGeography.

In addition to the public switched networks, the development of alternate infrastructures, such as cable television networks, is important because they provide potential competition to the existing fixed networks. In the context of information infrastructures CATV networks provide an important means of access to customers, both business and residential. It is not yet clear whether residential customers will access information services on-line via telecommunication networks, or CATV networks (or both). Nor is it clear how the two different networks will evolve toward broadband. However, it is likely that the two networks will become similar in terms of their ability to provide services. In terms of ensuring adequate levels of competition, CATV networks, by providing a second wire to the home, are important.

Even greater differences exist among OECD countries in their development of cable television infrastructures compared to telecommunication infrastructures ( Table 2.7).

**Table 2.7. Percent of Households Subscribing to Cable TV**

| COUNTRY | CABLE TV |
|---|---|
| Europe | 20.5 |
| Germany | 31.0 |
| France | 3.0 |
| UK | 2.0 |
| Italy | N/A |
| Spain | 1.0 |
| Austria | 28.0 |
| Belgium/Luxembourg | 92.0 |
| Denmark | 34.0 |
| Finland | 27.0 |
| Greece | N/A |
| Ireland | 39.0 |
| Netherlands | 84.1 |
| Norway | 40.0 |
| Portugal | N/A |
| Sweden | 43.0 |
| Switzerland | 60.0 |
| US | 59.0 |

*Source:* OECD, various according to country.

**Future network development**

In a technologically simple world telephony was limited to copper wire and policy makers did not have to dwell on choosing technologies. Investments were undertaken in a planned and structured way with well calculated pay-back periods, and new technologies were often eschewed because sufficient revenue was being earned from existing technologies. Competition, or the imminent threat of competition, together with rates of technological change affecting all facets of the infrastructure, is now requiring rapid strategic decisions by PTOs.

There are a range of new technologies entering the market some of which are competitive, some complementary, and some likely to be used only for niche markets. The characteristics and economics of these new technologies are also changing rapidly, and will continue changing through competition, and through consumer demand which may give preference to a particular technology.

Policy makers can learn some useful lessons from past experience with new technologies, especially in a monopoly environment. A number of years ago the accepted scenario for the development of communication infrastructures was to put into place narrow-band integrated services digital networks (ISDN), and to migrate from there to broadband integrated services digital networks (B-ISDN). The ISDN concept was first put forward in the late 1960s and defined and standardised in the 1970s and 1980s. The concept of ISDN is aimed at supporting a wide range of voice and non-voice applications using the same network (and thus using the same subscriber line). The services offered on ISDN are divided into Basic service and Primary service: basic service uses copper telephone as the subscriber line and primary service uses optical fibre as the subscribe line.

The diffusion of ISDN has begun to accelerate in the last few years. Although by 1993 ISDN subscribers in OECD countries amounted to only 925 000 or about 0.2 per cent of telephone connections in the OECD (Table 2.8), the acceleration in subscribers has been driven by the demand for access to information services, in particular Internet based services, and has been facilitated by more rational pricing by operators which in certain countries has made ISDN access affordable even to residential customers. They therefore preferred to lease circuits and create private networks. Recent experience shows an acceleration in the availability to access ISDN lines in the US (Table 2.9). A similar acceleration is occurring in Europe with a number of European countries having set the date for national ISDN coverage as early 1996. The recent spurt in the number of ISDN subscribers has been responsive to PTOs offering better pricing purchases for ISDN services. However, there are still OECD countries which have no plan for nationwide ISDN coverage. The ability of operators to offer international ISDN service has also been very limited, although it is becoming more positive within Europe.

The growth in new customer demand, linked with the opening of competition in the provision of data communication services in some countries, and increasing liberalisation of leased line usage, have been prime motivating factors in PTOs growth in ISDN subscribers.

The early development of ISDN in a number of countries is indicative of the strategy of many monopoly public telecommunication operators who have put emphasis on long phase-in periods for new technology with long payback periods and did not have a commercially driven strategy. Increased awareness of the potential market of ISDN, new growth in demand, and a widening choice of applications has accelerated emphasis placed on ISDN by suppliers and users. The development of alternate infrastructures, especially cable television networks equipped with cable modems, has also placed pressure on PTOs to expand their ISDN market base. Strategy was not commercially driven and thus the benefits of new technology were relatively slow in trickling down to customers. With pressure to implement broadband, from governments and users, and because of increasing competition, carriers are facing pressure to accelerate investment. This requires them to look at technologies which do not offer the full capability that integrated broadband communications may offer in the longer term, but have surer payback periods. A weakness in PTO strategies has also been to neglect the residential market for services such as ISDN. Their strategy to skim the market by charging high prices and not trying to stimulate usage has been the main reason for this lack of strategic forward planning.

At present most public operators have, for technological reasons, a number of networks to provide different services: a network for telephony, for packet switched data services, etc. This has also restricted price declines for many service areas. New broadband technologies will eventually allow for a single integrated network to provide a range of services, offer high speeds, and process data, voice and image on the same network. This allows for economies of scale and scope lacking in previous developments. As well, the significant diffusion in fibre capacity will allow for the transmission of integrated services. This certainly does not imply that only a single national network is required.

## Table 2.8. ISDN Subscribers (Basic and Primary service)

| | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| Australia | n.a. | 8000 | 1600 | 26300 | n.a. |
| Austria | No service | No service | 200 | 452 | 3949 |
| Belgium | 208 | 414 | 835 | 1510 | 11950 |
| Canada (Bell) | No service | 0 | 0 | 2900 | n.a. |
| Denmark | No service | No service | 883 | 2354 | n.a. |
| Finland (HTC) | No service | No service | No service | No service | 1200 |
| France | 6600 | 26000 | 63000 | 103000 | n.a. |
| Germany | 16300 | 64700 | 150100 | 300000 | n.a. |
| Greece | No service | No service | No service | No service | No service |
| Iceland | No service | No service | No service | No service | No service |
| Ireland | n.a. | n.a. | n.a. | n.a. | n.a. |
| Italy | No service | No service | 1095 | 3989 | 343642 |
| Japan (NTT) | 27873 | 85890 | 159920 | 239431 | n.a. |
| Luxembourg | No service | No service | No service | No service | 530 |
| Netherlands | n.a. | n.a. | n.a. | 770 | 7800 |
| NZ (TCNZ) | No service | 20 | 82 | 253 | 586 |
| Norway | n.a. | n.a. | n.a. | 1350 | n.a. |
| Portugal | n.a. | n.a. | n.a. | n.a. | n.a. |
| Spain | n.a. | n.a. | n.a. | 640 | n.a. |
| Sweden (Telia) | n.a. | n.a. | n.a. | 4585 | n.a. |
| Switzerland | 370 | 930 | 1980 | 7960 | n.a. |
| Turkey | No service | No service | No service | No service | No service |
| UK (BT) | 2000 | 6000 | 12000 | 50000 | n.a. |
| US | 11320 | 68000 | 99720 | 179500 | n.a. |
| | | | | | |
| OECD Total | 64671 | 252754 | 491415 | 924994 | 41177 |
| Average | 9239 | 25275 | 37801 | 54411 | 5882 |

1. The number of subscribers of basic and primary ISDN service. Both 2B+D and 23B+D or 30B+D connections are calculated as one subscriber.

*Source:* ITU, OECD.

## Table 2.9. ISDN Deployment by Regional Bell Operating companies: 1993 and 1995

| Regional Bell Operating Companies | Percentage of lines with access to ISDN | |
|---|---|---|
| | 1993 | 1995 |
| Bell Atlantic | 59 | 90 |
| NYNEX | 33 | 70 |
| Bell South | 46 | 59 |
| Ameritech | 68 | 78 |
| Southwestern Bell | 22 | 23 |
| US West | 46 | 69 |
| Pacific Bell | 56 | 80 |
| National Average | 48 | 70 |

*Source:* Forrester Research Inc. Cambridge, Mass., 1993.

Future network development will make use of a number of new technologies. The technology best suited for broadband applications[19] has been defined by the ITU as asynchronous transfer mode (ATM) which is based on packet switching techniques and can switch and process at high speeds data, voice and image on the same network. One of the characteristics of ATM technology is its ability to meet variable demands for bandwidth and in handling a large amount of information. This flexibility is important in terms of an integrated network where some customers require, for example, full-video or high speed file transfer, whereas others require simple telephony. Although carriers are expected to start introducing ATM into their networks in 1995/96 it can be expected that several years will be required before more widespread introduction takes place. Synchronous Digital Hierarchy (SDH, defined by the ITU in 1988) is also a key transmission standard to upgrade existing networks toward broadband infrastructures.

Speed in network development will depend on a number of factors. First, as argued in the following two chapters, on an adequate market framework being in place; second, on the development and diffusion of applications in business and residential markets. While price will certainly be a key factor in diffusion, the perception of the utility of new applications to customers, and their flexibility in adapting to new technologies and applications all play a role in the development process. In the context of the residential market Box 2.2 shows that relative long periods for diffusion of new technologies may be needed. However, once these markets have been established they have shown considerable growth and continued dynamic development in terms of product innovation.

Network development is important, but in addition to networks there are another two layers which are crucial in the successful deployment of information infrastructures: systems integration and services. Systems integration is likely to be primarily driven by software architectures. Increasingly firms are co-operating in this area acknowledging both the difficulty in developing systems, but the necessity from a market standpoint to have coherent standards.

**Box 2.2 Rate of Diffusion of Technology**

| | | |
|---|---|---|
| VCR | 1975 - 1988 | 60 per cent of Households |
| PCs | 1975 - 1995 | 40 per cent of Households |
| Cable TV | 1950 - 1991 | 60 per cent of Households |
| Telephone | 1876 - 1950 | 60 per cent of Households |

*Source*: US Consumer Federation of America (cited in Scientific America, August 1993).

### *Fibre to-the-home*

Future multimedia interactive applications will require large amounts of bandwidth for transmission. Bandwidth requirements for various applications are shown in Box 2.3. Without appropriate bandwidth certain applications will not be available or will be of poor quality. However, it is not always possible to have a clear picture of demand requirements.

Up to now there is still insufficient consensus as to whether information infrastructures require fibre in the local loop and, if this is the case, whether this should be fibre-to-the-home (FTTH), fibre-to-the-curb (FTTC), or whether other network architectures are more appropriate. The fibre-to-the-home solution is in any case long term. A full fibre network would require between 15 to 20 years and would be costly. One estimate in the US puts the cost of FTTH at between $200 to $400 billion[20]. The per household costs of FTTH in Japan would amount to some $7 000[21]. In Australia it is estimated that hybrid

fibre/coaxial systems upgraded for limited communicative services will cost A$4 360 per household[22]. Technology and prices are likely to change significantly over the potential investment period considerably changing the economics of investment and per household costs of development. Historically the transmission capability of fibre has increased tenfold approximately since 1975 and technological developments are continuing to improve fibre performance; for example, doping fibre with rare elements has significantly enhanced the speed performance of fibre allowing signals to be sent further without regeneration therefore promising increased price performance capability in the future (experiments have shown the feasibility of sending 6 gigabits/second for 1 million kilometres without regeneration).

**Box 2.3 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.

Somes countries, for example Japan, believe that it is important to promote fibre-to-the home solutions for information infrastructures. In this context a low interest loan programme has been implemented which is available to all market participants in order to upgrade networks. In addition, test-bed applications are being encouraged in that country.

The recuperation of investment costs based on existing patterns of residential user demand or expected medium term levels of usage and consumer demand would require long term payback periods, unless demand changes are significantly higher.

Some analysis indicates that the technologies to improve capacity of traditional copper twisted pairs are in many cases sufficient in the short term given perceptions of demand growth. Others, because they view these technologies as transitional believe it is necessary to invest immediately in fibre. The debate between the technology led investment strategy and the commercial (or demand led) strategy is not fruitful since the investment strategy of market participants is based on an evaluation of the present and future growth in demand relative to the cost-efficiency and performance of different technologies. For example, some companies offering business services are investing in fibre to the building in central business districts where the demand for capacity is high. Other companies such as BT provide a fibre connection to companies demanding five or more main lines. The evaluation of companies will also take into account the strategies of their competitors.

The perceived demand for different applications will play an important role in determining the type of technology. For example, if interactivity requires only low capacity signalling from residential customers ADSL[23] may be sufficient since it can deliver signals at a high rate but allows for return signalling at low rates. However, for high degrees of interactivity this technology would be insufficient since it would not support a number of multimedia services which require outgoing and incoming signalling at the same (high) rates. Table 2.10 shows one forecast of technology used for new lines in the United States.

**Table 2.10. Technology Used for New Lines**

| | 1994 | 2003 |
|---|---|---|
| Copper | 65% | 8% |
| Radio | 3 | 8 |
| ADSL | 0 | 1 |
| Fibre to home/office | 10 | 16 |
| Fibre to curb/remote | 22 | 67 |

*Source:* Ovum.

In Australia, the Bureau of Transport and Communications Economics (Table 2.11), using a model to examine revenue estimates for different demand scenarios and estimates of network and service costs, concluded that[24]:

- hybrid optic fibre coaxial cable (HFC) will eventually predominate in urban areas;
- the range of services HFC will be able to deliver and the significant economies of scope between services that HFC will offer, works in favour of this delivery platform;
- direct broadcasting satellite and MDS (low powered broadcasting) are likely in the longer term to become niche platforms;
- the payback period for all platform networks will be long even under optimistic demand scenarios;
- the extension of HFC platforms to rural and remote areas is highly unlikely at least over the next decade.

**Table 2.11. Summary of the Infrastructure Costs of Each Delivery Platform in Inner Urban Areas**

| **Platform cost item** | **Estimated cost per home (1994 $) (1)** |
|---|---|
| Hybrid optic fibre coaxial cable (HFC) distribution analogue-network capital costs including CPE | 1 260 |
| HFC - upgrade to centralised interactive (analogue to digital plus interactivity) | 1 100 |
| HFC - upgrade to 'limited' communicative | 2 000 |
| Total HFC upgraded to 'limited' communicative services | 4 360 |
| HFC - upgrade of distributive analogue to include integrated telephony | 600 |
| FTTH (optic fibre to the home) | > 10 000 (2) |
| ADSL - distributive | 500 |
| Direct Broadcasting Satellite | 1 000 |
| Multipoint distribution system (MDS) | 500 |

1. Assumes a 100 per cent penetration rate for all platforms.
2. Estimate is an average for Australia. Separate estimates for each geographic area were not made.

*Source:* Bureau of Transport and Communications Economics (Australia), Communications Futures Project, Paper No. 6, Towards the networked home: the future evolution of residential communications networks in Australia, 1994.

**Policy choices in development**

Left to market forces, some of the existing or emerging technologies will be successful, others may only have a short effective life span, yet others may prove to be unsuccessful. Telepoint services with one-way calling capability, for example, had a very short lifespan in some countries. On the other hand facsimile services (and equipment) have showed significant growth over a very short period (Table 2.12) aided to a large extent by the elimination of restrictions on the connection of terminal equipment to the network. Nevertheless, even facsimile in its present form may be in danger of being changed in the medium term, for example by electronic mail.

**Table 2.12. Penetration Rate of Fax Equipment**
(Units per 1000 inhabitants)

| | 1989 | 1992 | 1995 (est.) |
|---|---|---|---|
| European Union | 7.1 | 16.8 | 22.4 |
| France | 5.9 | 17.6 | 26.5 |
| Italy | 8.3 | 18.2 | 21.9 |
| UK | 9.7 | 17.4 | 24.0 |
| Sweden | 13.4 | 28.6 | 34.4 |
| Japan | 24.4 | 46.9 | 67.7 |
| Canada | 8.2 | 19.5 | 23.6 |
| U.S. | 13.7 | 41.9 | 72.9 |

*Source:* OMSYC, Key Figures and Indicators for the World Telecommunications Market, 1995.

The only reason in choosing one technology over another in the context of information infrastructures is because it is thought that it offers better access to a range of **services** which are viewed as being important. Since at this stage it is difficult to define different services or predict their relative importance or even determine if such services can only be provided using a single technology, it is in turn difficult to argue that any one technology is the most appropriate for a multimedia era. It is also clear that the value users have placed on different technologies are changing. For example, it is only in recent years that mobility has become highly valued with respect to telephone services. Interactivity may in the future be a new requirement demanded by users. Technologies are also altering so that today's choice can become obsolete relatively rapidly.

Policy incentives, however, can influence rates of investment. For example, it has been argued that allowing telephone companies to provide video-on-demand can accelerate investment in fibre for the local loop[25]. Clearly companies will not invest in costly high bandwidth infrastructure if they do not perceive that there are sufficient opportunities to earn revenue on this investment. Presently, most companies view video entertainment services as one of the more promising mass market applications. Thus, on this basis, it would appear as important for governments to allow network operators to provide these services. However, from a regulatory perspective stimulating the construction of the infrastructure can clash with goals of ensuring a competitive market and reducing the dominance of incumbent telecommunication operators. For this reason some governments have been reluctant to allow incumbent operators to offer video entertainment services on existing networks. Similarly, allowing CATV operators to offer telephony and business services will provide an incentive for these companies to accelerate the deployment of their networks, as well as providing a stimulus to competition in the local loop.

Regulators usually try to ensure that there is open access to networks (see Chapter 5). This goal can also act as a disincentive to network construction. This is because the network operator wants to ensure that investment costs can be recuperated from revenues provided on the network. Equal access implies that services of other companies will be competing with the services of the network operator so that the initial high revenue streams obtained from new services could be diluted significantly. As a result open access may in certain cases slow investment growth in new infrastructure. Regulators must ensure, therefore, that access rates are sufficient to provide an incentive to deploy new facilities. In Australia, for example, this issue led to the regulator to place limitations on open access for pay-TV allowing the incumbents to restrict access to other pay-TV service providers until mid 1997[26]. Another area where policy can play an important role in stimulating investment is by mandating common usage of rights of way. A high proportion of telecommunication infrastructure costs arise from obtaining rights of way and the laying of cables. Sharing of conduits may therefore help companies defray cable laying costs. In many cases rights of way have been obtained by companies through their privileged positions as government-sanctioned monopolies (water and electricity utilities and railways). If these are made accessible to other private sector firms investment costs can be reduced.

**Broadcasting**

The broadcasting sector has also undergone significant structural changes. Before 1980 only Finland, Luxembourg and the UK authorised private TV channels. Since the 1980s the rapid growth in private TV channels has resulted in a relatively large loss of audience for European public broadcasting networks (Table 2.13). These structural changes in the market were also linked to adjustment in the financing of broadcast TV which began to rely heavily on advertising whereas government support as a percentage of total revenue for broadcasting entities remained constant.

**Table 2.13. Loss of Market Share for Public TV Channels: 1985-1990**
(percentages)

| | 1985 | 1990 |
|---|---|---|
| Denmark | 100 | 100 |
| Portugal | 100 | 100 |
| Sweden | 100 | 100 |
| UK | 52 | 47 |
| Finland | 60 | 52 |
| Spain | 100 | 85 |
| Switzerland | 55 | 38 |
| Austria | 100 | 82 |
| Ireland | 100 | 75 |
| Netherlands | 100 | 75 |
| Belgium | 85 | 56 |
| Germany | 100 | 71 |
| Norway | 100 | 70 |
| Italy | 91 | 50 |
| France | 100 | 33 |
| Greece | 100 | 32 |

*Source:* Conseil Superieur de l'Audiovisuel, Le Positionment des Chaînes Publiques et Privées en Europe, Paris 1992.

Cable TV developments, Current Status of Communication Infrastructure Regulation), Pay-TV and direct broadcasting satellites have all played a role in changing traditional broadcast markets. The diffusion of these technologies will accelerate over the next few years. Traditional public telecommunication operators have shown great interest in entering the market for distribution of such services as video-on-demand, viewing the potential revenue stream as important in justifying investment in broadband technologies.

## CHAPTER 3 THE ECONOMIC IMPACT OF INFORMATION INFRASTRUCTURES

### Introduction

The OECD Jobs Study argued that "Technological development is the main force determining growth in productivity, employment and living standards in the medium and long run.....[T]he higher productivity associated with process innovations increases real incomes, while the creation of new products and services generates additional demand[27]". Lessons from past waves of technological change are often cited as providing supporting arguments for the positive impacts of technology. Nevertheless, questions have also been posed as to whether such traditional precepts always hold[28]. Is the present wave of technological change different than in the past? If so, will the impacts be different? What are the short term implications compared to the long term? What are the structural consequences on jobs and industry? These are complex questions which, without an adequate evaluation of how the information economy will unfold, are difficult to answer. Some analysts have compared the changes as similar to those which occurred in the industrial revolution. The extent to which the present developments constitute an information revolution can only be judged through hindsight. What is clear is that there are opportunities for the economy and for society and there may be risks. Governments must exploit these opportunities and minimise the risks.

Even though we are aware of existing technologies, it is difficult to project their diffusion which depends on a number of economic and social conditions and factors. As well, it is difficult to predict what new technologies are on the horizon and how they will impact on existing technologies, especially with regard to the economic evaluation of these existing technologies. Knowledge of existing technologies, and even knowledge of some of the potential applications, is insufficient to make predictions on the development and diffusion of new applications; ultimately it is these applications which will determine the economic and employment impact of information infrastructures. A main factor in determining the impact of new technologies is the extent to which their potential is exploited by economic actors, including governments, or is prevented from being exploited by policy or institutional roadblocks.

There are good reasons to believe that the present cycle of technological change, based on the convergence of computer and communications technologies, digitalisation, driven to a large extent by software developments and incorporating intelligence in integrated systems, differs from other cycles of technological development. This does not necessarily call into question the benefits of the new technologies, but rather that their impacts may differ in scope and magnitude and may raise a number of new issues which over time need to be resolved. There is also good reason to believe, given the dynamics of the sectors involved, the wealth of different applications emerging, and the fact that these applications are relevant to most economic sectors and residential markets, that there are a significant amount of opportunities which can be harnessed to create in the long term new economic activities and jobs.

This paper began by noting that a paradigm shift is occurring in economic and social structures as a result of the diffusion of the present generation and emerging information and communication technologies. These new technologies are not restricted to an individual industry or service sector. They can be applied to agriculture, resource exploitation, manufacturing, the service industries, residential

markets and in public service markets. However, they do not differ from previous technologies (the case of electricity would be a close analogy) just because they are widely applicable to all economic sectors, but because they have the capability to integrate a number of different functions in the production process, they have the ability to control, monitor and provide information as required in different production processes, and they can integrate different economic sectors. The importance of information and communication technologies is that they are capable of adding intelligence to different tasks, manipulations, and transactions in production and commerce.

Their impact on residential markets and the fact that information and communication technologies tie production, distribution and final demand together in a frictionless market is another factor differentiating these technologies from previous experience. The importance of 'perfect' information in economic relations -- in market demand and supply decisions -- has always been cited as the cornerstone of the market economy; these technologies may help move market structures a bit closer to that ideal. Further, being based on intelligence, and trying to emulate intelligence, information and communication technologies go well beyond mechanisation processes characterising previous waves of technological development. Unlike mechanisation, information and communication technologies are applicable in all layers of an organisation and may equally impact on management layers as on blue collar workers. As well, they can reduce the disadvantages and frictions caused by distance in economic relations and transactions.

As for the case of electricity, the direct and indirect economic weight of the sector may remain relatively small, even though it provides a driving force for the economy. But the spillover effects of information and communication technology applications can be significant. The widespread nature of information and communication technologies and the fact that many applications are customised for a particular process or market creates difficulties in measuring their impact.

Information has become an increasingly important and distinct input in the production process. The process of digitalisation of information has allowed for common treatment of information as a coherent factor of production. The growth in the availability of information for use in production is a source of output growth in itself. Linked to this is the productivity growth resulting from developments in II and applications. This is impacting and making more productive existing inputs in the production process. In general, the growth stimulated by information infrastructures will be broadly based on capital and software intensive production factors, and because of this mainly in skilled labour inputs.

This Chapter provides an overview of some of the perceptions on the impact of information infrastructures[29]. Measuring the impact of new technologies, new services, or new organisational structures on the economy is invariably fraught with difficulties. Technological progress can result in the growth in output as well as lead to shifts in demand and supply curves. Untangling the effect of these factors and the different time paths during which these impacts unfold is not possible. II will result in a change in the structure of economic activities involving organisational change, and the emergence of a number of new applications. In this context there is a problem of clearly defining how existing activities will change, what new activities will occur, when they will emerge, and how new technologies and services will interact, and effect, existing economic activities. In addition to the measurement aspects there is a problem, specific to II, that is the speed of change in government policy will be important in determining the development and impact of information infrastructures and applications.

Some of the foregoing arguments could provide an impression that with high rates of technological change and the potential for economy-wide impact, that there can be optimism for high productivity growth and job creation in the economy. However, the communications and broadcasting sectors are not structured in a way which favours development of new applications or their diffusion. As

such net job creation is jeopardised. What are the roadblocks? The main impediment to growth is the monopoly or protected market structures for the construction and operation of information infrastructure networks, and the provision of services on these networks. These market structures tend to restrict investment, maintain high prices, restrict output and new applications, and tend to maintain labour in low productivity posts.

The conclusion is therefore that the development of information infrastructures depends crucially on changes in the regulatory framework of the communications sector which eliminate restrictions on new entry into the industry, eliminate investment restrictions, and eliminate restriction on cross-sectoral infrastructure and service development. This conclusion was also stressed by the European Union in its 1993 White Paper on Growth, Competitiveness and Employment which recognises the establishment of trans-European networks as a "precondition for the creation of the common information area". Further, the primary role of the private sector to respond to the challenges of broadband technology has been stressed, recognising that governments need to provide a clear and stable regulatory framework and an example in applications areas [30].

As noted in previous chapters information infrastructures and multimedia applications are dependent on a range of technologies. Technology is not neutral with regard to market structures and existing market structures may be providing the wrong signals to investors. For this reason as well there is a need to restructure existing markets.

**General economic and social impact**

The communications, information services and broadcasting industries already play an important role in OECD economies. In the case of the public telecommunications service market revenues of $392 billion were produced in 1992 by OECD countries amounting to some 2 per cent of GDP, investment by public operators has averaged around 3 per cent of gross fixed capital investment for OECD countries amounting to some $ 102 billion in 1992. The revenue of equipment manufacturers globally was about $161 billion in 1994[31]. The wider communications market is significantly larger[32]. For example in the United States alone the communications and information services market has been estimated at $300 billion (Box 3.1). The development of information infrastructures will enhance the economic weight of these industries in OECD countries, increasing their share according to some estimates, to between 10-15 per cent of GDP.

**Box 3.1 US Communications Services Market, 1994**

| | |
|---|---|
| Local exchange | $78 billion |
| Long distance (minus access) | $35 billion |
| Information Services | $70 billion |
| Video distribution | $71 billion |
| Application software | $37 billion |
| Transaction processing | $16 billion |
| Interactive media | $ 3 billion |

*Source*: SPRINT.

The communications industry has shown some of the highest rates of technological change and productivity growth among industries in the OECD area[33]. For example, in the United States productivity growth in the communications industry was, at 4.6 per cent for the 1977-93 period, significantly high compared to all other sectors while its relative importance in terms of labour intensity was relatively low (Table 3.1). Such productivity developments are closely linked with technological change occurring in areas closely tied to the communications industry such as software, semiconductor and computer technologies.

**Table 3.1. Measured Productivity Growth by Industry, per cent**
1977-93

| | Share of Man-hours, 1993 | Annual Productivity Growth, 1977-93 |
|---|---|---|
| **Total** | 100.0 | 0.6 |
| Private Industry | 82.5 | 0.8 |
| Commodities | 23.2 | 1.7 |
| Agriculture and Fisheries | 1.6 | 2.4 |
| Mining | 0.6 | 2.6 |
| Construction | 4.3 | -0.7 |
| Manufacturing | 16.8 | 2.2 |
| **Service Industries** | **76.9** | **0.2** |
| Transportation | 3.2 | 1.6 |
| Communications | 1.1 | 4.6 |
| Utilities | 0.9 | 0.2 |
| Wholesale Trade | 5.5 | 3.2 |
| Retail Trade | 15.9 | 0.6 |
| Finance, Insurance, Real Estate | 6.2 | 0.2 |
| Services (narrowly defined) | 26.7 | -0.5 |
| Government | 17.5 | 0.2 |

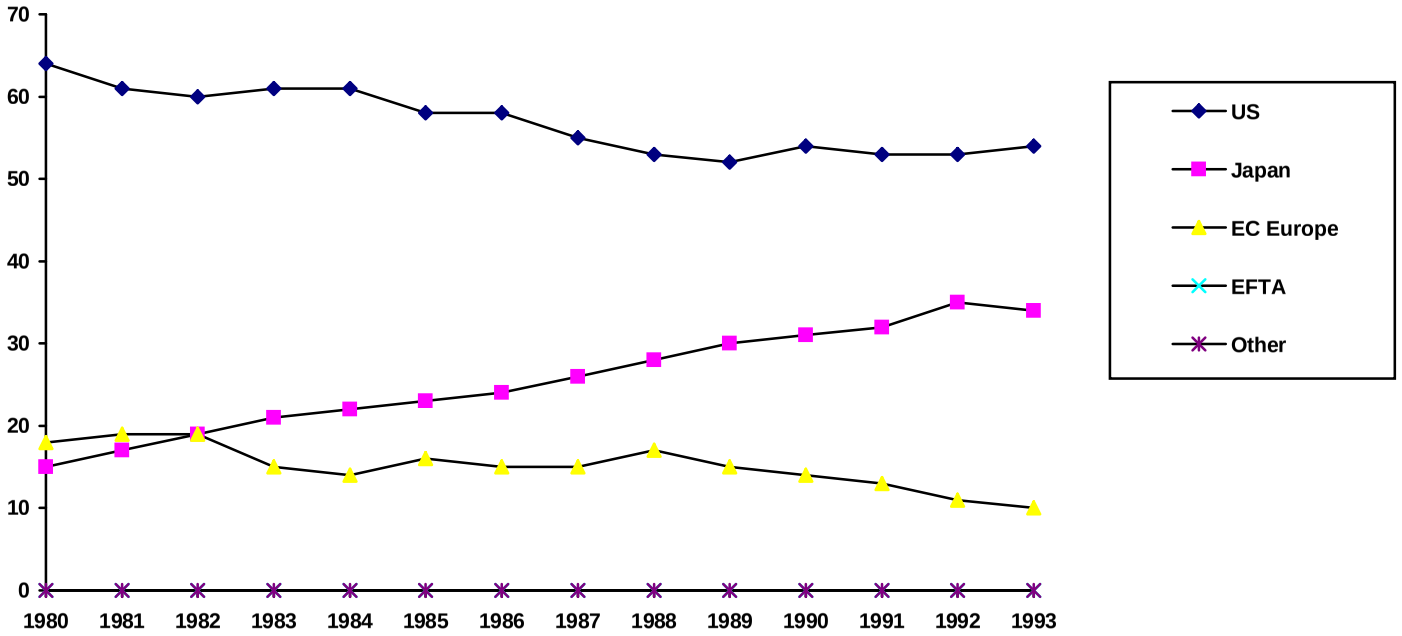
*Source:* D. Kelly, Service Sector Productivity and Growth in Living Standards, The Service Economy, Vol. 9, No. 4 October 1995.

Evidence from patent data (Figure 3.1), and existing developments in switching technologies, in semiconductor and computer technologies, would indicate that high rates of technological change will continue to influence the communications industry, software development, computer and component development[34].

Convergence, which is the outcome of technological change, is also having the effect of accelerating technological change as industry seeks to develop new applications and accelerate the convergence process. Partly this is resulting from firms trying to ensure that they are correctly positioned for the significant growth opportunities foreseen by industry, and partly as a result of new synergies arising from different sectors working closely together on the development of new applications.

The economy-wide diffusion of II technologies and applications is in itself important, but needs to be viewed in the context that information infrastructures will also lead to structural changes in economic interactions including in markets and market transactions. These impacts will be global in scope and may change a number of economic parameters which are viewed as being important at present: for example, the geographic necessity for either buyers or sellers to be physically present in a market, or for suppliers to cluster around their main customer. Global markets may become more integrated but global manufacturing and service production could become more dispersed since the integration will be through information infrastructures (i.e. a "virtual integration") rather than in physical space. These developments will also enhance the tradability of products and services.

**Figure 3.1. Share of patents granted in electronic components and communication equipment industry by the US Patent office (per cent)**




*Source: OECD.*

On the other hand developments in information infrastructures may also place some limitations on government policies. By definition information-based industries are highly footloose and can therefore change locations quickly and easily so that national differentials in their treatment can influence the location of their activity. Once global broadband networks are in place it may be difficult to prevent cross-border service delivery, or even determine in which location economic activity of certain services were generated. Thus, it has been argued that:

> "Nations are finding it increasingly difficult to manage their national economies. Globalization means that monetary and fiscal policies are tied to developments elsewhere. Few nations are so powerful that they can follow an independent monetary or fiscal policy. Most are tied to international market developments. Fearful of changes to the value of their currencies or to the prospect of an international bond market that re-evaluates their risk, most national governments have little room for new policies."[35]

Once secure means of electronic payment are developed use of on-line services can be expected to accelerate: from the purchase and downloading of on-line software, music or video, to the more sophisticated use of business services. These activities will take place without respect to national borders and their consumption will be a function of the best price and quality. In the longer term these activities may serve to reduce existing national price differentials but may also reduce the ability of governments to maintain economic and fiscal control over certain activities. It is difficult to determine the impact of on-line trading with regard to long term tax receipts. A report of the US Advisory Commission on Intergovernmental Relations[36] estimates that $ 3.3 billion in state and local taxes are lost each year to untaxed mail order sales. Already some call-back telephone service providers are taking advantage of the fact that value-added taxes are added to international telephone charges in the markets they target whereas their customers can avoid these charges. This alone can provide service providers with an arbitrage margin of between 10 to 20 per cent in certain cases.

Historically, infrastructures have played a key role in developing and expanding markets. However, estimating the link between investments in infrastructure projects, their impact on GDP, and long term net additions to employment has always been problematic, partly because of data limitations, but also because of methodological and conceptual difficulties. In particular there is the difficulty in untangling the direction of causality between infrastructure investment and economic growth. This has led to some contradictory evidence on the role of infrastructure on economic growth. Recent analysis in the United States has suggested a strong relationship between the stock of public capital and output per unit of private capital estimating that a 1 per cent rise in public infrastructure investment would raise labour productivity by between 0.3 to 0.4 per cent[37]. Another study has found that a $1 increase in infrastructure investment is associated with a rise in output of $4[38]. Recent work at the OECD on telecommunications has indicated that a 1 per cent increase in the penetration rate (main lines per capita) increases aggregate economic growth by nearly 1 per cent. Analysis in Japan suggests that investment in communication-broadcasting facilities had a multiplier effect of 2.08 in terms of increased production in the Japanese economy[39]. Many analysts, however, caution against trying to make a direct link between the development of infrastructure and employment creation.

A number of estimates have been undertaken, especially in the US, on the impact of introducing more competitive market structures and changing regulatory frameworks. These studies focus on the impact of eliminating the regulatory restrictions which were imposed on the Regional Bell Operating Companies by the Modified Final Judgement[40]. For example, the United States Council of Economic Advisers estimated that the recent legislative proposals by the US Administration[41] aimed at opening telecommunication markets to more competition could add $ 100 billion to GDP over the next decade[42]. The estimates indicate that the share of the telecommunication and information sector in GDP could

double by the year 2003 and that there could be a net increase of 1.4 million jobs in that sector. Incremental capital investment over the next decade is estimated to reach $75 billion[43]. The significance of the Council of Economic Advisers' study is the underlying recognition that existing regulatory frameworks are an impediment to investment, service development and employment growth. A similar study estimated that by eliminating line of business restrictions on the Bell Operating Companies, the economy would gain 3.6 million additional jobs over the next 10 years, 0.5 per cent in manufacturing output, and $ 247 billion would be added to GDP[44].

Other studies have attempted to estimate differences in impact from investing in different technologies. For example, the Economic Strategy Institute has estimated consumer benefits from narrowband technologies compared to broadband from 1993 to 2007. The study estimates that broadband provides significantly more benefits and that consumers benefit from lower prices for goods, from savings by reducing travel because of the use of communications, and from the transfer of benefits to consumers from medium-to-large corporations which have made savings via use of communications. The total of such savings are given as $19.5 to $48.5 billion over 1998-2002 and $57 to $112.5 billion between 2003-2007[45].

Estimates in Europe forecast a cumulative incremental growth of EU GDP between 1993-2008 of between 2.7 per cent to 6 per cent ($160-$353 billion) depending on alternative development scenarios (neutral where no additional stimuli are introduced by government, pro-active during which broadband network development is shortened and an accelerated scenario which stimulates usage)[46]. Another study[47] estimates that productivity gains from broadband networks and information/communication technologies will add an incremental growth of 2.7 percentage points to GDP and between 4-6 per cent, if diffusion is accelerated.

In Japan one study has estimated that 2.43 million jobs can be created and new economic activity will increase, as measured by the multimedia market, by 123 trillion yen[48] . These estimates are based on a scenario of having in place a full nation-wide broadband network development for a target year of 2010. A number of representative industries and services which II will generate are used as a basis for projections. Other estimates in Japan are for market growth in the information/communications area of 12 per cent annual average growth between 1993 and 2010 (Table 3.2) expanding the market to 25 trillion yen.

A common element of these studies cited above is their optimism in terms of the positive impact of information infrastructures and applications on the economy. Nevertheless it must be stressed that these studies only examine a partial picture in that in certain cases job loss is not considered. In addition, insufficient consideration is given to the fact that an important percentage of new multimedia services for business, residential and public markets will come from repackaging existing products and services. Many of these will be less labour intensive than the products and services they replace although they will be more skill intensive. A number of analysts have tried to determine "killer applications" for multimedia, that is, an application which will lead the surge in demand. There is no clear opinion on whether such an application will result from the business or from the residential market. However, present patterns of development suggest a number of areas where demand will develop including some areas based on traditional services such as telephony but which are given enhanced characteristics (e.g. video-telephony). Another limitation of many of the studies is the assumption that supply will be supported by demand growth, and therefore an increase in economic activity will follow naturally from investment in infrastructure.

**Table 3.2. Japan: Estimated Market for New Growth Businesses in Information/Communications**

| Areas of new/rapid growth | Market size (billions of yen 1993 | 2010 | Average annual growth rate (%) |
|---|---|---|---|
| **Video** | 277.4 | 3 603.3 | 16.3 |
| Multimedia equipment | 160.6 | 925.1 | 10.8 |
| Next-generation TV | 39.5 | 632 | 17.7 |
| Video-based multimedia | 77.4 | 1 758.2 | 20.2 |
| Video Communications | - | 288 | - |
| **Data Transmission** | 624.1 | 4 125.7 | 11.8 |
| Wide area network | 38.8 | 2 760 | 28.5 |
| Mobile communications handsets | 400 | 590 | 2.3 |
| Uninterruptible power supplies | 65 | 171.1 | 5.9 |
| Data-based multimedia | 120.4 | 604 | 10.0 |
| **Data processing/storage** | 819.3 | 11 351.2 | 16.7 |
| Integrated office systems | 0 | 3 340 | - |
| dedicated servers | 39 | 396 | 14.6 |
| Personal digital assistants | 15 | 250 | 18.0 |
| IC cards | 14 | 52.8 | 8.1 |
| LANs | 491 | 5 343 | 15.1 |
| Electronic Publishing | 16.2 | 768 | 25.5 |
| Database Services | 244.1 | 1 201.4 | 9.8 |
| **Infrastructure** | 1 487.8 | 6 261 | 8.8 |
| B-ISDN | 0 | 1 008 | - |
| Subscriber based fibre optic networks | 0 | 369 | - |
| ATM switching equipment | 0 | 639 | - |
| Mobile Communications networks | 253 | 825 | 7.2 |
| Cable TV (including interactive) | 87.7 | 1 008 | 15.4 |
| Information systems for national/local government | 1 147.2 | 3 420 | 6.6 |
| Total | 3 208.6 | 25 341.2 | 12.9 |

1. Data include services and equipment.
*Source:* Nomura Research Institute Quarterly, Spring 1995, Y. Kumon, Japan's New Growth Industries.

Other studies have taken a different approach examining the demand side. For example, a study undertaken for the Commission of the European Communities[49] estimates that total business and residential multimedia services for the European Union will reach 25 billion ECU by 2004 (this includes connection, subscription and service revenues for the communication service industry). The study views that early growth of multimedia will be most marked in the business sector, although the residential sector offers the greatest potential in the long-term. The demand from the business sector will be mainly for enhanced communications. The study concludes that to invest in infrastructure solely on the basis of multimedia revenues would not be very profitable and that telecommunication services and cable TV will remain the revenue drivers in the next decade.

In France one study has estimated that the market for network-based services ('teleservices') will increase from 33 billion French Francs in 1993 to between FF 86-195 billion by 2005, depending on whether no action is taken to stimulate the market (low growth hypothesis) or whether a number of policy steps are implemented (high growth hypothesis). In addition based on these hypotheses, employment was estimated as increasing from 65 000 in 1993 to between 170 000 to 370 000 [50]. A number of policy steps are suggested including, creating a market place for teleservices by ensuring that certain requirements are

in place (billing, security, interoperability, pricing), ensuring adequate financing mechanisms are in place, adapting the regulatory framework, government use of network-based services, promoting on-line education and telemedicine. As this study point out, globalisation, and on-line services readily allow for the export of jobs. The study estimates that for France the number of jobs susceptible to overseas relocation would represent by the year 2005 about 1 per cent of service employment.

Irrespective of the magnitude of the economic impact of information infrastructures, the most important factor for policy makers is to understand the social costs of inefficiencies in non-competitive or insufficiently competitive markets. These costs arise in particular from lower rates of investment, slower development and diffusion of applications, higher prices and lower output in the less competitive markets. Given that the communications industry and the main using industries, especially the service sector, form an increasing part of the economy, this results in social costs being relatively higher. Empirical results have shown that spillover effects from information and communication technologies also have an important influence on the productivity level of the whole economy[51], and inefficient markets will limit these spillover effects.

**Intra-industry impact**

Despite the high rate of technological change characterising the communications industry, the diffusion of a number of new services has been relatively slow. This is due to a large extent to the market structures of the communications industries and their highly regulated nature which has played a significant role in slowing down the diffusion of new services. Many OECD PTOs have been slow in introducing new services or have tended to overprice new services slowing down rates of diffusion. Call revenues still form the core business of PTOs whereas new markets have remained undeveloped. Mobile cellular services provide an example of how competitive markets stimulate the take-up of new services and how monopoly/duopoly markets have slowed down market growth: mobile communications is one of the fastest growing areas of telecommunications employment having generated more than 90 000 jobs in network operators by 1992. Competition in mobile services has been playing a key role in stimulating usage and expanding the customer base, and continues to play a role in expanding employment opportunities. Countries such as Japan and the UK experienced a twofold increase in mobile employment after moving from a duopoly to a competitive market, and Australia experienced a threefold increase when moving from a monopoly to a competitive market[52].

The delays in introducing new services have had economic costs. In addition to the potential job losses, "[s]ubstantial benefits are being lost not only by the contribution an efficient mobile telecommunication market can make for economic development, but in the social gains possible through the application of mobile telecommunication for universal service requirements..."[53]. These regulatory delays are also having adverse effects on dynamic economic efficiency. Research has shown that the introduction of new telecommunication services can lead to very large gains in consumer welfare[54].

For example, in Japan it has been estimated that the liberalisation of use of leased circuits would create a market of 500 billion Yen and 21 000 jobs by the year 2000 [55]. Already in Europe the significant difference in the UK situation with its competitive market and the rest of Europe is quite evident: for example, it is reported that 80 per cent of European 2/mbit leased lines are in operation in the UK[56]. Perhaps the most significant failure in the development of communication infrastructures (undertaken under monopoly market conditions) is the fact that the price performances which have become typical in other high technology areas which support the communications industry as well (semiconductors, software, computing), have not been evident in the telecommunication service area. Competition will play its most significant role in downward pressure on prices thus stimulating new applications and usage (see

Chapter 4). In turn this will help create jobs. The pace of market restructuring, and therefore the rate of change in policy frameworks will be a prime factor stimulating the required tariff changes. Competition will also change the approach many PTOs have had to taking an "engineering approach" to market development rather than a marketing and commercial approach thus neglecting consumer requirements.

***Service markets***

Competition and the development of information infrastructures are expected to have significant structural changes on network operators. The convergence of network infrastructure allowed for by digital technologies and the significant expansion in the range of services which can be carried on these networks will result in important economies of scope and scale. This factor is already resulting in a large number of mergers, joint-ventures and other types of co-operative agreements between firms in the telecommunications and content industries. In addition, the high level of financing required for infrastructure provides an incentive for network operators to enter into the provision of information services and content as an additional revenue source. There is also a longer-term incentive for network operators to enter into the provision of information/content services which results from the potential low returns from simple carriage.

The high capacity of fibre optic networks which in the longer term will be developed in the local loop will result in very low costs in carrying traffic. With zero, or close to zero marginal costs for transport and, as a result of competition, small margins for carriage, it will become necessary for operators to find new sources of revenue (see also Chapter 4 on Pricing). The high cost of developing broadband interactive networks also means that operators will be seeking a return above those from traditional services. For these reasons telecommunication operators want to offer a full range of services. However, the requirement to ensure fair and effective competition is likely to place limits on the extent to which telecommunication operators can enter into all lines of business (or can do so by limiting access to their networks).

The OECD has concluded in earlier work that "[c]ompetition encourages improvements in efficiency of public telecommunication operators and opens up new employment opportunities in and beyond the telecommunication sector"[57]. In terms of employment in the telecommunication service sector itself the longer term trend has been toward a reduction of employment. Previous work at the OECD has indicated that during the 1982-92 period employment in public telecommunication operators declined by 7.5 per cent[58]. In many competitive markets downsizing of the labour force has continued as digitalisation has accelerated. There is evidence from those countries that have allowed infrastructure competition that new entrants help stabilise employment levels. Nevertheless, even with new entrants it should not be expected that the development and operation of infrastructures will result directly in longer term employment growth. One recent benchmarking exercise estimated that if PTOs world-wide adopted best practice employment levels labour cost savings of US $90 billion would be achieved[59].

There will be forces compensating for these job losses. Technology and competition, although forcing incumbent operators to restructure their operations and become more efficient, thus reducing their labour intensity, are also creating new employment opportunities. This is resulting from the new operators entering the business as well as from the expansion in market size as prices fall and new services emerge through greater innovation. Competition among public operators is also helping to stimulate the "communications intensity" of user companies through more aggressive marketing by PTOs and lower prices so that many employment opportunities are being transferred into these user industries. The growth opportunities will come from the user industries. Slow change in telecommunication market structures

will tend to exacerbate the employment problem since many incumbent PTOs are already shedding labour as a result of technological change, whereas the dynamic market conditions to create new jobs in the application areas do not exist in those countries.

Many of the new "telecommunication jobs" may not be recognised as such or fall into other industry categories. Thus on-line banking employees are considered as working in the banking sector although their job is highly dependent on the underlying network which supports transactions. As network architectures change distributing intelligence in terminal equipment and servers, many of these "telecommunication jobs" are also moving into the user industries. However, the challenge for policy makers is to ensure that these jobs in manufacturing and service industries are created. This will only take place with a dynamic and changing communications service industry.

In addition to the changes taking place in the total number of employees of the public telecommunication operators, there are also changes taking place in terms of the occupational structure of employment[60]. Typically, the occupations most affected by employment restructuring are those in the core telecommunications business, whereas new demand is for information technology specialists, in the area of information services, marketing, sales, etc. The new demands are also for occupations with higher educational/skill levels with the largest impact of job losses affecting those with only a primary education.

***Equipment markets***

Information infrastructures will have their most immediate impact on the equipment manufacturing industry and the communication and broadcast service industries. The replacement of analogue by digital switches which accelerated in the late 1980s is still continuing but the rate of growth has slowed down. Therefore a shift toward investment in new switches (ATM and other equipment), and accelerated investment in transmission technology, including fibre, will provide important benefits to the industry. But, the costs of developing ATM, and the limited number of ATM switches required in even the most developed markets create uncertainty as to whether this technology will be important in terms of employment creation. The introduction of competition in the industry will also result in new entrants purchasing equipment. But the equipment industry is highly concentrated in certain areas such as central office switching, and competitive, and in terms of employment generation from new demand is not expected to lead to significant employment gains.

In terms of employment in the equipment industry the trend in industry structure has been toward consolidation and a reduction in employment levels. The latter has become possible because of the development of digital switches based on semiconductor boards requiring insertion and the elimination of wiring requirements. The structure of employment has changed as well given that new switching technology is software intensive. In addition, the capacity of digital switching equipment means that a significant reduction in the number of switches which are required to service a particular country is taking place. For example, Telecom Finland now uses 50 switches in 25 locations for its local network compared to 2 500 switches, and Deutsche Telekom is expected to reduce the number of trunk exchanges from 71 to 23 and local exchanges from 9 000 to 500 in the context of its network digitalisation programme: the three-layer switching hierarchy in some countries is being reduced to two. Fewer switches, and the technical characteristics of digital switching require less maintenance labour inputs. Thus, technologies such as SDH (Synchronous Digital Hierarchy) are being put into place not only because of their technical characteristics but because they are labour saving. The importance of information infrastructure development may therefore be in bringing about more stable employment levels in the central office switching industry. However, the production of communications equipment is highly concentrated in just a few countries so that the geographic impact will be limited.

Investment in the network infrastructure is also highly capital intensive. For example, the laying of fibre optic cable can be undertaken rapidly using mechanised means and even the splicing of cables which initially was labour intensive is now capital intensive. This also limits the employment impact. Fibre cable will also result in significant reductions in maintenance. It has been estimated that a hybrid fibre-coaxial infrastructure costs 30 per cent less that a traditional copper-based transmission system. The savings realised are for labour costs associated with reduced maintenance[61]. An indication of market development is shown in table 3.3 which shows short-term estimates for the North American market.

**Table 3.3. Telecommunication Equipment Market Revenues, 1988-1997**
(in $ million)

| | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|
| Data & networking equipment | 17 147 | 20 161 | 23 077 | 26 396 | 30 407 |
| Network equipment | 12 607 | 14 375 | 16 458 | 18 896 | 25 183 |
| Emerging technology (equipment) | 5 598 | 6 407 | 7 328 | 8 280 | 9 158 |
| Cellular network & Subscriber equipment | 3 390 | 3 767 | 4 144 | 4 475 | 4 878 |
| Facsimile equipment | 2 297 | 2 474 | 2 786 | 2 875 | 2 800 |
| Call/voice processing equipment | 3 397 | 4 117 | 4 783 | 5 430 | 6 056 |
| Teleconferencing equipment(1) | 2 301 | 3 060 | 4 081 | 5 500 | 7 489 |
| Consumer telecommunication equipment | 3 628 | 3 787 | 3 885 | 4 146 | 4 429 |
| Private branch exchanges | 1 971 | 2 153 | 2 242 | 2 231 | 2 237 |
| Computer telephone integration (2) | 104 | 130 | 234 | 514 | 845 |
| Key/hybrid telephone systems | 1 915 | 2 174 | 2 363 | 2 458 | 2 544 |
| Public pay phones | 386 | 388 | 391 | 393 | 394 |
| TOTAL | 54 741 | 62 993 | 71 772 | 81 594 | 96 420 |

1. Includes service revenues.
2. Includes software revenues.

*Source:* North American Telecommunication Association.

The equipment sector which is likely to benefit significantly from the growth and development of information infrastructures and multimedia applications is the terminal market. Many multimedia applications such as video-telephony, video-conferencing, and interactive television will require peripheral terminal equipment. These developments will also have positive economic effects on the electronics industry and downstream related activities. An example of where a potential mass market seems to be developing is for cheap Internet access terminals. Again, an important factor in terms of the economic impact will be the geographic location of production entities.

### Impact on using industries

The turbulence in the job creation and job destruction process which takes place at the microeconomic level is well described in the economic literature. This process results from a number of economic and social factors, including technology, changes in relative prices, changing tastes, population structures, etc. Information infrastructures and related applications will have a significant impact on the churn in job posts. It is likely that in the short term this impact will be negative. This is because the immediate introduction of networks and multimedia applications will be in direct labour substitution, that

is in increasing efficiency in existing service provision. Only as output expands, and new services are created will new job creation emerge. The more dynamic the market, the quicker will be the job creation process. The transition process will not only depend on general economic conditions but on whether the service suppliers are efficient, prices are sufficiently attractive for customers, and appropriate frameworks are in place to allow new markets to expand (these include legal and institutional frameworks).

There are already a large number of sectors which rely on electronic trading (electronic commerce). These include the banking sector, financial services, transport and tourism, newspaper publishing and the distribution sector. Increasingly the retail trade sector is adopting electronic market structures and these systems are becoming more and more relevant for the manufacturing sector. In many user sectors which are communications intensive the initial impact has already been underway for a fairly long period (e.g. banking), but even in those sectors enhancement of existing application is likely to lead to job loss. Even now many banks are starting "branchless" banks offering 24 hour on-line services via integrated service networks: this is starting a new wave of restructuring in that industry[62]. The customer/service staff ratio can be dramatically improved using on-line banking services; for example, estimates in the UK for First Direct (an on-line bank owned by the Midland Bank in the UK) indicate a ratio of 1 to 112 for a traditional branch banking service, compared to 1 to 1 000 for telebanking facilities[63].

Other industries such as insurance are accelerating their use of communications as a tool to market their products directly to clients as well as to service these clients. For example, many companies are achieving significant economies in reducing their sales force and using direct marketing. UK data show that direct telephone marketing costs only £6 per client call compared to £120 incurred in on-site visits and the number of clients accessed per day were 25 per staff compared to 5 per direct visits[64].

Many industries are using communications as a competitive tool to deliver services more quickly and efficiently to clients. There are a number of industrial and manufacturing sectors which are also intensive users of communication infrastructures and applications. Table 3.4 shows the extent that computing employment has already concentrated in some sectors As the service range of communication products change, price structures alter and with the emergence of new services, the number of industries using communications intensively in their production functions will change. But, many of the product and service areas which are expected to grow because of II are in themselves heavy users of II technology so that growth in output will not necessarily be accompanied by employment growth. The broadcasting and film industry is a case in point. Automated production techniques reduce labour requirements by a significant amount.

**Table 3.4. Concentration of Computing Employment: Australia**

| | |
|---|---|
| Finance, Property and Business Services | 40.0 % |
| Wholesale and Retail Trade | 15.6 % |
| Public Administration | 11.8 % |
| Community Services, Health, Recreation | 11.1 % |
| Manufacturing | 10.9 % |

*Source:* Department of Employment, Education and Training: Education and Training needs of Computing Professionals and para-professionals in Australia, Canberra, 1990.

Even though the development and diffusion of inter-enterprise networks has been on-going for well over a decade and leading to a restructuring of corporate strategy and structures, the capacity and potential of new networks and applications are significantly improved, allowing this process to broaden across a wider field within enterprises. An OECD/BRIE project concluded that "..network technologies can be increasingly important to the attainment of corporate strategy objectives. They can permit more rapid response to customers, speedier and better integrated management and work processes"[65]. Given different rates of change in the development of new applications, and different impacts which are generated by applications which are new and those which are improved, the economic and employment impact will be difficult to discern.

The range of activities where new network-based applications may be able to impact have been illustrated by Breton[66]. Some of these include:

| | |
|---|---|
| Functional Teleservices | - telesecretarial, teleprinting |
| | - teletranslation, tele-interpretation |
| | - teleconsultation, telemanagement |
| Telecomputing | - tele-engineering, teledevelopment of software |
| | - telesecurity services |
| | - tele-installation |
| Telemanagement, telesurveillance | - telemanagement of building heating plant, elevators |
| | - telesecurity services |
| | - telemanagement of utilities |
| | - telemanagement of transport networks |
| | - telemonitoring of meters (water, electricity, etc.) |
| Tele-education | - training |
| | - university |
| | - adult education |
| Telemedecine | - diagnostics |
| | - medical assistance |
| | - transfer of files |
| | - consultation of images |

For some of the above application areas firms will be outsourcing functions (externalisation of employment). This will allow some service firms to attain economies of scale. The net effect of such externalisation on employment is ambiguous. The immediate impact may be to reduce jobs, but many of the new service companies may be able to create new jobs through offering value-added functions. Savings achieved may also help stimulate economic growth in new areas. One example of potential saving is that of a US local electrical utility company which is investing $585 per household to install fibre-optic cable aimed at better monitoring household consumption and allow cost saving as well as providing new services such as itemised billing. It is estimated that monitoring of consumption will allow savings of 1.5 kW per household. The utility, Entergy (Little Rock, Arkansas) estimates it would have to spend $1 250 per household to supply an extra 1.5 kW. The type of applications noted above can reduce intermediaries in the economy (a result already apparent in the insurance sector of some countries). Many small service companies have profited from playing such an intermediary role. Again the net effect of this will tend to be negative in terms of jobs, at least in the short term. As well, many applications noted above will reduce many labour-intensive functions e.g. reading meters.

It is important for governments, however, to facilitate the growth of applications and their diffusion. The impediments are not necessarily only from communications regulations. There are a number of other factors which can slow the process of diffusion in that there are more general regulations which limit enterprises taking full advantage of new technologies and services. In some cases these are viewed as necessary regulations (privacy for example). In other cases these regulations may need to be reviewed as new service potentials develop; for example, the Tax Act in Japan requires that transaction documents be maintained on paper rather than allowing them maintained on electronic media. Box 3.1 describes the example of an electronic cash card, an application where growth is dependent on the development of information infrastructures and on the implementation of a number of other policy requirements. Governments' policy role is to facilitate such private sector initiatives.

**Box 3.1 Changing Forms of Transaction: The Case of the Multibanco Electronic Purse**

The last several decades have seen significant changes in the way financial transactions are undertaken on a daily basis. In particular the growth in the use of credit cards and on-line verification of credit card transactions at national and international levels have become common and have been aided to a large extent by packet switched communications technology. Building on this success other forms of payment are emerging. One example is the use of prepayment cards or electronic purses. In Portugal an inter-bank group, the Sociedade de Serviços (SIBS) operating on behalf of 30 Member banks has been developing the concept of an electronic purse to replace cash transactions and offer the prospect of a cashless retail outlet. In particular, such prepayment cards would be beneficial to small retail outlets where the minimum payments accepted on credit/debit cards are too high to be of benefit to them. A second consideration of the banks was to reduce handling of cash which is used in 90 per cent of payments in Portugal and which imposes high costs on Banks.

The Multibanco Electronic Purse (MEP) has been conceived as a rechargeable card compatible with existing automated teller machines and which can be recharged by these machines. There will be a limit on the amount of 'cash' users can load on the card which will be anonymous (i.e. no PIN number or users name on the card). Retailers accepting the card require a terminal to withdraw 'cash' from the card and these payments can then be deposited on-line into SIBS. For the user the card offers convenience, speed of use, transferability, and acceptability. For the merchant it offers convenience, lower cash handling costs, security, and reduced fraud. For banks it offers new income streams, lower transaction costs and cash handling costs, and new merchant clients.

*Source*: Room Document No. 11, Sociedade Interbancaria de Serviços, Presentation to the ICCP Special Session on Information Infrastructures, 3-4 April 1995.

It is not possible to determine the net balance of information infrastructures in terms of job creation and destruction. This balance is in any case dependent on the time frame under consideration and the type of applications which emerge. If governments move slowly to implement change, then in the short term, the balance will be negative since the initial applications of information infrastructures are likely to be labour saving. For this reason, in particular, it is incumbent on governments to accelerate market change in the regulatory framework to allow new applications to emerge and diffuse as rapidly as possible and to allow competition to reduce prices, to stimulate demand levels and to create jobs.

Other than the employment impact, information infrastructures and multimedia applications will impact on the demand for different skills. Evidently convergence will result in a general demand for skills in the areas directly affected by the development of multimedia: in Australia for example, during 1994-95 demand for computing professionals increased by 86 per cent and for electrical/electronic tradespeople by 110 per cent[67].

***Residential markets***

Consumption patterns in the residential market have changed dramatically over the last several decades. The share of spending on food, for example, has in many countries become a relatively small part of total expenditures whereas the share of services has grown tremendously. In the US the share of national consumption on consumer services reached 46 per cent in 1995 whereas consumer goods accounted for 34 per cent. Consumer expenditure on entertainment has increased from 4.3 per cent of income before taxes (1991) to 5.3 per cent (1993)[68]. Therefore, given the weight of services in household budgets, productivity improvements in services consumed by households which result from information infrastructure developments can have an important impact on standards of living.

Much emphasis has been given to the potential in the development of mass consumer markets for multimedia services in areas such as entertainment on demand, home shopping, other on line services such as banking as well as interactive services. Emerging technologies provide expectations of a significant transformation of the home market. Some studies have indicated that in the long term the residential multimedia market will have the greatest potential for growth[69]. However, the development of residential markets will depend on a number of factors. Disposable income will be, of course, a primary factor. It has been argued that the distribution of household budgets is not sufficiently elastic to provide a real margin for shifting expenditures toward new markets[70].

The evaluation of consumer demand is difficult. A number of consumer surveys have indicated that public interest in many areas is limited. For example, a recent European Survey (ITECO Corporation) concluded that households would be slow to pick up on multimedia applications. Similarly in the US a study of consumer attitudes to communication, information and entertainment services showed that there was a high level of satisfaction with the existing level of services[71]. Evidence of consumer reaction is varied: in a number of cases for new products or services consumers have reacted rapidly and positively (e.g. CATV in a number of countries), while in other cases consumer demand has been insufficient (videotex services in several countries). Other than income (and linked with this price of services and products), many of the information infrastructure applications require that households have in place the necessary equipment -- a personal multimedia computer equipped with a modem or cable television with a cable modem -- in order to access and use on-line services.

Terminal equipment is necessary to access on-line services; from this perspective, there is still insufficient diffusion across OECD economies to create a mass market rapidly. As well, there is still an important gap, even in many of the OECD economies with high penetration rates for PCs, between those segments of the population with potential access to on-line information and those who are not yet in a position to obtain access. In Canada, for example, the number of households with PCs increased from 10 per cent in 1986 to 25 per cent by 1994, however, while 44.5 per cent of the highest income quintile had PCs only 9 per cent of the lower income quintile had PCs and 15 per cent in the second lowest. Similarly, Canadian data show that there is a higher rate of diffusion of PCs in families with children compared to other household categories[72]. In the US a recent survey shows that the poorest households in central cities have the lowest telephone penetration rate (79.8 per cent) while the rural poor are lowest in terms of computer penetration at 4.5 per cent[73]. The concern of many governments has been that the transition toward an information society will lead to exclusion of the population from advanced services. The US data in Table 3.5 confirm the risk of exclusion linked with the low PC penetration. But, perhaps the concern should be aimed first at trying to ensure that all segments of the population have telephony: data even from advanced OECD economies show that a large number of households either do not want or cannot afford telephone service. In the US, for example, it is estimated that 6 per cent of households (14.8 million people) still do not have telephone service[74].

**Table 3.5. Percentage of US Households with a Computer by Age and By Rural, Urban and Central City Areas**

| | RURAL | URBAN | CENTRAL CITY |
|---|---|---|---|
| | | | |
| Under 25 years | 12.3 | 20.7 | 21.0 |
| 25 - 34 years | 22.3 | 27.8 | 25.0 |
| 35 - 44 years | 34.7 | 36.6 | 31.4 |
| 45 - 55 years | 32.5 | 36.8 | 31.8 |
| 55 years and older | 1.9 | 13.8 | 12.0 |

*Source:* US Department of Commerce, Falling through the Net: A Survey of the "have nots" in Rural and Urban America, July 1995.

The acceleration in PC sales noted above is encouraging for the longer term development of on-line service markets. In the US shipments of PCs to consumers accounted for 41 per cent compared to 47 per cent for business markets. Equally important is the diffusion and growth in modems. For Europe, for example, Dataquest estimates that the number of modems installed will increase from around 12 million in 1995 to 24 million by the year 2000.

Another factor of importance for the development of residential markets is time availability which will determine utilisation by households especially with respect to entertainment services, but as well as for adult education services, etc. One argument that has been put forward is that information infrastructures and multimedia services by providing greater flexibility in work, facilitating teleworking, and increasing productivity, will also facilitate a radical change in work patterns and number of hours worked. Such changes, it is argued, linked with widespread diffusion of multimedia applications, could provide a significant boost to new applications for household use and consequently the proportion of final demand spent on multimedia.

The time and difficulty of users to acquire competence in new applications should not be underestimated. Linked with this is the necessity in certain cases to stimulate social and behavioural change before certain applications reach the mass market stage

***The public sector***

Governments are often technologically backward in their provision of services and in the use of technology for administration. They should use the challenge which IIs offer to provide the appropriate incentives in the development of applications as well as use of IIs. In many application areas governments should be able to increase the efficiency in service provision and reduce the costs of service provision. In that demand can be an important constraint in developing information infrastructures governments can act as an important catalyst in stimulating the development of applications by the private sector[75].

However, governments must also be willing to provide public institutions with the appropriate resources to use information infrastructures. Schools, for example, will need a budget for the required terminal equipment and to access different applications. Similarly hospitals will require equipment and funds to cover usage charges. It is insufficient to discuss the benefits of information infrastructures to society if the funding issue is not addressed. Although some of the applications being put forward for public services may reduce costs, many will enhance existing service provision in terms of quality and scope and therefore cannot depend on budget savings to cover their provision. Education, health, and other public services have suffered in recent years from budget cuts aimed at reducing government deficits.

Many telecommunication operators and some on-line service companies have facilitated access to schools and hospitals and other institutions by providing free or reduced costs for access. Some examples include:

- Ameritech Ohio is making available $2.2 million for funding of computer centres in Ohio to make information highways accessible to low income communities and is providing $18 million to allow schools to purchase computer network equipment and services over the next 6 years with schools in low income areas to receive priority.

- In Wisconsin the State and GTE have agreed that GTE provide schools, libraries and government agencies in 560 communities with access to broadband at reduced cost over a 5 year period.

- AT&T is to invest $ 150 million to make advanced information services available to the US's 110 000 public and private elementary and secondary schools by 2000. The aim is to provide schools with free dial-up Internet services and 100 hours of free Internet usage.

- In Iowa the State will construct a backbone fibre-optic network to link all schools, libraries, state government agencies, community colleges, and Universities.

- Oracle, the software group, is to provide free software and computer access to all 25 000 British primary and secondary schools.

- In Canada under the School net programme 16 500 schools will be linked by II by 1998 and 1 000 rural and remote communities will be provided with public access.

- Stentor (Canada) has indicated a willingness to offer tariffs which would discriminate in favour of educational and health service entities. The CRTC is carrying out a public proceeding on this issue in particular to determine the impact of preferential tariffs on competition.

- The State of California plans to connect all the state's classrooms to the Internet by the year 2000 and incorporate technology in the school curriculum. The State has estimated that by year 2000, 60 per cent of new jobs will require skills held by only 20 per cent of the workforce so that it has placed importance on using the technology to enhance education.

Although these initiatives meet the goal of many governments to link schools and other public institutions to information infrastructures, policy-makers must take care that free or reduced cost for access do not have implications for competition and that any cross-subsidisation is not used so as to impact adversely on new entrants and their market share".

The role of government is to provide for the general administration of the country (provision of government services, policing, tax collection), to provide services to the public at large (education, health care), and to provide for the public infrastructure (airports, highways, etc.). In most of these functions governments are involved in collecting, processing and distributing information. In this sense they are in a unique position to use information infrastructures and help in building-up the required threshold in demand to sustain the development of infrastructures and new applications. The impact governments can have as a user and as a catalyst in stimulating new applications can be important, and for this reason

governments must be cautious to ensure that their policy do not have a distorting impact on markets. The constraints are not only technological, they are also institutional in a number of cases, see for example the case of telemedecine (Box 3.2).

**Box 3.2 TELEMEDICINE**

The ability to undertake two-way, interactive video communication between a physician and a patient, that is to provide a telemedicine service, is viewed as having significant potential in improving health-care delivery and in changing cost structures for the provision of health-care. Telemedicine includes remote diagnostics, remote monitoring of patients, electronic billing, remote outpatient care, etc. Early work on telemedicine began in the late 1950s; for example in the US the University of Nebraska implemented a telemedicine network in 1959. Early successful projects which followed on from this included the Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) programme bringing together NASA, Lockheed and the US Public Health Service. The take-off of telemedicine began in the 1990s: current telemedicine installations in the US are estimated as accounting for 3.5 per cent of the more than 7 000 hospitals in the country. One factor which is increasing interest in telemedicine is the move toward health-care reform and attempts to reduce health-care budgets. In the US, as well, the changing payment structure for health-care is also providing an incentive to invest in telemedicine: there is a shift away from a "fee-for-service" payment structure *i.e.* a predetermined fee for a specific intervention a hospital undertakes for a patient, to a "capitated" payment structure, *i.e.* a hospital receives an annual predetermined payment for each consumer signed up to their health plan irrespective of whether that consumer receives any treatment. This provides an incentive, first for preventive medicine where telemedicine can play an important role, and second to extend the hospital's geographic coverage to cover more consumers.

.../...

Technological developments, especially digital compression techniques, and linked with this the decline in teleconferencing equipment and other technologies, as well as communication costs, are also making telemedicine more cost effective. Studies have found that more than $ 36 billion in specific annual cost reductions could be achieved from telecommunication health care applications (Arthur D. Little Inc., Health Care Cost Reductions: The InterLata Component, 1992). These studies also concluded that government restrictions which in the US prevent the Bell Operating Companies from providing services across the local access and transport areas (LATAs) are a significant constraint in achieving the potential savings; it was estimated that $9.7 billion or 25 per cent of specific costs reductions could be achieved by lifting telecommunication restrictions. In Japan it has been estimated that by the year 2000 310 billion yen and by 2010 2 960 billion yen in cost reductions could be achieved in the health area through the use of information infrastructures (MPT News, Vol. 5, No. 21, 6 February 1995). The European Union programme on Advanced Informatics in Medicine (AIM) has estimated that telemedicine can help reduce costs in the region of 5-10 per cent.

There are, however, a number of constraints in the development of telemedicine. Finance for equipment, training, etc. will be a problem in most countries. For many health institutions their short-term budget problems are an important constraint in all fields of health delivery: many will view the potential cost savings which can be achieved through telemedicine as being a long-term outcome which, given their present financial situation, is an investment which will need to be deferred. Lack of standardisation in equipment and in the format for patient files is also a factor slowing down applications. As Breton notes, there are also organisational obstacles, inflexible work habits among the medical profession and hospital administrations, scepticism, institutional obstacles, etc. which need to be overcome. Existing regulations can also act as a break on diffusion. In the US, for example, a doctor would need to be licensed in every state to provide consultation services using communication networks. Malpractice liability has been cited as a factor which could impede application of telemedicine especially in that the consulting doctor will not have complete "data" by the fact that the patient is not physically present. Technical compatibility for systems is also important both within countries and internationally.

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This box draws extensively on Rebecca Whitehead, The Evolution of Telemedicine, Teleconference, Vol. 14#1, 1995, and; J.H. Sanders, Telemedicine Challenges to Implementation, Presented to the Subcommittee on Investigations and Oversight, US congress, Medical School of Georgia, 2 May, 1994, Thierry Breton, Les Téléservices en France, op. cit.

Governments need to put in practice the many reports they have issued on the information infrastructure and use the potential for jobs, for higher quality public services and to improve standards of living. In Europe the slow pace of public telecommunication operators in offering access to new applications on preferential terms for public services should be of concern. On the other hand governments need to ensure that the dominant network operators do not monopolise access to public institutions.

# CHAPTER 4 PRICING STRUCTURES

## Introduction

Present telecommunication pria cing structures are completely unsuitable for access to and use of multimedia applications. If network operators, service suppliers and governments wish to stimulate the development of on-line multimedia applications, then existing telecommunication pricing structures will require fundamental change.

Pricing for telecommunication services is commonly based on a fixed charge for access to the network (consisting of a one-off charge for connection to the network and monthly subscriptions charges), and a usage charges which varies with distance and time on the network. In a few countries local calls are untimed or may be free. These different charging practices are often compensated through higher fixed charges. PTOs also pay an access charge to other operators to terminate calls, or at the international level they face accounting rates which are well above cost and penalise international calling[76]. For data services, especially using packet switched networks, pricing is normally insensitive to distance. Pricing for broadcasting differs significantly from telecommunications. Broadcasting received off-the-air is often not charged to the user, or is charged through a yearly licence fee which is often well below cost. On the other hand CATV is charged on the basis of a connection charge and monthly subscription charges. Developments in the pricing of Internet services have differed significantly from telecommunication pricing by not charging for distance, not having an access charge between network providers, and in a number of cases not charging for usage.

The issue of pricing is extremely important in the development of information infrastructures, global information infrastructures and multimedia applications. This is because the economic and social impact of information infrastructures will depend largely on the development and diffusion of mass market applications for business and residential users. An important factor in this market growth and development of applications will be the tariffs for access to and use of information infrastructures. These tariffs will, at least in the early stage of development in applications, have a relatively important weight in the total charge to users for new multimedia services, and the tariff structures for access and use of networks are likely to influence tariff structures for end-user services.

Facilities-based competition may not only affect the level of prices but may also change the structure of prices. But given the strength of embedded dominant carriers in most countries, it can be expected that for competitive forces to successfully change pricing structures a long adjustment period would be required. For tariffs to be suitable for multimedia applications there are two requirements: tariffs must not be time-based, and tariffs must not be distance-based. The application of such tariffs need not be generalised for all services. There may be services which, because of their use of network resources should be subject to time based charges in order to dissuade excessive utilisation. For other services the set-up charge may be most important (this may be the case for video-on-demand). Although there has been discussion in the past on how communication costs are not time sensitive and, because of the

significant availability of capacity transmission, access to networks is becoming considered as a commodity and usage costs will consequently become extremely low, the available evidence shows that these are coming into play but only at a fairly slow pace.

Tariff developments in competitive mobile markets (such as in the UK) have shown the different tariff options that can emerge providing subscribers customised options to suit their usage pattern. Similar developments on broadband infrastructures would provide a significant boost to multimedia applications.

Many national policy statements on information infrastructures have given insufficient detailed emphasis to communication tariffs for future multimedia services. The purpose of this chapter is to highlight and examine some developments in tariffs for high speed communications in OECD countries and examine the implications this may have for future tariff policy.

In Australia the Broadband Service Expert Group noted that tariff policy is one of the key regulatory issues and thought that long distance tariffs and access charges are an important factor for broadband communications. The Group placed emphasis on the importance of price diversification for service provision and cost-oriented pricing both for infrastructure and content. The report argued that for pricing purposes the separation of content and infrastructure is necessary for fair competition avoiding cross-subsidisation. On the other hand, "artificial" separation of the two would hinder development.

The Danish report has recognised that tariff reductions will stimulate applications and usage of broadband dramatically. The Ministry has suggested that it is impossible to realise sufficiently low tariffs by means of regulatory initiatives except through liberalising the market[77]. The recommendation made by the High-level Group on the Information Society to the European Council is based on the concept that demand would be greatly improved by reducing the cost of long distance communications including international communications and leased line services. In Germany the government regards the current tariff structures as creating major obstacles to the expansion of multimedia technology.

The Telecommunication Council in Japan[78] has reviewed the tariff system and its report emphasises the importance of exploiting the reduced cost of fibre-optic cable and at the same time emphasises the necessity for an appropriate tariff system for the multimedia era. These results were published in an interim report in 1995. The main issues for discussion for new tariff structures are viewed by the Council as being : diversification of revenue sources, responsiveness to increased video services, expanding opportunities for user selection, and taking into account the international perspective. The Ministry of Posts and Telecommunications has set up a Study Group to look at pricing in the multimedia era[79]. The Dutch government has recognised that the relatively high tariff and slow introduction of advanced services (such as broadband leased lines, ISDN, GSM) is a weakness.[80]

Recent developments and trends for high speed communications services (defined as high speed leased line services and ISDN services) can provide some insight and lessons for broadband communications. Leased line services are at present the most important services for advanced business usage at the national and international level. In most OECD countries the provision of infrastructure, and therefore leased circuits, has been undertaken within a monopoly market structure, so that leased circuit prices have not benefited from competition. The business community has often drawn the attention of governments to the fact that they considered tariff levels for leased circuits as being significantly above cost and in many countries this has been viewed as detrimental to their competitive situation. OECD work has already shown the wide divergence which exists in telephony, and other telecommunication charges[81]. Previous work has also shown that competitive markets perform significantly better in terms of price than monopoly markets[82].

Tariff levels for leased line services in non-competitive markets are generally well above those in competitive markets. For example, in the case of 1.5 Mbit/s leased line services, although tariffs in non-competitive countries decreased by 8.2 per cent on average from 1992 to 1994, the absolute level of tariffs for non-competitive countries is still 58 per cent more expensive than those in competitive markets. Considering the fact that leased lines provide an important infrastructure for advanced applications, there could be serious economic costs in non-competitive markets resulting from high prices which would retard the development of applications and the use of advanced communications services. Considering, as well, that many European OECD countries will not be opening their markets to competition for infrastructure until 1998 (and some countries much later), their ability to develop applications will be retarded given the fact that competitive pressure from new entrants is likely to take time before it impacts on the incumbent operator. For those countries delaying competitive entry, the high prices which consumers will continue to face and the delay in diffusion and use of multimedia applications will impose considerable costs on consumers and business and ultimately on jobs. As well, high prices will also retard the diffusion and development of local content in terms of multimedia applications.

Conventional PSTN tariffs have been becoming less time and distance dependant because of changes in cost structures resulting from changing technologies. Flat rate tariffication is no longer an unrealistic option and is likely to be required to stimulate mass market applications for multimedia services. Although, if such tariff structures were to be implemented, the transition process to this new structure may become an important issue. Again, the speed at which competition is introduced will be an important factor. Conventional PSTN tariffs need to be freed, however, from the political and historical factors which have shaped them in order to adjust to new service configurations and new demand structures. Governments must, in this context, allow flexibility in tariff setting, keeping in mind the importance of having in place a set of regulatory safeguards to avoid using pricing structures to unfairly gain competitive advantage.

The structure and level of PSTN prices has also played a considerable role in shaping tariffs for high speed communication services. It is therefore important to examine high speed communication tariffs together with trends in PSTN. An important factor in slowing change to new tariff structures is the fact that telephony at present provides PTOs with a large percentage of their revenues. Many operators are therefore reluctant to take the risk to implement new pricing structures which may in the longer term impact telephony pricing structures.

**ISDN**

ISDN (Integrated Services Digital Networks) have been considered by a number of analysts as providing the initial starting point or norm leading to the development of information infrastructures. However, ISDN tariff structures have been based on conventional telephone tariff structures which are not suitable for information infrastructure applications and would not provide an incentive for entrepreneurs to develop new multimedia services. The recent surge in the number of ISDN subscribers is due to users starting to realise the economic advantages in using ISDN services as a substitute for conventional services. The initial development of ISDN was heralded as providing a breakthrough in terms of telecommunication technology and the ability to provide a range of integrated services. As noted previously, the take-off point for ISDN services was expected to occur in the mid-1980s and the ability to integrate services was viewed as providing significant benefits to consumers. Prices were certainly not the only factor that played a role in retarding ISDN diffusion so significantly, but they were important.

Currently, to provide bulk data transfer or interactive communications capability for emerging multimedia services, highspeed leased line services or ISDN would be the major option. User decisions on which services to use would not only based on prices but take into account many other factors such as security, speed, quality, etc. However, where services are used for commercial purposes, price would be the most important factor in determining which service to use in the long term. In the following section, leased line services and ISDN are selected as examples of the underlying communication services to be utilised for the delivery of future applications.

For the most part ISDN usage charges have followed PSTN charges (Table 4.1). For data communication usage, charging schemes differ among OECD countries. Some carriers in the US and Japan have service options for high speed ISDN links[83] but otherwise the ISDN tariff is calculated on the basis of the number of 64 kbit/s digital lines in local communications service provision level. The dependence of ISDN tariffs on current PSTN tariff structures is partly due to the fact that ISDN services are dependent on existing network facilities so that operators may consider that it is difficult to justify using a different tariff structure for ISDN compared to other services using the same network. However, since PSTN tariffs are generally not cost-based, it is difficult to understand why such pricing decisions have been made. On the marketing side, given that ISDN services substitute for other services, ISDN tariffs were also structured so that they would not lead to significant migration. As well, underlying the fact that ISDN tariffs are set slightly higher than the equivalent PSTN service is the notion that ISDN provides a greater value added than conventional services and therefore merits being more expensive.

**Table 4.1. ISDN Usage Charge in OECD Countries**

| | Telephone usage | Data communications usage |
|---|---|---|
| The same as PSTN | All OECD PTOs except listed below | Finland, Spain, Sweden, UK, Japan (64kbit/s), |
| The same as PSTN<br>Plus additional call set-up charge | Belgium<br>Denmark<br>Netherlands | Belgium (Further additional call set-up charge)<br>US (Additional Surcharge) |
| Similar to PSTN | | *More expensive*<br>France, Ireland, Italy (non-packet), Japan (384kbit/s, 1.5 Mbit/s)<br>Netherlands (+call set-up)<br><br>*Less expensive*<br>Norway (+call set-up) |
| The same as X.25<br>Independent of Distance | | Austria, Denmark,<br>Italy (packet), Japan (packet),<br>Luxembourg, Switzerland |

1. US - NY area.
*Source:* OECD, TARIFFICA.

Tariff policy for ISDN has therefore not been aimed at stimulating usage or developing new applications. This may explain partly why ISDN diffusion has been so slow. A number of countries have emphasised in their policy discussion papers on national information infrastructures that the structure and level of ISDN tariffs might not be suitable for multimedia services[84]. For example, in Japan one calculation shows that existing ISDN services costs users US$ 375-6750 to transmit a two hour video programme, US$ 37.5-675 for a CD-ROM, and US$ 2.2-133.3 for an on-line medical X-ray depending on the distance

of the transmission[85]. For local loop transmission costs are less, but for long distance service provision costs are almost prohibitive. This is because usage charges for ISDN are basically designed on the PSTN structure based on time and distance concepts.

**Leased line service**

The trend for leased line tariffs in OECD countries is shown in Table 4.2. Prices for medium speed leased circuits (54/64 kbit/s) declined by about 15 per cent between 1992-1994 while for high speed circuits (1.5/2 Mbit/s) price reductions were relatively less, while for voice level service (9.6 kbit/s) the average price level rose 26.0 per cent. PTOs have been encouraging customers to shift from using low speed circuits to higher speed circuits which may account for the large tariff increase in 9.6 kbit/s service. In fact, some OECD countries have stopped providing circuits at this speed. During the same time period PSTN tariffs for business subscribers were reduced by only 3.9 per cent on average across the OECD, significantly less than price decreases for 54/64 kbit/s and 1.5/2 Mbit/s leased circuit services. Part of the explanation may be that the rebalancing process has been underway for a number of years for PSTN tariffs so that the significant price reductions in leased circuits represent a catching-up process.

**Table 4.2. Time Series of Leased Line Tariffs for OECD Countries**
(Index)

| OECD Index (Simple average) | 1992 | 1993 | 1994 |
|---|---|---|---|
| Leased Line services | | | |
| 9.6 kbit/s | 100.00 | 105.80 | 125.98 |
| 54/64 kbit/s | 100.00 | 102.71 | 84.44 |
| 1.5 / 2 Mbit/s | 100.00 | 101.89 | 92.51 |
| | | | |
| PSTN | 1992 | 1993 | 1994 |
| Business | 100.00 | 98.55 | 96.12 |
| Residential | 100.00 | 99.30 | 99.87 |

1. For leased line tariffs the data listed below are not calculated in this time series:
   9.6 kbit/s - Sweden ( 1)
   54/64 kbit/s - Australia (2), Iceland (2), Sweden (1)
   1.5 / 2 Mbit/s - Finland (3), Spain (3), Sweden (3)
   The data are not calculated because of;
   (1) Tariff system change,
   (2) Data discrepancy during the period,
   (3) Data unavailability.
2. All figures are simple OECD averages of the Index.

*Source:* OECD.

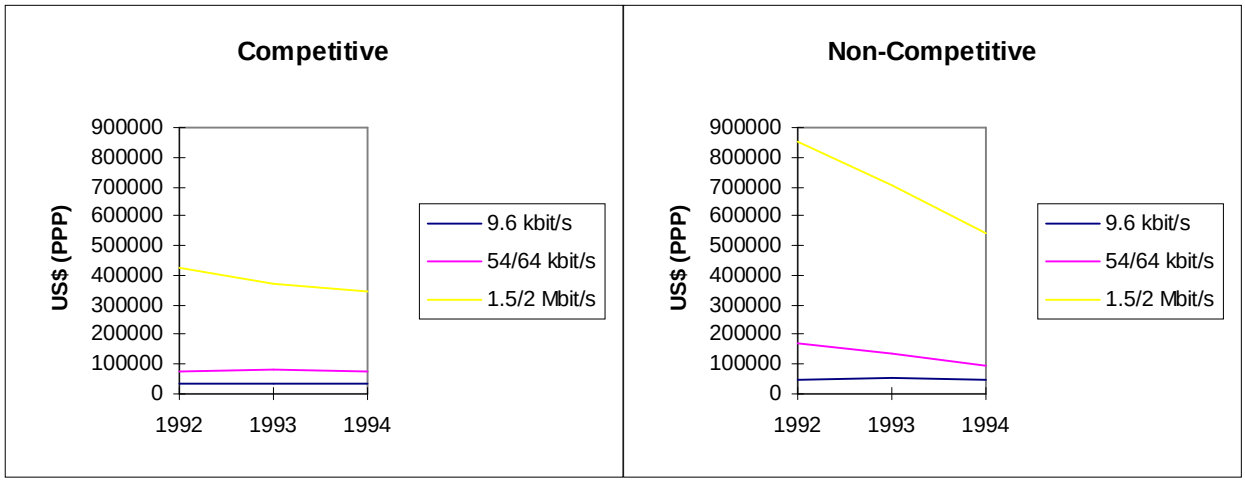
There are several reasons for these changes in leased line tariffs. First, many operators in the past had a strategy to maintain business customers on the PSTN or on public data networks. The relatively large gap in prices between public networks and leased circuits was aimed at providing a disincentive to business to use leased circuits. Pressure from the business sector for access to leased circuits at affordable prices, the realisation that users of leased circuits tended to continue to use public networks, often increasing their data throughputs, and increasing competition among operators to provide one-stop-shopping services and managed data networks placed pressure on operators to facilitate the use of

leased circuits. Despite the fact that restrictions still remain in some countries with respect to access and use of leased circuits there is clearly increased emphasis by many operators to facilitate and manage the communication needs of companies, especially transnational enterprises.

Although strategic behaviour of a number of telecommunication operators has changed, market structures have not changed or have not changed sufficiently fast and, as a result, there is an important gap in prices between competitive markets and non-competitive telecommunication markets. The absolute leased line tariff basket for different market structures is shown in Figure 4.1. This figure indicates clearly that tariffs in monopoly markets are still 25 per cent to 58 per cent more expensive than those in competitive environments even though operators in non-competitive countries are reducing their prices relatively rapidly.

The price comparisons undertaken here do not take into account various tariff options or bulk discounts being offered by operators. However, since most of the tariff options or volume discounts tend to be made available in competitive markets, the data would tend to understate the relative favourable position of competitive markets in leased circuit services.

**Figure 4.1. Leased Line Tariff Trends: Competitive and Non-competitive Markets**




Tariffs for PSTN services (measured as an index) decreased by 8 per cent in a competitive environment while in a monopoly environment tariffs stayed more or less the same during the 1992-1994 period (Table 4.3). The implications that can be drawn from the above is that competition would play a significant role in decreasing tariffs for leased circuits. In turn this could be expected to stimulate their usage by industry and stimulate applications. Thus, OECD countries which attach high priority to information infrastructures and the economic and social benefits that they may bring should place equally high priority on stimulating competition in infrastructure in order to increase the development and diffusion of new applications.

The recognition of the potential negative effects of high leased line prices, has been put forward strongly by the European Commission. The Commission has noted that the industrial competitiveness of Europe relative to its major trading partners, and especially the United States, is jeopardised by high leased line tariffs. The Commission has argued that high speed leased line tariffs in the Community are almost

ten time as expensive compared to the US[86] (Table 4.4). Underlying this comparison is the concept that should Europe become a single economic area, should be on the same footing in terms of industrial competitiveness as US enterprises[87].

**Table 4.3. The Impact of Competition on Leased Lines and PSTN Tariffs**
(Index)

| Leased Line Service | 1992 | 1993 | 1994 |
|---|---|---|---|
| COMPETITIVE | | | |
| 9.6 kbit/s | 100.00 | 85.68 | 107.78 |
| 54/64 kbit/s | 100.00 | 99.80 | 99.30 |
| 1.5 / 2 Mbit/s | 100.00 | 99.96 | 94.33 |
| | | | |
| Non-COMPETITIVE | | | |
| 9.6 kbit/s | 100.00 | 112.90 | 132.40 |
| 54/64 kbit/s | 100.00 | 103.62 | 79.80 |
| 1.5 / 2 Mbit/s | 100.00 | 102.66 | 91.78 |
| | | | |
| PSTN | 1992 | 1993 | 1994 |
| COMPETITIVE | | | |
| PSTN Business | 100.00 | 98.35 | 91.82 |
| PSTN Residential | 100.00 | 98.53 | 95.98 |
| | | | |
| Non-COMPETITIVE | | | |
| PSTN Business | 100.00 | 98.61 | 97.98 |
| PSTN Residential | 100.00 | 100.00 | 101.84 |

1. For leased line tariffs:
   The competitive countries are; Australia, Canada, Japan, NZ, UK, US.
   The data listed below are not calculated in this time series for leased lines
   9.6 kbit/s - Sweden (1)
   54/64 kbit/s - Australia (2), Iceland (2), Sweden (1)
   1.5 / 2 Mbit/s - Finland (3), Spain (3), Sweden (3)
   The data are not calculated because of:
   (1) Tariff system change,
   (2) Data discrepancy during the period,
   (3) Data unavailability.
2. For PSTN tariff:
   The competitive countries are; Australia, Canada, Japan, NZ, UK, US and Sweden (only from 1993).
3. All figures are simple OECD averages of the Index.

*Source:* OECD.

The implication for EU policy from a comparison of EU leased line prices with the US is the need to place more emphasis on stimulating competitive market structures across national frontiers: the 1998 elimination of reserved services and infrastructure monopolies although important could be slow in being implemented, especially in several countries which by the end of 1995 had not made much progress in implementing the necessary regulatory framework for competition. Thus it may only be around the year 2000 before sufficient competition emerges.

In Japan the level of domestic leased line tariffs has remained static over the last three years and as a result it is becoming relatively expensive (but still lower than the OECD average except for 1.5 Mbit/s services (Table 4.5). However, for international circuits Japan is one of the most expensive OECD countries. The significantly high market concentration that still exists in Japan may be a reason for this.

**Table 4.4. High Capacity Leased Circuit Prices in ECU (as of 1 Jan. '94)**

| EU half circuit | Rental to nearest EU | Rental to furthest EU |
|---|---|---|
| | | |
| Belgium | 21 793 | 29 380 |
| Denmark | 17 658 | 19 865 |
| France | 24 185 | 31 815 |
| Germany | 27 889 | 33 422 |
| Greece | 26 115 | 33 174 |
| Ireland | 4 027 | 30 312 |
| Italy | 27 685 | 33 769 |
| Luxembourg | 16 739 | 27 170 |
| Netherlands | 18 700 | 24 933 |
| Portugal | 21 117 | 31 777 |
| Spain | 30 192 | 30 821 |
| United Kingdom (BT) | 10 041 | 40 778 |
| United Kingdom (Mercury ) | 8 817 | 23 958 |
| | | |
| EU | 20 461 | 29 901 |

| | | |
|---|---|---|
| EU total circuit price | 40 922 | 59 802 |
| US | 4 601 | 6 236 |

1. Rental charges are in ECU for monthly rental of a 2 Mbit/s line on 1 year contracts.
2. "EU total circuit price" is sum of two EU average circuit halves.
3. Figures for US represent AT&T charges for a 1.5 Mbit/s circuit (T1) from New York to Washington (520 km) and New York to Chicago (1 100 km).

*Source:* European Commission, Coopers & Lybrand, 1994/

**Table 4.5. Leased Line Tariff of Japan compared to OECD Average.**

| Japan / OECD average | 1992 | 1993 | 1994 |
|---|---|---|---|
| 9.6 kbit/s | 86.40 | 83.04 | 86.33 |
| 54/64 kbit/s | 46.52 | 58.15 | 78.04 |
| 1.5 / 2 Mbit/s | 74.28 | 90.66 | 115.20 |

1. Percentages represent the tariff of Japan divided by OECD average tariff.

*Source:* OECD.

## Tariffs for the emerging GII

Usage charges at the international level for 64 kbit/s ISDN service are shown in Table 4.6 for selected OECD countries. The OECD simple average for a standard one minute communication at peak time is US$ 0.92 as measured using PPP, while the equivalent average for an international telephone call is US$ 0.78. One of the more interesting points in Table 4.6 is that, in contrast to domestic tariffs, operators in some countries set cheaper tariffs for ISDN 64 kbit/s services than for PSTN call charges. Although this comparison does not take into account related fixed charges, in terms of usage charges countries such as Austria, Denmark, the Netherlands, and Sweden have cheaper ISDN usage charges than for the PSTN and less expensive fixed charge for ISDN compared to the other OECD countries (see last row of Table 4.6).

**Table 4.6. International Usage Charge of ISDN 64 kbit/s**

| From | Aus. | Bel. | Den. | Fin. | Fra. | Ger. | Irel. | Italy | Japan | Neth. | Nor. | Port. | Spain | Swe. | Switz. | UK (BT) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To | | | | | | | | | | | | | | | | |
| Aus. | - | 0.54 | 0.36 | 0.99 | 0.61 | 0.54 | 1.08 | 0.71 | N/A. | 0.68 | 0.64 | 1.08 | 1.39 | 0.50 | 0.61 | 1.00 |
| Bel. | 0.57 | - | 0.36 | 0.65 | 0.61 | 0.54 | 0.82 | 0.71 | 2.45 | 0.45 | 0.64 | 1.08 | 1.39 | 0.42 | 0.61 | 1.00 |
| Den. | 0.57 | 0.54 | - | 0.34 | 0.74 | 0.54 | 1.08 | 0.71 | 2.45 | 0.52 | 0.28 | 1.08 | 1.39 | 0.23 | 0.61 | 1.00 |
| Fin. | 0.91 | 0.68 | 0.27 | - | 1.04 | 0.65 | 1.08 | 0.71 | N/A. | 0.85 | 0.28 | 1.31 | 1.39 | 0.23 | 0.61 | 1.00 |
| Fra. | 0.57 | 0.45 | 0.36 | 0.65 | - | 0.54 | 0.82 | 0.71 | 2.45 | 0.45 | 0.64 | 1.08 | 1.39 | 0.50 | 0.55 | 0.86 |
| Ger. | 0.57 | 0.45 | 0.32 | 0.65 | 0.61 | - | 0.82 | 0.71 | 2.45 | 0.45 | 0.64 | 1.08 | 1.39 | 0.42 | 0.61 | 0.86 |
| Irel. | 0.91 | 0.54 | 0.36 | 0.81 | 0.74 | 0.54 | - | 0.71 | 2.45 | 0.68 | 0.64 | 1.08 | 1.39 | 0.42 | 0.86 | 0.86 |
| Ital. | 0.57 | 0.54 | 0.41 | 0.99 | 0.61 | 0.54 | 1.08 | - | 2.45 | 0.68 | 0.64 | 1.08 | 1.39 | 0.50 | 0.55 | 1.00 |
| Jap. | 1.29 | 1.89 | 1.46 | 1.65 | 2.26 | 1.52 | 2.74 | 2.19 | - | 1.64 | 1.90 | 2.47 | 3.68 | 1.40 | 1.69 | 3.29 |
| Net. | 0.57 | 0.45 | 0.36 | 0.65 | 0.61 | 0.54 | 0.82 | 0.71 | 2.45 | - | 0.64 | 1.08 | 1.39 | 0.42 | 0.49 | 1.00 |
| Nor. | 0.57 | 0.68 | 0.27 | 0.34 | 1.04 | 0.65 | 1.08 | 0.71 | 2.45 | 0.68 | - | 1.31 | 1.39 | 0.23 | 0.61 | 1.00 |
| Port. | 0.91 | 0.58 | 0.36 | 0.99 | 0.74 | 0.54 | 1.08 | 0.71 | N/A. | 0.68 | 0.75 | - | 1.39 | 0.50 | 0.86 | 1.00 |
| Spa. | 0.57 | 0.58 | 0.41 | 0.99 | 0.61 | 0.54 | 1.08 | 0.71 | 2.45 | 0.68 | 0.75 | 1.08 | - | 0.50 | 0.86 | 1.00 |
| Sw. | 0.57 | 0.68 | 0.27 | 0.34 | 1.04 | 0.65 | 1.08 | 0.71 | 2.45 | 0.42 | 0.28 | 1.31 | 1.39 | - | 0.61 | 1.00 |
| Sz. | 0.57 | 0.54 | 0.36 | 0.65 | 0.61 | 0.54 | 1.08 | 0.71 | 2.45 | 0.42 | 0.64 | 1.08 | 1.39 | 0.50 | - | 1.00 |
| UK | 0.57 | 0.45 | 0.36 | 0.81 | 0.61 | 0.54 | 0.69 | 0.71 | 2.45 | 0.52 | 0.64 | 1.08 | 1.39 | 0.42 | 0.49 | - |
| | | | | | | | | | | | | | | | | |
| Avg | 0.69 | 0.64 | 0.42 | 0.76 | 0.83 | 0.63 | 1.10 | 0.80 | 2.45 | 0.65 | 0.67 | 1.22 | 1.55 | 0.48 | 0.71 | 1.13 |
| Ratio | 79 | 106 | 99 | 146 | 126 | 101 | 148 | 113 | 133 | 94 | 157 | 83 | 137 | 86 | 130 | 177 |

1. Tax is excluded.
2. Standard rate one minute call.
3. Data are from March 1995.
4. Calculated using 1994 PPP average.
5. Ratio in last row is the ratio of the ISDN 64 kbit/s line tariff to equivalent PSTN tariff.

*Source:* PTT Netherlands, OECD.

The data in table 4.6 are also shown in relative terms in table 4.7 where relative prices of 64 kbit/s services are compared to PSTN and leased line services. On average, ISDN 64 kbit/s services are about 20 per cent more expensive than conventional PSTN international call while 64 kbit/s leased line services are 50 per cent more expensive than 9.8 kbit/s leased line tariffs.

Observations of these relative prices leads to the conclusion that:

- ISDN usage charges relative to PSTN charges are cheaper than relative to leased lines.
- The pricing of ISDN international usage is more consistent than for international leased line pricing.
- The pricing of ISDN 64 kbit/s and leased line 64 kbit/s relative to 9.8 kbit/s are strategic rather than cost oriented otherwise it is difficult to justify the wide divergencies of the first and second columns of table 4.7.
- There are five countries which have cheaper ISDN 64 kbit/s tariffs compared to PSTN usage tariffs and the fixed charge of ISDN relative to PSTN fixed charge is not much more expensive in these countries. Relative prices of 64 kbit/s services are virtually the same price as 9.8 kbit/s services both in ISDN and leased lines in Denmark and the Netherlands.

The last two columns in Table 4.7 show relative break-even points for usage time of different services. Thus, on average, it is cheaper to lease circuits if the user requires to communicate more than 3.62 hours a day in case of 64 kbit/s circuits and 2.77 hours a day for 9.8 kbit/s circuits. Price differentiation is greater among operators for 64 kbit/s compared to 9.8 kbit/s.

**Table 4.7. Relative Levels of International Usage (Rental) Tariff in Selected OECD Countries**
(Service to Service Comparison)

| | Relative price of 64 kbit/s service to 9.8 kbit/s service | | Leased line break even point for a day against equivalent switched service | |
|---|---|---|---|---|
| | ISDN64 / PSTN9.8 | L.L. 64 / L.L. 9.8 | L.L. 64 / ISDN64 | L.L. 9.8 / PSTN 9.8 |
| | | | (Hours) | (Hours) |
| Austria | 79.13 | 202.77 | 6.64 | 2.59 |
| Belgium | 106.62 | 169.39 | 4.26 | 2.69 |
| Denmark | 99.61 | 100.83 | 3.43 | 3.41 |
| Finland | 146.39 | 124.69 | 2.19 | 2.58 |
| France | 126.66 | 294.56 | 5.51 | 2.37 |
| Germany | 101.88 | 151.62 | 4.09 | 2.76 |
| Ireland | 148.92 | N/A. | N/A. | N/A. |
| Italy | 113.01 | 143.02 | 4.44 | 3.52 |
| Japan (KDD) | 133.63 | 132.12 | 2.73 | 2.76 |
| Netherlands | 94.56 | 118.89 | 3.16 | 2.53 |
| Norway | 157.28 | 131.87 | 2.83 | 3.40 |
| Portugal | 83.06 | 138.49 | 4.38 | 2.63 |
| Spain | 137.40 | 112.90 | 2.10 | 2.58 |
| Sweden | 86.29 | 130.58 | 3.67 | 2.44 |
| Switzerland | 130.59 | 103.66 | 2.49 | 3.14 |
| UK (BT) | 177.93 | 203.83 | 2.37 | 2.08 |
| | | | | |
| Average | 120.18 | 150.61 | 3.62 | 2.77 |
| Standard deviation | 0.24 | 0.32 | 0.35 | 0.15 |

1. L.L. = Leased Line.
2. PSTN tariff as of Jan. 1994. Calculation based on average 1 minute call charge for a 4 minute call in peak time.
3. Leased line tariff as of Sep. 1994. Calculation based on Monthly rental charge.
4. ISDN 64 kbit/s line tariff as of Mar. 1995. Calculation based on maximum 1 minute call charge including data communications.
5. ISDN 64 / PSTN9.8: Ratio of simple average of international one minute call charge of ISDN 64 kbit /s line to the equivalent of PSTN call.
6. L.L. 64 / L.L. 9.8: Ratio of simple average of international 64 kbit/s leased line half rental charge to the equivalent of 9.8 kbit/s leased line.
7. Break even point (L.L. 64 / ISDN64): Necessary hours per day to make ISDN 64 kbit/s line cost (fixed charge and usage charge) equal to twice the simple average of international 64 kbit/s leased line half rental charge.
8. Break even point (L.L. 9.8 / PSTN 9.8): Necessary hours per day to make PSTN line cost (fixed charge and usage charge) equal to twice the simple average of international 9.8 kbit/s leased line half rental charge.
9. Standard deviation is deflated by average.
10. Calculations use 1994 average PPP.
11. Tax excluded.

*Source:* OECD.

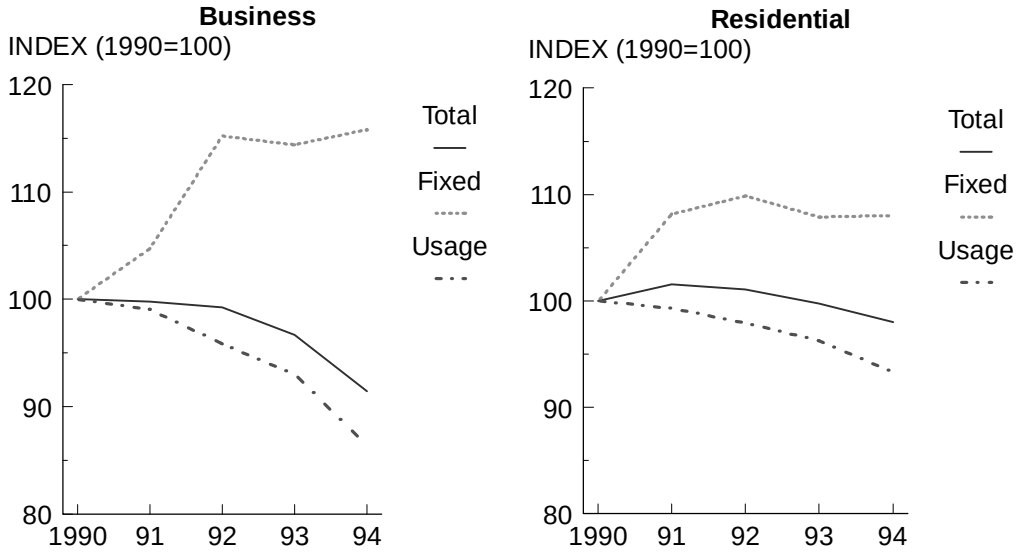
The level of international prices for use of infrastructure, relative prices between different services and the structure of prices are certainly not suitable for the development of global information infrastructures. In a number of countries a significant amount of tariff rebalancing and restructuring would need to take place before suitable tariffs for global services emerge. ISDN prices are far from suitable to allow this service to become the backbone infrastructure for the development of an international information society.

**Recent PSTN tariff trends**

In previous sections data have shown the relative price of leased circuits of different speeds and of ISDN services. In this section empirical data on PSTN tariff trends over the last 5 years are discussed.

Recent analysis shows that telephone tariffs in OECD countries are becoming less and less dependent on time and distance which have traditionally formed the basis for usage charges. Figure 4.2 shows that fixed charges for residential and business customers, which are set independent of time and distance, are becoming more important relative to usage charges. Recent developments in the US for long distance are promising. The main long distance providers have introduced postalised rates for residential customers whereby for a charge of $0.22-0.26 (depending on the operator) customers can call anywhere in the US during peak periods and for between $0.15-0.10 during off-peak periods.

**Figure 4.2. Telephone Tariff Rebalancing**



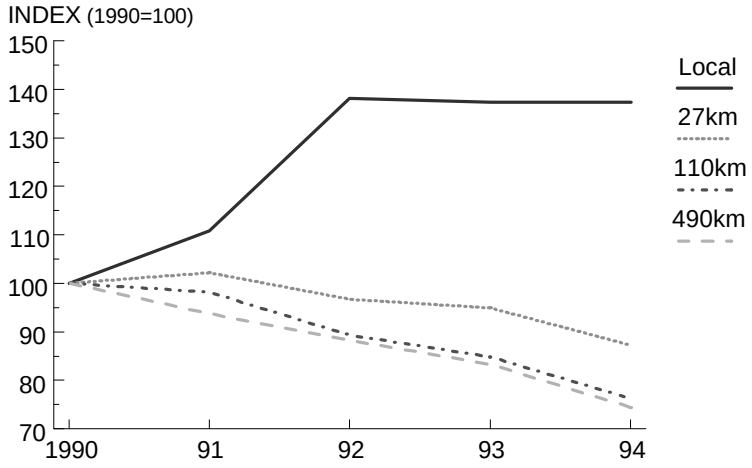

*Source*: OECD Telecommunications Tariff models.

Although technological changes could help explain the rebalancing of tariffs between fixed and usage charges, there has also been a fundamental change in perception of pricing for telecommunications. In the early stages of development of telecommunication networks many operators set tariffs so that access was relatively cheap in order to attract new customers and because network externalities were viewed as being important. Low access charges were compensated for by relatively higher usage charges. With high penetration rates and the need to stimulate revenue, greater emphasis has been placed on stimulating

usage (traffic). In addition a rebalancing of charges from usage to fixed is observed where there is an increase in price elasticity with respect to usage charges usually resulting from increased competition. With no alternative network providers in monopoly markets, subscriber demand for access was inelastic relative to usage. With new entrants demand for access is becoming more price elastic and it can be expected that this situation will change rapidly especially with the emergence of new technologies which provide near substitute service such as mobile and CATV telephony.

In addition to the shift between access and usage charges there has also been a rebalancing within the range of usage charges with a relative increase in local calling and relative decreases in long distance calling (Figure 4.3). An important reason in this context is technology which has decreased the costs of long distance transmission.

**Figure 4.3. Telephone Tariff Rebalancing (By distance)**




*Source*: OECD Telecommunications Tariff Model.

**Flat rate tariff and resource scarcity**

From observations made above, access or fixed charges are becoming relatively more significant in terms of the total tariff faced by customers. This results not only from technological changes but also from strategic pricing decisions of operators. To what extent is it feasible to use flat rate tariffication for future high speed communication services? The benefits from flat rate tariffs would be:

- to reduce geographical disadvantages and thus promote universal service in the geographic sense;

- to promote multimedia usage and stimulate development of network applications.

An important requirement in non-usage based tariffication is the availability of ample communications capacity. If communications capacity is no longer considered a scarce resource commodity pricing would be followed and traffic increases would not result in an increase in incremental costs. To attain such a situation a single broadband network is unlikely to be sufficient. Competition, however, would provide an incentive for multiple networks, declining prices and pricing structures which would reflect a commodity market situation. Essentially, arguments made against competition on the basis that this would lead to a duplication of facilities are erroneous because they ignore the importance of

price and the effect of prices in stimulating the development of applications. Monopoly infrastructures have resulted in infrastructure becoming a scarce resource and distorting prices and price structures. Competition will not hurt the ability of network operators to invest since it will stimulate usage and therefore traffic streams.

The policy problem is not so much in the long term in a competitive situation, but in the transition from existing pricing structures to long term pricing structures. Only operators with a dominant position are likely to be in a position to price access in a strategic manner, i.e. on the basis of the expected long term price. Thus price surveillance may be important to prevent anti-competitive behaviour. Certainly, in the short to medium term, as capacity is put into place and with a rapid increase in demand there is the possibility of congestion and therefore the need to set priorities through tariffication[88]. The setting of priorities through prices would allow users to decide on whether to pay extra to avoid congestion costs. As well, the notion of flat rate tariff structures does not imply that time based pricing should not be used for some services where connection time may be at a premium.

**Cost allocation and pricing**

Cost-oriented pricing has been emphasized in recent years, in particular with emphasis being placed on price rebalancing. However, with the development of broadband networks the allocation of cost for different services may not be feasible. Cost separation in a network providing integrated services, and when network resources are also a service (users may specify the speed and capacity they require on demand), will prove extremely difficult, if not impossible. Strategic pricing will become important in order to provide the proper incentives for users. This does not imply that in present conditions cost separation is not important. On the contrary the lack of effective competition and unbalanced market entry between long distance and the local loop requires cost separation to be practised until this situation changes.

**Pricing for multimedia**

The development of information infrastructures in a competitive environment, and the development of mass market applications, will require that prices for access and use of the infrastructure are low and form a small percentage of the price for access and use of applications. Pricing structures need to be seamless so that users are only faced with a single price. A current example of such a seamless structure is the videotex service in France (Minitel) where users pay a different per minute charge depending on which “kiosque” they access. Cable television in most countries also offers a pricing structure which may be suitable for some mass applications. Prices are charged on a fixed basis, irrespective of use, and in some countries users wishing to have access to more channels or channels which offer current films, pay a premium. It is evident from the data presented in this paper that existing pricing structures for leased circuits or ISDN services are inappropriate for the development of mass market applications. Alternative models to traditional PSTN pricing need to be adopted rapidly in order to stimulate the development and usage of applications.

# CHAPTER 5 THE POLICY REQUIREMENTS FOR INFORMATION INFRASTRUCTURES

## Introduction

Previous Chapters have discussed the technological and economic developments driving change in the communication industry and the economic impacts that these changes, and applications based on information infrastructures can have on economies and society. It was stressed in those chapters that these changes and impacts are contingent on the development of a market structure which supports diffusion of new services, supports convergence of industries and services, supports efficient pricing structures, and supports employment creation and productivity growth.

Evidence regarding the development of networks, applications and pricing indicate that existing market structures and therefore policy frameworks in most OECD countries are not conducive to support the rapid and efficient development of information infrastructures and multimedia applications. This has been underscored in the European Union by the Heads of State and Governments in their conclusion that : "The European Council sees the basic decision of liberalising the telecommunication infrastructure by 1 January 1998 as a decisive step in establishing information infrastructures for the future."[89] Present market structures are detrimental to the development of new service activities, new job creation and the growth of new economic activities. The economic costs of deferring to existing vested interests of companies or labour is significant relative to the national economic benefits which could be gained from changing existing policy structures to stimulate the creation of new activities and jobs. Mention has already been made in previous chapters with regard to the economic costs of delaying decisions. Such delay is incongruous given the emphasis governments have placed on job creation and growth.

This chapter examines some specific policy areas which governments need to address in order to develop information infrastructures and multimedia activities. National initiatives need to be followed by international ones. Given the global nature of new communication technologies and activities it is important to have in place international principles and frameworks to ensure the harmonious development of global information infrastructures. The following chapter addresses the requirements for such international policy frameworks. Most of the regulatory requirements and tools are not new and in a number of countries the essential framework is in place. In other countries they are under discussion.

Unlike previous regulatory change which concentrated in moving back the borders of existing monopoly restrictions, the requirements for information infrastructures are much wider. There is still the need to eliminate monopoly or quasi-monopoly market structures, but moreover it is necessary to eliminate the traditional regulatory paradigm based on strict service boundaries and parallel non-substitutable networks and services. This latter challenge is much the harder given vested industry interests and fears that integration will lead to dominant players in the content market and bottleneck positions in the infrastructure market. There is also a need to review content regulation, especially in terms of liberalising the provision of transborder flows of information including content.

The message that the success of information infrastructures will be closely dependent on having in place an appropriate regulatory and policy framework has been repeated throughout this paper. In the present policy and market context the activity areas on which II is dependent, broadcasting, the cable television sector and the telecommunication sector, are highly regulated and in many countries are based

on monopoly market structures. The content area is in some countries regulated with respect to its distribution. By contrast the computer and information services sectors, and to a large extent the multimedia area, are not regulated.

There are a range of policies associated with the development of information infrastructure and multimedia applications which need to be examined by governments. Many of these are not dealt with in this report since they are outside the direct policies of the communications and information services areas. Such policies would include education and training, specific administrative and legislative changes in different sectors (education, health, retail, banking, insurance, etc.) which may hamper, or which can facilitate the provision of services on-line. Moreover, there are many important legal issues related to intellectual property protection, privacy and security which are being undertaken in the context of other work for the ICCP Committee and are not mentioned in this Chapter.

**Market structures**

Telecommunications has traditionally been provided on a wire-based network providing point-to-point communications and priced on a usage basis. The market structure for telecommunication services has been evolving over the last decade: the traditional model of a single state-owned company having monopoly control over the infrastructure and services is, gradually, being replaced by a model which has multi-carriers with no limitations on market access either for infrastructure or for services, and where state ownership has been limited. As in present policy frameworks, emphasis on universal service, pricing and common carriage is expected to remain as important in the changed model for telecommunications markets. While this model is far from being adopted by all OECD countries (only 8 countries have to date infrastructure competition, and of these only four have completely privatised operators), there has been widespread agreement that there should be facilities-based competition in the industry, the notion of monopoly services should be eliminated, and that privatisation (even partial) is important. By 1998 most OECD countries will have begun to move toward a multi-carrier environment. The importance of maintaining regulatory oversight in the transition from monopoly to competitive market structures has also been accepted by most countries and collectively OECD countries have built up considerable experience in appropriate regulatory mechanisms, tools and principles. However, at the national level many countries still need to develop appropriate national administrative experience in regulation.

Service definitions for basic telecommunication services have been changing over time. For example, the service monopoly where it exists refers only to real-time voice communications. Integrated voice-data services can be provided on private networks. Developments in telephony, such as through call-back services and the development of telephony on the Internet, are continuing to lead to changes in service definition. The rapid growth of text messaging services, some with the ability for limited response, can be expected as well to lead to changing service definitions.

Broadcasting (audio-visual) is the simultaneous delivery of content to two or more domestic residences. The mode of delivery for point-to-multipoint services has been over terrestrial transmission or satellite. Broadcasting has been financed on the basis of advertising, general government budgets, through licences and through user fixed charges. Restructuring of broadcasting markets, in particular in Europe, over the last decade has led to market entry by commercial broadcasters, Pay TV, and cross-border TV transmission through satellite. National and international competition for programming have also impacted on industry structure. In addition, cable television development which has taken place in many countries has partly complemented, as well as competed with traditional broadcasting. These developments have expanded the programming market and have not had a negative impact on the broadcasting industry

which, for example, participates actively in CATV markets. In the case of cable television services, charges have been through fixed fees. Broadcasters are viewed as providing public services and as such have been subject to regulatory oversight. Regulation for broadcasting has been based on entry limitations and on stressing programming, both in terms of its content and some cases its origin. Cable operators are not considered as providing public networks and, while subject to some regulation, have not been regulated in general as common carriers.

Public broadcasting has a range of underlying obligations not always very well articulated in their implementation. These include universal obligations i.e. universal geographic coverage of signals; in a number of countries it has traditionally been viewed that broadcasting has an obligation to promote national culture, and broadcasting has often been viewed as playing a role in developing a local content industry.

Broadband will change the concepts of point-to-point and point-to-multipoint classifications. For example for the concept of broadcasting video-on-demand cannot be considered as broadcasting in the normal regulatory use of the term and already a number of regulators have exempted video-on-demand from broadcasting regulatory requirements. Presumably many new services, such as home shopping, education services, etc., would not be considered as "broadcasting" even though they are provided on the same infrastructure as television programmes. Would interactive television be considered as broadcasting? The concept of "broadcasting" normally implies that a programme can be received by any viewer with access to the appropriate receiver. But what if programmes are provided on a store and forward basis? Are multimedia computers which are also TV receivers subject to licence fees? How should full-video on the Internet be treated? Wireless in the local loop will be able to provide a range of services in the near future. Will services provided over wireless to two or more people be regarded as broadcasting? Similar communication messages will be capable of being broadcast to multiple customers (e.g. junk mail).

The technology of information infrastructures will allow for the provision of different programmes in a variety of ways and will allow customisation to a certain extent. This changes existing concepts of broadcasting. These changes imply that broadcasting definitions need to be amended so as not to encompass (and therefore by definition regulate) interactive and other broadcasting applications. However, the challenge from information infrastructures to the broadcasting industry is much more fundamental since the technological and service merging of II is providing an incentive for PTOs to enter the market for the delivery of programming, and thus in pressure to merge infrastructures as well as market structures. The ability to significantly increase the number of channels is also resulting in a dilution of the traditional role of state-owned companies which played a primary role in national markets.

What type of market structures should governments encourage for the development of information infrastructures and multimedia applications? There is widespread agreement that the transition to an information society based on the development of information infrastructures will need to take place on the basis of competitive market structures. Therefore, the task for regulators will be to allow and provide the proper incentives for the merging and interconnection of networks and merging of services presently based on different technologies and structures: the public switched telephone network (copper, narrowband, interactive, delivery of information); cable television (coaxial cable, higher bandwidth than the PSTN, unidirectional, delivery of content); broadcasting (microwave, satellite, unidirectional, delivery of content). This is necessary from the technological perspective since it has become increasingly difficult to maintain legal and market separation.

In that II networks will support a range of integrated services this will not only make it difficult to maintain the existing service distinctions as well as differentiate between the different types of information carried on these networks, but it will also make it difficult to distinguish the origin of services

carried on networks. The question then arises as to how content will be regulated both as to the type of content as well as in terms of cultural origins. Thus, the technological changes, the expansion in number of channels, and the globalisation of networks put into doubt the ability, and desirability, of governments to maintain broadcasting quotas and other content restrictions. The diversity of content, the fact that content can be 'assembled' on line raises questions of whether good definitions can be maintained to ascertain where a particular programme was produced.

Without competition the development and diffusion of new technologies and applications will be severely retarded[90]. It needs stressing that political and economic importance given to information infrastructures is based on the potential impact of applications. The development and diffusion of these will thrive significantly better in an open competitive market. The implications of a competitive market structure for information infrastructures are considerable. First, it requires facilitating multiple market entry. Second, it implies elimination of restrictions on cross-sector service provision (and may involve reviewing cross-sectoral ownership limitations). Third, it requires reviewing existing policy and regulatory frameworks. Fourth, it requires separation of facilities regulation from any regulation on service applications.

Sufficient experience has been built up to indicate that a single broadband infrastructure is not the goal. Rather the goal is to develop a range of applications and an efficient market which requires not only competing fixed-link structures but competing technologies and networks. Some infrastructures may be narrowband, other broadband; some may be dedicated to specific services, while others may offer a range of integrated services. Some infrastructures may offer service only on a national or regional basis and others may be international. Governments should have no role in deciding on the number or types of networks except where there are clearly defined resource limitations which may require rationing (e.g. spectrum). On this premise there will be a number of information infrastructures based on a number of technologies. Will this result in over-investment or in the dilution of investment efforts? Experience has shown that this will not be the case. The time period required to develop information infrastructures, in particular the time period required to upgrade the local loop would tend to imply that under competitive conditions much more rapid development can take place at lower cost.

The lessons from introducing competition in telecommunication markets have shown that market restructuring and the elimination of entry barriers often requires a transition phase to attain a fully competitive market. This can be a relatively long process requiring an effective regulatory framework with adequate safeguards to ensure fair competition. This process will be complicated in the case of merging of a number of different sectors, such as telecommunications, broadcasting and cable television, showing different market characteristics, some with highly competitive markets and others highly regulated and subject to different policy and legal frameworks. Recent private sector initiatives have shown a tendency for both horizontal and vertical integration among key players in the different sectors participating, or with the ambition to participate, in the development of information infrastructures and multimedia. These developments as well as the need to be subject to scrutiny by policy makers to ensure that this does not affect the competitive process.

Although it has become accepted that a competitive environment is necessary in order to maximise efficiency and economic gains from telecommunication activity, the process of market transformation has been slow. Some countries which have been early starters in opening markets to competition have made little further progress although in several cases these countries have taken, or will take, steps to accelerate change; other countries have hardly started the process of change. Only a few OECD countries have at this stage an overall communication market structure which stimulates II developments. Broadcasting markets in particular have hardly been addressed in national or international policy debates. The latter also tend to be sensitive since they are closely linked with cultural aspects and

policies on content. Some countries prefer to move slowly in changing market structures arguing for the need for a period of adjustment. Again, experience from telecommunication markets has shown that slow adjustment periods often do not provide the incentives required in adjustment and therefore tend towards creating immobility and increasing the difficulty for future change. Rapid adjustment is often more efficient and tends to lessen the costs of adjustment.

The immediate difficulty policy makers will face in most OECD countries will be to attain broad political, public, and industry support for restructuring existing telecommunication and broadcasting markets. The process of restructuring markets, obtaining political and social consensus, will take time and will consequently impact on the rate of diffusion of new technologies and applications.

To attain the required political support and that of the public at large it is very important to document the impact and economic potential of national information infrastructures, in particular the employment and social aspects. As part of the process in obtaining a national consensus, a number of governments have set up task forces to examine the economic, social, policy, and technological implications and requirements of information infrastructures. The emphasis that has been placed in the United States, for example, on universal service and the use of IIs for education, health and other social requirements is crucial in obtaining a broad consensus to change existing policy and regulatory structures (this emphasis is also crucial to stimulate the required services which will be needed to ensure the success of IIs). Similarly in Europe the European Union has stressed the "information society" aspects to which information infrastructures can contribute.

The question has been raised whether broadcasting of entertainment should be required to use wire transmission rather than over-the-air transmission in order to free spectrum for other communications requirements. In the long-term this may have to occur, but it is probably too early to make any decisions on this issue. On the contrary the fact that broadcasting is accessed easily and cheaply in its present form is extremely useful and continues to make it a very viable and dynamic part of the information infrastructure. Policy makers, however, should allow the market to determine the best infrastructure for the provision of particular services and should not place unnecessary restrictions on services migrating to different infrastructures. As well, conventional broadcasting is also changing with new technologies, in particular with digital technology. A constraint of conventional broadcasting is the lack of interactivity, but development of the Internet, for example, suggests the feasibility of setting up two-way interaction for conventional broadcasting by using PSTN connections.

**Universal service**

Universal service in the telecommunication service sector has been a fundamental policy objective for all OECD countries. In general universal service obligations have constituted a requirement that public telecommunication operators provide basic telephone service to all who request it at a uniform and affordable price even though there may be significant differences in the costs of supply. Universal service also has implied obtaining the service at similar quality levels. The provision of uneconomic telephony services subject to universal service objectives has been through cross-subsidisation usually through relatively high long distance charges and low charges for local access and use. In addition the geographic postalisation of connection charges and monthly subscription rates has also been justified as part of the universal service concept. For broadcasting charges (e.g. through licence fees) have not covered the cost of service provision for public channels and these charges have been postalised across the country.

A number of OECD governments have stated their belief that participation in the information society must be ensured through the availability of information infrastructures to all at affordable prices. To achieve this governments have stated that the current concept of universal service must be expanded [91]. However, national reports do not go into detail as to the scope of an expanded universal service concept or the type of financing mechanism envisaged. Concern has in particular been expressed that the development of an information society, based on the development of information infrastructure applications could result in exclusion by less privileged members of society which could increase the already existing gap between rich and poor. However, although the concerns expressed are very legitimate, before taking such a policy decision careful consideration needs to be given to define specifically and transparently what universal service would entail in the context of information infrastructures, under what conditions it should be made available, and what methodology should be used to estimate and apportion costs.

The articulation of universal service can be viewed from different perspectives as emphasised in previous OECD work[92]. These include:

- universal geographic access;
- universal affordable access;
- universal service quality;
- universal access by the disabled;
- tariffs for universal service.

For telecommunications, universal service has traditionally referred to the provision of voice-grade telephone **service**. This service has always been well defined in terms of its general technical characteristics and in the early stages of telecommunication development was a simple service without competitive substitutes or variants on the existing service. Technology has implicitly changed concepts of universal service: rotary dialling and access to an operator where once considered as sufficient, now touch-tone service, higher quality of service levels, and direct dialling are considered the norm. However, the many value added features which are also available for telephony such as call waiting, call forwarding, number identification, etc. are in most cases not considered as part of the basic telephone service and may be charged for separately.

Despite the fact that most OECD countries are considered as having attained universal service and even though telephony has changed in terms of its characteristics, the fundamental objective of universal service has remained unchanged and there have been in a number of countries no attempts to modify existing universal service definitions to include the new characteristics available. Partly, this is because definitions of universal service have always remained vague.

On the broadcasting side there has also been a concept of universal service, in that at least state-owned broadcasting entities have attempted to ensure that their signals could be received throughout the country. As well, the concept of not charging for reception (i.e. the fact of broadcasting) has had elements of ensuring that there was universal access to programming. In certain countries through public television channels the concept of allowing access to broadcasting by special interest groups has also been viewed as important. In many cases the primary public channels are funded through general government revenues.

In the context of information infrastructures and multimedia applications what would an extended definition of universal service imply? There are a number of possibilities which are not necessarily mutually exclusive. Universal service in a multimedia era could mean that a potential subscriber could, on demand, obtain a connection to a network with some specified technical characteristics defined by the regulator. Such a definition could be on the basis of a certain technology, for example, a fibre-to-the-home connection, or be based on a set of specifications, such as capacity/speed and/or on quality characteristics. However, if regulation is to remain technologically neutral, it would be preferable for an expanded universal service definition to only specify access to a given set of required technical characteristics.

To define universal service on the basis of a set of technical characteristics, however, only makes sense if the regulator has a given set of services in mind which can only be attained through infrastructures meeting these requirements. This latter point is important since access to services are closely linked with technical characteristics of infrastructures. Presumably an expanded universal service definition would want to make available to subscribers telephony service and the ability to access a number of other services which are deemed as having useful characteristics (these could be information services, health services, access to library services, access to government information, etc.). Since access to these services will require a certain bandwidth, quality, etc. the service and technical access are linked and any changed definition of universal service will need to reflect this requirement for access and service availability.

One factor which may detract from such a definition is that, at least in the medium term, a number of technologies which are emerging will be very competitive in price with existing local loop infrastructures and therefore will be of benefit to present definitions of universal service (providing telephone service at affordable prices). This is expected to be the case for example with fixed radio-based technologies for the local loop. Some of these technologies may not initially have the necessary bandwidth to provide universal access to certain information services. Penalising these technologies at their early stages of development by excluding them as being inappropriate for universal service would be an error.

The previous discussion raises the question of whether the definition of universal service should be based on service definitions? The rationale given to extend the service definition of universal service is to avoid a society of “haves” and “have-nots” (or information-rich and information-poor). Much of the present information available on-line is also available “off-line”. In the long term this may not be the case and therefore arguments to extend access to specific types of information could be made, but most on-line information available at present can be accessed through a PC and modem on exiting copper wire networks. There is no reason to believe that in the future this will not be the case. It should be noted here that in many cases (see Chapter 3) the problem of access is that lower income households often lack the appropriate hardware. What type of services should be made available? A minimum range of services which are necessary to integrate users into the “information society” needs to be specified, but given that the development of an information society is only at an early stage of development it would be premature to specify a set of services at this stage.

In terms of making on-line information services available there are alternate strategies to consider especially in the short-term. For example, having available access points in public places (shopping malls, libraries, etc.) where government information and other information can be accessed. This is equivalent to extending the concept of public telephones to meet the requirements of an information society. In terms of cost and rapid coverage of the population to ensure universal geographic access such a policy is more economic, and tends to be technologically neutral.

There is another rationale to extend the concept of universal service and this would be that, given that new societies will become predominantly based on information infrastructures, the general population should, for learning purposes, have access to new services and infrastructures. However, these structural shifts in economic relationships and societies will take time and the population will evolve with these changes. It is therefore not necessary at this stage to distort investment decisions or add financial burdens on investors. However, there is justification perhaps to ensure that certain essential service areas are given access to sufficient broadband capacity. These may include health establishments, fire and police, government services, education establishments, etc. As shown in Chapter 3 there is a significant effort by operators to contribute to this development through direct contribution to school systems. This needs to be encouraged. An example could be taken from the regulation of CATV where in certain countries local service providers are required to make channel capacity available for community services and the public at large. Such a requirement on network operators would not be costly once sufficient capacity is in place.

The technology underlying the network infrastructure for information infrastructures is changing rapidly which would imply that it would be difficult to define universal service on the basis of access to services based on any specific technology. It is also realistic to expect that the provision of information infrastructures will require a significant roll-out period implying that a number of geographic areas, and usually the less economic areas, will obtain access at a much later date than highly dense (and more profitable) urban areas. The question of the time period that universal service obligations for information infrastructures should be in place is therefore also important.

Telephony has often been provided on the basis of "affordable" access although what constituted "affordable" has never been well defined. In a general sense prices for access and use of network resources have been postalised (geographically averaged) in most countries whereas price changes have in a large number of cases been kept under the rate of increase of the general price index. The fact that telephony has been viewed as an essential service has been the reason for placing emphasis on its affordability. Are new information services essential? There is no evidence to suggest that this is the case so that it would be difficult to justify other than cost-based pricing for services. Again in the longer term new information services might be viewed as essential, but in the present context it would be too early to make any predictions.

Service quality considerations should apply primarily to the network rather than to applications offered over information infrastructures. This is the case at present with regard to telephone networks and it would be appropriate that operators of information infrastructures are required to meet certain quality standards. This would also be the case for introducing targeted programmes to meet the requirements of the disabled.

The move toward more competitive telecommunication environments and the emphasis being placed on cost-oriented tariffs has changed concepts with regard to pricing for universal service. A number of alternative mechanisms have been put forward: these include a continuation of broad uniform tariff policies sustained by cross-subsidisation although on a more limited scale, specifically targeted subsidies paid directly by government and funded by general taxation revenue, and specifically targeted subsidies paid by government, but funded through a universal service levy on all telecommunication network providers. The latter would appear the most suitable from an administrative point of view as well as from an equity point of view.

The other issue regulators will need to examine with regard to universal service is who should bear the general responsibility as a provider of universal service. To a large extent this depends on how universal service will be defined. The problem, however, is that in a competitive environment it is more

difficult to allocate responsibility for provision of universal service to a particular service or network provider. If subsidised universal service is provided through a universal service fund then this problem can be resolved fairly easily.

In short, the principle of universal service needs to be maintained for information infrastructures and appropriate services which are viewed as essential and are defined over time. Network operators must be made aware at this stage that they may be required to provide a number of services to households in the future. This implies that regulators need to ensure that regulation clearly specify that the concepts of universal access and universal service will be subject to modification and adjustment as information infrastructures expand and develop, thus maintaining the option to review universal service concepts.

**Tariff policies**

Chapter 4 examined the issue of tariffs for information infrastructures. It was stressed there that the economic and social success of information infrastructures will depend on the development and diffusion of mass market applications of new services for residential and business markets and, this in turn depends on pricing levels and structures.

What role should regulators have in pricing decisions? At present regulators, depending on the country, decide or control access and usage prices for telephony and for broadcasting. For many telecommunication network-based applications, such as value-added services, pricing is left to the market. In general for new service areas many service suppliers are free to set their own prices and are not subject to government control. In the transition to a broadband environment governments may need to have the possibility to control pricing for access to and use of networks, but should wherever possible allow the market mechanism to play the primary role. The importance of government having reserve power for price control needs to be stressed since it is conceivable that public switched network operators with dominant positions, and broadcasting entities also with dominant positions, could through pricing structures influence their competitive position. General competition policy provisions may be sufficient in such cases rather than specific communication regulations.

With regard to the pricing for services these should generally be left to the market except where universal service criteria are applied and governments feel a requirement for specific action to ensure "affordability" of services. It is also necessary that consideration be given by regulators to which services should be provided as public information at no cost to the user: for example should there be a charge to access information directories or certain bulletin boards? Given the plethora of services that are expected to be made available in a multimedia environment it would seem necessary that individuals should at least be able to access a directory of services (i.e. the equivalent of a directory inquiry service) at little or no cost.

**Interconnection and equal access[93]**

Underlying the notion of information infrastructures is the concept of a number of interconnected networks, both competitive and complementary. The success of a competitive market structure for information infrastructures hinges on an effective framework being in place for interconnection and equal access. In other words, interconnection is a necessary condition for efficient competition, but it is insufficient in itself unless new entrants can attain access to infrastructure on an equal basis. In a

competitive information infrastructure market there will be several levels of interconnection and equal access: between different network providers; between the carriers and resellers; between service providers and carriers.

Principles of interconnection are only beginning to be developed in many OECD countries. At the international level these issues have yet to be considered. But, developments in service provision will require a framework for interconnection which is based on common international principles. Any developments in liberalised international trade in services, for example, will depend on effective interconnection conditions.

Interconnection needs to be viewed from several perspectives. There is first the question of physical interconnection. Second, there is the requirement for one network operator to pass traffic to another operator for transit and/or termination. This is essentially a carriage function. Third, there is the issue of access whereby a carrier provides other carriers or service providers access to customers. Under present market conditions with limited competition, customers are usually accessed by a single local access network. Increasingly as cross-sector service provision is allowed customers will be accessed through more than one local access network (for example, in the United Kingdom CATV operators provide telephony in addition to fixed link telephone carriers).

The principle of equal access suggests that networks are open on a non-discriminatory basis to all service providers. This implies that exclusivity with regard to service provision on networks will be denied. Thus, while vertical integration may be allowed, it cannot be used to foreclose the network to other service providers. For programming this implies non-discriminatory access for programmers to information infrastructures and making available sufficient channel capacity. In effect, equal access implies that information infrastructure networks will be subject to common carriage principles. Governments need to decide whether this concept should be generalised or applied only to certain networks; for example, networks which are national may be subject to common carriage principles, whereas some types of networks may be exempt (wireless networks for example). Viewed from the perspective of the customer, equal access implies that they should be able to undertake transactions with all service suppliers and networks on an equal basis (and in a seamless way).

Interconnection requirements will need to cover, in addition to technical and physical arrangements between operators, issues such as tariffication, billing arrangements, availability of capacity, at which level of the network interconnection takes place, etc. Access to directory listings and information, access to databases and associated signalling is also important to enhance competition. Consideration must also be given to how access to rights of way can be improved for new entrants. There are different viewpoints as to the extent that regulators should play a role in these issues: there is however a general agreement that regulators need to be able to arbitrate when private enterprises cannot reach a speedy agreement.

The basic principles of interconnection and equal access are efficiency, transparency and non-discrimination. Efficiency means that interconnection charges by the providing carrier to the interconnecting carrier should be based on the minimum cost of providing the facilities and charged on a cost basis. Transparency means that the charges and arrangements for interconnection are well known or published and that the cost basis of charges is open to scrutiny. Non-discrimination means that all interconnecting carriers have the same prices and arrangements available to them for the same requirements.

Linked to the notion of interconnection and equal access is the requirement to provide competitors with necessary information. For example, each carrier should inform its competitors, in advance, of their planned service areas, future area expansion plans, and their planned point of presence locations. Equal access also requires fairness in such important areas as numbering. This requires that all numbers are owned, administered and controlled by the regulator or by an independent agency. As well, enabling customers, especially business users, to take their numbers with them from one carrier to another fosters competition and price reductions, increases penetration rates, and therefore the market share for the new operators.

The most important element for the new entrants, from an economic point of view, is the amount they shall pay to the incumbent for the conveyance of their traffic and the use of its infrastructure. The determination of access costs for information infrastructures will become a key issue and will be important in fostering competition. Interconnection charges can also be crucial in determining whether a new entrant invests in information infrastructure. At present much emphasis is placed on the need to unbundle costs to ensure that the different network component costs are transparent and by so doing identify interconnect costs. However, at the level of the infrastructure with greater integration between infrastructures and multi-service provision, it may become increasingly difficult to unbundle costs. Competition and transparency will be important elements to ensure equitable interconnect charges.

Industry convergence is also raising important issues with regard to access. Some of these are more correctly linked with the issue of bundling, others may be viewed as being an access issue. A key question is whether a carrier, which also provides information services, is required to provide common carriage. There is legitimate concern that existing public telecommunication operators, given their market dominance, should have open access to their networks. Thus, in the UK it has been decided that BT cannot provide entertainment services over its telephone network until 2001. In the US the FCC is implementing open video system (OVS) rules. While regulators must avoid putting in place policies which provide disincentives to investment, they need to also ensure that markets are open to access.

Linked with interconnection and equal access issues is that of numbering. The development of information infrastructures, new services, and competition will require the implementation of a framework for number portability and management of numbering resources. Policy issues on numbering need to be taken at an early stage in the process of opening markets to avoid that incumbent PTOs use numbers to slow down the competitive process. In this context an important initiative by countries would be to establish a consultative body to represent all users of number resources[94]. Premium numbers will also increase in importance and their allocation also needs to be undertaken within a proper regulatory framework.

**Interoperability and standards**

The necessity of having seamless interconnection among network operators is becoming fairly well established among the industry in OECD countries. This principle developed in the telecommunication service industry is less well established with regard to the computer services, software and computer hardware industries where, nevertheless, it is important to have interoperability and common interfaces to allow access to different services. There have been a number of calls for common standards (interfaces, protocols) and interoperability for II from industry[95] and from governments[96] . The key question for policy makers is whether interoperability can be left to industry to reach agreement or whether it should (and can) be mandated. From the public policy perspective the question of whether, or in what detail, interoperability is a public or private sector issue is difficult to clarify.

In a highly developed information economy interoperability in terms of vertical compatibility between systems and services, and different services, is important in terms of ensuring the development of services and their diffusion across the economy. Interoperability allows third parties to write applications and enter the market to provide services. The lack of interoperability can have important negative social and economic consequences. These include reducing competitive forces and thus increasing dominance in a market, reducing economies of scale and scope, and reducing innovation and the rate of diffusion of new innovations. In turn this would negatively impact on the employment growth prospects in new sectors, their diffusion across economic sectors and their potential impact on improving productivity.

Interoperability has emerged to a significant extent from the process of competition and co-operation which has characterised many firms in high technology and software sectors. A number of on-line service providers would view interoperability as beneficial, but there are a number of firms opposing mandatory interoperability since they believe that this would affect their intellectual property. The debate is based on whether open and non-proprietary interfaces be made available on a non-discriminatory basis and on reasonable terms or whether doing so is tantamount to making available to competitors key technologies which they could then emulate in their own products. The fact that interoperability can help reduce market transaction costs, and can stimulate market size is an important factor bringing companies together. In a number of cases given the software intensity of new applications, interoperability can be achieved through software. Providing customers the means to access services easily and cheaply has become recognised in the industry and accounts partly for the success of services on the Internet.

However, leaving the decision on interoperability to the private sector alone can be problematic. This would occur in particular when there is a firm in the industry with a dominant position which would, therefore, have no incentive to co-operate with other firms. This can also be a problem in vertically integrated markets when dominance in one market allows a firm to attain dominance in other markets. At the international level a number of countries may also look askance at dominant *de facto* standards from one market trying to extend their reach and become dominant world-wide.

On the equipment standardisation side there seems to be a greater consensus on the need for firms to agree on voluntary standards. For example, the US private sector, in recognising the importance to reach rapid agreements on standards, set up the ATM Forum in October 1991 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 business and residential customers. The Forum has over 550 participating member companies. Other such informal bodies exist, usually including the user community, and these bodies have helped speed the process of standards.

The ITU has been working on broadband standards for a number of years and a number of Recommendations have been adopted. For example, Study Group 11 adopted 20 draft Recommendations in September 1994 on protocols for B-ISDN signalling systems. However, in the context of broadband technologies there are a number of proprietary standards being developed. It is not intended in this paper to address the issue of standards except to note that encouragement needs to be given by government to obtain a rapid consensus on appropriate standards in order to ensure interoperability and rapid diffusion of new products and services. Private sector initiatives need to be encouraged in this context and they need to be open to all market participants.

The G7 Brussels Conference on the Information Society, in recognising the importance of interoperability, had chosen as their second theme area for a pilot project “Global Interoperability for Broadband Networks”. The objective of this project is to “provide a means for developing and testing trans-national applications that will support the promise of a Global Information Society”.

**Vertical integration and unbundling**

There are two counteracting forces developing in the communications industry. The costs of networks expansion and upgrading, and the necessity therefore to generate revenues, is leading infrastructure providers to try and diversify into application areas. This is evident from the efforts of public telecommunication operators trying to offer video on demand. On the other side the importance attached to controlling the distribution of services and having direct access to customer interfaces is leading firms from the "content industries" to try and diversify downstream into infrastructure provision. These pressures for upstream and downstream vertical integration can have important implications for the development of markets and the degree of competition in different market segments. This is especially the case in that many of the main economic sectors involved in providing information infrastructures, and their applications, are sectors which have a background of monopoly or oligopolistic market structures.

For example, as noted BT is constrained in the UK with regard to providing entertainment services. In Canada the CRTC has suggested that programming services should be produced and distributed by separate companies to prevent preferred access to distribution networks. However, it was not viewed as necessary to have structural separation for on-line services[97]. Thus equal access and vertical integration issues are linked since distribution and services may be bundled and may tend to steer demand to a single service provider[98].

Telecommunication regulatory experience has shown that a long period may be necessary for the transition from monopoly or limited entry market structures to competition. In this transition period the incumbent or incumbents often have a bottleneck position by controlling access to the existing infrastructure and through this access to the customer base. Other market participants are dependent on incumbents while building-up a customer base and a network. In order to reduce the dominant position of incumbents regulatory safeguards are necessary. It may be necessary, as some regulators are presently doing, to impose a system of regulation which is asymmetric favouring new entrants.

A key question for regulators touched upon earlier will be to decide whether telecommunication operators with existing networks and a large customer base can enter new market segments and provide services using existing networks. Linked with this question is the issue of whether network operators can limit access to their networks thus retaining exclusivity for entertainment and interactive services. Already there are a large number of multimedia joint ventures which include ventures between PTOs and information service or content producing companies[99].

Some parts of industry would tend to argue in favour of vertical integration citing the costs of network upgrading, software development and costs associated with the development of interactive and other broadband services. In a nascent industry which is transiting from oligopolistic or monopolistic structures, allowing full vertical integration would make it difficult to develop a competitive environment. As well, one of governments' goals to develop applications and to promote diversity is unlikely to be met within a framework which allowed vertical integration.

Because of the suspicion, at least in the early stage of transition from relatively limited competition in telecommunication and broadcasting markets to competitive markets, that integration will retard, if not prevent, competition from merging effectively, most governments will tend not to support integration without some unbundling. Concentration of economic power in a specific area can result in *de facto* entry barriers. This unbundling could take a number of forms, the most common which is accounting separation or structural separation.

The main purpose of separation is to ensure that parts of the network which do have bottleneck characteristics are not used to inhibit competition elsewhere in the network or in the industry generally and that existing or potential market power is not used in an uncompetitive way. In the US it is generally agreed that the structural separation of AT&T in 1984 contributed to the promotion of competition in the long distance market. On the other hand, in some European countries accounting separation has been adopted. Recently the Telecommunications Council of Japan, an advisory body to the Minister of Posts and Telecommunications has proposed structural separation of NTT because of the difficulties experienced in the Japanese market in realising non-discriminatory interconnection. For example, it can be argued in several OECD countries that, given the competition in the mobile and fixed link telecommunication markets, structural separation is no longer required and may unduly harm the progression in changing service provision.

This issue is important since the extent to which integration is allowed (or disallowed) can have significant implications for the future structure of the industry. It is an issue which requires careful consideration, but rapid resolution, since already industry participants are making strategic investment decisions. As the G7 Brussels Conference noted [Chairman's Statement] "Competition rules need to be interpreted and applied in the light of the convergence of new technologies and services ... Competition authorities should not prohibit the emergence of global players".

**Ownership**

In a multi-carrier competitive communications environment the ownership of infrastructure assets will become an increasingly important issue. The transformation of the telecommunication sector from state-owned monopolies toward infrastructure competition has shown that it is difficult for the state to be both a shareholder as well as a regulator. To be an effective regulator the state may need to take action which goes counter to the best interests of the shareholder. In a number of countries, for example, the competitive process has been slowed down in order for the share-holder (the State) to maximise earnings in the sale of part of its assets even though the introduction of competition may have generated important overall economic gains for the economy.

The reduction of state ownership in the communication sector (broadcasting and telecommunications) is closely linked with the issue of allowing foreign investment in infrastructure. Complicated requirements exist in many countries with regard to media ownership. Many of these laws and regulations will need to be reviewed in the face of convergence between infrastructures, content and information services. These laws and regulations have usually been put into place to reduce control in national markets by media service providers or content producers and tend to be contrary to developments in multimedia. In many cases these laws and regulations have weakened national companies, but they have benefited international companies who have in turn exerted significant control over content and information services at the international level. In the present market and technological context the necessity of foreign investment restrictions on investment should be reviewed. Direct regulatory policies, including licensing, might be a more efficient means of safeguarding security or other requirements which ownership is assumed to confer on governments.

**The structure of regulatory bodies**

It has now become the norm in OECD countries that regulation should be separated from operational functions with respect to telecommunications. The same principle applies to the regulation of broadcasting. Should these regulatory structures change as a result of the development of information infrastructures?

The elimination of specific "broadcasting" as opposed to "telecommunication" infrastructures which arises from technical and service convergence and the argument that there should be no restrictions with respect to the type of services offered on different infrastructures leads to the conclusion that regulatory frameworks should also be merged as they relate to infrastructures. This implies that the different laws and regulations, and decisions on access, interconnection and regulatory safeguards with respect to infrastructure investment, operation and service provision come under a single undifferentiated decision making process and are subject to a single legal and regulatory framework. This does not imply that all networks need to be covered by the same regulatory frameworks. For example, private networks may not need regulation and those for which there are no common carriage requirements would also be regulated in a different way. Over the air services may require some different considerations. The regulation of infrastructure and access to this infrastructure should be separated from issues dealing with content and its regulation. The regulation of content should be dealt with through separate administrative entities as is in fact the case in a number of OECD countries.

# CHAPTER 6 INTERNATIONAL POLICY REQUIREMENT FOR INFORMATION INFRASTRUCTURES

> "The smooth and effective transition towards the information society is one of the most important tasks that should be undertaken in the last decade of the 20th Century". Chair's Conclusions, G-7 Ministerial Conference on the Information Society[100].

The concept of a global information infrastructure implies the seamless delivery of services across national borders. It also implies that all information flows, which will be in digital form, will in principle be undifferentiated. The fact that in a GII environment there will be no border restrictions can have important policy implications. The concept of global information infrastructures must be viewed also as a mechanism to enhance world-wide co-operation in the development of infrastructures and multimedia applications among the developed economies, and especially between the advanced and the developing economies. This was stressed at the G-7 conference on the Information Society which put forward a number of principles (see Box 6.1). As well, the importance of co-operation between developed and developing countries was stressed in the concept of an Asia-Pacific Infrastructure (APII) put forward under the auspices of APEC.

The previous chapter examined a number of policy changes which would be necessary to support the development of information infrastructures and the expansion of multimedia applications. If many of the policy recommendations suggested in the previous chapter were implemented, global markets for investment in and operation of information infrastructures, as well as the services offered on these infrastructures, would be essentially open. Nevertheless, it is also important to have international policy frameworks in place, and above all develop national information infrastructures at the global level to allow for the development of a global information society.

Existing national voice and data communication networks are already interconnected world-wide. Satellite communications also provides global coverage for telecommunication and in making television broadcasting available throughout the globe. An embryonic global information infrastructure has already emerged. It is embryonic because for a large number of countries and for a large percentage of the world population the infrastructure is undeveloped at national levels, rather than because it is underdeveloped at the international level: low income economies in the world have an average of 1.5 main lines per 100 inhabitants, the lower middle income economies 8.4 main lines per inhabitant in contrast to over 50 main lines per 100 inhabitants in the OECD area[101]. In contrast there has been rapid build-up of international networks through cable and satellite, although this build-up has been concentrated in heavy traffic areas. For example, new cable construction to construct a Pan-African undersea network with a number of landing points is only a recent project. As well, there are a number of countries or regions which still need to improve in terms of capacity and quality their international communication connections, or obtain direct connections.

The concept of a global information infrastructure (GII) was evoked at the World Telecommunication Conference[102] in 1994. Principles put forward included the emphasis required on private investment to develop global infrastructures, the need to promote competition, the requirement for a flexible regulatory environment and open access to the network for all providers and users and the

emphasis on universal service. These principles were incorporated into the ITU's Buenos Aires Declaration on Global Telecommunication Development for the 21st Century. The concept of GII is important in helping diffuse the message of the importance of communications and information technologies to economic development and expansion, to help in the process of formulating effective national and regional regulatory frameworks and policies by developing common principles, and to help enhance and strengthen economic linkages.

Globalisation is a multidimensional phenomenon[103]. It has been characterised by large international capital flows, increasing trade in goods and services, foreign direct investment in manufacturing capacity, flows of technology and flows of information. The globalisation process has been stimulated by the development of communication infrastructures. Thus, the globalisation of economic activity and the development of communication infrastructures at the global level play a mutually reinforcing role. The outcome of this interactivity is apparent in the six-fold growth in channel capacity on trans-Atlantic and trans-Pacific routes over the last decade (Table 6.1 ). This development also reflects the fact that much of foreign direct investment, both in terms of originating and receiving regions, includesNorth America, Western Europe, and the Asia-Pacific region. These regions also include the major financial markets. Nevertheless 129 countries will have direct access to global undersea fibre cables by 1998.

**Box 6.1 G-7 Vision of the Global Information Society**

promoting dynamic competition
encouraging private investment
defining an adaptable regulatory framework
providing open access to networks

while

ensuring universal provision of and access to services
promoting equality of opportunity to the citizen
promoting diversity of content; including cultural and linguistic diversity
recognising the necessity of world-wide co-operation with particular attention to less developed countries

These principles will apply to the Global Information Infrastructure by means of:
- promotion of interconnectivity and interoperability
- developing global markets for networks, services and applications
- ensuring privacy and data security
- protecting intellectual property rights
- co-operating in R&D and in the development of new applications
- monitoring of the social and societal implications of the information society

*Source*: Chair's conclusion, G-7 Ministerial Conference on the Information society, 25-26 February 1995.

Changing strategies of companies in the globalisation process can be expected to reinforce their dependence on global networks. This is because development of markets, which in the past often required physical presence, is now more and more dependent on networks given that markets are more open internationally, and the fact that the products of most multinationals have become globally recognised. The new emphasis is on integration of purchasing, marketing, management, etc., that is, rationalisation, and producing global products.

Further, the concept is a recognition that information infrastructures and applications can be accessed and provide services on a global scale by the nature of the technology. Geographical and political barriers are not relevant to these technologies, nor are national policies sufficient since they can in most cases be easily by-passed. The benefits of these technologies and applications are global, but the legal, economic and social frameworks in which they take place need to be similar to ensure efficient service provision.

**Table 6.1. Cable and Satellite capacity on Trans-Atlantic and Trans-Pacific Routes, 1986-1995**

| | Trans-Atlantic Voice Paths | | Trans-Pacific Voice Paths | |
|---|---|---|---|---|
| Year | Cable | Satellite | Cable | Satellite |
| 1986 | 22 000 | 78 000 | 2 000 | 39 000 |
| 1987 | 22 000 | 78 000 | 37 800 | 39 000 |
| 1988 | 60 000 | 78 000 | 37 800 | 39 000 |
| 1989 | 145 000 | 93 000 | 37 800 | 39 000 |
| 1990 | 145 000 | 283 000 | 37 800 | 39 000 |
| 1991 | 221 000 | 283 000 | 114 200 | 27 000 |
| 1992 | 296 600 | 496 000 | 190 500 | 27 000 |
| 1993 | 372 200 | 620 800 | 264 000 | 83 000 |
| 1994 | 664 000 | 620 800 | 264 000 | 234 000 |
| 1995 | 1 264 000 | 710 800 | 864 000 | 234 000 |

*Source:* TeleGeography 1994, G. Staple (editor).

**Towards an international policy framework**

OECD countries have become convinced of the benefits of free trade. Since the post-war period a number of successive GATT Rounds have progressively eliminated tariff and non-tariff barriers to trade in manufactured goods and as a result there has been a significant surge in world trade with global benefits. Adjustment in industrial structures which have placed increased emphasis on services, changes in production methods requiring information as a production input, and the trend toward globalisation have been creating a new mode of production and trade. Transborder product flows are being replaced by the increasing relative importance of transborder data flows, and the vehicle for this new mode of trade are information infrastructures. The importance of unrestricted transborder data flows is obtained early recognition at the OECD and resulted in a Declaration on Transborder Data Flows (Box 6.2).

The Uruguay Round adopted a General Agreement on Trade in Services which in principle covers all tradable services. In recognition of the importance of telecommunication services and infrastructures for the efficient carriage and development of trade in services, the World Trade Organization began negotiations on basic telecommunications with the purpose of trying to agree on a framework for implementing progressive liberalisation of basic services and infrastructures. At present there are 27 participating countries[104] in the negotiations which are scheduled to conclude in April 1996. The basic WTO principles of market access, transparency, non-discrimination and national treatment remain important in these negotiations.

**Box 6.2 A Reminder: OECD DECLARATION ON TRANSBORDER DATA FLOWS**

The acceleration in the flows of data and information which are characterising developments of information infrastructure and multimedia services is increasing the relevance of the OECD's Declaration on Transborder Data Flows adopted by the Governments of the OECD Member countries on 11 April 1985. In this declaration OECD countries declared their intention to:

a) Promote access to data and information and related services, and avoid the creation of unjustified barriers to the international exchange of data and information;

b) Seek transparency in regulations and policies relating to information, computer and communications service affecting transborder data flows;

c) Develop common approaches for dealing with issues related to transborder data flows and, when appropriate, develop harmonised solutions;

d) Consider possible implications for other countries when dealing with issues related to transborder data flows.

Further, the Governments of the OECD Member countries agree to co-operate and consult with each other in furthering the objectives of the declaration.

Previous OECD work has examined the issue and requirements for international infrastructure competition[105]. This analysis argued that "(f)ull domestic and international infrastructure competition entails that operators from one foreign country would be able to invest in another country to provide competition on an end-to-end basis. This means that they would be able to construct a national, and local network if this was required, as part of their business strategy (pg. 7)". A number of issues need to be resolved to reach such a stage of market liberalisation:

- national restrictions on investment in infrastructure need to be reviewed;
- restrictions on foreign ownership need to be reviewed;
- there needs to be greater harmony between national regulatory concepts and practices, in particular with respect to interconnection frameworks;
- the present system of international telecommunication tariffication and settlements needs to be reviewed.

The issue of foreign investment and limitations placed on ownership by foreign entities of domestic network operators is key to the process of international infrastructure competition and liberalisation. In many cases the issue has yet to be faced by policy-makers in that it does not arise in present market structures with monopoly state-owned operators. Any concerns governments have with respect to protecting the public interest can be dealt with through specific regulatory safeguards, and therefore are not dependent on government ownership or investment restrictions. With regard to the pricing framework for international telecommunication services, and in particular the system for settling accounts for bilateral traffic flows, the OECD has since 1991 been pressing for reform and has put forward a number of concrete proposals (see ICCP 34 and ICCP 36)[106]. Some of these proposals have been put

forward for discussion at the WTO. In Europe with facilities-based competition beginning in 1998 it is likely that the intra-European settlement system (TEUREM), as well as the intercontinental bilateral system will be subject to considerable pressure to change. The rapid introduction of competition would provide the best means to restructure international telecommunication pricing structures. International agreements on the principles underlying interconnection will be of particular importance here.

The ability to provide services, entertainment and interactive services on a global basis through seamless international information infrastructures will provide a policy challenge especially for content regulation. There will be a requirement for global norms and agreements to ensure some minimum standards are met. While GII will give an opportunity for countries to export programming and other content-based services, it will also provide an immediate advantage to countries with an already existing programming base and therefore the initial impact may be to put at a disadvantage fledgling programming countries. However, one of the most rapid and effective ways to develop national applications based on national culture is the example of Internet, which has shown how some countries can use these infrastructures to diffuse and stimulate new applications using their specific cultural heritage. Protectionism will have the long term effect of stultifying cultural development and the development of an information society.

The G-7 initiative putting forward a number of initiatives on pilot projects (Table 6.2) should be extended. Such projects help in allowing for better understanding in the process of market liberalisation and diffusing any potential problems which may arise from government assistance in the development of new technologies and services and the implementation of national information infrastructures. Most major OECD economies believe in the importance of new communication and information technologies with regard to economic growth and may have different approaches in their policies and strategies toward promoting the development of II. Policy differences could occur in areas such as how countries stimulate investment in infrastructure, the development of applications, the use of government in stimulating demand, and in preferential treatment for services and equipment. Such frictions tend to build up when there are significant differences in national capabilities in such areas as technology, software, and the provision of services. In trying to catch-up on their trading partners, national initiatives can become protectionist.

**The developing economies**

Can it be expected that the developing economies which lack even a basic telephony infrastructure should open their markets and be guided by a liberal GII formula? To do this countries need to be convinced that competitive markets can develop infrastructure more quickly and efficiently than monopoly markets. More importantly these countries need to be convinced of the benefits which will accumulate to the economy at large from applications which are based on these infrastructures.

A number of developing economies have introduced competition in their telecommunication sector and encouraged foreign investment in recognition of the economic benefits that can be attained from an efficient telecommunication sector. The exchange of information and knowledge which developing economies can gain from global information infrastructures, as well as the opportunities which they derive in using information infrastructure applications to diversify their economies, integrate more fully into the global economy, and better use their cultural and human resources, needs to be stressed. The information gap between the developed and developing economies needs to be narrowed and is dependent on narrowing the gap in the physical infrastructure.

**Table 6.2. G7 Pilot Projects**

| THEME | OBJECTIVE |
|---|---|
| Global Inventory project | To create and provide an Internet-based multimedia inventory of information regarding national & international projects. |
| Global Interoperability for Broadband networks | To provide a common basis for the promotion of joint R&D, demonstration and pre-commercial trials of advanced high speed services and applications. |
| Cross-cultural Education and Training | Network-based intensive cross-cultural education and training. |
| Bibliotheca Universalis | To advance international co-operation toward the establishment of global electronic library systems. |
| Multimedia Access to world Cultural heritage | Interoperability of multimedia cultural heritage databases, availability of software products and services on telecommunication networks, & a better appreciation of world cultures. |
| Environment and Natural Resources Management | To increase the electronic linkage and integration of sources of data and information relevant to the environment and natural resources. |
| Global Emergency management Information Network Initiative | Develop and implement systems to acquire, process, manage, display and disseminate information to support decision making for natural, technological, biological and humanitarian disaster responses, environmental monitoring and risk management. |
| Global Healthcare Applications | To facilitate the work of public health institutions to fight against infectious diseases, to help increase efficiency of epidemiological and clinical studies, the establishment of a global teleconsultation system, nomenclature, coding and standards with tools for navigation and access to networks with harmonisation of security standards for patient related data exchange. |
| Government On-line | To promote collaboration in the area of best practices and to improve public services through the increased use of on-line systems. |
| Global Market place for Small and medium-sized Enterprises | To contribute to the development of global electronic environment for the open and non-discriminatory exchange of information for the benefit of SMEs, and to expand electronic data interchange /electronic commerce to enable enterprises to carry out their business. |
| Maritime Information Systems | To demonstrate the potential and benefits of applications for a broad range of maritime activities in fields of safety, protection of environment, exploitation of marine resources and increased competitiveness of maritime industries. |

The problem of accelerating development of national communication infrastructures of developing economies has been a key policy issue for over a decade. Little has been done, however, to close the development gap with the exception of a few countries which have under their own policy impetus taken action to try and build up their infrastructure rapidly. There is a danger that developing economies in trying to build their networks may be putting in place technologies which in the longer term may not serve them appropriately for the information economy. There is also the other danger that the development gap may increase as a result of OECD economies rapidly building up their broadband

infrastructures. The capital deepening process in OECD countries could move significantly faster than the capital expansion process in many developing countries. As well, the process of convergence, the new service developments, and the new opportunities for market access in OECD economies may result in scarce capital resources being retained within OECD markets.

The aim of developing economies should be to develop their networks as rapidly as possible by whatever means possible. This challenge is not in the hands of developed economies (although they have an important role to play) or the lending institutions. The greatest challenge is for the developing countries themselves to understand at the highest political level the benefits that communication infrastructures can provide them and put forward the appropriate framework to facilitate this.

**Time to press on**

The report "Europe and the global information society"[107] urged that it was 'time to press on' recognising that the development of information infrastructures and related applications "is a revolutionary tide, sweeping through economic and social life." The report recognised the global nature of new market opportunities based on information infrastructures, and that to participate in these, European enterprises needed to be efficient and markets should function properly. The basis for this was to develop a "common regulatory approach to bring forth a competitive, Europe-wide market for information services. The recommendations put forward in that paper for change are echoed in the US's "Global Information Infrastructure: Agenda for Co-operation"[108] which stresses the global societal benefits that developments of information infrastructures can bring about. The OECD in its Special Session on Information Infrastructures also stressed the economic benefits that global information infrastructures would bring and that government needed to ensure that "road blocks to its implementation were removed"[109]. There is consensus that action is required, however what is lacking perhaps is speed in implementation. The next several years will be crucial as countries change their legal frameworks, with the opening of the European Union to infrastructure competition, and as the WTO negotiations move to conclusion.

Although the main principles are in general agreed to, the difficulty is in the details: in the implementation stage. It would speed the process of change if OECD countries could begin informal exploration of the types of international frameworks they wish to see in place and which would aid in rapid development of applications and infrastructures. It would also be useful if OECD countries began a more coherent dialogue with developing economies to provide them with experiences and lessons on regulatory structures and requirements and the appropriate training to implement these.

## NOTES

[1] CRTC, Competition and Culture on Canada's Information Highway: Managing the Realities of Transition, 19 May 1995, Ottawa.

[2] See Mansell, Robin, The New Telecommunications, A Political Economy of Network Evolution, Sage Publications 1993.

[3] The G7 Conference on Employment in Detroit (March 1994) put forward, among several questions for the OECD to examine, a specific question on how public policy can best facilitate developing information infrastructures.

[4] See Goldfinger, Charles, L'Utile et le Futile: L'Economie de L'Immatériel, Editors Odile Jacobe, Paris, 1994.

[5] The National Information Infrastructure: Agenda for Action, Information Infrastructure Task Force, September 15, 1993.

[6] The Challenge of the Information Highway, Final Report of the Information Highway Advisory Council, Ottawa, September 1995.

[7] The term 'multimedia has been defined as "..an umbrella term that describes an evolving host of processes under synchronous computer control that integrates in real time various external visual and audio inputs with computer generated text, graphics, animation, and audio into sight-and-sound programs that are transmitted through standalone or network delivery systems." Encyclopaedia Britannica Research Service.

[8] COM(85)113, 113/2 Proposal for RACE Definition Phase.

[9] COM(86) 47 Final, 29 October 1986.

[10] An overview of these legal issues is provided in OCDE/GD(96)74, Report on Ad Hoc Meeting of Experts on Information Infrastructures: Issues Related to Security of Information systems and Protection of Personal Data and Privacy, 30 November-2 December 1994.

[11] Mexico is excluded from this figure for reasons of continuity. With Mexico included main lines per 100 would have stood at 45.9.

[12] See OECD, Communications Outlook, 1995, table 4.17.

[13] For example, the European Commission has used this estimate in many of its documents.

[14] The turnover of the top 50 equipment manufacturing companies has been estimated by IDATE as $161 190 million in 1994.

[15] ICCP39, Mobile Communication: Pricing Strategies and Competition. This OECD publication notes that in 1994 more than 1.2 million customers per month were added to mobile communication networks -- double the rate in 1992.

[16] The World-wide LAN Server market is expected to grow by 22 per cent between 1992-1998 according to IDC Computer Industry Report, May 1995.

[17] For example, in the US fibre system route miles increased from 20 039 to 94 824 between 1985-92.

[18] Fibre-optic Link Around the Globe.

[19] The ITU has defined broadband to apply to services where the information flow rate exceeds 2.048Mbits/s (CEPT) or 1.54Mbits/s (US).

[20] Consumer Federation of America.

[21] Reform Toward the Intellectually Creative Society of the 21st Century, Report of the Telecommunications Council, Tokyo, May 31, 1994.

[22] Communications Futures Project, Work in Progress Paper No. 5, Costing New Residential Communications Networks, Bureau of Transport and Communications Economics.

[23] Asymmetric digital subscriber line permits transmission of compressed video signals on copper wire by attaching transmitters and receivers to subscriber lines.

[24] pg. 66-67. See table 10 for source.

[25] BT in the UK have used this argument extensively as have some of the Bell Operating Companies in the United States.

[26] The Government can decide to extended this exemption to June 1999.

[27] OECD Jobs Study, OECD, 1994, pg. 44.

[28] For example, in C. Freeman and L. Soete, Work For All or Mass Unemployment?, Pinter Publishers, London 1994, it is stated "Just because in previous waves of technical change job creation has ultimately outstripped job loss, it does not follow that this will inevitably be true in the future." (Page 2).

[29] The impact of multimedia on the economy is examined in a separate paper undertaken in the context of the OECD's work on Technology, Productivity and Jobs.

[30] See "Europe and the Global Information Society: Recommendations to the European Council", Report of the EC High Level Group on the Information Society, 26 May 1994, adopted by the European Council in July 1994.

[31] IDATE.

[32] Good comparable data are not available for the OECD countries on the communications and information services market as a whole. In particular activities such as value-added network services are difficult to define and obtain comparable data.

[33] See Sakurai, N. Papaconstantinou, G. and Ioannidis, E., The Impact of R&D and Technology Diffusion on Productivity Growth: Evidence for 10 OECD Countries in the 1970s and 1980s OECD/GD(96)27, Paper Presented at the Conference of Advanced Technologies and Innovation practices on Firm Performance: Evidence from Establishment and Firm Data held at the National Academy of Sciences in Washington D.C., 1-2 May 1995.

[34] The information technology and communication industry has been subject to significant reductions in prices with high rates of change in product features (this has also tended, at times, to result in buyers deferring purchases because they are waiting for new products and/or a fall in prices). In present market conditions, for example, the product life of some personal computers is under one year.

[35] A.J. Cordell and T. R. Ide, The New Wealth of Nations, Paper prepared for the Club of Rome, Buenos Aires, 30 November -2 December, 1994, page 28.

[36] Taxation of Interstate Mail Order Sales: 1994 Revenue Estimates.

[37] Munell, Alicia, New England Economic Review 1993.

[38] Aschauer, David, Contemporary Policy Issues, 1993.

[39] Report for the Study on Communication IO Table Configuration, MPT, Japan 1993.

[40] Many of these studies have been financed by the Bell Operating Companies which are seeking to lift the restrictions imposed by the Modification of Final Judgement following the break up of AT&T in 1984.

[41] The legislative proposals referred to here were not passed by the last session of the Congress although presently a new draft law is under consideration in Congress.

[42] Economic Benefits of the Administration's Legislative Proposals for Telecommunications, June 1994, Executive Office of the President, Council of Economic Advisers.

[43] Infrastructure investment is estimated to be in hybrid technologies, i.e. fibre combined with coaxial, copper and wireless transmission so that the economic impact scenario is not dependent on a 100 per cent fibre solution.

[44] The WEFA Group, Economic Impact of Eliminating the Line-of-Business Restrictions on the Bell Companies, July 1993.

[45] An Evaluation of the Economic Benefits of Narrowband and Broadband Communications, Economic Strategy Institute, Washington 1993.

[46] Cattaneo, Gabriella, TEKNIBANK, The Macroeconomic Impact of Advanced Communications in Europe, Paper presented to OECD Workshop on the Productivity Impacts of Information Technology Investments, November 11-13, 1993.

[47] European Community, Perspectives for Economic and social Impacts of Advanced Communications in Europe - PACE 1994.

[48] Telecommunication Council, Ministry of Posts and Telecommunications, Reforms towards the Intellectually Creative Society of the 21st Century, May 31, 1994.

[49] Devotech, Development of Multimedia in Europe, Report to the Commission of the European Communities, January 1995.

[50] Breton, Thierry, Les Téléservices en France, Quels marchés pour les autoroutes de l'information?, La documentation française, 1994.

[51] See, for example, van Meijl , H. and Soete, L.: IT Spillovers and productivity growth: an empirical application to France, MERIT, OECD/GD(95)142 presented to the OECD Workshop on the Economics of the Information Society, Toronto 28-29 June 1995.

[52] OECD, op. Cit., figures 3, 4, and 5.

[53] OECD, op. Cit. pg. 10.

[54] Hausman, J. and T. Tardiff, Valuation and Regulation of New Services in Telecommunications, Draft paper presented to the OECD Workshop on the Economics of the Information Society, Toronto, 28-29 June 1995.

[55] MPT News, April 3, 1995.

[56] H. Ungerer, The European Information Superhighway, Telco-Cable Europe, London, 1 June 1994.

[57] OECD Statement on the Benefits of Telecommunication Infrastructure Competition, March 1994.

[58] OCDE/GD(95)99, Restructuring in Public Telecommunications Operator Employment, General Distribution document, 1995.

[59] Mercer Management Consulting, 1995 Mercer International Scorecard, Presentation at OECD Workshop on Telecommunication Performance Indicators, September 1995.

[60] See OCDE/GD(95)99, op.cit.

[61] Mercer Management Consultants, Future Policy for Telecommunications Infrastructure and Cable TV Networks, Study for the European Commission, 1994.

[62] In the case of banking the initial wave of restructuring affected the internal service production process of the sector, whereas the new wave is affecting the consumer/service interface.

[63] The Henley Centre for Forecasting Ltd., 1994.

[64] ibid. And The Institute of Direct Marketing, UK.

[65] OECD-BRIE, Telecommunications User Group Project, Final Report, François Bar and Michael Borrus, October 1989.

[66] Breton, Thierry, op. cit.

[67] National Board of Employment, Education and Training, Converging Communications and Computer Technologies: Implications for Australia's Future Employment and Skills, Discussion Paper, 1995.

[68] US Census, Consumer Expenditure Survey.

[69] Devotech, Développment d'un Environment Multimédia en Europe, Rapport Final, Janvier 1995.

[70] Punie, Y. Media Use on the Information Highway: Towards a new consumer market or towards increased competition toward the consumer?, Paper presented to PICT International Conference on the Social and Economic Implications of Information and Communication Technologies.

[71] Network Modernization Study, New York State, Department of Public Service, cited in W.G. Bolter, Economic Impact of National Information Infrastructures: A Perspective of major Issues from US Experience, Presented at ICCP Forum, October 1994.

[72] Frank, J., Canadian Social Trends, Statistics Canada, catalogue 11-008E, Autumn 1995.

[73] US Department of Commerce, Falling Through the Net: A survey of the "Have Nots" in Rural and Urban America, July 1995.

[74] M. Mueller and J. Schement, Universal Service from the Bottom Up; A profile of Telecommunication Access in Camden, New Jersey, Research Performed for Bell Atlantic, 1995.

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[76] For further discussion of the international telecommunication pricing system see OECD, ICCP No.36, International Telecommunication Pricing Practices and Principles, A Progress Review, 1995.

[77] INFO-SOCIETY 2000, Ministry of Research, 1994.

[78] The Telecommunication Council is the body responsible for the report for the Japanese version of NII. This Council also deals with the MPT's tariff policy consultation.

[79] PRESS REVIEW, Information Society, ISPO 5, Dec., 1994.

[80] Action Programme, Electronic Highway from metaphor to action, Dec. 1994 Government of the Netherlands

[81] See OECD, The Communications Outlook, 1995.

[82] OECD, Telecommunication Infrastructure, The Benefits of Competition, ICCP No. 30, 1995.

[83] Source TARIFFICA service.

[84] See Annex.

[85] Nikkei Communications, July 1994.

[86] Green paper on the Liberalisation of Telecommunications Infrastructure and Cable Television Network, Part One, European Commission.

[87] For this reason the comparison is between i*nternational* leased line tariffs in Europe and US *domestic* leased line tariffs.

[88] See, for example, Pricing the Internet, Jeffrey K. MacKie-Mason and Hal R. Varian, April 1993.

[89] Essen 9-10 December 1994.

[90] See OECD, Infrastructure Competition: the Benefits of Competition, ICCP No. 36, Paris 1995.

[91] See: Networking Australia's Future (July 1994, Broadband Services Expert Group, Interim Report), Australia, pg 10; The Canadian Information Highway: Building Canada's Information and Communications Infrastructure, Canada, April 1994, pg. 13; Reforms toward the intellectually creative society of the 21st Century: Programme for the establishment of High-Performance info-communications infrastructures (31 May 1994, Telecommunications Council, Ministry of Posts and Telecommunications), Japan, pg.51; The National Information Infrastructure: Agenda for Action, United States, 15 September 1993, page 8.

[92] OECD, Universal Service Obligations: Their Provision in a Competitive Telecommunication Environment, ICCP No. 38, Paris, 1995.

[93] The issue of interconnection has been treated by the Working Party in a number of documents. See, in particular, Interconnection and Equal Access: A Policy Framework.

[94] See, OECD, The Economic and Regulatory Aspects of Telecommunication Numbering, OCDE/GD(95)117, 1995.

[95] Eurobit, Information Technology Industry Council, Japan Electronic Industry Association: Global Information Infrastructure, Industry Recommendations to the G7 Meeting, Brussels, 25-26 February 1995.

[96] For example, in the US the NTIA has stated that the NII should be seamless and support a wide range of equipment (The National Information Infrastructure: Agenda for Action, NTIA, Washington, D.C. 1993).

[97] CRTC, Competition and Culture on Canada's Information Highway: managing the Realities of Transition, Ottawa, 1995.

[98] This is reminiscent of the problem of airline reservation systems when a single airline also owned the dominant reservation system. Access to the reservation system would first provide information on the flight schedules of the airline owning the reservation system.

[99] For example, BT and four US companies have joined together to form a multimedia company Atlantic Vision, and Deutsche Telekom has a joint venture with Microsoft.

[100] Brussels, 25-26 February, 1995.

[101] International Telecommunication Union, World Telecommunication Development Report, 1995.

[102] Statement by Vice-President Al Gore, 21 March 1994.

[103] See Les Firmes Multinationales, Des entreprises au coeur d'industries mondialisées, Michel Delapierre et Christian Milelli, Géographie éonomique, Paris 1995.

[104] As of September 1995 with a further 31 countries participating as observers.

[105] OCDE/GD(95)133, International Infrastructure Competition: Towards A Policy Framework.

[106] ICCP 34, International Telecommunication Tariffs: Charging Practices and Procedures, Paris, 1994, and ICCP 36, International Telecommunication Pricing Practices and Principles: A progress Review, Paris, 1995.

[107] Europe and the global information society, Recommendations to the European Council, Brussels, 26 May 1994.

[108] Global Information Infrastructure, Agenda for Co-operation, Al Gore, Vice-President of the United States, Ronald H. Brown, Secretary of Commerce and Chairman Information Infrastructure Task Force, February 1995.

[109] Chairman's Closing Statement, ICCP Special Session on Information Infrastructures "Towards Realisation of the Information society", 3-4 April 1995, Paris, OECD/GD(96)28.