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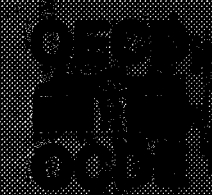
CONVERGENCE OR COLLISION? NO. 29

OECD

INFORMATION COMPUTER COMMUNICATIONS POLICY

TELECOMMUNICATIONS AND BROADCASTING:

Convergence or Collision?



INFORMATION COMPUTER COMMUNICATIONS POLICY

29

TELECOMMUNICATIONS AND BROADCASTING:

Convergence or Collision?

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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TÉLÉCOMMUNICATIONS ET RADIODIFFUSION :
Convergence ou collision ?

FOREWORD

This report was prepared in the context of the OECD's work on the policy implications of the convergence between communications technologies, specifically between telecommunications and broadcasting. The report was discussed at a draft stage by the Telecommunications and Information Services Policy (TISP) Working Party and by a seminar convened on February 11-12 1991 which was attended by representatives from the public and private sectors. The Committee for Information, Computer and Communications Policy (ICCP) recommended that the report should be made available to the public at its meeting in October 16-18 1991. It is published on the responsibility of the Secretary-General.

The report was drafted by Dr. Tim Kelly of the OECD's Science, Technology and Industry Directorate. The author is grateful to those representatives of national governments who responded to the postal questionnaires used to compile the Annex to this report, and to other members of the Directorate for their helpful comments and support.

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SUMMARY

The three strands of the information industry – computing, communications and broadcasting – have evolved historically as separate sectors. But conventionally understood boundaries between them are now blurring as these sectors mature. The technical convergence between computing and telecommunications is well-documented and, even if the process is taking longer than expected, it has already been widely anticipated through structural changes in policy administration and corporate organisation.

The convergence between telecommunications and broadcasting is less well-publicised but will have far-reaching implications. The boundaries between the two are largely artificial, since they are delineated by regulation rather than by the technology itself. As a result it is policy-makers who have the power to define or foreclose emerging market opportunities.

The first half of this report considers the evidence for convergence. It is argued here that convergence is taking place through three main processes – technical, functional and corporate convergence. In Chapter two, technical progress in storing, processing, communicating and displaying information in a digital form is examined. The progress of digitisation, first in computing, latterly in telecommunications and now in the broadcasting sector, is traced through product and service evolution. It is clear that once digital information flow is possible between the communications media and terminal equipment of each industry, it will no longer be relevant to treat them as separate sectors.

Chapter three looks at functional convergence. Functional convergence in this sense means the development of new "hybrid" services such as data broadcasting or audiotex; new ways of using existing services such as telesales or junk fax; and a shift in public attitudes as to the functions of broadcasting and telecommunications. The convention that broadcasting is used exclusively for education and entertainment while telecommunications is used for business and social purposes no longer holds true. The technical capabilities offered by future networks, based around the use of fibre optic technology, demand an increasing integration of voice, text, data and image if they are to be used to their full potential.

Technological change has also affected the way in which services are sold and by whom. Differing corporate strategies towards the integration of telecommunications and broadcasting are examined in Chapter four. Service operators in broadcasting have traditionally been funded by indirect means such as advertising, license fee collection or direct government subsidy, whereas telecommunications operators have charged the customer directly for the services consumed. In fact both types of organisation now draw their revenues from a wider base of funding sources. Corporate convergence is more likely, however, to come from equipment manufacturers rather than service providers.

Policy proposals for the regulation of networks and services under "convergence"

1. Restrictions on cross-provision should be strictly limited to firms with an actual or potential dominant market position.
2. Restrictions on cross-ownership should only be considered for acquisitions by firms with an existing dominant market position.
3. Network sharing should be promoted where it creates new services or provides new investment which would not otherwise exist.
4. Sharing of network facilities and support services should be actively encouraged where it leads to reduced costs and greater environmental efficiency.
5. Policy-makers should not attempt to specify a minimum viable scale for market players.
6. Regulators should move towards a market mechanism for allocating the civil radio frequency spectrum.
7. Licences for carriers and service providers should not specify what technology or mode of delivery should be used.
8. Regulators should be principally concerned with issues of access to, and interconnection of, networks and services.

Note: For more information, see Chapter seven.

They have more to gain from the development of new markets, notably for high-definition television (HDTV).

In Chapters five and six, some of the policy implications of convergence are examined, beginning with the future evolution of public networks. It is argued that there has actually been a divergence rather than a convergence at the level of networks as new technologies, based on radio or satellite transmission, have come to challenge fixed link networks. In consequence, it is not so necessary for regulators to keep telecommunications and broadcasting networks structurally separated. Indeed, there are strong arguments in favour of allowing network sharing on the grounds of technical and environmental efficiency.

In Chapter six, the future of service regulation is examined with particular focus on the question of economies of scale and scope, regulatory regimes, access to and interconnection of networks, and the licensing of "converged" carriers and service providers. It is argued that there are few remaining reasons to favour the continuing separation of telecommunications and broadcasting services. There is no real pressure from service providers at present to allow cross-sectoral provision of services, but equally, there is no compelling reason to disallow it. It is argued that regulators should seek a new role in policing access to, and interconnection of, public networks. Some of the policy proposals taken from the conclusions drawn in Chapter seven are summarised below.

Chapter one

INTRODUCTION

1.1 The economics of information

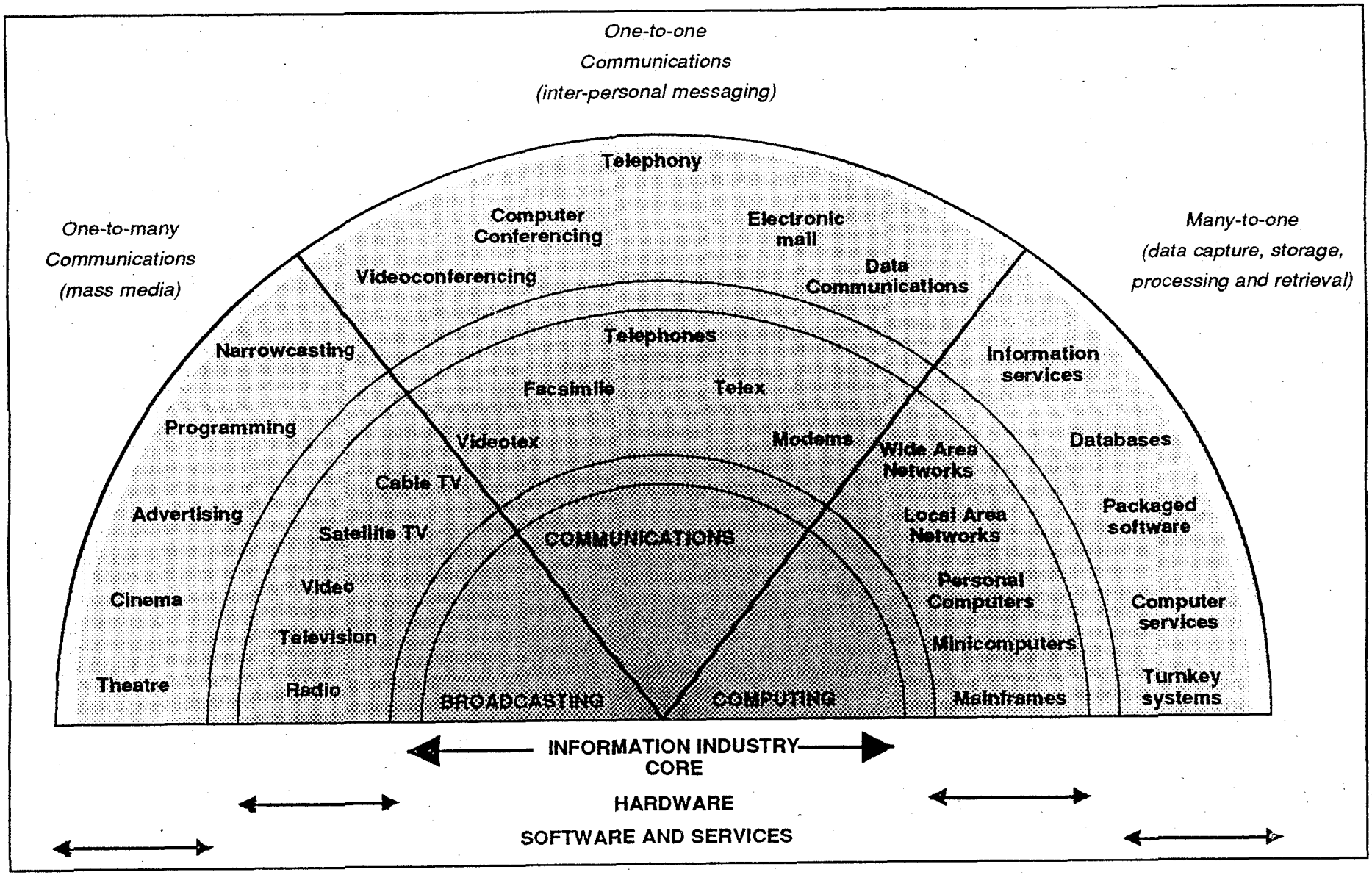
It is fashionable to talk about the ''information industry'' as the leading growth sector of the advanced industrial economy. In terms of conventional economics, information is the ultimate consumer good with no obvious limits to the level of supply and demand. The consumer is unlikely to need more than a small number of durable goods such as fridges, washing machines and cars, and has a satiable appetite for services such as travel, banking, shopping or eating out. By contrast, it is difficult to assign a theoretical ceiling to the amount of information that can be consumed, except perhaps for the time taken to consume it.

But here is the catch – information for consumer advantage quickly loses its economic value as it passes from the private to the public domain. In general terms, the unit value of information declines as its volume increases, as its timeliness is dissipated, if its quality is questioned, and as its uniqueness is generalised. Furthermore, information only gains real value when it is targeted. Unsolicited information, or information out of context remains as mere data. If a seam of information is to be mined economically, it needs to be extracted, processed, refined and delivered quickly to the customer as if it were a precious metal rather than a commodity product.

It is possible to subdivide the information industry in a number of different ways according to the content of the information or the way in which it is treated. The conception of the information industry developed in this paper is shown in Figure 1.1. At its core are the three sectors of broadcasting, communications and computing. These depend on a number of different hardware devices, some of which are commonplace such as the television (TV), the telephone or the personal computer; but many are highly specialised to the needs of different businesses. The services upon which each sector depend cover the ''culture'' industry of entertainment and education; the ''communications'' industry of inter-personal messaging; and the ''software'' industry of computing applications. From a wider perspective, the information industry might be viewed in terms of concentric circles of businesses and professions that use information to a greater or lesser degree.

This segmentation relates both to the content of the information and the way it is handled. Broadcasting is characterised by one-to-many transmission of information, communications is conventionally one-to-one interaction while computing generally involves giving individual access to multiple information sources, either stored locally or on distant computers (many-to-one). Such distinctions are easier to make from an intellectual or conceptual point of view than from a practical standpoint. Indeed, the difficulty

Figure 1.1 **The structure of the information industry**



of such arbitrary line drawing is the principal theme of this report. The report is concerned with the "convergence" between the different parts of the information industry, especially between the two communications technologies of broadcasting and telecommunications.

1.2 The concept of "convergence"

The term "convergence" has become something of a buzzword in the information industry: the currency of which is high on concept, but low on content. Convergence is defined here as the blurring of technical and regulatory boundaries between sectors of the economy. In the context of this report, the convergence between telecommunications and broadcasting is viewed as occurring at three levels: networks, services and corporate organisation (see Figure 1.2.).

- At the level of *networks,* convergence may imply "sharing" of resources such as switches, concentrators, satellites, cable, interfaces, ducts or poles. Convergence may also imply "competing" where resources are finite, such as the civil frequency spectrum or slots in geo-stationary orbit. Ultimately, convergence may also lead to an "integration" of networks; if not an integration of network providers.
- At the level of *service provision,* convergence is used to describe both the emergence of new "hybrid" series such as datacasting or video-conferencing; and the use of existing services in new ways, such as telesales, junk fax or audiotex.
- At the level of *corporate organisation,* convergence may mean cross-ownership of broadcasting and telecommunications facilities by the same parent company, or cross-provision of services by the same company. More common than either of

Figure 1.2. **The concept of "convergence"**

Level	Telecommunications	Convergence	Broadcasting
Networks	Copper Fibre Cable Mobile Satellite Microwave	Network sharing? Network integration? Video dial-tone?	Terrestrial Satellite Microwave Video-cassette rental/sale
Services	(Switched) Voice Data Image (One-to-one)	Video-conferencing? Datacasting? Narrowcasting? Video dial-tone? Interactive services?	(Non-switched) Radio/TV Programming Scheduling Transmission (one-to-many)
Corporate	Hardware manufacture Service provision	Dual manufacture? Cross-ownership? Cross-provision?	Hardware manufacture Service provision

these is the practice of dual manufacture of equipment for both the communications and the consumer electronics industries.

At each of the three levels there are important regulatory questions raised, especially in the area of competition policy. While the principle of promoting competition is supported, in the abstract, in all OECD countries, there is a general recognition of the need for safeguards, for instance to protect the notion of universal service, to promote technical efficiency or to reign back the market power of former monopolies. In this particular case, there is the added problem of sectors which are unequal in size (the telecommunications industry is far larger than the broadcasting industry) and which have distinct traditions of regulation (carrier-regulated for telecommunications; content-regulated for broadcasting).

1.3 Structure of the report

This report has been written in two halves following the structure outlined above. The first half (Chapters two to four) examines the evidence for convergence in OECD countries both in terms of the existing situation and the technical pointers to future developments. The second half (Chapters five and six) analyses the policy implications in terms of a series of issues which policy-makers will need to confront over the coming decade.

In Chapter two, the technical basis for network convergence is considered. It is argued that the technical rationale for differentiating between the sectors is weaker than ever in that they increasingly treat information in a digital electronic form and because the infrastructure of transmission – cable, satellite, frequency modulation – is generic.

In Chapter three, the report looks at the content of the information in terms of the emergence of new services (service convergence) and new ways of using existing services (functional convergence). There are strong historical reasons why the businesses of broadcasting and telecommunications should have grown up separately but increasingly there are new hybrid services emerging such as datacasting, narrowcasting, chat lines or telesales which know no such history and which straddle sectoral boundaries.

In Chapter four, the evidence for convergence is examined at the level of corporate organisation. At present, there are relatively few companies engaged in both types of activity but this lack reflects, in part, the regulatory restrictions in operation in certain OECD countries. Cross-ownership and cross-provision may be expected to increase in the future if, as expected, synergies between telecommunications and broadcasting become more apparent.

Chapter five of the report opens the section on the policy implications of convergence with an examination of the future of public networks. Even if convergence seems far away as a commercial reality, decisions about network investment and network architectures need to be made now. In the past, the debate has centred on the question of how to cost-justify the deployment of "fibre to the home", in other words the deployment of fibre in local distribution networks. Increasingly it is being recognised that "fibre close to the home" is sufficient to provide most of the services subscribers may need. Such a network configuration can be provided equally well by either public telecommunications operators (PTOs) or cable TV (CATV) operators. Nor is fibre the only solution, as the rapid growth of radio and satellite-based technologies has shown.

Chapter six of the report analyses the argument that there is a need for ground rules to govern the development of service competition, especially where different service providers are competing for finite spectrum or for access to the public network. There is general agreement that if there is to be further liberalisation of inter-sectoral competition, then it should be on the basis of a ''level playing field'', but there is little consensus on how that might be achieved, or even whether it *can* be achieved through regulation.

Chapter seven presents the conclusions of this report with a focus on highlighting policy questions. Two main issues are addressed: to what extent should network sharing be permitted, or indeed encouraged; and what criteria should be applied for the licensing of network operators and service providers. A number of guiding principles for policy-makers are proposed. Later work to be conducted under the ''convergence'' theme will deal with the issue of appropriate regulatory regimes and whether existing structures are flexible enough to accommodate the pressures from communications convergence. OECD countries differ as to whether or not they have a unified regulatory regime for the information sector and several countries are currently in the process of reviewing the situation.

The annex to this report presents a country-by-country analysis drawing upon material presented at a communications convergence seminar held on February 11-12, 1991 at the OECD in Paris and responses to an OECD questionnaire distributed at that meeting. The country-specific analysis complements the thematic policy review in the main body of the report.

Chapter two

TECHNICAL TRENDS

2.1 Bits, bytes and broadband

At the heart of the concept of convergence between telecommunication and broadcasting lies the fact that they are difficult to separate from a technical standpoint. Information relieved of its content, whether it be a Shakespeare play or a computer programme, is reduced to mere data. Data relieved of its structure of meaning, whether it be alphabetical or numeric, is reduced to electronic impulses, sound waves or light waves. By taking such a reductionist approach to the study of information it is possible to summarise most of the transactions which characterise telecommunications and broadcasting services in terms of the transfer of a certain amount of information (stored as electronic bits) at a certain speed of transmission (bits per second) over a certain time period (session, or holding time).

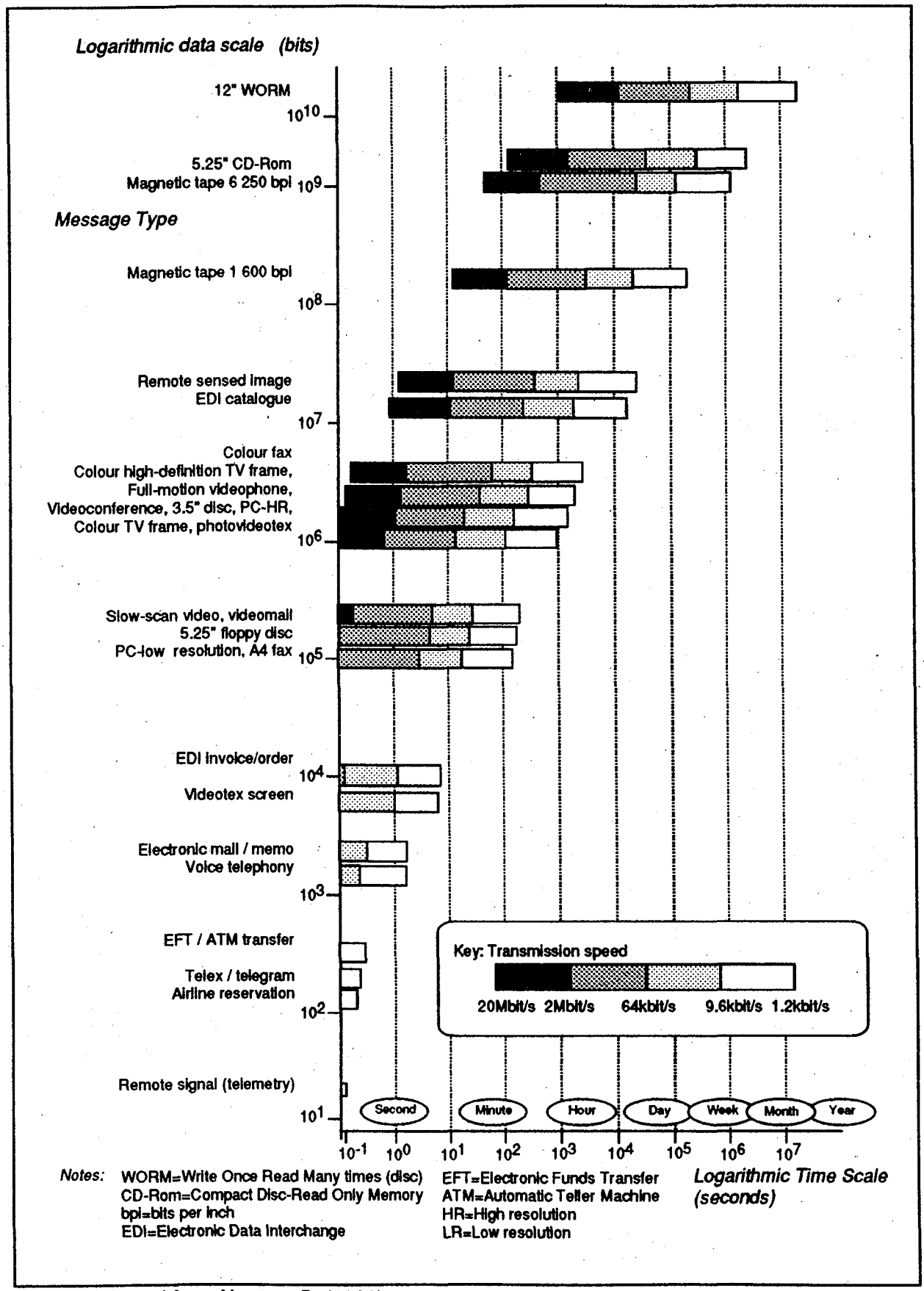
Figure 2.1 puts data storage and data transmission speed on two axes of a graph to show the characteristics of different message types. These range from a telemetric signal from a device such as a remote temperature monitor, to file transfer of data contained on a 12 inch Write Once Read Many times (WORM) computer disc. The former would typically take less than a tenth of a second to transmit 4 bytes of data even at a primitive line speed of 1.2 kbit/s. By contrast, the latter would take 33 weeks to transmit 24×10^9 bits of information if it were to operate at the same speed, or 20 minutes operating at 20 Mbit/s.

In general terms, the applications in the lower half of the graph ($1 \times 10^1 - 3 \times 10^5$) fit within the domain of traditional telecommunications. This includes voice telephony, transaction processing, text and data communications. Above this, the demands for data storage and transmission generally need either a higher bandwidth (e.g. 64 kbit/s and above) or operate using store-and-forward (e.g. voice mail, photovideotex). Above 3×10^6 most of the applications listed involve image transfer, broadcasting or computer data transfer.

2.2 Media parameters: human or technical?

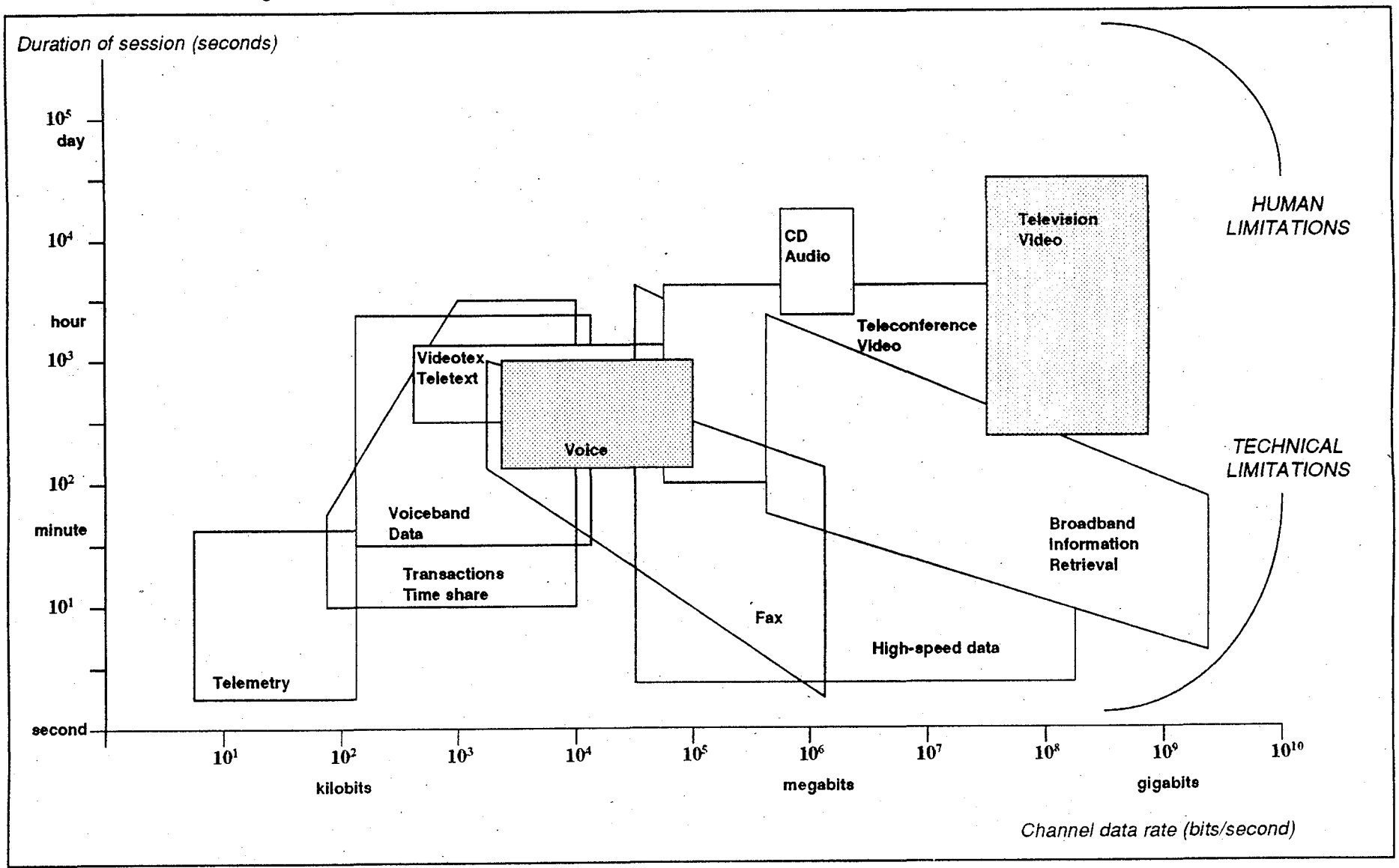
An alternative way of viewing the continuum between the two media of telecommunications and broadcasting is in terms of the amount of data transmitted over a particular time period, or session. The characteristics of different information services are summarised in Figure 2.2. The two shaded areas represent the traditional terrain of voice telephony and full-motion colour TV. Voice telephony is optimised for traffic which uses

Figure 2.1 **Transmission times for information network-based applications by speed of transport**



Source: Adapted from Newton, P. (1989).

Figure 2.2 **Channel data rate and holding time for electronic information services**



Source: Adapted from Nussbaum (1989, Fig 1).

a relatively low bandwidth (3 kHz) and a short holding time (three minutes, on average). By contrast, an action-packed TV programme might transmit data at a much higher bandwidth (6-8 MHz) over several hours. Both rely on transmission and reception taking place in real time and both assume user terminals which are relatively dumb, that is having no memory storage facilities.

The parameters of the two media are, to some extent, defined by human and technical limitations. The boundaries of human limitations (upwards and outwards in Figure 2.2) are those of hearing, seeing and concentration and may be regarded as relatively fixed. In some fields of product development, for instance high definition television (HDTV) incorporating digital stereo, performance quality has already reached the point at which further improvement would be imperceptible to the average human. The boundaries of technical limitations (downwards and outwards in Figure 2.2) probably cannot be specified. Indeed, the limits for what can be achieved are already defined more by economic than technical constraints. It is, however, possible to recognise ''generations'' of equipment defined by memory storage (valves, transistors, integrated circuits, semiconductors, very large scale integration (VLSI) semiconductors) and by transmission medium (twisted pair, coaxial cable, fibre optic cable).

As technological change has advanced, there have emerged a number of different services with overlapping characteristics in terms of channel data rate and circuit holding time. Many of these new services rely on a certain amount of terminal intelligence for store and forward functions and a much higher bandwidth than is available on conventional networks. Thus the trend towards convergence is primarily located towards the bottom right-hand side of the graph. Here are found the broadband information services which are common to advanced telecommunications, high speed data transfer and compressed video transmission. It is in this area where true communications convergence is likely to take place.

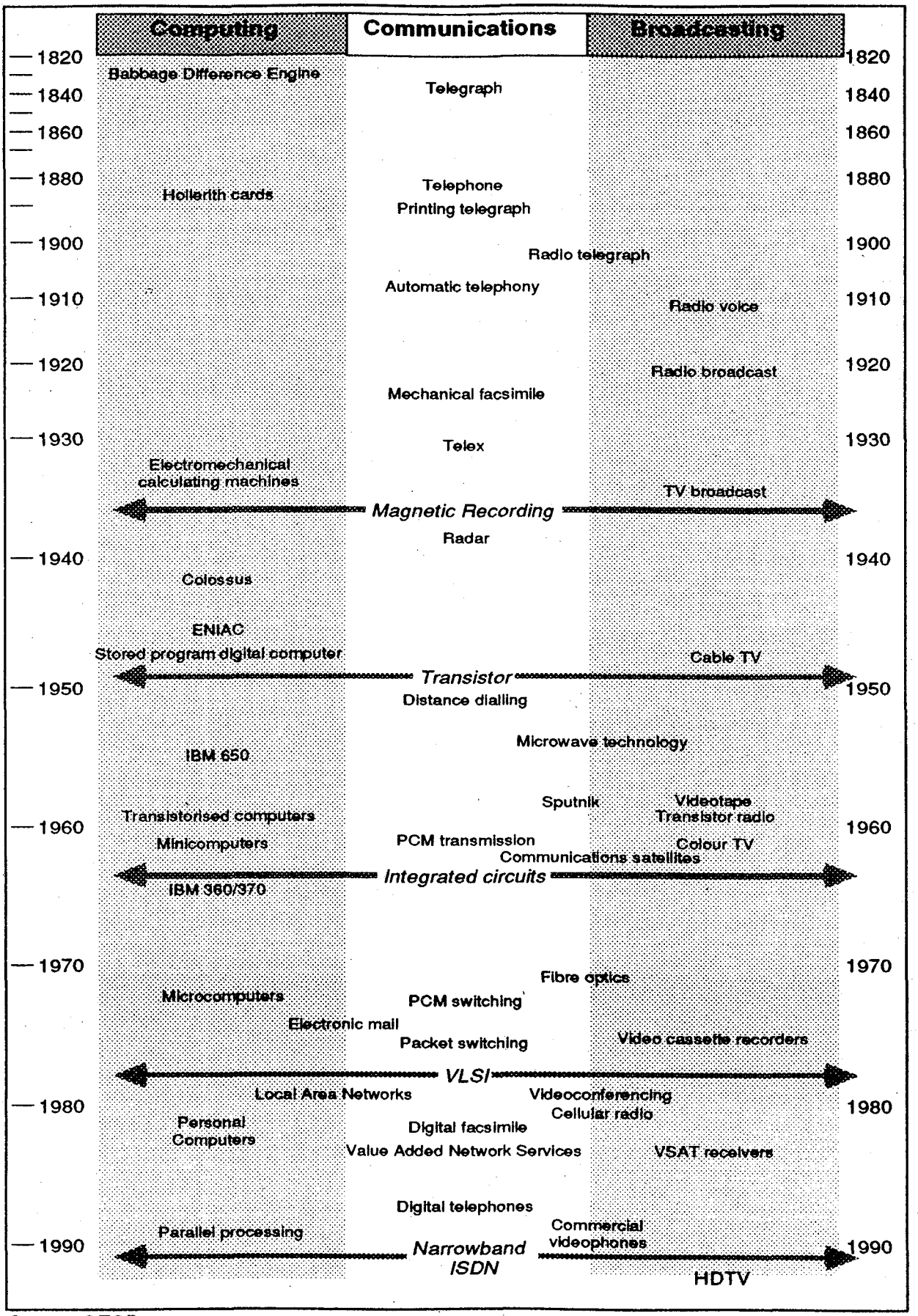
2.3 Product and service evolution

A third way of viewing the convergence issue is in terms of the historical development of the industries of computing, telecommunications and broadcasting (Figure 2.3). The commercial application of a particular product or service is a combination of the state of technical progress at the time, plus a high degree of chance. Technical history is full of cul-de-sacs and false turnings, and surprisingly few products which attempt to optimise the technology of the era turn out to be commercially successful.

The three industries started from different points in history and the development of incompatible standards has tended to keep them apart. Human institutions of training, management and administration also reinforce disciplinary barriers. However, there are a number of technical factors which have counteracted this tradition of separate development and which have served as centripetal, converging forces. These include particular innovations, such as magnetic recording techniques, or successive generations of electronic components from transistors to VLSI semiconductors.

Perhaps the most significant factor for convergence is the shift from analogue to digital technology. Despite the fact that computing is the youngest of the three industries, it is here where the notion of the storage and transmission of information in digital form was first apparent in the development of the stored programme digital computer in the

Figure 2.3 **Technical evolution of the information industry, 1820-1990**



Source: OECD.

late 1940s. Digitisation came to telecommunications in the late 1950s and early 1960s with the development of pulse code modulation (PCM) techniques, applied first to transmission and later to switching. The shift from analogue to digital in the telecommunications industry has been evolutionary rather than revolutionary and relatively few service providers can yet claim to offer an all-digital network. Indeed analogue products still hold a considerable price advantage over their digital rivals. Nor is digitisation inevitable; the explosive growth of fax compared to the hesitant progress of electronic mail shows that technical considerations are often secondary to questions of ease of use, or commercial advantage. Nevertheless, it is generally recognised that digitisation is inevitable in the next generation of services and products.

During the 1970s and 1980s a number of products and services have been developed which utilise the facility of a digital interlink between computing and telecommunications products. Computer communications had previously been based around master-slave systems between a host computer and an array of dumb terminals; or based on time-sharing principles of batch processing. What is new about the current "networking" phenomenon is the way in which it permits "peer-to-peer" networking and interactive working. Developments such as Local and Wide Area Networks (LANs/WANs) have greatly facilitated file transfer while services such as electronic mail or Value-Added Network Services (VANS) have exploited the medium of digital electronic communication to launch new growth markets. However, convergence between computing and telecommunications at an organisational level has proved to be slower than at a technical level. Until recently, institutional barriers have kept apart the computing and communications departments in all but the most forward-looking companies. Nor has the ability to provide both services been a guarantee for commercial success. However, alliances and mergers between firms in the two sectors continue as the recently-announced tie-ups between AT&T and NCR, Fujitsu and ICL demonstrate.

Convergence between telecommunications and computing has been more evident within firms, using private networks, than between firms using public networks. The public network providers had pinned their faith on the development of integrated services digital networks (ISDNs) to recover traffic lost to private networks and to build upon the business potential of convergence. Narrowband ISDN is designed to extract maximum performance out of the existing copper-based infrastructure by offering a single interface to users for voice and data services at speeds of either 56/64 kbit/s (basic access) or 1.5/2.0 Mbit/s (primary access). Public ISDNs are now established in several OECD countries but the take-up has been slow and it is becoming clear that narrowband ISDN offers little which is not already available to users on private networks.

The CCITT-defined ISDN offers little network intelligence and for this reason attention is shifting to so-called Intelligent Networks (INs) and the potential of broadband ISDN. This would involve the laying of new networks based on fibre optic cable, but would provide much higher operating speeds of 155 Mbit/s and above. It would open many new service possibilities including the merging of video functions with voice and data. There are a number of trial programmes of integrated broadband networks, notably under the European Commission's RACE (Research and development in Advanced Communications technologies in Europe) programme. Many of these involve laying fibre direct to the home or to the terminal and aim to integrate interactive (telecommunications-based) services with distributive (broadcasting) services. However, the economics of broadband depends crucially on the development of new services which will exploit the extra bandwidth. The leading candidate of the moment is HDTV.

The race to develop a successor to current colour TV technology has been underway for at least two decades. The Japanese public broadcasting organisation, NHK (Nippon Hoso Kyokai), working in close co-operation with local manufacturers, provided live HDTV coverage of the opening and closing cermonies of the Seoul Olympic Games in 1988 to demonstrate its MUSE (Multiple Sub-Nyquist Sampling Encoding) technology followed later on by daily broadcasts by satellite. The success of the Japanese technology prompted efforts to get the 1125/60 system (1125 lines per picture/60 Hz field frequency) adopted as an international standard by the CCIR (International Radio Consultative Committee of the International Telecommunication Union). This was opposed by the European Commission. In Europe, the main impetus has come from the manufacturers Philips (the Netherlands) and Thomson (France) which are the chief contractors for the EUREKA-95 project and are the driving forces behind the VISION 1250 consortium. The European system is based on the MAC (Multiple Analogue Components) family of standards which include D2-Mac (an interim standard used for satellite broadcasting) and which should eventually culminate in HD-MAC. The European system is being supported by the European Commission which has proposed a memorandum of understanding to provide subsidies for broadcasters in converting to HDTV technology and to impose a requirement that all satellite dishes and new TV sets with screens above 52 cm sold after January 1993 must have HDTV capability.

The US response has been somewhat different in that the current plan is for HDTV to be delivered over-the-air by simultaneous broadcasting (''simulcasting'') of HDTV and conventional signals. In order to achieve this, it is likely that an all-digital transmission standard will be chosen as opposed to the hybrid analogue digital systems being proposed in Europe and Japan. A number of different systems are being tested by the FCC Advisory Committee on Advanced Television Services which has been charged with delivering raw data and making recommendation to the Commission by September 30, 1992.

Despite the high cost for broadcasters and consumers of conversion to HDTV, it seems unlikely now that there will be a single world standard and that at least three different standards will co-exist. In the short-term, the prospects are for a proliferation of ''black box'' converters between these incompatible systems.

2.4 Bandwidth eaters and data crunchers

Technical evolution is taking place in a number of seemingly contradictory ways. On the one hand, there is the emergence of advanced forms of one-to-one telecommunication service that are intensive in their use of bandwidth, such as colour fax or videoconferencing. But this is counteracted by new data compression techniques which use sophisticated software and intelligent terminals to squeeze a higher performance out of existing networks, such as the delivery of the 10 Mbit/s ethernet local area network standard over conventional twisted pair telephone lines. In terms of their impact on convergence, both trends are similar in that they tend to blur the technical boundaries between telecommunications and broadcasting. However, in terms of their impact on policy and specifically on network investment strategies, they are radically different. The two trends are discussed below.

2.4.1 *Broadband or multimedia?*

The history of the development of broadband communications services has largely been a case of technology-push rather than demand-pull. It has long been appreciated that the technology exists to provide a very high throughput of data using fibre optic cable, microwave transmission or high-power satellites. The data feed can be delivered right to the desktop or straight to the home, but the problem then becomes – ''what to do with it?'' This problem has three main elements:

- *Terminal design* for products that can make use of the raw, digital power offered by fibre. Typical typing speeds can be accommodated by the 300 bit/s offered by telex terminals and most PCs can only download data at 9.6 kbit/s or less. If these type of desktop products are to be used with fibre then they would need network interfaces with much larger and relatively sophisticated memory buffers. Telephones too would have to be substantially redesigned to cope with digital input and would need to have an independent power source such as rechargeable batteries as fibre cannot carry an electrical current. Furthermore, the commercial advantage of fibre, that it cannot be tapped, becomes a disadvantage if the user wants to attach extension phones. In the case of both the PC and the telephone, terminal redesign would produce a much more costly product without any corresponding improvement in performance that would be evident to the user. Only for the TV would the extra bandwidth of fibre be justified and even here it becomes relevant only if multi-channel high definition television (HDTV), or some degree of two-way transmission, was envisaged.
- *Interface standards* need to be agreed before any mass market can develop. Here a distinction can be drawn between committee-defined standards and proprietary or de facto industry standards (see Shumate, P., 1989; Simpson, A., 1990). The former include FDDI (Fibre Distributed Data Interface) and SONET (Synchronous Optical Network) which some analysts reckon will become the standard fibre optic transmission protocol for local area and wide area networks (LANS/WANS) respectively. The latter are more numerous and often incompatible. As yet there are, for example, no generally recognised standards for an optical network architecture or for an optical user interface. The installation and ''termination'' of fibre is a highly-skilled craft and this adds greatly to the cost of fibre relative to copper.
- *Lack of services* remains the biggest obstacle to fibre to the desktop or home. There is still a prevailing belief that once the network is available then services will follow naturally. However, pilot evaluation projects, of which there are now an increasing number across the globe (see Figure 2.4) have generally failed to identify an overriding ''must have'' service which is sufficient to drive demand. Many broadband services have been tried – including video-telephony, video-conferencing, video on-demand, database retrieval, electronic newspapers or colour fax. Also, under the EC RACE Programme, specific demonstration programmes have been mounted for applications such as health care, transport services, flexible and distance learning and the linking of national administrations. Service evolution is discussed at greater length in Chapter three.

The arguments presented above show that there are relatively few individual services or individual terminals that can, at the present time, cost-justify the delivery of fibre right to the desktop/home. Only if some form of network sharing between services is

Figure 2.4. **Examples of pilot programmes for the installation of fibre to home/desktop**

Location	Carrier/Vendor	Dates	Comments
Mitaka, Tokyo (Japan)	NTT	1984-87	Implementation of INS system for narrowband ISDN and picture distribution in suburb of Tokyo.
Higashi-Ikoma, Nara (Japan)	NTT	1980-84	Hi-OVIS trial – use of fibre in CATV network.
Heathrow, Florida (USA)	Bell South with Northern Telecom	1988	Telephony, ISDN and CATV; up to 4 000 homes.
Perryopolis, Penn. (USA)	Bell Atlantic with Alcatel Network systems	1989	Telephony and CATV; up to 100 homes.
Cerritos, Calif. (USA)	GTE Service Corp. AT&T Network Systems, GTE Labs and American Lightwave Systems Inc.	1989	Telephony, CATV and advanced broadband services; up to 5 000 homes.
Rimouski, Quebec (Canada)	CONSORTEL (Québec Téléphone plus COGECO)	1988	A joint venture between a telco and a CATV operator; 150 homes.
Biarritz (France)	France Télécom	1983	Videotelephony, ISDN and picture distribution.
Berlin (Germany)	DETECON (DBP)	1986-89 (1st phase)	Video-conferencing, CATV, data communications and video on-demand. Second phase will concentrate on business sector.
Sloten, Amsterdam (Netherlands)	Netherlands PTT with AT&T, Philips and Amsterdam cable TV	1991	Fibre-to-the-home trial in 100 households.
Bishop's Stortford (UK)	BT	1990	400 homes and 28 businesses provided with a range of services incl. video-telephony, CATV, video on-demand and home-shopping. Two systems are being trialled – with a local switch and a central exchange switch.

Note: This list is intended to be illustrative rather than complete.
Sources: Bickel *et al.* (1989), Clery (1990), MPT (1990), Shumate (1989) and Public Network Europe (1991).

permitted can fibre be considered as potentially *economic* and even here it would only be attractive to business users, or new residential subscribers, not to replace existing copper-based networks. There are, of course, formidable regulatory barriers to network sharing, as discussed in Chapter five.

It becomes clear that fibre to the desktop/home is a technological solution to a problem which does not yet exist. Almost all future communications needs can be met by a hybrid network of fibre close to the desktop/home with a copper (coaxial cable or twisted pair) feed in the local loop. The local loop itself may also be a hybrid between different types of architectures (e.g. switched/non-switched, central star/LAN/cable TV/ wireless). In such an arrangement, the fibre backbone could provide the raw, undifferentiated transmission power for any number of different services, while local distribution networks would be copper or wireless-based, tailored to deliver different services, and optimised to the needs of those services.

A second trend which is apparent is the move away from centralised towards local processing. This feature has been evident for many years in computer systems where older, central mainframe-based architectures have been superseded by departmental, minicomputer-based networks and latterly by PC-based LANs. In the telecommunications industry, the same trend is manifest in the decentralisation of network intelligence away from the central office exchange to customer premises equipment, such as PBXs and featurephones. The trend towards local intelligence should, in theory, reduce the amount of communication necessary by reducing the functions of the central host. In practice, however, it has only changed the nature of the communication away from individual commands and transactions towards high-volume file transfer. Again this architecture may be best served by a hybrid network with a fibre backbone connecting coax based departmental clusters or LANs in data communications and twisted pair local distribution networks in telecommunications. Providing there are adequate switches and/ or gateways, local systems can be optimised to specific functions or machine types with open standards being implemented on the fibre backbone.

Hybrid fibre/copper networks are also being implemented in cable TV systems. Cable systems operators are finding that many of their objectives for network modernisation – such as improved picture quality and reliability, lower maintenance costs, greater channel bandwidth and eventual HDTV capability – can be realised simply by installing fibre in the trunk cables up to the head ends (Anderson, L., 1990, p.76-77). The installation of fibre can be achieved relatively cheaply through ''overbuilds'' on existing copper links or through ''blown fibre'' in pre-laid pipes. Not only does fibre offer a higher bandwidth than cable, it also reduces the number of amplifiers or repeaters that are necessary in the network. Cable TV operators argue that hybrid fibre-coax networks could eventually accommodate more than 100 standard TV channels, or up to four HDTV channels and a smaller number of conventional channels (CCTA, 1989).

The only areas currently foreseeable where a hybrid fibre/copper network would not be adequate is for full two-way video or for computational video. The video-conferencing market is growing in business and educational use, but for most practical purposes one-way video broadcasting with a two-way voice link is sufficient. For computational video, or ''multimedia'', current trends indicate that it will be an ''off-line'' market utilising interactive CD-Rom (Compact Disc Read-Only Memory) storage devices rather than an ''on-line'' market utilising broadband transmission. Also, it is not yet clear for what purposes the technology of computational video (the combination of visual and computational functions) will be used – education, entertainment and games are the leading

contenders so far. Some, of these questions may be answered by the European Commission's RACE programme where there are plans to demonstrate multimedia applications integrating voice, text, data and image.

2.4.2 Data compression technology

The development of hybrid networks has been greatly facilitated by progress in data compression technology which allows service providers and users to squeeze extra functionality out of existing, copper-based networks. In the telecommunications field, time-division multiplexing and packet-switching are long-standing examples of data squeezing technologies. In the broadcasting field, picture compression involves transmitting only those parts of the picture which change between frames. Current progress in compressing video signals is around 20:1 in experimental transmissions though this is still some way short of the 180:1 that might be needed to compress an HDTV signal within the spectrum allocation of a conventional TV channel (Renaud, 1990, p.13).

Perhaps the best way to illustrate the scale of progress in data compression is by a series of examples:

- The ISDN (integrated services digital network) standards for *digitised voice* originally envisaged an allocation of 64 kbit/s for each voice channel. Technology now permits up to 8 voice channels operating at 8 kbit/s to be squeezed into one 64 kbit/s channel.
- Early studies of *video-conferencing* anticipated that at least 140 Mbit/s of capacity would be necessary, but it is now becoming possible to provide a lower quality, but still perfectly acceptable level of video capability at 2 Mbit/s. This is within the scope of primary rate access as defined in narrowband ISDN. Futhermore, the availability within the last year of single-chip processors capable of packing video and audio signals at compression ratios of up to 500:1 promises further significant breakthroughs, especially in the area of multimedia technology (Leonard, 1990).
- The standards defined for Group 1 fax in 1968 specified a target of around 20 minutes to transmit an A4 page. Today *Group 3 fax,* which uses much more sophisticated data compression and error correction protocols to transmit the same page is between 20-60 seconds, depending on complexity, on the same analogue lines. The rate of improvement in G3 fax has closed the gap considerably with G4 fax which is designed to operate over digital, 64 kbit/s lines at 5 seconds per A4 page.
- *Local Area Network* standards originally needed the full capacity offered by coaxial cable with lots of repeaters, to operate the 10 Mbit/s ethernet standard. Over time, technology has progressed sufficiently to allow ethernet to be used with thin coaxial (''cheapernet'') and latterly with standard, twisted pair telephone lines. The current technological challenge is to put 100 Mbit/s transmission speeds over twisted pair.
- The transition from low-power to medium-power, and latterly to high-power satellites, has been accompanied by a corresponding decrease in the size of antennae from 1.2-1.8 m, to 65-90 cm to 30-45 cm respectively. However, current trends indicate that *medium power satellites* such as those operated by SES Astra are winning the battle for market share because of their early start in the market, their greater channel capacity and their use of existing broadcast technologies

(PAL, SECAM, NTSC) rather than ''next generation'' technologies such as MAC or MUSE family standards.

These examples are admittedly very mixed, but it is possible to identify a number of common themes which run through them:

- products and services which attempt to optimise the technology of tomorrow are often pre-empted by those which merely make the best use of what is available today;
- investment in data compression is often more cost-efficient than investment in new infrastructure;
- evolutionary technologies and those which have an early market start, generally do better than those based on revolutionary, non-compatible standards which suffer from delays.

These trends also illustrate that the job of technological forecasting becomes much more complex. In the semiconductor industry over the last twenty years, there has been a reliable rule of thumb that semiconductor power would double approximately every two years with a consequent fall in price/performance ratios. This technological dynamic has also fired the evolution of the computer industry. In the telecommunications service industry, however, the technological vector could almost be said to be reversing with advances in data compression technology currently being more potent than the development of high bandwidth technologies. Because the added-value in a telecommunications network lies as much in the cabling and the associated ducting and trenching as in the equipment which is attached to the cable, it makes sense to squeeze extra functionality out of the existing network rather than continually to replace it.

2.5 The mobile revolution

Technological convergence can also lead to technological competition and conflict, especially where the two sectors of broadcasting and telecommunications compete for the use of scarce resources. The recent, phenomenal growth of mobile communications promises to be as pervasive in the telecommunications industry as the PC revolution has been in the computer industry. The number of subscribers for cellular radio systems in the OECD countries was close to 11.1 million at the end of 1990 (see Figure 3.3). As subscribers grow in number, and as the volume of traffic multiplies, there will be increasing demands from mobilephone operators for a greater allocation of frequency and for equitable access to fixed link networks (Lewyn & Coy, 1990).

The literature on the convergence theme has traditionally concentrated on ''network convergence'', namely the provision of telecommunications and broadcasting services over the same *cabled* networks. The emergence of mobile telecommunications modifies this debate in a number of ways. Firstly, it implies ''airwaves convergence'' as well as network convergence. Secondly, it implies a potential dilution of revenues from cable, or fixed-link telephone services as mobile technology increasingly becomes a substitute for conventional telephony. Amongst other things, a diminution of revenues may lead public telecommunications operators to revise their investment strategies for fixed link networks, especially in the local loop. Thirdly, the mobile communications revolution brings

a number of new operators into the market in those countries which have licensed multiple mobile service operators in competition to PTO services.

These three trends – airwave competition, dilution of revenues and new market entrants – could easily be described as "divergence" rather than "convergence", but the question of semantics is of secondary importance. It is necessary to take as broad a view as possible of the future of the information industry when attempting to identify policy questions. In terms of technology forecasting, the key question is the extent to which mobile services will actually *compete* with fixed link services as well as *complementing* them. This issue is the subject of a separate OECD study, but it is convenient here to review some of the main technological developments.

2.5.1 Cellular radio

The basic principles behind the use of radio for inter-personal communications are well-established and specific closed user groups – such as emergency services, taxi services or the military – have long been users of mobile radio services. The provision of a mobile telecommunications service open to the general public was, however, delayed by a number of factors:

- Sophisticated computer technology is necessary for switching between frequencies and/or between cells and for squeezing as many channels as possible into the limited frequencies: such technology only became available in the 1970s;
- Frequency availability for cellular radio was limited until the World Administrative Radio Conference (WARC) of the ITU allocated a 25 MHz chunk of radio spectrum in the 900 MHz band for cellular radio in Europe in addition to space in the 450 MHz range;
- Microchip and battery technology was, until recently, a limiting factor on the size, portability, safety and usage time between recharging of mobilephones.

A commercial analogue cellular radio service, based on the Advanced Mobile Phone System (AMPS), was introduced in Chicago, USA in 1983 and a variant upon this, Total Access Communication System (TACS), was introduced in other countries shortly afterwards.

In Scandinavia, the Nordic Mobile Telephone (NMT) system has been operating since the early 1980s using the 450 MHz frequency, and latterly 900 MHz. The NMT consortium was a joint development between four Nordic PTOs and they have had some success in exporting the system elsewhere in the world, including Switzerland and Spain. Other European countries have developed their own analogue mobile systems including the Siemens-based C450 network in Germany and the Radiocom 2000 system in France which operates at 300 and 450 MHz.

Within Europe it is hoped that the shift to a digital mobile system will be achieved in the early 1990s with a great deal more unanimity on standards and with the aim of allowing mobile handsets to "roam" throughout Europe. In 1982, the CEPT (European Conference of Post and Telecommunications Administrations) established the "Groupe Spéciale Mobile" (GSM) to study the harmonization of the technical and operational characteristics of a pan-European digital cellular system at 900 MHz. The current plan is for a GSM to be introduced in Europe from July 1991 onwards. While a digital system is undoubtedly more efficient in its use of the spectrum (2-3 times more efficient) and will offer a higher quality, more secure system, it is clear that it will also be more expensive

in the short-term. Handsets may well be quite bulky initially until the chip technology becomes mature and the digital system may have to ''compete'' for spectrum with established analogue services. There is also a genuine question mark over whether existing users will be willing to junk their existing analogue handsets for an unproven technology. Finally, there is also the question of competition between digital cellular radio and other emerging radio technologies such as Telepoint and Personal Communications Networks (PCNs). These are discussed below.

2.5.2 Telepoint

Telepoint services, or more accurately 2nd generation cordless telephone services (CT2), have commenced operations in the UK where four service providers have been licensed, and are at an advanced planning or pilot stage in other OECD countries. Telepoint handsets are designed to be cheaper and smaller than cellular telephones and can be used within 100-200m of a base station, which might be at home or in a public place such as a railway station or post office. The service has yet to settle on an international standard though the ''Common Air Interface'' promoted by the Department of Trade and Industry (DTI) in the UK, and the DECT (Digital European Cordless Telephone) standard which is being defined by the European Telecommunications Standards Institute (ETSI) may go some way to solving incompatibility problems. The service is also crippled by the limiting factor that users can only make outgoing calls, cannot normally receive incoming calls from public base stations and cannot handover between base station zones.

The current experience of Telepoint in the UK shows it to be a commercial flop in comparison to the booming cellular radio market. Agreement on common standards and the development of new products such as a cordless PBX or a combined pager/telephone may help to relaunch the service. It may also be used more widely for in-company networks, but ultimately Telepoint should probably be regarded as a gap-filler product with a relatively short life-span.

2.5.3 Personal communications networks (PCN)

PCN technology, also referred to as a Universal Personal Messaging System (UPMS), combines elements of both cellular radio and Telepoint. The technology is still unstable, but it is likely that any future PCN service will be based on ''micro-cells'' of up to 3km in towns with ''macro-cells'' providing wide area coverage. The frequencies used will probably be higher than those currently allocated for cellular radio. In the UK, the frequency band from 1.7-1.9 GHz has been reallocated from TV use to PCNs and three operators have been licensed. They expect to start offering services in 1992. In the US, the FCC has indicated that at least some of the spectrum allocated for PCN should be in the 1.8-2.2 GHz range. It intends to begin the first phase of allocation in 1992.

PCN handsets should also be much smaller than those currently in use for analogue cellular radio. A PCN system will also call for a radical rethink of the numbering system in operation nationally. One option is to allocate a single transferable number to a person which can be used for his/her handset of choice rather than a separate number assigned to each terminal device.

2.5.4 Voice-mobile satellite networks

A yet more radical proposal is to create a cell network from narrowly targeted satellite beams. Motorola has proposed a global network of 77 low-orbiting satellites to provide an international telecommunications service. The ''Iridium'' project is proposed to become operational in 1996 but there are formidable technological, regulatory and financial problems to be overcome before then. A similar, if less ambitious, land-mobile satellite system has been proposed by Eutelsat for operation after 1994. The advantages of satellite networks would be particularly marked for areas of the world which are poorly covered by existing land-based services. Its viability in other areas of the world would depend crucially on tariff levels.

2.6 Technological scenarios

To conclude this Chapter, it may be argued that future trends in the information industry will be characterised by:

- *multimedia networks* using a hybrid of fibre, copper and wireless;
- *multi-service networks* carrying a selection of different services, possibly even from different service providers if regulations permit, over the same network;
- *multi-functional terminals* incorporating a variety of different computational, communicative, and visual functions in the same box.

In other words, it seems that the range of choices that determine how a service is packaged and delivered to users has been greatly widened. On the one hand therefore, technology continues to be a driving factor shaping market evolution in the information industry. On the other hand, it could be argued that technology is becoming less important as a limiting factor constraining innovation. Instead, it is other factors, such as pricing, quality, marketing and the level of demand which determine the success of new services. These factors are considered in the next Chapter.

Chapter three

SERVICE CONVERGENCE

3.1 Every home should have one

If the argument that broadcasting and telecommunications are converging was based solely on technological determinism, it would be very flimsy indeed. It must be shown also that there is a functional convergence in the way that the services are used, and a corporate convergence in the way that they are sold. Institutional barriers to convergence tend to be self-reinforcing in that service providers rarely attempt to offer new services which are genuinely innovative and often merely repackage what the customer already has in a different format. The fact that television and telephony have historically developed separately is the strongest argument to say that they will continue to develop separately in the future. There is a psychological separation of the two in the minds of users and distinctly different corporate cultures at the level of the suppliers.

The barriers to convergence are probably strongest in the residential market. The TV and the telephone are the two work horses of the communications industry and, along with printed media, are the two main "information feeds" into the home. Within OECD countries, TVs and telephone sets have reached a similar level of penetration of 51 and 64 per 100 inhabitants respectively.

Despite the data limitations in counting TVs and telephone sets (see Figure 3.1), it can be seen that there is a high degree of market saturation in both. Some countries appear to have more TVs than telephones (e.g. USA, Turkey), whereas others are over-represented by telephones (e.g. Sweden, Switzerland) compared to the OECD average. Both data sets are highly correlated with Gross Domestic Product ($R^2 = 0.95$ for TV sets and 0.98 for telephones) which suggests that, despite cultural differences in the way consumers express their preferences, ownership is still largely a matter of affordability and availability. This contrasts with cable TV and mobilephones, where penetration rates bare little relationship with GDP and reflect instead the historical evolution of services in different countries.

There are three possible ways in which the functional convergence of the TV and the telephone might be expected to take place:

- Convergence in the product itself (form);
- Convergence in the services received (function);
- Convergence in the way the services are transmitted and received (medium).

These possible outcomes are discussed below.

Figure 3.1. **TV receivers and telephone sets in OECD countries, 1989**

	TV receivers (thousands)	TV receivers per 100 inhabitants	Telephone sets (thousands)	Telephone sets per 100 inhabitants
Australia	7 800	46.4	10 430*	62.1
Austria	2 788	36.6	4 310	56.5
Belgium	3 258L	32.8	5 138	51.7
Canada	14 895	56.7	21 252*	81.0
Denmark	2 215L	43.2	4 398	85.7
Finland	2 390L	48.1	3 570*	71.9
France	18 459L	32.9	40 179*	71.5
Germany	29 577L	37.6	46 189	58.7
Greece	1 750L	17.4	4 522	45.1
Iceland	73L	28.9	161*	63.6
Ireland	826L	23.5	1 210*	34.4
Italy	14 687L	25.5	30 716	53.4
Japan	71 500	58.1	76 423*	62.1
Luxembourg	140	37.0	260*	68.8
Netherlands	7 000	47.1	10 094*	68.0
New Zealand	1 220	36.5	2 533*	75.8
Norway	1 700L	40.2	3 220*	76.2
Portugal	1 626L	15.7	2 485*	24.0
Spain	14 314	36.8	17 836*	45.9
Sweden	3 293L	38.8	8 444*	99.4
Switzerland	2 630	39.1	6 050	90.0
Turkey	9 000	16.3	7 467	13.5
United Kingdom	24 650	43.1	37 076*	64.8
United States	197 000	79.2	195 762*	78.7
OECD	432 791	51.0	539 725*	63.6

L Based on TV licenses and/or declared receivers.
* OECD estimate based on number of main lines.
Note: The data used in Figure 3.1 are not perfect. Many countries base their estimates of TV sets on those which are declared or licensed. This may be considerably less than the actual number of TVs which exist in the country. The statistic for telephone sets is also based on estimates in those countries where the sale and installation of telephone handsets has been liberalised. In these countries, the number of main lines has been used to derive an estimate of the number of handsets using ratios for the number of sets per main line in the country before terminal market liberalisation and/or in the OECD as a whole.
Sources: Adapted from data in the ITU Yearbook and the UNESCO Statistical Yearbook.

3.2 Videophone or phoney vision?

Both the TV and the telephone have changed considerably in form and performance over the last thirty years. The TV has moved on from black and white to colour and has gained improved picture quality and sound, a bigger picture and remote control. The telephone has extended its reach through automatic dialling, first at the local level and later at the long-distance and international level. It has gained touch-button dialling and some memory functions such as last number re-dial or stored numbers. The telephone has also gained portability through the cordless telephone and successive generations of mobile telephones from carphones, to handheld mobilephones, telepoint, PCNs (Personal Communications Networks) and to digital mobilephones.

However, the merging of the television and the telephone in the videophone seems still to be as far off as ever. Video-telephony has been at the top of the search and development agenda of telecommunications equipment manufacturers for many years and there have been numerous showcase trials of its abilities. However, despite the immense sums invested, the videophone is not yet a commercial reality.

The three main reasons put forward for the failure of the videophone are technical, economic and cultural. The technology for providing simultaneous transmission of voice and vision has long been available, but the necessary networks of high bandwidth cable will not be available nationally in OECD Member countries before the next century. Even then, there will still be the economic drawback that video telephony will carry a considerable price premium over voice telephony. Like all one-to-one communications products, there is a critical threshold of market size below which it will not take off. Finally there is the cultural reason that the videophone invades public perceptions of privacy.

There will be a limited niche market for videophones if they can be sold to particular groups, e.g. geographically divided families or businessmen working from home. In Japan, a slow-scan picturephone which refreshes the picture every 10 seconds or so has been successfully marketed to operate over conventional telephone lines. Similarly, in Europe there have been trial applications, such as in the "cabled city" of Biarritz in South-west France. However, it is likely that the videophone will not be a mass-market product for some years to come.

3.3 Service competition

3.3.1 Competition between TV services

Standard terrestrial TV services are now under competitive pressure from a number of different sources. The most evident is from video cassette recorders, through time-shift recording from TV, and through rental (and increasingly sale) of videos. Video cassette recorder ownership in OECD countries has risen fast and is estimated to be as high in Japan as 70 per cent of TV households (*Screen Digest,* Nov. 1988). For the OECD as a whole in countries where data is available, the rate of video ownership was 16 per 100 inhabitants, or 31 per 100 TV sets in 1989 (see Annex Figures C9 and C10).

Cable TV operators are also serious competitors to national TV stations in some areas of the OECD. They are generally able to offer a wider choice of viewing, in co-operation with conventional and satellite TV providers, and more modern systems may also be able to offer interactive services such as videotex or home shopping. Contrary to popular expectation that satellite television would be in direct competition to CATV, they have in fact complemented each other by widening the range of programming and extending the audience reach for each channel, at least in the UK.

In the OECD area, it is possible to recognise three types of countries: those which, for historical reasons, have a high level of national cable penetration of 50 per cent of TV households or more, including North America, Benelux and Switzerland. Secondly, those countries which have limited coverage of cable in some geographical areas such as big cities or remote areas not reached by terrestrial transmission. These countries include most of Scandinavia, the German-speaking countries and Ireland, and have a penetration rate of between 10-30 per cent of TV households. Thirdly, those countries which have no history of cable TV but which have launched plans or franchises for the development of

cable during the 1980s – with a mixed degree of success. These countries include France, the UK, Italy and Spain and generally have a penetration rate of less than 10 per cent at present.

A third form of competition comes from satellite TV operators which offer extra channels either direct to the home through Direct Broadcasting by Satellite (DBS) or through intermediate media such as Cable TV, Satellite Master Antenna TV (SMATV), Low Power TV (LPTV) or Microwave Multi-channel (Multi-point) Distribution Services (MMDS). In the short term at least, satellite TV operators are dependent on other distributors to be able to gain a start up audience and to generate a revenue flow. In the longer term, however, there is the possibility of the growth of a large consumer market for satellite dishes or Television Receive-only (TVRO) antennae, at least in those countries where either the number of channels is limited or where the density of cabled households is low. In Europe, experiments with using high-power DBS satellites to broadcast using the D/D2-MAC standard (an interim standard en route towards true HDTV) appear to have foundered for the time being following the merger between Sky and BSB in the UK and the technical problems experienced by TDF-1 and TDF-2 in France. It seems that the short term market message is that satellite TV should be used to give a wide choice of channels rather than a higher quality signal where these two aims are incompatible.

Finally, different forms of pay TV have been provided in competition to standard "free", advertising-funded or license fee-funded TV. Pay TV comes in a number of forms including via cable, encrypted terrestrial transmission or off-peak hours broadcasting. Apart from cable, pay TV has been fairly limited in success, especially in those countries which have no shortage of "free" channels. However, some pay TV operators such as Canal Plus in France have found a profitable niche in providing first-run movies, major sports events or "adult" entertainment.

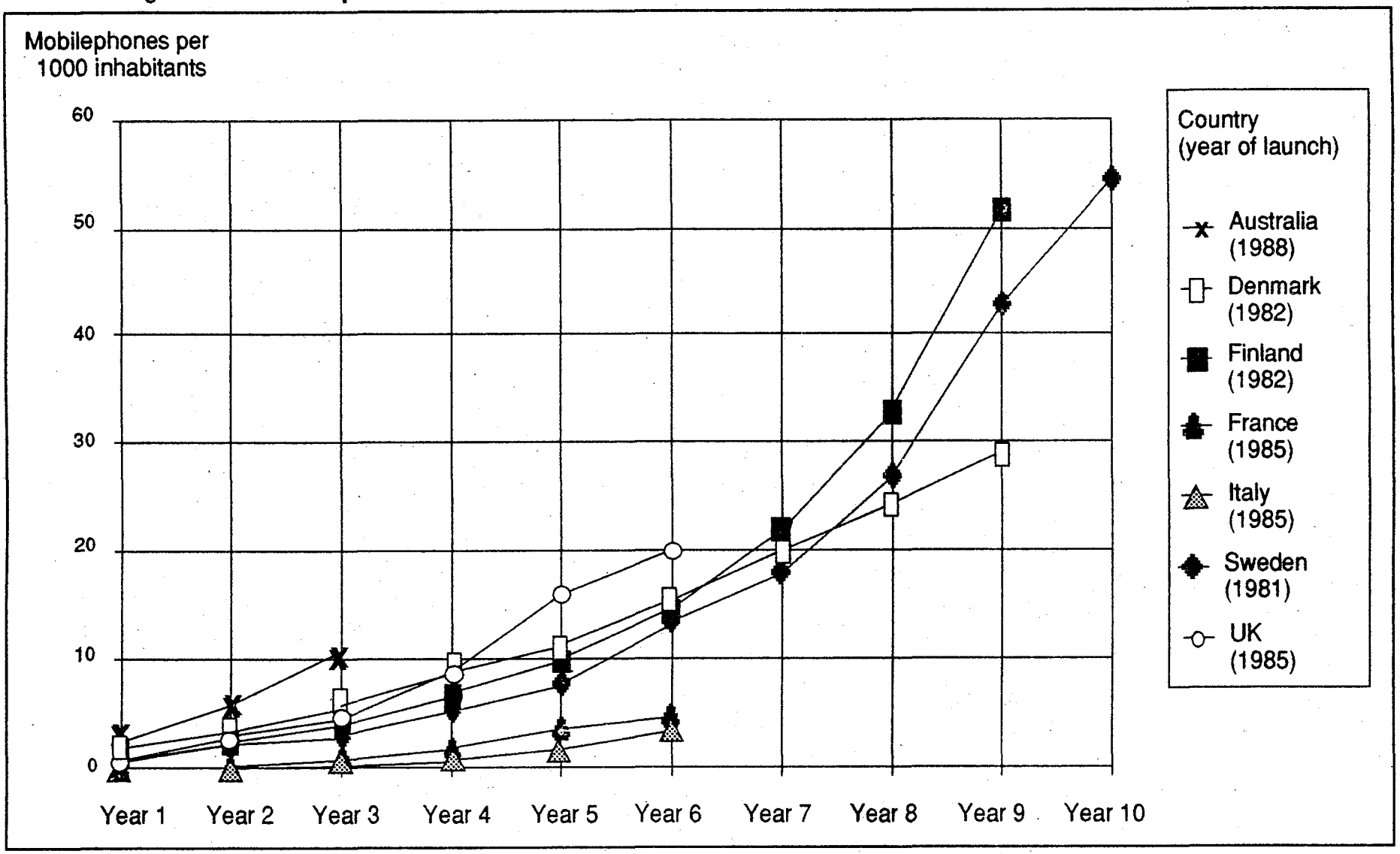
3.3.2 Competition between communications services

As with broadcasting, communications services can be delivered to the home via satellite, terrestrial, cable or physical means. In the case of the latter, postal services have generally been viewed as being complementary rather than competitive with telephony, and only latterly with the development of text-based services such as fax, electronic mail or electronic data interchange (EDI), has real competition emerged between postal and telecommunications services.

Traditional telephony has generally been delivered to the customer via the Public Switched Telephone Network (PSTN) by land lines, usually twisted pair, though 4-wire cable is used in some countries. Apart from fax and dial-up use of PC communications, most data communications are conducted over specialised data networks such as the telex network, public data networks (e.g. packet-switched or circuit-switched) or leased lines. The promise of the Integrated Services Digital Network (ISDN) is to unite all these different networks and services in a single customer interface, though at present the prevailing trend is towards specialisation of services based on customised software rather than integration of service offerings based on a single hardware interface.

The major competition to fixed-link telecommunications networks comes from mobile telephony (see Figure 3.2 and Annex Figures C5 and C6) in a variety of forms. Most OECD countries have now established cellular radio services, many of which compete directly with established PTO services. Levels of penetration are highest in

Figure 3.2 **Mobile penetration rates since launch of service, selected OECD countries, 1981-1991**



Source: OECD, Adapted and updated from Austel, 1990.

Scandinavia, where the services are longest established, but are rising everywhere. As the graph in Figure 3.2 shows, the Nordic model of slow start-up and rapid expansion after three or four years is echoed in other countries. Australia and the UK have shown rapid early growth due to the practice of using air time revenues to subsidise handset and connection costs. Other countries, such as France and Italy, have shown a slower initial start-up which might be ascribed to lack of frequencies, higher connections costs for users and non-standard technologies. Nevertheless, even here growth has accelerated recently.

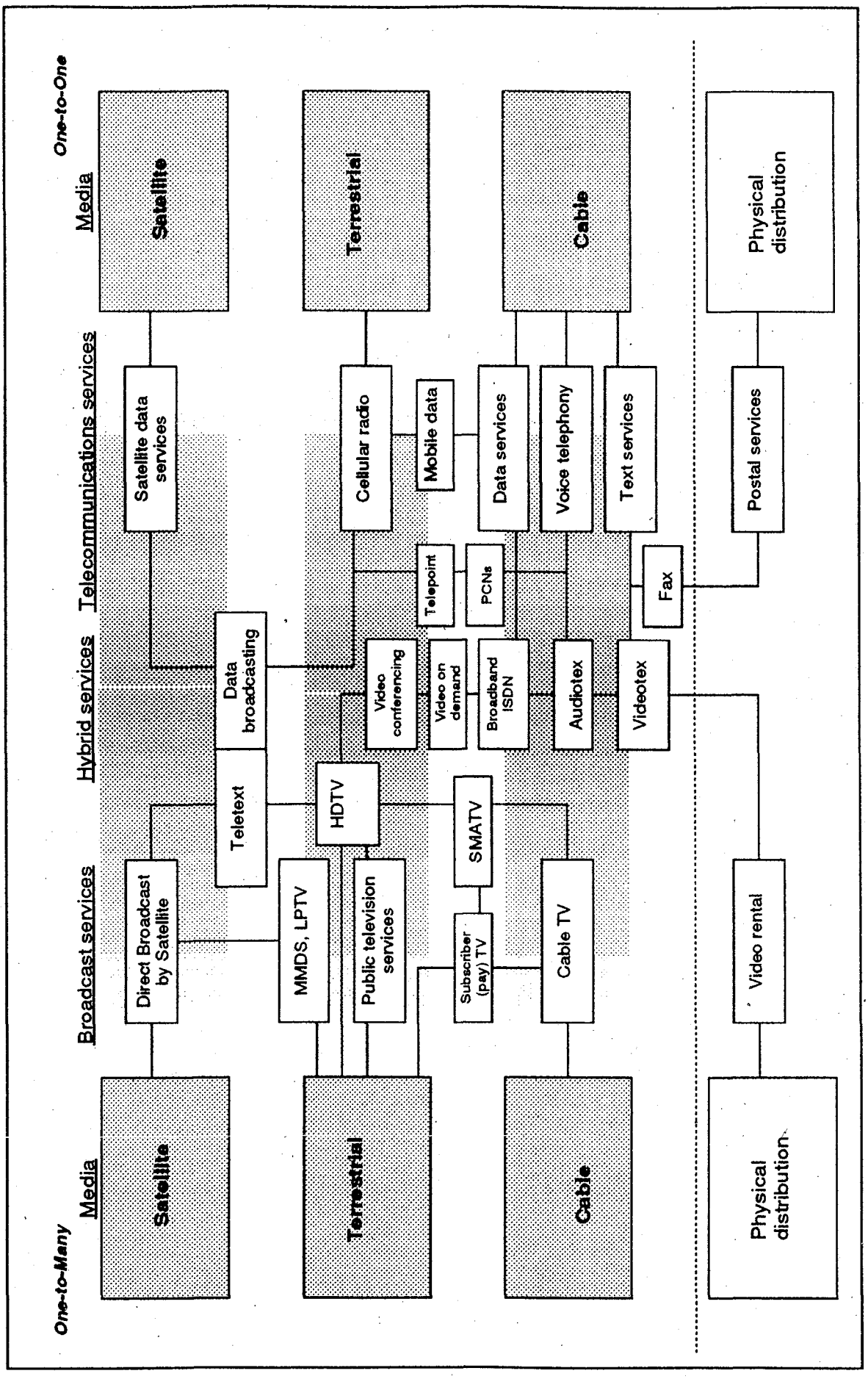
As discussed in Chapter two, the prospective mobilephone user is presented with a complex technological choice between existing and imminent services. Several countries have announced licensees for a number of different mobile services including Telepoint, Personal Computer Networks and Digital Mobile Radio as well as cellular radio and paging. Some forecasts show that, taken together, mobile communications handsets will rival standard telephones in number when the market is mature and that, by the year 2000, 60 per cent of all calls will include some mobile or cordless components (Austel 1990, quoting estimates from Telecom Australia). However, at present the cost of a mobile call is, on average, some four times the cost of an equivalent PSTN call so that mobile services must still considered as complementary rather than competitive to the PSTN. Nevertheless, the overall trend is downward as the technology matures and the initial investment costs are amortised. In Denmark, for instance, the fixed charges for the cellular radio service (connection and rental) are actually lower than for the fixed-link service.

Finally, telecommunications services can be delivered to the customer via satellite or microwave, either passing through or by-passing the public switched telephone network. Satellite services were once seen as the greatest threat to PTO services in that they offer large firms the possibility to set up their own private networks using VSATs (Very Small Aperture Terminals) with flexible and rapid possibilities for changes in configuration. In fact, this threat of cream-skimming has never really materialised, partly because the infrastructure of fibre optic cable and its associated cost structure presents a much more attractive and cost-effective option than satellite links, especially on the transatlantic route; but mainly because regulators have disallowed the construction of private facilities in most OECD countries. The CEC Green Paper on satellite technology (CEC, 1990), together with the reduction in the price and size of receivers and the tie-up with mobile technology, may lead to a new growth phase in the provision of voice telephony by satellite.

3.4 Hybrid services

The arguments presented above might be summarised as fragmented services provided over multiple media. In the last few years, a number of hybrid services, which sit between the traditional domains of telecommunications and broadcasting, have been added to this picture (see Figure 3.3). At present these services are at an early stage of their development and some may not progress beyond this, but nevertheless they challenge conventional notions of regulation.

Figure 3.3 **A taxonomy of broadcasting and telecommunications services**



3.4.1 Data broadcasting

The most extensive category of hybrid service is data broadcasting. This term is principally used to denote the transmission of data to specially adapted TV sets or other terminals using the vertical blanking interval in TV broadcasts. During the course of the 1980s, "teletext" services have been established in most OECD countries such as Antiope in France, Videotext in Germany or Ceefax, Oracle and 4-tel in the UK. One of the most extensive services is in Switzerland where an independent company, Teletext Suisse SA, broadcasts up to 1 000 pages of information, including advertising and sponsored pages in three languages. The capacity of conventional TV channels is around 256 kbit/s for data but more advanced broadcasting technologies, such as the MAC (Multiplexed analogue component) family of standards raise this to around 1 Mbit/s.

In addition to teletext, other data broadcast services are provided via sub-carrier or sideband radio channels, via specialised satellite services and via broadcast paging services. In general, these services are offered to specially-adapted terminals and/or are delivered in encoded format to closed user groups. Applications provided via data broadcasting include educational computer software programmes, sports results, share prices and other business information. Some analysts view data broadcast services as evolving to provide an electronic newspaper with specific topics selected by the reader. Commercial development of data broadcasting has been slow, partly because of the lack of terminal equipment but also because of regulatory barriers to the use of satellite services in many OECD countries. As two-way point-to-point satellite services are liberalised in more OECD countries, and as the price of VSAT satellite dishes falls for both telecommunications and television use, then point-to-multipoint data broadcast services should increase their public profile.

Given the range of diverse forms of data broadcasting, including public service broadcasts, it is difficult to put together estimates of market size. Mulgan (1990) estimates that the UK market was worth more than £100m ($170m) in 1989, though he notes that the UK is probably ahead of other European countries in market development.

3.4.2 Narrowcasting

Satellite broadcasting is also used for closed user group television, for instance, for in-house business meetings or for education. In the US, there is a large market for live business television and in Europe a number of companies, such as BSB Datavision, have been set up to provide similar services. Closed user group broadcasting for education is more limited in scope and experimental in nature. In Europe, for instance, the Olympus high power satellite has been launched for use by schools and universities in several European countries. Closed user group broadcasting can also be provided by cable TV, closed circuit TV or "off-air broadcasting", i.e. broadcasting during night hours and primarily intended for TV receivers equipped with videocassette recorders. However, it is difficult for live broadcast television to compete on price with video for such specialised purposes.

Closed user group broadcasting might be viewed as a particular subset of "narrowcasting". Narrowcasting differs from broadcasting in that TV programmes are targeted at a specific audience rather than being intended for general entertainment. The audience might be self-selective, for instance, viewers may choose to watch a particular specialised programme, but in a more pure sense it is the broadcaster who selects the audience, for instance, by broadcasting in a particular language or by encrypting the broadcast. The use

of the ASTRA satellite to broadcast programming in Japanese to the estimated 200 000 Japanese nationals living in Europe is an example of narrowcasting.

3.4.3 Interactive services

The third category of hybrid services are those which involve the two-way transmission of image-based services. These services may be classified according to the volume of data needed to create each screen and the rapidity with which each screen is refreshed.

At the bottom end of the scale is videotex, such as provided over the French Minitel, the German Bildschirmtext or the US-based Prodigy system operated by IBM and Sears. These typically offer a mixture of text plus graphics with low-level animation. These services generally operate over standard telephone lines for subscriber links. Data is transmitted from information providers to user terminals at speeds of 1 200 bits per second and higher, and alphanumeric text can be transmitted back from the user at speeds of 75-300 bits per second.

A number of different systems exist in OECD Member countries (see *Videotex Development Strategies,* ICCP Series No. 16, OECD, Paris, 1988) and are often incompatible with each other. However, none have reached the same level of market development as in France, where small black and white Minitel terminals have been provided free to residential subscribers for use with electronic directory services, thus creating an instant user base. The French system is used for a number of different applications such as messaging, database inquiry, bulletin board, reservation systems, home banking, advertising and recently electronic mail integrated with the postal system. A close link has been established between television and Minitel services through audience participation in TV programmes, and audience response to advertisements including direct selling by TV.

In terms of functionality, the next stage up from videotex is towards systems which provide a low-resolution picture image with a slow screen-refresh time. Applications in this field have the advantage that they can run over conventional telephone lines or low-speed leased lines. However, there is a certain psychological resistance amongst users who are accustomed to seeing full-motion TV standard pictures. Applications which have been developed so far include still-picture videophones, photo-videotex, used for instance by estate agents transmitting pictures of properties between branches, and slow-scan video for security purposes or remote monitoring. This last application can also be provided at the local level on a site such as a factory, hospital or university campus over a broadband local or metropolitan area network (LAN/MAN). Such applications are growing, especially in the manufacturing sector where fibre optic backbone networks allow for integration of command and control systems with image-based application.

At the top of the hierarchy is interactive full-motion video which requires high bandwidth cable, usually fibre optics, or alternatively a dedicated satellite link. Most applications which use interactive video offer full service in one direction but limited services in the opposite direction. For instance, in remote learning applications, only the teacher requires full-motion video and the pupils can respond via voice-lines or a fax link. Similarly in narrowcast or closed user group broadcasting applications such as might be used within a business for informing shareholders and employees, pictures can be transmitted from one location with questions taken by voice from multiple locations.

The growth of the market for genuine two-way video-conferencing has been limited by prohibitive costs, and technical constraints. Furthermore, those business executives

whose time is sufficiently valuable to justify video-conferencing are usually not technically competent to make full use of the facilities, or unwilling to substitute video meetings for business travel and its associated perks. There is probably a large potential market for video-conferencing providing the installation and service costs can be reduced and providing businesses can take a more imaginative approach to cost-justifying its use at more junior levels of management.

Like many new services, video-conferencing was initially treated with great enthusiasm by the press and widely optimistic market forecasts were produced. When these forecasts proved unfounded and when a number of new market entrants went out of business, it then became fashionable to criticise video-conferencing as proving to be a commercial flop. The subsequent steady growth of video-conferencing applications has generated less excitement to users, but greater revenues. It is clear that video-conferencing is slowly becoming more cost-effective and attractive to users, especially as data compression technology has reduced the bandwidth requirements and now that user-expectations are more modest.

3.5 Service innovation

3.5.1 Audiotex

The theme of functional convergence is marked not only by the development of new ''hybrid'' services but also by innovation in the way in which existing services are commercially exploited. Perhaps the most striking example of this is the growth of so-called ''audiotex'', or value-added voice services. Audiotex is similar to videotex in that information providers are supplying database, messaging and bulletin board services but via voice rather than visual means. Audiotex suppliers begin from the starting point of a ready-made installed base (the public telephone network) and a service (voice telephony) with few psychological barriers to usage, unlike videotex suppliers which must not only create a user base but also educate it. Consequently audiotex suppliers have very low market entry costs and the growth of the market, while largely uncharted, has been quite spectacular in those countries where the service is allowed. The FCC (Federal Communications Commission) estimates that the US market was worth around US$600m per year in 1989 and is expected to grow to US$1 billion by 1991.

Applications of audiotex include sports results, financial market services, shareholder information, chat lines, quiz competitions and ''adult'' services. The services are paid for by a premium rate tariff which benefits both the network provider, through increased traffic, and the service provider. In some cases, services which had previously been provided as public information (e.g. rail timetables, weather forecasts, time checks) can now be self-financing or even profit-making.

3.5.2 Toll-free telephone services

The provision of toll-free telephone numbers, also referred to as ''800 numbers'' or ''green numbers'', is another example of a service innovation, this time bringing together telecommunications and advertising. The principle, behind toll-free calls, that the receiver of the call pays rather than the sender, is very simple but the potential applications, when combined with computerised customer information databases, can be quite sophisticated. Toll-free calling provides a powerful marketing tool and the trend towards

quoting toll-free numbers in TV advertisements provides a further example of the growing overlap between the television and the telephone.

3.5.3 Off-talk communications

A specific form of communications service which has been developed in some countries, notably Japan, is the one-way broadcast of information over telephone lines connected to a speaker when they are not in use. The Japanese service "Off-talk communications" is provided by NTT (Nippon Telegraph and Telephone) mainly in rural and remote areas. It is paid for by agricultural or fishery trade associations or by local government to broadcast public information such as weather forecasts, crop prices, storm or earthquake warnings. In a variation on this general theme, some off-talk services, such as weather forecasts, are now also provided to fax terminals. In other countries, such as Switzerland where the topography limits over-the-air broadcasting, telephone lines are used for radio and music broadcasts.

3.5.4 Telesales and junk fax

A rather less welcome form of service innovation is the use of telecommunications facilities for advertising and direct selling, both via the telephone (telesales or cold-calling) and the fax (junk fax). As Figure 3.4 shows, advertising in the OECD is now a US$210 billion plus business and spending on TV advertising in some countries, such as the US, is more than $100 per person per year. Advertising by television accounts for nearly a quarter of all advertising but suppliers are constantly searching for new ways to reach potential clients, especially in highly-targeted product or service markets. For this reason, advertisers are increasingly using one-to-one selling techniques, despite the much higher cost.

One proposed form of advertising, which might be used via telecommunications networks, is to broadcast recorded messages with brief advertising slogans during the set-up phase of a call. Advertising is already inserted into the hold message broadcast on many in-company PBX networks. It could also be used on public networks as call camp-on (holding the line until the engaged party is free) or call queuing facilities become more widely used. It would be imperative however for potential advertisers to overcome the nuisance value of such advertising. This could be done by giving subscribers who agree to receive advertising a reduction in their rental charge. This would have a parallel with advertising-funded television.

Telesales to business is already widely used, for instance by newspapers selling advertising space, but it is now being introduced for selling directly into the home. A particularly insidious form uses computerised messages sent out during the evening with the responses of potential clients being recorded for follow-up. Despite the well-developed laws preventing telephone-tapping, few countries have restrictions on the invasion of personal privacy through telesales, though "sugging" (selling under guise, e.g. market research) is banned in some countries.

Selling by junk fax imposes more than just an inconvenience because it actually consumes the unwilling receiver's expensive fax paper and may block the line for important incoming calls. Given the ease with which fax terminals with memory functions can poll and broadcast messages to hundreds of other machines simultaneously during off-peak hours, junk fax will undoubtedly grow in usage. In some American states, junk fax is banned, though in others the principle of free speech is upheld.

Figure 3.4. **Total advertising and TV advertising expenditure, in OECD Member countries, 1988**

	Total advertising expenditure (US$m)	TV advertising expenditure (US$m)	Per capita (US$)	TV as percentage of total
Australia	3 475.0	1 151.2	69.6	33.1
Austria	762.7	201.8	26.6	26.5
Belgium	1 173.4	124.5	12.6	10.6
Canada	6 058.8	1 014.1	39.1	16.7
Denmark	791.9	11.9	2.3	1.5
Finland	1 765.6	174.0	35.2	9.9
France	6 936.5	1 705.6	30.5	24.6
Germany	11 750.1	1 044.4	17.0	8.9
Greece	299.2	132.7	13.3	44.4
Iceland	n.a.	n.a.	n.a.	n.a.
Ireland	233.9	73.1	20.7	31.3
Italy	5 051.5	2 416.3	42.1	47.8
Japan	34 471.3	10 330.9	84.3	30.0
Luxembourg	n.a.	n.a.	n.a.	n.a.
Netherlands	2 562.5	257.5	17.4	10.0
New Zealand	627.1	188.9	56.8	30.1
Norway	761.9	7.7	1.8	1.0
Portugal	240.9	120.0	11.6	49.8
Spain	5 880.3	1 384.2	35.5	23.5
Sweden	1 494.0	n.a.	n.a.	n.a.
Switzerland	1 972.9	131.2	19.7	6.7
Turkey	n.a.	n.a.	n.a.	n.a.
United Kingdom	12 076.0	3 789.0	66.4	31.4
United States	118 150.0	25 686.0	104.3	21.7
OECD (countries)	216 535.5 (21)	49 945.0 (20)	65.5 (20)	23.2 (20)

n.a. : Not available.
Note: The numbers in brackets show the valid number of countries for each column.
Source: World Advertising Expenditures (23rd edition), Starch INRA Hopper Inc and IAA.

Recently Congress passed a bill that would regulate junk fax for the first time. The bill has been sent to the Preisident for his signature. Other countries are considering legislation or codes of practice but the difficulty will be in enforcing such a law and defining the distinction between genuine information (e.g. change of address, new product announcements, price lists) and advertising.

3.6 Multi-service media

The argument for service convergence lies not in the merging of consumer terminal *equipment,* though that may eventually come, but rather in the nature of the *services* provided and the *medium* by which they are conveyed to the customer. Thirty years ago it was possible to think of both television and telecommunications as services which were almost defined by the medium of delivery. Where the prevailing geography permitted,

television was transmitted by terrestrial "over-the-air" means in most areas, and telephony was conveyed by fixed lines. Both television and telephony began as a public service, provided by a monopolistic organisation in most OECD countries though not the USA. The roles of each were fairly clearly defined: television to broadcast educational material and entertainment to the general public; telephony for private, personal and business conversations.

For better or for worse, this philosophical homogeneity has now been lost. First television and latterly telecommunications services, have been provided on a commercial basis by competing service providers. The role of the state has greatly diminished, especially in Europe. The range of services offered has multiplied both by diversification of the means of delivery and by the development of hybrid services. Furthermore there is now a considerable overlap between the traditional functions of telecommunications and broadcasting with the former carrying more advertising and entertainment while the latter is being used for closed user group broadcasting or "narrowcasting" to business users.

In summary, therefore, attempts to separate the two domains of telecommunications and broadcasting which are based upon the transmission medium they use, the content of the message, or the fact that the communication is interactive (two-way) or passive (one-way), can no longer be sustained. As will be discussed in Chapter six, this has important implications for the way in which the two services should in future be regulated. Before then, however, it is necessary to look at the third type of convergence, corporate convergence – that is the trend towards cross-ownership and cross-provision of services by the same company.

Chapter four

CORPORATE STRATEGIES

The argument for convergence developed thus far has concentrated on technical trends and newly-emerging service markets. The third component of the argument is based on the overlap in the activities of individual firms (corporate convergence). Evidence for the cross-ownership of firms active in both the telecommunications and broadcasting fields, or for the cross-provision of telecommunications and broadcasting services, is relatively weak. Indeed, the natural constituency of telecommunications firms seems to be to form alliances with computer firms while broadcasting organisations often have ties with newspapers, publishing houses or other information services firms. The gap between telecommunications and broadcasting is indeed wide and is reinforced by regulatory barriers limiting the degree of cross-ownership in a number of OECD countries. Furthermore, the corporate culture of telecommunications companies tends to be technically-oriented while broadcasting organisations recruit widely from liberal arts and business graduates.

The argument for corporate convergence is therefore based on the potential for what *might* happen if regulations were relaxed, in terms of joint ventures, alliances and takeovers, rather than the current existing situation. The arrangement also depends on the existence of synergy between the two sectors such that firms operating in both might gain benefits from economies of scope and scale or from commercial spin-offs. At present, the case remains unproven. In order to investigate the evidence for corporate convergence, this Chapter examines firstly the revenue structures of the two industries; secondly, the competitive positioning of the leading players; and, thirdly, some examples of diversification strategies with profiles of selected ''converged'' companies formed through cross-sectoral alliances.

4.1 Revenue structures for broadcasting and telecommunications operators

In general terms the major difference between the revenue structures of public broadcast and public telecommunications operators is that the former are indirectly funded while the latter are directly funded. In other words, TV services are paid for mainly through advertising revenues and from license fees whereas telecommunications services are paid for directly by the user. What is common to both sectors, however, is a diversification of revenue sources and a broader base of funding. For instance, the broadcasting industry as a whole is now gaining more of its revenue from direct user payment (e.g. pay-per-view TV, video rental, cable) while the telecommunications indus-

Figure 4.1 **Revenue structures for the public telecommunications services industry in OECD countries, 1988**

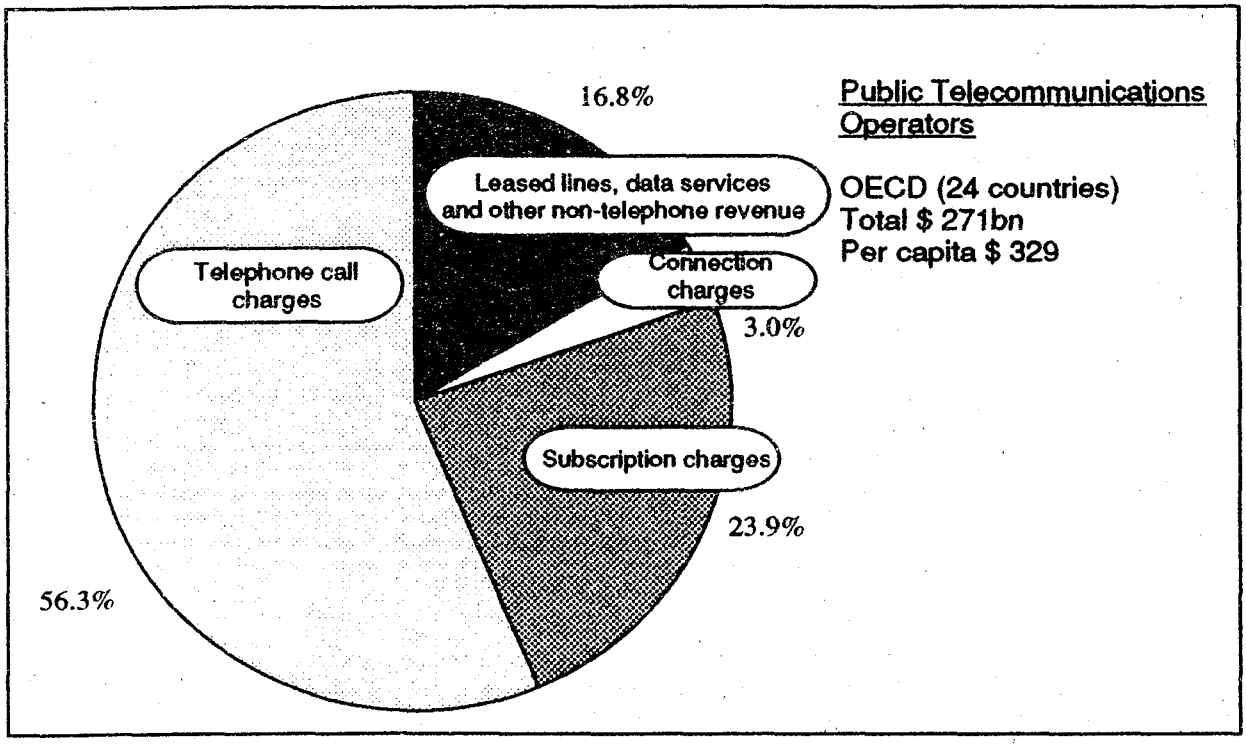
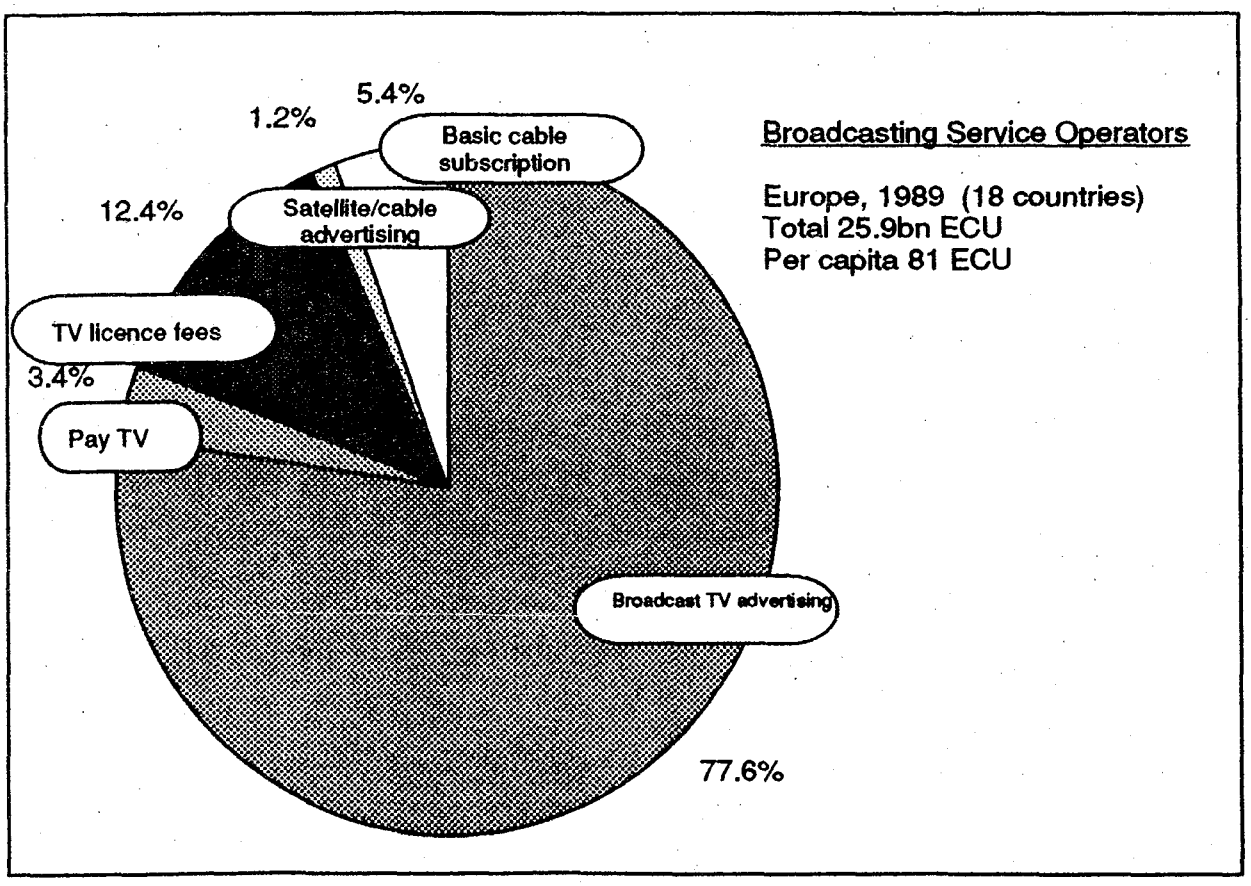


Figure 4.2 **Revenue structures for the public broadcast services industry in Europe, 1989**



Source: Adapted from ITU Yearbook and European Institute for the Media estimates.

try is gaining more revenue indirectly from third-party service providers, access charges and from flat-rate tariffing of services (e.g. for leased lines or packet-switched data networks).

It is difficult to collate accurate, comparative data on the revenue structures of the telecommunications and broadcasting industries and therefore the numbers quoted in Figures 4.1 and 4.2 should be taken as illustrative rather than definitive. The actual amount spent per capita in EC countries on broadcasting services was around ECU 81 per year in 1989 (US $73.5), of which 53 per cent came from advertising. This compares with the estimate of $329 per year spent by consumers in all OECD countries on public telecommunications services in 1988.

Clearly, then, convergence is not a merging of equal partners. However, if one takes standard voice telephony, which still accounts for more than 80 per cent of the revenues of the PTO in most OECD countries, out of the equation, then the comparison is more balanced. Non-voice telecommunication services grew by 15 per cent in gross terms between 1978-88 compared with a growth of just 8.6 per cent for voice telephony. Within the broadcasting sector, according to the figures compiled by Logica and Screen Digest (Renaud, 1990), revenues from advertising have been growing by 21.7 per cent per year, compensating in part for slower growth from TV licenses and state subsidies (6.1 per cent per year) which has been barely above the rate of inflation. The fastest growing parts of the broadcasting sector are subscription TV, growing by 76 per cent per year (though not necessarily yet profitable), and cable subscription revenues growing by 32 per cent per year.

4.2 Competitive positioning

It is useful also to look at the competitive positioning of the major players in the broadcasting and telecommunications industries. As Figures 4.3 and 4.4 show, the top ten leading firms in the media industry are, on average, only one fifth of the size of their counterparts in the telecommunications services sector. These estimates accord with the proportions shown for the approximate size of the two industries in Figures 4.1 and 4.2. Furthermore, the top ten suppliers in the telecommunications services sector are more specialised in the sense that they gain, on average, 90 per cent of their revenues from services provision. By contrast, the ten leading media suppliers gain only 40 per cent of their revenue from the broadcasting industry, broadly defined (TV, radio, cinema).

The natural alliance of broadcasting services suppliers appears to be with the newspaper publishing and recording industry (NTIA, 1990), at least in those countries where there are no "line of business" restrictions on cross-ownership of publishing and broadcasting interests. Relatively few of the companies in the field of broadcasting services have interests also in telecommunications, though a number of companies offer electronic database information services, specialised satellite services or value-added network services.

Among the top ten telecommunications services suppliers listed in Figure 4.3, most of the companies have regulatory barriers which limit the extent of their involvement in broadcasting or other information services provision. The US Regional Bell Operating Companies (RBOCs) for instance, were until recently prevented from providing certain information services in the US, under the AT&T Consent Decree sometimes referred to

Figure 4.3. **Top ten media services companies, 1987**

Rank	Company	Origin	Media sales (US$m)	Press, publishing recording (%)	Radio-TV Cinema (%)
1.	Time/Warner	US	7 597	56	44
2.	Capital Cities/ABC	US	4 440	23	77
3.	Bertelsmann	Germany	3 689	54	18
4.	News Corp.	Australia	3 404	49	51
5.	General Electric	US	3 165	0	25
6.	Gannett	US	3 079	88	12
7.	Times Mirror	US	2 994	85	11
8.	Gulf & Western	US/Italy	2 904	37	63
9.	Yomiuri Group	Japan	2 848	63	23
10.	CBS	US/Japan	2 762	0	100
Top ten			36 931	52	40

Figure 4.4. **Top ten telecommunications services suppliers, 1987**

Rank	Company	Origin	Services sales (US$m)	Total sales (US$m)	Services as a % of total
1.	NTT	Japan	40 926	40 926	100
2.	ATT	US	23 292	33 598	70
3.	Deutsche Bundespost	Germany	21 185	28 960	70
4.	France Télécom	France	16 650	16 650	100
5.	British Telecom	UK	16 598	17 344	96
6.	Bell South	US	12 269	12 269	100
7.	Nynex	US	12 084	12 084	100
8.	GTE	US	11 794	15 421	76
9.	Bell Atlantic	US	10 298	10 298	100
10.	STET	Italy	9 737	12 519	78
Top ten			173 393	200 069	87

Source: UNESCO World Communication Report, 1989

as the Modified Final Judgment (MFJ). In July, 1991, the US federal district court issued a ruling lifting this ban, but stayed its ruling pending appeal. The stay, however, was vacated on 7 October 1991 thereby lifting the ban against allowing the RBOCs to provide information services. The appeals process is likely to take several years. Under previous decisions of the court, RBOCs could provide transmission of information services generated by others, such as so-called information service gateways and voice mail services. Pursuant to the US Cable Act (1984), telcos are prohibited from engaging in cable television operations within their service area. However, there is nothing in the Commission's Rules or the MFJ which would otherwise prevent Bell Companies from being common carriers for other programmers. The Rules only prohibit Bell Companies from originating and selecting programming. The MFJ is not presumed to prohibit RBOCs from being common carriers for such programming. In addition, the Bell Companies have taken steps towards becoming involved in cable TV provision in the UK where the joint provision of TV and telephony services is permitted. This is discussed in the next section.

The degree of involvement in broadcasting services of the major European PTOs, listed in Figure 4.4, varies considerably. France Télécom is involved both in the laying of cables, where it is a shareholder in many cable TV companies and plays an active role in the French Government's Plan Câble, and in the provision of satellite TV services, through TDF-1. The Deutsche Bundespost (DBP) is also the main provider of cable in Germany and plays a crucial part in realising the project of creating a broadband national grid. In the UK, British Telecom is prevented from providing cable or satellite services over its main network and this prohibition is likely to last until at least 1997 (DTI, 1990). However, until recently, BT played an active role through subsidiaries in ownership of cable TV franchises and it markets transponders of the satellite TV company, SES-ASTRA.

The pressure for corporate convergence is perhaps more likely to come from the equipment supply part of the industry rather than from service providers. Many of the leading suppliers of electronics hardware, notably the Japanese majors, have vertically integrated structures which stretch from the production of microelectronic components through computing and communications to consumer electronics. For these companies the possibility of new hybrid services, such as HDTV, data broadcasting, video-conferencing, cellular radio or multimedia, is a major opportunity to launch new product ranges and to inject new growth into saturated product markets.

In both Japan and Europe the major consumer electronics suppliers, such as Sony, Toshiba, Hitachi, Philips or Thomson, have been the main driving force behind the development of HDTV. In the US, it is the military equipment manufacturers which have played an active role in lobbying the government for R&D support. Only in Japan, however, have broadcasting companies shown themselves to be equally committed to the idea of HDTV. The lack of movement from the broadcasting services suppliers may lead to the hardware manufacturers themselves moving into services provision. Much has been made, for instance, of the acquisition by Sony of the recording interests of CBS and latterly Columbia Pictures, or the involvement of Philips in the second Dutch TV channel RTL Véronique. Equally, a close link has developed between some satellite dish manufacturers such as Amstrad or Matsushita and the service providers. Perhaps in the future the consumer electronics manufacturers and programme makers will form strategic alliances in the communications industry similar to those between hardware manufacturers and software houses in the computer industry. If this trend becomes a reality then it will

certainly force the pace towards multimedia integration in the electronics industry as a whole.

4.3 Globalisation and diversification

Two salient trends which will continue to characterise corporate activity in the information sector during the 1990s are globalisation and diversification. In this context, globalisation might involve cross-border investment to secure participation in firms and subsidiaries in several different countries and continents. Diversification implies entry into a number of different lines of business across the information sector. Both can be accomplished through acquisitions, alliances and new ventures, to gain new geographical and cross-sectoral coverage. Both have the same ultimate end in mind – namely, profitable growth through exploiting economies of scope and scale. Often both globalisation and diversification occur in tandem. For instance, a firm which has a fixed link network in one country may invest in a mobile communications network in other countries. At least one RBOC (Bell Company) has done precisely this. Such international venturing is an important part of the process towards corporate restructuring. Where a company's activities encompass several countries, the position of national regulators and policy-makers could be affected. For this reason, it is worth examining the processes of globalisation and diversification in more detail through a number of examples.

4.3.1 Cross-border media investments

Within the broadcasting, publishing and entertainment (mass media) sector, there has been a trend towards the emergence of international conglomerates (NTIA, 1990). Examples might include:

- *News Corp.*, registered in Australia and 45 per cent owned by Rupert Murdoch, has newspaper and magazine publishing interests in Australia, UK, USA and Hong Kong; TV station interests in the US (Fox Broadcasting) and Europe (British Sky Broadcasting), the 20th Century Fox film studio in the US, and publishing holdings throughout the world, principally through HarperCollins Publishers.
- *Sony Corp.* registered in Japan, is still best known for its range of video and audio consumer electronics equipment including colour TVs, VCRs, Walkmen and CD players, but has recently made important acquisitions in entertainment services in the USA including the recording interests of CBS and the TV film and cinema company Columbia Pictures Entertainment. Sony also manufactures telephones, notably in the US.
- *Time-Warner Inc.*, which was formed in the 1989 through the merger of Time Inc. and Warner Communications, combines an international array of publishing and entertainment interests including Time magazine, Warner Bros. TV Productions, American TV and Communications Corp. (Cable TV), Home Box Office and Atlantic Records.
- *Fininvest,* registered in Italy which is the investment vehicle for the Berlusconi Group, has important TV station holdings in Italy (Italia 1, Canale 5 and Rete 4) plus film and TV studios in Spain.

To this list of emerging international media giants, one could add names such as Bertelsmann, Hachette, Axel Springer, Capital Cities/ABC, Yomiuri Group and many others.

4.3.2 Cross-border telecommunications investment

Examples of cross-border investment in the telecommunications services industry are less numerous but have been increasing recently following the privatisation and/or sell-off of several national PTOs, market opening moves in Central and Eastern Europe and elsewhere, and the growth of cellular systems. A few examples are listed below:

- *AT&T,* registered in the US, is one of the world's largest supplier of telecommunications equipment and, after NTT of Japan, the second largest provider of telecommunications services. Following the divestiture of the Regional Bell Operating Companies in 1984. AT&T has followed a strategy of diversification and expansion of international activities. In computing, it ranked 17th in the world according to the Datamation 100 1990, listing before its planned take-over of NCR. AT&T's international expansion includes joint ventures in equipment manufacture with Italtel and Philips, the take-over of ISTEL, a UK-based network services company, and investments abroad by AT&T Microelectronics. Through its Global Messaging Service, AT&T is now offering a value-added network service directly in a number of countries including the UK and Canada.
- Most of the US RBOCs now have activities outside the US. By way of example, *Pacific Telesis* has interests in consortia to provide mobile communications services in Germany (Mannesmann Mobilfunk GmbH), the UK (British Aerospace consortium for PCNs) and Thailand (PacLink paging service). Through PacTel Cable, it holds interests in a number of Cable TV franchises in the UK and it intends also to offer local telephony services through those companies. Pacific Telesis also has interests in an international Japanese carrier, IDC, and a Korean VAN service provider.
- *British Telecom,* registered in the UK, has expanded its interests in North America through the purchase of a controlling stake in Mitel (PBX manufacturer), its acquisition of Dialcom (electronic mail company) and Tymnet (X.25 packet switching carrier), and a minority shareholding in McCaw Cellular Communications. BT also has operations in a number of South-East Asian countries, notably Thailand and Malaysia.
- A number of countries have recently privatised, or are planning to sell off their public telecommunications for cross-border investment. Telecom New Zealand was sold in 1990 to Bell Atlantic and Ameritech, while the Argentinian PTO was sold in two halves to Telefónica (northern half). In Mexico, Telefonos de Mexico has been privatised and sold to a consortium in which France Télécom and Southwestern Bell have equal shares of the minority interest. The Malaysian operator has been privatised and similar moves are afoot in a number of other countries including Venezuela and Costa Rica.

4.3.3 Telco investment in UK cable TV

A specific instance of globalisation and diversification strategies working in tandem is the investment by telecommunications companies (telcos) in holders of cable TV franchises in the UK. This subject has been covered in more detail in other OECD

research (see, for example, Janfils, 1990), but it is worth examining here as it is one of the few experiments up to now of the integration of telecommunications and broadcasting operators that have been permitted in OECD Member countries.

The UK Government awarded its first Cable TV (CATV) licences in 1983, but the level of interest among potential operators was relatively low and up to 1988 only 24 franchises in total had been awarded. Since 1988 however, interest has revived and a further 111 franchises have been awarded, 42 of which are now operational. The revival of investment interest has been led by North American investors including the entertainment company United Artists (8 franchises; 7.0 per cent of total investment), the Bell Operating Companies (BOCs) – Pacific Telesis (14 franchises; 5.2 per cent), US West (13 franchises; 4.3 per cent), and South-western Bell (8 franchises; 3.6 per cent); and the Canadian PTO, Bell Canada (10 franchises; 3.0 per cent). As Figure 4.5 shows, by July 1990 around 82 per cent of total new investment in UK cable had been made by foreign companies of which around a quarter was from telcos. Franchises now cover 70 per cent of all UK homes, though many companies have still to commence operations.

All CATV licenses issued in the UK include permission for the operation of fixed-link telecommunications services within a defined area. In its recent White Paper, *Competition and Choice: Telecommunication Policy for the 1990s* (Cm 1461) the Government announced its intention to allow cable operators to provide voice telephony in their franchise areas in their own right, no longer having to work with BT or Mercury. Nine cable operators currently offer voice telephony serving some 2 000 homes and 3 000 businesses.

At present, the two main fixed-link telecommunications operators are not permitted to either provide entertainment services (TV or radio programming) or to convey signals over their main network. In the White Paper it was announced that the Government does

Figure 4.5. **Major investors in UK cable TV, July 1990**

Country of parent company	Telco (%)	CATV or utility (%)	Other (%)	Total (%)
United States	14.1 (e.g. Pacific Telesis, US West, Southwestern Bell)	45.0 (e.g. United Artists, US Cable, Insight)	–	59.1
Canada	8.0 (e.g. Bell Canada)	12.4 (e.g. Videotron, McLean Hunter)	–	20.4
United Kingdom	0.4	–	6.8 (e.g. Goldcrest)	7.2
France	–	2.3 (e.g. Comp. Gen. des Eaux)	–	2.3
Total	22.5	59.7	6.8	89.0

Note: The remaining 11 per cent is made up of small investors, mainly of UK origin, in the "other" category.
Source: OFTEL (adapted from Knight, G.P. 1990, pp. 2-3).

not intend to remove the present restriction on BT, other national PTOs and Kingston Communications from conveying entertainment services in their own right until ten years after the publication of the White Paper. The Government would be prepared to reconsider the position after seven years if the Director General of Telecommunications advised that removing the restriction would be likely to promote more effective competition in telecommunications.

These new proposals allow a much higher degree of freedom for the CATV companies to link up directly with each other, or via third party providers, to provide telecommunications services. Examples of services provided might include leased lines, data communications, home shopping, video-conferencing, security systems and interactive video games. The wave of investment by North American telcos seems to be a recognition of this new freedom of action. However, it appears likely that several possible motives are in play:

- Telecommunications services might provide sufficient incentive in themselves for telcos, especially now that the Government has decided to end the duopoly policy in the UK.
- Entertainment services have been given a boost by new channels such as British Sky Broadcasting, Eurosport, Super Channel or Disney Channel. The lack of programming had been a major constraint on the early development of cable in the UK.
- The combination of both telecommunications and broadcasting features may facilitate the provision of innovative services not currently available on the market, for instance interactive television.
- The North American companies may be using the UK market to experiment with services that they may ultimately want to provide in their own market. Equally, the telcos may use their UK experience to lobby the US Congress for greater freedom of action in cross-provision of telecommunications and entertainment services in their home market.

All these motives are likely to be in operation, to a greater or lesser degree, together with a general commercial awareness of the investment opportunities of potential growth markets. The fact that an opportunity exists does not, of course, imply that it is profitable and the experience of those operators offering both telecommunications and broadcasting is that the take-up of services is slow and patchy, even when there are demonstrable cost-savings to the end-user.

Nevertheless, the UK experiment has succeeded in attracting investment capital into the CATV industry and stimulating a considerable revival of interest. A similar project by Hong Kong Cable Communications (HKCC) Ltd. to build a joint CATV and telecommunications network in Hong Kong (with US West as a 25 per cent shareholder) foundered in November 1990 when it became clear that no protection could be offered against rival companies offering TV services via satellite using SMATV installations (O'Rourke, 1990).

4.4 "Converged" company profiles

It was argued earlier that "pure" converged companies are relatively rare at present. However, it is possible to identify a number of companies that might fit this description

and which may act as role models in future years for the development of the information industry. In this section, three contrasting companies have been chosen to be profiled. They are:

- *Rogers Communications Inc.* of Canada, as an example of a network provider involved in radio and TV broadcasting, in CATV, mobile telecommunications and, soon, voice communications.
- *Reuters* of the UK, as an example of an information services provider that has, over time, built up its own global, private network. Reuters is an example of a company that has combined content and carriage of information to good effect.
- *Matsushita* of Japan as an example of a hardware manufacturer of consumer electronics and telecommunications terminals which has recently, through its acquisition of the film and TV studios of MCA, moved into the business of entertainment services.

4.4.1 Rogers Communications Inc.

Rogers Communications Inc., based in Toronto, Canada, is a good example of a ''converged'' communications services group. Its 1989 turnover was CDN$600.8 million (US$507 million) divided between four operating groups of cable television (52.4 per cent), TV/Radio broadcasting (7.7 per cent), mobile communications (28.6 per cent) and a newly-acquired interest in Unitel (formerly CNCP Telecommunications). Other related interests include video rental stores and a home shopping network (CHSN).

Rogers' move away from being a broadcasting and CATV oriented company towards a merged communications company came through a series of acquisitions and disposals in 1989/90. In March 1989, Rogers sold its US Cable TV interests and subsequently used part of the proceeds to finance its 40 per cent stake in Unitel and to acquire the remaining 50 per cent ownership of Cantel, Canada's second mobile communications operator, and a 21.9 per cent stake in Canadian Satellite Communications Inc. Rogers now has 1.57 million basic cable subscribers (87 per cent of homes passed) and 157 200 cellular telephone subscribers (0.9 per cent of the population in the area served).

Rogers' corporate positioning appears to reflect expected changes in Canada's regulatory position with regard to broadcasting and telecommunications. In particular, Unitel filed a successful application to the Canadian Radio-television and Telecommunications Commission (CRTC) in spring 1990 to provide long distance voice telecommunications. This will complement Unitel's existing business in telex, leased lines, data communications and facsimile networking (Harvey, 1990).

4.4.2 Reuters Holdings PLC

Reuters, a public company registered in the UK, describes itself as an ''electronic publisher'' and provides a good example of a company that both provides information services and controls the network by which they are delivered. The competitive advantage of Reuters lies in the timeliness of the information provided and for this purpose the cross-provision of content and carriage is essential. Reuters is difficult to classify in the terms used in this report because it is unique in its particular combination of business interests. However, out of its 1989/90 turnover of £1 186.9 million (US$1 947 million), it is possible to identify the following segments:

- *Real-time information services* (65 per cent of turnover); the broadcast of specialised financial information to a network of 194 000 video terminals in some 127 countries. This network, probably the largest privately-owned telecommunications network in the world, uses a variety of technologies to reach its customers. Some information feeds operate via leased lines on PTO networks, but increasingly the data is broadcast directly to the user via satellite to a VSAT receiver. As well as providing the network and the information it carries, Reuters also provides specialised terminals and workstations.
- *Transactional processing* (13 per cent); two-way communications allowing users to trade in foreign exchange, shares and futures.
- *News gathering and dissemination* (7 per cent); the traditional part of Reuters' business but now increasingly automated. As part of its media operations, Reuters owns Visnews, a television news agency.

Reuters' other services include the supply of electronic trading systems (11 per cent) and historical data bases including newspaper archives and company information (4 per cent). In contrast to Rogers Communications, Reuters is truly international in its trading with 60 per cent of its turnover coming from Europe, the Middle East and Africa, 21 per cent from Asia and 19 per cent from North America.

4.4.3 Matsushita Electric Industrial Co. Ltd

Matsushita Electric Industrial Co. Ltd, based in Japan, is one of the largest consumer electronics companies worldwide with a 1989/90 turnover of ¥6 002 thousand million (US$ 37.7 billion). Since its recently-announced take-over bid (November 1990) for

Figure 4.6. **Commercial interests of Matsushita Electric Industrial Co. and MCA Inc., 1989/90**

Matsushita			MCA		
Product	Sales (US$ m)[1]	Per cent of total	Product	Sales (US$ m)	Per cent of total
Video equipment incl. VCRs, camcorders, satellites TV dishes	10 050	(27)	TV/Cinema entertainment	1 740	(51)
Audio equipment incl. radios, cassettes hi-fi, car audio	3 530	(9)	Music	765	(23)
Communication & Ind. incl. fax, word processors, PCs, CATV	8 650	(23)	Publishing	189	(6)
Components & semiconductors incl. ICs, CCDs and CRTs	4 910	(13)	Other incl. TV stations, theme parks, retail	690	(20)
Other incl. home appliances, batteries, cameras and bicycles	10 610	(28)			

1. Exchange rate conversion used: ¥159 = $1.
Sources: Matsushita Annual Report (1989/90), Grover & Dobrzynski (1990).

MCA Inc., the US-based TV, film, recording and publishing concern, Matsushita has positioned itself with interests in both the ''hardware'' and ''software'' sides of the information industry and might be considered a vertical integrated, ''converged'' company. Figure 4.6 lists the principal interests of Matsushita and MCA.

Matsushita's move can be interpreted partly as a defensive move, following the Sony take-over of Columbia Pictures, but also as an aggressive move which positions the company well in areas such as video rental, satellite TV broadcasting, HDTV and multimedia. As part of the deal, Matsushita will sell-off MCA's TV station interests as the US Communications Act restricts direct foreign equity ownership to 20 per cent. Nevertheless, the marriage of the producing and display aspects of the entertainment industry, which is illustrated by the merger, suggests an increasingly blurred division within the information industry as a whole.

Chapter five

NETWORK CONVERGENCE OR DIVERGENCE?

5.1 The policy-maker as market-maker

The previous three Chapters have analysed the evidence for the convergence between telecommunications and broadcasting. In Chapter two it was argued that technology is progressively eroding traditional boundaries between sectors leading to increased competition between transmission media such as cable, radio waves and satellite. In Chapter three, evidence was presented to show the growing range of services now offered by broadcasters and telecommunications companies, including hybrid services. In Chapter four, the revenue structures and the leading players in the two industries were examined to analyse the extent of cross-provision of services and cross-ownership of business interests.

In the second half of the report, the emphasis shifts away from the evidence for convergence to look at the policy questions raised and the initial responses from Member countries. This Chapter looks at policy issues at the level of public networks and their future evolution. It is here that the need for foresight is greatest. That is because public networks represent a considerable sunken investment which has been planned, implemented and will be amortised over a lengthy time period. Consequently, even if the question of convergence is still five to ten years away, as many analysts argue, the implications for investment need to be spelled out now.

Of course, given that public networks are increasingly held in private hands, the actual investment decisions are generally a matter of commercial strategy, not necessarily government policy. Even in those countries where the PTO or the broadcast company is still under public ownership, they have generally been released from the obligations of financing investment from within the overall government finance budget and can obtain investment funds from the private sector as well as from their own operations. Nevertheless, even where the decision is purely commercial, it is often necessary for strategists to "second-guess" what the regulators will do, or what the regulatory position might be in five years time.

For example, a PTO may need to decide whether fibre optic cable rather than copper is justified in the local distribution network as well in the trunk network. The question of whether or not they will be allowed to convey TV signals is central to the problem of demand forecasting. Similarly, CATV companies may need to decide whether or not to incorporate a switching function into their network topology and thereby to offer interactive services as well as one-way broadcast TV.

These two examples illustrate the potential role of the policy-maker as market-maker. Even though policy-makers have a declining influence on commercial investment decisions, they still have the power to define the parameters of activity and to determine who can offer what service, and where. In the information field, even absence of direct intervention or regulation is a form of policy and in the specific case of convergence, policy-makers have the ability to define or to foreclose new market opportunities.

It has been the experience of those countries which have followed the path of liberalisation of telecommunications that rather than eliminating the need for regulation, the introduction of competition actually makes the job of the regulator more important. A monopoly licence takes very few words to define, but to create an environment for free and fair competition, with appropriate safeguards for restraining former monopolists, protecting minority interests and defending political pluralism, is much more complicated. A policy position which is too rigid might constrain technical and entrepreneurial innovation. A policy statement which is too loose is a lawyer's paradise.

In this Chapter, some of the policy issues which may determine whether there is a convergence or divergence in public networks in OECD countries are examined. In section 5.2, trends in the total level of PTO investment are examined with a focus on different strategies adopted in Member countries. In section 5.3 alternative scenarios for the evolution of public networks, towards convergence or divergence, are examined. It is concluded that much hinges on whether or not network-sharing between telecommunications and broadcasting services is permitted. The economics of network sharing are examined in section 5.4 and a number of guiding principles for public policy are proposed in Chapter seven.

5.2 Investment strategies

5.2.1 PTO investment

Investment in public networks is the legacy of one generation to the next. In 1988, telecommunications capital investment by public network providers in the OECD area excluding land and buildings and excluding private investment in networks and terminals was just over US$70 thousand million or a quarter of PTO revenue in that year (see Figure 5.1). For the OECD as a whole, the average investment was just over US$200 per line (equivalent to US$87 per capita) but this average masks a wide range of differences. Interestingly, the countries with the highest level of investment per line are often those which already have a high penetration rate such as Switzerland (US$407 per line; 54 lines per 100 inhabitants) or Germany (US$318 per line; 46 lines per 100 inhabitants).

In order to interpret different strategies in investment, it is helpful to distinguish between expansion of the network (investment broadening) and modernisation of the network (investment deepening), including the development of data networks and other non-basic services. Figure 5.2 uses cumulative investment data over the period 1980-88, together with statistics for the increase in telephone main lines over the same period. Total investment, in constant 1987 US dollar prices, stands at more than US$560 thousand million, while almost 80 million new lines have been added to networks in OECD Member countries. A rough and ready formula can be used to distinguish between network expansion and network modernisation: the approximate cost of a new main line is around US$1 500 though this varies considerably between countries and has declined

Figure 5.1. **Telecommunications investment by PTOs in OECD Member countries, 1988**

	Investment in 1988 (US$m)	Investment per line, 1988 (US$)	Investment as percent of revenue
Australia[1]	1 568.25	225.17	33.22
Austria	924.47	308.02	39.24
Belgium	453.04	127.29	21.24
Canada[1]	2 275.67	172.32	23.76
Denmark	523.77	187.60	27.55
Finland	563.31	228.06	34.05
France	4 675.62	181.03	28.18
Germany	8 935.31	318.22	41.93
Greece	219.64	60.75	21.00
Iceland	12.10	103.11	14.44
Ireland	200.30	237.70	21.79
Italy	5 496.97	273.60	42.56
Japan	12 641.68	253.11	28.37
Luxembourg	35.22	209.65	25.23
Netherlands	937.99	145.06	23.77
New Zealand	364.63	251.17	25.83
Norway	587.85	291.56	27.59
Portugal	411.30	222.42	40.07
Spain	2 827.28	256.08	48.34
Sweden	1 037.69	185.27	27.81
Switzerland	1 479.74	407.33	38.51
Turkey	645.54	131.19	51.35
United Kingdom[1]	3 075.16	138.92	18.34
United States[1]	21 262.50	174.99	19.05
OECD	71 155.05	208.48	26.21

1. 1987 data.
Source: OECD, adapted from ITU.

over time. On this basis, it can be seen that around a fifth of investment has been spent on new lines ranging from as much as 98 per cent in Turkey to as little as 12 per cent in Switzerland.

Analysis of PTO investment trends in OECD countries (Darmaros, 1990) shows a high degree of stability over time despite the technological and regulatory changes which have shaken the telecommunications industry over the last decade. The absolute level of investments, in constant prices, has fluctuated by no more than 10 per cent under the influence of the business cycle. However, it is clear that there are big differences in the investment needs and in the approaches taken in different countries.

It is possible to pick out four overlapping groups of countries:

- Above average investment per line and above average growth in lines; those countries which have set out to provide basic universal service and have benefited from a corresponding growth in revenues. These countries include Spain, Italy, Portugal, Ireland and Norway.
- Below average investment per line but above average growth in lines; countries which continue to experience a strong demand for network expansion but have

Figure 5.2. **Telecommunications investment for network expansion and network modernisation, OECD Member countries, 1980-88**

	Cumulative telecom investment (1980-88) (US$m)[1]	Additional main lines (1980-88) (thousands)	Invesmt. in network expansion (Per cent)[2]	Invesmt. in modernisation (Per cent)[3]
Australia[4]	23 165	2 505	16.2	83.8
Austria	7 095	810	17.1	82.9
Belgium	4 924	1 096	33.4	66.6
Canada[4]	19 402	3 611	27.9	72.1
Denmark	3 638	566	23.3	76.7
Finland	3 789	730	28.9	71.1
France	46 648	9 929	31.9	68.1
Germany	67 763	7 544	16.7	83.3
Greece	2 432	1 346	83.0	17.0
Iceland	99	33	50.0	50.0
Ireland	2 308	360	23.4	76.6
Italy	38 052	7 075	27.9	72.1
Japan	90 560	10 012	16.6	83.4
Luxembourg	199	36	27.1	72.9
Netherlands	6 247	1 574	37.8	62.2
New Zealand	1 365	315	34.6	65.4
Norway	4 746	819	25.9	74.1
Portugal	2 113	860	61.1	38.9
Spain	15 613	3 812	36.6	63.4
Sweden	7 446	781	15.7	84.3
Switzerland	9 731	794	12.2	87.8
Turkey	4 252	2 773	97.8	2.2
United Kingdom[4]	25 932	5 675	32.8	67.2
United States[4]	179 201	16 181	13.5	86.5
OECD	566 720	79 237	21.0	79.0

1. Constant 1987 US$ values, corrected for inflation.
2. Assuming an average cost of US$1 500 per new line (1987 values).
3. Network modernisation assumed to be total investment minus network expansion.
4. 1979-87 data.

Source: OECD, adapted from ITU Yearbook.

been unable to match investment levels in other OECD countries. These countries include Turkey, Greece and Belgium. In the case of France, rapid expansion was achieved in the 1970s and early 1980s and investment levels have subsequently been reduced.

- Below average investment per line and above average density of main lines; countries which have a relatively "mature" telecommunications infrastructure such as the USA, Sweden or Denmark. In these countries, there has generally been a significant increase in the level of investment in private networks.
- Above average investment per line and above average density of main lines; countries which have also reached a high level of maturity but which are continuing to invest heavily in network modernisation and digitisation. These countries include Switzerland, Japan, Austria and Germany.

5.2.2 *Supply-led investment strategies*

This last category of countries have chosen a particular strategy of continued high investment in public networks which might be characterised as a supply-led strategy. These countries continue to be the most committed to the implementation of an ISDN strategy and have pursued investment strategies which are designed to anticipate demand rather than respond to it. The private networking sector is generally poorly developed in these countries, partly because of relatively high tariffs for leased lines, but also because of the prevailing philosophy that telecommunications should be a publicly provided service.

An example of a supply-led investment strategy is provided by Japan. The major Japanese carrier, NTT, has issued a vision of its plans for network evolution in the document "Visual, Intelligent and Personal Communications Service: A service vision for the 21st century". The network development plan envisages an orderly transition from the current PSTN with the phasing out of analogue crossbar switches by 1995, and the digitisation of all remaining switches by 1999 (Figure 5.3).

By the turn of the century, therefore, NTT plans to be able to provide a standardised, digital narrowband ISDN interface through the country. In 1995, however, NTT plans to commence the construction of a broadband ISDN network based on optical fibres for nationwide coverage by 2015. NTT foresees three main demand-drivers:

> *"The three basic communications services forming the core of 'Visual, Intelligent and Personal' Services will be telephony, text mail and video-telephony. NTT plans to provide these one-to-one, interactive communications services uniformly throughout the country" (NTT, March 1990, p.10).*

Perhaps the most surprising aspect of this vision is the intention to provide video-telephony as a universal service to Japanese homes with an anticipated 20m units in operation by 2015. Other public carriers appear to have rejected video-telephony as a viable commercial service, preferring to focus instead on video-conferencing and to look to other services, such as video on-demand or HDTV, as possible broadband demand-drivers.

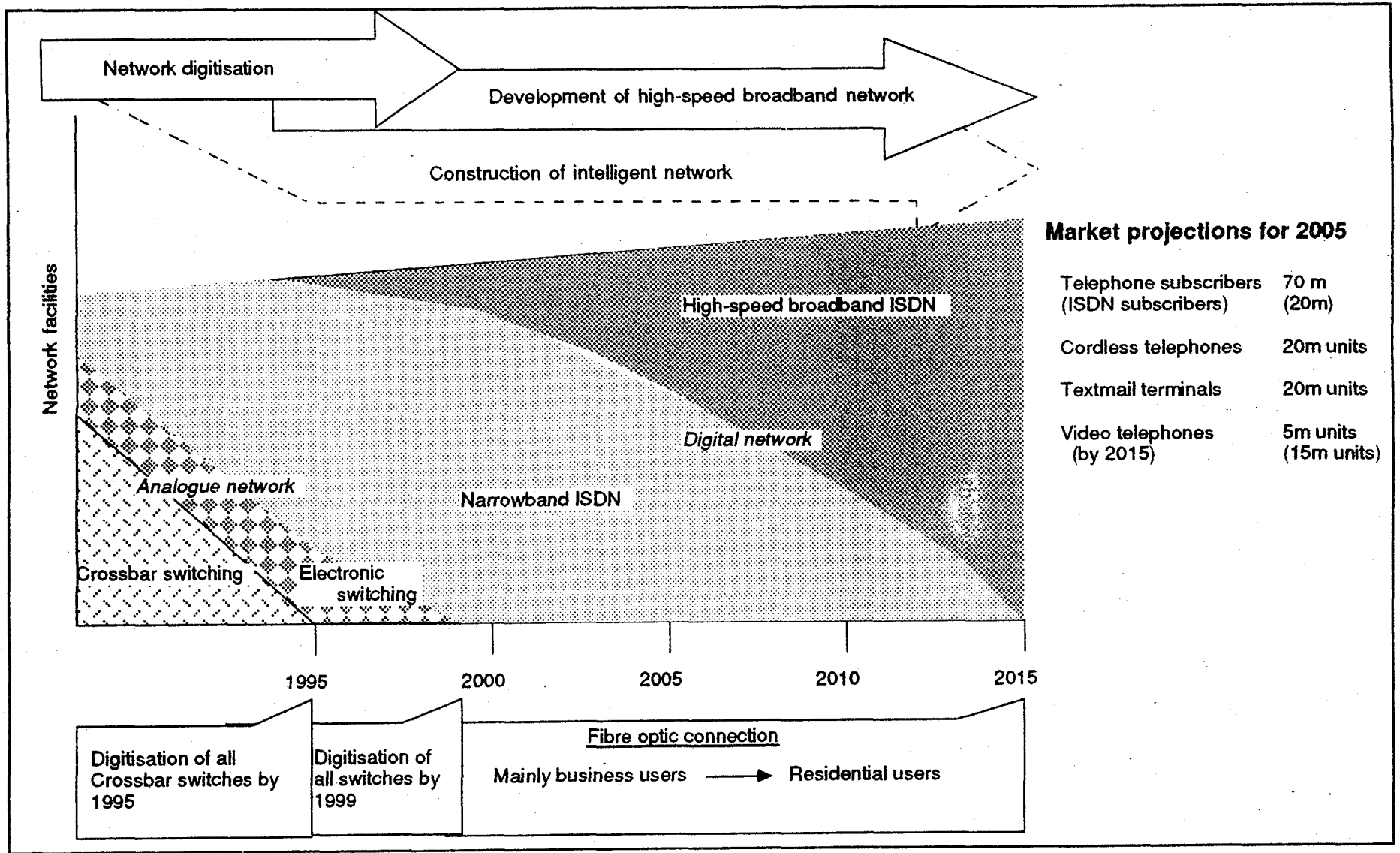
NTT has estimated that the implementation of the first stage of this programme, between 1990 and 1994, will require investment of ¥1.8 trillion per year (US$13.1 billion) or $263 per line, which is consistent with current levels (Nakahara, 1990).

Interestingly, bold policy statements such as this from NTT tend to have an echo effect elsewhere in the world. The MITI fifth generation computer programme for instance was, at least in part, responsible for spawning similar copy-cat government-supported R & D programmes in Europe and the USA. It is likely that private industry in its lobbying of government will now raise the threat of Japanese domination of the video-telephony industry, even though the market potential is unproven. In November 1990, the French Ministry of Posts, Telecommunications and Space (MPTE) announced a programme to put videophones in French homes by 1995 with the specific intention of countering Japanese products in this field (Rocco, 1990).

5.2.3 *Demand-led investment strategies*

Other countries in the OECD area, such as those in the third group above, profess to be more attuned to a demand-led investment strategy. In this scenario, investment planning is a response to demonstrable user demand rather than an anticipation of future

Figure 5.3 **Network development in Japan: NTT's vision**



Source: Adapted from NTT, March 1990, P16.

demand. The danger here of course is that users only ask for more of what they already have and rarely ask for completely new services. In other words, there is a chicken and egg conundrum of what comes first – the network or the services? In practice, no investment strategy can be completely demand-led and there is always a degree of speculative planning; but the real difference lies in the fact that there has been a shift within these countries from public to private network expenditure. In telecommunications economics, there is always a trade-off between long-term and short-term planning. While countries which adopt a demand-led strategy claim to reap benefits from closer attention to user demand, there remains the danger that no long-term policy vision will emerge and development will be piecemeal and uncoordinated.

5.3 Alternative scenarios for network evolution

The discussion on network investment above emphasises the different starting positions of various OECD countries and the range of strategies adopted. This makes it all the more difficult to predict scenarios for future network evolution.

As recently as five years ago, it was possible to build a model of the evolution of the telecommunications and broadcast infrastructure which showed an inevitable convergence towards an integrated broadband communications network (IBC). A model similar to that promoted by the European Commission's RACE programme in the mid-1980s is shown in Figure 5.4. This model is characterised by the substitution of alternative networks which are ultimately subsumed by a single, technologically optimised, broadband network based on fibre optics. This model contained a number of implicit assumptions:

- a single network provider for all public infrastructural requirements.
- technologically-driven investment based on corporate data and image transmission requirements.
- continuing primacy of fixed link technology.
- residential and business requirements met by the same network – one information feed into the home and the office.
- rapid phasing out of "obsolete" networks.

During the course of the late 1980s and early 1990s, several factors have emerged which throw doubt on this basic concept:

- ISDN has received a lukewarm market response. Far from replacing the existing specialised networks (PSTN, Telex, CSDN, PSDN) it has become just another separate offering in the marketplace alongside these multiple alternatives.
- Fax has become the medium of choice for messaging in preference to telex, electronic mail, videotex and other alternatives; but again it has not replaced them.
- Private networks have continued to proliferate, especially within buildings and within firms. Even where ISDN may offer a cheaper alternative, it is generally only used as a back-up to private networks; third party service providers offering network facilities management and value-added services have grown in importance.
- Mobile technologies have boomed, especially cellular radio, and now represent a very real threat to revenues from fixed-link services.

Figure 5.4 **A 1980s vision of network evolution towards integration**

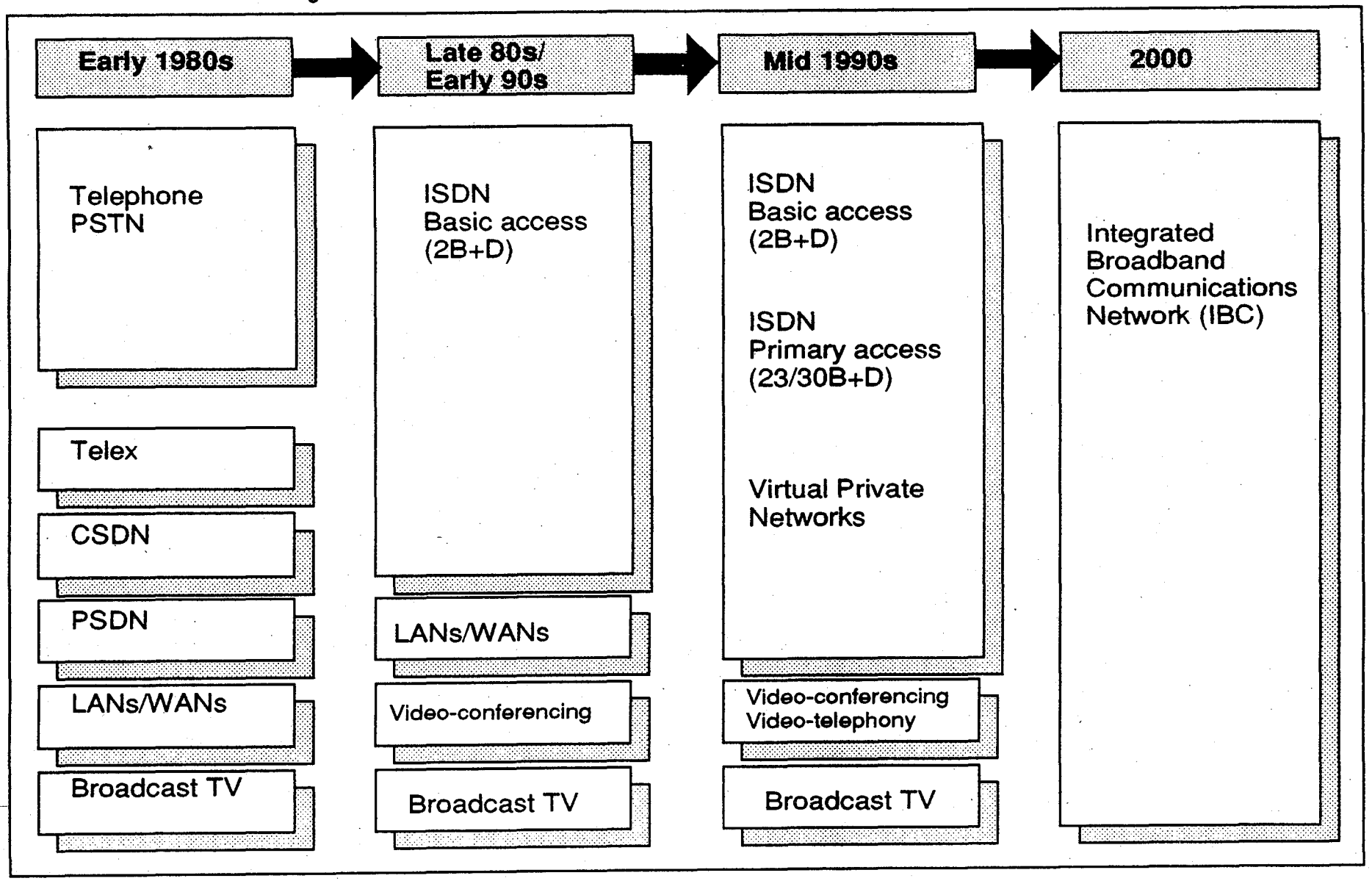
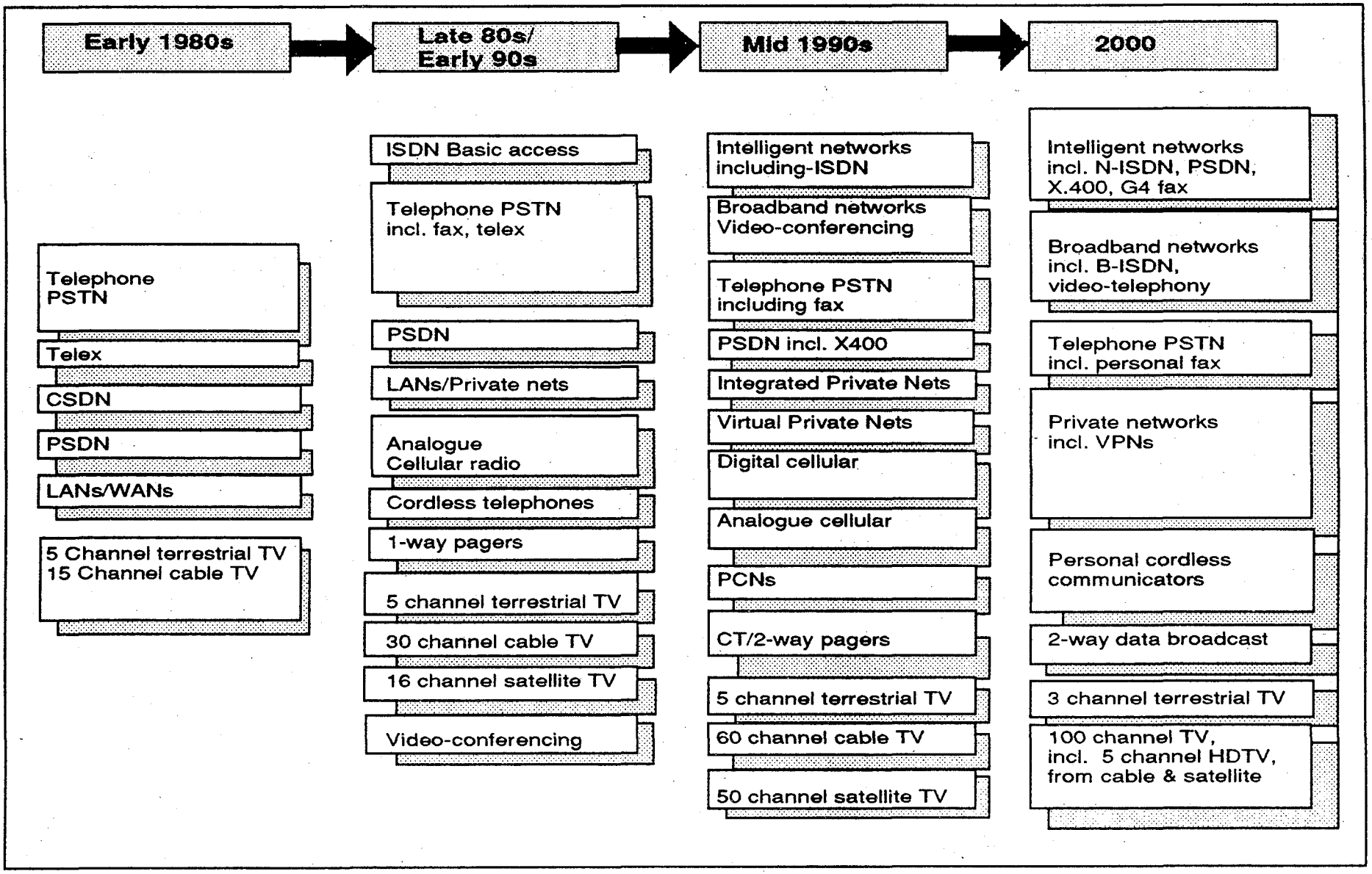


Figure 5.5 **A 1990s vision of network evolution towards diversity**



- Where market liberalisation allows, there are now several network operators, especially over long distances, and multiple service providers, principally for value-added services.

As a result of these emerging trends, it is necessary to redraw this model of evolution in favour of a diversity of technological options (Figure 5.5). This alternative model is based on a different set of assumptions.

- multiple network providers competing on the basis of alternative technologies (e.g. twisted pair, coaxial cable, fibre, radio, satellite, and hybrids);
- demand-driven investment based on "personal" voice, fax and entertainment services;
- dilution of service revenues between transmission media in the context of an enlarged total market;
- divergence of residential and business requirements and continuing separation of telecommunications and television infrastructures;
- continuity of "obsolete" services which compete against newer technologies on price and reliability and trickle down to the small firm/residential market.

This new alternative model of network evolution is more complicated and much less tidy than the former model. It involves a high degree of overlap and duplication but also, crucially, more competition both between alternative transmission media and between competing network providers. It is probably less efficient in terms of investment strategy, but it does imply more choice for users, including tariff choice. At the heart of this concept is the idea of telecommunications as a "personal" service in the same way that computing has become a personal resource. Voice communications continues to be the main demand-driver followed by personal fax and multi-channel TV. Business communications will increasingly be met by integrated private networks and third-party service providers offering virtual private networks. Analogue communications will continue to thrive, especially for voice telephony and conventional TV broadcasting. Digital communications will grow in importance for business users, for mobile communications, for HDTV and for other services where data compression is essential.

5.4 The economics of network sharing

The vision developed above of network coexistence rather than network integration suggests that there will be a growing need for the interconnection of different networks and the sharing of some network facilities.

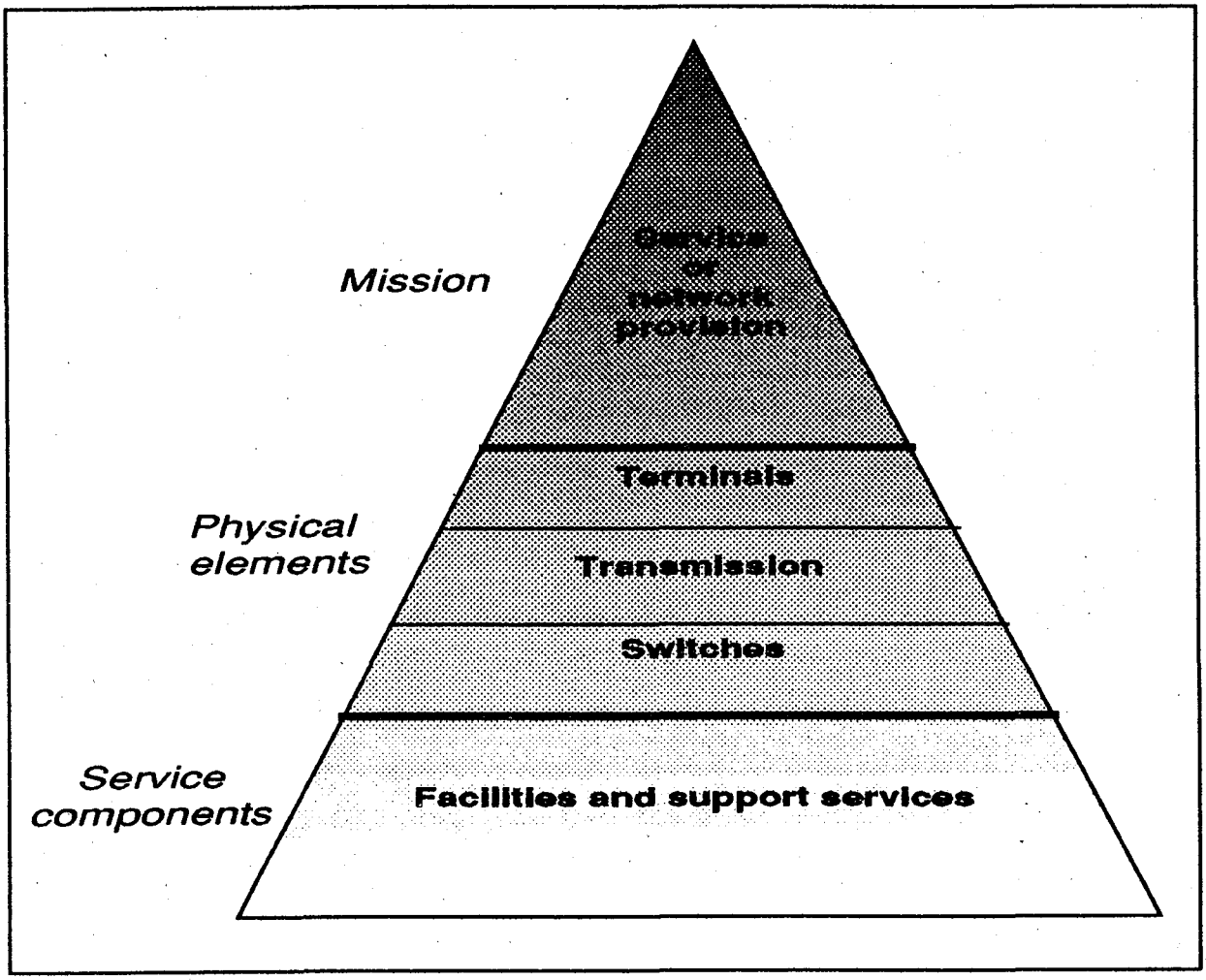
The issue of network sharing seems set to become one of the major policy questions facing regulators over the coming decade. In the context of the convergence theme, network sharing implies the use of the same physical infrastructure to convey more than one type of service and/or services from more than one service provider. In section 5.4.1 a possible typology of different forms of network sharing is defined. In sections 5.4.2 and 5.4.3 the arguments for and against network sharing from an economic point of view are examined and then these issues are summarised in section 7.2 which identifies specific policy questions and proposes some guiding principles for policy-makers.

5.4.1 Network sharing principles

Network sharing is a complex phenomenon which needs to be unbundled if the regulatory implications of the question *''who can share what, and with whom?''* are to be understood. In Figure 5.6, three different levels of the network hierarchy are identified and these are used as the basis for the discussion below:

- at the top of the hierarchy is the *mission* or main purpose of the network provider which may be narrowly defined (e.g. to provide leased circuits for private networks), or very broadly defined (e.g. to provide a range of communications network facilities and services in response to customer demand);
- in the middle of the hierarchy are the different *elements* of the network such as terminal equipment, cable or switches;

Figure 5.6 **Basic model of a communication network**



– at the bottom of the hierarchy are the *components,* in the form of network facilities and support services, which are necessary to provide and run the network.

At an abstract level, it is possible to distinguish between the *network,* the *service,* and the *service provider* and each might be provided on a monopoly basis (same network, service or service provider) or on a competitive basis (different networks, services and service providers). This defines a three dimensional matrix and examples of each type of permutation are shown in Figure 5.7. Logically speaking, one could add a fourth dimension, that of monopolistic or competitive *network providers,* but in practice there are relatively few examples of dual network infrastructures in OECD countries and anyway, this has few implications for the question of network sharing.

In Figure 5.7, boxes (1) and (8) show the two opposite extremes of fully integrated and completely separate, parallel networks. For all the boxes in between, there is some degree of sharing taking place. Boxes (2) to (4) define a certain level of inter-service and inter-network competition which might take place within the same organisation. For instance telex and videotex compete with each other to a certain extent and can both be provided over different networks. Ultimately, there may be a possibility of conversion between services or networks, for instance via an X.400 message handling service. If so, the choice of service with which to initiate or receive a message lies with the user, and the choice of which manner to carry and transmit the message lies with the service provider. Thus the level of real competition is minimised, but a degree of choice is maintained.

Boxes (5) to (7) show examples of competition between different service providers. True network sharing is illustrated in box (7) where both CATV and telephony are delivered over the same network. In practice, it is difficult to find many examples of pure network sharing in OECD countries. The UK situation described in section 4.3.3 above is closer to box (4) at present in that the CATV operators continue to lay separate cables for voice and for television which share only the same duct and/or sheathing. The situation in box (3) is possible however, especially in a digital fibre network where separate services can be carried simultaneously, but kept separate by techniques of time-division or frequency-division multiplexing. A broadband LAN used internally within a company and shared by different departments for uses such as video-conferencing, data transfer, voice communications and telemetry is an example of (7). However, the use of (7) in public networks is quite tightly controlled in most OECD countries.

Moving down the hierarchy described in Figure 5.6, a second way of classifying the extent of network sharing which is taking place is to analyse different elements of the physical infrastructure such as terminal equipment, the local loop or exchange switches. Figure 5.8 gives examples of shared and dedicated services. In general terms, it can be seen that dedicated services are older, and analogue-based (e.g. telex, telegraph) or are limited in their scope to closed user groups or similar communities of interest (e.g. INMARSAT position-fixing satellites). Shared infrastructure tends to be more modern and digital in nature. However, there is nothing to suggest that multi-functional networks are implicitly *better* than dedicated networks. Dedicated networks such as telex have survived for so long precisely because they are optimised to their task. Also, the choice of providing a service-specific terminal may be a conscious, commercial decision to create a proprietary network e.g. Reuters' market information service. All that can be said for certain is that dedicated networks are becoming less common than shared networks.

Figure 5.7 **Matrix of options and examples of network sharing**

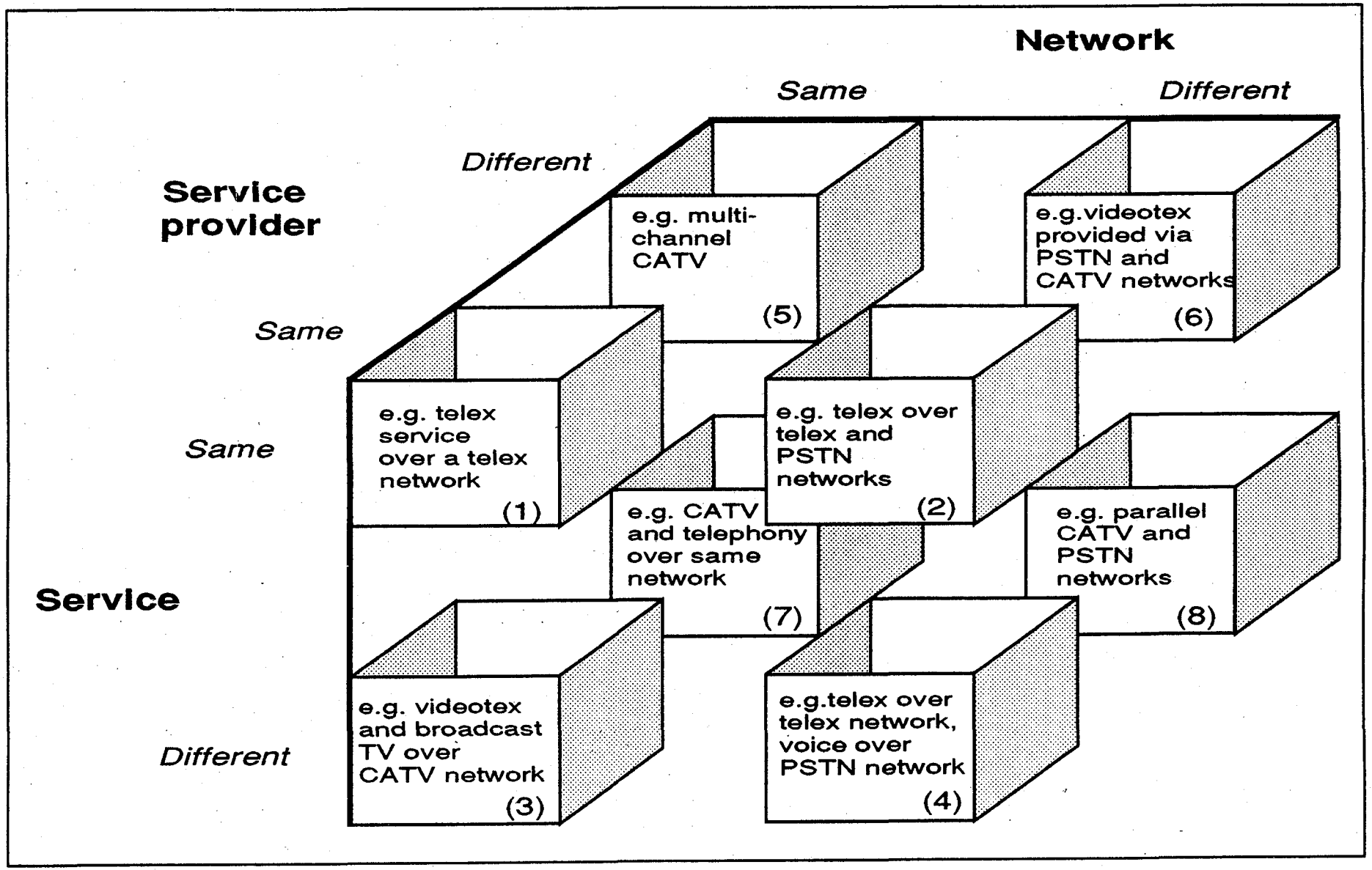


Figure 5.8. **Examples of dedicated and shared network infrastructures**

	Dedicated	Shared
Terminal equipment	e.g. Telex terminal, fax terminal	e.g. Computer with modem, VSAT receiver, Minitel terminal
Local loop	e.g. Residential PSTN used for voice telephony alone	e.g. Business ISDN line used for voice, fax and data
Local switch	e.g. Packet Assembler/Disassembler (PAD) device in an X.25 network	e.g. Data switch used for data networking and voice switching
Exchange switch	e.g. Telex exchange on dedicated network	e.g. Digital exchange with feeds from mobile, satellite and fixed-link services
Trunk cable	e.g. Telegraph line	e.g. Fibre optic cable carrying voice, data and image
Satellite	e.g. Marine position-fixing satellite	e.g. Dual-use satellite with transponders used for telecoms, TV and data broadcasting

A third way of distinguishing the degree of network sharing is to examine what specific components are being shared. For instance, a list of possibilities might include:

- *Shared terminals,* such as a VSAT receiver which is used either for data broadcast signals or for TV signals.
- *Shared cable,* such as a coaxial cable in the local loop used for both CATV and telephony. Either the actual cable may be shared (e.g. by frequency- or time-division multiplexing) or alternatively several cables, or individual fibres, may be encased in the same sheathing.
- *Shared duct* or trench that might be used for delivery of a number of different information feeds (e.g. CATV, telephony, security system) or utility services (telephone, gas, electricity, sewage, water) into the home/office.
- *Shared physical infrastructure,* such as telegraph poles, concentrators, amplifiers etc.
- *Shared switches,* such as combined data and voice PBXs.
- *Shared exchange offices* where switches from several different service suppliers might be co-located.
- *Shared sites* – where radio transmitter masts occupy prominent positions, they may be shared by several different uses such as TV broadcasting, mobile telecommunications cells, microwave transmission, private networks, satellite earth stations etc.
- *Shared personnel,* such as installation and maintenance, user support services, directory enquiries, operator services etc.

Clearly then, there is a hierarchy of different possible parameters to determine the extent to which the network is shared. For the purposes of the discussion below, the following terms will be used:

- *cross-ownership* of more than one type of service provider;
- *cross-provision* of more than one type of service by the same service provider;
- *integration* of two or more services using the full resources of a single network;
- *shared facilities* of two or more services using some of the elements of the same physical network, including terminal equipment, the local loop, switches or cables;
- *shared support services* of two or more services using some of the support services of the same network, including ducts, trenches, telegraph poles, sites or personnel.

5.4.2 Arguments for structural separation

There are two main arguments for the structural separation of activities along lines of business (i.e. the prohibition of network sharing). The first argument is that telecommunications and broadcasting activities have historically developed separately, representing quite different business cultures, and therefore they should continue to be kept separate unless there is overwhelming evidence of market failure or unless there is pressure from participants to allow sharing. The second argument is based on the desire to create and maintain competition in service provision. There is a wide body of economic literature which supports the notion that competition is a superior alternative to monopoly provision of services with the benefits of competition being evident in the range of consumer choice, innovation and the development of new services, lower prices, higher quality of service and productivity gains by the operator.

While recognising the validity of the first, essentially negative argument, the discussion below will focus on the second, more positive argument in favour of structural separation. A pro-competitive policy stance would tend to favour cross-provision of services insofar as this increases the total number of service providers in the market, but it would limit cross-provision if there were arguments that this might lead to an unstable market structure, with monopolistic tendencies. For instance, if the service providers in market A are demonstrably larger, or have greater access to resources of investment, infrastructure or personnel than those in market B, then there may be an argument for restricting cross-provision, or limiting it to providers already involved in market B. More powerfully, if there were evidence that firms from market A would only enter market B by buying-out existing firms, thus reducing the total number of operators, then constraints might be considered for both cross-provision and cross-ownership.

Evidence from the previous Chapter suggests that there is indeed an imbalance in the average size of firms with those involved in the broadcasting field being much smaller than those in the public telecommunications field. However, the existing market structure in telecommunications is largely a reflection of previous regulatory positions. In Japan, for instance, since deregulation of the telecommunications market in 1985, there are now some 66 new Type I carriers (service and network facility providers) with an average 1989 turnover of ¥3.6 billion (US$26.3 m) and more than 900 Type II carriers (service providers only). Despite this proliferation of new market entrants, NTT still holds a 96 per cent share of the total Type I telecommunications market. This would suggest that, in Japan at least, any regulatory restrictions aimed at increasing competition should be applied only to NTT.

Several policy stances are possible on the question of cross-ownership or cross-provision. These are described in Figure 5.9. Case (1) is the most restrictive policy stance

Figure 5.9. **A matrix of policy options for restrictions on cross-ownership and cross-provision**

Degree	Scope	
	Restrictions on all carriers	Restrictions only on dominant carriers
Restrictions on cross-provision	(1)	(2)
Restrictions on cross-ownership	(3)	(4)
Restrictions on cross-ownership attained through acquisition	(5)	(6)

while case (6) is the most liberal. In practice (3), and (5) are relevant only to those countries which have a liberalised telecommunications service market. In Canada and the US, the policy stance is at (3) in the sense that, for the most part, PTOs can neither start-up or buy-up TV services, nor become video programmers. The definition of PTO used here is quite limited and there are some examples of cross-provision by firms which are not primarily telecommunications service providers (e.g. General Electric). The USA has statutory restrictions that bar foreign countries from direct ownership of more than 20 per cent of TV stations.

In Japan, there are few restrictions on either cross-ownership or cross-provision and there are some examples of Type I carriers that provide both leased lines and TV services (e.g. Lake-City Cablevision Co. Inc. which operates in Nagano prefecture). However, NTT is prevented from directly offering content-based information services, such as cable TV, under the provisions of the NTT law. In the UK, the current policy stance is a modified version of (2) with BT and Mercury restricted from providing CATV on their main network, but no similar restrictions on other operators, including foreign operators. In most other OECD countries, it seems that no policy position has been specified, probably because there is little demand from the dominant PTO to provide TV services.

The "preservation of competition" argument can also be applied to the question of whether or not integration of networks should be allowed and equally whether this might be extended to the sharing of facilities or the sharing of support services. The argument against integration is that to provide only a single electronic information feed into a home or business may lead to an undesirable level of control over the competition that might be allowed, or the services provided, over the information feed. In the publishing industry, for instance, there is a long history in many OECD countries of regulatory policy aimed at maintaining political pluralism. Some analysts have argued that to put the means of diffusion of information (i.e. electronic networks) into the hands of one organisation could lead to a totalitarian scenario in which information flows into the home are manipulated and controlled.

But how likely is such a scenario? For a start, the electronic network is only one of many information feeds into the home. Others include the airwaves, satellite antennae and the letterbox. Furthermore, control of a network does not necessarily imply control over the services provided on that network.

Figure 5.10. **A typology of network and service providers**

Content	Scope		
	Network provider only	Service provider only	Network and service provider
Telecommunications only	(1) No major examples in OECD countries	(4) e.g. Type II carriers (Japan)	(7) e.g. Type I carriers (Japan)
TV only	(2) e.g. NOZEMA (Netherlands)	(5) e.g. Disney channel (US)	(8) e.g. BBC (UK)
Telecommunications and TV	(3) e.g. INTELSAT	(6) e.g. SSSO licensees (UK/Germany)	(9) e.g. Rogers Communications Inc. (Canada)

Figure 5.10 provides a possible typology of network and service providers. In fact, telecommunications organisations which provide the network only – case (1) – are quite rare in OECD countries. At an early stage in its reform planning process, Germany considered splitting the network and services operations of the Deutsche Bundespost. From a theoretical standpoint, such an arrangement, in which a network operator leases capacity to competing service providers, would seem to provide a sound basis to establish genuinely "equal access", but in practice such a proposal is likely to encounter stiff opposition from incumbent operators.

Case (2), in which an independent organisation provides broadcasting transmission facilities only, is more common in OECD countries. In the Netherlands, for instance, NOZEMA plays this role (Arnbak, 1990), while in the UK, the soon-to-be-privatised National Transcom Ltd. has been separated out from the Independent Broadcasting Authority (IBA) and can now compete for outside work. It is likely that organisations in category (2) will increasingly migrate to category (3) by providing sites and shared facilities for mobile communications operators, or even to category (9) by providing cellular radio services. Satellite service providers such as Intelsat or Eutelsat, regularly provide studio-to-studio transfer of TV programmes and increasingly also direct broadcast by satellite in addition to telecommunications services (3).

The division between (4) and (7) corresponds to the Japanese distinction between Type II and Type I carriers. Most OECD countries have only one company in category 7, though Britain, Japan, New Zealand, and the USA (for long distance services) are exceptions. Several other countries have multiple mobile operators, including France, Germany, Sweden, Australia and Denmark.

Most OECD countries have multiple firms in both categories (5) and (8), though in some cases there may be a single broadcasting authority that provides transmission to several TV stations or channels. Category (6) is under-represented in OECD countries, though arguably specialised satellite service operators such as the SSSO licensees in the UK and Germany may evolve to become providers of mixed narrowcast TV and two-way data communications over leased satellite capacity. Finally, category (9) shows the "converged' company, Rogers Communications Inc., which was profiled in Chapter four.

At present, regulations in Canada restrict Rogers' ability to unify its CATV, mobile, satellite and telecommunications networks. Nevertheless, the investment in switched fibre optic networks for CATV in Toronto which Rogers is currently undertaking appears to anticipate a future relaxation of restrictions on cross-sectoral provision.

5.4.3 Arguments in favour of shared networks

The main argument in favour of network sharing rests on the issue of technical efficiency. There is a certain irony in the fact that residential telephony uses a fraction of the available bandwidth of a copper wire and is in use, typically for less than ten minutes per day, while television uses great swathes of the available UHF and VHF frequency spectrum and is in use for several hours per day. Technologically speaking, a much more efficient solution would be for television to be provided by direct line and for telephony to be provided by radio waves. This concept is sometimes referred to as the "upside down house". The fact that this has not been the case historically leads to problems in making the best use of tomorrow's technologies. The replacement of copper with fibre optic cable direct to the home can not be cost-justified at present on the basis of voice telephony alone either from an economic point of view (copper is still cheaper than fibre) or an efficiency point of view (fibre can carry up to 10 000 voice conversations simultaneously whereas most homes require only one). Equally, if HDTV were transmitted over the airwaves, the number of channels that could be broadcast would inevitably be limited.

Both the telcos and the CATV operators could potentially benefit from a relaxation of regulations which prevent network sharing. More than anything else, network sharing would be a way of ensuring that fibre to the home might be cost-justified. The laying of fibre optic cable directly to the home opens up a whole range of new interactive service possibilities in the field of voice, video, text and data transmission. When combined with the new range of intelligent user equipment this could create completely new markets, for instance for video on-demand (home programming), electronic newspapers and books, video-telephony or distance working/learning.

The arguments presented above beg the question of whether this would create a local "super-monopoly" providing both cable TV and telephony. If so, this would seem to run counter to the goals of promoting competition and pluralism. It would certainly appear to reduce the possibilities for network transmission (infrastructural) competition between carriers in the same geographical area. From a competition point of view, would it not be better to maintain at least two separate networks for cable TV and telecommunications?

There are three main responses to this viewpoint – firstly that a monopoly in the provision of the network does not necessarily imply a monopoly in the provision of services; secondly that there is already competition to the local loop from cellular radio and direct satellite transmission; thirdly that there could be competition between geographical areas across the nation through a system of franchises as already exists for CATV in many countries. The argument put forward here is that "line of business" regulation is inappropriate for the promotion of technological change and could be superseded by regulation based on the division between networks and services; and/or between alternative transmission media.

The first alternative could be used to justify an infrastructural monopoly, on the basis that it is environmentally inefficient to lay multiple cables in the same geographical area. However, services provision could still be provided on a competitive basis even at

the local level. There may even be a case for a regulatory division between the network provider and the service operator, with competing service providers paying an access fee to use the same network. The second alternative, of a regulatory divide between transmission media, becomes increasingly possible as services such as mobile telephony, PCNs and data broadcasting develop in competition to cable-based services. The third alternative of different licensees in different areas should promote competition in network innovation and might make it possible to withdraw or reallocate licences of specific regional operators if their performance is not up to par.

The ultimate test of policy is whether or not the customer benefits. No policy-maker can decide on the customer's behalf what he or she actually needs, but it is possible to follow certain guidelines such as increased choice, higher quality, lower price and greater service innovation. There are certainly dangers associated with convergence, for instance integrated service provision and the high investment cost it entails may lead to higher prices in the short term. Also a diversion of traffic on to mobile or data broadcast networks may lead to higher unit costs in conventional services. In the broadcasting field too, experience shows that an increase in the number of channels may, through the dilution of revenues, lead to a measurable loss of quality. Nevertheless, it is also necessary to point out the opportunity costs in terms of technologies and services whose development might be retarded if a convergence policy is not followed – a fibre optic-based infrastructure, new interactive services and high-definition television.

Chapter six

SERVICE REGULATION AND DEREGULATION

In Chapter five, some of the policy implications of convergence for the future of public communications networks were examined. It was argued that policy-making should move away from line-of-business regulation, in which networks and network providers are regulated according to their principal service function. Instead, regulations based on structural separation should be relaxed and measures which promote the technical and environmental efficiency of the network, for instance through network sharing or the upgrading of the physical infrastructure, should be encouraged.

In order for this type of policy to be implemented, it needs to be assumed that the competitive (or allocative) efficiency of the market is not impaired. In response to the assertion that network sharing and cross-provision would inevitably lead to a ''super-monopoly'' network provider, covering both telephony and television services, two counter-arguments were advanced:

- That there is growing competition between *transmission media* – cabled, mobile/radio, microwave and satellite networks;
- That an infrastructural monopoly need not lead to a service monopoly but rather to *competition between service providers.* Indeed, where the upgrading of the physical infrastructure creates extra bandwidth, this may actually enhance the potential for shared use between competing service providers.

In this Chapter, the main purpose is to examine the validity of the proposition that policy-makers can afford to turn a ''regulatory blind eye'' to infrastructural supply trends. Specifically, the analysis in this Chapter examines the preconditions for achieving a genuinely open and competitive market.

In section 6.1 the arguments concerned with economics of scale and scope of service providers are evaluated. In section 6.2, the appropriateness of different regulatory regimes, actual and potential, is considered. In section 6.3, the focus narrows to look at appropriate regulatory regimes for the particular question of the allocation of the civil frequency spectrum. Finally, section 6.4 attempts to define efficient and equitable principles for access to, and interconnection of, public communications networks, In section 7.3, these principles are applied to the question of the licensing of operators.

6.1 Economies of scale and scope

6.1.1 The theory

The economics literature is replete with examples of the advantages to be gained from the size (scale) and coverage (scope) of operations. The received wisdom in the telecommunications industry is that "bigness" brings certain benefits, especially where the operator is able to operate internationally. In this argument, it follows that a large operational scale is necessary to support a full range of user services; i.e. that economies of scope are dependent upon economies of scale. This received wisdom is rarely challenged and is too often taken to be self-evident when advanced as a reason for preserving large, monopolistic structures such as the PTOs in their traditional form.

The economies of scale and scope argument is based on the following assumptions:

- That larger size allows a *lower unit cost* so that, for instance, a large operator can obtain bulk purchase discounts for supplies or can install larger exchange switches with a lower cost per line.
- As a consequence, large operators can provide a *lower marginal cost* for each new subscriber, thereby allowing them to offer lower fixed charges (for installation, maintenance, billing, operator services, etc.) which in turn promote higher rates of usage (i.e. more calls per line). In a virtuous circle, this should lead to reduced tariffs and therefore even higher network utilisation.
- Centralised costs such as *research and development* can only be supported by large enterprises. Thus a big PTO should be able to stay ahead with network modernisation and should be more innovative than its smaller counterparts.
- Users are presumed to want *systems integration,* that is the ability to purchase all the communications services they want from one single company (one-stop shopping), especially where that company is able to provide a comprehensive range of services, with good coverage outside its operating area (i.e. international services).

These four main arguments add up to the contention that "big is beautiful" in the provision of telecommunication services and would seem to warn against the introduction of competition or the hiving off of activities which might fragment the structure of service provision and generally reduce the efficiency of the operator.

In the communications industry one can add a third generic type of economies of size; namely, the benefits that arise from "networking" (see, for instance, the discussion in Hayashi, 1991). Economies of networking may be described as the benefits that arise from increasing the number of partners with whom one can correspond. The average size of PTO networks in OECD countries range from the monolithic NTT of Japan with more than 52m direct subscribers to the smallest of the fifty-plus regional telcos in Finland with only 1 500 subscribers. Similarly, the density (penetration rates) of OECD networks varies from more than 65 telephone main lines per 100 inhabitants in Sweden to less than 15 in Turkey. It can be argued that the telecommunication network is increasingly global and therefore the size of the local unit is irrelevant. However, there are still big differences in the level of tariffs between domestic and international operations. Furthermore, in networks more advanced than simple voice telephony, tariff differences are often reinforced by incompatibilities in standards.

6.1.2 Counter arguments

The principal weakness with the economies of scale and scope thesis is that it underestimates the benefits of competition. It is possible to counter the arguments advanced above with equally convincing reasons to believe that a lack of competition may lead to diseconomies of scale and a concomitant weakness in market structure:

- Competition can reduce *unit costs* by emphasising the need for operators to streamline operations and by putting pressure on suppliers that might not be possible in a monopolistic market, and by giving users the power to express market preferences.
- Competition can also reduce *marginal costs* in that it forces down prices and therefore increases usage. Competition may encourage substitutability between transmission media and thereby force operators to apply cost-based tariffing principles.
- Competition can encourage more radical forms of innovation and *R&D* in that new market entrants have no existing base of established market share or sunken investment to defend. Consequently, there is more likelihood that there will be substitutability between innovative services and existing services.
- The argument that users want one-stop shopping or *systems integration* has more to do with what operators think they want rather than the preferences that users themselves express. In the computer industry, by comparison, there has been a discernible trend towards multi-vendor environments as users discover the freedom to break away from proprietary, sole-vendor operating systems. A healthy market structure is one that can accommodate small, niche market suppliers as well as across-the-range international players.

Trends in policy-making reflect this methodological uncertainty over the true value of economies of scope and scale. One can identify trends towards concentration and centralisation, especially the bringing together of domestic and international operators (for instance, in Australia, Denmark and perhaps soon, Italy). Equally, there are examples of divestiture and decentralisation notably in the US, New Zealand and, to a lesser extent, Japan. The truth seems to be that the centralisation/decentralisation argument tends to go in cycles of popularity with first centralising trends prevailing until diseconomies of scale become evident, at which point a decentralising trend takes over. The cycle is then reversed when problems of fragmentation, lack of co-ordination and insufficient scale of operations become critical.

6.1.3 Testing the hypothesis

In order to test the hypothesis that economies of scale and scope are a dominant factor in shaping the communications industry, it is necessary to use proxy variables for performance. The most readily available indicator, and the easiest to interpret, are price comparisons. Recent OECD research (see *Performance Indicators for Public Telecommunications Operators,* ICCP series, No. 22) has presented a comprehensive and reliable dataset for relative prices in business communications services in 21 OECD countries (comparative data is not available for all services in Greece, Luxembourg and the USA). A composite basket of five different business services expressed in indices with the OECD average equal to 100, was established as follows (for December 1989 tariff data):

- domestic telephone tariffs; 50 per cent of total basket, of which 10 per cent in fixed charges and 40 per cent in usage charges;
- international telephone tariffs; 20 per cent;
- mobile telephone tariffs; 10 per cent of basket of which 3.3 per cent in fixed charges and 6.7 per cent in usage charges;
- leased line tariffs; 10 per cent of basket;
- X.25 packet-switching tariffs; 10 per cent of basket of which 3.3 per cent in fixed charges and 6.7 per cent in usage charges.

This price index can be examined in relation to a number of possible explanatory variables:

- *economies of scale,* which can be approximated by either the size of the country or the total telecommunications revenue of the country;
- *economies of networking* are more difficult to define but can be estimated by the penetration rate of telephone main lines per 100 inhabitants;
- *economies of scope* cannot really be measured here as they relate to cross-sectoral provision of telecommunications and broadcasting services which does not yet exist to any substantial degree in OECD Member countries.

6.1.4 Interpreting the results

It is not possible to test the hypothesis using a sophisticated statistical technique such as multiple regression because of the high degree of multicollinearity and spatial auto-correlation in the explanatory variables. Nevertheless, it is clear from a simple linear regression that the strongest observable relationship is between the two measures of economies of scale and the price index. However, the relationship is a positive one (i.e. a larger country has higher prices) rather than the expected inverse relationship. In other words, the evidence shows clear *dis*economies of scale; that the larger PTOs are the most expensive (Figure 6.1).

Only the proxy variable for economies of networking (main lines per 100 inhabitants) shows that some benefits are derived by PTOs with high penetration rates. However, even here there is a degree of circularity in the argument in that PTOs with low prices are, by definition, "efficient" and can therefore be expected to have a denser network structure.

It is not possible to draw firm policy conclusions from these inconclusive results. However, there is no evidence that suggests that governments should support large incumbent PTOs on the basis that they preserve economies of scale. Furthermore, there is no evidence of positive or negative effects which might accrue from allowing greater cross-sectoral coverage and therefore higher network utilisation.

6.2 Regulatory regimes

6.2.1 Unitary or sectoral regulation?

The countries of the OECD are divided on the issue of whether there is a need for a single regulatory authority to oversee the information industry. In some countries there is a single national regulatory body, such as the Federal Communications Commission

Figure 6.1. **Economies of scale and scope for PTOs in OECD countries**

	Telecommunications price index (Dec. 89)[1]	Population 1988 (thousand)	Revenues 1988 (US$m)	Main lines per 100 inhabs. 1988
Australia	100.63	16 538	4 720[2]	42.11[2]
Austria	127.68	7 595	2 355	39.52
Belgium	73.73	9 879	2 133	36.03
Canada	96.06	25 950	9 575[2]	50.89[2]
Denmark	56.77	5 130	1 901	54.42
Finland	79.32	4 946	1 654	49.94
France	105.36	55 873	16 594	46.22
Germany	148.85	61 451	21 312	45.69
Iceland	52.98	250	84	46.93
Ireland	117.44	3 538	919	23.82
Italy	127.53	57 441	12 917	34.98
Japan	137.71	122 613	44 568	40.73
Netherlands	71.78	14 765	3 946	43.79
New Zealand	93.06	3 326	1 412	43.65
Norway	101.41	4 211	2 130	47.88
Portugal	86.54	10 304	1 026	17.95
Spain	141.65	38 996	5 848	28.31
Sweden	72.54	8 438	3 731	66.38
Switzerland	92.94	6 672	3 842	54.45
Turkey	123.87	53 969	1 257	9.12
United Kingdom	92.15	57 065	16 768[2]	38.79[2]
OECD[3]	100.00	568 950	158 698	37.97
X coefficient[4]		0.0006	0.0013	–0.8970
R squared[4]		0.3971	0.2584	0.1816

1. Composite price index of telecommunications services derived from OECD tariff comparison model. Services include national and international voice telephony, mobile communications, leased lines and packet-switched services.
2. 1987 data.
3. 21 OECD countries only: data for Luxembourg, Greece and USA is incomplete.
4. The X coefficient and R squared values show the results of simple linear regression analysis between the price index and a serie of possible explanatory variables.

Sources: OECD, with additional data from ITU Yearbook.

(FCC) in the USA, with public utilities commissions (PUCs) having jurisdiction over telecommunications at the state level. In Japan, the Ministry of Posts and Telecommunications (MPT) is responsible for communications, in the broad sense of the word, incorporating postal services, telecommunications and broadcasting. In other countries, the two industries of telecommunications and broadcasting are regulated separately, for instance by the Office of Telecommunications (Oftel) and the Independent Television Commission (ITC) in the UK; or by the Direction Générale de Réglementation (DGR) and the Conseil Supérieur de l'Audiovisuel (CSA) in France. In practice, no country has a totally unified regulatory structure and it is only recently that pressures have arisen to treat the information industry as a whole.

A similar debate over whether or not there should be a unified regulatory regime exists also at the international level. The International Telecommunication Union (ITU) is

currently considering a proposal to unite its two main subsidiary bodies – the International Telephone and Telegraph Consultative Committee (CCITT) and the International Radio Consultative Committee (CCIR) and their respective World Administrative Conferences (WATTC and WARC). If this is carried out, it would bring international regulations for telecommunications and broadcasting together, including the administration of radio frequencies.

Surprisingly, at the national level, a liberal policy environment in one field does not necessarily map onto a similar environment in the other. Italy, for instance, has a very liberal regime in broadcasting but is still highly regulated in telecommunications. It does not follow that unitary regulation is superior to fragmented regulation. Indeed, monopolistic regulation may be as harmful to an industry as the monopolistic provision of services. However, it is necessary that there should be a unified policy vision and agreement on common goals and a clear decision-making hierarchy if possible policy contradictions are to be avoided. This might be achieved through the establishment of special commissions or working parties, whose brief extends beyond disciplinary boundaries, rather than by bringing all the regulatory functions under the same roof.

6.2.2 Traditional regulatory models

In broad terms, it is possible to identify three main models of regulation which have been applied in the information industry. Firstly a ''newspaper publishing'' model designed to limit the ownership of newspapers or to prevent monopolistic control of the mass media. The interest here is principally to protect political pluralism. Secondly, a ''public broadcasting'' model, originally applied to the cinema and later to television. Here the concern is with the actual content of what is being broadcast or advertised and its potentially harmful effects on minorities, children, or the public sense of decency. In some countries, this concern with content also stretches to the protection of cultural identity, especially in those countries with multiple languages such as Canada, Belgium, Switzerland or Wales. Thirdly, a ''telecommunications'' model of carrier regulation designed to ensure the realisation of social and economic goals such as universal service, a high level of investment and penetration, and low levels of tariffing.

These three models of ''control'', ''content'' and ''carrier'' regulation are to some extent contradictory. For instance, the newspaper model was designed to ensure that there are at least two suppliers in the market, whereas the telecommunications model has been sometimes used to justify a monopoly. Such contradictions are not necessarily a problem where inter-industry barriers are well-defined but problems may arise under convergence. For instance, morally doubtful services which would not be allowed under broadcasting regulations may not be censored when they are offered over the telephone or a videotex network. Similarly, many countries report the case of children becoming compulsive users of chat lines for which their parents must pay the telephone bill. Regulatory policy-makers may need to ensure that service providers do not use an alternative transmission medium to by-pass content regulations operating in the original medium. The requirement is for consistency in the application of existing regulations rather than for new regulatory forms per se.

6.2.3 Alternative regulatory models

It is possible to identify a variety of alternative regulatory models from other industries which might find a possible application in the information industry. Some are

already in use, to a certain extent, and they complement the "control", "content" and "carrier" models discussed above:

- The *strawberry jam* model of regulation which states that, for a jam product to be marketed as "strawberry", it must have a certain minimum content of strawberries. Applied to telecommunications, this might have applications for type approval procedures for terminal equipment, in specifying what minimum characteristics a terminal should meet such as safety requirements and network interworking. It could also be used to specify what community service obligations need to be met by a PTO, or what minimum "core" services should be provided by a PTO licence-holder.
- The *resource allocation* model of regulation whereby a certain portion of a finite resource is allocated to specific firms, such as mineral extraction rights or airport landing rights. In the context of the communications industry, there are two main contenders for resource allocation: the civil radio frequency spectrum and slots in geo-stationary orbit. Mechanisms for the allocation of frequencies are examined in section 6.3.
- The *franchise* model, as used by fast food companies, which grants exclusive rights to market services in a specific geographical area for a guaranteed timespan. This is used quite frequently for cable TV or other broadcasting licences but it differs from the licensing model used for telecommunications in which licences are usually granted without specific time limits or regional boundaries. The franchise model may be appropriate for those fields in which too many competitive players would make the market unattractive for investment, for instance for services which depend upon terminal-to-terminal inter-operability.
- The *equal access* model of regulation, as applied to education, health services or legal services. The principle here is that each of the players should be given equal access to a common resource such as a public network or a numbering plan. A trivial example is the random access to telephone numbers of taxi firms given by directory enquiries. More sophisticated examples are being developed in the USA, the European Community and Japan in the thinking behind Open Network Architecture (ONA), Principles (ONP) and Doctrine (OND) respectively. More detailed research on equal access principles can be found elsewhere in OECD studies (see, for example, *Trade in Information, Computer and Communications Services,* ICCP series No.21, OECD, 1990; or Darmaros, 1990).
- The *positive discrimination* model of regulation as exercised in favouring disadvantaged or under-represented social groups. In the communications industry, positive discrimination might arguably be applied to new market entrants competing against an incumbent PTO.
- *No cross-subsidisation* as a regulatory principle may be applied to firms allowed to compete in more than one regulated sector. In practice, however, no cross-subsidisation remains as a theoretical principle which, in most cases, is neither possible nor desirable to enforce fully, because it would rule out the majority of new service innovations. Nevertheless, this principle is increasingly employed in distinguishing between the monopoly and competitive fields of PTO operations, or to limit the level of cross-subsidy of local loop services with funds from long distance and international telephone services.

Clearly there is no shortage of regulatory tools in the policy-makers' armoury, but the objectives of each particular policy need to be carefully defined and there should be a

clear statement of what aspects of market failure the policy is meant to remedy. The following sections look at specific applications of new regulatory models relevant to the ''convergence'' topic in the allocation of the civil radio frequency spectrum, access and interconnection principles for networks and service providers, and the licensing of ''converged'' operators.

6.3 The economics of frequency spectrum allocation

6.3.1 Supply and demand

The frequency spectrum is a relatively bountiful and potentially profitable public resource, but ultimately it must be regarded as finite. For this reason, it is desirable that its use should serve the public interest, however that may be defined, and that its use should be as efficient as possible with adequate mechanisms for avoiding conflict or interference between users. The allocation and assignment of rights to use the spectrum is generally at the discretion of national governments. However, policy mechanisms were generally developed in an era when spectrum was viewed as a virtually boundless resource. Most current principles for allocating spectrum are based on ''first-come, first-served'' rationing techniques with no formal means for recovering portions of the spectrum which are no longer used. What is needed is a shift to market mechanisms which provide incentives for efficient use and innovation while penalising spectrum hogging.

Pressure to review spectrum allocation policy is coming from both the demand and the supply side:

- A multiplication of demands for spectrum use notably in public and private cellular radio systems, but also in other mobile communications technologies such as telepoint, Personal Communications Networks (PCNs) and ground-to-air systems. As well as mobile communications, more traditional spectrum users such as the broadcasters may wish to use extra bandwidth for high definition television signals (HDTV) and compact disc quality sound (digital radio). The electronics industry more broadly is also developing new radio-based products, such as baby monitors, security systems, microwave cookers, tracking systems, or wireless LANs and PBXs. The International Frequency Registration Board (IFRB) of the International Telecommunication Union (ITU) notes that the number of applications to use the spectrum in the last ten years outweigh the previous eighty years, and applications in 1989 exceed the previous decade.
- While no new spectrum can be discovered, there are some encouraging trends towards better supply management. Firstly, data compression techniques and digital technology are enabling spectrum users to be more conservative in their usage requirements. Secondly, there are moves to reallocate spectrum from government/military to commercial use. For instance, in the USA, a proposal that some 200 MHz of spectrum be reallocated from government use is under discussion in a bill promoted by Representatives Dingell and Markey. In Central and Eastern Europe too, such transfers can be expected. Thirdly, on the technical side, research is finding potentially profitable uses for previously unused spectrum at higher wavelengths. Even if existing spectrum assignments remain unchallenged, there is an urgent need to choose a way to allocate and assign newly-available bandwidth between competing players.

6.3.2 The economic and international dimensions

In the field of telecommunications economics, frequency spectrum allocation is a rare example where relatively pure economic principles such as rent, efficient use or resource allocation can be brought to bear. However, spectrum allocation has traditionally remained the domain of engineers and civil servants. There is general agreement among economists that the best solution to create competition, innovation and efficiency in the use of the spectrum, is to create a market. In other words, it is necessary to determine some sort of value for the airwaves. Multiple options exist which vary according to the nature of the beneficiaries and the degree of regulation exercised by the State:

- an auction of spectrum rights either directly, by the State, or indirectly through resale in the open market: where the notion of spectrum allocation as a tradeable property right is accepted, a market can develop in resale or through subdivision of spectrum rights even where the first round allocation has taken place through standard rationing techniques;
- a rental or tax system which penalises under-utilisation;
- system of franchises or leases which could be periodically renewed or reallocated if the user fails to provide services which are in the public interest;
- a voting system in which different users compete for votes;
- a technocratic rationing system in which "experts" assign the spectrum;
- a quasi-price market in which economic values are assigned to intangible public goods such as "entertainment", "freedom to communicate" or "emergency services".

As well as the economic dimension there is also an international dimension to the question. The frequency spectrum recognises no international boundaries, especially when services are delivered by satellite. The converging of radio with fixed link services will have a major effect on the process of international standards-setting within the ITU. At this time, when the ITU High Level Committee is looking into how the Union should be best structured to meet the needs of its member Administrations in the twenty-first century, consideration must be given to whether a merger of some of the functions of the CCIR and the CCITT is both necessary and desirable. The World Administrative Radio Conference (WARC) is due to meet in Spain in 1992 with issues such as PCN services, HDTV and services provided by low-flying communications satellites (such as Motorola's proposed Iridium service) high on the agenda.

Developing countries are keen to avoid a carve-up of international frequency spectrums when they are not in a position to take advantage of emerging technologies. On the other hand, the advanced countries would like to press ahead with releasing spectrum to encourage innovation while focussing on maximising the economic value of the spectrum.

A new OECD study is examining current policies towards the allocation of frequency and innovative procedures. For instance, New Zealand has announced its intention to auction the spectrum above 1 000 MHz and the UK has awarded PCN licences in spectrum space previously reserved for television. In the USA, the Commerce Department's National Telecommunications and Information Administration recently issued a report examining how market principles could encourage more efficient, fair and innovative spectrum use (see Annex). The OECD's study is based on a realistic assess-

ment of evolutionary steps that could be made now rather than on the application of pure economic principles.

6.4 Principles for interconnection and licensing of operators

6.4.1 New forms of network operator

In Chapter five, it was argued that a combination of technical and regulatory changes was leading to a divergence of public networks. In addition to the incumbent PTO and CATV operators, with their predominantly fixed-link network, there might be a number of other generic types of network and service provider:

a) a *leased facilities network,* in which a service provider leases capacity from an established network provider and then resells spare capacity to third parties;
b) a *parallel network,* designed to emulate the geographical coverage, technology and operations of an incumbent PTO or CATV operator;
c) an *alternative network,* based entirely around a particular form of transmission medium such as cellular radio, cable TV, VSAT terminals or microwave;
d) a *hybrid network* containing a mixture of transmission technologies, possibly drawn from several different suppliers.

Leased facilities networks *(a)* (Type II carriers in Japan) already exist in those OECD countries which have liberal regulations on the use, interconnection and resale of leased lines. Their start-up costs can be kept to a minimum and their services can be optimised to a small number of large users. However, their ability to stay in the market-place as a vendor of pure transmission capacity (i.e. without any added service value) depends on their ability to exploit anomalies in the tariff structure of the incumbent PTO. It is likely that third-party resellers will increasingly be squeezed as incumbent PTOs rebalance their tariff structure and reduce the overall level of tariffs, or offer volume discount tariff packages to major customers. The future for third-party resellers is to move away from pure capacity resale towards added value, for instance as a VANS provider, a facilities manager or a niche-market specialist.

Pure capacity resellers will themselves face competition from the virtual private network (VPN) operations of the PTOs themselves which aim to repackage spare network capacity, together with volume discounts, enhanced network facilities and creative billing to attract those companies that do not wish to have the responsibility of running their own private network.

Parallel network providers *(b),* such as Mercury in the UK, are relatively rare in the OECD area, partly because of the expense of setting up a complete new network from scratch, but also because of the difficulty of doing so while competing with an incumbent PTO. For this reason, it is unlikely that many other examples will emerge.

Alternative network providers *(c)* are much more common because the start-up costs of a new mobile, microwave or VSAT network are generally lower than for a fixed-link network. However, networks based on alternative transmission media still have to interwork with the public network and therefore, except in local areas or in niche markets, it is unlikely that they would be able to compete on price with the main PTO network.

Figure 6.2. **Alternative technological options for hybrid networks**

Local loop	Switch	Trunk network
PSTN	PTO exchange	Copper cable
Cellular radio	Co-located switch	Fibre optic cable
Cordless telephone (CT2/CT3)	Equal access switch	Microwave
Cable TV	Software-defined network	Satellite
VSAT	Private exchange	Leased lines

It is perhaps in hybrid networks *(d)* that the main opportunity for competition against the PTO arises. As shown in Figure 6.2, there are now at least five different technological options for each main element of the network (local loop, switch, trunk network) giving more than a hundred possible permutations for hybrid networks. Clearly not all possible options will be realised, but a few likely configurations can be predicted:

- cellular radio operators may use an inter-city microwave network for mobile to mobile call distribution;
- a long distance and international service provider with a fibre optic network may team up with a CATV operator for local call distribution and collection, especially for high bandwidth video-conferencing services;
- a satellite operator may collect calls from VSAT terminals but then switch them, via satellite to an earth station where they would be treated as local PSTN calls in the receiver country.

Clearly, many possible alliances are possible and there is considerable scope for competition between media according to what is more efficient in each local situation. Much of the potential of hybrid networks depends on the use of sophisticated software for addressing and switching messages and for automatically selecting the most cost-effective call routes. It also depends on observable patterns in the distribution of calls which make it possible to bundle calls together on high volume routes and gain economies from digital transmission. Effectively, what is happening is a "commodification of bandwidth" in which the actual nature or content of the call – voice, data or image – becomes irrelevant in that all calls are treated alike as a digital bit-stream. Such a concept of the future network, as an optical ether with software-defined switching and multiple technical options for call collection and delivery (Cleevely, 1990) demands a new role for the regulatory agencies.

6.4.2 A new role for regulators

Historically, "carrier regulation" in the telecommunications industry has been based on the licensing of individual carriers to carry out a pre-defined task using a specific technology. So, for instance, in the UK there have, up to now, been specific licenses for fixed network providers (BT, Mercury plus Kingston Telecommunications), cellular radio operators (2), telepoint operators (4), PCN operators (3), specialised satellite service operators (7), paging operators (multiple), VANS providers (multiple) and

CATV franchises (multiple). However, under convergence the system of licensing operators on the basis of the transmission technology they use breaks down. Licensing a technology inevitably defines limits and parameters which may quickly be superseded in a dynamic industry where the technology continues to evolve.

An example of the problems which arise from licensing technologies rather than operators comes from the satellite communications industry. In the late 1970s, a number of distinct categories of satellite were defined which could offer:

- Fixed-Satellite Services (FSS);
- Broadcasting-Satellite Services (BSS);
- Mobile-Satellite Services (MSS);
- Radio-determination Satellite Services (RSS).

In practice, these categories were quickly overtaken leading to regulatory anomalies. The direct broadcast satellite TV services in Europe provided by the SES-ASTRA satellite, for instance, are actually provided over an FSS service rather than a BSS service. This means that the ASTRA satellite has been able to side-step the European Commission's directive that DBS satellites should broadcast using the D/D2-MAC family of standards. ASTRA continues to use the older PAL standard (CEC, 1989, 1990; Renaud, 1990).

Given these difficulties in licensing technologies, an alternative role for regulators must therefore be sought in defining principles for the interconnection of carriers on equitable terms and for granting access to public networks. In other words, what needs to be regulated is not the technology, or even the operators themselves, but rather the relationships between them. In this context, regulation would not attempt to specify how or to whom a service should be provided, merely to ensure that the user has, wherever possible, a choice of service providers who are all competing on even terms. The regulator should therefore become less of a team manager, more of a referee.

6.4.3 Access and interconnection of networks

The question of access to, and interconnection of networks is much broader than just a question of the interworking of different types of network and has been treated in detail elsewhere in OECD research (see, for example, *Trade in Telecommunication network-based services,* Ypsilanti, D. 1990; and *New concepts for public telecommunications: Their impact on regulatory frameworks,* Darmaros, 1990). For this reason the discussion here will focus on supply conditions and specifically on the interworking of network and service providers rather than the conditions of access for users.

The first issue to be determined is what networks should be regarded as open to interworking? The definition should be as broad as possible covering all those networks which are intended to be open to the public (i.e. excluding inter-firm networks or closed user group networks). Two possible caveats might be added to limit access to those networks intended for services which are defined in a particular country as reserved services (e.g. simple voice telephony) or for networks which are regarded as too small to permit general access. These two caveats should be closely defined, should be regularly reviewed, and should not be used to discriminate unfairly against any particular category supplier.

The second issue to be discussed is whether the switching function should be defined as part of the network? In the recent reform of the telecommunications system in

Germany, for instance, the function of switching was specifically excluded from the network monopoly of DBP Telekom which is, instead, restricted to a monopoly over transmission facilities. Other countries appear to regard switching as an integral part of the network. Several alternatives arise for the issue of access to, and interconnection of, switches:

- simple interconnection to the PTO's general system of switches on the PSTN and other networks;
- "equal access" switches which automatically route each message via the customers' preferred carrier;
- "co-located" switches by which several switches from alternative carriers reside in the same exchange office and interchange messages;
- "software-defined" switching whereby the digitised message itself carries the details of its route and recipient and in which the network performs as a transparent transmission facility;
- a private exchange, owned and operated by a private company on a network which is not intended for access by the public but which may have a link to the public network, for instance as a back-up in case of network failure.

Each of the above forms of switch make use of the public network to a greater or a lesser degree. Therefore, the third issue to be determined is what form of compensation needs to be made to the public network provider for use of the network? This may take several forms:

- Access charges per call which are the same as would be charged to an individual network user. This principle is applied in Japan where NTT's local call tariffs effectively become access charges for use of the local distribution network by the New Common Carriers (NCCs).
- A reduced rate access charge per call which recognises the fact that an alternative service provider is different to an individual network user and should therefore benefit from some degree of discount by volume of calls. For instance, a switch might be programmed to separate out calls from the service provider and calls from ordinary users and then apply different tariffs to each.
- A leased line type of access charge for service providers that only use a certain limited number of routes, call destinations or organisations. This type of tariffication might be appropriate for virtual private network (VPN) operators or facilities management contractors. Similarly, where a CATV operator also provides a video-conferencing service, there will be a limited number of potential users and most calls which are switched via the public network could be treated as leased line access.
- A fixed charge for use of network facilities which would extend the principle of leased line tariffing to all calls. This would encourage the alternative service provider to increase the volume of traffic generated, but might act to deter new market entrants which have a limited initial volume of traffic. This tariff principle would be appropriate where switches are co-located and only the space in the physical building is being rented from the incumbent PTO.

By extension from these general principles of tariffication, a fourth issue which needs to be determined is what settlement arrangements should be made to deal with situations where there is an imbalance of calls between two service providers? This

situation may be likened to international traffic between operators. The country which produces more outgoing than incoming traffic usually pays some compensation to the receiver country for the use of its network. Settlement rates between operators thus provide an alternative to the principle of tariffing alternative service providers merely as ordinary large users.

A further issue to be determined is should the tariff structure adopted by the dominant network operator be regulated? There is a general consensus on the need to implement cost-based tariff principles so that service prices reflect the actual cost of providing the service rather than the value of the service to the user. This principle can be extended to the argument that the network provider should not attempt to guide users away from a particular service by service of adopting a punitive tariff. However, tariff regulation as a principle should not be regarded as a long-term substitute for genuine competition. Rather it is a short-term solution for a communications environment in which some services are provided competitively while others are reserved for monopoly provision. Tariff regulation may also be necessary to create a level playing field where the size and competitive ability of operators is markedly uneven.

A sixth issue is the contentious area of whether or not standards constitute a technical barrier to trade? It seems fair that each network provider should be allowed to choose their own standards for transmission protocols, interfaces and network software. Most network providers will choose standard solutions to increase their potential market. However, where a network is intended for use by the general public or where its development has been funded by the state, then there is a strong argument that open standards should be mandatory rather than voluntary, at least for basic services.

Finally, there is the question of what access should be granted to network intelligence, including the administration of the numbering plan. As networks grow in sophistication, information on subscribers, calling patterns, credit-worthiness etc. is increasingly collected and stored on a routine basis. Some critics argue that possession of this information gives an outstanding market advantage to the incumbent PTO. This is undoubtedly true, but equally it would be unsatisfactory to allow unrestricted access to sensitive, personal information about subscribers. Furthermore, it is essential to recognise the rights to the intellectual property vested in the network, for instance proprietary network management software. What is needed is some degree of independent policing of network intelligence to grant restricted access to competitive service providers, but without undue discrimination and without endangering legitimate property rights.

Chapter seven

CONCLUSIONS

7.1 The convergence debate

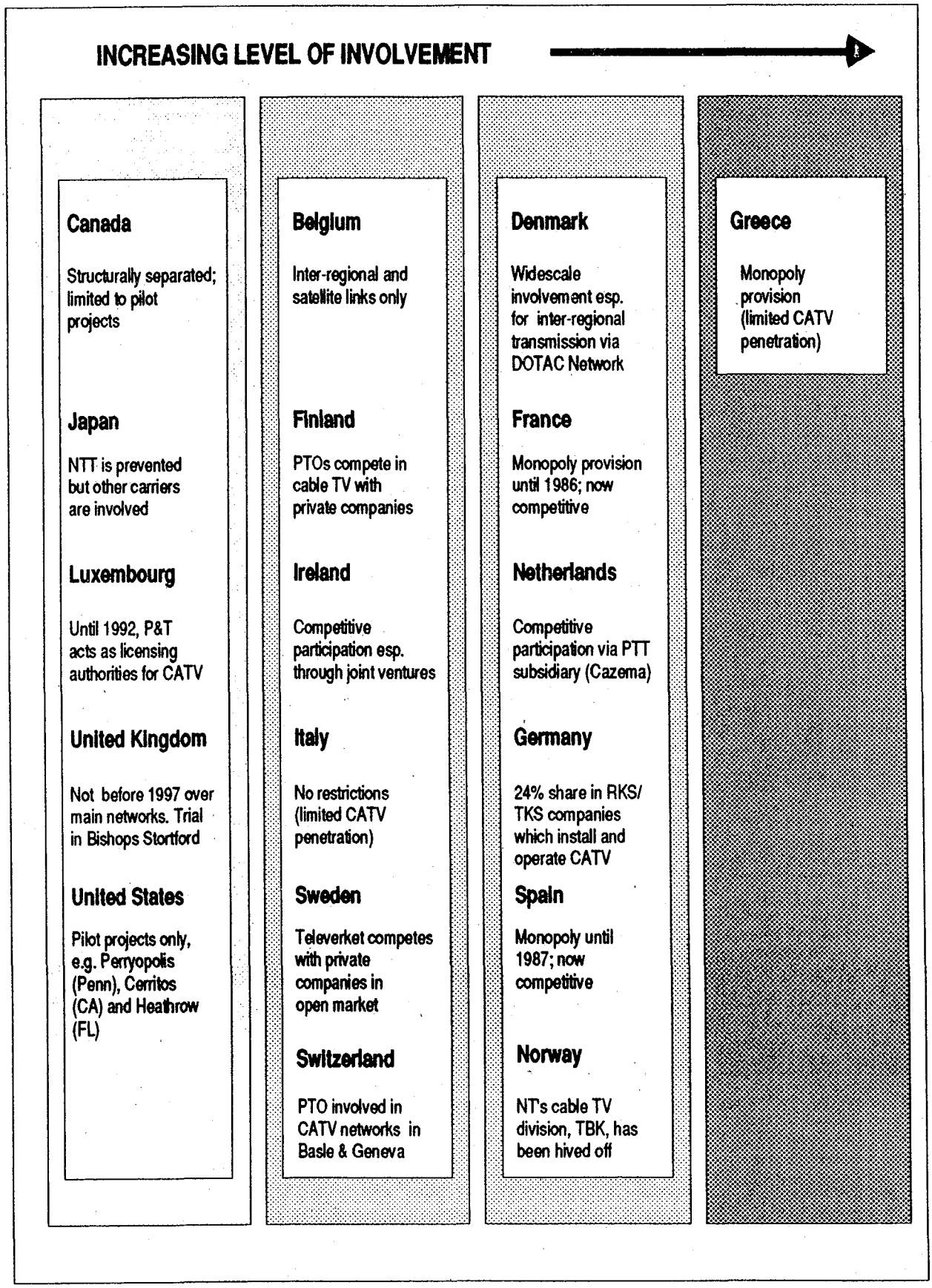
This report has been concerned with examining the evidence for, and assessing the public policy implications of, the convergence between communications technologies, specifically between telecommunications and broadcasting. In this context, convergence is taken to be the growing overlap between the technologies, services and firms active in each sector. It is argued that technological change, notably the trend towards processing information in a digital format, is the main driving force behind convergence. This has resulted in the emergence of new "hybrid" services and innovative ways of providing and using existing services.

Chapters two to four presented the evidence for convergence in OECD Member countries, both as it appears at the moment and as it may evolve over the next ten years. The presentation of evidence did not attempt to determine whether convergence should be regarded as a good thing or a bad thing. The main vector is technological convergency, though it is difficult to estimate the likely timescale. Furthermore, convergence should not be viewed as inevitable from the standpoint of individual companies or public policy-makers. Here, at least, there are still important choices to be made about the desirability of a "single-wire" approach to the carriage of different communications services. At present there appears to be little indication that incumbent PTOs or broadcasting organisations wish to move towards cross-provision of services or cross-ownership of operators. This is hardly surprising as they appear to have little to gain and much to lose from any threat to their comfortable coexistence. Traditional service providers are poorly placed with regard to supplying the newly emerging service markets created by technological convergence and are understandably concerned more with defending their existing market positions.

Instead, the pressures for convergence at the corporate level are coming from two main sources:

- new communications service providers and potential new market entrants who see that technical convergence is creating potentially profitable new growth markets in data broadcasting, personal mobile communications, interactive video-based services, high-definition television, multimedia computational video and other hybrid services;
- hardware manufacturers who are ready to provide the network and terminal equipment to supply these new markets.

Figure 7.1 **Summary table of PTO involvement in cable TV, selected OECD countries**



Source: OECD Convergence Study.

It is this new alliance of competitive service providers and hardware manufacturers that is pressurising governments in OECD Member countries for a relaxation of the regulations which define lines of business and which keep broadcasting and telecommunications structurally separate.

Chapters five and six examine the policy implications which arise out of the convergence topic. The two main questions relate to how public communications networks will evolve and how the use of those networks should be regulated. It is argued that what needs to be regulated is not the technology, nor even the operators themselves, but rather the relationships between operators. In particular, it should be the role of the regulator to ensure that all operators have equitable access to, and effective interconnection with, public networks. In this sense, the regulator is taking on the role of a referee in assuring that there is free and open competition between players in the communications market without favouring one technology over another.

It may well be the case that many of the forecasts in this report about the growing convergence between telecommunications and broadcasting never really materialise, or prove to be only short-lived. If so, this should be a market decision and not a decision imposed by policy-makers. Such benefits that might arise from convergence can therefore be achieved through innovative corporate strategies rather than through administrative procedures.

It is hoped that the issues highlighted in this report will help to promote a more comprehensive debate over the convergence issue. A number of countries, notably Canada, Japan and the Netherlands, have recently established special commissions to examine the nature of convergence and to develop an appropriate policy response. Other countries, such as the UK and New Zealand, have adopted a position on some aspects of convergence as a part of a broader review of communications policy. At the international level, the ITU is considering bringing together the activities of the two committees which currently deal separately with line-based and radio-based standards (the CCITT and the CCIR). However, for the most part, convergence has not yet been considered in a systematic way by the governments of OECD countries, and policies continue to develop in an ad hoc fashion. The lack of unanimity among OECD countries can be shown in the specific area of the involvement of PTOs in the carriage of cable TV services which lies at the heart of the convergence issue. The situation at present is summarised in Figure 7.1 which groups countries according to their degree of involvement.

In terms of policy, the convergence debate translates into two main questions:

- what forms, if any, of network sharing should be permitted on public communications networks?
- what procedures, if any, should be adopted for the licensing of network operators and service providers?

These are discussed below in the form of guiding principles for consideration by public policy-makers.

7.2 Principles for network sharing

The arguments presented in Chapter five show that while it might be possible to defend the continuing prohibition of network sharing on the grounds of competitive

efficiency, it is difficult to justify in terms of technical or environmental efficiency. However, it is clear that the question of *"who can share what, and with whom?"* remains as complex as ever. In order to move toward a position that could be adopted by policy-makers, three approaches are possible:

a) to assume that network sharing should be prohibited along line-of-business definitions unless there are specific reasons to justify it;
b) to assume that no restrictions should be placed on network sharing except where they can be specifically justified;
c) to argue that regulations should seek to encourage or enforce sharing or equal access to specific elements, facilities and support services of public networks.

The approach taken here is a mix of *(b)* reinforced by *(c)*. It should be remembered that in a free market economy, regulation often produces unintended side-effects. In general terms, regulation is justified only in instances of market failure and should be regarded as an imperfect substitute for real competition. In this spirit the following principles for the sharing of networks are proposed:

1. *Restrictions on cross-provision should be strictly limited to firms with an actual or potential dominant market position.*

The main argument in favour of restrictions on network sharing is that cross-provision may lead to non-competitive or monopolistic market structure. Furthermore, it may be necessary to use cross-provision restrictions to limit possible cross-subsidy between the monopoly and competitive activities of an operator, or between regulated and non-regulated markets. However, given this rationale, it seems pointless to apply this restriction to new market entrants or other firms competing against a long-established, incumbent public network operator. To allow smaller market players to exploit any benefits which may arise from economies of scope and scale through cross-provision may actually lead to a more competitive market structure. Even where one firm has a demonstrably dominant position, or may acquire such a position, the reasons for imposing cross-provision restrictions should be closely defined and should be regularly reviewed:

- where cross-provision would kill off new market entrants and other competitors, or significantly raise market entry barriers (infant industry support argument);
- where cross-provision would reduce the global level of investment in infrastructures or stifle service innovation (net market loss argument);
- where cross-provision in network infrastructure would lead to a decline in competition at the service level with a resulting decline in choice and increase in price at the service level (service competition argument);
- where cross-provision may endanger the diversity of ideas and opinions expressed via public electronic networks or otherwise constrain the free flow of information (political pluralism and cultural identity arguments).

2. *Restrictions on cross-ownership should only be considered for acquisitions by firms with an existing dominant market position.*

There is a major fear that dominant firms in the telecommunications sector will enter the broadcasting sector simply by purchasing existing players leading to a net market loss of investment and a reduction in the number of players. Equally, there is a fear that cross-

ownership may lead to anti-competitive cross-subsidy in the absence of adequate safeguards. However, these arguments are insufficient to justify a total ban on cross-ownership. Specifically, if firms in one market sector wish to enter another through a start-up or joint-venture rather than outright acquisition, and where the safeguards for maintaining competition (listed under *1.* above) are met, then cross-ownership should not be prevented. In the case of non-dominant firms, it might actually be encouraged.

3. *Network sharing should be promoted where it creates new services or provides new investment which would not otherwise exist.*

The argument that network sharing may actually generate new investment and new services (additionality), rather than leading to a net market loss (substitutability), is a powerful one. Two particular instances might be cited:

- where a conversion from copper to fibre in the local loop can only be justified by shared revenues from telecommunications and broadcasting services or the economies of scope gained from carrying out both activities together (technical efficiency argument);
- where a household or office in a geographically remote or socially disadvantaged area would not otherwise be connected to the public network unless revenues can be generated from both telephony and television (social obligation argument).

The technical efficiency argument is the more powerful of the two. Here a distinction might be made between cases:

- new buildings or new estates where no previous infrastructure has been laid;
- areas in which an existing copper network would need to be replaced anyway to improve service quality, to reduce the number of line failures and to reduce maintenance costs;
- areas in which replacement is only justified to provide new services not currently available.

The arguments for installing fibre direct to the home or the terminal (the last mile) are strongest in the first argument and weakest in the last which is the most common situation in OECD countries. At present, few PTOs seem ready, on the basis of a purely commercial decision, to replace copper with fibre in local distribution networks. This situation might change as the relative cost of fibre comes down and as the maintenance costs of analogue copper-based networks rise. Estimates of the costs of fibre to the home vary but the median estimate seems to be around US$2 500 per connection for fibre compared with around US$1 500 per connection for copper (Shumate, 1989). Moreover, the cost of connecting subscribers is greatly increased by the cost of the opto-electronic devices installed in network termination points and in customer premises equipment. The cost of this will fall as standards stabilise and as a volume production market emerges. Furthermore, some of the costs will presumably be met by the consumer rather than the network operator but nevertheless this will still add, on average, a further $US500 to the cost of a fibre-based solution.

On the demand side of the equation, average revenue from business and residential telecommunications services is around US$750 per line per year in OECD countries. For cable TV residential markets, revenues from the mature US market stand at around US$350 per year and would presumably be much higher if two-way interactive services such as home shopping, video on-demand or video-conferencing were available. As a

rule-of-thumb, one can estimate that the initial cost of laying fibre to the home or terminal would be around twice that of laying copper, but if the network operator could offer interactive video services as well as telecommunications, the pay-back period would be halved. However, if the cost of providing interactive video service over a cable network turns out to be less than this incremental cost, then the business case for a fibre network would be weaker. What is critical is the need for a clear indication of whether or not PTOs would be allowed to carry video-based services on their main network in order to clarify forward planning for network strategies (see, for instance, discussion in the 1991 NTIA Infrastructure report).

The social obligation argument is less likely to be raised, at least in OECD countries where penetration rates are generally high and there is a tradition of geographical averaging of connection costs and universal service. Nevertheless, it may become significant in countries where the existing infrastructure is under-developed or which are poorly served by over-the-air broadcast services.

With regard to what, if any, the role of the State should be in ''promoting'' network sharing, it is possible to make the following observations:

- policy-makers should aim to remove any regulatory, financial or legal barriers which prevent network-sharing except where they are justified on anti-competition grounds (see *1.*above);
- policy-makers may, in certain circumstances, bring together interested parties, or may promote pilot schemes, demonstration projects or regional programmes;
- policy-makers may, where necessary, act as arbitrators in the event of a dispute between parties or where reasonable network access is being denied by one party.

The argument of this report is that network-sharing should, in most cases, be to the benefit of both parties, but it should be remembered that the sunken investment in a physical investment is part of the commercial assets of a company. That company may wish to defend its competitive position and is entitled to resist any measures which would downgrade its assets. However, it is often the case that the state itself owns the assets of the network operator or has played a major role in funding the development of the network. In such cases, it is hardly justifiable that the network operator should deny reasonable access to the network. As an arbitrator between interested parties, the state should also consider the position of the end-user who has little to lose and much to gain from network-sharing.

4. *Sharing of network facilities and support services should be actively encouraged where it leads to reduced costs and greater environmental efficiency.*

Studies of network economics often show that the network facilities and support services, such as ducts, trenches, telegraph poles, sites, exchange offices, maintenance personnel, directory services and transmitter stations add up to a substantial part of the total cost of providing the network (Levin & Meisel 1990; Newman, 1990). Furthermore, whereas the network elements, such as terminal equipment, switches or cables, actually contribute to the revenue-earning potential, the network facilities and support services generally add only to the costs. For this reason, it ought to be in the best interests of the network operator to lease out network facilities wherever possible and to maximise their cost-sharing potential.

In reality, however, the practice of facility-sharing is fraught with difficulty because the facilities owner is usually in a monopolistic situation and can therefore exploit the dependence of other users of the facilities, especially where rental values need to be re-negotiated on a regular basis. In North America, facilities sharing agreements, such as the leasing of space on telegraph poles, are regulated. Consequently, this creates an adversarial environment which is not conducive to engendering trust or co-operation. The history of hostility between the telcos and the nascent cable TV operators is one of the major factors working against convergence in North America (see, for example, the Canadian Cable TV Association's response to the Canadian Department of Communication's Inquiry on local distribution networks, CCTA, May 1990, pp.7-9).

In spite of these practical problems, it must be emphasised that there are great potential gains to be made from network facilities sharing from the environmental standpoint. Because the environment does not have a market price, it is difficult to assess the loss to amenity caused by the continual digging up of roads, parallel trenching or untidy telegraph wires. Nor is it possible to quantify the cost to the built environment by the visual intrusion of home satellite dishes or the radio transmitters. Nevertheless, it is imperative that such intangible costs are considered by policy-makers in actively encouraging the sharing of network facilities.

7.3 Principles for the licensing of operators

In view of the discussion in Chapter six on service regulation, it is possible to formulate a number of principles that might guide policy-makers in the licensing of "converged" network operators and service providers:

5. *Policy-makers should not attempt to specify a minimum viable scale for market players.*

The discussion of economies of scale and scope gave no support for the idea that there are significant economies to be gained by large PTOs, but equally no evidence of a minimum viable size. To test this hypothesis further, it would be helpful to be able to look at the situation where there are several competing providers in the same market. Only in the US, and to a lesser extent in Japan and the UK, does this situation pertain. The evidence suggests that it is possible to build a profitable and high-growth operation even with a small share of the total market size. A market structure in which large, general service providers can coexist and compete with smaller, niche-market players may well be more efficient than a monopoly or an oligopoly. There is no reason for policy-makers to intervene to define an ideal size for players, and neither should they rule out the possibility of licensing potential new market entrants on the grounds of a minimum size threshold. However, this general principle may need to be reviewed where regulators are responsible for allocating scarce resources such as the frequency spectrum.

6. *Regulators should move towards a market mechanism for allocating the civil radio frequency spectrum.*

Unless there are convincing reasons to do otherwise, regulators should move toward greater dependence upon market mechanisms to allocate and assign the radio frequency spectrum so that it can be used according to where it can be most valuable. A market

approach would need to be backed up by proper safeguards to ensure that the frequency spectrum continues to be used in ways which support the public interest. These may include the setting aside of portions of the spectrum as rent-free havens for the emergency services, community services and other non-profit making organisations. The frequency administrator may also retain the right to withdraw franchises where airspace privileges are being abused.

The rental fees raised by instituting a market mechanism for allocating the frequency spectrum might be earmarked for a number of functions which might include:

- research on spectrum optimisation techniques;
- to fund worthy organisations without access to funds to bid for the spectrum, such as ethnic minorities;
- to ensure coverage of the transmission network in marginal or remote areas.

A market mechanism, such as rental, sale, or leasing, should serve to improve the technical efficiency of use of the spectrum, to encourage innovation and to arbitrate between competing claims.

7. *Licences for carriers and service providers should not specify what technology or mode of delivery should be used.*

Except for the special cases of the civil radio frequency spectrum which is a demonstrably scarce resource, and patented technologies where intellectual property rights need to be respected, regulators should not attempt to define what technology a licensee should use or what the preferred mode of delivery should be. Insofar as a system of licensing of operators is retained, the licence should refer to the company itself and its relationships with other companies, but not to the actual technology employed.

The main danger associated with the licensing of technology is that this tends to ossify technical progress or to define artificial parameters. This inevitably limits technological change and may stultify innovation. One of the most pervasive arguments emerging from the discussion in Chapters two and three is that there will be a growing trend towards the "hybridisation" of networks and services. This will be facilitated through the digitisation of electronic information flows which means that information can pass more easily from one transmission medium to another. By way of example, there is likely to be a market opportunity for network providers that use radio as the medium for call distribution and collection at the local level coupled with fibre optics and/or satellite links for long distance and international transmission. Such a network provider would be a formidable competitor for traditional fixed-link PTO networks. Attempts to licence technology or to specify the preferred mode of transmission might endanger the emergence of new operators using hybrid networks.

8. *Regulators should be principally concerned with issues of access to, and interconnection of, networks and services.*

In a competitive environment in which there are many different players in the overlapping areas of telecommunications and broadcasting, it is necessary for regulators to play a new role as referees who ensure fair play in the market. In particular, this role should be concerned with issues of access to public networks and interconnection between networks and service providers.

This new role for regulators as referees is the logical consequence of the trends discussed above:

- growing overlap and competition between transmission media, notably between radio and fixed-link networks;
- increasing scope for the sharing of network facilities and connections;
- a larger number of players including international carriers, domestic carriers and local or niche-market service providers.

In this new environment, it is the relationship between players rather than the players themselves which is a candidate for regulation.

Where there is perfect competition, the regulator may even be put out of a job, but that day has not yet arrived in the communications industry. On the contrary, the job of the regulator seems set to become more involved and more detailed than ever before.

ANNEX

Part A

OECD QUESTIONNAIRE ON THE CONVERGENCE BETWEEN TELECOMMUNICATIONS AND BROADCASTING

PART A

OECD questionnaire on the convergence between telecommunications and broadcasting

1. Telecommunications network operators

Which companies are licensed to provide public telecommunications network facilities?

Local loop	Long distance	Microwave	Cellular radio	Satellite	Other

What organisation is responsible for licensing network operators?

What legal barriers to entry restrict new market entrants?

2. Telecommunications network facilities

For the main public telecommunications network, what is the current and planned level of digitisation?

	1990	1995	
Exchange lines	.....	.....	(as percentage of total)
Central switches	.....	.....	(as percentage of total)

How much fibre optic cable or other broadband facilities will have been installed?

	1990	1995	
Local loop	.....	.....	(as percentage of total)
Trunk network	.....	.....	(as percentage of total)

What market trials or pilot projects exist for installing fibre to the desktop/home?

3. Mobile communications services

Which operators are licensed to provide mobile communications services?

Service	Operators	Technology	Spectrum
Cellular radio			
Telepoint			
PCN			
Radio paging			
Other			

Which organisation is responsible for allocating the use of the frequency spectrum?

What charges are made, if any, for the use of the frequency spectrum?

4. Broadcast TV operators

Which operators are licensed to provide broadcast television services?

Public TV (terrestrial)	Commercial TV (terr.)	Pay TV (terr., cable, satellite)	Cable TV	Satellite TV	Other

What organisation is responsible for licensing operators?

What legal barriers to entry restrict new market entrants?

5. Data broadcasting

What data broadcast services are offered and by whom ? Private or public services?

e.g. Videotex .....
Teletext .....
Audiotex .....
by satellite .....

6. Video-based services

What interactive video-based services are offered and by whom? Private or public?

e.g. Video-telephony .....
Video-conferencing .....
Video on-demand .....

What market trials or pilot projects exist for interactive video-based services?

7. Specialised satellite services

Which firms are licensed to provide specialised satellite services?

Service	No. of satellite transponders	Size of receiving antennae	One-way/ Two-way?	Encryption?
TV broadcasting				
Data broadcasting				
Telecommunications				
Other				

What organisation is responsible for regulating satellite operations and controlling access to international satellite organisations such as INTELSAT or INMARSAT?

8. Cross-ownership and cross-sectoral service provision

What restrictions, if any, prevent the cross-ownership of telecommunications and broadcasting services?

What other restrictions exist on the ownership of telecommunications and broadcasting firms?

e.g. Foreign ownership .....
Political control .....
Restrictions on cross-ownership of mass media .....

What restrictions prevent telecommunications companies providing TV services?

e.g. Over their main network .....
Through subsidiary companies .....

What restrictions prevent cable TV companies from providing interactive telecommunications services?

e.g. Leased lines (microwave/satellite) .....
Data communications .....
Voice telephony .....

What restrictions prevent the sharing of network facilities by telecommunications companies and cable TV companies?

e.g. Sharing of cable .....
Sharing of switches .....
Sharing of ducts, trenches .....

What obligations are placed on the public telecommunications operator (PTO) to interconnect with other network and service providers?

Which organisation is responsible for regulating the interconnection of operators?

9. Network dimensions

For the latest available year, please supply the following data: Year: [ ]

Number of Public Switched Telephone Network (PSTN) connections (main lines) [ ]
Number of high-speed (>1.5Mbit/s) network connections (e.g. leased lines) [ ]
Number of cellular radio subscribers [ ]

Number of television sets [ ]
Number of video cassette recorders [ ]
Number of homes with cable TV access (subscribers) [ ]

Number of one-way, receive only satellite antennae [ ]
Number of two-way, send and recieve satellite antennae [ ]

10. Additional information

Please add any additional information you feel is relevant to the question of convergence between communications technologies, especially related to competition policy and regulation.

Part B

COUNTRY ANALYSIS

B1. AUSTRALIA

(Questionnaire response received on 16 May 1991,
and additional comments on 28 June 1991 and 4 December 1991)

B1.1 Telecommunications network operators

At present in Australia there are three public telecommunications carriers:

- Telecom Australia (domestic services only);
- OTC (international services only);
- AUSSAT (long-distance and international services using satellite and microwave technology).

In November 1990, the Australian government announced its latest plans for the reorganisation and liberalisation of the telecommunications services market. The main changes announced were as follows:

- The merging of Telecom Australia and OTC into a single carrier providing all network facilities. This entity is to be called the Australian and Overseas Telecommunications Corporation (AOTC).
- The licensing of AUSSAT as a second carrier able to compete in all domestic and international markets including fixed-link, microwave, satellite and mobile technologies, and the sale of AUSSAT to be completed by 31 December 1991. The Government has announced that Optus Communications will become Australia's second telecommunications carrier. The Optus consortium is 51 per cent owned by Australian companies with Cable and Wireless (UK) and Bell South (US) being the main foreign participants.
- The issuing of three Public Mobile Telephone Services (PMTS) licenses will be issued including Telecom Australia's existing MobileNet service, a new license for the AUSSAT-based second carrier, and a third licensee to be announced in 1992. Additional mobile licenses will be considered after 1995.
- Full network competition from 30 June 1997.

The implementation of these new regulatory arrangements is nearing completion.

New telecommunications legislation has been put in place to provide the framework for the new environment. The legislation includes the *Telecommunications Act* 1991 and the *Australian and Overseas Telecommunications Corporation (AOTC) Act 1991.* In addition, carrier licences have been issued. The new legislation provides for two types of licences – general telecommunications and public mobile carrier licences. A general telecommunications licence has been issued to each of Telecom, OTC and AUSSAT to enable these carriers to continue their current operations. The AUSSAT licence will be transferred to Optus Communications, the consortium which the Government has

selected to purchase AUSSAT, during the sales process. The AOTC will also receive a general telecommunications licence upon the merger of Telecom and OTC. A public mobile licence has been issued to Telecom for its MobileNet service, and Optus will also receive a public mobile licence as part of the AUSSAT sales process.

The main regulatory body is AUSTEL which operates under the policy guidance of the Minister for Transport and Communications. AUSTEL's regulatory powers have been strengthened through the new legislation.

B1.2 Telecommunications network facilities

Some 26.3 per cent of exchange lines in Australia are connected to digital switches at present and this is due to increase to 56.3 per cent by 1995. The proportion of digital exchanges as a percentage of all exchanges is much lower (3.2 per cent increasing to 10.6 per cent) as rural areas are generally served by small analogue switches.

According to Telecom Australia's annual report, some 182 000 km of fibre optic cable has been laid and is operational. It is planned that by 1995, an interstate fibre optic network linking all state capitals and major towns including Tasmania will be complete. ISDN has been available in Australia since July 1989 (Macrolink) and a scaled-down version for small and medium-sized enterprises (Microlink) was launched in August 1990.

In 1988, Telecom Australia undertook two residential pilot installations of fibre to the home. Approximately 100 homes in both Melbourne and Sydney were provided with narrowband telecommunications services over an all-fibre network. A small number in each were also subsequently provided with distributive video services. In 1992, Telecom Australia proposes a large size field trial (up to 5 000 customers) of fibre to the home/ business for a range of narrowband and video services.

B1.3 Mobile communications services

At present, Telecom Australia's MobileNet Service enjoys a monopoly in the provision of cellular telephone services, though a second mobile telephone license will be issued by the end of 1991, and a third operator will be selected by the end of 1992, to commence operations in the second half of 1993. MobileNet was launched in 1987 and is based on the North American Advanced Mobile Phone System (AMPS) technology operating in the 900 MHz band. In September 1991, the number of subscribers was 340 000 – an increase of 85 per cent over the previous fifteen months. The European GSM system has been selected as the initial digital standard for public mobile telephone services.

In addition to mobile telephone services, the provision of Public Access Cordless Telephone Services (PACTS) is open to full competition as from 1 July 1991. The definition of PACTS is based on CT2 technology, or Telepoint, but the intention is to regulate the service and not the technology. Possible requirements for Personal Communications Networks (PCN) are being considered and it is likely that the DECT (Digital European Cordless Telephone) standard will be one of the technologies supported.

Radiopaging has been a competitive market in Australia since the early 1980s, but the largest operator is Telecom Paging, owned by Telecom Australia.

Frequency management in Australia is the responsibility of the Department of Transport and Communications. Following the introduction of competition in mobile communications, Telecom Australia will be obliged to sell air-time to the additional licensees on a non-discriminatory basis. In AUSTEL's report on Public Mobile Telephone Services (AUSTEL, 1990), it was proposed that mobile licence holders should pay an annual fee for use of the spectrum, based on revenues. The money could be used to finance research and development and to cover AUSTEL's costs. No final decision has been made but the report suggests a fee of around A$ 250 000 (US$195 000) per licensee as appropriate to cover AUSTEL's costs. Licence fees for individual items of radiocommunications equipment are already published, (see Department of Transport and Communications, 1990*b*).

B1.4 Broadcast TV operators

The regulatory regime for television broadcasting in Australia is currently based on the 1942 Broadcasting Act and is administered by the Ministry of Transport and Communications. Licences are issued by the Australian Broadcasting Tribunal. There are four main categories of operator:

- The Australian Broadcasting Commission (ABC) provides a comprehensive range of programmes throughout Australia.
- Commercial TV stations operating under licence from the Australian Broadcasting Tribunal. In May 1991, there were 52 commercial TV stations.
- The Special Broadcasting Service (SBS) provides multilingual and multicultural services in all major cities except Darwin, and several regional centres in south-eastern Australia.
- Direct broadcasting by satellite (DBS) services are provided nationally by the ABC, in south-eastern Australia by the SBS, and in other parts of Australia by three Remote Commercial Television Services.

Work is currently underway to draft a new regulatory framework for broadcasting in Australia. The proposed new Broadcasting Services Bill is intended to provide a more flexible and technology-neutral regulatory framework. The Bill is expected to be finalised during 1992.

B1.5 Data broadcasting services

Videotex services in Australia consist of DISCOVERY, operated by Telecom Australia, plus some 60 or so smaller, private services. DISCOVERY was formed in 1989/90 through the combination of the VIATEL videotex service and the Keylink public messaging service.

Audiotex services are described in Australia as ''0055 services''. Some 4 000 services are available and in 1989/90 the number of calls made was 21.3 million, up by 163 per cent over the previous year.

Teletext services are available on commercial TV channels. Satellite data broadcasting is offered by AAP and Omnicast.

B1.6 Video-based services

The current moratorium on the provision of pay-TV services to domestic premises will be lifted from 1 October 1992 as recently announced by the Australian Government. Satellite is expected to provide the major means of delivery, but other technologies can be used. Existing cable television networks are small and limited to domestic areas where off-air television reception is unsatisfactory, and to resort developments. Other video-based services are carried on the telecommunications network. These include broadcast TV links, video conferencing, surveillance and some business television services.

B1.7 Specialised satellite services

Satellite services in Australia are provided primarily by AUSSAT, set up in 1981, which currently has three satellites in orbit and is planning a second series of launches. AUSSAT was 100 per cent owned by the Australian Government. The privatisation and sale of AUSSAT, was planned for completion by 31 December 1991.

AUSSAT will not have Universal Service Obligations (USOs) after privatisation – it will be fully commercial. Funding will be provided to the TV licensees. The pay-TV requirement, if and when it is imposed, will not be confined to rural and remote areas. As part of its new status, the restrictions on the territories in which AUSSAT can operate and the technologies it can use will be have been lifted under the *AUSSAT Amendment Act, 1991.*

Four organisations currently use satellite for direct TV broadcasting: ABC, SBS, RCTS and Sky Channel. In addition satellites are used extensively for TV and radio programme exchange. When all satellite users are taken into account (including TV, data broadcasting, government use and business telecommunications) some 29 transponders are used in total of which 60 per cent are used primarily for TV and radio. The number of TV channels carried by AUSSAT will grow in response to the lifting of the moratorium on pay-TV.

The Department of Transport and Communications is responsible for:

- co-ordination of orbital assignments and spectrum requirements of satellite systems through the International Telecommunication Union (ITU);
- policy matters concerning the use of satellites for broadcasting and telecommunications;
- licensing of satellite earth stations within Australia.

The Australian Telecommunications Authority (AUSTEL) monitors and enforces the Government's telecommunications regulatory regime, including that which relates to satellites.

From 1 July 1991, access to satellite capacity, including INTELSAT and INMARSAT, will be provided mainly via licensed telecommunications carriers. Australia's arrangements for Signatory to the INTELSAT and INMARSAT Operating Agreements

ensure non-discriminatory access by other licensed carriers to INTELSAT and INMARSAT. The Government has the power to direct the Signatory in relation to general policies that are to apply in the performance of its Signatory role. OTC is Australia's current Signatory to INTELSAT and INMARSAT.

Direct technical access by users to satellite capacity for international private networks is allowed under Australia's private satellite earth station (PSES) policy provided that:

- Australia's international obligations are met;
- users hold the relevant license under the *Radiocommunications Act 1983;*
- users comply with the terms of the service providers class license provided for under the *Telecommunications Act 1991.*

Lease of INTELSAT and INMARSAT capacity by PSES users continues to be subject to Signatory arrangements.

B1.8 Cross-ownership and cross-sectoral service provision

The Australian and Overseas Telecommunications Corporation Ltd (AOTC), into which the assets and operations of Telecom and OTC will be merged, has been established as a company under the Corporation Law. It will remain wholly-owned by the Australian Government. Subject to agreement by AUSTEL, there are no limits on the technologies it can choose to exploit or the services it can provide. Telecom Australia already provides transmission facilities for the national television service under contract to the Ministry of Transport and Communications, but it does not provide television services or programming directly.

Under the terms of the sale agreement for AUSSAT, the company is being sold free of debt and any future income tax benefit is not being passed on to its new owner. It is also stated that at least 51 per cent of the share capital should be Australian-owned within five years of the sale. AUSSAT must also continue to provide TV transmission facilities by satellite, including carrying the ABC's Homestead and Community Broadcasting Satellite Service and the Remote Commercial Television Service. The Government has announced that Optus Communications will become Australia's second telecommunications carrier. From the outset, Optus will have 51 per cent Australian ownership.

There are at present no direct cross-ownership restrictions between telecommunications and broadcasting services. There would be cases where the telecommunications company is subject to indirect restrictions, for example when competing for resources of limited availability it would be subject to the same constraints as those applied to other applicants. The important area where this is relevant is the allocation of the radio frequency spectrum.

Other restrictions on ownership include:

- *Foreign ownership:* AOTC is 100 per cent Government owned. The second telecommunications carrier, Optus Communications, based on the privatised AUSSAT, will have 51 per cent Australian ownership from the outset of operations, thereby exceeding the Government's requirement to achieve majority Australian ownership after five years.

- *Political control:* carriers licences to be awarded by the Minister for Transport and Communications will have to abide by licence conditions.
- *Restrictions on cross-ownership of mass media:* the Government's current policy is that ownership of newspapers, radio and TV should be separate. The draft *Broadcasting Services Bill* proposes that cross-media limits involving radio be discontinued.

The Ministry of Transport and Communications policy statement on telecommunications reform (November 1990, p.4) states that Telecom/OTC will be required:

"(D4) To provide interconnection for the second carrier on an equal access basis;

(D5) To share ducts and radio sites where practicable and where these have been acquired as a result of its legislated rights of access rather than on a commercial basis."

The policies outlined in the Ministerial Statement have been incorporated in large part in the *Telecommunications Act 1991,* and others will be included in carrier licence conditions currently being developed.

In addition, the policy statements set out principles for interconnection standards, numbering, billing, non-discriminatory network access, access to network information and arbitration procedures for both national and international traffic. It is stated in the report that interconnection access should be provided on a "directly attributable incremental cost and equal access basis". The report also announces an intention to prevent Telecom/OTC from cross-subsidising its activities in more competitive areas from profits on activities in less competitive areas, but does not prohibit all cross-subsidisation within Telecom/OTC.

In its response to the OECD questionnaire, the Australian Government notes the growing difficulties posed by the convergence issue:

> *"It is increasingly difficult to frame a regulatory regime for telecommunications which is consistent with radio-communications and broadcasting needs. Current and growing problems include how to the ensure encouragement of development in all technologies and industries while implementing Government telecommunications policy. Also, broadcasters are becoming nervous of telecommunications carriers possibly positioning themselves to carry broadcasting and other related services (e.g. pay TV). This problem may be significantly overcome in 1997 when the limit on the numbers and types of carriers is removed."*

B1.9 Information Sources

The principal source of information is the Australian response to the OECD questionnaire delivered on 16 May 1991 by Ms Mary Mertin, Acting Director, International Strategy, Telecommunications Policy Division, Department of Transport and Communications and additional comments received on 28 June 1991 and 4 December 1991.

Figure B1. **Network dimensions and service revenues in Australia**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	7 786.9	Thousands	1985-90	+4.7
Penetration rate		47.1	Per 100 inhabitants		
High speed (>1.5 Mbit/s) connections	1990	6.0	Thousands		n.a.
Cellular radio		340.0	Thousands	1988-91	+141.6
Penetration rate	9/1991	2.02	Per 100 inhabitants		
TV sets	1991	9 800.0	Thousands	1984-91	+5.4
Penetration rate		59.3	Per 100 inhabitants		
VCRs	1988	3 420.0	Thousands		n.a.
Penetration rate		20.7	Per 100 inhabitants		
Cable TV	1990	very few			n.a.
Telecommunications revenues:					
National	1989	8 878.9	A$ million	1984-89	+13.2
	1989	6 942.1	US$ million	1984-89	+11.9
International	1989	1 459.4	A$ million	1984-89	+18.0
	1989	1 140.7	US$ million	1984-89	+16.6

n.a.: Not available.
Sources: Telecom Australia, OTC, UNESCO.

Additional information from:

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B2. AUSTRIA

(Questionnaire response received on 30 April 1991)

B2.1 Telecommunications network operators

The supply of telecommunications networks and services in Austria remains as a government monopoly, but operations are split between two bodies:

- the Österreichische Post und Telegraphenverwaltung (ÖPT), which holds a legal monopoly on public and telecommunications networks and basic telephone services;
- Radio Austria, which is licensed by the PTT Ministry to provide certain telecommunications services, including international telegram services, inter-continental telex, facsimile and value-added services.

The regulatory body is the Federal Ministry of Public Economy and Transport, of which ÖPT is a sub-department. The legal monopoly is laid down in the Telecommunications law (Fernmeldegesetz) of 13 July 1949, updated most recently in 1974. Potential new market entrants are prohibited by Article 15 of the Austrian Constitution Law.

B2.2 Telecommunications network facilities

At the start of 1990 there were 47 electronic digital exchanges with around 12 per cent of all subscribers connected. This is expected to rise to 70 per cent by 1995. ÖPT plans to lay 7 000 km of fibre optic cable by 1992.

A medium-speed (64 kbit/s) data transmission service was introduced in 1988, but the introduction of ISDN has been postponed because of a fear of mis-investment.

B2.3 Mobile communications services

A cellular radio system based on the NMT 450 Hz standard (Network C) was introduced by the ÖPT in November 1984. This had 50 721 subscribers at the start of 1990. Radio paging is also an ÖPT monopoly, with 23 477 subscribers at the start of 1990. The ÖPT is also responsible for allocating the use of the frequency spectrum.

B2.4 Broadcast TV operators

Broadcasting in Austria is a monopoly held by the government-owned station, Österreichischer Rundfunk (ORF), which provides two channels. They are financed by licence fees (50 per cent), advertising (39 per cent) and other forms of income, including public subsidy (11 per cent). Advertising is highly regulated. The licensing and regulatory authority for broadcasting in Austria is the Bundeskanzleramt (BKA) or state chancellor's office and ORF itself has a board of trustees.

B2.5 Data broadcasting

ÖPT and Radio Austria co-operate to provide a videotex service, BTX, which follows CEPT standards, but has a certain amount of terminal intelligence and is therefore more powerful than similar systems in other countries. At the start of 1990, there were 9 717 subscribers.

ORF provides a teletext service during most of the day of around 550 pages, with no advertising. Audiotex is an open market.

B2.6 Video-based services

Some 176 cable companies exist in Austria of which the largest, Telekabel, serving the Vienna area, is owned by Philips. However, only 15 of these networks have more than 1 000 subscribers. Most cable networks are run by a mixture of municipal and local authority ownership. ÖPT has a monopoly on satellite down-links and only programmes originating from ORF or from authorised foreign channels are permitted.

A digital broadband network, O-Netz, operating at 140 Mbit/s and based on hybrid microwave, coaxial and fibre transmission technology, is planned for western Austria between Salzburg-Innsbruck-Feldkirch.

A public video-conferencing studio was opened in Vienna in 1986.

B2.7 Specialised satellite services

Direct digital satellite communications were made available by ÖPT in 1988. VSAT terminals are permitted, under licence from ÖPT and a monthly rental is charged. However, if they are used for television reception, the user must obtain written permission from each TV station.

ÖPT itself is the signatory for international satellite organisations but Radio Austria is free to provide satellite data broadcasting services.

B2.8 Cross-ownership and cross-sectoral service provision

Both of the main service providers in Austria, ÖPT and ORF are part of the government administration. There is some, very limited, degree of cross-provision of services – for instance ORF operates a mobile electronic news-gathering service (Reportage-Funk) at 230 MHz. However the question of competition and/or network sharing between the two organisations does not arise and is not at present under consideration.

B2.9 Information sources

The principal source of information is the Austrian response to the OECD questionnaire delivered on 30 April 1991 by Dr. W. Zehetner, Director of C&C policies at the Austrian Ministry of Economics.

Figure B2. **Network dimensions and service revenues in Austria**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1989	3 102.8	Thousands	1984-89	+3.3
Penetration rate		40.8	Per 100 inhabitants		
Medium-speed lines (64 kbit/s)	1989	432	Connections	1988-89	+111.4
High speed lines (2 Mbit/s)	1989	93	Connections		
Cellular radio	1989	50.7	Thousands	1986-89	+42.7
Penetration rate		0.67	Per 100 inhabitants		
TV receivers	1991	2 788.0	Thousands		
Penetration rate		36.7	Per 100 inhabitants		
TV licences	1987	2 475.0	Thousands	1980-87	+1.5
VCRs	1991	1 132.0	Thousands	1988-91	+10.7
Penetration rate		14.9	Per 100 inhabitants		
Cable TV	1991	663.0	Thousand households	1987-91	+14.8
Penetration rate		23.7	Per 100 households		
Telecommunications revenues	1988	29 071.0	Aust. Sch. million	1983-88	+8.0
	1988	2 355.8	US$ million	1983-88	+18.2
Broadcast TV revenues	1987	4 416.0	Aust. Sch. million		n.a.
	1987	349.4	US$ million		n.a.
	of which: licence fees (50%)				
	advertising (39%)				
	other, including public subsidy (11%)				

n.a.: Not available.
Sources: ÖPT, ORF, ITU, Optima (1991), Austrian questionnaire response.

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B3. BELGIUM

(Based on a text submitted by the Belgian authorities on 4 December 1991)

B3.1 Telecommunications network operators

The market structure in the field of telecommunications in Belgium has evolved, over the last few years, in parallel with changes in the European environment, notably following the actions undertaken by the CEC, in particular:

- the Telecommunictions Green Paper and subsequent policy measures;
- the Common Position adopted on the liberalisation of the terminal market;
- the CEC Directive on competition in telecommunications service markets;
- CEC action on the establishment of a single market for telecommunications services, notably through the Open Network Provision (ONP) Directive.

In Belgium, the Régie des Télégraphes et des Téléphones (RTT) is the sole network operator for public telecommunications. Its status is still defined, at present, by the law of 19 July 1930. However, following a new law voted on 21 March 1991, concerning the reform of certain public enterprises, two new organisations will shortly be created:

- *The Belgian Institute of Postal and Telecommunication Services (IBPT),* which is a public body under the direct authority of the PTT Ministry, will take charge of a certain number of regulatory tasks previously undertaken by the RTT. This division of regulatory and operational tasks is in line with the CEC Directive. In particular, the IBPT will take responsibility for strategic planning for telecommunictions policy in Belgium, technical specifications, for type approval and accreditation of test laboratories and, in general terms, will assist the Ministry in the efficient conduct of telecommunications policy;
- *BELGACOM,* which will be the new network operator taking over the current responsibilities of the RTT, and will retain the monopoly for those services defined as "reserved" under the CEC Green Paper as well as participating in competitive markets.

It should be emphasised that the public service mission of the antonomous public operator will be defined by the Law; notably its licence conditions will be specified in a "management contract" agreed between the operator and the State. The new operating regime should be relatively flexible.

B3.2 Telecommunications network facilities

The inter-exchange network of digital transmission lines based on fibre and microwave which was begun in 1984 is now virtually complete. A second network, comprising exclusively monomode fibre optic cable was begun in 1989 and should be finished in 1995. Currently some 40 per cent of access lines to the PSTN are digital and the RTT plan to increase this to 80 per cent by the year 2000.

B3.3 Mobile communications services

A cellular radio system, based on the NMT 450 MHz standard, was opened in June 1987. This system is interconnected with similar networks in Luxembourg and the Netherlands. A 900 MHz GSM system is planned for 1992. At the end of 1991 there were some 48 000 cellular radio subscribers.

At present, RTT has a monopoly in the supply of radiopaging services, though the equipment market is open. A third generation of the Sémaphone system began in 1989 and had just over 123 000 subscribers at the end of 1991. As with cellular radio, this system is integrated with operators in Luxembourg and the Netherlands.

Frequency management in Belgium is currently the responsibility of the RTT. More specifically, the Service National de Contrôle du Spectre (NCS), sits within the Département de la Transmission of the RTT. In the near future, this task will be transferred to the IBPT.

B3.4 Broadcast TV operators

Television broadcasting in Belgium is divided along linguistic and cultural lines, in accordance with the law of 8 August 1980 on institutional reform. For the Flemish Community, a policy of open access to the network (TV without frontiers) is followed. In the French community, the relevant legislation is:

- the Decree of 17 July 1987 an audiovisual matters;
- the Decree of 19 July 1991, which modified the law of 6 February 1987 concerning radio and TV distribution networks and commercial publicity on TV and radio; the Decree of 12 December 1977 defining the statutes of the radio-télévision belge de la communauté française (RTBF); and the Decree of 12 July 1987 on audiovisual matters.

The TV broadcasting stations recognised by the French-speaking community are as follows:

- *Public channel:*
  - RTBF;
- *Private channel:* For the whole French community;
  - RTL-TVI:
- *Private channels:* For local and community TV:
  - Antenne Centre (La Louvière);
  - No Télé (Tournai)

- Canal C (Namur)
- RTC-Liège.
- Télé Sambre (Charleroi)
- Télé Bruxelles
- Télé Vesdre (Verviers)
- TV Com (Ottignies)
- Télé Mons Borinage
- Vidéoscope (Rochefort)
- Canal Zoom (Gembloux)

– *Private channel:* For pay-TV:
  - Canal Plus.

The TV channels recognised by the Flemish Community are:

– *Public channel:*
  - Nederlandse Radio – en Televisienitzendingen in België, (BRTN)

– *Private channel:* For the whole Flemish community:
  - NV Vlaamse Televisie Maatschappij (VTM)

– *Private channels:* For local and community TV:
  - VZW Regionale Televisie-Omroep voor Ost-en West Vlaanderen (RTVO – East and West Flanders);
  - VZW Audio Video Studio (AVS – Ieklo);
  - VZW Antwerpse Televisie (ATV – Antwerp);
  - VZW Regionale Televisie Leuven (RTVC - Leuven);

– *Private channel:* For pay-TV:
  - Filmnet.

B3.5 Data broadcasting services

Teletext services are supplied by BRTN during the afternoon and evening. No advertising is permitted and approximately 300 pages are transmitted.

Videotex in Belgium has been provided by the RTT since 1986. It is distinguished by the fact that transmission takes place over the DCS public packet switched network and the user base is therefore mainly composed of professionals rather than residential users. The protocols used are compatible with télétel, Prestel and BTX. Growth has been steady, especially since the connection with télétel in France was established in 1988. At the end of 1990, there were some 7 750 subscribers, and 192 service providers.

B3.6 Video-based services

Belgium is the most densely cabled country in Europe with coverage close to 90 per cent of households. There are 43 operators either in the public sector, the private sector or joint mixed-stock companies. A licence from the municipal authority and from RTT are essential. The transmission of commercial TV programmes requires a further licence from the culture minister of the relevant community.

A commercial ISDN service, Aline, available at both 64 kbit/s and 2 Mbit/s has been operational in Belgium since June 1989. Trials for a broadband ISDN service began in 1993 with the aim of producing a laboratory test network in 1993. The research is being carried out jointly by the RTT and a grouping of equipment manufacturers known collectively as the Belgian Broadband Association (BBA).

A fixed video-conference studio was established by RTT in Brussels in 1988 and a mobile unit has also been made available. RTT is also participating in the European Community's own video-conferencing scheme.

B3.7 Specialised satellite services

The market for TV receive only and one-way VSAT terminals has recently been liberalised in Belgium subject to the type approval process. However, earth stations and two-way VSAT terminals remain as an RTT monopoly. The market for TVRO terminals in Belgium is likely to remain small as the country already has a dense cable TV network.

RTT is the sole Belgian signatory for international satellite organisations.

Figure B3. **Network dimensions and service revenues in Belgium**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	3 912.6	Thousands	1985-90	+5.2
Penetration rate		39.3	Per 100 inhabitants		
Medium & high speed lines (48 kbit/s-2 Mbit/s)	1990	348	Circuits	1985-90	+12.2
Cellular radio	1991	44.5	Thousands	1988-91	+60.7
Penetration rate		0.45	Per 100 inhabitants		
TV licences	1990	3 296.4	Thousands	1985-90	+3.9
Penetration rate		33.1	Per 100 inhabitants		
VCRs	1990	940.2	Thousands		n.a.
Penetration rate		9.5	Per 100 inhabitants		
Cable TV	1990	3 383.4	Thousand households		
Penetration rate		91.8	Per 100 households	1985-90	+2.8
Telecommunications					
Revenues	1990	90 026.5	BF million	1985-90	+8.2
	1990	2 572.2	US$ million	1985-90	+16.3
Broadcasting					
Revenues	1990	22 000.0	BF million, estimated		n.a.
	1990	628.6	US$ million		

n.a.: Not available.
Sources: RTT, Datapro, ITU, UNESCO, Renaud (1990).

B3.8 Cross-ownership and cross-provision

Cable TV and telecommunications are kept strictly separate under Belgian law though RTT does provide some inter-regional cables and satellite down-links. Interconnection principles are not relevant as there is only one network operator for telecommunications.

B3.9 Information sources

The principal source of information is the official Belgian comments submitted to the OECD on 4 December 1991 by Mr. R. Grainson, RTT.

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For other sources, see section B2.9.

B4. CANADA

B4.1 Telecommunications network operators

The telecommunications service market in Canada represents the outcome of a slow process of coalescence of small regional carriers. As recently as 1975 there were some 850 separate telephone companies. This has been reduced to around 100 major carriers of which those affiliated to Telecom Canada represent around 95 per cent of revenues. The single most important carrier is Bell Canada whose revenues account for around 55 per cent of the total.

In addition to the Telecom Canada affiliates, a second company, Unitel (formerly CNCP – 60 per cent owned by Canadian Pacific; 40 per cent owned by Rogers Communications Inc.) is involved in providing data communications, including messaging services. Rogers Inc. also owns Cantel, a cellular radio operator and has a 21.9 per cent share of Cancom, a satellite communications company. In 1990, Unitel filed an application with the Canada Radio-television and Telecommunications Commission (CRTC) to be allowed to provide long-distance voice telephony services in competition with existing carriers. Judgement is expected during 1992.

Most of Canada's international traffic is handled by Teleglobe Inc. except for connections with the United States which are negotiated directly by domestic carriers in the two countries. Teleglobe Canada was created as a Crown Corporation in 1950 and continued as such until 4 April 1987 when it was sold to Memotec Data Inc., a Canadian company with interests in networking and systems integration. Teleglobe's 1989 sales amounted to C$ 223 million (US$188.3 million).

The CRTC is the major regulatory body for both telecommunications and broadcasting in Canada. Until recently Provincial regulators played a major role, but following a court ruling in August 1989 it is now clear that CRTC's jurisdiction covers all carriers except those which are Provincial crown corporations. This geographical anomaly should be rectified shortly by an amended to the Railways Act which is the legislative basis for regulation in Canada. At the end of 1989, CRTC-regulated carriers, including Teleglobe, accounted for 78.8 per cent of the C$ 13.7 billion (US$ 11.6 billion) revenue of the Canadian telecommunications industry (excluding cellular radio services; see section B4.3 below).

B4.2 Telecommunications network facilities

Telecom Canada affiliates recently completed a Trans-Canada fibre optic network of over 7 000 km. However, the degree of digitisation in local networks varies considerably between carriers.

Unitel has also recently completed a coast-to-coast digital network using a hybrid of fibre and microwave, and hopes to be able to offer its customers an all-digital network by 1992.

A pilot project to establish the feasibility of providing fibre to the home was set up in 1988 and implemented in March 1990 at Rimouski, Quebec, covering 150 homes. The project is managed by Consortel, an R&D consortium set up jointly between a telecommunications carrier (Québec-Téléphone) and a cable TV distributor (Cogéco Télécom). The pilot project is intended to test the viability of providing interactive, digital services to the home including:

- voice telephony;
- data communications;
- videotex;
- ISDN to cover all low-speed applications (e.g. telemetry, energy monitoring);
- three high quality switched digital video channels for both cable TV and other services, including video on-demand and video databanks;
- HDTV;
- video output (e.g. for video-telephony or video-conferencing).

At present, Consortel operates with a division of labour drawn along regulatory lines so that Québec-Téléphone looks after telephony and videotex while Cogéco Télécom handles the video services.

B4.3 Mobile communications services

There are more than 120 common carriers in Canada providing cellular radio and radio paging services. However, there are only two major companies operating on the market:

- Cellnet Canada, which consists of the cellular radio subsidiaries of Telecom Canada and its affiliates which provide services in their own geographical regions;
- Cantel Inc., which is a wholly-owned subsidiary of Rogers Communications Inc. and has been licensed to provide a nationwide cellular radio system since 1985.

Both Cellnet Canada and Cantel operate an AMPS-based system at 800-900 MHz.

B4.4 Broadcast TV operators

The broadcasting sector in Canada is even more fragmented than the telecommunications sector, but it is possible to recognise a number of major clusters:

- Canadian Broadcasting Corporation (CBC), the major public broadcasting channel. In March 1990 it had 29 directly-owned stations and a further 29 affiliated stations. It is funded 90 per cent from government sources with the rest from advertising.
- Other public broadcasting organisations owned by provincial governments and providing mainly educational material.

- Five major privately owned television networks which account for the majority of commercial TV, including CTV, Global Television, Le Réseau de Télévision Quatre Saisons, the TVA Network and the Atlantic Satellite Network.
- Some 1 968 separate cable TV systems operators (including SMATV) in 1990, up from 950 in 1986. Despite the large numbers, there is in fact a relatively high degree of concentration with around 80 per cent of Canadian subscribers belonging to just five major companies.
- Other services including pay-TV, speciality services, microwave TV (MMDS) and pay-per-view (PPV).

The broadcasting industry in Canada is regulated by the CRTC which operates a system of licensing operators for regional franchises. The CRTC is concerned to maintain a balance between the different languages groups and cultures in Canada and to promote the domestic film industry and Canadian programming.

B4.5 Data broadcasting services

Data broadcasting services are provided both by broadcast TV operators and telecommunications operators in Canada, and this is one of the areas in which the overlap and competition between the two sectors is most evident. The main services on offer include:

- Non-programming services, alternatively known as alphanumeric channels and carried mainly by cable TV operators. Non-programming services include home shopping, classified advertisements, and property advertising. The Canadian Cable Television Association (CCTA) estimated that revenues from these services amounted to C$1.6 million (US$1.2 million) in 1987 or 0.2 per cent of total CATV revenue. The provision of full-motion video on non-programming services is prohibited.
- Videotex services of which the principal example is ALEX, operated by Bell Canada. It was piloted in Montreal in 1988 and was extended to Toronto in April 1990. It now has around 20 000 subscribers for services which include home shopping, database searches, railway timetables, etc..
- Audiotex services, or ''976 services'', are treated as other value-added services, though the regional carriers have a monopoly on switching and service providers are granted access to the network on a non-discriminatory basis. The tariffs for 976 services are regulated but not the content. Recently, a citizens advisory panel has been set up to advise Bell Canada and the CRTC on content regulation for audiotex services. Other data broadcast services such as teletext and datacasting can be developed upon application to the CRTC under a generally liberal environment.

B4.6 Video-based services

Canada has a dense cable TV network and a tradition of service innovation. Consequently, even though non-programming services offered by cable TV operators are

relatively inconsequential as a proportion of overall revenue, they have considerable growth potential. One specific example of service innovation is the Vidéoway service, offered by Vidéotron since 1989 in Quebec. As well as videotex and video games, Vidéoway also offers interactive TV. The principle underlying Vidéoway is to offer the possibility of home editing of different programme feeds. So, for instance, a viewer watching a tennis match might be able to choose between several different camera angles, or in a weather forecast between forecasts for different regions. The take-up of the service has been good and 55 000subscribers were expected by the end of 1990. The special converter terminal can also be used as a pay TV decoder. If successful, a higher degree of two-way interactivity will be introduced at a later date.

A second form of experimental use of video is for a pay-per-view pilot which was licensed by the CRTC in 1990 to be offered to 20 000 subscribers in Saskatchewan by Allarcom Pay TV Ltd. Pay-per-view in this sense can be regarded as a half-way stage to true video-on-demand in that the service is in close to "video on the hour" with viewers able to choose between a range of different programmes distributed between certain hours of the evening.

A third form of video-based service is in security systems; another market which is currently being targeted by both telcos and CATV companies.

For their part, a number of CATV operators have taken a minority shareholding in a company called Cableguard which offers closed circuit TV monitoring of premises. The telcos are offering more conventional forms of telesurveillance.

Finally, video-conferencing services are offered in Canada, as elsewhere, primarily by the telcos including Telecom Canada (Video Forum service), Teleglobe (Confratel service), Unitel and Telesat.

B4.7 Specialised satellite services

There are two main satellite organisations operating in Canada:

- Telesat Canada, established in 1969, is jointly owned by the federal government and Telecom Canada. Until 1987, its primary role was in acting as a carrier for other organisations, mainly Telecom Canada affiliates and broadcasting organisations. However, in that year the CRTC approved changes in its operating agreement allowing it to sell its services directly to end users. Telesat Canada now provides private VSAT networks and operates a number of teleports.
- Cancom (Canadian Satellite Communications Inc.), a value-added reseller of satellite services which provides data communications, broadcasting, private VSAT networks and other communication services. Cancom is privately-owned with some 21.9 per cent being in the hands of Rogers Communications Inc.

B4.8 Cross-ownership and cross-sectoral service provision

The scope for direct competition or co-operation between cable television and telephone companies is very limited under the current Canadian federal regulatory framework. The Canadian Cable Television Association (CCTA) estimates that areas in which

competition exists at present (e.g. non-programming services) account for less than 1 per cent of total cable TV revenues and are peripheral to the core business interests of the two sectors.

The legal basis for this structural separation is the Broadcasting Act which defines the licensing arrangements for "broadcasting undertakings". Telephone companies are excluded under this legislation and furthermore, as CRTC regulations allow only one cable company to serve a market, telcos wishing to get into cable TV must seek out an unserved area (less than 30 per cent of the Canadian population in mainly rural areas) or seek a waiver (as Sasktel has done for the Rimouski pilot project). Bell Canada is specifically prohibited from entering the cable TV market.

In a similar manner, it is currently impossible for companies which are not members of Telecom Canada (e.g. broadcasting companies) to own and operate telecommunications facilities. Reselling is possible, but only in the domain of "value-added services". However, it is theoretically possible for "non-carrier provided local system and public non-voice systems" to be interconnected with the public telecommunications network. Thus it is possible to create hybrid networks.

In spite of these regulatory obstacles, there have been some moves towards cross-provision and cross-ownership. In particular, Rogers Communications Inc. (see profile in main report) has positioned itself to provide cable TV, mobile communications and (via Unitel) data communications services. In the future Rogers may also be able to offer long-distance voice telephony services via Unitel. However, the real prospects for synergy lie in being able to use the same network for both types of service. The fibre-based switched network architecture which Rogers is installing currently in Toronto could theoretically be used for shared services at some stage in the future if regulations permit.

In September 1989, the Canadian Dept. of Communications invited public comment on the future evolution of local distribution networks as part of a major policy review. In the interests of promoting competition, two general principles are put forward in the notice of inquiry:

- no cross-subsidisation between broadcasting and telecommunications services;
- non-discriminatory access to networks between cable TV companies and telcos.

The comments received by May 1990 generally supported these two propositions but there was less support for the idea of promoting a competitive duopoly in local distribution networks and no real consensus on future technological trends. Some policy changes are likely as a result of the review, but it is too early to judge what direction these will take.

Figure B4. **Network dimensions and service revenues in Canada**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1989	14 601	Thousands	1984-89	+5.1
Penetration rate		56.3	Per 100 inhabitants		
Cellular radio	1990	462	Thousands	1986-89	+74.1[1]
Penetration rate		1.78	Per 100 inhabitants		
TV receivers	1987	14 895	Thousands	1980-87	+5.0
Penetration rate		57.4	Per 100 inhabitants		
VCRs	1988	5 398	Thousands		n.a.
Penetration rate		20.8	Per 100 inhabitants		
Cable TV	1989	8 661	Thousand households	1985-89	+4.1
Penetration rate		98.8%	Of households in franchise areas		
Penetration rate		78.8%	Of households		
Telecommunications revenues	1989	13 697	C$ million	1984-89	+5.9
	1989	11 564	US$ million	1984-89	+8.3
Broadcast TV revenues	1987	2 120	C$ million[2]		n.a.
	1987	1 599	US$ million[2]		n.a.
	of which: 37.8% from Govt. funds, 57.2% from advertising, 5.0% from other sources.				

n.a.: Not available.
1. Cantel only.
2. Including public radio services.
Sources: CRTC, Telecom Canada, Wall 1991, CCTA, ITU, UNESCO.

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B5. DENMARK

(Questionnaire response received on 30 April 1991
and additional comments on 2 December 1991)

B5.1 Telecommunications Network Operators

Since 1987, Denmark has had a system of regional telecommunications franchises which, even though they do not compete directly with each other, provide a form of competition through "emulation" and the matching of performance criteria. This system was modified in 1987 and again more recently following a political agreement reached on 22 June 1990 which passed into a new law on 14 November 1990. The most recent trend has been towards centralisation through the establishment of a holding company, Tele Danmark, which will fully own all five telecom companies, and will have a concession running from 1 March 1992 for five years. The Government will own 51 per cent of Tele Danmark with the rights to purchase the remaining shares at 125 per cent of their face value.

The five operating companies for the PSTN are:

- Copenhagen telephone company (KTAS – Københavns Telefon Aktieselskab) with approximately 47 per cent of the subscriber base.
- Jutland telephone company (JTAS – Jydsk Telefon Aktieselskab) with 39 per cent of the installed base.
- Funen telephone company (FT – Fyns Telefon) with 8 per cent of the installed base. Until the recent changes, FT was a municipal co-operative enterprise.
- South Jutland Telecom (SJT – Tele Sonderjylland) with 4 per cent of the installed base. Until the recent changes, SJT was a state enterprise, run as a part of the central P&T administration.
- Telecom Denmark (ST - Statens Telejeneste) responsible for international telecommunications services, the national trunk network of inter-regional links, and national radio & TV broadcasting. Until the recent changes, Telecom Denmark was a state enterprise run as part of the central P&T administration.

The reason put forward for the greater degree of centralisation is the need to foster international competitiveness, to strengthen R&D and the development of the Danish electronics industry, to continue to improve operating performance and to meet CEC directives in the telecommunications field. Even though Tele Danmark will be granted overall group management, it is expected that the regional operating companies will be preserved. For instance, tariff harmonisation is not expected.

The VANS market was liberalised in Denmark in June 1988, though the scope for simple resale is strictly limited. The data communications market is due to be liberalised

by 31 December 1992 and a second mobile operator with a GSM license is due to start operations after 1 March 1992.

Regulatory functions for radio broadcasting type approval and access to the mobile telephone network are currently carried out by the National Telecom Agency (NTA), which is answerable to the central P&T administration. When the changes described above are implemented, the NTA will be functionally removed from service operations. The licensing of operators is currently performed by the General Directorate of PTT.

B5.2 Telecommunications network facilities

Denmark has a high level of telephone penetration and a relatively sophisticated network. In 1990, 65.6 per cent of trunk lines and 44.8 per cent of central switches were digital. The level of digitisation is highest in Tele South Jutland. These percentages are expected to rise to 93 per cent and 75 per cent respectively by 1995.

An extensive fibre optic network is operated by Telecom Denmark and the regional companies. Fibre optic cable constitutes 41.6 per cent of the trunk network at present and this is expected to rise to two-thirds by 1995. For radio and TV broadcasting, a separate "Hybrid Network" is operated which has a fibre trunk but co-axial subscriber connections. Some degree of convergence involving the use of the Hybrid Network for broadband data communications as well as cable TV is possible.

Fibre in the local loop is relatively restricted at present (less than 1 per cent of total cable). A fibre network in the Cophenhagen area of more than 13 000 km has been laid as part of the city district heating network. When competition in data communications is introduced after 1992, this network, which is already one of the world's largest, could theoretically be used for commercial telecommunications purposes.

A number of pilot projects are currently being conducted in Denmark. These include:

- A field trial to test the practical application of an optical fibre network to provide TV and radio programmes in rural and thinly-populated areas.
- A field trial to test the practical and economic feasibility of a purely optical distribution and feeder network.
- A pilot project based on fibre to the home. Four individual fibres are provided to each home. These are used for CATV, telecommunications services and interactive videotex with the fourth reserved for broadband ISDN.

B5.3 Mobile communications services

Denmark, in co-operation with other Nordic countries, launched the NMT 450 cellular radio service in 1981. It reached its full capacity in 1987. In that year an NMT 900 service was opened and coverage has slowly been increased to cover the whole of the country. A GSM service, with two competing operators, is due to commence in March 1992. Tele Danmark Mobil was recently created as a wholly-owned subsidiary of Tele Danmark, responsible for mobile communications services. A second GSM licence was awarded in May 1991 to Dansk Mobil Telefon. The NMT systems are currently operated

by Tele Denmark Mobil on behalf of the regional operating companies. At the start of 1991, there were 151 300 subscribers.

The National Telecom Agency (NTA) is responsible for allocating the use of the frequency spectrum in Denmark. At present no charges are levied for the use of the spectrum.

A radiopaging service, OPS, was established by the P&T administration in 1983 and is operated today by Tele Danmark Mobil with 60-70 000 subscribers.

B5.4 Broadcast TV operators

The national broadcasting organisation, Danmarks Radio, which was established in 1925, held a monopoly on over-the-air broadcasting until June 1986. Danmarks Radio is not permitted to carry advertising and is funded from a licence fee. A new radio and TV broadcasting act of 4 June 1986 authorised the establishment of TV2, an independent broadcasting organisation which is funded partly by advertising (strictly regulated) and partly from the licence fee. In addition, there are a number of local TV stations. The transmitter networks for both Danmarks Radio and TV2 are operated under contract by Telecom Denmark.

B5.5 Video-based services

Denmark has a relatively dense cable TV network. There are no ''CATV companies'' as such and ownership is restricted to telephone companies, local municipalities or user associations. Inter-regional transmission is operated by Telecom Denmark. The Hybrid Network provides the backbone of the service distributing up to 24 TV channels to 530 000 households. However, nationwide coverage has not yet been established by the Hybrid Network and in the meantime a number of small, independent systems with down-links via a TVRO have been established. Of the four regional operators, the KTAS/ Cabel-TV network has approximately 300 000 subscribers and Funen Telecom/Cabel-TV has around 40 000. South Jutland Telecom has not established a hybrid network. Competition to cable comes from DBS and SMATV. For the latter, a new market entrant since 1989 is Finvik, part of the Swedish Kinnevik Group. Finvik offers a partial pay-TV system.

Market trials are currently being conducted for the provision of video-telephony via ISDN. Video-conferencing services are provided by Telecom Denmark as part of the European Video-conferencing System (EVS). There are 4-5 public studios in Denmark owned by the Telecom administration, and approximately five private studios. All the studios operate using 2 Mbit/s transmission and most are connected to the Danish MegaNet switched network. Telecom Denmark links into international services via 2 Mbit/s links with Hamburg and Stockholm and other centres served by satellite.

An internal video-on-demand type of service is operated by Telecom Denmark in serving the needs of the two Danish TV channels and smaller local TV channels. Approximately 50 per cent of all live TV transmissions are provided in this way using microwave and the 140 Mbit/s Hybrid Network.

There are also three or four different projects experimenting with interactive video service. These are mainly for distance learning and agricultural support services. In addition, a network called RESAM (Remote Expert Support for Aircraft Maintenance) has been established to test the viability of advanced broadband communications for aircraft maintenance including video-conferencing, remote tutorial assistance and access to video libraries.

B5.6 Data broadcasting services

A videotex service, Teledata, that is compatible with Prestel, BTX and ASCII, was introduced by KTAS and JTAS but has grown only slowly and had less than 2 500 subscribers at the start of 1989.

Teletext services (400 pages per day) are provided by the TV news department of Danmarks Radio as well as by TV2.

A toll-free telephone service (Grønt Nummer) has been in operation since October 1989.

B5.7 Specialised satellite services

The Danish Party to the international satellite agreements and conventions is the Government, represented by the General Directorate of the P&T, while the signatory is Tele Danmark. Tele Danmark also represents Denmark in NORDTEL, the Nordic co-operation set up in 1980. At present, two satellite transponders are used for telecommunications purposes. Denmark is also a member of the Nordic Satellite System, Tele-X, set up in March 1989 for DBS TV and business TV. TVRO markets have been liberalised in Denmark but VSATs remain a monopoly.

Telecom Denmark operates a satellite earth station at Blavand for handling INMARSAT-C traffic for the Atlantic Ocean region including Europe, the Middle East and Africa. This service is used for low-speed data applications and mobile tracking systems.

B5.8 Cross-ownership and cross-sectoral service provision

The level of cross-ownership in Denmark is relatively low following the laws set down in the telecommunications and broadcasting acts of 1990 and 1986 respectively. Telecommunications companies cannot obtain a licence to broadcast though in the field of cable TV there are a number of joint ventures between local municipal associations and user associations with telcos, or direct ownership by telcos such as the KTAS/Cabel-TV network. On the other hand, cross-sectoral service provision is actively promoted by the government by encouraging telcos to provide infrastructural support for cable TV and the over-the-air TV network. Indeed, policy decisions have encouraged the creation of a fibre optic based dual-use telecommunication and broadcasting network, the Hybrid Network or DOCAT (Digital Optic Cable TV). Similarly, since April 1990, all cable networks constructed must have a star configuration, i.e. not tree and branch and therefore having the theoretical possibility of providing a two-way switched service. At

Figure B5. **Network dimensions and service revenues in Denmark**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	2 909.3	Thousands	1985-90	+3.4
Penetration rate		56.7	Per 100 inhabitants		
High speed (>1.5 Mbit/s) leased lines	1990	1 340	Connections		n.a.
Cellular radio	1990	151.3	Thousands	1988-90	+25.3
Penetration rate		2.94	Per 100 inhabitants		
TV receivers	1989	2 215.0	Thousands	1980-87	+0.9[1]
Penetration rate		43.2	Per 100 inhabitants		
VCRs	1989	720.0	Thousands		n.a.
Penetration rate		14.0	Per 100 inhabitants		
Cable TV	1991	1 300.0	Thousand households	1987-91	+41.0
Penetration rate		59.0	Per 100 households		
One way satellite antennae	1991	36 000	Antennae		n.a.
Two way satellite antennae	1991	50	Antennae		n.a.
Telecommunications revenues	1989	12 796.0	Danish Kr million	1984-89	+13.8
	1989	1 750.0	US$ million	1984-89	+16.9

n.a.: Not available.
1. Growth in licences.
Sources: Telecom Denmark, UNESCO, ITU, Danish questionnaire response.

present, however, public telecommunications services cannot be provided over the subscriber link of a CATV network. Only Tele Danmark can use the same network to share TV and telephony signals, and then only in the trunk network.

What is less certain is the degree of real competition that is implied by the system of emulation between regional operators. At present, they have more to gain from co-operation. Nevertheless, in Denmark there is the potential for a second fixed link telecommunications operator to emerge based either on the cable TV network or the urban district heating network, such issues will undoubtedly be discussed again when Tele Danmark's franchise comes up for renewal in March 1997.

B5.9 Information sources

The principal source of information is the Danish response to the OECD questionnaire delivered on 30 April 1991 by Mrs. Vibeke Petersen, Head of Section, General Directorate of P&T, with further comments sent on 2 December 1991.

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For further information, please see section B2.9 and B3.9.

B6. FINLAND

(Questionnaire response received on 15 March 1991)

B6.1 Telecommunications network operators

In the local loop, there are some 55 different concessions of which:

- fifty-two are defined geographically;
- one is defined geographically and in terms of the telecommunications services which can be provided;
- two are defined in terms of the kind of telecommunications services which can be provided and/or by the minimum speed of network connection.

For long distance services, there are four concessions in all, of which:

- one is unlimited;
- three are defined in terms of the telecommunications services which can be provided.

In theory, additional concessions could be granted for microwave networks. For cellular, satellite and other network concessions, please see below.

The Council of State in the Government is responsible for licensing network operators. All concessions should be Finnish, that is, registered and established in Finland.

B6.2 Telecommunications network facilities

In the main public telecommunications network, the level of digitisation was 28.8 per cent of exchange lines and 47.2 per cent of exchange switches at the start of 1990. These figures are expected to increase to 50 per cent and 60 per cent respectively by 1995.

At the start of 1990, some 30 615 km of fibre optic cable and other broadband connections (e.g. coaxial cable for cable TV) had been laid. There are no extensive pilot programmes for fibre to the home/desktop underway. Instead, development has been concentrated on terminal and transmission equipment.

B6.3 Mobile communications services

The following operators are licensed to provide mobile communications services:

Service	Operators	Technology	Spectrum
Cellular radio	2	NMT	450, 900 MHz
Digital circular radio	2	GSM	900 MHz
Telepoint	52	CT2 etc.	900 MHz
PCN	52	not chosen	
Radiopaging	52	several	
Other (Trunking networks)	53	diverse	

The GSM networks are expected to start operating in the summer of 1991. Telepoint is at an experimental stage, but commercial operations in a few cities are expected also in the summer of 1991. PCN is still on the distant horizon.

Radiopaging is offered both locally, in a few places, and nationwide. Finally, there are around 25 trunk radio networks in use though only one concession covers the whole of the country.

The organisation responsible for frequency allocation is the Telecommunications Administration Centre (TAC) which is an independent telecommunications regulatory centre reporting directly to the Ministry of Transport and Communications. No charges are made for the use of the frequency spectrum.

B6.4 Broadcast TV operators

The following broadcast TV operators are licensed in Finland:

- Public TV (terrestrial): The Finnish Broadcasting Corp.
- Commercial TV (terrestrial): Mainos-TV Co. Ltd., Kolmos-TV Co.
- Cable, satellite and pay-TV: 205 units

Operators are licensed by the Council of State and all concession holders must be Finnish citizens or entities.

B6.5 Data broadcasting services

In Finnish legislation, videotex services are viewed as being a computer database service rather than a data broadcast service.

A teletext service is offered publicly, and free of charge, by the Finnish Broadcasting Corp. under the name Text TV. The Finnish Broadcasting Corp. has also applied to offer a Datacast service through its transmitter network.

B6.6 Video-based services

Cable TV is operated by:

- The Finnish PTT in 72 locations;
- Regional PTOs in 40 locations;
- CATV co-operatives or apartment companies in 33 locations, plus other "companies" operating systems in small apartment blocks (under 120 households);
- Cable TV companies in 30 locations;
- Others in 30 locations.

There are no restrictions on the number of channels that cable TV companies can distribute and so most of them distribute satellite TV and a few offer pay-TV. For channels which transmit their own programming, domestic production must equal 15-50 per cent of total programme time depending upon the terms of each concession.

A slow-scan video-telephony service is offered on a 64 kbit/s digital, end-to-end switched Integrated Digital Network (IDN) though this is a service which depends upon the intelligence resident in the terminal rather than the network. A 2 Mbit/s normal-scan service is under development.

The Finnish PTT and a number of regional operators also offer a public video-conferencing service.

B6.7 Specialised satellite services

At present, the Finnish PTT is the only organisation permitted to run international telecommunications services, and this monopoly extends to all networks including satellite services. Many satellite services, such as satellite TV, are shared with other Nordic countries and it is therefore hard to determine the number of transponders in use. It is estimated that there are around 10 000 TVROs in Finland, though this market was liberalised in 1988 so no exact numbers are available.

The Council of State is ultimately responsible for regulating the use of satellite systems in Finland with technical aspects being handled by the Ministry of Communications and the TAC. The Finnish PTT operates the uplink with INTELSAT and INMARSAT.

B6.8 Cross-ownership and cross-sectoral service provision

There are no formal restrictions which prevent the cross-ownership of telecommunications and broadcasting companies. However, foreign ownership is limited to a maximum of 20 per cent of shares or, with special permission, 40 per cent. This restriction applies to all sectors of the Finnish economy, not just communications. The upper limit of ownership limits the rights of the company to own real estate, though this legislation is currently under review.

Telecommunications companies wishing to offer broadcast signals, direct to the public would need a concession from the Council of State, though there is no restriction on programme exchange. One cable TV company has applied and been granted a

Figure B6. **Network dimensions and service revenues in Finland**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	2 581.8	Thousands	1985-90	+3.3
Penetration rate		52.2	Per 100 inhabitants		
High-speed lines (>1.5 Mbit/s)	1991	120	Connections		n.a.
Cellular radio	1991	133 686	NMT-450 subscribers		
		92 297	NMT-900 subscribers		
		29 372	ARP subscribers		
		255 355	Total	1988-91	+35.7
Penetration rate		5.16	Per 100 inhabitants		
TV receivers	1991	2 390.0	Thousands	1987-91	+6.7
Penetration rate		48.3	Per 100 inhabitants		
VCRS	1991	1 026.0	Thousands	1988-91	+12.4
Penetration rate		20.7	Per 100 inhabitants		
Cable TV	1991	616.0	Thousand homes	1988-91	+10.2
Penetration rate		42.3	Per 100 households		
Telecommunications	1988	6 925.0	Million Finn. Marks	1983-88	+9.7
Revenues	1988	1 657.9	US$ million	1983-88	+17.2
Broadcasting	1985	1 686.7	Million Finn. Marks		n.a.
Revenues	1985	310.9	US$ million		n.a.
	of which:	53.4%	from TV licence		
		42.9%	from advertising		
		3.7%	from other sources		

n.a.: Not available.
Sources: Finnish questionnaire response, ITU, UNESCO.

geographically-restricted concession for programme transfer and associated data communications. There are no restrictions on the sharing of network facilities such as cable, switches, ducts or trenches.

Each PTO in Finland has a number of obligations to interconnect with other PTOs and with value-added service providers (defined legally as a user in Finland) which are specified in the concession of licence. Interconnection and network access issues in Finland are administered by the Ministry of Transport and Communications and the TAC.

B6.9 Information sources

The principal source of information is the Finnish response to the OECD questionnaire delivered on 15 March 1991 by Mr. Vesa Palonen, Asst. Head of Dept., Department for Communications Administration, Ministry of Transport and Communications.

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For further information, please see sections B2.9 and B3.9.

B7. FRANCE

B7.1 Telecommunication network operators

During 1990, a number of new laws were passed which served to clarify the status of France Télécom, the principal state-owned network operator, without greatly challenging its monopoly. In particular:

- The law of 2 July 1990 which separated France Télécom from the postal service and which defined its new status as a ''public operator'', able to compete with a higher degree of autonomy in competitive markets and in the international arena (''corporatisation''). This new law altering the legal status of France Télécom replaced an earlier law dating from 1923. The new law became operative on 1 January 1991.
- A reform of telecommunications regulation which defines the areas of France Télécom's monopoly, the areas of open competition and the grey areas of regulated competition. In addition the new law defines the areas of responsibility between the telecommunications regulatory body, the Direction de la Réglementation Générale (DRG), and the audiovisual regulatory body, the Conseil Supérieur de l'Audiovisuel (CSA). In so doing, the new law supersedes an earlier law of 30 September 1986 which had established the Commission Nationale Communication et Libertés (CNCL) which covered the communications sector as a whole. The new regulatory law itself replaced an earlier law dating from 1837.

Under the new regulatory regime, the monopoly area of the public network operator is defined as encompassing:

- fixed link transmission network for voice telephony (the PSTN);
- public payphones;
- the telex network.

In return, France Télécom must meet certain ''public service obligations'' (in French, ''Cahier des Charges'') covering aspects such as service availability, quality, technical criteria, public defence and security requirements, and universal service obligations.

Infrastructure competition is limited to mobile communications services using the electromagnetic spectrum. In this area, a system of licensing of operators is maintained. All potential operators must fill the following criteria:

- serving the public interest by providing services not covered by the public network;
- compatibility with the public operator, in particular not undermining its tariff structure;

- meeting a number of public service obligations including paying for the use and management of the frequency spectrum, and a contribution towards research and standardisation work.

Foreign ownership in mobile operators is limited to 20 per cent of share capital.

The new law also defines a category of "support services" which are subject to regulation. This category covers transport services for data communication and it is subject to a licensing regime similar to that for mobile communications. The obligations specified by the Minister for Telecommunications would cover the geographical coverage, the availability, continuity and quality of service, and technical specifications.

Under the new law, equipment markets remain liberal though the procedures for type approval have been modified to meet the CEC Directive on mutual type recognition. The value-added network services market is also relatively open: Services provided over public switched networks (e.g. télétel services to minitel terminals) are fully open, services based on leased lines must be declared, and services above a certain size and capacity must be authorised.

B7.2 Telecommunications network facilities

Following a period of high investment in network expansion and modernisation during the 1970s and early 1980s, the public telecommunications network in France has been transformed and is now highly technically advanced. cIndeed, in a number of areas such as network digitisation, ISDN, packet-switching and cardphones, France is in a position of technical leadership.

At the start of 1990 some 74 per cent of the transmission network and 70 per cent of the real-time switching network was digital. During 1989 some 85 000 km of monomode fibre was laid.

The French ISDN service (Numéris) has been in operation at the basic rate (64 kbit/s) since 1986 and at the primary rate (2 Mbit/s) since 5 October 1989. France Télécom has conducted an extensive pilot programme for broadband ISDN, including video-telephony, in the town of Biarritz in South-west France since 1983.

France Télécom has a strong reputation for basic research with some 1.8 billion francs (US$282 m), or 2 per cent of turnover, committed to the CNET (Centre National d'Etudes des Télécommunications).

B7.3 Mobile communications services

By comparison to other sectors of telecommunications, mobile communications services in France are less developed. France has adopted a technology which is not truly cellular and which is not used elsewhere in the world. As a consequence, the available frequencies are limited and, in certain areas such as Paris, the system rapidly became saturated. The main hopes for mobile services in France are centred on the rapid adoption of the digital GSM standard, and the cordless telephone service, "Pointel".

France Télécom's mobile telephone network, Radiocom 2000, which operates in the 200 MHz and 450 MHz ranges, began operating in November 1985. At the start of 1990,

there were some 170 000 subscribers, a growth of 70 per cent during the year. Coverage can now be guaranteed to 80 per cent of the landmass and 96 per cent of the population of France.

A second, private operator, Société Française du Radio Telephone (SFR) opened for business in March 1990 using a modified version of the NMT 450 standard. SFR was formed by a consortium of the equipment manufacturers, Alcatel (France) and Nokia (Finland), with the water utility Générale des Eaux. SFR's current frequency allocation gives it a maximum capacity of 140 000 users.

In March 1991, the French Minister announced that France Télécom and SFR would each be granted licences to operate GSM-based digital cellular radio systems starting in 1992. A frequency allocation of 25 MHz would be split equally between them giving a theoretical capacity of four million users.

Radiopaging in France is offered both directly by France Télécom: Alpha page service, opened in 1988 and Eurosignal, opened in 1975) and by the broadcasting operator Télédiffusion de France (TDF) which is 51 per cent owned by COGECOM, the France Télécom holding company (Operator, a digital service).

A cordless telephone service, Pointel, is due to be opened by France Télécom in Strasbourg in 1991. The technology is close to that of Telepoint used in the UK, but differs in the crucial feature of being able to receive incoming calls from a public base station.

B7.4 Broadcast TV operators

Until the 1980s, both TV and radio broadcasting were state monopolies in France. Private competition was allowed in radio from 1982 onwards and in television from 1984 onwards. There are now four main terrestrial channels:

- TF1, which was privatised in March 1987 with 50 per cent of the shares going to a consortium of operating companies (main shareholder is Groupe Bouygues), 40 per cent of the shares were floated are the stock exchange and 10 per cent went to employees;
- Antenne 2 (A2), state-owned;
- France Regional 3 (FR3), a state-owned channel with a regional emphasis;
- M6, a private company licensed in 1987 which is 25 per cent owned by CLT (Compagnie Luxembourgeoise de Télévision).

Other terrestrial TV companies broadcast from Luxembourg (RTL) and Monaco (RMC). Télédiffusion de France (TDF), a 51 per cent subsidiary of France Télécom, is responsible for broadcast transmission.

In addition to the terrestrial channels, there are a number of other TV channels:

- Canal Plus, set up in 1984 with the Havas agency as the main shareholder, which is a pay-TV channel broadcasting mainly first-run movies and sports events. The programmes are distributed over-the-air, by cable and by satellite and are scrambled for most of the day.
- La Sept, a state-owned "culture" channel that broadcasts by satellite, by cable and, via the ARTE network.

– Other channels broadcasting by satellite and by cable including Canal J, TV Sport and Paris Première.

B7.5 Data broadcasting services

The great success of the French videotex service, télétel, which is delivered by minitel terminals, has put all other forms of data broadcasting in the shade. Even audiotex services seem to be primarily a spin-off from, or a back-up to, videotex.

The minitel strategy of providing consumers with a free terminal for an electronic directory service is well-documented (see, for instance, *Videotex Development Strategies,* ICCP Series No. 16, OECD). At the start of 1990 there were five million minitel terminals in France of which a growing number are advanced terminals used by businesses or private subscribers who pay rental fees. The rate of growth of traffic has slowed down (+16.6 per cent between 1989-90) but the number of information providers goes on increasing with some 13 000 at the last count.

Teletext services (Antiope) are available on TF1, A2, FR3 and Canal Plus.

Toll-free telephone services are marketed under the name ''Numéro Vert'' in France. In 1989 there were 13 000 subscribers of which 1 000 subscribed to the international service.

B7.6 Video-based services

Cable TV is relatively underdeveloped in France, though the number of subscribers has grown recently. Under the original ''plan câble'' announced in 1982, France Télécom was encouraged to develop a technically advanced fibre optic network. However, the number of subscribers grew only slowly to 35 000 in 1987. Under the 1986 law, France Télécom's monopoly was broken up and individual cities were permitted to give franchises to private companies. Among those who entered the market are Générale des Eaux, Lyonnaise des Eaux, Caisse des Dépôts et Consignations, Télédiffusion de France and the construction company Bouygues. The introduction of competition, together with a less ambitious technical plan, has seen the number of subscribers grow to 300 000. Some 3 650 000 homes were passed by early 1990.

France Télécom has invested heavily in research in video-telephony services, especially in its Biarritz pilot project. In November 1990, the French minister for telecommunications announced an ambitious plan to launch a video-phone service by 1995. An initial volume order for 100 000 video-phones has been announced with the supplier SAGEM. The objective is to bring down the unit price of the terminal to 5 000 francs (US$910) by 1995.

Video-conferencing facilities are offered by France Télécom in a number of major cities and from mobile units.

B7.7 Specialised satellite services

France Télécom is the sole national signatory to international satellite organisations such as INTELSAT and INMARSAT and has played a leading role in the establishment of EUTELSAT, which has its headquarters in Paris. France Télécom has a network of satellite earth stations which include centres at Pleumeur-Bodou, Bercency-en-Othe, Rambouillet and French overseas territories.

The TELECOM 1 series of satellites was marred by the failure of 1B, but 1A and 1C are now used extensively for TV programme distribution and business television. The TDF series of high power satellites have also suffered technical problems. Their commercial viability was also affected by from the French government policy of promoting D2-MAC as a broadcasting standard for satellite TV. D2-MAC is an interim standard en route to HD-MAC, a European high-definition TV standard. However, there is little programming material and there are few receivers equipped to benefit from D2-MAC broadcasting at present.

In theory, a licensing regime exists for TVRO satellite antennae, but in practice this is just a formality. VSAT terminals were a France Télécom monopoly until May 1991 when France became the third country after Germany and the UK to liberalise two-way VSATs. Polycom, a subsidiary of France Télécom and Agence France Presse operates an extensive VSAT data network in Europe, Asia and Africa.

Figure B7. **Network dimensions and service revenues in France**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	27 000.0	Thousands	1985-90	+4.1
Penetration rate		48.3	Per 100 inhabitants		
High speed data connections	1990	17 300	Connections		n.a.
Cellular radio	1990	170 000	Subscribers	1988-90	+134.0[1]
Penetration rate		0.30	Per 100 inhabitants		
TV licences	1987	18 459.0	Thousands	1980-87	+2.1
Penetration rate		33.0	Per 100 inhabitants		
VCRs	1988	7 878.0	Thousands		n.a.
Penetration rate		14.1	Per 100 inhabitants		
Cable TV	1990	300 000	Households	1987-90	+104.0
Penetration rate		1.5	Per 100 households		
Penetration rate		8.2	Per cent of households passed		
Telecommunications revenues	1990	94 500.0	Million Francs[2]	1985-90	+2.9[3]
	1990	14 812.0	US$ million[2]	1985-90	+6.5[3]

n.a.: Not available.
1. Radiocom 2000 only.
2. Includes contribution from COGECOM holdings not involved in telecom activities (estimated 4 630 million FF0.
3. Estimated growth; accurate figures are unavailable due to the introduction of VAT after 1988.
Sources: France Télécom, ITU, UNESCO.

B7.8 Cross-ownership and cross-sectoral service provision

France has a high degree of cross-ownership and cross-sectoral service provision. Examples include:

- the involvement of the PTO, France Télécom, in the provision of broadcasting infrastructure through the laying of cable, the provision of satellite television facilities and a 51 per cent ownership in TDF;
- the laying of fibre optic cable capable of two-way services such as video-telephony and broadband ISDN as well as CATV.
- The involvement of TDF in radiopaging operations.

However, given that the ultimate owner of both France Télécom and TDF is the government, the actual level of competition is practically zero.

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For additional information sources, please see sections B2.9 and B3.9.

B8. GERMANY

(The following text is based on a submission from the German authorities received on 11 September 1991)

B8.1 Telecommunications network operators

The telecommunications market in Germany has been transformed by the new legislation on the reform of Deutsche Bundespost (DBP) which came into force on 1 July 1989, and by the reunification of the western and eastern parts of the country which was completed on 3 October 1990. In talking of the current situation in Germany, it is continually necessary to stress the contrast between the western part, which at the start of 1990 had a penetration rate of 46.2 telephone main lines per 100 inhabitants with a ''gold-plated'' quality of service, and the eastern part which had a telephone penetration of just 10.8 per 100 inhabitants and an abysmal quality of service. In such circumstances, it is unrealistic to talk about an ''average'' figure for Germany.

With the reform of 1989, decisive changes were made to the telecommunications market. According to the Post and Telecommunications Ministry, in future the following principle will apply to this market: ''Competition is the rule, monopolies are the exceptions requiring justification.''

Telecommunications reform was marked by the following key elements:

1. The political and sovereign tasks of the Deutsche Bundespost have been separated from operational and entrepreneurial tasks, the former (e.g. the approval of terminal equipment, frequency allocation, monopoly regulation) being performed by the Federal Minister of Posts and Telecommunications, and the latter by three enterprises: DBP TELEKOM, DBP POSTDIENST and DBP POSTBANK.

2*a*. The network, telephone service and radio installation monopolies are maintained. The Ministry argues that the network and telephone service monopolies are required to finance infrastructural tasks.

2*b*. All other telecommunications services and telecommunictions terminal equipment can now be provided under competitive conditions. Deutsche Bundepost TELEKOM can participate in this competition.

3. In addition, the Federal Minister of Posts and Telecommunications has the possibility, by issuing licences in the remaining monopoly areas, of granting market access to private enterprises as co-competitors of Deutsche Bundespost TELEKOM. This possibility has already been employed several times. Meanwhile, various licences have been granted for mobile communications and private satellite networks.

The separation of the political and sovereign tasks from the entrepreneurial tasks was completed when the three enterprises, DBP TELEKOM, DBP POSTDIENST and DBP POSTBANK, were established on 1 January 1990. At the same time, the Ministry of Posts and Telecommunications took on the basic tasks of a regulator such as the FCC in the USA or Oftel/DTI in the UK. At present, the German constitution does not allow the three public Deutsche Bundespost enterprises to be transferred to companies under private law.

Even before unification on 3 October 1990, endeavours were made to create uniform and general regulatory conditions in both parts of Germany and also to implement the telecommunications policy pursued in the old states in the five new federal states within an acceptable period of time. In line with the provisions of the unification treaty, the *Law concerning the Structure of Posts and Telecommunications* has been in effect since 3 October 1990 for the whole of Germany in the field of telecommunications.

In view of the dire state of the telecommunications infrastructure in the former German Democratic Republic, it was considered necessary to support the endeavours made by DBP TELEKOM to develop an efficient telecommunications infrastructure by further private initiatives. A major step in this respect was DBP TELEKOM's decision to award contracts to private companies for a majority of its network development projects as "turnkey projects" and thus to ease the burden on its own resources.

Decisions in favour of the new states were also taken in the regulatory field. Private satellite operators have, for instance, been granted permission until the end of 1997 also to handle the telephone service traffic (third party switched voice) within the five new states and for their communications with the rest of Germany. In this way the offices in the former GDR with access to this service can reach virtually all telephone subscribers across the world and vice versa. This exceptional regulation, limited in time, does not mean however that the regulatory policy implemented in the eastern part of Germany is different from the one in the west. Operation of the terrestrial cable networks remains reserved for DBP TELEKOM in the former GDR, too.

B8.2 Telecommunications network facilities

The contrast between the western and eastern parts of the country is especially marked in their telecommunications network infrastructures. The western German network is relatively advanced, having benefited from a high level of investment per line.

According to DBP TELEKOM's plans for the digitisation of exchanges, the long distance network should be completely digital by 1995. At the local level, the existing analogue exchanges are to be replaced by 2019. Some 4bn DM will be spent for this purpose in both 1991 and 1992. Although at present there is no intention to accelerate digitisation, it may be necessary to replace exchanges at the local level more quickly due to various factors influencing network development, for instance the need for a broader international range of services and facilities, intelligent networks, or the use of optical fibres in the subscriber local loop.

By the end of 1990 roughly 135 cities had access to ISDN facilities. By the end of 1993, that is five years after its introduction, ISDN should be available nationwide. With the continuing digitisation of the telephone network towards an ISDN network, new and

more complex telecommunications services can be provided at transmission rates of up to 64 kbit/s, for instance videophones and image-based telephone services.

Another step towards implementing new nationwide services more rapidly and flexibly on narrowband networks, is the ''intelligent network'' concept. In 1992 a nationwide operational trial will start, with initially four services provided, (Service 130, Televotum, Tele-info service, universal access numbers). Other services requiring a higher degree of intelligence in the network will be implemented at a later date.

Two major objectives have shaped plans for establishing an optical fibre network for broadband person-to-person communication:

- Fibre optics was regarded in economic and operational terms as the standard solution for long distance communications. DBP TELEKOM has been using optical fibre technology as standard technology since 1983 in the trunk network for purely economic reasons and for inter-connecting new digital exchanges in the local network.
- The second objective was to provide a minimum optical fibre infrastructure (overlay network) at the local level and thus to create the prerequisites for developing and testing new broadband services. Following this plan, an optical fibre overlay network was established in 29 cities and will be completed by the end of 1991.

In addition, Deutsche Bundespost TELEKOM carried out pioneering work when putting into operation a digital automatic switched broadband network in February 1989. This research is not limited however to technological network innovations but aims primarily at the early development of market-oriented services for broadband person-to-person communication through an intensive dialogue with users and by testing these capabilities under real conditions of demand.

This broadband network, which is almost unique in the world, currently allows up to 1 000 interested subscribers to be connected. They are granted the opportunity to experiment with new forms of broadband communication and to develop know-how. In particular the video-conferencing service, which currently has some 240 private video-conference accesses used on a commercial basis via the broadband network, emphasizes the importance of this network and the interest demonstrated by users.

The operational objectives of the broadband network are supported and supplemented by the BERKOM (Berlin communication) project. In Berlin an extensive optical fibre test network, incorporating ATM (Asynchronous Transfer Mode) exchanges has been established on the basis of an overlay network. In the field of broadband applications and associated terminal equipment, the BERKOM project has focused on areas such as computer interworking, telepublishing and telemedicine, amongst others.

The close cooperation practised within the BERKOM project between DBP TELKOM and private industry, research institutes and interested users should ensure results which are realistic and technically promising. Co-operation with users should help DBP TELEKOM in the development and marketing of applications for broadband services which are in line with user requirements.

Along with the switched broadband network put into operation in 1989, TELEKOM already provides a mimimum optical fibre infrastructure close to the customer's home for new broadband services with a bandwidth of 140 Mbit/s. However, optical fibre systems in the subscriber local loop have not yet been shown to be successful. The subscriber

local loop is the most cost-intensive part of the telecommunications network and represents the outcome of long-term investment and development. Given this time frame, it is virtually impossible to forecast customer requirements, which are anyway partly contradictory, with any degree of accuracy for future investment.

In the next few years DBP TELEKOM's work will therefore focus on the objective of establishing the economic viability of optical fibre technology as a broadband transmission medium in the local network and in the cost-intensive subscriber local loop. For this purpose technical concepts are being elaborated which allow an optical fibre infrastructure to be built up through the economic use of established services. At a later date the optical fibre systems may also be used for less costly broadband communication services, thus creating a good basis for the future development and acceptance of these services and building upon existing experience at DBP TELEKOM in this area.

Broadband ISDN is a further step in the process of network innovation. The flexibility of Broadband ISDN is designed to meet all transmission requirements ranging from 64 kbit/s to more than 100 Mbit/s (through ATM switching). Broadband ISDN also offers the possibility of integrating different networks and telecommunications services ranging from the telephone, data, office and multimedia communication to videophones with TV quality, and with the longer-term possibility of distributing TV and HDTV broadcasts. This will amost certainly stretch ATM technology to its technical and economic limits. DBP TELEKOM intends to invite competition for pilot projects in ATM technology as early as 1991. The aim will be to convert these pilot projects into service offerings by the mid-1990s.

In the eastern part of Germany, work has initially focussed on establishing a modern telecommunications network. In accordance with the ambitious master programme "Telekom 2000", DBP TELEKOM intends to bring the telecommunications level of the new federal states to the level of the old states by 1997. This will involve installing:

- 50 000 Datex-P accesses;
- 68 000 coinbox and card telephones;
- 300 000 mobile communications accesses;
- 360 000 telefax accesses;
- more than 5m cable TV accesses;
- more than 7.2m telephone accesses.

In establishing a modern and efficient telecommunications infrastructure, the strategy is quite clearly directed towards digitisation. In mid-1991 eight digital main exchanges and four digital regional exchanges were put into operation. At the same time the old analogue network in the new federal states was connected to a new, efficient digital overlay network at the so-called upper network level. In addition, many junction lines were put into operation between the new and the old federal states. In this way, unification of the previously separate eastern and western telephone networks was initiated separated was begun. By putting into operation the digital overlay long-distance network and increasing the number of international circuits, it will be possible for all customers having a telephone to make calls in the new federal states and between the old and new federal states and abroad, largely without any problems. At the same time, around 500 000 new telephone accesses will be installed during in 1991. The cost of the establishment of a digital network in the eastern part of Germany is estimated at around DM60 billion between 1991 and 1997. The amount invested by DBP TELEKOM in 1991

alone totals approximately DM7 billion. DBP TELEKOM is thus the largest individual investor and employer in the new federal states.

B8.3 Mobile communications services

The German Telecommunication Installations Act grants the Federal Minister of Posts and Telecommunications the right to allow private activities within the monopoly areas by granting special licenses in the form of administrative acts or contracts under public law. This transfer of rights is however limited where DBP TELEKOM's infrastructural tasks are jeopardised. Legally, satellite and mobile communications are part of the monopoly of radio installations and transmission lines. In this area private activities are possible only on the basis of a licence granted by the Federal Minister of Posts and Telecommunications.

Through the licensing procedures, the know how and capital of private companies can be directed to the growth sectors of telecommunications. The licensees must fulfil specific infrastructural obligations fixed in the licensing conditions. One particularly important structural aim of the licensing policy has been to establish a fair basis for competition between DBP TELEKOM and its rivals. Pursuant to the Law concerning the Structure of Posts and Telecommunications, DBP TELEKOM can engage in this field without a licence.

The radio-telephone network (B/B2) of DBP TELEKOM was put into operation in 1968. The cellular C network was established in the 450 MHz band and has been operated since 1986. By the summer of 1991, this had around 430 000 users. Since unification, the C mobile communications network has been extended to the eastern part of Germany. It is envisaged that coverage will extend across the whole of the new federal states by the end of 1991.

Early in 1990 a licence was granted to Mannesmann Mobilfunk GmbH for establishing and operating a digital cellular mobile communications network on the basis of the GSM standard agreed for the whole of Europe. Mannesmann thus provides its mobile communications services over the D2 network in competition with DBP TELEKOM operating the D1 network. The Mannesmann Mobilfunk GmbH consortium includes Pacific Telesis with 26 per cent and Cable and Wireless with a 5 per cent stake.

Radiopaging in Germany is offered as the Eurosignal service, which has been operating since 1974 and the Cityruf service, which has been operating since 1989. In May 1990 this service was extended to eastern Germany, starting in Leipzig. At the start of 1991, there were some 290 000 subscribers.

Licences are also granted in other areas of mobile communications. Six licences for trunking networks had been granted to various consortia by mid-1991. In 1991 a total of 28 licences for trunking networks will be granted. Radiopaging and data broadcasting licences are also planned.

B8.4 Broadcast TV operators

In broadcasting (radio and television) a legal distinction is drawn between cultural and telecommunications aspects. Pursuant to Art. 73 of the Basic Law, the Federation has

power to provide regulations governing the technical equipment used for the transmission of broadcasts (excluding studio techniques). However, sovereign broadcasting functions relating to cultural matters, licences and the content of programmes are the responsibility of the individual states. This has led to a federal broadcasting structure.

Through their state media organisations (Landesmedienanstalten) the states take a decision on which broadcasting organisations are allowed to transmit broadcasts. For this purpose the states have enacted laws of their own. The states also allocate the frequencies provided by the Federal Minister of Posts and Telecommunications. On the other hand, the Federation is responsible for international broadcasting (Deutschlandfunk). Furthermore, terrestrial coverage is still subject to permission granted by the Federal Minister of Posts and Telecommunications.

Broadcasting is provided either under public law or under private law.

At present, there are three TV channels operating under public law:

- ARD (Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland), established in 1950. ARD is the sole shareholder in the satellite channel Eins Plus.
- ZDF (Zweites Deutsches Fernsehen), established in 1961 by a state contract of the Länder and originally intended as a centralised TV station. ZDF is the major shareholder in the satellite channel, 3-Sat along with ORF of Austria and SRG of Switzerland.
- A third channel (5 regional programmes) established by ARD in 1963.

At present, the legal basis for providing public law broadcasting in operation in the old federal states is being elaborated for the new federal states. Broadcast receiver licence fees are used for broadcasters operating under public law. These fees are paid by everyone having a radio set. Between 10 and 40 per cent are taken from advertising revenues.

There are also many broadcasters operating under private law. Of these, RTL plus, SAT1, PRO 7 and TELE 5 also provide their programmes over the terrestrial transmitter network (over-the-air), where the relevant frequencies are available. One or two of these four programmes can be received in each state. The legal basis of private law broadcasting was only established after 1980. Private-law broadcasters are exclusively financed by advertising revenues. There is also a pay-TV channel (Premiere).

The operator for terrestrial transmission systems is generally DBP TELEKOM, though ARD operates its own transmitters.

B8.5 Video-based services

In the former Federal Republic of Germany, television transmission is possible via a variety of different media including;

- broadband cable systems;
- satellite master antenna TV systems (SMATV);
- direct broadcast satellites (DBS);
- telecommunications satellites (e.g. ASTRA);
- terrestrial (over-the-air) systems.

MMDS (Multichannel Microwave Distribution Systems) are not used for direct customer provision.

With regard to the old federal states, some 8.95 m households were connected to the broadband cable network on 30 June 1991. 16.3 m households were passed by cable. Of a total of 26.3 m households 63.1 per cent are provided with cable television. No exact coverage ratio can be given for the new federal states; it is however planned to connect 550 000 households by the end of 1991 and 1.3 m households by the end of 1992 to the broadband cable network.

The right to establish and operate broadband cable systems is basically reserved for DBP TELEKOM. However, the monopoly ends at premise borders. When marketing cable TV accesses, the DBP is supported by private companies known collectively as RKS (Regional Kable-Servicegesellschaften) in which the DBP's holding is restricted to a maximum of 24 per cent. According to the Law concerning the Structure of Posts and Telecommunications the services based on broadband cable systems (e.g. broadcasting, paging) can also be provided under competitive conditions.

Decisions on which channels should be permitted are made exclusively by the individual states which negotiate directly with programmers. Consequently, to distribute programmes nationally in Germany, cable broadcasters must come to separate agreements with each of the states, including the five new eastern states.

The broadband distribution network for telecommunications services is probably further advanced in Germany than any other OECD countries following years of massive investment and planning towards the goal of establishing a broadband ISDN infrastructure. The idea has been to establish a switched fibre optic overlay network, initially covering 14 cities but later extended to 29, that could be used for video-conferencing and video-telephony as well as for radio and TV distribution alongside the narrowband ISDN. Pilot projects have been operated in Berlin (BIGFON Metropolitan Area Network; BERKOM fibre-to-the-home/desktop). By late 1990, DBP Telekom had installed around one million kilometres of fibre optic cable of which one quarter was in local networks and the rest in the trunk network. The plan is to extend the percentage of fibre in the local loop through replacement and extension networks in western Germany and through new builds in the east, as far as this is justified by cost and time. Seven trial projects are planned for optical access lines (OPAL) or fibre to the home/desktop. These are designed to test the capabilities of different network topologies and equipment from different manufacturers. The first trials were launched in May 1990 (Cologne) and the second in the third quarter of 1991 (Frankfurt/Main).

At present, the Bundepost has 12 regional video-conferencing centres which operate via fibre optic and satellite links.

B8.6 Data broadcasting services

Videotex in Germany is operated as the Bildschirmtext (BTX) service which began commercial operations in 1983. At the start of 1989, there were 148 000 subscribers. The BTX service can also be used for data transmission and an extensive, if low-speed, application is used in the pharmaceutical retail and distribution industry.

Teletext sevices in Germany are offered by ARD, ZDF and Sat 1 with roughly 500 pages per day.

B8.7 Specialised satellite services

Germany is only fourth, after Spain, the UK and France in its utilisation of EUTELSAT. Nevertheless, two recent trends counter-balance this:

- Germany pre-empted the European Commission by liberalising two-way VSAT terminals in the July 1989 reform. The terminals cannot be used for two-way voice traffic for third parties as this might infringe the telephone monoply. Any other service however is admissible. This also applies to medium and high speed data transmission (above 16kbit/s): here the licensee has only to give proof that he does not provide a telephony service, as this is reserved for DBP-TELEKOM. Interconnection with the public network is, however, basically admissible.
- The desperate need for a communications infrastructure in eastern Germany is likely to favour satellite technology if only as an interim measure before other fixed-link infrastructures are constructed. The Post and Telecommunications Ministry has recently licensed voice traffic by VSAT between east and west for up to six years.

Despite this generally liberal stance on satellite communications, DBP Telekom remains the sole signatory for international satellite organisations.

In broadcasting via satellite, a distinction is drawn between telecommunications and broadcasting satellites:

- TV-SAT (broadcasting satellite): provision of four television programmes (RTL Plus, SAT 1, ARD, Eins Plus) and 15 digital satellite sound broadcasting programmes;
- DFS Kopernikus (telecommunications satellite): provision of 11 television programmes and 21 sound broadcasting programmes (of which 15 digital satellite channels are identical to those of TV-Sat).
- ASTRA (telecommunications satellite): provision of currently 25 domestic and foreign television programmes (amongst others Sat 1, 3-Sat, Eurosport, ARD 1 Plus, DFKK, PRO 7, Premiere, TELE 5) and 12 sound broadcasting programmes.

There is a licence fee payable for the use of SMATV equipment in Germany. In theory the states control which programmes are distributed, but this control is only nominal. The German DBS strategy has been based on the TV-Sat high power satellite. At first, the German satellite TV channels, Sat 1, RTL Plus, 3-Sat and Eins Plus, were distributed using the D2-MAC standard. However, they are increasingly being broadcast also in PAL via such satellites as ASTRA, DFS Kopernikus and EUTELSAT. Both TV-Sat and DFS Kopernikus are operated by the Bundespost. The total number of TVRO dishes is currently around 900 000 though PAL-compatible dishes greatly outnumber D2-MAC dishes. Despite the market success of medium-power satellites, it is still likely however that broadcasting via the high power TV-Sat will continue, both because of the programming deals agreed with the states and because the German Government and the French Government intend to introduce the D2-MAC standard as a way of sustaining a European broadcasting equipment industry.

Figure B8. **Network dimensions and service revenues in Germany**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines					
Western Germany	1990	28 400.0	Thousands	1985-90	+3.2
Penetration rate		46.2	Per 100 inhabitants		
Eastern Germany	1990	1 800.0	Thousands	1985-90	+3.2
Penetration rate		10.8	Per 100 inhabitants		
Germany	1991	30 200.0	Thousands	1985-90	+3.2
Penetration rate		38.7	Per 100 inhabitants		
Cellular radio					
Germany	1990	330.0	Thousands	1988-91	+44.7
Penetration rate		0.53	Per 100 inhabitants		
TV licences					
Western Germany	1987	23 378.0	Thousands	1980-87	+1.8
Penetration rate		38.8	Per 100 inhabitants		
Eastern Germany	1987	6 199.0	Thousands	1989-87	+1.1
Penetration rate		37.2	Per 100 inhabitants		
Germany	1987	29 577.0	Thousands	1980-87	+1.7
Penetration rate		37.9	Per 100 inhabitants		
VCRs					
Western Germany	1988	11 614.2	Thousands		n.a.
Penetration rate		18.9	Per 100 inhabitants		
Cable TV subscribers					
Western Germany	6/1991	8 950.0	Thousand subscribers	1987-91	+29.2
Penetration rate		34.0	Per 100 households		
Western Germany	6/1991	16 300.0	Thousand homes passed		n.a.
Penetration rate		63.1	Per 100 households		
Take-up rate	6/1991	54.9	Per cent of homes passed		n.a.
One-way satellite antennae	1991	900 000	Antennae		n.a.
Penetration rate		11.4	Per 1 000 inhabitants		
Two-way satellite antennae	1991	350	Antennae		
Telecommunications revenues					
Western Germany	1989	37 424.7	Million DM	1984-89	+4.5
Western Germany	1989	21 309.7	US$ million	1984-89	+14.2
Eastern Germany	1984	1 761.3	Million GDR DM	1980-84	+4.5
Eastern Germany	1984	652.3	US$ million	1981-84	–6.0
Broadcast TV and radio revenues, Western Germany	1985	10 417.4	Million DM		n.a.
	1985	4 224.9	US$ million		n.a.

n.a.: Not available.

Sources: German Ministry of Posts and Telecommunications, DBP, ITU, UNESCO, Renaud (1990), Logica (1987).

B8.8 Cross-ownership and cross-sectoral service provision

As in a number of neighbouring countries such as Denmark, France and Switzerland, there is a high degree of cross-sectoral service provision in Germany with the PTO being responsible for infrastructural provision for most over-the-air, cable TV and DBS TV services. There is thus a considerable incentive for the Bundespost to invest in a broadband national grid suitable for the combined transmission of video and telecommunications traffic. The new telecommunications legislation in Germany is based on the guiding principle of encouraging competition while protecting the Bundespost's infrastructural responsibility and it is unlikely that any major infrastructural projects would be set up to challenge the Bundespost's monopoly in this area. Only for satellite TV, where the staying power of PAL seems to have been underestimated and the market appeal of D2-MAC overestimated, has there been a substantial move to other carriers, in this case the ASTRA satellite. The Bundespost is now having to re-equip its cable headends with ASTRA receiving equipment in competition to its own TV-Sat and DFS Kopernikus satellites.

With the possible exception of the Bundepost's shareholding of up to 24 per cent in the regional cable companies, there is little cross-ownership in Germany. Indeed, given the politically sensitive nature of TV broadcasting, ownership and control are quite clearly specified in the constitution and it is difficult to challenge the control of the states in this area. Again, satellite TV is challenging some traditional views on regulation in this area on the simple grounds that regulation is virtually impossible to enforce.

B8.9 Information sources

The principal source of information is the German text and questionnaire response submitted to the OECD on 11 September 1991 by Section 201 of the Federal Ministry of Posts and Telecommunications.

Additional information from:

Datapro Research (1990), ''Germany: The commercial and regulatory environment'', Delran, USA, October, 11 pp.

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For additional sources of information, please see sections B2.9 and B3.9.

B9. GREECE

(Comments received on 29 August 1991 and 29 November 1991)

B9.1 Telecommunications network operators

The design, organisation, installation and operation of all public telecommunications services throughout Greece is a monopoly held by the Hellenic Telecommunication Organisation S.A. (OTE), a state-owned public utility, established in 1949. OTE reports to the General Directorate of Posts and Telecommunications within the Ministry of Transport and Communications. While the state does not intervene directly in the management of OTE, it is nonetheless responsible for regulating OTE's investments, procurement and tariffs.

B9.2 Telecommunications network facilities

The Greek telecommunications network has expanded rapidly, particularly since Greece's accession to the European Community in 1981, and at the end of 1990 had a penetration rate of 38.5 telephone mainlines per 100 inhabitants. However, many parts of the network are obsolete or overstretched and quality of service is quite poor in some areas. At the start of 1990, the number of outstanding applications was 1.1 million which, at the current rate of new connections, would imply a waiting list of six years. However, OTE plans to increase its rate of installation of new lines to 300 000 per year in 1991 (double the current rate) and 400 000 in 1992 and 1993. The aim is to reduce the waiting list to a few months.

The Greek Government has been the beneficiary of considerable assistance from the European Community, notably under the STAR programme for telecommunications development in less-favoured regions. In March 1991, the CEC awarded a major consultancy contract worth US$2.8 million to Coopers & Lybrand, working with ETCO and the OTE, for a series of reports on the reform of the Greek telecommunications structure. A public X.25 packet switched data network (HELLASPAC) has recently been launched on a commerical basis and should have 32 nodes across the country by the end of 1991.

Digitisation of the network is progressing slowly. Some 15 digital exchanges (Ericsson and Siemens technology) were due to be installed by the end of 1990 providing capacity for 15 per cent of local and 25 per cent of long distance traffic. In addition, some 140 km of fibre optic cable were due to be laid in the Athens area and 130 km in the rest of the country. A public high-speed digital data network, HELLASCOM, a pre-ISDN overlay network with an initial capacity of 1 200 network termination points is under

construction and should be operational by mid-1992. It would support low, medium and high speed (up to 2 Mbit/s) data communications nationwide.

B9.3 Mobile communications services

Greece is the last country in the OECD to start a cellular radio service. A number of contracts were initially discussed, but a final decision has been consistently delayed. A number of private radio networks, licensed by the Ministry of Transport and Communications, exist in areas not served by OTE.

A radiopaging service exists, mainly in the cities of Athens and Thesaloniki, though the growth of the system was initially constrained by the lack of radiopaging receivers for which OTE has a monopoly. At the start of 1991 there were 8 658 subscribers and the waiting list was initially eliminated.

B9.4 Broadcast TV operator

Greece has three public TV channels, ERT1, ERT2 and ERT3, though their origins are quite different. ERT1 began operations in 1966 as part of an autonomous organisation, the Hellenic National Broadcasting Institute (MNBI). ERT2 began life in 1968 as YENED, a military information service channel. ERT3 was founded in the late 1980s as a regional channel on the model of Germany's ARD3. A fourth private channel started in 1990.

During the late 1980s with the growth of satellite TV, a number of companies offering rebroadcast packages from different satellite TV channels have been established. As well as DBS transmission, many local channels have been set up using over-the-air VHF and UHF channels.

The public broadcasting organisations are mainly financed by a levy added to the electricity bill, but an increasing share of income comes from advertising. Following reform of the structure of broadcasting in the late 1980, regulation is no longer the direct responsibility of the Government out of two new bodies, one for "social regulation" and the other for "political regulation". The spread of local TV channels rebroadcasting satellite derived material has been, to a large extent, unregulated.

B9.5 Video-based services

Cable TV is practically non-existent in Greece though some limited networks do exist in the north of the country. OTE has a monopoly over the construction of cable TV networks but is preoccupied with the business of providing telephony services.

An OTE video-conference service was inaugurated in December 1988, but at present there are only two studios, both in the greater Athens area. Consequently, traffic is restricted to international services, via EUTELSAT.

B9.6 Data broadcasting services

OTE is in the process of installing a public videotex service, named HELLASTEL, with a view to providing nationwide coverage in 1992. HELLASTEL supports CEPT profiles 1, 2 and 3 as well as ASCII and has dual Greek or Latin alphabet operation. Nine cities share ten access nodes and the plan is to provide capacity for an initial 2 000 subscribers and 100 service providers, interconnected via the HELLASPAC X.25 network. An electronic directory assistance system is also planned for introduction in 1992.

Teletext is not available.

B9.7 Specialised satellite services

OTE is a signatory of the major international satellite organisations and operates three earth stations at the Thermopylae Satellite Communication Centre. However, both one-way and two-way VSAT terminals remain a public monopoly in Greece.

The development of satellite TV has exceeded the development of public regulation and TVROs and SMATV equipment is generally available on the private market. Satellite TV is proving more popular than the public channels in Greece as they are associated closely with the Government. There were more than 2 000 dishes in operation at the start of 1990. Satellite TV channels include Megachannel, Antenna TV, MTV and TV Plus.

Figure B9. **Network dimensions and service revenues in Greece**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1991	3 862.7	Thousands	1986-91	+4.4
Penetration rate		38.5	Per 100 inhabitants		
TV licences	1987	1 750.0	Thousands	1980-87	+2.2
Penetration rate		17.5	Per 100 inhabitants		
VCRs	1988	660.7	Thousands		n.a.
Penetration rate		6.6	Per 100 inhabitants		
Telecommunications revenues	1990	204 567.0	Dr. million	1985-90	+22.1
	1990	1 292.8	US$ million	1985-90	+20.4
Broadcast TV	1985	3 013.6	Dr. million		n.a.
	1985	20.4	US$ million		n.a.

n.a.: Not available.
Sources: OTE, ITU, UNESCO, Logica (1987).

B9.8 Cross-ownership and cross-sectoral service provision

The level of cross-ownership in Greece is ultimately very high in that the government is involved directly in both telecommunications and broadcasting as owner and operator. In practice however there is little cross-over between the two sectors though, in theory, OTE could compete with ERT1/2 by providing cable TV. For the moment, the major area of convergence is satellite technology.

B9.9 Information sources

Datapro Research (1989), ''Greece: The commercial and regulatory environment'', Delran, US, November, 4 pp.

MULLINS, S. (1991), ''EC awards consultancy contract to Coopers and Lybrand'', p. 5 in *FinTech Telecom Markets,* 7 March.

OTE, ''Annual Report''.

For other information sources, please see sections B2.9 and B3.9.

B10. ICELAND

B10.1 Telecommunications network operators

The Post and Telecommunications Administration (Póst-og símamálastofnunin) of the Icelandic Government holds a monopoly for the provision of telecommunications infrastructure and services in Iceland.

B10.2 Telecommunications network facilities

Iceland has a relatively sophisticated network with some of the lowest tariffs in the OECD area. Around 44 000, or 32 percent of exchange lines are digital. Around 660 km of fibre optic cable have been laid for long distance services and 100 km in the local loop.

B10.3 Mobile communications services

A cellular radio service, based on the NMT 450 technology and operated by the P&T Administration was established in 1986. There are now almost 8 000 users. An experimental radiopaging service was opened in 1989.

B10.4 Broadcast TV operators

The Icelandic National Broadcasting Service is the major TV broadcasting organisation in Iceland with transmission facilities provided by the P&T Administration.

B10.5 Video-based services

Only limited services are available.

B10.6 Data broadcasting services

No videotex or teletext services exist in Iceland.

Figure B10. **Network dimensions and service revenues in Iceland**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	126 136	Subscribers	1985-90	+5.3
Penetration rate		50.5	Per 100 inhabitants		
Cellular radio	1991	10 259	Subscribers	1989-91	+25.4
Penetration rate		4.10	Per 100 inhabitants		
TV licences	1990	73 000	Licences	1980-87	+1.9
Penetration rate		29.2	Per 100 inhabitants		
Telecommunications revenues	1990	5 769.8	ISK million	1985-90	+33.6
	1990	98.5	US$ million	1985-90	+24.2

Sources: P&T administration, UNESCO, ITU.

B10.7 Specialised satellite services

A satellite earth station has been established at Efstaleiti, Reykjavik which is used mainly for the distribution of TV signals from the European Broadcasting Union, transmitted via EUTELSAT.

B10.8 Cross-ownership and cross-sectoral service provision

Given the small size of the Icelandic market, it is understandable that the P&T administration is responsible for both the telecommunications and the TV broadcasting infrastructure. The Government owns both the national telecommunications administration and the broadcasting service.

B10.9 Information sources

Póst- og símamálastofnunin (Annual), ''Árssyrsla''.

For other information sources, please see sections B2.9 and B3.9

B11. IRELAND

B11.1 Telecommunications network operators

Telecom Eireann, which was established on 1 January 1984, has a monopoly in Ireland for the provision and maintenance of telecommunications services. Telecom Eireann was born as a result of the Postal and Telecommunications Services Act of 1983 which divided postal and telecommunications services and separated out the operation of the network from the Department of Communications. The latter body is responsible for the regulation of telecommunications and authorises Telecom Eireann's tariff structure and investment plans. Since 1984, Telecom Eireann has transformed itself from a debt-ridden loss-maker to a profitable enterprise which is fully self-financing.

B11.2 Telecommunications network facilities

Since Telecom Eireann was formed in 1984, it has succeeded in almost doubling the size of the PSTN network and has reduced the waiting list virtually to zero. Nevertheless, the rate of penetration of telephone mainlines in Ireland is relatively low by OECD standards (26 mainlines per100 inhabitants) reflecting perhaps the fact that tariffs for residential users are among the highest in the OECD. Despite its new-found profitability, interest payments at 17 per cent of turnover, are still very high compared with other OECD PTOs.

The last Strowger exchanges were removed during 1989 and over 55 per cent of customer lines are now connected to digital exchanges with a target of reaching 100 per cent by 2000. Full digitisation of the trunk network was planned for 1990/91.

B11.3 Mobile communications services

A cellular radio service, Eircell, was launched in December 1985 by Telecom Eireann. It is based on TACS 900 technology and is compatible with services operating in the UK. By 1992 it is hoped to be able to reach 90 per cent of the population.

Radiopaging in Ireland has been provided since May 1988 by Eirpage Ltd, a joint venture between Telecom Eireann (51 per cent) and Motorola (49 per cent). There were 3 500 radiopaging subscribers in Ireland in 1990.

B11.4 Broadcast TV operators

Radio Telefis Eireann (RTE) began TV broadcasting operations in 1960. It is an autonomous Government-owned statutory body which reports to an authority of nine people nominated by the Government. Two TV channels are operated by RTE.

In 1988 a new body, the Independent Radio and Television Commission (IRTC) was established to oversee the development of independent TV companies in Ireland such as those which provide cable TV and MMDS programming.

B11.5 Video-based services

Cable TV is relatively well-developed in Ireland with a penetration rate of almost 50 per cent of households. There are some 41 cable operators in total of which Cablelink Ltd, based in Dublin, is by far the largest. Cablelink was, until recently, owned by RTE, the state broadcaster. This is an unusual position in Europe in that national broadcast organisations rarely control cable TV. In 1989, 60 per cent of Cablelink was sold to Telecom Eireann with RTE holding the remaining 40 per cent. In the Shannon area, Westward Cable is co-operating with Telecom Eireann to provide a fibre optic switched star network for cable TV and telephony.

Telecom Eireann has video-conferencing studies in three cities and four additional public video rooms.

B11.6 Data broadcasting services

Despite trials with videotex since 1986, a full public service has been delayed until 1991. A new joint venture company, Minitel Corporation, has been established between Telecom Eireann (30 per cent) France Télécom (30 per cent) Credit Lyonnais (20 per cent) and the Allied Irish Banking Group (20 per cent) to try to import the French minitel phenomenon to Ireland. The venture is being supported by a grant from the CEC STAR Programme.

Teletext is provided by RTE as the Eirtel service. Around 190 pages are distributed with advertising and sponsored pages.

B11.7 Specialised satellite services

Perhaps as a consequence of the fact that Ireland is used as a gateway to Europe from several transatlantic fibre cables such as PTAT-1, satellite communications are correspondingly underdeveloped. VSAT terminals are partially liberalised in Ireland.

TVRO terminals are fully liberalised and in 1990 there were an estimated 21 000 satellite dishes. The Irish DBS franchise was won by AtlanticSat, a joint venture between Hughes Aerospace (80 per cent) and Jim Stafford (20 per cent) an Irish Entrepreneur, in competition with Telecom Eireann. However, given the problems which have beset other DBS franchisees, it unlikely that AtlanticSat will go ahead with its launch plans.

B11.8 Cross-ownership and cross-sectoral service provision

Ireland is an interesting case study of convergence because the rapid development of cable TV (spurred by the availability of high quality English language channels from the UK mainland) has involved both telecommunications and broadcasting operators. The main cable TV operator, Cablelink, is now jointly owned by RTE and Telecom Eireann. In Westward Cable too Telecom Eireann has a shareholding and is using this franchise to experiment with a video-based service. For the moment, the actual degree of competition between RTE and Telcom Eireann is limited and there are few other significant players in the market. As technology progresses and Telecom Eireann develops a wider range of video-based services, and makes greater demands on the frequency spectrum, the current spirit of co-operation may change to one of competition.

The involvement of both RTE and Telecom Eireann in the Dublin CATV supplier Cablelink has permitted the development of a unique pilot project for the provision of an integrated broadband telecommunications network, called the ICEberg. With funding from the CEC's RACE programme, the ICEberg project is intended initially to support two separate infrastructures based around a broadband switch:

- A Dublin-wide Metropolitan Area Network (MAN) intended chiefly to interlink local area networks to provide services such as high-speed data transfer, voice

Figure B11. **Network dimensions and service revenues in Ireland**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	879 032	Subscribers	1985-90	+5.6
Penetration rate		24.0	Per 100 inhabitants		
Cellular radio	1990	22 106	Subscribers	1988-90	+131.0
Penetration rate		0.62	Per 100 inhabitants		
TV licences	1987	826 000	Licences	1980-87	+4.3
Penetration rate		23.3	Per 100 inhabitants		
VCRs	1988	456 400	Thousands		n.a.
Penetration rate		12.9	Per 100 inhabitants		
Cable TV	1989	460 000	Households	1985-89	+20.2
Penetration rate		48.9	Per 100 households		
Telecommunications revenues	3/1989	621.0	IR million	1985-89	+12.5
	3/1985	880.3	US$ million	1985-89	+22.3
Broadcast revenues	3/1985	74.8	IR million		n.a.
	3/1986	93.4	US$ million		n.a.
	of which:	44.0% from licence fees			
		35.0> from advertising			
		12.4% from cable TV			
		7.6% from other			

n.a.: Not available.
Sources: Telecom Eireann, ITU, UNESCO, Malik (1990), Logica (1987), Renaud (1990), Kagan World Media (1991).

communications, and compressed video, plus an international connection for broadband services (e.g. video-conferencing). The technology is based on the IEEE 802.6 standard developed by QPSX Ltd (Australia) and will eventually operate with a capacity up to 155 Mbit/s.

- A digital, fibre-based residential CATV network offering a much higher channel capacity than the existing 11 channels plus a degree of interactivity (e.g. video-on-demand, broadband videotex) by using a switched star topology rather than a tree and branch structure.

Initially, only the switch will be integrated but eventually it is likely that the two infrastructures will be united and connected with a wider range of narrowband services. The ICEberg project is a good example of the creative synergy which can emerge from the convergence of telecommunications and broadcasting interests.

B11.9 Information sources

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MALIK, R. (1991), "Telecoms in Ireland: An Overview", p. 92 in *1992: Single Market Communications Review,* January, London.

O'SULLIVAN, J. (1991), "The ICEberg Project", pp. 96-99 in *1992: Single Market Communication Review,* January, London.

Telecom Eireann (Annual), "Report and accounts for the year".

For other information sources, please see sections B2.9 and B3.9.

B12. ITALY

(Questionnaire response received on 8 May 1991,
and additional comments on 31 July 1991)

B12.1 Telecommunications network operators

The structure of the telecommunications services industry in Italy is probably the most complex in the OECD area, and a brief description here cannot do justice to its complicated division of responsibilities. It is sufficient to say that the origins of the current structure are due to a sequence of private regional operators progressively coming under the control of the IRI-STET Group, a joint-stock company in which the State has a majority ownership. The future of the current structure is also in doubt because of political uncertainty, but it seems likely that there will be a degree of rationalisation into a new national operator, provisionally christened "Telecom Italia".

Within the Italian Government, the two main organisations concerned with telecommunications are the Industrial Reconstruction Institute (IRI – Instituto per la Ricostruzione Industriale) and the Ministry of Posts and Telecommunications. IRI has an 85 per cent shareholding in STET (Società Finanziaria Telefonica) which in turn is the main shareholder in three concessionary companies:

- SIP (Società Italiana per l'Esercizio delle Telecommuncazioni), responsible for the planning, maintenance and operation of local telephone services and some long distance, data transmission, mobile services, VANS and transmission for cable TV; (STET has a 61.4 per cent shareholding).
- Italcable, responsible for international services between Italy and countries outside Europe and the Mediterranean (49.3 per cent shareholding).
- Telespazio, responsible for all domestic and international satellite links. Telespazio is 33 per cent owned by IRI and 33 per cent of this is held via RAI, the Italian state broadcaster.

For its part, the Ministry of Posts and Telecommunicating acts as a controlling body for:

- ASST (Azienda di Stato per i Servizi Telefonici), responsible for long-distance telephone services on high volume routes plus international services to Europe and seven Mediterranean countries;
- DCST (Direzione Centrale Servizi Telegrafici) which operates the telex service in Italy, Europe and the Mediterranean countries;
- DCSR (Direzione Centrale Servici Radioelettrici), responsible for maritime radiotelephone services.

The Ministry of Posts and Telecommunications is also responsible for planning, administering and regulating telecommunications services in Italy which it carries out with the help of the following bodies:

- the ''Isepttorato'' responsible for the implementation of telecommunications plans and their compliance with operational standards;
- the ''Instituto Superiore'' which sets standards and is responsible for type approval and conformance testing;
- The Administrative Council (''Consiglio di Amminstrazione''), which advises the Ministry on reglatory, financial and tariff issues;
- The Technical Council, (''Consiglio Superiore Tecnico'') which advises the Ministry on long-term technical planning.

B12.2 Telecommunications network facilities

The Italian telecommunications network is relatively well-developed with a density of around 44 telephone lines per 100 inhabitants, but there is a long-standing difference between the well-developed north and an underdeveloped network in the south of the country and the islands of Sicily and Sardinia. This regional disparity persists despite a policy of regional assistance backed by funds from the CEC.

The Italian network is also distinguished by two other peculiarities:

- The specialised network (RFD - Rete Fonia-Data) is used extensively for voice traffic as well as for data and interconnects with the PSTN. Effectively the RFD is an overlay, digital network for business subscribers.
- Italian planners attempted to ''leap-frog'' to automatic, digital exchanges by missing out the semi-automatic stage. Digitisation has however proved slower than expected. Some 33 per cent of exchange lines were digital at the end of 1990 and this was expected to increase to 63 per cent in 1994.

Around 450 000 km of fibre optic cable has been laid in Italy of which 95 per cent is in the trunk network. This will increase to 1.4 million km by 1994.

B12.3 Mobile communications services

The history of mobile communications services in Italy has been an evolution between systems and between technologies as each has become progressively saturated, but rapid growth has only been witnessed since 1990:

- The initial system was an Integrated Mobile Telephone and Paging Service (RTMI) operating since 1973.
- In 1985, this was superseded by a 450 MHz cellular radio system called RTMS but having a limited capacity. At the start of 1990 there were 66 000 subscribers.
- In March 1990, a TACS-based 900 MHz system was introduced to provide extra capacity ahead of the introduction of a digital GSM network.

At present, all mobile services with the exception of maritime systems are operated by SIP under an exclusive licence until 2004. The post and telecommunications ministry is responsible for administering the frequency spectrum.

A digital radiopaging system, Teledrin, based on Motorola technology was also introduced in 1985 and had 52 500 subscribers at the start of 1990.

B12.4 Broadcast TV operators

Whereas the telecommunications environment in Italy is highly restrictive with the state continuing to have a virtual monopoly on the provision of services, either directly or via STET, the broadcasting environment is probably the most open in Europe with up to 400 private local channels in operation. However, this situation has arisen more by accident than design. The national broadcaster RAI (Radiotelevisione Italiana), which is state-owned via the IRI, has been broadcasting TV programmes since 1952-54. RAI now has three national channels. It continued to hold a monopoly until 1974 when a Constitutional Court confirmed the state monopoly of RAI but at the same time permitted private companies to offer a local radio and TV service via cable up to a maximum of 40 000 viewers. In 1976, this concession to local private companies was extended to over-the-air broadcasting and there followed rapid growth of local TV stations. However, the attempt to regulate this explosion of private TV led to a number of anomalies:

- Local TV stations could not be "networked". In other words, each station had to be substantially independent. In practice, a high degree of syndication exists and during the 1980s the Berlusconi organisation, Fininvest, has come to control around 80 per cent of private TV viewing mainly through the three channels, Canale 5, Rete 4 and Italia 1.
- Regulation has, if anything, conspired to keep quality low. For instance, the lack of scope for economies of scale through networking means that viewers are served a diet of cheap, imported shows with a high percentage of advertising and programme sponsorship. Local TV channels are prevented from showing news and current affairs programmes so that rulings intended to increase the volume of locally-produced material tend to generate game shows and phone-ins.
- The proliferation of private local TV has stunted the development of rival media such as cable TV, VCRs or satellite TV.

Until recently, television regulation in Italy was handled in an unco-ordinated manner by the local courts, though the P&T Ministry was nominally in charge of licensing operators. There were no barriers to entry except where an operator already owns a dominant position in newspapers and other media. In 1990, a new bill introduced new classes of licence forover-the-air broadcasting including a "public broadcasting service" (RAI) and private licencees for both national and local TV. Effectively this meant the end of RAI's national monopoly.

B12.5 Video-based services

As described above, local TV in Italy has tended to be delivered over-the-air rather than by cable. Until recently, SIP held a theoretical monopoly over the infrastructure

provision for cable TV. In 1991, a new bill permitted private operators to provide cable TV and radio services on a national as well as local basis using the public network.

SIP provides three video-based services, mainly over the RFD network:

- Videolenta: black and white slow-scan video;
- Telescrittura: an enhanced fax service for tele-conferencing;
- Videoconferenza: a video-conferencing service operating at 2 Mbit/s with studios in eight major cities.

B12.6 Data broadcasting services

The Italian videotex system, Videotel, has been in operation since 1986 and is based on the UK Prestel standard, but has gateways to the French télétel system. Following slow growth, SIP has moved closer to the French model by subsidising low-cost minitel-type user terminals. At the start of 1989 there were 27 499 terminals but following the introduction of the new strategy this had risen to more than 80 000 terminals a year later.

Teletext services in Italy are provided by RAI as the "Televideo" service. There are 900 daily pages of information including advertising. Other operators also provide teletext services competitively.

Audiotex services are growing in Italy and the toll-free telephone service (Numero Verde) now has 7 657 subscribers, having tripled in size since 1988.

B12.7 Specialised satellite services

Italy has two major companies concerned with satellite technology. The monopoly service operator is Telespazio which is part owned by RAI, STET and Italcable amongst others. This shared ownership is reflected in its division of business with 40 per cent of its turnover of L275 billion (US$ 200.8 m) coming from telecommunications, with the rest from TV, remote sensing and other activities. The other major satellite company is Selenia Spazio, sold by STET the IRI-Finmeccanica Group in 1989 and renamed Alenia, which is manufacturing company and was responsible for constructing the Italsat-1 satellite.

Italy has experimented with DBS but has not yet launched regular commercial activities in this field. RAI broadcasts via the Olympus satellite. There is no licensing legislation for TVROs, though in theory SIP holds a monopoly for SMATV equipment.

B12.8 Cross-ownership and cross-sectoral service provision

Cross-ownership in Italy is relatively high with SIP, Italcable, Telespazio and RAI all belonging to the IRI Group. However, this is all within the context of state control. Private sector cross-ownership between broadcasting and publishing interests is controlled through anti-trust regulations. In theory, cross-sectoral service provision exists for cable TV as CATV companies are encouraged to use the networks of the PTO. In practice, cable TV is underdeveloped in Italy. Cross-sectoral service provision exists only

Figure B12. **Network dimensions and service revenues in Italy**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1991	26 766.0	Thousands	1986-91	+5.7
Penetration rate		46.3	Per 100 inhabitants		
Cellular radio	1991	416 000	Subscribers	1988-91	+231.1
Penetration rate		0.72	Per 100 inhabitants		
TV licences	1987	14 687.0	Thousands	1980-87	+1.4
Penetration rate		25.6	Per 100 inhabitants		

in satellite services where Telespazio has the distinction, rare among satellite providers, of being relatively profitable. In 1989, some 12 per cent of revenue was net profit.

B12.9 Information sources

The principal source of information is the Italian response to the OECD questionnaire delivered on 8 May 1991 by Dr. Morganti, STET.

Additional information from:

Datapro (1990), "Italy: The commercial and regulatory environment", Delran, USA, February, 11 pp.

SIP (Annual), "Reports and financial statements for the year".

STET (Annual), "Reports and accounts for the year".

Telespazio, "Annual Report".

For other information sources, please see sections B2.9 and B3.9.

B13. JAPAN

(Comments received on 13 August 1991)

B13.1 Telecommunications network operators

Until 1985, Nippon Telegraph and Telephone Corporation (NTT) and Kokusai Denshin Denwa (KDD) enjoyed a monopoly for the provision of domestic and international telecommunications services respectively. In December 1984, the Japanese parliament passed new legislation bringing a formal end to this monopoly as from April 1985. The new law is in two volumes:

- the Telecommunications Business Law;
- the NTT law.

The new legislation allowed for the privatisation of NTT. In March 1990, external shareholders held 34.1 per cent of the equity of NTT, but there is a provision in the law for this to rise to 66.7 per cent with the rest being held by the government. KDD has always been a private company since its foundation in 1952, though it has been able to draw upon government resources for investment.

The Telecommunications Business Law established a framework for competition recognising the following categories:

- Type I Businesses, which can construct their own infrastructures. At 1 November 1990, there were some 66 new common carriers (NCCs) in addition to NTT and KDD.
- General Type II carriers, which can offer specialised telecommunications services within the Japanese domestic market using leased facilities. At 1 November 1990 there were 873 General Type II carriers.
- Special Type II carriers, which can offer general telecommunications services, both nationally and internationally, using facilities leased from Type I carriers. At 1 November 1990 there were29 Special Type II carriers.

Overall, the number of new carriers has increased steadily from 85 in 1985, to 565 in 1988, to 968 in 1990. The Type I new common carriers (NCCs) are the most significant here and they include:

- Two international carriers, licenced on 30 November 1987, which act as rivals to KDD. They are ITJ Inc (International Telecom Japan), jointly owned by Mitsubishi, Mitsui, Sumitomo, Matsushita, Marubeni, Nisho Awai, the Bank of Tokyo and 130 other firms, which has been offering services since April 1989; and IDC Inc. (International Digital Communications), which is a consortium involving Cable & Wireless, C. Itoh, Toyota, Pacific Telesis and Merill Lynch, and has been offering services since May 1989. The new international carriers have been

relatively successful, taking 3 per cent of the market for telephone traffic and 13 per cent of the market for leased lines from KDD in 1989/90. KDD has reduced its tariffs 11 times since 1979 but the new carriers are still able to maintain a price advantage of 1.5 per cent for voice traffic and 6.8 per cent for leased lines.

- Three long-distance carriers which are DDI (Daini Denden Inc.) which is owned by a consortium including Kyocera, Mitsubishi and Sony; Japan Telecom, which is one-third owned by the Japan National Railway (JNR); and Teleway Japan, of which the main shareholder is Toyota. The long-distance NCCs operate at present only along fairly restricted routes between the main business areas of Japan, but their licences covers the whole territory of Japan. Their tariffs are around 29 per cent cheaper than NTT for the longest distance call. In 1988/89, the new long-distance carriers took 3.1 per cent, by value, of national telephone traffic and 4.8 per cent of leased line traffic.
- Seven regional carriers including LakeCity Cablevision, an operator 1988/89 which offers both data communications and cable TV services in seven cities including Suwa and Okaya. In 1988/89 regional operators took 2 per cent, by value, of the leased circuit market.
- Two satellite carriers - Japan Communications Satellite Co. Inc. (JCSat) operating since April 16 1989 and Space Communications Corp. (SCC) operating since 8 July 1989.
- Sixteen companies offering cellular radio and other mobile communications services.
- Thirty-six companies offering radiopaging services.

The telecommunications industry is regulated by the Telecommunications Policy Bureau of the Ministry of Posts and Telecommunications (MPT).

B13.2 Telecommunications network facilities

The level of telephone mainline penetration in Japan is now equal to the OECD average after having been substantially below it for most of the post-war period. The increase in penetration has been realised partly through a system of Telephone Subscriber Bonds (TSBs) purchased by potential subscribers in lieu of an installation charge.

In recent years, the focus of attention has shifted away from network expansion to network modernisation. NTT re-invests some 30 per cent of its annual revenue and sets aside a further 4.2 per cent for R&D. These figures are higher than for most other PTOs in the OECD area. The fruits of NTT's investment programme are foreseen in the "Visual, Intelligent and Personal" (VIP) service vision discussed in the main part of this report(see Figure 5.3). This plan foresees the full digitisation of the main network by 1999 and the development of a broadband ISDN network to complement the existing narrowband ISDN network service starting in 1995. Digitisation of NTT's network is also an important precursor to the introduction of competition on an equal access basis according to the concept of "Open Network Doctrine" (OND). In 1990, around 34 per cent of NTT's exchanges and 65 per cent of its trunk lines were digital.

For their part, the long-distance NCCs have the luxury of being able to start with an all-digital network. In the case of DDI, this network is largely based on microwave

circuits, and for Japan Telecom and Teleway Japan the networks are based on fibre optic cables laid along the railway lines and highways respectively.

B13.3 Public mobile communications services

The Japanese mobile communications service is operated by NTT in the 900 MHz band. Restrictions on market entry were lifted in April 1985 and a number of new competitors have entered the market including eight offering cellular radio, three offering marine radio, and one Japan City Media Inc. offering digital mobile data transmission in Tokyo. In March 1991 some 36.8 per cent of the 868 078 subscribers were with the new market entrants. Radiopaging has also been a competitive market since 1987. Some 32.4 per cent of the 5.1 million subscribers had been taken by new market entrants by March 31 1991.

B13.4 Broadcast TV operators

The origin of the modern TV broadcasting system in Japan dates from the 1950 Broadcasting Act which established a dual system of public and private broadcasting. The national, public broadcaster, NHK (Nippon Hoso Kyokai), is funded almost entirely by "receivers fees". Its independence is guaranteed in the Broadcast Law, though its Board of Governors are appointed directly by the Japanese Prime Minister with the consent of both Houses of the Diet. NHK began TV broadcasting in 1953 and now provides two national channels (General TV (GTV) and Educational TV) plus two satellite TV channels.

The first commercial TV broadcasters were licenced by MPT in 1958 and there are than 113 companies operating, most of them quite small. All the private companies have regional franchises but in practice there is some syndication of programmes which gives the impression of national coverage. The major private companies are:

- Nippon Television Network Corporation (NTV) owned by the Yomiuri Group;
- Asahi National Broadcasting Company (ANB);
- Fuji Television Network;
- Tokyo Broadcasting System Inc (TBS);
- Television Tokyo Channel 12 Ltd.

The commercial broadcasters are represented by the National Association of Commercial Broadcasters in Japan (NAB).

The regulatory authority and licensing body for broadcasting in Japan, as for telecommunications, is the Ministry of Posts and Telecommunications (MPT).

B13.5 Video-based services

Cable TV began in Japan in the 1950s as a way of extending the reach of over-the-air transmission. In the early days, NHK played a leading role in constructing cable systems alongside other non-profit making bodies, local government groups and public

organisations. Even now, only 49 per cent of the 944 systems with more than 500 drop terminals are operated by private business.

After the passage of the Cable TV Act in 1972 there was a mini-boom in cable TV, but it was not until the mid 1980s, with the arrival of satellite delivered programming, that cable TV has really taken off. Between 1984 and 1988 the number of cable broadcasters supplying their own programmes doubled to 237 and the number of subscribers grew by 35 per cent. There are now around 18 per cent of households receiving cable TV.

Experimental projects to show the technological potential of interactive cable TV, such as the Coaxial Cable Information System (CCIS) operated by MPT or the Hi-Ovis project operated by the Ministry of International Trade and Industry MITI, have served to raise the profile of CATV. However, many of the existing systems are limited to seven channel capacity and most system operators (98 per cent) have less than 500 drop terminals.

At present, NTT is prohibited by the NTT Law from entering the cable TV industry. However, from a financial perspective, it would be easier to realise ambitious projects such as the 150-channel ''Space Cable'' with the involvement of NTT. Equally, from observation of broadband network trials in other countries, it is difficult to envisage how NTT could cost-justify its ambitious ''Visual, Intelligent and Personal'' service vision, or its fibre-to-the-home plan without being able to provide video-based entertainment services. For the moment, in its publicity material NTT stresses the potential of videophones and ''three dimensional television'', but the initial costs of such an investment would surely have to be financed by offering conventional TV services rather than untried, technological wizardry.

NTT's existing video-based services include a specialised video-conferencing service with 44 corporate subscribers, but this is now being reduced in scope in favour of a video-conferencing service offered over primary rate ISDN (INS-Net 1500) which was introduced in 1989/90.

B13.6 Data broadcasting services

NTT's videotex service, CAPTAIN (Character and Pattern Telephone Access Information Network) was introduced in 1984 and in 1990 had around 100 000 subscribers. In addition to the basic service, there are specialised high performance services for private businesses (SUPER CAPTAIN/HIGH CAPTAIN) and for higher education (HEART).

NTT offers a number of other data broadcasting type services which include:

- audiotex and premium rate telephone services (Dial-Q2 information services) with around 900 different information providers;
- off-talk communications using unoccupied telephone lines to transmit music, local news or weather/earthquake alerts (41 000 subscribers).

For its part, the national broadcast company NHK has been offering a teletext service since 1985 to TVs equipped with teletext capability.

B13.7 Specialised satellite services

In June 1989, the Broadcast Law and the Radio Law were revised to take account of the growing use of satellites for both broadcasting and telecommunications services and to clarify the separate regulation for each. In that month, NHK started broadcasting two satellite TV channels including a few hours per day of HDTV (Hi-Vision) which has subsequently been extended. The satellite (BS-2b) covers the whole of Japan and is a high power satellite for use with antennae of 45-75 cm. At the end of March 1990, there were around 2.4 million receiving households, but this is expected to increase rapidly. A second satellite (BS-3) launched in 1990 is shared between NHK and commercial broadcasters, including pay-TV services. A slightly higher "receivers fee" is charged to households equipped with satellite dishes.

There are a number of competing satellite service providers for telecommunications and TV programme exchange including:

- the NTT-CS3 satellite service;
- Japan Communications Satellite Co.'s JCSAT service;
- Space Communications Corporation's "Super Bird" service.

In total, the three companies share 117 transponders.

B13.8 Cross-ownership and cross-sectoral service provision

The public communications system in Japan has many similarities with the US system but without the compleities and adversarial nature of the latter. In particular:

- Japan has a unified structure for regulation with MPT being responsible for both telecommunications and broadcasting, including the licensing of operators, thereby fulfilling a similar role to that played by the FCC (Federal Communications Commission) in the USA.
- Despite the unified administrative structure, Japan has a tradition of separate regulation for the two sectors of the communications industry. Indeed, the recent changes made in June 1989 to the Broadcasting Law and the Radio Law amounted to little more than a tidying up exercise and a reclassification of activities.
- Like US regulators, Japanese policy-makers have also developed a keen sense of what constitutes a monopoly position and they have prevented NTT from entering the broadcasting field, even though this might have been more technically efficient as a way of cabling Japan.

In other ways, however, it is more instructive to point out the differences between Japan and the USA:

- Japan seems committed to delivery of HDTV by satellite with some cable TV rebroadcasting whereas the FCC still thinks it will be possible to deliver HDTV over-the-air;
- Cable TV is less well-developed and less commercial in Japan.

There have been a number of interesting pilot projects and innovative entrepreneurial activities that are relevant to convergence. For instance, the MITI/MPT project such as New Media Communities, Teletopia, Hi-Vision Communities or Hi-

Vision cities have been based on the integrated provision of telecommunications and broadcasting services. Also some of the regional carriers offer cross-over services, for instance:

- LakeCity Cablevision Inc., a cable TV company, registered as a regional Type I telecommunications carrier in 1986, has been offering services which include telemetry for water meters, telecontrol for reservoirs and two-way transmission of medical data.
- TTNet (Tokyo Tsushin Network) is registed as a regional Type I carrier and offers local telecommunications services over its own infrastructure. TTNet's main shareholder, TEPC (Tokyo Electric Power Company – 35 per cent) is involved in the cable TV industry, laying CATV cables where its electrical facilities make over-the-air reception difficult. Recently, however, it has taken a more active interest in CATV, buying minority shareholdings in small urban companies. TEPC is therefore ideally placed with its existing infrastructure of sites, electrical power lines, access to homes and businesses, and CATV interests

Figure B13. **Network dimensions and service revenues in Japan**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	52 410[1]	Thousands	1985-90	+2.9
Penetration rate		42.7	Per 100 inhabitants		
High speed circuits (>56 kbit/s; excluding ISDN)	1990	7 494	Circuits[2]	1988-90	+32.2
Cellular radio	1991	868 078	Subscribers	1988-91	+57.2
Penetration rate		0.71	Per 100 inhabitants		
TV licences	1987	71 500.0	Thousands	1980-87	+1.8
Penetration rate		58.3	Per 100 inhabitants		
VCRs	1988	27 710.0	Thousands		n.a.
Penetration rate		22.6	Per 100 inhabitants		
Cable TV	1989	5 774.8	Thousand households	1985-89	+7.9
Penetration rate		18.0	Per 100 households		
Telecommunications revenues	1990	5 958.1	Billion Yen	1985-90	+3.7
	1990	43 187.5	US$ million	1985-90	+16.6
Broadcast TV revenues	1990	1 854.1	Billion Yen	1986-90	+2.1
	1990	13 439.4	US$ million	1986-90	+9.1
	of which: 21.1% is from receivers fees				
	77.4% is from advertising				
	1.5% is from other sources				

n.a.: Not available.
1. Financial year end 31 March for most of data in this table.
2. NTT only.
Sources: NTT, MPT, Koike (1990), NHK, ITU, UNESCO.

to become a true telco-TV company, constructing a broadband network that does not have the constraints imposed on NTT.

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For other information sources, please see sections B1.9 and B4.9.

B14. LUXEMBOURG

B14.1 Telecommunications network operators

The Luxembourg P&T, an integrated postal and telecommunications administration which is part of the government of the Grand-Duchy of Luxembourg, currently has a monopoly over the supply of telecommunications services. On 1 January 1992, a new law came into force which should lead to:

- the ''corporatisation'' of the P&T which will become a public enterprise, owned by the State, but with financial and administrative autonomy;
- the separation of regulatory and functional operations though the creation of a new Ministry of Communications;
- the separation of postal, telecommunications and post-bank activities.

In this, as in other respects, the Luxembourg P&T is moving in line with EC telecommunications policy. Value-added network services (with the exception of simple voice resale) and terminal equipment markets, are already liberalised and competition will be introduced in other areas according to the CEC's timetable. The main threat of competition at present is the loss of potential business to monopoly PTOs in surrounding countries, but equally there is a major new opportunity to win business from them.

B14.2 Telecommunications network facilities

Luxembourg has a relatively dense telephone network with 48 mainlines per 100 inhabitants but also, perhaps surprisingly, a waiting list for new subscribers of almost four months which is one of the worst in Northern Europe. The Luxembourg P&T attributes this to staffing constraints which it hopes to eliminate once it is free of government financial control.

The PSTN network has 20 per cent of lines provided by digital, EWSD (Siemens) exchanges. Other lines are electromechanical (62 per cent) or semi-electronic (18 per cent). The P&T hope to raise digitisation to 45 per cent by the end of 1992.

During 1989 some 52 km of fibre optic cable at 140 Mbit/s was laid internally and a further 20 km to augment its international links with France. Luxembourg now has 565 Mbit/s links with France, Germany and Belgium.

B14.3 Mobile communications services

As with other technologies, Luxembourg has followed decisions made in Netherlands and Belgium on cellular radio. Originally, in the 1970s, Luxembourg chose the German B-Netz radiotelephone system, but in 1985, it went for the Scandinavian cellular radio system, based on NMT450 technology. However, because of the incompatibility of NMT with the French and German systems, there were only 655 mobilephones in use at the start of 1990 of which a third still belong to the older system. The P&T pin many hopes on the future digital, pan-European GSM system for the take-off of mobile communications in Luxembourg.

The radiopaging service, Sémaphone, again tied in with the Dutch/Belgian system, has been more successful since its start in 1981 and had 2 161 subscribers in mid-1989. A more advanced form of Sémaphone was launched in June 1989 which permits the use of a wider range of paging devices. This had1 569 subscribers at the start of 1989. Finally, an alphanumeric system, Lux-paging, which was launched at the same line, has an additional 135 subscribers.

B14.4 Broadcast TV operators

The Compagnie Luxembourgeoise de Télédiffusion (CLT), which broadcasts as Radio-Télé Luxembourg (RTL) has a monopoly concession for television in Luxembourg. It has always been a commercial station, 100 per cent funded by advertising, and in this respect it has played an important role in bringing private, commercial TV to surrounding countries in the same way that it brought commercial radio through Radio Luxembourg.

RTL TV began broadcasting in French to Luxembourg, Belgium and eastern France in 1955. This channel was joined by a German language channel, RTL Plus, in 1984. This channel broadcasts to Luxembourg, Germany, Austria and parts of Central and Eastern Europe, mainly by satellite.

CLT has made a number of concessions to its audience in surrounding countries:

- since the mid 1980s, an increasing share of its production and programming have been carried out in those countries;
- RTL Plus is majority-controlled by German interests including Bertelsmann (39 per cent) and Deutsche Bank (10 per cent);
- CLT has stakes in other commercial channels such as the French M6 (25 per cent) as well as providing programming for French and German satellite TV;
- Luxembourg is also the home to the commercial Dutch channel, Télé-Véronique, now renamed RTL-4.

CLT itself is owned by a number of private interests including Groupe Bruxelles Lambert (55 per cent), Schlumberger (12 per cent) and Paribas (10 per cent). It is regulated by a Luxembourg government commissioner and two commissions, one technical, the other concerned with programming.

B14.5 Video-based services

In common with Belgium and the Netherlands, Luxembourg has a high level of cable TV penetration with more than half the households cabled. However, as the system was originally built with "first generation" technology (e.g. cables run along the side of houses rather than being fully buried) the channel capacity is limited to 10-20.

Video services offered by the P&T administration are mainly on behalf of the European Commission for its European Video-conferencing Experiment (EVE) between Brussels and Luxembourg.

B14.6 Data broadcasting services

The potential for data broadcasting services is limited in Luxembourg both by the small size of the national market and, as a consequence, the fact that other forms of information dissemination are generally more efficient. Nevertheless, Luxembourg does have its own videotex system, based on the German (BTX) standard. At the start of 1990, there were 339 subscribers.

B14.7 Specialised satellite services

The Luxembourg P&T has a small satellite earth station and also holds a monopoly over the installation of SMATV systems of which there were 153 in 1990. However, the main contribution of Luxembourg in the satellite field has been in the development of DBS. RTL was one of the pioneer providers of satellite programming and Luxembourg is also home for SES (Société Européenne des Satellites) which operates the ASTRA satellites under Luxembourg's licence for FSS (fixed satellite service) activities. ASTRA programmes are now available to 1.5 million homes via DBS and a further 20 million via cable. ASTRA was founded in 1988 and its shareholders include banks, investment houses and media interests including UK commercial broadcasters Thames, Television South-West (TSW) and Ulster, and the Swedish Company Kinnevik. Around 20 per cent of ASTRA's shares are held by Luxembourg-based banks. British Telecom acts as a marketing agent for some of ASTRA's transponders. ASTRA does not publish an annual report, but it is estimated that its 1990 turnover was around US$140 million.

B14.8 Cross-ownership and cross-sectoral service provision

The level of cross-ownership in Luxembourg is minimal with the P&T being owned by the Government and CLT being privately-owned. There is, however, some degree of cross-over in service provision and regulation. For instance, the P&T provides re-broadcasting facilities, and has a monopoly over SMATV installations. Until the Ministry for Communications comes into existence, the P&T also has the licensing authority for cable TV. However, Luxembourg's main contribution to deregulation has been in the field of commercial television where it was the pioneer of commercial radio, over-the-air TV and latterly satellite TV.

Figure B14. **Network dimensions and service revenues in Luxembourg**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	176 363	Subscribers	1985-90	+3.7
Penetration rate		47.0	Per 100 inhabitants		
Cellular radio	1990	665	Subscribers	1987-90	+31.5
Penetration rate		0.18	Per 100 inhabitants		
TV licences	1987	140 000	Receivers		n.a.
Penetration rate		37.3	Per 100 inhabitants		
Cable TV	1989	90 000	Households	1985-89	+3.0
Penetration rate		64.3	Per 100 households		
Telecommunications revenues	1989	4 743.8	Million Lux. Francs	1984-89	+8.5
	1989	120.4	US$ million	1984-89	+19.9
Broadcasting revenues (including TV and Radio)	1985	8 154.0	Million Lux. Francs		n.a.
–	1985	164.7	US$ million		n.a.

n.a.: Not available.
Sources: Luxembourg P&T, ITU, UNESCO, Logica (1987), Renaud (1990).

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For other information sources, please see sections B2.9 and B3.9.

B15. THE NETHERLANDS

(Questionnaire response received on 30 July 1991)

B15.1 Telecommunications network operators

Telecommunications liberalisation, and the "corporatisation" of the main network operator, came to the Netherlands on 1 January 1989 as the culmination of a long process which began with the Steenbergen Commission report in July 1985. Under the terms of the new legislation, PTT Telecom BV is a 100 per cent owned subsidiary of the Royal PTT Nederland NV, which acts as a holding company for posts, telecoms and other activities including a company which controls most of the cable TV networks. The Royal PTT Nederland NV is a limited liability company which is 100 per cent owned by the government of the Netherlands. In addition to corporatisation, the new legislation:

- Has given PTT Telecom BV greater freedom to raise capital in the private market.
- Clarified the extent of PTT Telecom BV's monopoly as covering the infrastructure and switching for PSTN, telex/telegraphy and public switched data services. It also covers the compulsory provision of basic telephony, telex/telegraph and public switched data services.
- Opened the market for customer premises equipment to competitive supply.
- Opened the value-added network services market (excluding simple voice resale) to competitive provision by private companies, including the PTT.

The regulation of telecommunications in the Netherlands is the responsibility of the Department for Telecommunications and Posts (HDTP) within the Netherlands Ministry of Transport and Public Works. HDTP's responsibilities include licensing of operators, type approval and radio frequency management. In addition, an independent advisory body, The Netherlands Post and Telecommunications Council (RAPT) provides long-term planning consultancy to the Government at Cabinet level.

B15.2 Telecommunications network facilities

The Netherlands enjoys a relatively high level of telephone penetration (45 per 100 inhabitants) together with a tariff structure for national call charges which is among the lowest in the OECD area. A programme of introducing digital switching in each of the 13 administrative districts was begun in 1981. A major fibre optic inter-city network, the Digital Backbone, was completed in 1987.

In April 1991, a market trial of fibre in the local loop was initiated in the Amsterdam/Sloten area. Over 100 households will receive TV, radio, data and telephony over a single fibre. The participants include PTT Telecom Netherlands, AT&T and Cable TV

Amsterdam. It is also likely that the RACE demonstrator project Broadband User/ Network Interface (BUNI) will also be located in the Netherlands, at Leidschendam.

B15.3 Mobile communications services

Mobile communications services in the Netherlands are compatible with those offered in Belgium and Luxembourg. The first service ATF1, based on the German B-Netz network, opened in 1981 and was superceded by a true cellular system ATF2, based on NMT450 technology in 1985. The third extension of the network, ATF3 based on NMT900 technology, was carried out in 1989. At the end of 1990, the number of mobile telephones in use totalled 79 000. GSM digital cellular radio is expected to be introduced in the Netherlands in 1992 and it is likely that a second operator will be considered. Telepoint (CT2/CT3) trials have also been carried out jointly by PTT Netherland and Koning & Hartmann.

Radiopaging is also operated on a Benelux-wide level with the Semafonie service having been introduced in 1980 and expanded in 1987 and again in 1988 with the addition of alphanumeric capability. At the start of 1989 there were 170 000 subscribers.

The organisation responsible for allocating the use of the frequency spectrum in the Netherlands is the HDTP Department of the Ministry of Transport and Public Works.

B15.4 Broadcast TV operators

The structure for public broadcasting in the Netherlands is guided by the principles of ''accessibility'', ''non-commercialism'' and ''co-operation'' which are enshrined in the 1967 Broadcasting Act. This established NOS (Nederlandse Omroep Stichting) as a non-commercial foundation to co-ordinate the activities of the various private broadcasting groups which represent political, religious and regional interests. Several categories of broadcaster exist (class A, B, C, and other) according to the number of subscribers or ''members'' which each have. There are eight principal groups and around forty in total. Three main public channels are broadcast by NOS via the transmitter company NOZEMA NV (Netherlands Broadcast Transmitter Company). NOZEMA has a legal monopoly for broadcasting, established in 1935, and until recently was jointly owned by the State (via the PTT) and NOS. At the time of corporatisation of the PTT, the shares in NOZEMA were not included in the capital transferred by the Government to the new company. It is expected that NOZEMA will be privatised.

A new Media Act, passed in October 1986, created a framework for the introduction of private, commercial over-the-air TV. However, the final decision was delayed by political controversy and new channels would be deterred in any case by the Netherlands' restrictive rules on advertising. In the meantime, a new Dutch language station, RTL Télé-Véronique, (renamed RTL-4) has been established in Luxembourg and has been broadcasting to Dutch speakers in Belgium and the Netherlands. Due to restrictions in Belgium, it is not allowed to be rebroadcast via cable there. The major shareholder is CLT (51 per cent) of Luxembourg, but other owners include the Dutch publishers, Elseviers (19 per cent), VNU (19 per cent) and the manufacturer Philips. RTL-4 has succeeded in taking a large share of the viewing market and has thrown the traditional

broadcasting system into a crisis of declining revenues. At present, commercial terrestrial TV is still prohibited in the Netherlands but a reform of broadcasting legislation with more liberal advertising regulation is planned for 1993.

The regulation of broadcasting in the Netherlands, under the 1986 Act, is the responsibility of the Ministry for Welfare, Health and Culture (MWHC). Inspection of the regulations is carried out by the ''Commissariat voor de Media''. The Media council is an advisory body to the MWHC.

B15.5 Video-based services

The Netherlands has a very dense cable TV network, second only to that of Belgium, with close to 80 per cent of households being able to receive cable channels. Most of the Dutch cable systems are being upgraded for distribution of HDTV broadcasts using the MAC standard and additional (20 plus) PAL channels. An experiment with an upgraded, interactive cable TV network has been conducted in South Limburg, though this was ultimately cabled with co-axial rather than fibre optic cable due to cost reasons, so it was not possible to test the possibilities of a leading-edge system.

Most of the 300 companies licensed to operate cable TV infrastructures are quite small and are run by consortia led by municipal local authorities. They do not require a licence for rebroadcasting TV programmes though they may be fined if the rebroadcast material from pirate TV stations such as commercial Dutch language stations. In keeping with the general tradition of Dutch television, these groups are not motivated by profit-maximising criteria and, for the most part, are not inclined to look for other commercial services that could be offered via cable such as telephony or leased lines. One exception to this is CAZEMA NV, which is the largest cable TV operator with over 600 000 households, and is 100 per cent owned by the PTT. CAZEMA is investing actively to upgrade its networks ahead of the possible introduction of HDTV. Understandably though CAZEMA has no interest in offering services which would compete with its parent company.

In the mid 1980s, an inquiry into the future of cable TV in the Netherlands (the Zegveld Commission) concluded that the networks had no long-term future in the hands of the municipal local authorities and that, over the next 20 years or so, the PTT should gradually assume control over all networks. At the time, this was viewed as a sensible and technically efficient solution. However, the subsequent move towards a more liberal, competitive environment for telecommunications has led to a questioning of this policy direction and the fear that it would lead to a super-monopoly PTT which would be impossible to compete against. For the moment therefore, the debate remains unresolved.

Video-conferencing services in the Netherlands are provided by the PTT. There are studios in three cities and the Philips studio in Eindhoven is also available for commercial use.

B15.6 Data broadcasting services

The PTT videotex network, Viditel, was established in 1984 and is based on the UK Prestel standard though with gateways to other systems. However, the number of infor-

mation providers is relatively small and at the start of 1989 there were only 25 000 subscribers. The service is increasingly being used as an electronic mail service in conjunction with Memocom, a Dialcom-based system which is being converted to the X.400 standard. A new company, Videotex Nederland, has been established to promote an integrated television & cable TV videotex system. Other private companies in this field include RITS and Info Thuis.

Teletext in the Netherlands is offered by NOS as the Teletekst service. It has 850 pages of information but without advertising or sponsorship. Teletext is also offered on basis by Gouden Gids and by numerous other public or private local bodies.

The wider concept of data broadcasting cuts across the regulatory divide in the Netherlands. For instance, NOZEMA wishes to provide a low data-rate service similar to the datacasting services offered by BBC Enterprises in the UK. This situation is currently under-review. There are four private companies which provide datacasting services at present:

- NOB NV/Raet NV;
- CMG Informatieverwerking BV;
- Stichting openlucht bioscoop;
- High Key.

A data paging service is provided by Koning & Hartmann on an experimental basis.

B15.7 Specialised satellite services

Satellite services are not used extensively in the Netherlands, though the PTT is a member of all the international and regional satellite bodies. An international satellite leased line service, Multisat, is made available by the PTT.

Satellite TV is also relatively underdeveloped in the Netherlands as most households are cabled and already have the pick of the best channels in surrounding countries. SMATV installations are a PTT monopoly but TVRO dishes below 1.5 m do not require either planning permission or a licence. Satellite TV stations with a hub outside the Netherlands do not require a licence and no licences have been granted. The Scandinavian say-TV channel Filmnet is received in the Netherlands via the ASTRA satellite. The HDTP Dept. of the Ministry of Transport and Public Works is responsible for licensing satellite operators.

B15.8 Cross-ownership and cross-sectoral service provision

The issue of the convergence between telecommunications and broadcasting is taken very seriously in the Netherlands, though it has not yet been possible to formulate a stable policy to either promote or to regulate convergence. In 1990, a study of policy and the regulatory aspects of the convergence between communications for the Dutch Government by three university professors (see bibliography). There are many examples of convergence at present:

- PTT Telecom owns the major cable TV operator, CASEMA BV and, until recently, it part-owned the broadcast TV infrastructure supplier, NOZEMA BV.

There are no restrictions preventing PTOs from providing TV services. However cable TV companies are not allowed to have point-to-point connections via their network and for point-to-multipoint interactive connections, a special (second) licence is required.
- NOZEMA BV is hoping to provide data broadcast services in competition to the PTT.
- Both the PTT and cable TV operators have an interest in the Videotex Nederland company.

There are no restrictions preventing the cross-ownership of telecommunications and broadcasting firms at present though future legislation is expected which would prevent publishers with a certain market share from acquiring a significant stake in a commercial TV station.

Two other factors are stirring the convergence issue in the Netherlands. Firstly, the major Dutch manufacturing company, Philips, has a considerable investment in HDTV and has taken steps to influence the programming side of the broadcast industry by taking a small shareholding in RTL-4. If HDTV is going to become a reality in the Netherlands, it will probably need to be broadcast via cable. For this reason, there is a strong incentive to put the cable TV operators on a sounder commercial footing so that they are better placed to undertake the necessary investment. On the other hand, a second factor which needs to be considered is the strong Dutch tradition of non-profit making, open access, balanced television services. Moves which endangered this inheritance may be politically unpopular. A D2-MAC channel is planned to start broadcasting in the Netherlands in 1992. Members of this consortium, called D2TV, include Philips, NOB, NOS and PTT Telecom.

The current government view on convergence is mixed. On the one hand the PTT pays corporate taxes while NOZEMA and the cable TV operators do not. On the other hand, CATV operators pay value-added tax (VAT) while the PTT and NOZEMA do not. There is considerable scope for introducing network competition along scenarios which might include:

- privatising NOZEMA, giving it the right to provide data broadcasting services, and making it part of a consortium for the second Dutch GSM licence so that it can use its transmitter network and prime sites to good effect;
- separating CASEMA from the PTT and encouraging it to offer combined telecommunications and broadcasting services in competition with the PTT and encouraging it to buy out or to manage other local CATV operations.

By contrast, however, there is also scope for giving the PTT overall responsibility for all communications infrastructures in the Netherlands, along the lines of the Zegveld Commission's proposals, with a brief to develop an integrated broadband network for both telecommunications and cable TV capable of carrying HDTV. There are no restrictions on network sharing and the PTO already provides inter-regional programme exchange services to cable companies. With the PTT as a monopoly infrastructure supplier, it would still be possible to permit open access to different interest groups or TV stations in an "open network provision" (ONP) type framework. A model already exists in the form of NOB (Nederlands Omroep Bedriif) which provides studio facilities for all broadcasters in the Netherlands on an "open access" basis.

Figure B15. **Network dimensions and service revenues in the Netherlands**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1991	6 694.0	Thousands	1985-90	+3.5
Penetration rate		45.1	Per 100 inhabitants		
Cellular radio	1990	79.0	Thousands	1987-90	+72.8
Penetration rate		0.53	Per 100 inhabitants		
TV Receivers	1990	7 000.0	Thousands	1983-90	+1.4
Penetration rate		47.1	Per 100 inhabitants		
VCRs	1990	3 042.0	Thousands		n.a.
Penetration rate		20.5	Per 100 inhabitants		
Cable TV subscribers	1989	4 450.0	Thousand households	1985-89	+9.5
Penetration rate		79.5	Per 100 households		
Cable TV access	1990	5 250.0	Thousand household with access		
Penetration rate		93.7	Per 100 households		
Take-up rate		84.8	Per cent of households with access		
One way satellite antennae	1990	200 000	Estimate		n.a.
Penetration rate		1.3	Per 100 households		
Two way satellite antennae	1990	50	Estimate		n.a.
Telecommunications	1989	8 420.0	Million Guilders	1984-89	+7.4
revenues	1989	3 970.0	US$ million	1984-89	+19.1
Broadcast TV revenues	1985	850.5	Million Guilders		n.a.
	1985	239.6	US$ million		n.a.

n.a.: Not available.
Sources: Ministry of Transport and Public Works, Royal Netherlands PTT, ITU, UNESCO, Logica (1987), Renaud (1990).

Both these alternatives, a competitive or a unified infrastructure have certain advantages, but it is not clear yet what direction will be taken.

B15.9 Information sources

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For other information sources, please see sections B2.9 and B3.9.

B16. NEW ZEALAND

B16.1 Telecommunications network operators

New Zealand has probably the most open telecommunications environment of all the OECD countries. It is also unique in having a high level of foreign ownership of the main network operator, Telecom Corporation of New Zealand Ltd. (TNZ).

Until 1986, telecommunications services in New Zealand were a monopoly held by the New Zealand Post Office. In that year an Act of Parliament created a number of state-owned enterprises, including Telecom New Zealand which came into being on 31 March 1987. At the same time, a process of deregulation was set in motion including the liberalisation of telex services and customer premises wiring (Oct. 1987), telephone handsets (May 1988), PBXs (April 1989), third party resale and finally a full liberalisation of market entry.

As part of the corporatisation programme, Telecom New Zealand was split into several units:

- a corporate office based in Wellington;
- Telecom Networks and International for long distance, international and data services;
- four regional operating companies (ROCs) serving the Auckland area, the Wellington area, Central North island and the South island.
- "New venture" companies, including cellular, paging, directories, mobile radio, and repair services;
- joint ventures including equipment supplies, software and system support, and Netway Communications Ltd; for the freight transport industry.

At the time of the corporatisation of Telecom New Zealand, the Government announced its intention to sell the company, and this was completed on 12 September 1990 for a price of NZ$ 4.25 billion (US$2.5 billion). The main shareholders are:

- Bell Atlantic (US);
- Ameritech (US);
- Freightways (NZ);
- Fay Richwhite (NZ).

At the end of a three year period, the holdings of Bell Atlantic and Ameritech will be reduced to just under 50 per cent, the New Zealand shareholding companies will be increased to 10 per cent, and the remaining 40 per cent will be sold to the general public. As part of the sale, theNew Zealand government has retained a "special rights convertible preference share" (the "Kiwi share") which assures that certain universal service conditions, including tariff control are met.

A number of new entrants have also entered the New Zealand market since liberalisation of whom the major competitor is Clear Communications Ltd, which provides a variety of long distance and data services. North American companies are also involved as shareholders in Clear as well as in Telecom NZ.

The regulatory authority in New Zealand for telecommunications is the Department of Trade and Industry.

B16.2 Telecommunications network facilities

New Zealand has one of the most technically sophisticated networks in the world with a relatively high level of penetration (44 mainlines per 100) for a mountainous, rural country. Because New Zealand is an island country with no adjacent territories, there are less demands upon its frequency spectrum than in other OECD countries. Telecom NZ has therefore been able to construct an extensive microwave network. Microwave is also used for short-haul links by both Telecom NZ and competitors. In 1990, the New Zealand Government announced its intention to auction spectrum rights above 1GHz to the highest bidder and this has stimulated the market for PCN/microwave type applications.

A programme of digitisation of switches began in 1982 and this advanced rapidly after corporatisation. In 1990 some 72 per cent of lines were connected to digital switches.

B16.3 Mobile communications services

As noted above, New Zealand has a well-developed radio communications sector with microwave used extensively, almost 100 000 users of public mobile radio and advanced plans for PCN services. Cellular radio in New Zealand follows the US standard (AMPS/TACS) and has grown rapidly since its introduction in 1987. At the end of March 1990, there were some 29 197 subscribers on Telecom NZ's network. It is likely that other companies will enter this market shortly. Four new licenses were opened to tender in 1990.

Radiopaging has also boomed after a late start. The paging network, like the cellular radio network, covers 90 per cent of the country and there were 30 000 subscribers in March 1990.

B16.4 Broadcast TV operators

Until 1987, the Broadcasting Corporation of New Zealand (BCNZ), a statutory corporation, had a monopoly on TV broadcasting. In that year BCNZ was dissolved and two new state-owned corporations were formed, Radio New Zealand and Television New Zealand (TVNZ). The latter body takes 85 per cent of its revenues from advertising with the rest from licence fees. The licence fee revenues are allocated by the Broadcasting Commission. Amongst other obligations, the Broadcasting Commission also funds Maori language and culture programmes.

In 1987, a new TV channel, TV3, was licensed and it began broadcasting in November 1989. Six months later, the owners, TV3 Network Ltd., declared bankruptcy and a new purchaser has been sought.

In February 1990, a new system of allocating spectrum rights was announced. Existing broadcasters were given 20-year franchises in return for a "spectrum fee", and a further seven VHF national channels and 63 supplementary UHF channels for regional rebroadcasters were opened to tender. Bids were received in the range NZ$100 000 - $400 000 (US$60 000 - $240 000). Sky Network Television Ltd, in which TVNZ has a 35 per cent shareholding, was successful in gaining four channels which it plans to use for news, sports, films and entertainment. In April 1991, a 51 per cent share in Sky was acquired by a US-based consortium which includes the telcos Ameritech and Bell Atlantic and the CATV operators Tele-communications Inc. and Time warner. They hope to use Sky as a vehicle for pay TV. Also successful in the auction was BCL, the transmission subsidiary of TVNZ, though it is unlikely that this channel would be used in direct competition with TVNZ.

B16.5 Video-based services

There is currently little or no cable TV activity in New Zealand though the February 1990 legislation means that cable, along with satellite or MMDS distribution, is open to competition.

Telecom New Zealand offers video-conferencing on demand but does not have a national service.

B16.6 Data broadcasting services

Telecom New Zealand launched a videotex service, Vapnat, in May 1986. There are around 5 000 users and 70 information providers.

B16.7 Specialised satellite services

New Zealand joined INTELSAT in 1971 and established a satellite earth station at Warkworth in 1984. Telecom New Zealand also has an interest in the Australian satellite carrier, AUSSAT, having signed a Memorandum of Understanding that the AUSSAT-B satellites will also cover New Zealand. It is likely that the launch of these new satellites in 1991 and 1992 will also provide an opportunity for the development of DBS in New Zealand.

B16.8 Cross-ownership and cross-sectoral service provision

Until recently there was little cross-ownership and only limited cross-sectoral service provision in New Zealand. In the television field, market entry barriers were only lifted in February 1990, but already the North American telcos have purchased a share in

Figure B16. **Network dimensions and service revenues in New Zealand**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1989	1 451.7	Thousands[1]	1984-89	+3.4
Penetration rate		43.6	Per 100 inhabitants		
Cellular radio	1990	29 197	Subscribers	1988-90	+251.5
Penetration rate		0.88	Per 100 inhabitants		
TV Receivers	1987	1 220.0	Thousands		n.a.
Penetration rate		36.7	Per 100 inhabitants		
VCRs	1988	592.0	Thousands		n.a.
Penetration rate		17.8	Per 100 inhabitants		
Telecommunications revenues	1989/90	2 292.3	NZ$ million[2]	1985-90	+19.7
	1989/90	1 367.7	US$ million	1985-90	+25.4

n.a.: Not available.
1. Financial year ending 31 March for most data in this table.
2. Telecom New Zealand revenues only.
Sources: TNZ, UNESCO, ITU.

Sky Entertainment Television as well as Telecom New Zealand. For instance, the transmission subsidiary of TVNZ, BCL, has gained an extra allocation of frequency through the spectrum auction and may use this to compete in mobile communications services.

New Zealand's main contribution to the convergence debate is in its radical strategy for frequency spectrum allocation. The auction of television channels has generated considerable interest and as technology progresses it is likely that the spectrum above 1GHz will also become attractive for telecommunications applications. New Zealand is clearly in a privileged position in being able to allocate spectrum with little thought for co-ordination with neighbouring countries. Nevertheless, it is likely that New Zealand will be observed closely as a laboratory test case to examine the viability of using market mechanisms for allocating spectrum in other countries.

B16.9 Information sources

BRENNER, S. (1991), "Competition policy and a changing broadcast industry", unpublished OECD working paper, 69 pp.

Datapro Research (1989), "New Zealand: The Commercial and Regulatory Environment", Delran, USA, 7 pp.

Telecom New Zealand, "Annual Report".

Telecom New Zealand (1990), "Profile", Wellington, 32 pp.

For other sources of information, please sections B1.9 and B4.9.

B17. NORWAY

(Questionnaire response received on 7 May 1991 and additional comments on 28 August 1991)

B17.1 Telecommunications network operators

Until 1990, telecommunications services in Norway were a monopoly held by the Norwegian Telecommunications Administration (NTA) which was part of the government administration under the jurisdiction of the Ministry of Transport and Communications. On 1 January 1990, NTA was renamed as Norwegian Telecom (NT) as part of a transition to a more liberal environment for telecommunications services. Until recent years NT received loans from the government and its investment programme is still constrained by the governments' overall budget. Nevertheless, NT is now fully self-financing and in 1989 paid back Nkr 97.9 million (US$14.2 m) to the state.

Since 1988 there has been a progressive spread of liberalisation in Norway beginning with customer premises equipment and moving on to VANS which were liberalised in June 1989. NT has made a number of changes to separate the monopoly and competitive parts of its activities. In particular, six new bodies have been established for competitive markets:

- TBK AS was established as a wholly-owned subsidiary (limited company) of Norwegian Telecom on 1 January 1988, in order to compete in the liberalised terminal equipment and business communication markets;
- TBK Nett AS was established as a wholly-owned subsidiary (limited company) of TBK AS on 3 November 1989 in order to compete in the liberalised value added data network services market, with specific responsibility for Norwegian Telecom's biggest business customers;
- TBK Kabel-TV AS was established as a wholly-owned subsidiary (limited company) of TBK AS on 22 October 1990 in order to compete in the cable TV market by operating the company's cable TV networks and to design and build cable TV networks for customers;
- TelePost Communication AS was estalished as a jointly owned subsidiary (limited company) of Norwegian Telecom (50%) and the Norwegian Post Office (50%) on 1 August 1991, in order to develop and market electronic messaging services based on Norwegian Telecom's X.400 service Telema X.400;
- Tele Mobil was established as a separate unit within Norwegian Telecom on 1 January 1991, with separation of economy and accounts, in order to compete in the liberalised radio mobile services market;
- Norwegian Telecom International (NTI) was established as a separate unit within Norwegian Telecom on 1 May 1991 in order to handle all of Norwegian Telecom's activities in the international market.

On the regulatory side, a new body, the Norwegian Telecommunications Regulatory Authority (NTRA) was established to assist the Ministry of Transport and Communications with determining provisions and establishing standards, type approval of equipment, authorisation of companies, administration of radio frequencies, issuing licences for operating cable networks, broadcasting transmitters and land mobile networks, and representing Norwegian interests in international bodies dealing with telecommunication standards.

B17.2 Telecommunications network facilities

Norway has a technically sophisticated network with a high level of telephone penetration (51 per 100 inhabitants). Until recently, however, Norwegian tariffs were relatively high, especially compared with its Scandinavian neighbours. To some extent high tariffs reflected the difficulty of providing services given the unique geography of Norway. However Norway's international tariffs, with no such constraints, were also high. Recent tariff reductions have brought Norway closer to the European average.

By the start of 1991 some 39 per cent of exchange lines were digital and this was expected to increase to 73 per cent by 1995. Also, 8 per cent of central switches were digital and this should increase to 20 per cent by 1995. Over the period 1991-94, Ericsson is set to replace Alcatel as the main exchange supplier.

Around 75 per cent of the trunk network is based on fibre optic cable, and this will increase to 95 per cent by 1995. Fibre solutions have occasionally been used in the local loop to meet the needs of businesses in urban areas but only after a full cost-benefit analysis. There is no fixed policy on fibre to the home but two pilot projects are being carried out in 1991.

B17.3 Mobile communications services

Norway has shared in the success of the NMT (Nordic Mobile Telephone) system to the extent that, in 1989/90, mobile communications provided around 7 per cent of total revenue. In August 1991, there were more than 220 000 subscribers, representing one of the highest densities in the world. The NMT 450 service was introduced in Norway in 1981 and the NMT 900 in 1986 when the radio frequency in the 450 MHz band became saturated in densely populated areas. The NMT 900 service has subsequently enjoyed the faster growth.

It is planned that two GSM systems will operate in competition – Norwegian Telecom and a private competitor. Norwegian research played a major role in defining the European standard for GSM.

Wide area radiopaging was introduced in Norway in 1984 with a numeric service which is now called PS-tall 1. In August 1991, this service had more than 80 000 subscribers. In June 1991, an alphanumeric paging service (PS-tekst) was introduced, cabable of transferring text messages up to 128 characters.

In November 1989, a mobile data and text service with voice capabilities, Mobitex, was introduced at 160 MHz. The service covers the most densely-populated areas.

The NTRA is responsible for allocating the frequency spectrum and all licensees must pay a fee for its use.

B17.4 Broadcast TV operators

Norway has resisted the introduction of TV advertising longer than most OECD countries. The national broadcaster, NRK (Norsk rikskringkasting) is funded entirely by licence fees and its budget is controlled directly by Parliament. NRK broadcasts one TV channel. NRK's programmes are broadcast using facilities provided by Norwegian Telecom. For this service, NRK paid Nkr 175 million (US $25 million) which contributed just over 1 per cent of NT's turnover in 1989.

A second Norwegian TV channel, operated by a commercial company, was licensed in the late 1980s and NT is now planning a transmitter network. In addition, broadcasting trials for local TV have been permitted since 1984 providing that no advertising is shown and strict rules for copyright are followed. There are more than 100 concessions for local TV.

Broadcasting regulation is the responsibility of the Ministry of Culture assisted by a National Advisory Council (NAC), though the local broadcasting authority in Fredrikstad also plays a role in licensing operators.

B17.5 Video-based services

During the later 1980s, the Norwegian government began to encourage a more commercial approach to cable TV. In particular:

- the level of public funding was reduced;
- the cable TV division of Norwegian Telecom was separated from NT together with TBK AS and organised as a limited company;
- a new licensing regime was established by the Norwegian Cable Authority (Kabelnett Kontrollen), now part of the NTRA.

The density of CATV household is modest (around 30 per cent) and most systems have only six channels, though some system operators are upgrading their systems. There are ten system operators with more than 5 000 subscribers of which the largest, by far, is Janco Kabel-TV, serving the Oslo area.

Video-conferencing facilities have been available in Norway since 1985 and the coverage has been progressively extended with both public and private studios. Norway participates in the European Video-conferencing Service (EVS). There is also a pilot service for offering video-conferencing over ISDN. NT has also carried out considerable research in video-telephony. A visual service, with three exchanges, is already available to hearing-impaired users.

B17.6 Data broadcasting services

Norwegian Telecom's videotex service, Teledata, is based on the BTX standard and in October 1990 had over 5 000 users and 110 information providers. In 1990 an electronic directory service was made available via Teledata.

Teletext services in Norway are delivered over the NRK channel as the Text-TV service. This has 575 pages of information without advertising.

As part of its construction programme for the second TV channel, NT is including facilities for data broadcasting.

B17.7 Specialised satellite services

The NORSAT A satellite system was established in 1976 with the aim of serving the oil exploration industry. A second satellite, NORSAT B, was launched in 1989 to serve a wider range of users including the provision of high speed leased circuits and some data broadcasting.

Satellite TV is licensed by the Ministry of Culture but most of the infrastructural support is provided by Norwegian Telecom. Norway participates in the Nordic high power satellite consortium and NT has been broadcasting NRK programmes in both PAL and MAC formats via the Tele-X satellite since December 1989. In total, 3.5 transponders are used for DBS services.

B17.8 Cross-ownership and cross-sectoral service provision

Cross-ownership (by the Government) and cross-sectoral service provision (Norwegian Telecom) was, until recently, very high in Norway. However, this monopoly provision is gradually being reduced, for instance:

- by the hiving off of NT's cable division into a limited company;
- by the licencing of commercial TV channels, including delivery by satellite;
- by the liberalisation of the VANs market;
- by the licencing of a second GSM operator.

There are restrictions however on the provision of interactive services by CATV companies.

These recent changes are made on the basis of a technically strong network with a high level of penetration of both PSTN mainlines and mobile subscribers. Norway has also managed to maintain a leading edge position in critical areas of research such as GSM technology, video-telephony and the MAC standard for broadcasting.

Figure B17. **Network dimensions and service revenues in Norway**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1991	2 132.3	Thousands	1986-91	+3.9
Penetration rate		50.2	Per 100 inhabitants		
High speed connections (>2.0 Mbit/s)	1991	360	Connections		n.a.
Cellular radio	1991	196.8	Thousands	1988-91	+13.7
Penetration rate		4.67	Per 100 inhabitants		
TV receivers	1991	1 700.0	Thousands	1980-87	+2.8[1]
Penetration rate		40.3	Per 100 inhabitants		
VCRs	1991	900.0	Thousands	1988-91	+14.6
Penetration rate		21.4	Per 100 inhabitants		
Cable TV	1991	500.0	Thousand households	1987-91	+12.6
Penetration rate		33.3	Per 100 inhabitants		
One way satellite antennae	1991	70 000	Antennae		n.a.
Two way satellite antennae	1991	35	Antennae		n.a.
Telecommunications revenues	1989	14 269.8	Million NOK	1984-89	+9.8
	1989	2 066.7	US$ million	1984-89	+16.1
Broadcast TV revenues	1985	1 314.7	Million NOK		n.a.
	1985	174.1	US$ million		n.a.

n.a.: Not available.
1. Growth in licences.
Sources: Norwegian questionnaire response, Norwegian Telecom, ITU, UNESCO, Renaud (1990), Logica (1987).

B17.9 Information sources

The principal source of information is the Norwegian response to the OECD questionnaire delivered on 7 May 1991 by Mr. Kjell Johnsen, Asst. Director General, Ministry of Transport and Communications, with additional comments forwarded on 28 August 1991.

Additional information from:

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MULLINS, S. (1991), ''Norway's telecommunications carrier plans telephony via TV transmitters'', *FinTech Telecom Markets,* 21 March, pp. 5-6.

Norwegian Telecom, ''Annual Report''.

For additional information sources, please see section B2.9.

B18. PORTUGAL

(Questionnaire response received on 6 May 1991)

B18.1 Telecommunications network operators

Pressure for the liberalisation of telecommunications began to simmer in Portugal in the early 1980s and there were some moves to liberalise customer premises equipment and to separate the regulatory and operational functions of the PTT in the period 1981-83. However, this was overtaken by a period of political instability and was only revived in 1986 when the CEDITC Commission was formed (Communications Institutional and Technological Development Study). This Commission reported in June 1987 and its recommendations passed into a new telecommunications law in 1989. This new law recognises three operators:

- TP (Telecom Portugal), formerly CTT (Correios e Telecomunicacoés de Portugal) which is responsible for telephone and telex services throughout Portugal (except the cities of Lisbon and Oporto) and Europe;
- TLP (Telefones de Lisboa e Porto) operates the telephone network in these two cities;
- CPRM (Companhia Portuguesa Rádio Marconi) operates inter-continental telephone and telex links, and all satellite services.

At present each of the operators is state-owned, though CPRM is recognised as a private company in which the majority shareholder is the state-holding company, IPE. It is planned that 49 per cent of TLP will be privatised during 1991. It is planned also that the postal and telecommunications activities of the former CTT will be separated. The creation of TP in May 1990 and the separation of CTT's regulatory functions in a new body (ICP: Instituto des Communicaçoés de Portugal), formed in August 1989, were preliminary steps towards this.

The new law recognises three main levels of service:

- Basic services, including telephony, telex and switched data transmission.
- Complementary services which require the use of the basic fixed network in conjunction with other infrastructures. Mobile communications services are included in this category. There is a licensing procedure for complementary services with the constraint that companies participating should not be owned (more than 10 per cent) by PTOs offering similar services and should not be owned (more than 25 per cent) by foreign entities.
- Value-added services which do not require their own infrastructures. These services are subject to a simple authorisation procedure.

A fourth company, Transdata, was established in 1985, as a joint venture between TP (75 per cent) and TLP (25 per cent), and provides packet-switching and managed data communications services. This has an infrastructural monopoly over public data services until 1996 at the latest according to the EC directives. It is expected that VAN service competition will be introduced in 1991.

The Ministry responsible for telecommunications in Portugal is the Ministry for Public Works, Transport and Communications. The ICP is responsible for duties which include tariff and quality control, type approval, frequency management and the licencing of operators.

B18.2 Telecommunications network facilities

The level of telephone penetration in Portugal at around 25 mainlines per 100 inhabitants, is among the lowest in the OECD area, though the network is also one of the fastest growing. At the start of 1990, TLP was the larger company with 53 per cent of mainlines while TP had 47 per cent.

Around 50 per cent of trunk exchanges are digital in Portugal and almost 3 000 km of fibre optic cable has been installed. The length of fibre is expected to increase fourfold over the next five years. However, local services are much less well-developed with only 30 per cent digitisation. This is expected to increase to 67 per cent by 1995. Investment has increased recently, but the waiting list for telephones is still almost one year.

B18.3 Mobile communications services

Portugal has adopted the German C450 standard for cellular radio and began a pilot service in early 1989 using Siemens technology. The service, Telemovel, was initially offered only within Lisbon and Oporto but this has been subsequently extended to parts of the Algarve. There were 6 000 subscribers at the start of 1991.

It is planned that two GSM systems will be licensed with one operated by TP/TLP and the other still to be decided. The ICP is responsible for regulating the use of the frequency spectrum. Usage taxes are payable both for items of equipment and for use of the spectrum.

A radiopaging network was established in Portugal only in December 1989, relatively late by OECD standards, and it is currently restricted to four cities. The network, called Telebit, is operated as a joint venture between TP and TLP (Telemensagem) and it is planned that it should have national coverage by 1994.

B18.4 Broadcast TV operators

TV broadcasting in Portugal began in 1956 and at that time was a monopoly held by RTP (Radio Televisao Portuguesa). RTP was formed as a mixed capital company but was nationalised in 1979. It offers two channels and is funded partly by advertising and partly by a tax on TV and radio receivers.

In the mid 1980s there was a brief period when a multi-lingual consortium of public broadcasters established Europa Television, which was broadcast nationally, but this collapsed in 1986. Following new legislation in July 1989, invitations to tender and frequency allocations were announced for two new commercial channels.

The regulatory body for television broadcasting in Portugal is the ICP for technical aspects and the Directorate General for Social Communications (DGCS) for all other aspects.

B18.5 Video-based services

Regulation for cable TV networks is currently being discussed in Portugal in parallel with the July 1989 changes in broadcasting legislation.

In 1990, a video-conferencing service using a 2 Mbit/s line was opened between Lisbon and Oporto. Other studios are planned for the Algarve and Madeira.

B18.6 Data broadcasting services

A videotex service, supporting the BTX, télétel and Prestel standards, was opened in January 1990 operated by Transdata. At the start of 1990 there were around 800 subscribers. There are no teletext or data broadcasting services, but audiotex is an open market.

B18.7 Specialised satellite services

Legislation for satellite TV, like that for cable TV, is currently being developed. SMATV operators cannot charge for particular channels and all TVROs, of which there are around 10 000 in Portugal, are subject to type approval. CPRM is the Portuguese signatory to international satellite organisations and one international transponder is currently used for telecommunications purposes.

B18.8 Cross-ownership and cross-sectoral service provision

At present, there is little discussion of the convergence between telecommunications and broadcasting in Portugal, but this is likely to become an issue once the legislation currently being drafted for satellite TV and cable TV is settled. For interconnection issues, the stated policy is to follow the ONP principles developed by the CEC. Interconnection issues are the responsibility of the ICP.

Figure B18. **Network dimensions and service revenues in Portugal**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1991	2 612.5	Thousands	1986-91	+13.3
Penetration rate		25.4	Per 100 inhabitants		
Cellular radio	1991	6 500	Subscribers		n.a.
Penetration rate		0.06	Per 100 inhabitants		
TV licences	1987	1 626.0	Thousands	1980-87	+2.2
Penetration rate		15.8	Per 100 inhabitants		
VCRs	1988	639.0	Thousands		n.a.
Penetration rate		6.2	Per 100 inhabitants		
Telecommunications revenues	1988	147 755	Million Esc	1983-88	+21.2
	1988	1 026.4	US$ million	1983-88	+19.1
Broadcast TV revenues (Public TV only)	1987	17 074	Million Esc		n.a.
	1987	131.5	US$ million		n.a.
	of which: 5.9% from Government 26.8% from licence fees 67.3% from other (receiver tax).				

n.a.: Not available.
Sources: TP/TLP annual reports, ITU, UNESCO.

B18.9 Information sources

The principal source of information is the Portuguese response to the OECD questionnaire, delivered on 6 May 1991 by Mr. José Manuel Ferrari Careto of the ICP.

Additional information from:

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MENDES, F. (1990), "Re-regulation of Portuguese Communications", unpublished paper delivered at the Third Special Session of the ICCP Committee on Telecommunications Policy, 28-30 November, OECD, Paris, 68 pp.

For additional information sources, please see sections B2.9 and B3.9.

B19. SPAIN

B19.1 Telecommunications network operators

Spain differs from most other European countries in that its main operator, Telefónica de España, has been a private company since it was founded in 1924 with the government shareholding being only 35 per cent. On the other hand, Telefónica has had a monopoly for telephony services and, since 1970 for data services. The only exception to this monopoly is for telex, telegraphy and message switching which is the responsibility of the Dirección General de Correos y Telegrafos (DGCT), part of the government administration.

A limited measure of liberalisation was introduced in Spain in the Ley de Ordenación Telecommunicaciones (LOT) which opened up the market for customer premises equipment and value-added network services while confirming Telefónica's infrastructural monopoly. In order to compete in the VANS market, Telefónica created a wholly-owned subsidiary, Telefónica de Servicios, in 1988. In addition another subsidiary, Telefónica Internacional (TI) had been created in 1985 to promote Telefónica abroad. Despite being relatively heavily indebted the company has been particularly active in South America acquiring shareholdings in national operators in Argentina and Chile. Other joint ventures include AT&T Microelectronica de España and Fujitsu España.

Regulatory responsibility in Spain rests with the Ministry of Transport, Tourism and Communications.

B19.2 Telecommunications network facilities

Spain has historically had a relatively low level of penetration of telephone main-lines. At the start of the new decade there were around 30 per 100 inhabitants but Telefónica is currently engaged in a major push to increase this to 38 per 100 by the time of the Barcelona Olympics and Seville World Expo in 1992. Digitisation is also increasing rapidly, moving from 20 per cent of exchange lines to 28 per cent just during the course of 1990. The length of fibre optic cable also doubled during 1989 to 8 000 km, or 6.5 per cent of the basic infrastructure. One of the major targets is to reduce the waiting list for telephone service from the present two months to zero.

For business users, a pre-ISDN digital overlay network, IBERCOM, has been available since 1987 and now has 25 000 subscribers and 180 000 lines.

B19.3 Mobile communications services

Spain has taken the unusual step of changing technologies for analogue cellular radio systems when upgrading from 450 to 900 MHz technology. The first system adopted in 1986 (TMA-450) was the NMT 450 and around 50 000 subscribers were registered at the start of 1990. In May 1990, a TACS-900 system (TMA-900) was installed using equipment from Telecel (a Motorola/Amper joint venture). By the end of the year it had 2 000 subscribers.

Telefónica is planning to have pilot GSM systems established in Barcelona and Seville in 1992 built by Ericsson (Intelsa)/Teletra and Telecel respectively. No decision has yet been taken on a possible second GSM operator to compete with Telefónica.

Radiopaging is a competitive market in Spain with around 50 private local operations. Telefónica operates two services: Mensafónico, an analogue service, and Mensatel, a digital service.

B19.4 Broadcast TV operators

Until 1987, TV broadcasting in Spain was a monopoly held by RTVE (Radio Television Española) which is an autonomous entity created in October 1973 and reporting directly to the Presidential Ministry. The monopoly was confirmed in the Radio and Television Act of January 1980, but was reviewed in the mid 1980s. Commercial TV was authorised in 1987 and franchises for a number of national channels were authorised in addition to RTVE's two public channels. The new channels include:

- Canal Plus España, in which Canal Plus of France has a shareholding;
- Tele 5, in which the Berlusconi Group of Italy has a shareholding;
- Antenna 3;
- RTV (regional television);
- ETB;
- Galavision, owned by Univisa Inc.

B19.5 Video-based services

Until the 1987 law on telecommunications (LOT), Telefónica had a theoretical infrastructural monopoly which encompassed cable TV. Indeed there are a number of "unused" telephone cables in the Madrid and Barcelona areas which could quite easily be adapted for cable TV. The new law provides a framework for the control and regulation of cable. The major project underway is the plan to cable 90 per cent of Barcelona's households in time for the 1992 Olympics.

Video-conferencing was introduced in 1989 by Telefónica and serves six major cities.

B19.6 Data broadcasting services

Videotex came to Spain in 1986 in the form of the IBERTEX network which is based on the BTX standard. The system uses the PSTN for subscriber access and the X.25 network (IBERPAC) for interconnection of access points. In mid-1990 there were 130 000 users with 190 information providers but this will be boosted by users of the electronic yellow pages service, opened in October 1989, offered by a Telefónica subsidiary, Cetesa.

Teletext in Spain is offered by RTVE as the Teletexto service with 800 pages of information provided by the TV news service.

B19.7 Specialised satellite services

SMATV and TVRO installations were liberalised in 1986, though prior to this there had been little official regulation. MATV is already extensively used in apartment blocks in major cities to receive regular over-the-air broadcasts so it should theoretically be possible to develop a satellite TV market relatively quickly. Much depends on the availability of programming material in Spanish.

Telefónica has a major programme to build three Hispasat satellites to link the Spanish speaking communities of Spain, Latin America and the USA. A forerunner of this expansion of satellite use was the commissioning of a VSAT network covering

Figure B19. **Network dimensions and service revenues in Spain**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1991	14 476.6	Thousands	1986-91	+9.2
Penetration rate		37.1	Per 100 inhabitants		
Cellular radio	1991	52 000	Subscribers	1988-91	+63.7
Penetration rate		0.13	Per 100 inhabitants		
TV receivers	1987	14 314.0	Thousands	1980-87	+6.2
Penetration rate		36.7	Per 100 inhabitants		
VCRs	1988	3 860.0	Thousands		n.a.
Penetration rate		9.9	Per 100 inhabitants		
Cable TV	1989	330.0	Thousand households		n.a.
Penetration rate		3.0	Per 100 inhabitants		
Telecommunications revenues	1990	832 317.0	Million ptas	1985-90	+14.4
	1990	8 117.0	US$ million	1985-90	+24.1
Broadcast TV revenues	1986	89 388.0	Million ptas		n.a.
	1986	677.0	US$ million		n.a.

n.a.: Not available.
Sources: Telefónica, Logica (1991), ITU, UNESCO, Logica (1987).

Europe and South America for the EFE press agency via EUTELSAT. Spain is already the major user of EUTELSAT providing 22 per cent of the investment, ahead of British Telecom with 17 per cent. Much of this traffic is with outlying islands.

B19.8 Cross-ownership and cross-sectoral service provision

Spain is in an ideal position to choose between alternative media for broadcasting, because neither cable TV, nor satellite TV, nor even over-the-air distribution of commercial channels is well developed at present. Furthermore, there are no regulatory barriers which would prevent Telefónica or RTVE from getting involved in cross-sectoral service provision. For the moment, however, the main priorities are to modernise and extend the telecommunications infrastructure and to develop a Spanish language TV programming industry.

B19.9 Information sources

Datapro Research (1990), ''Spain: The Commercial and Regulatory Environment'', Delran, USA, May, 8 pp.

Ministry of Transport, Tourism and Communications (1987), ''LOT – The Telecommunications Law'', unofficial English translation, General Secretary of Communications, General Direction of Communications, Madrid, 40 pp.

Telefónica de España, ''Annual Report''

For other information sources, please see sections B2.9 and B3.9.

B20. SWEDEN

(Country comments received on 9 December 1991)

B20.1 Telecommunications network operators

Sweden is close to being a telecommunications paradise having the highest level of telephone penetration after Monaco in the world (67 mainlines per 100 inhabitants) at the same time as having some of the lowest domestic tariffs and one of the highest levels of quality of service. Furthermore, this has been achieved by the national operator Swedish Telecom (Televerket) without having a legal monopoly. Until recently, Televerket's monopoly in fixed link telephony hasn't been challenged simply because it would be difficult to compete against it and still remain profitable. Televerket is at present a state-owned public service corporation with a corresponding set of operating rules. The rules which specify the financial conditions for accounting and taxation are as close as possible to those of a limited company. In 1991, VAT was introduced on all telephony services.

In order to prepare Televerket for a more competitive market, Parliament has progressively afforded Televerket the right to act in a more business-like way. The creation of Teleinvest AB in 1981 was a strategic decision in this direction. Teleinvest AB is a holding company for the Teleinvest group, which for the moment includes 16 subsidiaries. Also, Televerket together with Ericsson owns Ellemtel AB which has developed the AXE-system. In the summer of 1991, Parliament decided to give Televerket a new legal form. The background for this decision was the dynamic telecom market in which the level of competition was increasing. The Government is now considering changing Televerket to a limited company in response to a request from the latter for partial privatisation.

Televerket imposes strict rules on the cross-subsidisation of services between its monopoly and competitive activities. Indeed, even in the monopoly area, individual activities are run as profit centres.

Between 1980 and mid-1989, there has been a slow process of liberalising equipment markets and the setting of frameworks for competition in other areas, such as VANS and mobile services, where no previous regulations existed. This process is now complete and all areas are open to competition even if Televerket retains a dominant position in some fields. Simple voice resale was liberalised in late 1990. Competition has mainly focused on the high growth area of mobile communications services (see below) but consortia have also been formed to compete against Televerket in data services (e.g. Volvo Data) and electronic mail (Scandinavian Infolink).

In April 1991, a new potential competitor to Televerket was announced, Tele2. The shareholders in the new company are the Kinnevik Group (60 per cent) which already has mobile communications and TV broadcasting interests in Sweden, and Cable and Wire-

less (UK, 40 per cent) which is the parent company of the second carrier, Mercury, in the UK. Tele2 intends to compete with Televerket across a full range of services and aims to have a 10 per cent share of the national market by 2000.

Government responsibility for telecommunications rests with the Ministry of Transport and Communications. There is no Telecommunications Act in Sweden. In line with Swedish tradition, Parliament and Government have provided only fairly general guidelines. Televerket still has some regulatory functions in the field. Now, however a full separation of all regulatory authority from operational and commercial functions in Televerket is underway. A wide-ranging governmental regulatory entity for telecommunications is being created. As a first step, a National Telecommunications Council (STN) was established at the beginning of 1990, devoted to regulation of terminal equipment. Also, a Telecommunications Act is now being created, and is expected to come into force in 1993. Matters which fall under the Competition Act are the responsibility of the Competition Ombudsman institution. A restrictive business practice, which is considered by the institution to be harmful, may be taken to a special law court, the Market Court.

B20.2 Telecommunications network facilities

As well as being one of the telephone densest networks in the OECD area, Sweden's network is also of a very high quality. In 1987, a digital service was made available throughout the country under the "Digitalen" programme. At the start of 1990, sufficient AXE digital exchanges had been installed to provide connection to 56 percent of subscribers, though in practice this represented only 37 per cent of actual exchanges as the majority are small exchanges serving communities of under 500 people. At the same time, around 75 per cent of the trunk network was digital and this should rise to 100 per cent by 1995. Some 2 000 km of optical fibre cable had been laid in the trunk network and a further 1 000 km in local networks.

Sweden has the highest density of data connections as well as PSTN connections in Europe. The main services offered are the Datex CSDN (38 000 connections at the start of 1990), the Datapac X.25 network (3 650 connections) private leased lines (38 000 analogue circuits and 2 500 digital circuits), Telebox electronic mail (2 500 subscribers) and an X.400 message handling service (TEDE 400) which opened in March 1989 and currently has 40 private electronic mail systems connected.

B20.3 Mobile communication services

In the last few years, Sweden has overtaken Norway to become the country with the highest density of cellular radio subscribers in the world. Thanks to the success of the NMT system, radio communications now constitutes 12 per cent of telecommunications sales. NMT-450 was opened in 1981 and had 240 000 subscribers at the start of 1991. This capacity was extended in 1986 with an NMT-900 system which now has 200 000 subscribers. There is also a private operator COMVIK (part of the Kinnevik group) which has around 21 000 subscribers. Televerket, NordicTel and COMVIK will each operate GSM networks.

Televerket opened a mobile data and text services, Mobitex, operating at 80 MHz (lower than the Norwegian 160 MHz). This system has also been exported to the UK, the US and the Netherlands.

Radiopaging has been operating in Sweden, in the context of a competitive market, since 1978 and two services have near-national coverage. These are MBS (opened in 1978) and Minicall (since 1985). There are currently 117 000 subscribers of which MBS accounts for three-quarters.

B20.4 Broadcast TV operators

The national broadcaster in Sweden, Sveriges Radio (SR), is a non-commercial corporation in which the majority shareholding (60 per cent) lies with various "popular movements" (including consumer groups, religious groups and labour associations) with the rest being held by private industry (20 per cent) and press agencies (20 per cent).

SR has four main subsidiaries of which two are involved in TV broadcasting.

- Sveriges Television (STV);
- Sveriges Utbildningsradio (UR - educational broadcasting).

STV opened its first channel in 1957 and a second channel in 1969. These are now run independently and are encouraged to compete in their range of programmes.

Until recently, all advertising was banned from Swedish television. In the late 1980s, however, a commercial TV channel was authorised but not before a number of new Swedish channels, designed for broadcast via satellite and cable, had already emerged. These include:

- TV3, a generalist channel broadcast from London via ASTRA in MAC format, owned by SCANSAT (Kinnevik);
- TV 1000, a subscription film channel also offered via ASTRA by SCANSAT;
- SF Succé, a subscription film channel owned by Warner Brothers (33 per cent) and the Swedish film industry (67 per cent);
- TV4, an advertising-supported channel owned by a consortium of interests including Kinnevik (30 per cent), AB Patricia (25 per cent), SPP (19 per cent) and others (26 per cent);
- TV Plus, a pay TV channel which started in December 1989.

Broadcasting in Sweden is regulated directly by the Parliament. TV licences are collected by RIKAB and are pooled in a Broadcasting Fund. Televerket is entrusted to build and operate the network and to transmit and broadcast programmes for SR/STV. These functions will be fully separated from Televerket during 1992, and possibly transferred to a limited company owned by the State.

B20.5 Video-based services

Swedish Cable TV is one of the fastest growing in Europe and probably in the world. Between 1985 and 1989 an extra 870 000 homes were cabled raising the penetration rate from 3 per cent to 29 per cent. Clearly the development of commercial channels

available for delivery to cable head ends and SMATV systems via satellite is a major factor behind this boom, but it is also in part due to the deregulation of cable which began in 1985.

Cable TV in Sweden is a competitive market, but the main operator with perhaps as much as two thirds of the market is Televerket which has a separate cable TV division. This division will soon become a company within the Teleinvest Group. This contributed 184 MSEK in 1988/89 (US$28.5m) or just under 1 per cent of total sales. Televerket has settled on a 30 channel system and is upgrading its older network to meet this standard. The rivals to Televerket hold approximately 40 per cent of the Cable TV market.

One of the features of cable TV in Sweden has been the high level of Pay TV. Both TV 1000 and SF Succé are subscription channels and the recently-opened TV Plus is close to being true pay-per-view (PPV) in that it permits viewers to order and pay for individual programmes. Televerket has been running a PPV experiment to evaluate different remote control systems and decoder techniques.

Video-conferencing services are offered by Televerket and others. Interest in an ISDN based video-conferencing service (2x64 kbit/s channels) is growing rapidly.

B20.6 Data broadcasting services

The Swedish Videotex network, originally launched as Datavision in 1982 and now renamed as Videotex, is based on the Prestel standard though other access protocols are possible. At the beginning of 1990 there were 29 000 subscribers.

Teletext in Sweden is provided by STV as the Text-TV service. It has 400 pages of information without advertising.

B20.7 Specialised satellite services

Televerket operates a number of satellite earth stations both for Sweden and other Scandinavian countries. The main ones are located at Tanum (for INTELSAT), Agesta (for EUTELSAT) and Kiruna (SPOT). The Tele-X consortium is owned by the Swedish State through Rymdbolaget AB.

VSAT receivers are liberalised in Sweden but two-way transmitters require a frequency permit from Swedish Telecom Radio. The use of SMATV systems for up to 50 homes and TVRO receivers under 1.8 m in diameter are unlicensed.

B20.8 Cross-ownership and cross-sectoral service provision

There is a high degree of cross-sectoral service provision in Sweden and an increasing degree of cross-ownership. For the moment, the main players are:

- Televerket: involved in fixed link and mobile telecommunications, cable TV, and the operation of the over-the-air transmission network.
- Kinnevik: involved in fixed-link telecommunications (Tele 2), mobile communications (COMVIK), TV programming (it owns TV3 and part-owns TV4) and

Figure B20. **Network dimensions and service revenues in Sweden**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	5 700.0	Thousands	1985-90	+2.1
Penetration rate		67.6	Per 100 inhabitants		
Cellular radio	1991	461.0	Thousands	1988-91	+42.3
Penetration rate		5.46	Per 100 inhabitants		
TV licences	1987	3 293.0	Thousands	1980-87	+0.6
Penetration rate		39.1	Per 100 inhabitants		
VCRs	1988	1 257.0	Thousands		n.a.
Penetration rate		14.9	Per 100 inhabitants		
Cable TV	1989	970.0	Thousand households	1985-89	+76.5
Penetration rate		29.4	Per 100 households		
Telecommunications revenues	1988	22 869.0	Million SEK	1983-88	+15.3
	1988	3 732.4	US$ million	1983-88	+21.6
Broadcast TV revenues	1986	2 625.9	Million SEK		n.a.
	1986	344.4	US$ million		n.a.

n.a.: Not available.
Sources: Televerket, Kagan World Media (1991), ITU, UNESCO, Logica (1987), Renaud (1990).

satellite TV (it has a minority shareholding in ASTRA/SES). Kinnevik is also the majority shareholder in the new national network provider, Tele2.
- SR: the State broadcaster.

It could be said that Kinnevik is a true "converged" company, covering a wide range of media interests, and exporting its success in communications to other areas of the world, especially in GSM.

Televerket also fits the description of a "converged" company and has shown how it is possible to build an extensive national CATV network virtually from scratch in just five years. For the moment Televerket has concentrated on increasing the size of the network using low cost SMATV systems out in the longer-term, it has the capacity to build an interactive broadband network with TV and telecommunications services delivered in parallel.

In the mobile communications field, Sweden continues to lead the world, but the fact that Televerket retains control over frequency administration is an anomaly that should soon be rectified. Frequency allocation is going to be fully separated from Televerket, possible as early as mid-1992.

B20.9 Information sources

Datapro Research (1989), "Sweden: The commercial and regulatory environment", Delran, USA, December, 7 pp.

Televerket, ''Annual report''.
Televerket (1989), ''Facts about Televerket'', 38 pp.

For additional information sources, please see section B2.9.

B21. SWITZERLAND

(Questionnaire response received on 13 June 1991
and additional comments on 13 December 1991)

B21.1 Telecommunications network operators

Switzerland has one of the densest and most sophisticated telephone networks in the OECD area but this has been achieved in an environment which, despite recent moves towards liberalisation, is still highly restrictive. The Swiss PTT has a legal monopoly for the provision of telecommunications and postal services (including for Liechtenstein) which dates back to the Federal Telephones and Telegraph Act of 1924. In many ways it is still a very traditional style PTT with a wide ranging monopoly encompassing the provision of broadcast TV transmission and the licensing of CATV systems as well as telecommunications and posts. The PTT has also, until recently, had a monopoly over most equipment markets and still maintains close links with Swiss-based manufacturers such as ASCOM (formerly Hasler, Autophon and Zellweger) and foreign subsidiaries such as Siemens Albis and STR.

Pressures for liberalisation began to grow in the late 1980s and the provision of telephone sets other than the first was opened up on 1 January 1988 and the market for fax terminals and modems was opened on 1 July 1989.

By a decree of 21 June 1991, the Federal Assembly approved a new Law on Telecommunications. The new Law came into force on 1 May 1992. It is characterised by further steps towards liberalisation which include the following elements:

- A clear distinction between the tasks of the operator and those of the regulator. The regulatory function will be assumed by a Federal Office of Communication (OFCOM), attached to the Federal Department of Transport, Communication and Energy, but managed independently from the Swiss PTT;
- Full liberalisation of terminal installation. Furthermore, subject to the agreement of OFCOM, each supplier can place its terminals on the market if they conform to technical requirements which follow international standards;
- An open market for VANS without the necessity for suppliers to register or to apply for a licence;
- A market for basic services which is to a large extent open: only telephony remains a monopoly;
- In order to guarantee a favourable environment for the continuing development of the telecommunications infrastructure across the whole territory, the Swiss PTT's monopoly over the network is maintained. However, licences can be granted by OFCOM to third parties to operate radiocommunications networks or for satellite

transmission, insofar as these do not infringe the telephony monopoly. In principle, these tasks will be taken on by a new office of frequency allocation;
- Leased lines for the provision of telecommunications services (excluding telephony) can be supplied to third parties subject to the imposition of a subscription charge. The level of this charge would be fixed by the Department. The cost of this subscription charge could be shared by several organisations and the interconnection of leased lines with each other or with the public network will also be permitted.

The Federal Department of Transport, Communications and Energy has responsibility for the communications sector in Switzerland though some regulatory functions, including equipment testing for type approval, are carried out by the PTT itself. It is likely that a new independent advisory body will be established when the new law comes into force. The Federal Department currently sets tariffs for most inland switched services while the PTT has responsibility for the rest.

B21.2 Telecommunications network facilities

In the OECD area, Switzerland is second only to Sweden in having the densest penetration rate of telephones (56.7 per 100 inhabitants). The network is also relatively sophisticated with 24 per cent of exchange lines and 39 per cent of central switches being digital in 1990. This is planned to increase to 62 per cent and 90 per cent respectively by 1995. During 1989, some 25 000 km of fibre optic cable were laid and this is used for the distribution of both telecommunications and television traffic. A pre-ISDN service, SwissNet 1, was launched in 1989 and a full ISDN service, SwissNet 2, is planned for 1992. In common with Germany, Switzerland has invested heavily in ISDN and is currently carrying out trials for broadband ISDN at 34 Mbit/s. A pilot programme is operating in Basle (BASKOM) along the same lines as the BERKOM trial in Berlin.

B21.3 Mobile communication services

Wireless communications have been used extensively to flesh out the basic telephone network in the mountainous and inaccessible regions of Switzerland. These have been complemented by a mobile radio service (Natel A and Natel B) operating since 1978, and a true cellular radio service (Natel C) based on NMT-900 MHz technology has been operating since 1987. The new network now covers 98 per cent of the population and had 73 000 subscribers towards the end of 1990. A GSM system (Natel D) was inaugurated in Geneva on 9 October 1991.

Radiopaging in Switzerland is characterised by of different generations of technology with five different services, all offered by the PTT. Some of these services (Citycall A and Vehicle Paging) are now being phased out but three others remain:
- Citycall B, a digital paging system operating since 1985 with some alphanumeric capabilities;
- Eurosignal, offered jointly with France and Germany, with18 850 subscribers at the start of 1990;
- VIP line wide-area radiopaging service operating at 25 MHz.

In addition, certain private companies offer radiopaging services in the 160 and 450 MHz bands.

B21.4 Broadcast TV operators

Television broadcasting in Switzerland, like telecommunications up to the mid-1980s, was a near-monopoly but lies in the hands of a private, non-profit organisation, Société Suisse de Radiodiffusion (SSR), rather than a state-owned organisation. SSR is obliged to produce programmes in each of the main languages:

- RDRS (German);
- SRTR (French);
- CORSI (Italian);

as well as regional programmes and programmes in the minority Romansh language.

A first stage of limited liberalisation was enacted in 1984 with the appearance of local TV stations (currently 23), which transmit almost exclusively by cable. However, these programmes were not authorised to be financed by advertising. At the same time, two licences for pay-TV were agreed:

- one in the French language to be broadcast over-the-air (Télécinéromandie);
- the other to be broadcast by satellite (Teleclub).

A further step towards full liberalisation was undertaken in April 1992 with the coming into force of a new federal law on radio TV (LRTV). The market for local and regional broadcasters, as well as international, was opened to full competition though at the national and regional-linguistic scale, SSR will retain a privileged position (competitors will not be allowed to endanger its public service mission).

The Swiss PTT is responsible for the planning, construction, operation and maintenance of the transmitter network and, until recently, leased studio equipment to SSR. Licence fees are also collected by the PTT. Up to now, advertising has been strictly limited and sold through an arms-length organisation – Société Anonyme pour la Publicité à la Télévision (SAP). However, a degree of liberalisation in the area of advertising and programme sponsorship is expected in 1992 in line with the new LRTV. The regulatory environment will conform, to large extent, to the European standards, following the Council of Europe Convention on trans-border television.

The SSR is in the process of restructuring and modifying its statutes to respond to the new challenges of meeting competition and improving its management efficiency. Its broadcasts will also be subject to a new independent complaints authority (AIEP). Responsibility for overseeing financial questions, including those regarding the rules on advertising, will rest with the Federal Department for Transport, Communications and Energy.

B21.5 Video-based services

Switzerland has one of the densest networks for cable TV in Europe. This partly results from the fact that over-the-air reception is often poor especially from neighbour-

ing countries, given the mountainous terrain of Switzerland. In order to respond to the needs of cable TV distributors and the public, the PTT has put into place quite quickly a system of programme exchange to cable head-ends. Cable TV is offered by licensee companies sometimes public but more often private, of which the largest is Rediffusion AG (in Zurich, Berne and Bienne). There are a number of restrictions:

- networks must not be joined together to form national coverage;
- operators require a licence from the Swiss PTT;
- the Swiss PTT has a monopoly for inter-regional infrastructures.

The PTT itself is prevented from owning and operating cable TV stations. Nevertheless it is actively involved through joint ventures in providing a CATV infrastructure in the thinly-cabled cities of Basle and Geneva. In the former it is experimenting with providing integrated telephony and television as part of the SwissNet BASKOM trial.

Video-conferencing services have been provided by the Swiss PTT since the mid-1980s with permanent studios in Zurich and Geneva and a mobile studio.

B21.6 Data broadcasting services

Videotex in Switzerland has been provided experimentally since 1984 and as a national service since 1987. The service is based on CEPT Profile 1 and in mid 1991 had 73 079 subscribers and 568 information providers. The Swiss PTT hopes to increase the number of users to 100 000 plus through a minitel-style strategy of providing low-cost terminals to overcome barriers to entry. Following the market opening moves due to come into force in line with the new Telecommunications Law, third parties will also be able to supply videotex services. The Swiss PTT however must ensure that full geographical coverage is achieved, probably by 31 December 1994 (service mandate).

Teletext in Switzerland is provided by an independent company, Teletext Suisse SA, in French, German and Italian with advertising.

B21.7 Specialised satellite services

The use and installation of VSAT terminals is subject to a licensing system administered by OFCOM. Switzerland is a party to the INTELSAT, EUTELSAT and INMARSAT conventions and the Swiss PTT is the signatory. One ASTRA transponder is used for pay-TV broadcasting (Teleclub) from Switzerland.

SSR participates in a number of satellite TV channels including:

- TV5 (French);
- 3 Sat (German, with ZDF and ORF);
- collaboration also with Rai SAT (Italian), Eurosport and CNN.

SMATV in Switzerland is a PTO monopoly and TVROs require a licence from the PTO plus the payment of an annual fee.

B21.8 Cross-ownership and cross-sectoral service provision

The level of cross-ownership in Switzerland is minimal but the level of cross-sectoral service provision is very high. The Swiss PTT, through its control of broadcast TV, satellite TV, TV licences and licensing of CATV systems has a high level of control over the development of broadcasting in Switzerland. The involvement of the PTT in the actual construction of cable TV networks direct to the subscriber as well as between cable head ends is a relatively new development. Much depends on the outcome of the BASKOM pilot to determine whether or not the PTT will become more involved in CATV. Given that the PTT has invested so much in the development of ISDN, it would be surprising if it did not compete more actively in the service delivery part of the network.

Figure B21. **Network dimensions and service revenues in Switzerland**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	3 784.5	Thousands	1985-90	+3.5
Penetration rate		56.7	Per 100 inhabitants		
High-speed network connections (>1.5 Mbit/s)	1991	140	Connections		n.a.
Cellular radio	1991	125.0	Thousands	1988-91	+185.5
Penetration rate		1.86	Per 100 inhabitants		
TV licences	1987	2 630.0	Thousands	1980-87	+1.9
Penetration rate		39.4	Per 100 inhabitants		
VCRs	1988	954.1	Thousands		n.a.
Penetration rate		14.3	Per 100 inhabitants		
Cable TV	1991	1 800.0	Thousand households	1987-91	+7.9
Penetration rate		73.4	Per 100 households		
One-way satellite antennae	1991	10 000	Estimation		n.a.
Two-way satellite antennae	1991	10	Estimation		n.a.
Telecommunications revenues	1989	5 997.0	Million SFR	1984-89	+5.0
	1989	4 286.6	US$ million	1983-88	+18.8
Broadcast TV revenues (Public sector)	1990	581.9	Million SFR		n.a.
	1990	418.9	US$ million		n.a.
	of which: 60% from licence fees				
	35% from advertising				
	5% from other.				

n.a.: Not available.
Sources: OECD Questionnaire, Swiss PTT, ITU, Logica (1987), Renaud (1990), UNESCO.

It is not clear to what extent the Swiss PTT can become involved in CATV in a competitive manner but if it chooses to do so it would be in a position to offer a much higher level of performance than the first-generation CATV networks installed in most cities. The new LRTV will reduce the PTT's influence in 1992 by transferring the decision-making function in a number of areas to OFCOM.

B21.9 Information sources

The principal source of information is the Swiss response to the OECD questionnaire, delivered on 13 June 1991 by Mathias Ramsauer, a Telecom Official at the Federal Dept. of Transports, Communications and Energy. Further comments were sent on 13 December 1991.

Other sources of information include:

Datapro Research (1990), ''Switzerland: The commercial and regulatory environment'', Delran, USA, April, 8 pp.

Entreprise des Postes, Téléphones et Télégraphes Suisses (Annual), ''Rapport de gestion''.

For other sources of information, please see section B2.9.

B22. TURKEY

B22.1 Telecommunications network operators

The Turkish General Directorate of Posts, Telegraphs and Telephones (PTT) holds a monopoly over telecommunications services in Turkey. This was confirmed in 1984 when the Turkish PTT became a State Economic Enterprise within the Ministry of Transport. However the PTT retains a degree of independence from the Government in that it regulates its own tariffs and organises the financing of its network investment without government assistance.

Even though the Turkish PTT has a legal monopoly, it has negotiated a number of deals with foreign manufacturers to stimulate network development:

- ''Build-operate-transfer'' (BOT) schemes under which a supplier constructs and operates a system until revenue targets are met, and then transfers it to the PTT;
- ''revenue sharing'' schemes operated by the PTT but with profits shared with the original equipment supplier.

A good example of the latter is the Turpak X.25 network which was established under contract by Northern Telecom. BOT projects are under discussion with NTT of Japan.

B22.2 Telecommunications network facilities

Turkey has the dual distinction of having the lowest rate of penetration of telephone mainlines in the OECD area (9.1 per 100 inhabitants) but also the highest rate of network expansion (+ 24.1 per cent CAGR over the period 1983-88). Turkey is currently in the second half of an ambitious ten-year investment plan which is due to terminate in 1992 when it is hoped that there will be 25 mainlines per 100 inhabitants. During some years, investment expenditure has actually exceeded revenues thanks to a system of debt-financing (40 per cent from PTO revenues; 50 per cent from private lending; 10 per cent from foreign credits). It is hoped that by 1995, the network will be fully automatic and that digitisation will have increased from the current 41 per cent of trunk lines to 90 per cent.

Turkey has pursued a policy of encouraging domestic manufacturers through joint ventures, PTT procurement and PTT minority shareholding. The main manufacturers are:

- TELTAS (PTT 40 per cent; with Bell Telephone Manufacturing Co. of Belgium);
- NETAS (PTT 49 per cent; with Northern Telecom of Canada);
- Turk Telefon (Iskra of Yugoslavia);
- local manufacture of EWSD exchanges by Siemens of Germany.

The system of giving preference to domestic manufacturers has enabled Turkey to keep trade deficits low and it is now beginning to build an export market, notably in the Middle East.

B22.3 Mobile communications services

Turkey's cellular radio system is a modified version of the NMT-900 MHz system. It was installed by Nokia Mobira of Finland under three contracts starting in 1986. Current capacity allows it to expand to 40 000 subscribers.

Radiopaging has also existed in Turkey since 1986.

B22.4 Broadcast TV operators

Broadcasting in Turkey was, until recently, a monopoly held by Turkish Radio and Television (TRT). TRT is a state-owned organisation but, like the PTT, it maintains an operational independence from the Government. There is a very small licence fee, but most of its income comes from advertising. Two channels are broadcast.

In late 1989 a second station, Magic Box, was launched by a consortium of investors and this has spread across the country through rebroadcasting in an ad hoc fashion.

B22.5 Video-based services

Cable TV is virtually non-existent in Turkey. Video-conferencing facilities were established in Ankara in 1986 and this service has grown mainly through the use of satellite links.

B22.6 Data broadcasting services

A videotex service, based on the French télétel service, has been made available since 1987 in Turkey. It is marketed by the PTT under the name TELEBILGI.

B22.7 Specialised satellite services

The Turkish PTT established a satellite earth station in Ankara in 1979 and has subsequently shown great interest in satellite communications seeing this technology as well-suited to the dispersed settlement structure of the country. Turkey is a member of both INTELSAT and EUTELSAT and has taken out a number of options for transponders in the EUTELSAT II generation of satellites.

SMATV and TVRO delivery of television signals has grown rapidly in Turkey in recent years and this has outstripped the development of regulation. A number of

Figure B22. **Network dimensions and service revenues in Turkey**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1988	4 920.8	Thousands	1983-84	+24.1
Penetration rate		9.1	Per 100 inhabitants		
Cellular radio	1990	5 101	Subscribers		n.a.
Penetration rate		0.01	Per 100 inhabitants		
TV licences	1987	9 000.0	Thousands	1980-87	+14.4
Penetration rate		16.7	Per 100 inhabitants		
VCRs	1988	3 076.0	Thousands		n.a.
Penetration rate		5.7	Per 100 inhabitants		
Telecommunications revenues	1988	1 784.2	Billion Turkish Lire	1983-88	+78.4
	1988	1 254.4	US$ million	1983-88	+28.8

n.a.: Not available.
Sources: Turkish PTT, ITU, UNESCO, FinTech.

different organisations have become involved with SMATV installations, including municipal authorities. No accurate figures are available to chart this growth.

B22.8 Cross-ownership and cross-sectoral service provision

There is no cross-ownership in Turkey except via the Government, but even this is conducted at an arms-length basis. The PTT has some involvement in the relay of TV signals through its Ankara satellite earth station and through its BAYKOK and TRAYKOK international cables. Nevertheless this is rapidly being overtaken by the proliferation of DBS and SMATV installations in private hands.

B22.9 Information sources

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B23. UNITED KINGDOM

(Questionnaire response received on 24 May 1991, and additional comments on 30 August 1991 and 28 November 1991)

B23.1 Telecommunications network operators

Prior to 1981, the General Post Office (GPO) held a monopoly for the provision of telecommunications services in the UK. In that year a programme of progressive liberalisation was launched which has culminated in the issue of a Government White Paper in March 1991 which foresees the virtually complete liberalisation of domestic telecommunications networks and services. Even though the UK has followed a progressive path towards liberalisation, unlike the US, it has now moved further than the US in that competition is allowed also in the local loop and specifically between telephone companies and CATV companies. The timetable of liberalisation since the early 1980s has been as follows:

- 1981: separation of posts and telecommunications, the creation of British Telecom (BT), and the liberalisation of some customer premises equipment markets (CPE market e.g. modems, telex, PABXs) under the 1981 British Telecommunications Act.
- 1982: the licensing of Mercury Communications Ltd. (MCL) to provide across-the-range competition to BT. This move foreshadowed the official duopoly policy which continued until 1990.
- 1984: a new telecommunications act which preceded the sale to the public (privatisation) of 51 per cent of BT, the creation of the Office of Telecommunications (Oftel) as a non-ministerial government department and regulatory authority answerable to the Dept. of Trade and Industry (DTI), the creation of a price-cap mechanism for tariff control and the liberalisation of remaining CPE markets including the first telephone handset market.
- 1984: the creation of a licence for value-added and data services (VADS) subsequently replaced in November 1989 by a new class licence for service providers which lifts the prohibition of simple resale from all but international lines (this restriction will also be reviewed as part of the new Act).
- From 1984 onwards: the licensing of mobile service providers for cellular radio, public mobile radio, telepoint, radiopaging, Personal Communications Networks (PCN) and other services (see section B23.3 below).
- From 1988 onwards: the progressive liberalisation of satellite services beginning with the licensing of seven specialised satellite service operators (SSSOs) to provide one-way services, the separation of the regulation of international satellite services away from British Telecom International and into a new Signatory Affairs Office (SAO), and ultimately the liberalisation of two-way satellite ser-

vices with the issue of a class licence for UK and international services not connected to the public switched network (2 August 1991).
- From 1983 onwards (though in practice only since 1988): the licensing of CATV companies to offer fixed link telecommunications services (including voice telephony in conjunction with BT or Mercury). It is likely that the requirement to work with BT or Mercury will be ended in the new Act, though conversely BT is to be prevented from providing entertainment TV services over its main network for at least the next seven years, and possibly longer (see section B23.5 below).

At the time of writing (May 1991) only three companies were licensed to provide fixed link telecommunications services in the UK: They are:

- British Telecom, of which the remaining 49 per cent Govt. shareholding will be sold later in 1991;
- Mercury Communications Ltd. now a fully-owned subsidiary of Cable & Wireless;
- Kingston Communications (Hull) plc, a licence restricted to the town of Hull.

In addition, broadband cable TV operators could provide telephony services in their franchise area in conjunction with either BT or Mercury. According to the policy discussion paper (Green paper) issued in November 1990, ''Competition and Choice: Telecommunications policy in the 1990s'', and the policy proposals (White paper) issued in March 1991, any application to offer fixed link telecommunications services in the UK will be considered on its merits. The licence will be awarded unless there are specific reasons not to do so, and will be irrespective of technology. In particular, this means that the existing mobile systems operators can apply for a licence to operate fixed link services though there are likely to be continuing restrictions on market entry into mobile services because of spectrum constraints.

A number of issues are left open in the White Paper and will need to be settled before the new system can be regarded as operational. One undecided issue is the extent to which international service provision (including both the creation of infrastructures and the simple resale of excess capacity on leased lines) will be liberalised. It is likely that agreements will be made on a bilateral basis according to the granting of reciprocal access to overseas markets. A second issue which remains to be resolved is the extent to which carriers other than BT will be required to share the burden of providing or financing universal service and other community service obligations. Thirdly, the whole issue of how to negotiate interconnection agreements and prices and how to create genuinely equal access to public networks still needs to be tackled.

Among the companies which have stated an interest in applying for licences are British Rail (which already provides wayleaves and network access to Mercury), British Waterways, British Gas, the Post Office (National Networks) several electricity boards and water companies, overseas telecommunications service providers (including France Télécom Transpac, which has acquired the London Underground computer network, and AT&T which owns the VANS company, ISTEL), commercial satellite providers, and various CATV companies, joint ventures and other consortia.

Responsibility for licensing telecommunications systems ultimately lies with the Secretary of State for Trade and Industry under the Telecommunications Act 1984. Licences are issued, in consultation with the Director General of the Office of Telecommunications (OFTEL) who has a statutory duty to advise the Secretary of State on State

on telecommunications matters, according to whatever policy guidelines are in force at the time. Systems which use radio will also need to be licensed under the Wireless Telegraphy Act 1949. Again, the ultimate responsibility for licensing lies with the Secretary of State for Trade and Industry. The Telecommunications and Posts Division of the DTI and OFTEL are responsible for administration of Telecommunications Act licences and the Radiocommunications Agency deals with Wireless Telegraphy Act licences.

B23.2 Telecommunications network facilities

Despite the progressive position of the UK in telecommunications liberalisation and the highly profitable status of its operators, Britain has been a relative latecomer to network digitisation. There are many reasons for this not least of which are the development problems associated with the GPT System (BT and Mercury now also buy Ericsson AXE and Northern Telecom DMS exchanges amongst others) and the fact that BT has sometimes found it more profitable to invest in North America and in business services rather than in its main networks. Problems, especially related to quality of service, came to a head in 1987. In that year some 60 per cent of BT's exchange lines were still connected to electromechanical exchanges (Strowger and Crossbar) while Mercury's network was still in a formative stage. Subsequently, BT has done much to improve quality of service. In March 1991 it had 50 per cent of exchange lines digital and, since June 1990, 100 per cent of trunk lines are digital. BT has also installed more than 3.5 million kilometres of fibre optic cable in its trunk and junction networks plus a further 150 000 km in the local loop.

Mercury has constructed an all-digital, figure of eight national network with 2 600 km of fibre optics and 2 000 km of microwave links. Mercury also has an increasing number of direct agreements with foreign PTOs and claims to have around 13 per cent of the UK market for international traffic, though its share of domestic UK traffic is probably less than 5 per cent.

Kingston Telecommunication's network is also 100 per cent digital with fibre in the trunk network and copper in the local loop.

Even though BT is the most profitable of the main international telecommunications carriers, it has a relatively low level of lines per employee. It is currently undergoing a major rationalisation and restructuring exercise (Project Sovereign) which should lead to the loss of 40 000 jobs over three years. Under the new telecommunications environment, BT will also be much freer to target businesses and to offer special volume tariff discounts for larger customers (e.g. Virtual Private Network agreements). Over the last few years, business lines have been growing by 10 per cent per year whereas residential lines have grown by only 3 per cent per year. BT will also be able to rebalance its tariffs to bring them more in line with costs, especially by increasing fixed charges relative to usage charges.

B23.3 Mobile communications services

Mobile communications services, especially analogue cellular radio, has been one of the success stories of deregulation in the UK. Under the 1984 telecommunications act, two cellular radio companies were licenced, both using TACS-900 MHz technology:

- Cellnet, 60 per cent owned by BT and 40 per cent owned by Securicor, a security company.
- Vodafone, operated by Racal-Vodafone, a subsidiary of Racal Telecom plc but with the possibility of an independent stock market listing in the near future. Racal co-operates with Mercury at present for the fixed link component of its service though this obligation should be lifted as part of the new telecommunications environment.

Both services started in January 1985 and have grown rapidly, partly due to the practice of selling "airtime" through accredited retailers who subsidise equipment prices on the basis of future revenues. In recent years, Vodafone has marginally outstripped Cellnet in its rate of growth, though there is little real difference between the two in terms of subscriber prices or national coverage. There are now more than a million subscribers to cellular radio in the UK. Both companies are nominally committed to introducing digital services, based around the GSM standard in July 1991, but it is doubtful whether subscribers will be willing to pay for the privilege of GSM unless they travel extensively in Europe.

In June 1985, private mobile radio networks (PMR) were licensed to use the 192-208 MHz spectrum previously used for 405-line black and white television. Two networks now operate nationally:

- Band Three Radio Ltd;
- GEC National Ltd.

Other companies operate in large cities. There are currently more than 22 000 subscribers to PMR in the UK.

Telepoint is a public telephone service using CT2 cordless telephone technology. Of the four consortia chosen to provide Telepoint services in January 1989, Mercury Callpoint has since decided to discontinue operations and Ferranti Creditphone (now Libera Telecom) has suspended its service for the time being. Phonepoint is converting its base stations to use the Common Air Interface (CAI) and BYPS (now owned by Hutchison Telecommunications UK Ltd) will commence service using the CAI. Subject to the satisfactory resolution of technical issues, the Telepoint operators may be allowed to provide Telepoint services direct to the home, a service known as Neighbourhood Telepoint.

In December 1989, it was announced that licences would be awarded to three companies to offer PCN (personal communications network) services in the 1.7-1.9 GHz frequency band previously reserved for television. However, the huge sums of money necessary for the construction of a micro-cell network means that the success of PCN in the UK is still in doubt. The owners of the three consortia have also changed. In July 1991, licences were awarded to:

- Microtel Communications, formerly a consortium of British Aeospace, Pacific Telesis, Millicom, Sony and Matra but recently acquired by the Hong-Kong based Hutchison Telecom (UK) Ltd.
- Unitel, comprising Northern Telecom (formerly STC), Thorn EMI and US West. A fourth company, DBP Telekom, has withdrawn.
- Mercury (MCN-Cable and Wireless). Motorola has withdrawn from this consortium.

It has also been announced that Mercury and Unitel will collaborate in constructing a network infrastructure.

Radiopaging in the UK has been a competitive market since 1983 though BT, which has offered services since 1972, still has around 85 per cent of the market. There are now seven radiopaging services in the UK:

- British Telecom Mobile Communications;
- Mercury Paging Ltd, a joint venture between Mercury (51 per cent) and Motorola (49 per cent);
- AirCall Communications Ltd;
- Digital Mobile Communications Ltd;
- Inter-City Paging Ltd;
- Racal-Vodapage Ltd;
- Hutchison Paging (UK) Ltd (formerly Millicom).

Euromessage Ltd runs a paging system at 466 MHz in the UK. Subscribers can be paged in areas of continental Europe where compatible systems are in operation.

The Radiocommunications Agency is responsible for allocating frequency use in the UK and publishes a list of fees.

B23.4 Broadcast TV operators

The story of television broadcasting in the UK is one of progressive increase in choice for viewers building upon a solid foundation of public broadcasting provided by the British Broadcasting Corporation (BBC). The BBC is an independent corporation funded principally by licence fees. The BBC is not permitted to show advertising. The chronology of broadcasting in the UK is as follows:

- The BBC, established in the 1920s and broadcasting experimental TV by the late 1930s. A second channel, BBC2, opened in the mid 1960s.
- Independent Television (ITV) established in the late 1950s to provide regionally-based commercial television. ITV is administered by the Independent Television Commission (ITC) which awards franchises to companies to provide programming in 14 regions. The franchises are due for renewal in 1992/93 when ITV as a whole will be renamed Channel 3. The criteria for franchise awards will be a complex mix of high financial bids plus a commitment to quality broadcasting. The new rules for franchise awards have been defined in a new 1991 Broadcasting Act which introduced the concept of a ''franchise auction''. The closing date for bids was 15 May 1991.
- Channel 4 which opened in 1982 and has a mandate to provide programming for minority interests and/or not covered by the mainstream channels. At present, Channel 4 is partly subsidised by the ITV companies but it is due to become financially independent in 1993. Channel 4 in Wales is provided by the Welsh Fourth Channel Authority (S4C).
- TV-AM, which began broadcasting in 1983 and provides nationwide breakfast television over the ITV network.
- Channel 5 which will be licensed in 1993 to provide terrestrial commercial TV to 70 per cent of the population.

In addition to the 4 (soon 5) terrestrial channels, there are five UK-oriented satellite TV channels delivered by British Sky Broadcasting (BSkyB), which was formed in November 1990 through a merger of Sky Television and British Satellite Broadcasting. As part of the Broadcasting Act 1990, the Independent Broadcasting Authority (IBA) was superseded by the Independent Television Commission (ITC) with a broader remit to regulate commercial TV. The ultimate regulatory authority is the Home Office, though spectrum issues are handled by the Radiocommunications Agency of the Department of Trade and Industry (DTI).

B23.5 Video-based services

Broadband cable TV in the UK is relatively underdeveloped with less than 200 000 homes cabled. The process of cable licensing prior to the Broadcasting Act 1990 was handled by the Cable Authority and the DTI. The first licences were awarded in 1983 but initial development was slow. In 1988, interest revived and by July 1990 a total of 135 franchises had been advertised and awarded, covering nearly 70 per cent of the population.

The operation of a cable system requires two separate licences, under the Telecommunications Act 1984 and (prior to 31 December 1990) the Cable and Broadcasting Act 1984. From 1 January 1991 the provisions of the Cable and Broadcasting Act 1984 were replaced by the Broadcasting Act 1990 but the distinction between the two licences remains. The Act established the new Independent Television Commission to absorb most of the functions of the Cable Authority. The licences issued by the Cable Authority automatically continue in effect for the 15 year term and when they expire licencees will be able to negotiate the terms on which they obtain a new local delivery franchise to cover a second 15 year period. At present around 5 000 subscribers are provided with voice telephony via cable networks. In anticipation of providing joint TV and telephony services over CATV networks, a number of foreign investors have been attracted into UK cable consortia, including Pacific Telesis, US West and Bell Canada. The involvement of these north American telcos in UK cable TV is discussed in more detail in chapter four of the main report.

At present, BT is prevented from providing entertainment television services over its main network, though it has in the past had shareholdings in some cable consortia which were handled through subsidiary companies. The Government's White Paper lays down that BT should be barred from conveying CATV signals over its main network for ten years with the possibility of review after seven. The rationale behind this is that it will give the nascent CATV industry in the UK the time to establish itself. However this restriction is controversial and seems to run counter to other pro-competitive measures in the new Act.

BT has invested over £20m (US$35m) on its R&D programme on the introduction of fibre in the access network. This has culminated in a technology trial of fibre to the home/street/desk at Bishop's Stortford. More than 200 trial customers will be installed by the end of 1991, receiving integrated telephony and entertainment TV on the same fibre. Two technologies are being trialled to compare relative merits. These are an active star approach (Broadband Integrated Distributed Star – BIDS) based on the addition of telephony to an upgraded system of the type used in the Westminister Cable TV franchise area, but employing fibre to the home. The second architecture employs the Passive

Optical Network approach, pioneered internationally by BT. This latter promises to be the most cost-effective solution for fibre in the access network.

Video-conferencing in the UK has been provided by BT as the ConfraVision service since 1972 and as the Videostream service since 1985. The latter service is based on 2 Mbit/s Megastream lines and allows much more flexibility for users. Video-conferencing is a competitive market in the UK and studio facilities and international services are also offered by Oceanics Communications and by Mercury Communications as well as by BT. BT is participating with other European PTOs in the EVE II video telephony trial.

B23.6 Data broadcasting services

Videotex has been available in the UK since 1980 as the "Prestel" service but without enjoying the success of Télétel and BTX in France and Germany, though there is a large number of private videotex systems. In 1987, Prestel was functionally combined with the Dialcom (Telecom Gold) electronic mail service. In 1990, there were around 110 000 Prestel users of which the business sector was growing fastest.

Audiotex has generally been much more successful than videotex in the UK. A number of different generic services are offered:

- 0800 services, a toll-free telephone;
- 0345 services for which callers pay only a local call charge;
- 0898 premium rate services for recorded messages, chatlines, etc.

In addition, BT now charges subscribers for its directory enquiries service. The provision of audiotex services, like videotex, is open to competition. Service providers in the UK are represented by the ATIEP (Association of Telephone Information and Entertainment Providers Ltd) industry association which has drawn up a code of practice for the industry in conjunction with ICSTIS (Independent Committee for the Supervision of Telephone Information Services).

Teletext services in the UK are provided by each of the main broadcasting companies including the BBC (Ceefax), ITV (Oracle) and Channel 4 (4-Tel).

Datacasting services are offered by a number of different organisations using a variety of different technologies. BBC Enterprises, for instance, offers a datacasting service over the terrestrial TV network while several of the SSSOs offer satellite data broadcasting (see below). It is estimated that data broadcasting is a US$100 million market in the UK and growing rapidly.

B23.7 Specialised satellite services

In 1988, the UK Government announced the licensing of seven specialised satellite service operators (SSSOs) for the provision of one-way point-to-multipoint services to VSAT or TVRO terminals in addition to BT and Mercury. They were:

- British Aerospace;
- Electronic Data Systems;
- Maxwell Satellite Communications;
- Uplink Ltd.;

- Satellite Information Services;
- British Satellite Broadcasting (now defunct, though a spin-off company, Datavision, may continue to provide services from the Marco Polo satellite, including business TV);
- Kingston Communications (Hull) plc.

In addition, the BBC and National Transcommunications Ltd have their own satellite news gathering licences and National Transcommunications has a satellite broadcasting licence.

Surprisingly, the company Reuters was unsuccessful in the initial awarding of licences, but it subsequently acquired the operations of Uplink Ltd. Of the SSSOs, by far the most advanced is Satellite Information Services which provides horse racing programmes and betting information to some 10 000 turf accountants in the UK.

In November 1989, the SSSO licences were extended to cover services to Europe and to allow re-broadcasting of satellite-derived programmes. The provision of specialised services has now been opened up to further competition with the issue of the class satellite services licence on 2 August 1991. This licence restricts connection to the public switched network, but subject to that it covers any kind of one-way or two-way service, UK or international. There is no upper limit on the number of operators under this licence, but operators must obtain individual clearance for the radio frequencies that they use.

BT and Mercury are both actively involved in the satellite communications market with the former offering customers its SatStream service. However, because BT has traditionally been the UK signatory to the international satellite organisations such as INTELSAT and EUTELSAT, it has now been encouraged to separate out the functions which regulate access to international space segments into an arms-length organisation, the Signatory Affairs Office (SAO). These arrangements are subject to review by Oftel.

Satellite TV broadcasting has grown rapidly in the UK since the late 1980s and there are now more than 1.5 million satellite dishes installed. The requirement to hold a licence for a TVRO was abolished in 1989 and local authority planning permission is now required only for antennae greater than 0.9m, second dishes or SMATV installations. The history of satellite TV in the UK has been one of fierce competition, incompatible standards and, until the present, huge losses. The franchise for the UK's allocation of high-power DBS channels was initially awarded to the BBC but when that organisation showed no interest, it was awarded (by tender) to the British Satellite Broadcasting (BSB) consortium in December 1986. BSB chose to operate using the D-MAC standard, which is an interim technology which anticipates true HDTV. However, BSB's service launch was delayed until April 1990 and in the meantime, Sky Television, owned by Rupert Murdoch's News International, began broadcasting four channels, in the PAL format, using the medium-power ASTRA satellite. Ultimately, in November 1990, a merger was announced between the two companies to form British Sky Broadcasting (BSkyB) which is 50 per cent owned by News International with the remaining 50 per cent held by BSB's original backers including Granada, Pearson, Reed International and Chargeurs (France). In financial terms it was a merger but in management and technology terms a victory for Sky. BSB's high power Marco Polo satellite and "Squarial" antennae are now practically abandoned.

The operators currently licensed to provide satellite broadcast TV services include:

- BSKyB: 5 channels including 1 pay-TV channel (Sky Movies);
- WHSmith Television: 3 channels;
- MTV Europe: 1 channel.

A further five operators provide and eight additional channels.

B23.8 Cross-ownership and cross-sectoral service provision

The level of cross-ownership in the UK is increasing in significance. The major example is the ownership by North American telcos of many of the small but growing UK CATV companies. There are specific restrictions however on the ownership of Radio Authority or ITC licences from controlling the companies which own licences. In particular, no PTO with an annual turnover in excess of £2.56bn (US$3.66bn) may hold a C3, C5, national radio or domestic satellite licence. Other organisations which are barred from control include local government, political or religious bodies, advertising agencies, newspaper proprietors (20 per cent limit) or interests controlled from outside the EC.

Much more significant than cross-ownership is the level of cross-sectoral service provision and here there are many more examples:

- the cross-provision of CATV and telephony by cable TV companies;
- the cross-provision of satellite TV and data broadcasting by the SSSOs;
- the cross-provision of over-the-air TV transmission and datacasting, and possibly in the future an involvement in mobile communications services, by the transmission subsidiary of the BBC, and by the soon-to-be privatised transmission arm of the IBA, National Transcommunications Ltd;
- individual companies involved in both telecommunications services and television: e.g. Reuters, Datavision, Maxwell Communications Corporation;
- participation by BT in the provision of business TV services, delivered principally by satellite;
- potential new market entrants in the two sectors.

However, in the crucial area of conveyance of entertainment TV signals by the main public telecommunications operator, BT is barred from doing this for at least the next seven years. In this respect, the UK is out of line with most of the rest of Europe and closer to Japan and the US which place similar restrictions on their carriers.

In 1986, the Peacock Committee report on the financing of the BBC noted that allowing BT to enter the CATV market would be an opportune way to allow the co-financing of fibre optic investment in the local loop from TV and telephony signals. In particular the Peacock Committee foresaw that a star-configured public network for CATV would enable the growth of interactive forms of television broadcasting, notably pay TV and video-on-demand, which would provide a long-term alternative to raising the licence fee or introducing advertising. At the time of the Committee's report, UK CATV was exhibiting very sluggish growth. It has subsequently been revived by the availability of more satellite channels and the attraction of inward investment from North American telcos and CATV companies.

The Government appears to have rejected the arguments for allowing BT to convey CATV, following the recommendations of the MacDonald inquiry into broadband communications in the UK (1988) and the DTI/OFTEL Green paper (1990). The rationale

appears to be that to allow BT to enter the CATV market would reduce the level of competition and would enlarge BT's dominant position. BT, for its part, has made no secret of the fact that it intends to make a US$1 billion market by the mid-1990s from video and image-based communications, and that it considers the seven/ten-year bar to be a major constraint on the development of its business.

It is argued by some that if BT can invest in CATV, this would deter other investors and slow down the development of the CATV market. This is not consistent with the experience of other countries (e.g. Sweden, Denmark, Germany) which have allowed their PTOs to compete in CATV markets and have experienced much higher rates of growth of penetration than the UK, where a significant number of franchise holders still haven't begun operations.

Secondly, it is argued that BT would enter the CATV market simply by buying up existing franchises rather than by investing itself. If this is a real fear then it could be prevented through competition law restrictions on BT rather than by technical restric-

Figure B23. **Network dimensions and service revenues in the United Kingdom**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1990	25 363	Thousands	1985-90	+3.9
Penetration rate		44.4	Per 100 inhabitants		
Cellular radio	1991	1 150.0	Thousands	1988-91	+32.0
Penetration rate		2.02	Per 100 inhabitants		
TV receivers	1987	24 650.0	Thousands	1980-87	+1.2
Penetration rate		48.2	Per 100 inhabitants		
VCRs	1991	14 000.0	Thousands		n.a.
Penetration rate		24.4	Per 100 inhabitants		
CATV households	1991	572.0	Thousand households *Of which:* 26 per cent are broadband.	1987-91	+31.0
Penetration rate		2.8	Per 100 households		
CATV access	1991	2 685.0	Thousand households *Of which:* 31 per cent are broadband.		n.a.
Penetration rate		13.0	Per 100 households		
Take-up rate		21.3	Per 100 households with access		
Telecommunications revenues	3/1991	12 721.0	£ million	1985-90	+10.7
	3/1991	22 427.7	US$ million	1985-90	+20.1
Broadcast TV revenues	1986	1 721.2	£ million		n.a.
	1986	2 374.1	US$ million		n.a.

n.a.: Not available.
Sources: DTI, BT, C&W, Kingston Communications, Logica (1987) Renaud (1990), Kagan World Media (1991), UNESCO, ITU.

tions. Finally, it is believed that to encourage CATV franchises to provide joint telephony and TV would be a way of introducing competition into the local loop, one of the few remaining areas in which BT has a de facto monopoly. Nevertheless this obscures the fact that competition in the local loop is much more real from mobile communications (one million subscribers) than from CATV/telephony subscribers (1 500 subscribers). If the goal of barring BT from providing CATV is actually to encourage competition in telephony, then there would appear to be much better ways to do so than this indirect way which harms the CATV market without creating true competition in local telephony.

In short, therefore, the seven/ten-year ban on BT from conveying entertainment TV over its main network seems ill-considered. If anything, there is a need to introduce more competition into CATV, where franchises are too often viewed as dormant investments, rather than into local telephony. To allow BT to upgrade its existing network to provide pay TV or video-on-demand would be an excellent way of generating geographical and technical competition in CATV.

B23.9 Information sources

The principal source of information is the UK response to the OECD questionnaire delivered on 24 May 1991 by Mr. Peter Doogan of the International Telecommunications Branch of the Telecommunications and its Branch of the UK Dept. of Trade and Industry (DTI) with additional comments forwarded on 30 August 1991 and 28 November 1991.

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For other sources of information, please see sections B2.9 and B3.9.

B24. UNITED STATES

(Comments received from US Government on 30 August 1991 and 2 December 1991)

B24.1 Telecommunications network operators

The provision of telecommunications services in the United States differs from the provision of such services in Europe. In the United States, telecommunications services have always been provided by private companies and, in recent years, have been provided in an increasingly competitive market environment. One of the three major long distance companies, and the oldest, is American Telephone and Telegraph Company (AT&T), which was incorporated in 1885. Until the late 1950s, AT&T had a virtual monopoly over the provision of telecommunications services. In 1959, the Federal Communications Commission (FCC), which was established in 1934, authorised the first steps towards competition by allocating spectrum for private point-to-point microwave networks. Further FCC moves toward open entry came in 1968 (*Carterphone* decision), which allowed terminal equipment to be electronically coupled with the public-switched network; 1971 (specialised common carrier decision), allowing competitive provision of private line services; 1972 (Open Skies), authorising domestic satellite common carriers; 1975/76, adoption of the terminal equipment registration programme (manufacturers' self-certification); 1978 (*Execunet* Federal Court decision), which permitted specialised common carriers (e.g. MCI) to provide inter-city switched services; and the 1980 IMTS/WATS decision, which required facilities-based carriers to allow resale and shared use of domestic switched network services. In 1985, the FCC authorised private submarine cables and international separate satellite systems.

In addition to these decisions fostering competition in existing and new markets, the FCC, in a series of decisions, streamlined regulation in markets that were subject to competition. In 1980, the FCC fully deregulated customer premise equipment (CPE) markets and enhanced services. During the 1980-84 period, the FCC eliminated rate and entry regulation for domestic carriers lacking market power, and in 1985, the FCC streamlined regulation of international common carriers without market power.

On May 9, 1991, the FCC proposed (in a Notice of Inquiry on Proposed Rule Making) to remove barriers to inter-state access competition by allowing independent providers to connect their facilities to those of local exchange carriers (LECs) at LEC central offices to provide inter-state special access. This change would result in further unbundling of LEC special access services, and would allow greater opportunities for the competitive provision of inter-state special access. Inter-state access consists of the delivery by a caller's local telephone company of an originating inter-state telephone call to the facilities of an interstate long distance carrier, with the completion of the call by a second local telephone company from the long distance carrier to the called party. These

changes have been made possible by the rapid advance of fibre optic technology, which significantly increases capacity and sharply reduces per-circuit costs. While the LECs still provide the vast majority of inter-state access services, fibre-based carriers now offer access services to large business customers in the central business districts of many major cities.

The major change to the US telecommunications environment was the structural change to AT&T in 1984. This resulted from an anti-trust case brought before a US Federal District Court in 1974 by the US Department of Justice, claiming anti-competitive conduct by AT&T. The case was settled in 1982, when AT&T agreed to divest itself of its local exchange carrier affiliates; 22 Bell Operating Companies (BOCs), subsequently reorganised into seven Regional Holding Companies (RHCs). The AT&T Consent Decree (also known as the "Modification of Final Judgment" or "MFJ"), approved by the court, became effective on 1 January 1984. This freed AT&T to take a more active part in non-common carrier markets, such as computers, including both services and equipment. It also placed line-of-business restrictions on the divested Bell companies.

In addition to AT&T, the major carriers in the US market are:

- Local Exchange Carriers (LECs) consisting of the Bell Companies plus other independent telephone companies. The Regional Bell Holding Companies are:
  - Ameritech;
  - Bell Atlantic;
  - Bell South;
  - NYNEX;
  - Pacific Telesis;
  - Southwestern Bell;
  - US West.
- Independent or non RBOC LECs include GTE Corporation (recently merged with Contel), and Rochester Telephone.
- Interexchange Carriers (IXCs) which provide long distance and international services. The major IXC is AT&T which still holds around 63 per cent of the market, down from more than 90 per cent ten years ago. Other IXCs include MCI, US Sprint, Allnet and Metromedia/ITT.

Under the AT&T Consent Decree the Bell Operating Companies (BOCs) may only provide service within defined Local Access and Transport Areas (LATAs). IXCs provide services between LATAs. IXCs pay LECs access charges for originating and terminating calls within the exchange area. Under the terms of the AT&T Consent Decree, all central telephone exchanges of the BOCs which service at least 10 000 access lines must offer exchange access that is equal in type and quality to all IXCs. Smaller, independent LECs may voluntarily provide equal access, but are not legally required to do so until they have received a request from an IXC for equal access. After receiving the request, the independent LEC has three years to implement equal access in its exchanges. Where equal access has not been implemented, competitive IXCs are given a 55 per cent discount relative to AT&T, allowing them to offer lower call charges. Equal access is now available for 97.2 per cent of RBOC lines, 86.5 per cent of lines operated by large independent LECs, and 35.5 per cent of other independent LECs.

Telephone companies are subject to different levels of control:

- state Public Utility Commissions (PUCs) which regulate local calls plus intra-state long distance traffic;
- the FCC which regulates inter-state services;
- additionally, with respect to the BOCs the AT&T Consent Decree, which is administered by a US district court judge, complicates federal and state regulation, although it is not, strictly speaking, a part of that regulatory system.

Until 1989 rate of return regulation, which sets an acceptable level of profitability for carriers, was the principal method used to control prices at the federal level and in most states. However, both states and Federal regulators are increasingly moving towards price cap regulation of carriers, beginning with AT&T, the RHCs and GTE. The FCC adopted price caps in 1989; a number of states did so earlier.

B24.2 Telecommunications network facilities

The foundation for the technical sophistication of the US network is the Bell Laboratories, founded in 1925. At the time of the divestiture it had around 25 000 employees. In response to the divestiture, two new R&D organisations were created:

- AT&T Bell Labs;
- Bell Communications Research (Bellcore), serving the regional Bell holding companies.

With the break-up of AT&T, some of the technical homogeneity of the Bell system was lost. LECs and IXCs continue to work together through voluntary associations, nevertheless carriers have followed different paths towards network modernisation. In particular, some have followed ISDN-based strategies whereas others have preferred to encourage private intelligent networks. The growing disparities between the regional networks are more evident in network management and associated control software than in hardware interfaces. For instance Bell Atlantic now has 75 per cent of its access lines served by signalling system No. 7 whereas for US West the figure is just 2 per cent.

Research conducted by Telephony/Market Research shows that spending on local network investment in 1990 was just over $20 billion while inter-exchange carriers spent a further $4 billion. An increasing percentage of this is being spent on fibre optics (6 per cent of the projected total for local exchange companies in 1991). To take one example, Bell Atlantic intends to lay288 000 km of fibre during 1991 bringing its total by the end of the year to just over one million kilometres. By the end of 1991, Bell Atlantic hopes to have just over 50 per cent of its lines digitised. For the local exchange carriers as a whole, the FCC estimates that around 40 per cent of access lines in mid-1990 were digital though the figure for the independent telephone companies is generally higher than for the Bell operating companies.

All of the Bell operating companies and several of the independents are engaged in pilot programmes for fibre to the home/desktop. Some of these are detailed in Figure 2.4 in the main report. Studies estimate that around 10 per cent of feeder loops are now based around fibre (fibre to the curb). However, apart from the pilot programmes, there is virtually no fibre in local distribution networks (the last mile). This situation will change

marginally as new access lines are added. However, many telephone companies argue that a substantial recabling of the local loop would only take place if they were enabled to act as a distribution network for entertainment TV services (''video dial tone'').

B24.3 Mobile communications services

B24.3.1 Market structure

Cellular communications services in the US have grown rapidly in the context of a competitive market structure under the regulation of the FCC. Cellular franchises are defined according to the Standard Metropolitan Statistical Areas (SMSAs) used in the 1980 census (large metropolitan areas, small metropolitan areas, less densely populated areas and rural areas). Two carriers are licensed in each area, with an allocation of 25 MHz each. One is generally the local telephone company while the other is a competitor. According to the FCC, there are some 1 232 separate cellular radio systems operation.

According to market estimates from Northern Business Information/Datapro, there were just over 5 million cellular radio subscribers at the end of 1990 of which the Bell operating company cellular subsidiaries (Ameritech Mobile, Bell Atlantic Mobile, Bell-South Mobility, NYNEX Mobile, Pactel Cellular, SW Bell Mobile and US West Cellular) accounted for 56 per cent of the market. Other leading players include McCaw Cellular Communications, which has 14 per cent of the market, and a newly merged operator GTE Mobile Net/Contel Cellular.

America is also fertile ground for other mobile technologies. There are a number of CT-2 (telepoint) trials in operation including Cellular 21 in the New York area. Other companies which are experimenting with PCN networks include Millicom in Houston and Orlando, Florida, and other companies in Washington D.C., Deerfield Beach, Florida, Ithaca, NY and Chicago.

Radiopaging in the US is a highly competitive market and is provided on a local, regional and national basis.

B24.3.2 Spectrum management policies

The FCC has handled the allocation of frequencies and the assignment of licences for commercial use in cases where there are mutually exclusive applications. Two main mechanisms are available. The first is based on public comparative hearings while the second is based on a lottery. For the larger markets, cellular telephone franchises were awarded in a comparative process; lotteries have been used for smaller markets. A vibrant market exists in the often highly profitable resale of winning franchises. The FCC is constrained in its ability to raise money by selling, renting or auctioning spectrum rights because the spectrum is viewed as ''a public resource''. Consequently, the FCC has gained virtually nothing from the estimated US$46-80 billion of franchises which have been given away in lotteries and comparative hearings.

There is considerable pressure for change in the allocation of frequency, and the National Telecommunications and Information Administration (NTIA) of the US Department of Commerce published a major report on spectrum management policies in February 1991. It argues that there should be ''a greater reliance on market principles in distributing spectrum... through a competitive bidding process'' (NTIA, 1991*a*, p. 1).

The report specifically proposed using competitive bidding for the US government's initial distribution of spectrum to users, and proposed the use of market principles in subsequent private transfers among users. While preferring this market-based approach, NTIA also stated its intention to explore various spectrum fee proposals that could apply when spectrum management objectives cannot be achieved through the market.

The NTIA report also examined various other issues regarding US spectrum management. These included improvements to the processes by which NTIA and the FCC manage the limited spectrum resource, and methods of adding flexibility to the block allocation system through technical standards or by increasing flexibility granted to users. In addition, the report analysed engineering aspects of increasing spectrum efficiency and conservation, and the importance of planning and forecasting.

Consistent with the recommendations of the NTIA report, the US Government has proposed legislation in Congress to give the FCC authority to use competitive bidding in the grant of spectrum licenses. The proposal is limited in the following respects:

- It would be used to assign licences to competing applicants, and not allocate spectrum for particular uses. Successful competitive bidding would serve as an initial condition to obtaining a licence, and would not change the duration or other terms or conditions of the licence or give the winning bidders any new rights in spectrum.
- Competitive bidding would apply only to new licences, and not to incumbents or renewals.
- Some "public interest" uses, such as public safety or non-commercial broadcasting, would be exempt from competitive bidding.

The NTIA study did not specifically address the effects of a competitive bidding system on frequency segments of the geostationary orbit, although an assignment system as described above would not necessarily be inconsistent with international conventions. Further analysis would be needed to address the domestic and international consequences of applying competitive bidding to this area.

B24.4 Broadcast TV operators

There are three main over-the-air TV networks operating in the US: NBC, CBS and ABC. Around 700 of the approximately 1 100 commercial TV stations which exist in the US have affiliate relationships with one of the three. However, the networks' traditional dominance in the TV market is diminishing in the face of competition from a number of sources and their share of US viewing has fallen to 60 per cent and below:

- There are (as of 1990) 380 independent TV stations in the US, a number which has grown three-fold over the last decade. Independent TV stations had a 19 per cent share of the US viewing market in 1989-90.
- A large number of the independent TV stations are affiliated with the Fox Broadcasting network of Rupert Murdoch's News International. Fox has set out to become a fourth national network and, through its ownership of the 20th Century Fox film studios and tie-ins with local TV and cable TV stations and listings magazines, is well on its way to becoming so.
- There are 340 educational TV stations, most of which are affiliated to the Public Broadcasting System (PBS). PBS channels took 3 per cent of the viewing market in 1988.

- Low power TV (LPTV) and the multichannel multipoint distribution service (MMDS) have been permitted nationwide since 1980 by the FCC.
- There is growing competition from cable TV and, to a lesser extent, from satellite TV (see below).

Broadcasting in the US is regulated by the FCC.

B24.5 Video-based services

Cable TV systems in the US first developed as a mechanism for re-broadcasting over-the-air TV channels. Consequently, they were initially regarded as an ancillary service to traditional broadcasting. The growth of satellite-delivered programming during the 1970s changed all this. In particular, in 1972 the FCC opened market entry for the provision of domestic satellite capacity; in 1976 authorised the resale of satellite communications services and transponder capacity; and in 1978 liberalised the market for satellite earth stations. The effect of these changes was to enable satellite re-broadcast of distant channels.

The 1984 Cable Act represented a landmark in codifying the national policy for cable TV, including establishing a framework for the franchising process, removing rate regulation from most firms and codifying FCC rules on cross-ownership. Cable TV has flourished and there are now more than 50 million households subscribing to basic cable TV (i.e. not pay-TV channels) and a further 30 million homes passed by cable.

The major cable TV channels, measured in terms of the number of subscribers include the ESPN entertainment and sports network (which began in 1979) the CNN news network (1980), Nickelodeon childrens' programming (1979) and MTV music programming (1981). In 1990, the main US Multiple System Operators (MSOs) were TCI Tele-Communications Inc. (11.8 million subscribers), Time Warner (6.2m), Comcast Cable (4.8m) and Continental Cablevision (2.6m). Total US cable revenues in 1990 were estimated to be US$17.9 billion of which 56 per cent came from basic service, 29 per cent from pay services and 14 per cent from advertising. These revenue estimates include pay-per-view, expanded basic, home shopping, installation fees and other revenue sources.

Video-conferencing services are provided by around 12 service vendors in the US, though the use of the service has grown rapidly in recent months following the availability of low cost terminals, cheaper tariffs and restrictions on business travel during the Gulf Crisis. One of the major services is The Meeting Channel provided by US Sprint since 1984 which serves 250 public studios and 500 private studios. At the start of 1990, it was estimated that there were around 2 000 systems in the US as a whole.

B24.6 Data broadcasting services

America has not proved to be a profitable market for videotex systems. Despite the fact that the market is open and that many ventures have been initiated including Knight-Ridder's Videotron and Times Mirror's Gateway, none of these has been successful to date. The emphasis is now shifting away from the NAPLPS standard towards simple

scrolled ASCII transmission. One of the latest projects to be established is the joint IBM/ Sears service, Prodigy, which was launched in late 1990. The Prodigy service has a ready-made customer base in Sears' mail order customers, but even so the potential of the service remains unproven. Most videotex services remain closer to database retrieval (e.g. Compuserve, Dow Jones) rather than a truly interactive service.

By contrast, audiotex in the US is a very big business with revenues of US$600 million per year just for the ''900'' services, or pay-per-use rate telephony services. AT&T for instance offers a service called Dial-It which is used for a number of functions including recorded information services and straw poll voting. Tollfree, or ''800'' services, provide a further $5 billion in revenues and have grown rapidly over recent years. 800 services are offered by most of the inter-exchange carriers with minor variations according to client sector.

Because of the size of the US market, other one-way data broadcasting services have developed mainly through satellite applications. The VSAT market in America was liberalised in the late 1970s. The density of VSATs in North America is several times that in Europe.

B24.7 Specialised satellite services

Domestic US satellite service provision was liberalised in the early 1970s and satellite systems separate from INTELSAT were first authorised in 1985. However, access to the international space segment of INTELSAT and INMARSAT remains a monopoly in the hands of COMSAT which is the US signatory. COMSAT functions as a carriers' carrier in distributing circuits to other companies. Some satellite telecommunications services are being provided by private satellite systems such as PanAmSat and, in the future by Columbia and Orion. However, such systems are not currently allowed to interconnect with the public switched network.

Satellite TV offered through direct broadcast has not thrived in the US, though satellite is used extensively for programme distribution to cable operators and independent TV stations. Satellite TV is widely viewed in the US as an economically marginal service suitable for remote locations without cable TV (less than 15 per cent of households nationwide). In fact, Sky Cable, a joint venture between News Corp., NBC, Hughes Communications, and Cablevision Systems Corp, folded in 1991. Nevertheless, the potential for satellite TV still remains. Up to 150 channels could be delivered by a high power satellite to relatively small dishes which would be competitive with the 30-50 channels delivered on traditional cable systems. Satellite may also be a superior medium for the delivery of pay TV and pay-per-view or for channels in non-English languages. Satellite television would complement the FCC's original policy of supporting localism in broadcasting because it could encourage more niche marketing of specialist programming to suit individual neighbourhoods.

B24.8 Cross-ownership and cross-sectoral service provision

As compared to other OECD countries, the United States has retained certain policies on cross-ownership and cross-sectoral service provision, despite recent moves

toward deregulation. Indeed, some US companies are allowed to do far more abroad than they can in their home markets. One example of this is the involvement of the US telcos in the ownership of European CATV companies in the UK, France and elsewhere. US telcos are generally not permitted to control CATV companies in the telco's local service areas. Equally, US CATV companies are not allowed in many states to provide both CATV and local telephony services as they do in the UK, although more and more states are permitting competition by CATV firms and other providers.

The roots of the US policy of structural separation of telecommunications and broadcasting activities go back to the 1940s and 1950s when telephone companies agreed to lease space on telephony company poles at relatively low prices. Later Bell system operating companies started building systems on behalf of CATV companies and then leasing them back (channel service). However, as the CATV companies grew in strength they preferred to build and operate their own infrastructures, leading to disputes over the level of fees they should pay for sharing poles and trenches with the telcos. In 1967, the FCC began investigating the issue of leasing arrangements and adapted rules in 1970 prohibiting telephone companies from directly or indirectly providing cable service in their telephone franchise areas.

As a consequence of the 1984 Cable Act and FCC rules, the level of cross-ownership of telco and CATV interests in the US is very limited:

- There is some limited cross-ownership by communications companies. Athough FCC rules prohibit broadcast stations from owning CATV systems in their local market areas, for the most part CATV companies have ownership interests in broadcasting stations, programme makers and newspapers rather than telecommunications companies. However, there are a number of exceptions to this general rule: for instance Comcast operates cellular radio systems and Cox has a licence for Personal Communications Services (PCS) as well as a minority shareholding in Teleport Communications;
- There are a small number of pilot projects or joint ventures between CATV companies for the provision of advanced interactive services, for instance between Bell Atlantic and Helicom, GTE and Apollo Cablevision, BellSouth and Heathrow Florida Cable System.

In most areas, cable TV systems remain as de facto geographical monopolies for the delivery of multi-channel television service despite court decisions which have challenged the protection given to individual franchises. There are relatively few (under 75) directly competitive systems currently in operation. The locations where competing cable systems exist include Allentown PA and Orange County, Florida where CCF, Cablevision Inc., and Telesat are all in competition.

Telco strategies concerning entry into the CATV market vary. A minority of telcos believe that they can generate sufficient revenues to justify deployment of video distribution facilities by simply leasing capacity to unaffiliated programmers on a common carrier basis. Other telcos believe they will need to develop their own programming or perhaps form joint ventures with existing video programmers or CATV systems. Still other telcos are seeking to enter the market in a way is qualitatively different from existing CATV companies, for instance by offering video-on-demand, pay-per-view, interactive services and a much higher channel availability. A number of current fibre-to-the-home projects are intended to test the viability of these services alongside more conventional telecommunications offerings. For their part, CATV companies are also

Figure B24. **Network dimensions and service revenues in the United States**

	Status			Change	
	Year	Number	Units	Year	CAGR (%)
Telephone mainlines	1989	121 507.0	Thousands	1984-89	+4.2
Penetration rate		49.3	Per 100 inhabitants		
Cellular radio	1991	5 051.4	Thousands	1989-91	+39.4
Penetration rate		2.05	Per 100 inhabitants		
TV receivers	1991	193 200.0	Thousands	1984-91	+3.4
Penetration rate		77.7	Per 100 inhabitants		
VCRs	1991	63 917.0	Thousands		n.a.
Penetration rate		25.7	Per 100 inhabitants		
Cable TV	1991	56 100.0	Thousand households	1986-91	+6.8
Penetration rate		60.3	Per 100 TV households		
Take-up rate		61.0	Per 100 households passed		
		95.0	Per cent of households are passed		
Telecommunications revenues	1990	162 660.0	US$ million	1985-90	+7.7

n.a.: Not available.
Sources: FCC, ITU, National Cable TV Association, UNESCO, Datapro, Statistics Office, NCTA, TV Bureau of Advertising, Dept. of Commerce Intl. Trade Administration.

gearing up to providing a higher quality of service through technically sophisticated networks. For instance, in March 1991, Time-Warner announced its intention to build a state-of-the-art 150-channel interactive video system in Queens, New York in co-operation with telecommunications companies. The system, which will be fibre-based, should be capable of delivering CATV, video-on-demand and HDTV. It may also be upgraded to provide some telephony services through PCN-type services or community telepoint.

B24.9 Information sources

This chapter is based on comments on 30 August 1991 and 2 December 1991 sent by Ms Helen Shaw of the Division of International Telecommunications Policy, NTIA containing analysis from the Office of Policy Analysis and Development (OPAD) of the NTIA and from the FCC.

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Other information was supplied by PTO annual reports and sources listed in sections B1.9 and B4.9.

Part C

ANALYTICAL TABLES

Figure C1. **Major telecommunications network operators**

	Operator(s)	Status	Control of PSTN
Australia	Telecom Australia/OTC AUSSAT	Govt. Business Enterprise Privatised by 31 Dec. 1991	Duopoly as from 1 July 1991
Austria	ÖPT Radio Austria	State-owned Licensee for some international telex	Monopoly
Belgium	RTT (BELGACOM)	State-owned	Monopoly
Canada	Telecom Canada Other carriers incl. Unitel Teleglobe (intl.)	Private/provincial ownership Private Subsidiary of Memotec	Limited geographical competition.
Denmark	TeleDanmark 4 regional operating companies Telecom Denmark	51% state-owned holding companies Private/public State enterprise	Geographically divided with limited competition
Finland	55 local concessions 4 long-distance concessions	Private/municipal ownership Private/public	Geographically divided with limited competition
France	France Télécom plus subsidiaries	State-owned	Monopoly
Germany	DBP Telekom	State-owned	Monopoly
Greece	OTE	State-owned	Monopoly
Iceland	P&T administration	State-owned	Monopoly
Ireland	Telecom Eireann	State-owned	Monopoly
Italy	SIP (local/long distance) Italcable (intl.) Telespazio (satellite) ASST (long distance) DCST (some intl. telex) DCSR (some mobile)	61.4% state-owned 49.3% state-owned 100% state-owned 100% state-owned 100% state-owned 100% state-owned	Geographically and functionally divided monopoly
Japan	NTT (domestic) 64 other Type I carriers KDD, ITJ, IDC (intl.)	66.2% state-owned Private Private	Open competition
Luxembourg	P&T administration	State-owned	Monopoly
Netherlands	PTT Telecom Netherlands	State-owned	Monopoly
New Zealand	Telecom New Zealand Ltd. Clear Communications Ltd. plus others	Privatised in Sept. 1990 Private	Open competition
Norway	Norwegian Telecom	State-owned	Monopoly
Portugal	Telecom Portugal TLP (regional) CPRM (some intl.)	State-owned Privatised by 31 Dec. 91 Private/Public	Geographically divided monopoly

Figure C1. **Major telecommunications network operators** *(cont'd)*

	Operator(s)	Status	Control of PSTN
Spain	Telefónica DCST (some intl. telex)	Private (30% state-owned) State-owned	Monopoly
Sweden	Televerket Tele2	Privatised in 1992? Private	Open competition
Switzerland	Swiss PTT	State-owned	Monopoly
Turkey	General Directorate of PTT	State Economic Enterprise	Monopoly
United Kingdom	British Telecom Mercury plus others	Privatised in 1984 Private public/private	Duopoly; soon to be open competition
USA Local Exchange Carriers	Regional Bell holding companies: Ameritech Bell Atlantic Bell South NYNEX Pacific Telesis Southwestern Bell US West Plus independents	Private	Competition in some States
USA Inter-exchange Carriers	AT&T, MCI US Sprint GTE/Cantel Plus others	Private	Open competition

Note: For more information, see country chapters in Part B of the Annex.

Figure C2. **Status of telecommunications operators and regulatory bodies**

	Corporatisation of main operator[1]	Privatisation of main operator	Regulatory bodies
Australia	(TA/OTC) 1975 (AUSSAT) 1990	No AUSSAT by 31 Dec. 1991	Ministry of Transport & Communications, AUSTEL
Austria	No	No	Federal Ministry of Public Economy & Transport
Belgium	1990	No	Belgian Institute for Post & Telecommunications (IBPT)
Canada (Telecom Canada) (Teleglobe)	Always 1950	Always 1987	Department of Communication CRTC Three Crown Provinces
Denmark	1987	Effectively from 1 March '92	National Telecom Agency, General Directorate of P&T
Finland	1987	n.a.	Ministry of Transport & Communications, Telecommunications Administration Centre (TAC)
France	1986/1990	No	Ministère des Postes, Télécommunications et de l'Espace, Direction de la Réglementation Générale (DRG)
Germany	1989	No	Federal Ministry of Posts and Telecom, Department of Regulatory Issues
Greece	1942	No	Ministry of Transport and Communications, Federal Directorate of Posts & Telecommunications
Iceland	No	No	Post & Telecommunications Administration
Ireland	1984	No	Department of Communications
Italy	n.a.	n.a.	Ministry of Posts and Telecommunications
Japan	1952	1985	Ministry of Posts & Telecommunications
Luxembourg	1992	No	Ministry of Communications
Netherlands	1989	No	Ministry of Transport and Public Works, Department for Telecommunications and Posts (HDTP)
New Zealand	1987	1990/1993	Department of Trade and Industry
Norway	1990	No	Ministry of Transport and Communications, Norwegian Telecommunications Regulatory Authority (NTRA)

Figure C2. **Status of telecommunications operators and regulatory bodies** *(cont'd)*

	Corporatisation of main operator[1]	Privatisation of main operator	Regulatory bodies
Portugal	1989/90 (TP)	1991 (TLP)	Ministry for Public Works, Transport and Communications, Institute for Communications in Portugal (ICP)
Spain	1924	1924	Ministry of Transport, Tourism and Communications
Sweden	Always	1992?	Ministry of Transport and Communications
Switzerland	1992	No	Federal Dept. of Transport, Communications and Energy, OFCOM (from 1992)
Turkey	1984	No	Ministry of Transport
United Kingdom	1968/81	1984	Department of Trade and Industry, Office of Telecommunications (Oftel)
United States	Always	Always	Federal Communications Commission

1. Corporatisation in this sense means the separation of the operator from the ministry, the definition of a new telecommunications law, and/or the separation of postal and telecommunications operations.

Figure C3. **Public Switched Telephone Network: Size, penetration and growth**

	Telephone mainlines at 1/1/90 (thousands)	Penetration rate per 100 inhabitants	5 year CAGR (%)
Australia	7 786.9	47.1	4.7
Austria	3 102.8[1]	40.9	3.3
Belgium	3 912.6[3]	39.3	5.2
Canada	14 601.0[1]	56.3	5.1
Denmark	2 909.3	56.7	3.4
Finland	2 581.8	52.2	3.3
France	27 000.0	48.3	4.1
Germany[2]	29 837.7[1]	38.2	3.6
Greece	3 862.7[1]	38.5	4.4
Iceland	126.1	50.5	5.3
Ireland	879.0	24.8	5.6
Italy	26 766.0[3]	46.3	5.7
Japan	52 410.0	42.7	2.9
Luxembourg	176.4	47.0	3.7
Netherlands	6 694.0	45.1	3.5
New Zealand	1 451.7[1]	43.6	3.4
Norway	2 132.3[3]	50.2	3.9
Portugal	2 612.5[3]	25.4	13.3
Spain	14 476.6[3]	37.1	9.2
Sweden	5 700.0	67.6	2.1
Switzerland	3 784.5	56.7	3.5
Turkey	4 920.8	9.1	24.1
United Kingdom	25 363.0	44.4	3.9
United States	121 507.0[1]	49.3	4.2
OECD	362 594.7	42.9	4.4[4]

1. 1/1/1989 mainlines; 1984-89 growth.
2. Eastern and western Germany together.
3. 1/1/1991 mainlines; 1986-91 growth.
4. Weighted average.

Sources: PTO and Ministry annual reports; ITU Yearbook, FCC Yearbook.

Figure C4. **Network modernisation in OECD countries**

	Percentage of exchange lines digital	Percentage of trunk lines digital	Comments
Australia	26.3	95.0	182 000 km of fibre optics; Inter-city backbone due for completion by 1995.
Austria	12	n.a.	7 000 km of fibre optics by end 1992; 70 per cent local digitisation by 1995.
Belgium	33	n.a.	Inter-exchange digital network now complete; 80 per cent digitisation by 2000.
Canada	Varies by operator	n.a.	2 000 km of fibre optics installed by Telecom Canada; Unitel should have all digital network by end 1992.
Denmark	16	65.6	80% of population can be reached by fibre optics, rising to 95% in early 1990s.
Finland	28.8	47.2	30 615 km of fibre optics; Digitisation expected to increase to 50% and 60% by 1995.
France	70	74	85 000 km of fibre optics laid during 1989; Primary rate ISDN in operation since October 1989.
Western Germany	12	50	Digitisation to increase to 24% and 100% by end 1992. One million km of fibre optic cable laid.
Eastern Germany	0	n.a.	1.2 million waiting list.
Greece	15	25	270 km of fibre optics. Waiting list of 1.1 million.
Iceland	32	n.a.	760 km of fibre optics.
Ireland	55	100	100% local digitisation by 2000.
Italy	33	n.a.	63% local digitisation planned by end 1994. 450 000 km of fibre optic cable has been laid.
Japan (NTT)	34	65	NCC's have all-digital network; Broadband ISDN service planned to start in 1995.
Luxembourg	20	n.a.	72 km of fibre optics laid during 1989.
Netherlands	n.a.	n.a.	Digital fibre optic backbone network completed in 1987.
New Zealand (TNZ)	72	100	Other carriers have all-digital networks planned.
Norway	39	n.a.	Local digitisation expected to increase to 73% by 1995; At present 8% of switches are digital.

Figure C4. **Network modernisation in OECD countries** *(cont'd)*

	Percentage of exchange lines digital	Percentage of trunk lines digital	Comments
Portugal	30	50	3 000 km of fibre optic laid. One year waiting list.
Spain	28	n.a.	8 000 km (6.5%) of basic infrastructure is fibre optic.
Sweden	56	75	100% trunk network digital by 1995; 3 000 km of fibre laid.
Switzerland	24	n.a.	62% of exchange lines should be digital by 1995. 39% of exchanges are digital; 90% by 1995.
Turkey	n.a.	41	90% trunk line digitisation planned by 1995.
United Kingdom (BT)	50	100	75% digital exchange lines by 1995; 3.65 million km of fibre optics, rising to 5.1 million km by 1995.
(Mercury)	100	100	4 600 km of fibre/microwave.
(Kingston)	100	100	
United States	Average: 40	n.a.	Digitisation generally lower in the former Bell system than among the independents.

Figure C5. **Analogue cellular radio networks: Operators, technology and start-up dates**

	Operator	Status	Start-up date	Technology
Australia	Telecom Australia (Mobile Net)	Monopoly until 1991 2 more carriers planned	1987	AMPS/TACS
Austria	ÖPT	Monopoly	1984 1990	C450 NMT 900
Belgium	RTT	Monopoly	1987	NMT 450
Canada	Telecom Canada (Cellnet Canada), Cantel Inc.	Regionalised monopoly	1985	AMPS/TACS
Denmark	Tele Danmark Mobil	Analogue monopoly	1981 1987	NMT 450 NMT 900
	Dansk Mobil Telefon	GSM duopoly	1992	GSM
Finland	Telecom Finland	Duopoly	1982 1987	NMT 450 NMT 900
	Radiolinja		1991	GSM
France	France Télécom (Radiocom 2 000)	Duopoly	1985	Radiocom 2 000
	SFR		1990	NMT 900
Germany	DBP Telekom Mannesmann Mobilfunk	Analogue monopoly	1986	C 450
		GSM duopoly	1991	GSM
Greece	No service	–	–	–
Iceland	P&T Administration	Monopoly	1986	NMT 450
Ireland	Telecom Eireann (Eircell)	Monopoly	1985	TACS 900
Italy	SIP (RTMI)	Monopoly	1985	RTMI
		GSM duopoly planned	1990	TACS 900
Japan	NTT 12 other companies	Regionalised competition	1985	NAMTS – MCCSS – HCATS
Luxembourg	P&T Administration	Monopoly	1985	NMT 450
Netherlands	PTT Telecom Netherlands (ATF2, ATF3)	Monopoly	1985	NMT 450
		GSM duopoly planned	1989	NMT 900
New Zealand	Telecom New Zealand + 4 others	Open competition	1987	AMPS/TACS
Norway	Norwegian Telecom	Analogue monopoly	1981 1986	NMT 450 NMT 900
		GSM duopoly	1992	GSM
Portugal	TP/TLP	Analogue monopoly	1989	C 450
		GSM duopoly	1992	GSM

Figure C5. **Analogue cellular radio networks: Operators, technology and start-up dates** *(cont'd)*

	Operator	Status	Start-up date	Technology
Spain	Telefónica	Monopoly	1986	NMT 450
			1990	TACS 900
Sweden	Televerket	Analogue duopoly	1981	NMT 450
			1986	NMT 900
	Comvik	GSM competition	1989	NMT 900
			1991	GSM
	Nordic Tel		1992	GSM
Switzerland	Swiss PTT (Natel C)	Monopoly	1987	NMT 900
Turkey	DG of PTT	Monopoly	1986	NMT 900
United Kingdom	Racal Vodafone Cellnet	Duopoly until 1991	1985	TACS-900
United States	Seven RBOCs plus others	Regionalised duopoly	1983	AMPS

Figure C6. **Analogue cellular radio networks: Size, penetration rate, and growth**

	Number of subscribers at 1/1/90	Penetration rate (per 1 000 inhabitants)	3 year CAGR (%)
Australia	340 000[4]	20.2	141.6
Austria	50 700[1]	6.7	42.7
Belgium	44 500[4]	4.5	60.7
Canada	462 000	17.8	74.1[3]
Denmark	151 200	29.4	25.3
Finland	255 355[4]	51.6	35.7
France	170 000	3.0	134.0[3]
Germany	430 000[6]	5.4	51.2
Greece	No service	0.0	n.a.
Iceland	10 259[4]	41.0	25.4
Ireland	22 106	6.2	131.0
Italy	416 000[4]	7.2	231.1
Japan	868 078[5]	7.1	57.2
Luxembourg	665	1.8	31.5
Netherlands	79 000[4]	5.3	72.8
New Zealand	29 197	8.8	251.5[3]
Norway	220 000[6]	46.7	13.7
Portugal	6 500[4]	0.6	n.a.
Spain	52 000[4]	1.3	63.7
Sweden	461 000[4]	54.6	42.3
Switzerland	125 000[4]	18.6	185.5
Turkey	5 101	0.1	n.a.
United Kingdom	1 150 000[4]	20.2	32.0
United States	5 041 429[4]	20.5	39.4[2]
OECD	10 407 590	12.3	44.6[7]

1. 1/1/89 data.
2. Two-year CAGR.
3. Growth for main operator only.
4. 1/1/91 data.
5. 1/3/91 data.
6. 1/8/91 data.
7. Weighted average (for 21 countries).

Sources: OECD Questionnaire, Fintech, PTO annual reports.

Figure C7. **Radiopaging services in OECD countries**

	Major Service Providers	Status of Market	Start-up date	Subscribers at 1/1/90	Penetration rate per 1 000 inhabitants
Australia	Telecom Paging	Competitive	1982	n.a.	n.a.
Austria	ÖPT	Monopoly	n.a.	23 477	3.1
Belgium	RTT Semaphone	Monopoly	1980	123 000[3]	12.4
Canada	–	Competitive	n.a.	n.a.	n.a.
Denmark	OPS Tele Danmark Mobil	Monopoly	1983	65 000[1]	12.7
Finland	–	Regional monopolies	n.a.	n.a.	n.a.
France	France Télécom TDF1	Duopoly	1975	n.a.	n.a.
Germany	Eurosignal DBP Cityruf	Liberalising in 1991	1974 1988	290 000[1]	3.7
Greece	OTE	Monopoly	1991	8 658	8.6
Iceland	P&T	Monopoly	1989	n.a.	n.a.
Ireland	Eirpage Ltd.	Joint-venture RTE/Motorola	1988	3 500	1.0
Italy	SIP Teledrin	Monopoly	1973	52 500	0.9
Japan		Competitive since 1987	n.a.	5 100 000[1]	41.4
Luxembourg	Sémaphone	Monopoly	1981	3 855	10.3
Netherlands	Semafonie	Monopoly	1980	170 000[2]	11.5
New Zealand		Competitive since 1989	1987	30 000	9.0
Norway	Tele Mobil PS-tall PS-tekst	Monopoly	1984 1991	80 000[3] n.a.	18.9
Portugal	Telemensagem (Telebit)	Joint Venture TP/TLP	1989	n.a.	n.a.
Spain	Telefónica (Mensafónico)	Competitive	1986	n.a.	n.a.
Sweden	MBS, minicall	Competitive	1978	117 000	13.9
Switzerland	Swiss PTT (Citycall Eurosignal)	Competitive	1975	n.a.	n.a.
Turkey	DG of PTT	Monopoly	1986	n.a.	n.a.
United Kingdom	BT plus 6 others	Competitive since 1983	1972	n.a.	n.a.
United States	Many firms	Competitive	1972	n.a.	n.a.
OECD (13 countries)				6 226 990	19.1

1. 1/3/91 data.
2. 1/1/89 data.
3. 1/8/91 data.

Sources: OECD Questionnaire, Fintech, Logica (1991).

Figure C8. **Broadcast TV operators in OECD countries**

	Broadcast TV operator(s)	Number of over-the-air channels	Status of service	Regulatory body
Australia	ABC plus 52 commercial stations	n.a.	Competitive	Department of Transport and Communications, Australian Broadcasting Tribunal
Austria	ORF	2	Monopoly	State Chancellor's Office
Belgium	BRTF BRT 3 Commercial	4 (+1 scrambled)	Liberalised in mid 1980s	Regional governments
Canada	CBC Other public broadcasters 5 main commercial channels	n.a.	Competitive	CRTC
Denmark	Danmarks Radio TV2	2 plus local	Liberalised in 1986	Directorate General of P&T
Finland	Finnish Broad-casting Co. Mainos-TV Co. Kolmos-TV Co.	3	Competitive	Council of State
France	TF1, A2, FR3, ARTE, M6, (Canal Plus)	5 (+ 1 scrambled)	Liberalised in 1986	CSA
Germany	ARD, ZDF + Regional stations	3	Competitive	State governments (Länder)
Greece	ERT1, 2, 3 + foreign channels re-broadcast	3	Liberalised since 1989	Two government bodies for "social regulation" and "political regulation"
Iceland	Icelandic National Broadcasting Service	1	Monopoly	Icelandic Government
Ireland	RTE	2	Monopoly	IRTC
Italy	RAI 1, 2, 3 Commercial channels incl. Canale 5, Rete 4, Italia 1	6 main channels	Liberalised in 1976	P&T ministry plus local and district courts

Figure C8. **Broadcast TV operators in OECD countries** *(cont'd)*

	Broadcast TV operator(s)	Number of over-the-air channels	Status of service	Regulatory body
Japan	NHK + 158 regional commercial channels	n.a.	Competitive	Ministry of Posts and Telecommunications
Luxembourg	CLT	4	Private monopoly	Two Government commissions for technical and content issues
Netherlands	NOS	3	Open access monopoly	Ministry of Welfare, Health & Culture
New Zealand	TVNZ, TV3 plus 7 private channels incl. Sky Network TV	Up to 10	Liberalised in 1987	Broadcasting Commission
Norway	NRK, TV2	2	Liberalised in 1989	National Advisory Council; Ministry of Culture
Portugal	RTP plus 2 commercial channels out to tender	2 (+2)	Liberalised in 1986	Institute of Communications in Portugal (technical) Directorate General for Social Communications (other)
Spain	RTVE plus private channels	Up to 8	Liberalised	Presidential Ministry
Sweden	SR, TV3, TV4, TVPlus, SF Succé, TV1 000	4 incl. DBS/Cable (+2 scrambled)	Liberalised	Swedish Parliament
Switzerland	SSR Téléciné-romandie and others	3 + 1 pay-TV Regional and local TV stations	Liberalising further in 1992	Federal Council (Executive); Federal Dept. of Transports, Communications and Energy; Independent Authority for radio and TV broadcasts complaints (AIEP)
Turkey	TRT, Magic Box	3	Liberalised in 1989	Ministry of Transport
United Kingdom	BBC 1, 2 Channel 3, Channel 4, (Channel 5 in 1993)	4 (+1)	Competitive since 1950s	ITC, Home Office

Figure C8. **Broadcast TV operators in OECD countries** *(cont'd)*

	Broadcast TV operator(s)	Number of over-the-air channels	Status of service	Regulatory body
United States	ABC, NBC, CBC, PBS, Fox plus others	Varies by area	Competitive	FCC

Sources: OECD Questionnaire, Logica (1987).

Figure C9. **Television sets: Penetration and growth rates**

	Units[1]	Number 1/1/1988 or latest (thousands)	Per 100 inhabitants	7 year CAGR (%)	Per 100 telephone mainlines in same year
Australia	R	9 800	59.3	5.4	125.8
Austria	R	2 788[2]	36.7	1.5[2]	89.8
Belgium	L	3 296[3]	33.1	3.9	84.3
Canada	R	14 895	57.4	5.0	107.2
Denmark	R	2 215[4]	43.2	0.9[2]	78.7
Finland	R	2 390[3]	48.3	6.7	89.6
France	L	18 459	33.0	2.1	74.1
Germany	L	29 577	37.9	1.7	102.7
Greece	L	1 750	17.5	2.2	51.2
Iceland	L	73[5]	29.2	1.9	57.9
Ireland	L	826	23.3	4.3	104.8
Italy	L	14 687	25.6	1.4	76.4
Japan	L	71 500	58.3	1.8	144.4
Luxembourg	L	140	37.3	n.a.	85.4
Netherlands	R	7 000[5]	47.1	1.4	104.7
New Zealand	L	1 220	36.7	n.a.	86.9
Norway	L	1 700[3]	40.3	2.8[2]	79.7
Portugal	L	1 626	15.8	2.2	93.6
Spain	R	14 314	36.7	6.2	128.8
Sweden	L	3 293	39.1	0.6	60.2
Switzerland	L	2 630	39.4	1.9	74.4
Turkey	L	9 000	16.7	14.4	182.9
United Kingdom	R	24 650	43.2	1.2	104.9
United States	R	193 200	77.7	3.4	159.0
OECD		431 049	51.2	3.0[6]	119.9

1. L – Licences; R – Receivers.
2. CAGR for licences.
3. 1/1/91 data.
4. 1/1/89 data.
5. 1/1/90 data.
6. Weighted average for 22 countries.

Sources: OECD Questionnaire, UNESCO.

Figure C10. **Video Cassette Recorders: Penetration rate**

	Number 1/1/89 or latest (thousands)	Per 100 inhabitants	Per 100 TV sets in same year
Australia	3 420.0	20.7	41.8
Austria	1 132.0[2]	14.9	40.6
Belgium	940.2[2]	9.5	28.5
Canada	5 398.0	20.8	38.1
Denmark	720.0	14.0	32.5
Finland	1 026.0	20.7	42.9
France	7 878.0	14.1	41.8
Germany[1]	11 614.2	18.9	48.8
Greece	660.7	6.6	36.9
Iceland	n.a.	n.a.	n.a.
Ireland	456.4	12.9	53.0
Italy	2 470.0	4.1	16.6
Japan	27 710.0	22.6	38.1
Luxembourg	n.a.	n.a.	n.a.
Netherlands	3 042.0[2]	20.6	43.2
New Zealand	592.0	17.8	47.6
Norway	900.0[2]	21.4	52.9
Portugal	639.0	6.2	38.5
Spain	3 860.0	9.9	25.4
Sweden	1 257.0	14.9	37.9
Switzerland	954.1	14.3	36.3
Turkey	3 076.0	5.7	34.2
United Kingdom	14 000.0[2]	24.0	55.2
United States	63 917.0[2]	25.7	33.1
OECD (22 countries)	155 662.4	18.8	36.1

1. Western Germany only.
2. 1/1/91 data.
Sources: OECD Questionnaire, UNESCO.

Figure C11. **Cable TV: Penetration and growth rate**

	Cable TV households (1/1/89) (thousands)	Per 100 households	4 year CAGR (%)
Australia	Very few	n.a.	n.a.
Austria	663.0[1]	23.7	14.8
Belgium	3 283.4[1]	91.8	2.8
Canada	8 661.0	78.8	4.1
Denmark	1 300.0[1]	59.0	41.0
Finland	616.0[1]	42.3	10.2
France	300.0	1.5	104.0[2]
Germany[3]	8 950.0[1]	34.0	29.2
Greece	Very few	n.a.	n.a.
Iceland	n.a.	n.a.	n.a.
Ireland	460.0	48.9	20.2
Italy	80.0	0.4	n.a.
Japan	5 774.8	18.0	7.9
Luxembourg	90.0	64.3	3.0
Netherlands	4 450.0	79.5	9.5
New Zealand	Very few	n.a.	n.a.
Norway	500.0[1]	33.3	12.6
Portugal	Very few	n.a.	n.a.
Spain	330.0	3.0	n.a.
Sweden	970.0	29.4	76.5
Switzerland	1 800.0[1]	73.4	7.9
Turkey	Very few	n.a.	n.a.
United Kingdom	572.0	2.8	31.0
United States	56 100.0[1]	60.3	6.8
OECD (18 countries)	88 834.6	34.7	9.3[4]

1. 1991 data.
2. 3-year CAGR.
3. Western Germany only.
4. 16 countries.

Sources: OECD Questionnaire, Cable & Satellite Europe, NAB.

Figure C12. **Videotex services: Size, penetration, technical standard and start-up date**

	Service(s) and/or operator	Start-up	Standard	Subscribers 1/1/1989 or most recent	Subscribers per 1 000 inhabitants
Australia	Telecom Australia (Discovery) plus many private services	1989	n.a.	n.a.	n.a.
Austria	ÖPT/Radio Austria	n.a.	BTX	9 717	1.28
Belgium	RTT	1986	Télétel, Prestel, BTX	6 400	0.65
Canada	Bell Canada (ALEX) plus competitive services including from CATV suppliers	1988 (ALEX)	n.a.	20 000 (ALEX)	0.77 (ALEX)
Denmark	KTAS/JTAS (Teledata)	1987	BTX	2 500	0.49
Finland	Helsinki Telephone Co. (Startel)	1980	Prestel	n.a.	n.a.
France	France Télécom (Télétel)	1983	Télétel	5 000 000	84.49
Germany	DBP (Bildschirmtext)	1983	BTX	148 000	1.89
Greece	OTE	1991	Prestel, Télétel	400	0.04
Iceland	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	Minitel Corp.	1991	Télétel	n.a.	n.a.
Italy	SIP (Videotel)	1986	Prestel	80 000	1.39
Japan	NTT (CAPTAIN) Plus competitive services	1984 (CAP.)	CAPTAIN	100 000 (CAP.)	0.82 (CAP.)
Luxembourg	P&T	1987	BTX	339	0.90
Netherlands	PTT (Viditel) Videotex Nederland	1984 1990	BTX, CATV Videotex	25 000 n.a.	1.69 n.a.
New Zealand	TNZ (Vapnet) plus competitive services	1986	Prestel	5 000	1.50
Norway	NT (Teledata)	1987	BTX	5 000	1.19
Portugal	TP/TLP	1990	BTX, Prestel, Télétel	800	0.08
Spain	Telefónica	1986	BTX	130 000	3.33

Figure C12. **Videotex services: Size, penetration, technical standard and start-up date** *(cont'd)*

	Service(s) and/or operator	Start-up	Standard	Subscribers 1/1/1989 or most recent	Subscribers per 1 000 inhabitants
Sweden	Televerket (Vidoetex)	1982	Prestel	29 000	3.44
Switzerland	Swiss PTT	1987	Prestel	73 079	10.87
Turkey	DG of PTT (TELEBILGI)	1987	Télétel	n.a.	n.a.
United Kingdom	BT (plus others)	1980	Prestel	110 000	1.93
United States	IBM/Sears (Prodigy) plus others	1990 (Prod.)	ASCII	n.a.	n.a.
OECD (18 countries)				5 745 235	11.11

Sources: OECD Questionnaire, Logica (1991).

Figure C13. **Telecommunications revenues, revenues per inhabitant, revenue per line and growth**

	Year	Revenues (US$ million)	Revenue per inhabitant (US$)	Revenue per line (US$)	5 year CAGR (%) (local currency)[1]
Australia	1990	8 080.6	488.6	1 037.7	13.9
Austria	1988	2 355.8	310.1	759.2	8.0
Belgium	1990	2 572.2	258.8	657.4	8.2
Canada	1989	11 564.0	445.6	792.0	5.9
Denmark	1989	1 750.0	341.1	601.5	13.8
Finland	1989	1 657.9	335.2	642.1	9.7
France	1990	14 812.0	265.1	548.6	2.9[2]
Germany[3]	1989	21 309.7	346.8	758.9	4.5
Greece	1990	1 292.8	128.8	334.7	22.1
Iceland	1990	98.5	394.0	780.9	33.6
Ireland	1988/89	880.3	248.8	1 001.5	12.5
Italy	1989	13 901.7	241.7	519.4	13.1
Japan	1989/90	43 187.5	352.2	824.0	3.7
Luxembourg	1989	120.4	321.1	682.5	8.5
Netherlands	1989	3 970.0	268.9	593.3	7.4
New Zealand	1989/90	1 367.7	411.2	942.1	19.7
Norway	1989	2 066.7	490.8	969.9	9.8
Portugal	1988	1 026.4	99.6	492.9	21.2
Spain	1990	8 117.0	208.1	560.1	14.4
Sweden	1988	3 732.4	442.3	654.8	15.3
Switzerland	1989	4 286.6	642.5	1 132.6	5.0
Turkey	1988	1 254.4	23.2	254.9	78.4
United Kingdom	1989/90	22 427.7	393.0	884.3	10.7
United States	1990	162 660.0	653.8	1 338.7	7.7
OECD		334 492.3	402.1	922.5	n.a.

n.a.: Not available.
1. Not corrected for inflation.
2. Growth rate not meaningful due to introduction of VAT.
3. Western Germany only.
Sources: OECD Questionnaire, ITU, PTO annual reports.

Figure C14. **Broadcasting revenues per inhabitant, per set and as a percentage of telecommunications revenues**

	Year	Broadcasting revenues (US$ million)	Revenue per inhabitant (US$)	Revenue per set (US$)	Broadcasting revenues as per cent of telecom[1]
Australia	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	1987	349.4	46.0	125.3	16.4
Belgium	1988	350.2	35.4	107.5	16.4
Canada	1987	1 599.0	61.7	107.4	15.5
Denmark	1984	114.0	22.2	51.5	16.7
Finland	1985	310.9	62.9	130.1	27.2
France	1986	1 604.4	28.7	86.9	27.8
Germany[2, 3]	1985	4 224.9	68.7	187.3	33.7
Greece	1985	20.4	2.0	11.7	4.1
Iceland	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	1984/85	75.5	21.3	91.4	20.3
Italy	1986	5 233.3	91.1	356.3	72.1
Japan	1990	13 439.4	109.6	188.0	31.1
Luxembourg[3]	1985	164.7	439.2	1 176.4 [4]	282.7
Netherlands	1985	239.6	16.2	35.0	12.1
New Zealand	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	1985	174.1	41.3	102.4	15.3
Portugal	1987	131.5	12.8	80.9	15.3
Spain	1986	677.0	17.4	47.3	19.8
Sweden	1986	344.4	40.8	104.6	13.6
Switzerland	1990	418.9	62.3	159.3	9.8
Turkey	n.a.	n.a.	n.a.	n.a.	n.a.
United Kingdom	1986	2 374.1	41.6	96.3	22.0
United States	n.a.	n.a.	n.a.	n.a.	n.a.
OECD (19 countries)		31 845.7	63.0	150.7	n.a.

n.a.: Not available.
1. Broadcasting and telecommunications revenues in same year.
2. Western Germany only.
3. Includes radio revenues.
4. Includes revenues from foreign broadcasts.

Figure C15. **Cross-ownership and cross-sectoral service provision**

	Cross-ownership	Involvement of PTO in cable TV	Involvement of PTO in other TV	Involvement of Broadcasters in telecommunications
Australia	Via Govt.	No cable TV in Australia	Transmission network (Telecom Australia). Satellite TV (AUSSAT)	No
Austria	Via Govt.	No	No	No
Belgium	No	Inter-regional and Satellite links	Programme exchange and satellite TV	No
Canada	Via Rogers Inc.	Structurally separated; limited to pilot projects	Satellite TV transmission	Limited provision of data communications, leased lines, videotex and mobile services
Denmark	Joint ventures	Widescale involvement esp. for inter-regional transmission via Hybrid Network	PTOs provide transmission TV network and satellite links	No
Finland	No formal restrictions	PTOs compete in cable TV with private companies	PTOs provide programme exchange and satellite TV	One CATV company offers programme exchange and data communications
France	Via Govt. and via France Télécom and its holding companies	Monopoly provision until 1986; now competitive	Satellite TV, and 51% ownership of TDF	TDF is involved in radiopaging
Germany	DBP Telekom has minority shareholdings in some CATV companies	24% share in RKS/TKS companies	Satellite TV	No
Greece	Via Govt.	Monopoly provision (in theory)	No	No
Iceland	Via Govt.	Monopoly	Satellite TV	No
Ireland	Via Govt. and Cable-link joint venture	Competitive participation esp. through joint ventures	No	No
Italy	Via IRI STET Group	No restrictions	No	No

Figure C15. **Cross-ownership and cross-sectoral service provision** *(cont'd)*

	Cross-ownership	Involvement of PTO in cable TV	Involvement of PTO in other TV	Involvement of Broadcasters in telecommunications
Japan	Some Type I and Type II carriers	NTT is prevented but other carriers are involved	Satellite TV provided by some Type I carriers	Some involvement in data communications, telemetry and leased lines e.g. LakeCity CableVision, TTNet
Luxembourg	No	Until 1992, P&T acts as licensing authority	Re-broadcasting and SMATV	No
Netherlands	Via Nozema and Cazema, subsidiaries of Netherlands PTT	Via Cazema	Until 1989, via Nozema for broadcast TV. Continuing PTO monopoly for SMATV	Nozema may enter datacasting and mobile markets
New Zealand	Via TVNZ and US RBOCs	No restrictions	Some involvement in SMATV and DBS. Bell Atlantic and Ameritech have shares in Sky TV.	BCL has licence for mobile services and may provide microwave lines
Norway	Via Govt.	NT's cable TV division has been hived off into a limited company	Provision of transmission facilities and DBS. Also datacasting via second broadcast TV network	No
Portugal	Via Govt.	Under discussion	Under discussion	No
Spain	No restrictions	Monopoly until 1987; now competitive	Some involvement in SMATV	No
Sweden	Via Televerket and Kinnevik	Televerket competes in open market	Operation, but not construction or planning, of transmitter network. Involvement in DBS	Kinnevik operates mobile services, and (soon) fixed link services
Switzerland	Via joint ventures	PTO involved in CATV networks in Basle & Geneva	Full involvement for broadcast TV transmission and SMATV	No

Figure C15. **Cross-ownership and cross-sectoral service provision** *(cont'd)*

	Cross-ownership	Involvement of PTO in cable TV	Involvement of PTO in other TV	Involvement of Broadcasters in telecommunications
Turkey	Via Govt.	No	International programme exchange	No
United Kingdom	Via CATV companies	Not before 1997 over main network	Marketing of transponders for ASTRA	CATV companies provide telephony. Satellite TV and broadcast TV companies provide datacasting. No restrictions after 1991.
United States	Structurally separated	Pilot projects only	No	No

Note: For more details, see the relevant country chapters in Part B.
Source: OECD convergence study.

Part D

BACKGROUND INFORMATION

Figure D1. **Annual average exchange rates 1988-90 in US Dollars**

	1988	1989	1990
Australia	1.27 991	1.26 460	1.27 944
Austria	12.34 770	13.23 070	11.44 909
Belgium	36.76 830	39.40 400	33.64 500
Canada	1.23 071	1.18 399	1.16 739
Denmark	6.73 150	7.31 020	6.22 830
Finland	4.18 283	4.29 122	3.84 352
France	5.95 690	6.38 010	5.47 970
Germany	1.75 623	1.88 004	1.62 698
Greece	141.86 100	162.41 700	158.78 300
Iceland	43.01 400	57.04 180	58.58 720
Ireland	0.65 647	0.70 554	0.60 868
Italy	1 301.62 000	1 372.09 000	1 204.76 000
Japan	128.15 000	137.96 000	145.81 000
Luxembourg	36.76 830	39.40 400	33.64 500
Netherlands	1.97 658	2.12 074	1.83 325
New Zealand	1.52 640	1.67 215	1.67 641
Norway	6.51 698	6.90 450	6.29 599
Portugal	143.95 400	157.45 800	143.49 600
Spain	116.48 700	118.37 800	102.54 300
Sweden	6.12 715	6.44 688	5.94 654
Switzerland	1.46 330	1.63 590	1.39 930
Turkey	1 422.35 000	2 121.68 000	2 587.94 000
United Kingdom	0.56 217	0.61 117	0.56 720
United States	1.00 000	1.00 000	1.00 000

Source: OECD.

Figure D2. **Population size, Gross Domestic Product, and GDP per capita in US$ 1989**

	Population, 1989 (thousands)	GDP, 1989 (US$ billion)	GDP per capita 1989 (US$)
Australia	16 807	282.9	16 832
Austria	7 624	126.7	16 619
Belgium	9 938	151.4	15 234
Canada	26 248	545.6	20 786
Denmark	5 132	105.3	20 518
Finland	4 964	114.7	23 106
France	56 160	948.5	16 889
Germany	61 990	1 200.2	19 361
Greece	10 033	53.8	5 362
Iceland	253	5.2	20 553
Ireland	3 515	32.7	9 303
Italy	57 525	864.0	15 020
Japan	123 116	2 812.1	22 841
Luxembourg	378	6.6	17 460
Netherlands	14 849	225.0	15 153
New Zealand	3 343	40.5	12 115
Norway	4 227	93.1	22 025
Portugal	10 337	45.2	4 373
Spain	38 888	376.3	9 677
Sweden	8 493	189.3	22 289
Switzerland	6 723	174.4	25 941
Turkey	55 255	81.6	1 477
United Kingdom	57 236	831.6	14 529
United States	248 777	5 165.8	20 765
OECD	831 811	14 472.5	17 399

Source: OECD.

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Glossary

A2	–	Antenne 2 (French TV channel)
ABC	–	American Broadcasting Company
ABC	–	Australian Broadcasting Commission
AIEP	–	Swiss Independent Authority for complaints concerning TV and radio broadcasts
AMPS	–	Advanced (or American) Mobile Phone System
ANB	–	Asahi National Broadcasting Company (Japan)
AOTC	–	Australian and Overseas Telecommunications Corporation Ltd (Australian PTO)
ARD	–	Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland (German broadcasting organisation)
ASST	–	Azienda di Stato per i Servizi Telefonici (Italy)
ATIEP	–	Association of Telephone Information and Entertainment Providers (UK industry association)
ATM	–	Asynchronous Transfer Mode switching
ATM	–	Automatic Teller Machine
AT&T	–	American Telegraph and Telephone (US long distance and international PTO)
AUSSAT	–	Australian satellite carrier and second operator
AUSTEL	–	Australian regulatory body
BBA	–	Belgian Broadband Association
BCNZ	–	Broadcasting Corporation of New Zealand (New Zealand)
BIDS	–	Broadband Integrated Distribution Star
BOT	–	Build-operate-transfer scheme for telecommunications network development
bpi	–	Bits per inch (storage memory density on magnetic tape)
BRT	–	Belgische Radio en Televisie (Belgium)
BSB	–	British Satellite Broadcasting (former satellite TV company now merged with Sky Television to form BSkyB).
BSkyB	–	British Sky Broadcasting (satellite TV company)
BT	–	British Telecom (UK PTO)
BTX	–	Bildschirmtext (videotex standard)
BUNI	–	Broadband Network/User Interface (EC RACE project)
CAGR	–	Compound Annual Growth Rate
CAI	–	Common Air Interface for CT2 services (technical standard for telepoint services in the UK)
CAPTAIN	–	Character and Pattern Telephone Access Information Network (Japanese videotex system)
CATV	–	Cable Television (also Community Access Television)

C&W	–	Cable and Wireless (UK-based international operator)
CBC	–	Canadian Broadcasting Corporation
CBS	–	US broadcasting organisation
CCD	–	Charged Coupled Devices
CCIS	–	Coaxial Cable Information System (Japan)
CCITT	–	International Telephone and Telegraph Consultative Committee (subsidiary body of the ITU)
CCTA	–	Canadian Cable Television Association (Canada)
CD	–	Compact Disc
CD-ROM	–	Compact Disc – Read-only Memory
CEC	–	Commission of the European Communities
CEDITC	–	Communications Institutional and Technological Development Study (Portugal)
CEPT	–	Conference of European Postal and Telecommunications Administrations
CLT	–	Compagnie Luxembourgeoise de Télévision (Luxembourg)
CNCL	–	Commission Nationale Communication et Libertés (France)
CNCP	–	Canadian carrier, now renamed Unitel
CNET	–	Centre National d'Etudes des Télécommunications (France)
CORSI	–	Italian language Swiss TV station
CPE	–	Customer Premises Equipment
CPRM	–	Companhia Portuguesa Rádio Marconi (Portugal)
CRT	–	Cathode Ray Tube
CRTC	–	Canada Radio-television and Telecommunications Commission
CT2	–	Cordless Telephone standard (Telepoint), also CT1 and CT3
CTT	–	Correios e Telecomunicacoés de Portugal (now Telecom Portugal)
D2-MAC	–	Interim European standard for high definition television
DAMPS	–	Digital Advanced (or American) Mobile Phone System
DBP	–	Deutsche Bundespost (German PTO)
DBS	–	Direct Broadcast by Satellite
DCS	–	Belgian packet-switched network
DCSR	–	Direzione Centrale Servizi Radioelettrici (Italy)
DCST	–	Direzione Centrale Servizi Telegrafici (Italy)
DDI	–	Daini Denden Inc. (Japanese new common carrier)
DECT	–	Digital European Cordless Telephone (technical standard)
DGCT	–	Dirección General de Correos y Telegrafos (Spain)
DGSC	–	Directorate General for Social Communications (Portuguese broadcasting regulatory body)
DOCAT	–	Digital Optic Cable TV network, also known as the Hybrid Network (Denmark)
DRG	–	Direction de la Réglementation Générale (French regulatory body)
DTI	–	Department of Trade and Industry (New Zealand, UK)
EDI	–	Electronic Data Interchange
EFT	–	Electronic Funds Transfer
ETCO	–	European Telecommunications Consultancy Organisation
ETSI	–	European Telecommunications Standards Institute
EUCOM	–	Joint venture in VANS provision between DBP and France Télécom
EUTELSAT	–	European satellite organisation
EVS	–	European Video-conferencing System, also European video-conferencing experiment (EVE)
Fax	–	Facsimile terminal or service
FCC	–	Federal Communications Commission (US regulatory authority)

FDDI	–	Fibre Distributed Data Interface
FR3	–	France Regional 3 (French TV channel)
FSS	–	Fixed Satellite Service (CCITT service category)
FT	–	Funen telephone company (Fyns Telefon – Denmark)
GBE	–	Government Business Enterprise (Australia)
GDP	–	Gross Domestic Product
GEIS	–	General Electric Information Service (US international VANS provider)
GHz	–	Gigahertz (measure of transmission speed/bandwidth)
GPO	–	General Post Office (former UK operator)
GPT	–	GEC Plessey Telecom (UK/German based manufacturer)
GSM	–	Groupe Spécial Mobile (digital cellular radio standard)
G3	–	Group 3 fax standard (CCITT-defined). Also G1, G2 and G4
GTV	–	General TV (Japan)
HCATS	–	High Capacity Telephone System (Japan)
HDTP	–	Department for Telecommunications and Posts (Netherlands)
HDTV	–	High definition television
HNBI	–	Hellenic National Broadcasting Institute (Greece)
IBA	–	Independent Broadcasting Authority (UK)
IBM	–	International Business Machines Corp. (US)
IBPT	–	Belgian Institute for Posts and Telecommunications
IC	–	Integrated Circuit
ICCP	–	Information, Computer and Communications Policy Committee of the OECD
ICL	–	International Computers Ltd. (UK/Japan)
ICP	–	Instituto des Communicaçoés de Portugal (Portugal)
ICSTIS	–	Independent Committee for the Supervision of Telephone Information Systems (UK)
IDC	–	International Digital Communications (Japanese international carrier)
IDN	–	Integrated Digital Network
IEEE	–	Institute of Electrical and Electronic Engineering (US standards body)
IN	–	Intelligent network
INMARSAT	–	International maritime satellite organisation
INS	–	Information Network System; Japanese form of ISDN
INTELSAT	–	International satellite organisation
IRI	–	Instituto per la Ricostruzione Industriale (Italian industrial holding company)
IRTC	–	Independent Radio and Television Commission (Ireland)
ISDN	–	Integrated Services Digital Network
ITC	–	Independent Television Commission (UK broadcasting regulatory body)
ITJ	–	International Telecom Japan (Japanese international carrier)
ITU	–	International Telecommunication Union
ITV	–	Independent Television (UK)
IXC	–	Inter-exchange carrier (US)
JCSat	–	Japan Communications Satellite Co. Inc. (Japan)
JTAS	–	Jutland telephone company (Jydsk Telefon Aktieselskab – Denmark)
kbit/s	–	Kilobits per second (measure of bandwidth or transmission speed)
kHz	–	kilohertz (frequency)
KDD	–	Kokusai Denshin Denwa (Japanese international carrier)

KTAS	–	Copenhagen telephone company (Københavns Telefon Aktieselskab – Denmark)
LAN	–	Local Area Network
LATA	–	Local Access and Transport Area (US)
LEC	–	Local Exchange Carrier (US)
LOT	–	Ley de Ordenación Telecommunicaciones (Spanish telecommunications law)
LPTV	–	Low Power Television
LRTV	–	Swiss federal law on radio and television
MAC	–	Multiplexed Analogue Component; family of European HDTV standards
MAN	–	Metropolitan Area Network
MATV	–	Master Antenna TV serving an apartment block or small community from a single aerial (see also SMATV)
Mbit/s	–	Megabits per second (measure of bandwidth or transmission speed)
MCCSS	–	Medium Capacity Cell Size System (Japanese cellular technology)
MCI	–	Microwave Communications Inc. (US carrier)
MCL	–	Mercury Communications Ltd (second UK operator)
MFJ	–	Modified Final Judgement (US regulatory decision)
MHz	–	Megahertz (measure of transmission speed/bandwidth)
MITI	–	Ministry of International Trade and Industry (Japan)
MMDS	–	Microwave Multi-channel (and/or Multipoint) Distribution System (for TV broadcasting)
MPT	–	Ministry of Posts and Telecommunications (Japan and other countries)
MPTE	–	Ministère des Postes, des Télécommunications et de l'Espace (France)
MSO	–	Multiple System Operator (US term for large cable TV companies)
MUSE	–	Multiple Sub-Nyquist Sampling Encoder (Japanese HDTV standard)
MWHC	–	Ministry for Welfare, Health and Culture (Netherlands)
NAB	–	National Association of Commercial Broadcasters in Japan (Japan)
NAC	–	National Advisory Council (Norway)
NAMTS	–	Nippon Automobile Telephone System (Japanese cellular technology)
NBBP	–	National Board of Building and Planning (Sweden)
NBC	–	US broadcasting network
NCC	–	New Common Carrier (generic term)
NCR	–	National Cash Register Corp. (US)
NCS	–	Service Nationale de Contrôle du Spectre (Belgium)
NHK	–	Nippon Hoso Kyokai (Japanese public broadcasting organisation)
NMT	–	Nordic Mobile Telephone (analogue cellular radio standard)
NORDTEL	–	Nordic Telecommunications Consortium
NOS	–	Nederlandse Omroep Stichting (Netherlands)
NOZEMA NV	–	Netherlands Broadcast Transmitter Company (Netherlands)
NRK	–	Norsk rikskring kasting (Norwegian broadcasting organisation)
NT	–	Norwegian Telecom
NTA	–	National Telecom Agency (Denmark)
NTA	–	Norwegian Telecommunications Administration (now Norwegian Telecom)
NTI	–	Norwegian Telecom International (Norway)
NTIA	–	National Telecommunications and Information Administration (US body)
NTRA	–	Norwegian Telecommunications Regulatory Authority
NTSC	–	National Television Standards Commission (US)
NTT	–	Nippon Telegraph and Telephone Corporation (Japanese domestic carrier)
NTV	–	Nippon Television Network Corporation (Japan)

OECD	–	Organisation for Economic Co-operation and Development
OFCOM	–	Federal office of communication (Swiss regulatory body)
OFTEL	–	Office of telecommunications (UK telecommunications regulatory body)
ONA	–	Open Network Architecture (US)
OND	–	Open Network Doctrine (Japan)
ONP	–	Open Network Provision (CEC)
OPAL	–	Optical Line Access
OPT	–	Osterreichische Post und Telegraphverwaltung (Austrian PTO)
ORF	–	Österreichischer Rundfunk (Austrian broadcasting organisation)
OTC	–	Australian overseas carrier
OTE	–	Hellenic Telecommunication Organisation S.A. (Greece)
P&T	–	Post and Telephone Administration (generic term)
PACTS	–	Public Access Cordless Telephone Services (Australian term)
PAD	–	Packet Assembler/Disassembler Device used in an X.25 network
PAL	–	Phase Alternation by Line (TV standard)
PBS	–	Public Broadcasting System (US)
PBX	–	Private Branch Exchange; also PABX – Private Automatic Branch Exchange
PC	–	Personal Computer
PCM	–	Pulse Code Modulation
PCN	–	Personal Communications Network (Mobile telecommunications standard – see also UPMS)
PMR	–	Public Mobile Radio
PMTS	–	Public Mobile Telephone Service (Australia)
PPV	–	Pay-per-view (TV service)
PSDN	–	Packet-Switched Data Network (X.25 standard)
PSES	–	Private Satellite Earth Station (Australian term)
PSTN	–	Public Switched Telephone Network
PTO	–	Public Telecommunications Operator (generic term)
PTT	–	Post Telegraph and Telephone administration (generic term)
PUCS	–	Public Utility Commissions, state level regulators for telecommunications in the USA
R^2	–	R squared; a measure of linear correlation in ordinary least squares simple regression
RACE	–	Research and Development in Advanced Communications Technologies in Europe
RAI	–	Radiotelevisione Italiana (Italy)
RAPT	–	Netherlands Post and Telecommunications Council
RBOCs	–	Regional Bell Operating Companies (US regional PTOs): even though this term is generally accepted and is used throughout this report, it is more technically correct to use the term Regional Holding Companies (RHCs) of which seven were created to own the 22 Bell Operating Companies (BOCs).
RBTF	–	Radio Télévision Belge Française (Belgium)
R&D	–	Research and Development
RCTS	–	Remote Commercial Television Service (Australian term)
RDRS	–	German language Swiss TV station
RFD	–	Rete Fonia-Data (Italian telecommunications network)
RKS	–	Regionale Kabel-Servicegesellschaften (German regional cable operator)
RMC	–	Radio-télé Monte Carlo
ROCs	–	Regional Operating Companies (New Zealand, Finland, Denmark)
RTE	–	Radio Telefis Eireann (Irish broadcasting organisation)

RTL – Radio-télé Luxembourg
RTMI – Integrated Mobile Telephone and Paging Service (Italy)
RTMS – First generation Italian cellular radio technology
RTP – Radio Televisao Portuguesa (Portuguese broadcasting organisation)
RTT – Régie des Télégraphes et Téléphones (Belgian PTO)
RTVE – Radio Television España (Spanish broadcasting organisation)

SAO – Signatory Affairs Office (UK body for international satellite issues)
SAP – Société anonyme pour la Publicité à la Télévision (Switzerland)
SBS – Special Broadcasting Services (Australian classification)
SCC – Space Communications Corporation (Japanese satellite carrier)
SECAM – Séquence Couleur à Mémoire (TV standard)
SES – Société Européenne des Satellites (Luxembourg)
SIP – Societá Italiana per l'Esercizio delle Telecommunicazione (Italian PTO)
SFR – Société Française du Radio Téléphone (France)
SJT – South Jutland Telecom (Tele 20 Sonderjylland – Denmark)
SMATV – Satellite Master Antenna TV (satellite dish serving apartment block or small community)
SMSA – Standard Metropolitan Statistical Area (US)
SONET – Synchronous Optical Network
SR – Sveriges Radio (Swedish broadcasting organisation)
SRG – Schweizerische Radio-und Ferngesellschaft (Swiss broadcasting organisation)
SRTR – French language Swiss TV station
SSR – Société Suisse de Radiodiffusion (Switzerland)
SSSO – Specialised Satellite Service Operator (UK term)
ST – Telecom Denmark (Statens Telejeneste – Denmark)
STET – Società Finanziaria Telefonica (Italian holding company)
STN – National Telecommunications Council (Sweden)
STV – Sveriges Television (Sweden)

TAC – Telecommunications Administration Centre (Finland)
TACS – Total Access Communication System (cellular radio technology)
Tele2 – Second Swedish national carrier
TBK – Televerkets Bedrifts Kommunikasjon (Cable TV Division of the Norwegian PTT)
TBSL – Tokyo Broadcasting System Inc. (Japan)
TDF – Télédiffusion de France
TDF-1 – Télédiffusion de France 1 satellite (also TDF-2)
Telco – Telephone company or privately-owned PTO (North American term)
TEPC – Tokyo Electric Power Company (Japan)
TI – Telecom Inspectorate (Teleinspektionen – Denmark, now superceded by National Telecom Agency)
TI – Telefónica Internacional (Spain)
TKS – Telepost Kabel-Servicegesellschaften (German cable TV organisation)
TLP – Telefones de Lisboa e Porto (Portugal)
TP – Telecom Portugal (formerly CTT)
TRT – Turkish Radio and Television
TSB – Telephone Subscriber Bond (Japanese term)
TTNet – Tokyo Tsushin Network (Japanese carrier)
TV – Television
TVNZ – Television New Zealand (New Zealand)
TVRO – Television receive-only satellite dish (Antennae)

UHF	–	Ultra High Frequency (radio-based transmission channel)
UNESCO	–	United Nations Educational, Social and Cultural Organisation
UPMS	–	Universal Personal Message System (see also PCN)
USOs	–	Universal Service Obligations
VADS	–	Value-added and Data Services
VANS	–	Value-added Network Services
VAT	–	Value-added Tax
VCR	–	Video Cassette Recorder
VHF	–	Very High Frequency (radio-based transmission channel)
VIP	–	Visual, Intelligent and Personal (Japanese service vision)
VLSI	–	Very Large-Scale Integration semiconductor
VPN	–	Virtual Private Network
VSAT	–	Very Small Aperture Terminal (satellite dish for telecommunications)
WAN	–	Wide Area Network
WARC	–	World Administrative Radio Conference
WATTC	–	World Administrative Telephone and Telegraph Conference
WORM	–	Write Once Read Many times; computer disc
ZDF	–	Zweites Deutsches Fernsehen (German broadcasting organisation)

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