New Telecommunications Services

BUTLER COX FOUNDATION

Research Report 78, December 1990

BUTLER COX FOUNDATION

New Telecommunications Services

Research Report 78, December 1990

Butler Cox plc

LONDON
AMSTERDAM MUNICH PARIS

Published by Butler Cox plc
Butler Cox House
12 Bloomsbury Square
London WC1A 2LL
England

Availability of reports
Members of the Butler Cox Foundation receive three copies of each report upon publication; additional copies and copies of earlier reports may be purchased by members from Butler Cox.

Photoset and printed in Great Britain by Flexiprint Ltd., Lancing, Sussex.

BUTLER COX FOUNDATION

New Telecommunications Services

Research Report 78, December 1990

Contents

A Management Summary of this report has been published separately and distributed to all Foundation members. Additional copies of the Management Summary are available from Butler Cox.

Report synopsis

Telecommunications costs are increasing, and represent a significant item of corporate expenditure for most organisations, yet corporate telecommunications services often fail to meet all the requirements of the business. The gap between user expectations and the adequacy of corporate telecommunications services is growing as application needs become more demanding and more geographically distributed. In the next five years, five new telecommunications services — new mobile services, intelligent networks, integrated services digital network (ISDN), metropolitan area networks, and VSAT satellite services — will play a very significant role in providing a flexible corporate communications infrastructure that can respond dynamically to the demands placed on it. The successful use of these new services will depend, to a large extent, on the ability of the telecommunications function to work closely with the systems department and its customers — the business managers — to define and build applications that will exploit these services.

Chapter 1

Five new ways of delivering telecommunications services

Organisations today are faced with a wide range of telecommunications requirements. At present, these requirements are usually met by a variety of separate networks for voice and data, based on a mixture of private and public telecommunications facilities. Local area networks are increasingly being used to provide high bandwidth communications within buildings and across sites, and there is a growing requirement to interlink such sites with minimum loss of performance. New ways of doing business also require that electronic links — often termed electronic data interchange — be provided with suppliers and customers.

Many organisations perceive public telecommunications services to be expensive and inadequate, and have therefore chosen to meet as many of their telecommunications requirements as possible by providing private networks and facilities. As a consequence, the corporate communications infrastructure comprises a complex mixture of private and public facilities. Moreover, the complexity has increased as telecommunications traffic and user demands have increased, and many organisations now have to employ highly skilled and expensive staff who are able to understand and manage their corporate network(s). Indeed, staff costs can, in some countries, now represent as much as 40 per cent of the telecommunications budget. Large amounts also have to be invested in sophisticated and complex equipment. The net result is that total telecommunications costs are increasing and represent a significant item of corporate expenditure. The telecommunications manager is under increasing pressure both to reduce costs and to improve the facilities available to the business.

Despite the increasing expenditure, the corporate telecommunications infrastructure in many organisations does not meet all the requirements. In particular:

- The performance of existing networks is inadequate, both in terms of the transmission quality and the bandwidth available. There is a growing demand for applications that require increasing levels of bandwidth.
- The existing infrastructure is inflexible in that it takes a long time to modify the network or to provide new facilities. In today's fast-changing business environment, an inflexible communications infrastructure is often a competitive disadvantage.
- Existing private networks were designed for intra-organisation communications. This means that it can be difficult to extend the 'reach' of the networks to customers and business partners, particularly if their networks are based on different standards.

The purpose of this report is to identify those new telecommunications services that will help to overcome these difficulties and that will be publicly available by the mid-1990s.

In the past, the provision of public telecommunications services has been highly regulated, with each national government owning (or licensing) a PTT as the monopoly supplier of these services. (In this report, we refer to providers of public telecommunications services as PTTs — Postal, Telegraph, and Telephone Administrations — even though this term is increasingly a misnomer; it is, however, the most widely accepted term.) Governments are realising that this arrangement may not provide businesses with the telecommunications services that they require to compete in today's fast-changing business environment. Many are therefore weakening the PTTs' traditional monopolies and forcing them to operate in a more competitive environment. Liberalisation of the market has removed much of the bureaucracy and has made way for new entrepreneurial suppliers of equipment and services. At the same time, technological developments are enabling new types of services to be offered to users, and the PTTs are positioning many of these services as cost-effective replacements for private-network facilities.

Sometimes, the threat of competition can be almost as effective as the reality. Seeing a trend towards deregulation elsewhere, some PTTs (France Telecom, for example) have adopted aggressive and innovative strategies for new services, either as a means of heading off potential competitors and of persuading their governments that major changes in the regulatory environment are not required, or as a way of securing a dominant position when competition is allowed.

Organisations need some form of 'filter' to identify which of the wide range of new services will be of most significance in planning their communications infrastructure for the mid-1990s and beyond. (The planning horizon for such an infrastructure is usually five years or longer.) The infrastructure should provide sufficient bandwidth to allow corporate users to access applications in a very similar way, and with equivalent performance, regardless of whether they are in the next room to the computer, or in a different office (which could be in the same city or a different country), or even at home. It should be flexible enough to allow the networks to be reconfigured quickly as business requirements change, and to enable new facilities to be added. It should also provide access to a wide range of telecommunications facilities — terrestrial, mobile, and satellite.

We began our research by reviewing all of the developments in new telecommunications services likely to occur between 1991 and 1996. (Figure 1.1 summarises the research we carried out.) In choosing the services to study in detail, we selected those that were most likely to play a significant role in providing the flexible corporate communications infrastructure described above. Using this criterion, we identified the five new telecommunications services that are, or will become, significant for Foundation members by the mid-1990s. For each of the selected services, we set out to define its function, to assess its likely benefits to user organisations, to identify possible problem areas (particularly in the areas of tariffs, standards, and regulations), to give a good estimate of when it might be available, and to assess possible developments beyond 1996.

Some of these services are already available, particularly in countries with fairly liberalised telecommunications environments. Their experiences indicate how these services might eventually develop elsewhere. Others are still at an early stage of development, and we sought the views of industry observers before formulating our own opinion about how they will eventually be applied. The five selected services are listed below; the scope of these services, and the ways in which they compete with and complement each other, are shown in Figure 1.2:

— *New mobile services*. Mobile communications can be established and reconfigured quickly and easily. A bewildering array of new mobile services is becoming available, but the most important development since our last report on this subject (Report 68, published

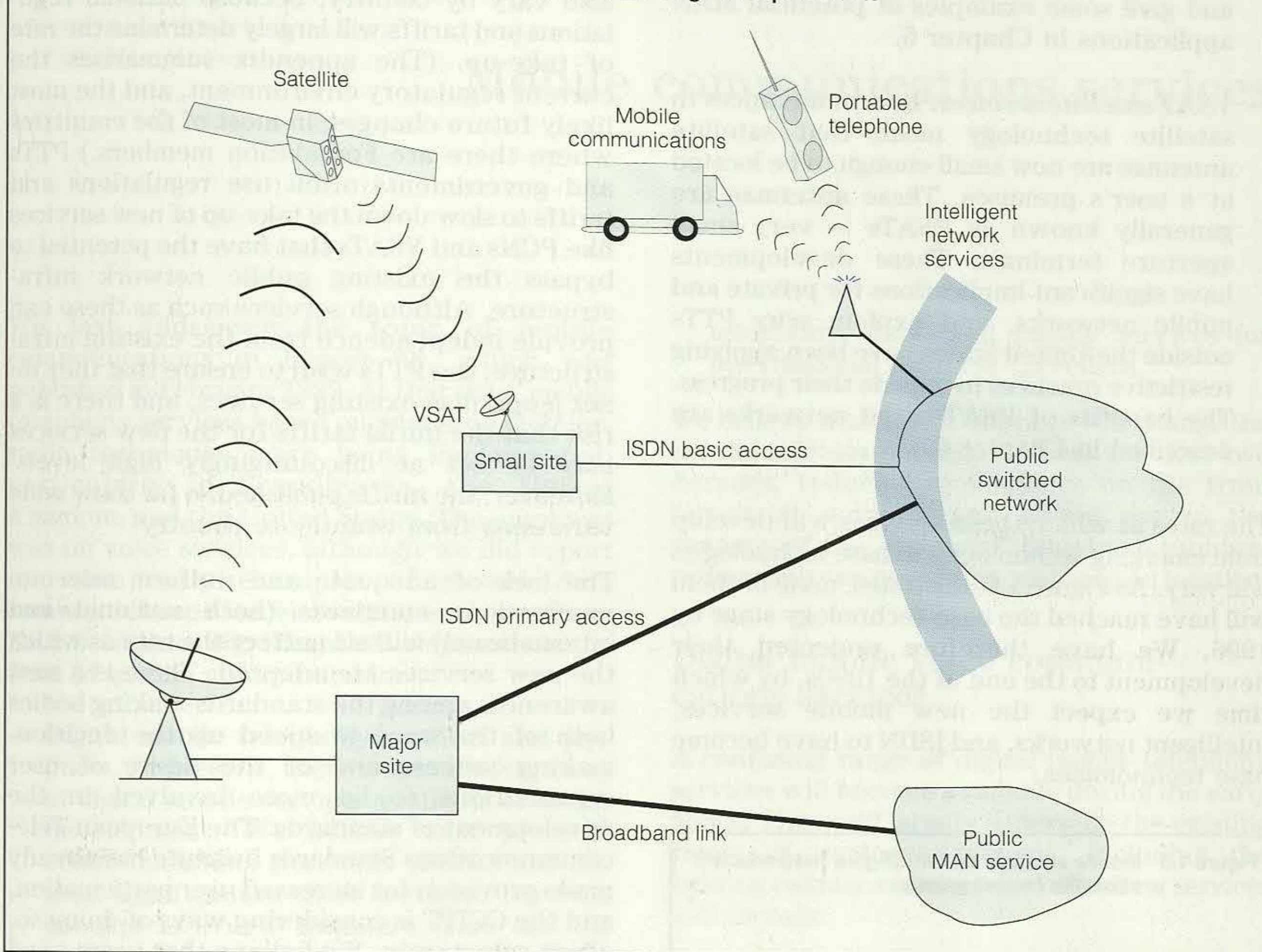
Figure 1.1 Research team and scope of the study

The research for this report was led by Bernard Clements, a consultant based in Butler Cox's Paris office. He was assisted by Edward Vulliamy, Janet Cohen, and Paul Turton, all consultants with Butler Cox in London. Further research was carried out by Onno Schroder (Amsterdam), Lothar Schmidt (Munich), John Cooper (Sydney), Antonio Morawetz (Milan), Hakan Henriksson (Stockholm), Francisco Hornos (Madrid), Roy Dohoo (Ottawa), and Warren Waldbrand (New York).

To obtain the views of Foundation members, and to help formulate the scope of the research, we circulated a document outlining what we saw as the principal issues that needed to be addressed. The 77 replies generally confirmed our proposed coverage, some suggesting additional lines of research, and others helping to focus the research on the areas of greatest concern to most Foundation members. Our selected approach was to identify the new services planned for the period 1991 to 1996, and to assess whether they had enough potential to warrant further investigation and inclusion in the research.

The research was carried out between March and October 1990. During this period, we interviewed users, telecommunications equipment suppliers, PTTs, and government and regulatory agencies around the world. In all, we talked to some 65 organisations, either in face-to-face meetings, or over the telephone. We should like to extend our thanks to those who gave generously of their time to help with our research.

Figure 1.2 New telecommunications services will meet a wide range of requirements



in February 1989) is the UK initiative on personal communications networks (PCNs). If current market projections are realised, PCNs will bring about a revolution in telecommunications. The pocket telephone could well become as necessary an item of personal equipment as the wristwatch is today. We describe the development of PCNs and other mobile voice services in Chapter 2, as well as recent progress in mobile data communications.

— *Intelligent networks*. By adding computing and database facilities to public-network architectures, PTTs can offer communications services and facilities to rival and improve on those provided by private PABXs and data networks, providing greater flexibility at less cost. In Chapter 3, we explain what these services are and give some examples of successful implementations.

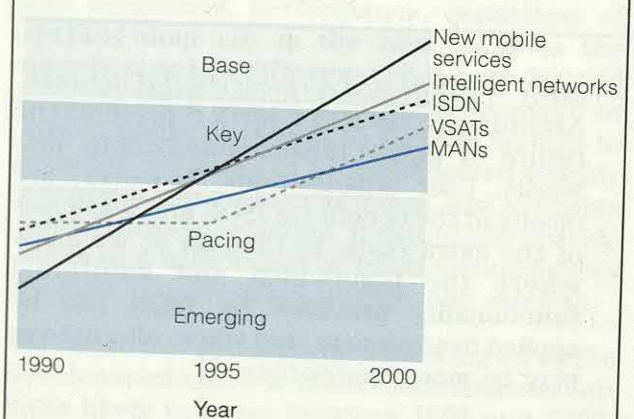
— *ISDN — integrated services digital network*. According to the PTTs, ISDN represents the future of public telecommunications networks. User organisations, however, are unsure of the benefits of ISDN and suspicious of the extra costs. In Chapter 4, we show where the bandwidth and additional functionality provided by ISDN can be applied to advantage, and where alternatives may be more appropriate.

— *Metropolitan area networks*. The increasing demand for high bandwidth services, initially for interconnections between local area networks, is leading to the development of telecommunications services that are radically different from those traditionally provided by public networks. Currently, there is a confusing variety of technical solutions, all of which come under the collective heading of metropolitan area networks (MANs). We unravel the confusion and give some examples of potential MAN applications in Chapter 5.

— *VSAT satellite services*. Recent advances in satellite technology mean that satellite antennae are now small enough to be located at a user's premises. These antennae are generally known as VSATs — very small aperture terminals. These developments have significant implications for private and public networks, and explain why PTTs outside the United States have been applying restrictive practices to impede their progress. The benefits of VSAT-based networks are described in Chapter 6.

The rates at which these services will develop from emerging technologies to base technologies will vary. As Figure 1.3 illustrates, none of them will have reached the base-technology stage by 1996. We have therefore projected their development to the end of the 1990s, by which time we expect the new mobile services, intelligent networks, and ISDN to have become base technologies.

Figure 1.3 Mobile services and intelligent networks will show the fastest growth



Base technology is in widespread use in organisations. It is an essential business tool.
Key technology is proven, and market leaders use it to gain competitive advantage.
Pacing technology is used for pilot systems.
Emerging technology is still at the laboratory stage, although there may be a few prototype uses.

The rates of growth of a particular service will also vary by country, because national regulations and tariffs will largely determine the rate of take-up. (The appendix summarises the current regulatory environment, and the most likely future changes, in most of the countries where there are Foundation members.) PTTs and governments often use regulations and tariffs to slow down the take-up of new services like PCNs and VSATs that have the potential to bypass the existing public network infrastructure. Although services such as these can provide independence from the existing infrastructure, the PTTs wish to ensure that they do not jeopardise existing services, and there is a risk that the initial tariffs for the new services may be set at discouragingly high levels. Moreover, the tariffs published so far show wide variations from country to country.

The lack of adequate and uniform telecommunications standards (both national and international) will also affect the rate at which the new services are adopted. There is a new awareness among the standards-making bodies both of the need to speed up the decision-making process and of the desire of user organisations to be more involved in the development of standards. The European Telecommunications Standards Institute has already made provision for increased user participation, and the CCITT is considering ways of doing so, albeit reluctantly. We believe that users need to be more active in the standards forums, hitherto dominated by the vested interests of PTTs and equipment suppliers.

Despite these constraining factors, we believe that the new mobile services and intelligent networks will have reached the key technology stage by 1995, followed not long after by VSATs — provided that the regulatory restrictions on the use of VSATs are lifted (and we believe that there is every possibility of this happening). ISDN and MANs, however, will remain at the pacing stage throughout most of the 1990s.

In the final chapter of the report, we assess the impact that all of these new services will have on public and corporate communications in the mid-1990s, and the way in which the role of the telecommunications function will be affected.

Chapter 2

Mobile communications services

We last addressed the topic of mobile communications in Report 68, which was published in February 1989. At that time, mobile telephony services based on analogue cellular-radio techniques were being implemented, particularly in Scandinavia, the United Kingdom, and the United States. The emphasis was on voice services, although we did report on some early examples of mobile data communications services. Since then, there have been three significant developments in the field of mobile communications:

- Digital mobile telephony services and products. At present, there is a confusing array of digital mobile services available or under development. We believe that personal communications networks (PCNs) are the most significant of these services. The PCN concept is a new initiative from the UK government. It is based on digital cellular techniques, and is aimed at creating the personal telephone of the future. The belief is that everyone will eventually carry a small pocket telephone, just as today everyone carries a wristwatch or a pocket calculator.
- Mobile data networks. Current mobile systems have been designed to handle voice communications. Although they can also be used for data communications, they are inefficient and expensive when used in this way. New mobile communications networks and services, aimed specifically at data communications, are now emerging.
- Land-mobile satellite services. Ships at sea have made use of satellite communications for some time, and airlines have recently started to provide in-flight satellite telephone services. Such services are now being extended to vehicles (and to individuals), opening up the prospect of worldwide mobile telephony, data, and paging services for international business travellers.

We believe that mobile services will change the face of telecommunications over the next two decades, reducing dependence on the fixed terrestrial network and giving rise to the concept of the 'personal' telephone number, rather than one associated with a fixed location.

Digital mobile voice communications services

A confusing range of digital mobile telephony services will become available during the early 1990s. They will largely supersede the existing range of analogue systems, including the existing cellular-radio services. The new services will include:

- Public Telepoint services, commonly called CT2 (or second-generation cordless telephones). Telepoint is being pioneered in the United Kingdom, where owners of small, personal, cordless telephones can make (but not receive) calls, provided they are within about 200 metres of an appropriate base station located in a public place such as a railway station, airport, shopping mall, or garage forecourt. CT2 telephones cost about £200 ($370).
- The pan-European digital cellular network (usually termed the GSM network after the name of the *Groupe Spécial Mobile* committee that drew up its specifications). GSM services, which are intended for voice communications with vehicles, are expected to become available in 1991/92. Initially, the services will be restricted to national boundaries. By the mid-1990s, however, a vehicle with a GSM telephone should be able to receive and transmit anywhere in Europe.

— Cordless PABXs, where radio transmission is used between the PABX and the handsets. Ericsson has developed the so-called CT3 (third-generation cordless telephone), and expects to have products available in 1992. Meanwhile, the European Telecommunications Standards Institute is developing the Digital European Cordless Telephone (DECT) standard for cordless PABXs. The standard will be ready in 1992, and products are expected to be available in 1993. Both the CT3 specification and the DECT standard are being extended so that they can be used for public Telepoint applications.

— Personal communications networks (PCNs). Services are expected to be available in 1992. The intention is that the general public will be able to own inexpensive, small (pocket-sized), portable telephones that can be used anywhere. A photograph of a PCN handset is shown in Figure 2.1.

Of these, PCNs are the most likely to have a revolutionary effect on telecommunications. PCNs offer the prospect, for the first time, of a truly portable inexpensive mobile telephone that is not constrained by the physical location of the user. PCNs will bring to telecommunications services the prospect of reaching an *individual* (via his hand-held portable telephone), rather than a *location* (with a fixed telephone).

Figure 2.1 With the advent of PCN services, the general public will be able to own inexpensive, pocket-sized, portable telephones that can be used anywhere

The origins of PCNs lie in the deregulation of telecommunications in the United Kingdom and the search for improving competition in the provision of telecommunications services at the local level (that is, between subscribers' premises and the local telephone exchange). A summary of events leading up to the decision to launch the PCN initiative is shown in Figure 2.2. The UK government has issued PCN licences to three consortia — Mercury Personal Communications (Mercury Communications Limited with Motorola, Telefónica, and US West), Unitel (STC with Thorn-EMI and DBP Telekom), and Microtel (British Aerospace with Matra, Pacific Telesis, Millicom, and Sony). The diverse list of participants demonstrates both the strong international interest aroused by the PCN concept, and the opportunity that it provides for new players to enter the communications market in an increasingly deregulated environment.

A view commonly held by PTTs and governments in continental Europe is that, in its desire to create a competitive environment, the UK government has overreacted by licensing too many different mobile communications services at the same time. Although this view may have been coloured by a desire to protect the *status quo*, we believe that there is a great deal of truth in it. If the UK government's intention is to promote the use of mobile communications by the general public, rather than by sophisticated business users, there will have to be a much clearer product/market segmentation than that envisaged by the Department of Trade and Industry. Its view is that the services will be differentiated in terms of the functionality they provide, and above all, in terms of the travelling habits of their users. As described in Figure 2.3, on page 8, first-generation cordless telephones (CT1) apply to the home, cordless PABXs to the office, second-generation CT2 to sites such as shopping centres and railway stations, PCNs to a particular area, and so on. Although certain of these systems and services can be

Figure 2.2 The origins of PCN lie in the UK government's drive for competition and deregulation

Objective	Action	Consequence
Create competition in UK telecommunications	Replace monopoly with duopoly	Limited improvement in selected business services. BT concentrates on competitive businesses at expense of residential services. Ineffective competition in providing services between subscribers' premises and the local exchange. 'Cosy' competition leaves tariff levels largely unaffected.
Satisfy latent demand for mobile telephone services	Establish new duopoly for mobile services	Huge growth in mobile business services. Creation of sophisticated infrastructure to support these. Costs high, and growth potential limited owing to shortage of frequencies.
Improve competition in residential services	Establish personal mobile services	False start with CT2 — one-way, limited-range service only. Technological back-alley, but adopted by other European PTTs because it creates no threat to the existing local telecommunications infrastructure.
Overcome CT2 deficiencies	Establish two-way PCN	A real alternative to the fixed connection between subscribers' premises and the local exchange. Higher frequencies facilitate mass growth. New tariff structures and potentially high volumes will lead to lower costs and mass appeal.

distinguished on this basis, it does not take account of the overlaps and inevitable competition between the various services.

If this view prevails, users will be confused by the multiple choices available, and the tariffs and prices associated with each type of service are unlikely to be sufficiently different to help them decide. This confusion is likely to mean that some service providers will go out of business, and could hold back the overall growth of mobile communications as users wait to see which of the competing services will be the winner.

PCNs will be the dominant form of mobile communications

We believe that PCNs are set to become the dominant form of mobile personal communications. The main casualties are likely to be CT2 services and paging services.

In the United Kingdom, the take-up of CT2 has been slower than expected. The reasons are not yet clear, but it certainly appears that the marketing of the service has been less than that demanded to capture the intended volume. There have also been criticisms of the voice quality within the vicinity of a base station, and the limited geographical coverage means that the handsets can be used only close to one of the base stations. The dial-out-only restriction is also a severe drawback.

Our view is that CT2 provides only a partial solution to meeting the needs of the general public for mobile communications. Some experts have predicted that CT2 operators will add paging and voice mail to compensate for the restriction of being able to use the handset only for making calls. We believe, however, that the emerging PCNs are likely to pose a severe threat to the survival of CT2.

Paging services, we believe, will also be superseded by PCNs. As PCNs become established, most business people who currently have a pager will acquire a PCN handset. The need for a separate paging device will therefore disappear, although some PCN handsets will provide paging facilities that can be used when it is not convenient to be interrupted by a telephone call. The need for in-building paging will also diminish as cordless PABXs are installed, so it is probable that the only segment of the paging market to survive will be international paging — probably based on satellite services.

PCNs will, however, co-exist with the GSM network. GSM has been designed for use in vehicles and will provide Europe-wide coverage for business users. PCNs, on the other hand, are

Figure 2.3 The UK government's view of the mobile communications market will lead to a bewildering choice for users

Type of service	Service characteristics
CT1 cordless telephones	CT1 is the standard domestic telephone installed in many homes. Calls can be made and received within about 50 metres of the base station.
Existing analogue mobile telephone systems	Voice and elementary data communications for mobile telephone users in vehicles or on foot. Full roaming between calls. Nationwide coverage.
CT2 Telepoint	Telepoint base stations are being installed in public places. Owners of CT2 handsets can make (but not receive) calls within about 200 metres of a base station. They cannot roam from one base station to another during a call.
GSM networks	European coverage. GSM is designed primarily for use in vehicles, and will provide restricted roaming during a call.
Personal communications networks (PCNs)	Owners of PCN handsets will be able to make and receive calls within about 1 km of a base station. They will be able to move about freely within one cell during a call, but it is not yet clear whether PCN services will provide the facility to roam from one cell to another. PCN is not intended for use in moving vehicles.
Cordless PABXs	Will be installed in offices. Calls (including calls to/from other PABX extensions) can be made within about 200 metres of the PABX. All the usual PABX facilities will be available.

aimed at a mass market and will provide somewhat less functionality and at lower cost.

PCNs will be technically similar to the GSM system

Late in 1990, European PTTs agreed to standardise PCNs, using the existing GSM standard as a basis. (The standard will be called DCS 1800.) This means that there will be a common air interface between competing networks, allowing the handset of one supplier to be used on any PCN network. There will, however, be three significant differences between PCN and GSM:

— The frequency will be twice as high as that used for GSM networks (1.8 GHz against 900 MHz), which will result in smaller cells (about 1 km across) and greater traffic capacity. The ability to make greater re-use of frequencies will provide the potential to handle (say) millions of subscribers within one European country.

— Telephone handsets will be small and lightweight, intended for portable use rather than for use in vehicles. This will result in cheaper handsets (a pocket-phone costing $175 is envisaged by the mid-1990s).

— There will be less functionality in terms of features, and restricted ability to move between cells during a call.

PCNs will require an infrastructure of base stations, interconnecting transmission links, switches, and interfaces with the public switched telephone network. The radio technology used for PCNs will be relatively straightforward. The base-station antennae will be small (less than a metre of wire) and can be installed anywhere; typically, they will be put on the outside of suitable buildings. Communications back to the radio base stations and to the switching centre (equivalent to a PTT local exchange) will be via millimetre-wave radio links. Speech will be transmitted digitally at 13.4k bit/s.

As Figure 2.1 illustrated, a central feature of PCNs will be the use of a smartcard for personalising a handset and for billing and security purposes. (A smartcard is usually identical in size to a standard credit card, but contains an embedded microprocessor and memory chip.) There have been predictions that dual PCN/CT2 handsets will be produced — a view we do not share because, as we stated earlier, PCNs are likely to make CT2 obsolete. Dual PCN/GSM handsets are a more likely proposition.

There is considerable demand for PCN services

Market research has shown that there are about 30 million business people in Europe who regularly travel off-site in the course of their work. The fact that two million of them already subscribe to analogue cellular-telephone services, despite the poor service and high cost, demonstrates that there is considerable demand for such services. We believe that in the mid-1990s, the advent of the $175 portable mobile telephone will lead to unprecedented demand for PCN and PCN-like services. Much of this demand will be from the mass market, where the pocket-phone will eventually join the wristwatch and the filofax as an everyday personal necessity.

In addition to standard telephony, PCN operators are likely to provide a range of business-oriented services, including:

- Value-added voice services, such as voice mail and toll-free calls.
- Information services (such as paging) that make use of the tiny screen on the handset.
- Data and facsimile communications (at 9.6k bit/s).
- Centrex-like services, which will be an alternative to cordless PABXs. (Centrex is described in Chapter 3.)

The advantages of such services, compared with other forms of mobile and conventional communications, are that PCNs will:

- Provide a better method of reaching staff when they are moving about either off-site or on-site.
- Together with the GSM network, offer better and cheaper facilities than can be provided with existing cellular networks.
- Offer a genuine alternative to the PTT's fixed-wired access to the local exchange.
- Through cordless PABXs and add-on modules, offer an alternative way of providing telephony within a building and of linking to public networks.

The business benefits of mobile communications were discussed in Report 68. They include substantial increases in productivity for sales staff and service personnel who are seldom in the office — increases that can be achieved for a modest outlay in equipment and call charges. PCNs are likely to make similar benefits available to a larger cross-section of business people.

PCN services will be launched in 1992

PCN services will be launched in the United Kingdom by the three licensed consortia (Mercury, Unitel, and Microtel) at the end of 1992, covering about 40 per cent of the population. The two existing UK analogue cellular-telephone operators (Racal-Vodafone and Cellnet) will compete strongly with PCN by bringing out their own versions of lightweight GSM handsets. Although tariffs have not yet been published for PCNs, we expect that, in the long term, the services will cost less than those for cellular telephony and be competitive with both existing PSTN services and future ISDN services. By the late 1990s, PCNs will therefore provide a real alternative to the (wired) direct exchange line for individual subscribers.

In other European countries, and in the rest of the world, it is not yet clear whether PCN technology (as described here) will be adopted, or whether PCN-like services will be derived from some other radio-based technology. We understand, for example, that the United States is favouring a spread-spectrum approach, a technology derived from military radio systems. The Federal Communications Commission (FCC) is currently considering PCN proposals — termed PCS (personal communications services) in the United States — and there is a lively debate as to who should be responsible and which frequency bands should be used. The FCC favours excluding existing cellular operators in order to encourage competition and investment by entrepreneurs.

Some observers of the telecommunications industry believe that, by early in the next century, the many disparate PCN-like systems will converge into a single universal mobile telephone system. The European Commission is considering the feasibility of just such a single system as part of its research programme on advanced communications in Europe. The idea is that a single pocket communicator, which can be used in the home, office, outdoors, inside or outside a vehicle, and anywhere in Europe, may be used without any special procedure on the part of the user. A single mobile system, however, will not become a reality until early in the next century. By then, PCNs could well be established as the global answer to mobile communications.

Mobile data services

As the use of mobile voice services has grown, so has the demand for mobile data communications, and the existing analogue cellular services (which were designed for voice communications) have been extended and adapted to meet this demand. Sales and maintenance staff, for example, are now often equipped with portable PCs and facsimiles that can be plugged into their car telephones. In Report 68, we indicated some of the significant benefits and opportunities for competitive advantage that could be derived from mobile data applications.

It is, however, inefficient to use a voice-oriented network for data transmission. In the case of mobile data communications, the inefficiency applies to a very scarce resource — the frequency spectrum. All of the mobile communications services mentioned earlier in this chapter (with the exception of the single universal mobile telephone system) are aimed primarily at voice services. The digital format of the air interface helps with data throughput and reliability, but it does not significantly address the unique problems caused by the bursty and sporadic nature of much data communication.

As a consequence, new mobile communications services aimed specifically at data communications will be developed over the next few years. These new networks will be based on packet-radio techniques that make efficient use of the available spectrum, in that the radio channel will be used only when data is being transmitted. This means that it will be possible to accommodate up to about 1,000 simultaneous users on a single channel, compared with 25 on conventional voice-oriented networks. Tariffs can thus be set in the light of the greater number of potential users and be based on the volume of data transmitted rather than on the time for which a connection is used. This should result in lower costs than those incurred by using alternative mobile networks for data transmission.

Unlike providers of mobile voice services, providers of mobile data services will need to provide more than simple transport infrastructures. The greater complexity of data communications means that they will need to provide value-added services, offering overall applications that can easily be integrated with corporate computer systems. We expect that sector-specific mobile data services will be offered, which means that there may be several value-added resellers in the marketplace, who will buy capacity from the mobile data communications operators and provide 'pre-packaged' mobile data applications.

The first public service aimed specifically at mobile data communications is Ardis (advanced radio data information service), which began operating in the United States in April 1990. This service uses airtime on an existing network set up for IBM field-service technicians. Using the system is estimated to save the technicians half an hour a day, which was sufficient to cost-justify the original system. Interest by IBM's customers in the facilities available from the network led the company and Motorola (the radio equipment supplier) to introduce it as a public service.

Once again, the UK government is leading the way in Europe and is in the process of issuing licences to four organisations to establish and operate public mobile data communications services, using the upper VHF band (178 to 190 MHz). The four are Cognito, Hutchinson Telecommunications, Motorola Storno, and RAM Mobile Data. Figure 2.4 provides some background information about each of these organisations. Once the licences have been issued, the organisations will be required to cover 40 per cent of the population within 30 months and 80 per cent within five years. To obtain such coverage, some operators will combine a packet-radio air interface with existing terrestrial data communications networks based on X.25. Others will establish their own proprietary terrestrial network using digital leased lines. The services are likely to be available by the beginning of 1991.

In Germany, DBP Telekom has introduced a pilot mobile data network called Modacom, using equipment from Motorola. A nationwide service is expected in 1994.

Terminals connected to mobile data networks will range from laptop PCs with adapters, to pocket-size battery-operated keyboards costing around $1,000. Since there are, as yet, no relevant standards, the internal protocols will be proprietary to a particular network operator. This will inevitably lead to incompatibilities and prevent interworking between different

Figure 2.4 Four organisations are in the process of being granted licences by the UK government to provide mobile data communications services

Cognito Group is controlled by the Dowty Group and is developing a mobile packet network for use in two-way messaging (paging), mobile data communications using hand-held terminals, telemetry, and accessing information services.
Hutchinson Telecommunications (UK) Ltd is a subsidiary of Hutchinson Telecommunications (Hong Kong), Hong Kong's leading public telephone operator, where it already provides a mobile data service.
Motorola Storno is a subsidiary of Motorola Inc and manufactures, sells, and maintains radio telecommunications equipment aimed mainly at the emergency services.
RAM Mobile Data is a subsidiary of the US RAM Broadcasting Corporation. In the United States, RAM operates a Mobitex mobile data service built by Ericsson.

systems. At the time of writing, no information about tariffs for mobile data services was available. Tariffs will obviously vary with the type of service and application provided.

Service-oriented businesses such as freight hauliers and businesses with extensive sales and field-service operations will be the main target users of mobile data services. The initial applications will be direct replacements for the existing two-way paging services typically used by taxi and road-haulage companies for vehicle-dispatch and messaging applications. (At present, these applications use existing analogue mobile telephone networks.) Later, the applications will be developed to provide generalised two-way paging services. Typically, a user organisation will access a message-management centre through a PC connected by a standard asynchronous dial-up link to the fixed part of the mobile data operator's network. Mobile data services will also enable travelling staff to connect their portable terminals to a wide range of host computers in the same way as if they were connected via a fixed link.

Land-mobile satellite services

Land-mobile satellite services are being established on a regional and global basis by several organisations. In Europe, for example, five such services are planned:

- Euteltracs from Eutelsat, the Paris-based consortium of European PTTs.
- Standard C, Standard M, and Global Paging — three services from Inmarsat.
- Locstar, based on the US Geostar position-fixing and messaging service.

The Euteltracs system is based on the American Omnitracs network, owned and operated by Qualcomm. It combines a position-fixing capability with a two-way messaging service that allows a variety of free-form and pre-formatted messages (up to 2,000 characters) to be transmitted by either the mobile unit or the base station. The service is aimed at the trucking and transportation industries, utilities, government agencies, construction companies, railways, long-distance bus companies, and the inshore shipping industry.

Inmarsat, in cooperation with 57 of the world's PTTs, provides global telephone, telex, data, and facsimile services to ships via a network of satellites and ground stations. Ship terminals (Standard A) are bulky and expensive, and telephone calls are currently charged at about $10 per minute. A recent change in Inmarsat's charter enables it to offer similar services to international airlines, and several ventures are underway to market and operate these services. A further change to Inmarsat's charter has recently been proposed to enable it to offer services to land-based mobile users.

The land-mobile data service proposed by Inmarsat is based on a small Standard C terminal designed originally for use on ships. Text messages of unlimited length may be exchanged at low speed (600 bit/s) in both directions. There is currently no position-fixing capability, but an add-on feature to the terminal is planned to make this possible, using existing navigational systems.

Inmarsat Standard M will be a more sophisticated land-mobile service for both land and maritime use, scheduled for introduction in late 1992. Three services will be provided:

- Voice telephony (at 4.8k or 6.4k bit/s depending on the speech algorithm and error-correction methods employed).

— Data communications at 2400 bit/s.

— Group 3 facsimile at 2400 bit/s.

Inmarsat is also currently working on the design of a satellite-based global paging system, which it plans to bring into commercial service in 1993. Pocket pagers of a 'Walkman' size will provide worldwide tonal, numeric, and alphanumeric paging facilities. The target pager price is $500, and a vehicle-mounted version is also planned. Inmarsat believes that the worldwide market for such pagers could be between 2 and 5 million.

Locstar was formed in 1988 as a result of a joint initiative between the French Centre National des Etudes Spatiales (CNES) and Geostar, a start-up company already providing position-fixing and messaging services in the United States. The Locstar system will provide position-fixing and elementary two-way messaging services (up to 100 characters) via dedicated satellites.

In Australia, Aussat is intending to introduce its Mobilesat land-mobile satellite service when its second-generation satellites come into service in 1992 (although, by then, Aussat is likely to have been sold off to a newly established private-sector competitor). Mobilesat will provide voice, messaging, and data transmission services. In the meantime, Aussat will be introducing a land-mobile service in collaboration with OTC (which handles international traffic to and from Australia) based on Inmarsat's Standard C terminal.

Aussat foresees several applications for its satellite services:

— Use by the Royal Flying Doctor service to access medical research.

— Transmission of social-security payment details to remote areas.

— Provision of voice services to remote homesteads and communities currently served by the digital radio concentrator service (DRCS). The 'school of the air' is a major user of this service.

— Transmission of information to and from service industries and personnel operating in remote areas, including livestock agents, long-haul truckers, police, public utilities, and government services.

One example of an innovative application is the provision of remote telemetry and control facilities for Australian state government water authorities. The plan is that river heights and water flows would be monitored automatically and transmitted, by satellite, to headquarters. In turn, instructions could be sent out to open and close valves automatically.

Australia's geography makes it an ideal test bed for the development of rural satellite-based mobile telecommunications, and many of the world's leading suppliers are piloting their products and systems in Australia before launching them globally.

An example of a global land-mobile satellite service is the Iridium service recently proposed by Motorola. This service would be based on low-orbit satellites, although at the time of writing, little further information is available. However, Iridium merits attention for three reasons:

— It appears that Motorola has adopted a realistic strategy for introducing the service by recognising that the existing global regulatory environment is too restrictive to make the establishment of an independent system possible. As a consequence, Motorola is discussing the project with the relevant international bodies.

— The use of low-orbit satellites not only provides the potential to offer a wide range of services (including voice and high-speed data), but also avoids the intractable regulatory problems associated with reserving geosynchronous orbital slots and with resolving the associated problem of frequency coordination.

— The network can take advantage of technological advances in satellite on-board processing and intelligent networks to make the system virtually independent of the terrestrial infrastructure.

This latter feature will enable the system to enter service as soon as the satellites can be launched, which is itself a problem. The Motorola system envisages using 77 low-orbit satellites to provide global coverage. The satellites will doubtless be small devices that can be launched several at a time, but launch schedules are booked up several years in advance, and a realistic time for implementing the system must be towards the end of the century.

Many road-haulage companies are realising the benefits of land-mobile satellite communications, and have installed or are planning to install satellite communications equipment in their vehicles. According to studies carried out for the European Space Agency (ESA), demand exists for both voice and data communications, with position-fixing considered as an additional — although not a central — service. Our view is that the reluctance to consider position-fixing as an essential service arises from the newness of the service, and a lack of experience with it. The ESA's studies cite three reasons that transportation companies give for planning to invest in land-mobile communications systems:

- To gain a competitive advantage by projecting a modern technological and professional image for the provision of a quality service.
- To increase revenues by reducing lead times, increasing the volume and value of loads carried, and reducing empty return trips.
- To reduce costs by optimising fleet utilisation, centralising dispatching, and managing the work-force better.

While these findings relate specifically to transportation companies, similar advantages will be gained by a wide range of businesses. Communications managers will increasingly need to take account of mobile communications, both voice and data, in their corporate networking plans.

Mobile communications services impose unique requirements on service providers in terms of network intelligence and complexity. Large databases and a sophisticated signalling system are required to keep track of potentially millions of subscribers and to authenticate and bill their calls on a realtime basis. In fact, mobile services will constitute the first large-scale application of intelligent networks, which we review in the next chapter.

Chapter 3
Intelligent network services

A modern telephone exchange is, in effect, a special-purpose computer designed and built to provide fast, highly reliable switching of calls. By adding additional computer-controlled functions and facilities to the telephone network infrastructure, the PTTs are able to provide enhanced services over and above the traditional switching and transmission of calls. These services, known as intelligent network services, fall into two categories. The first category is aimed at providing, via the public network, telecommunications facilities hitherto available only via private networks or facilities. The most significant are centrex (PABX-like facilities) and virtual private networks. The provision of these services will mean that even large organisations will have less need to use private-network facilities. The second type of intelligent network service (such as advanced freephone and call rerouteing) will be used to improve communications with customers and the general public.

The computers (and associated databases) that control the intelligent network services will be separate from the computers that control the basic switching functions. This will mean that:

— New services can be introduced faster and more easily, because it will not be necessary to modify (and retest) the switching systems.

— A new service can be introduced for a small number of subscribers cost-effectively.

— It is possible to give customers more control over the provision and management of the services they subscribe to.

— The PTTs have access to a database containing information about their customers and their calling patterns, and can use this information to design new services.

At present, intelligent network services are predominantly voice-oriented and often require callers to generate tones on their keypad to make service choices. Older instruments using rotary dialling cannot access some of the services. An example of the range of voice-oriented intelligent network services planned by one local carrier in the United States is given in Figure 3.1. However, the existence of an intelligent network infrastructure will encourage the PTTs to offer a wider range of data-oriented intelligent network services.

As is the case with most of the other services described in this report, implementation of intelligent network services is more advanced in North America than in Europe or elsewhere. Introduction of some intelligent network services may be the subject of fierce regulatory

Figure 3.1 BellSouth is planning to test a variety of intelligent network services

BellSouth, one of the US regional telephone companies, plans to conduct field trials in 1991 of the following intelligent network services:

Area number calling: Routes calls to the business location nearest the caller, who may have dialled a single, advertised telephone number.

Outgoing call management: Blocks long-distance calls to selected numbers.

Custom intercept with call complete: Intercepts calls made to a non-working number, and verifies that the call is being forwarded to the correct number.

Multi-location business extension dialling: Allows centrex users to dial a four- or five-digit number to reach other centrex users.

Computer access restriction: Enhances computer security by restricting dial-up computer access to calls originating from approved numbers.

Directory assistance call completion: Connects customers dialling directory assistance to the number that they are seeking.

debate, since the PTTs will see the 'intelligence' as a basic part of their network, and therefore entirely within their domain, while other network service providers may view this as restrictive practice.

A few very large organisations are constructing their own private intelligent networks. Where the regulations permit, some of these may consider providing intelligent network services to third parties. Some of the European railways, for example, are considering whether to move into this market. Provision of a full intelligent network service requires the PTTs to make significant changes to their network infrastructure. It may be possible for organisations with large private networks to modify them more rapidly than the PTTs can, and thus to obtain a substantial share of the emerging market for intelligent network services.

We begin by describing centrex and virtual private network services and the benefits that can be obtained from using them. We then describe the more general facilities available from intelligent networks, and the benefits they provide, before reviewing the progress that is being made in introducing such services outside the United States. The development and take-up of intelligent network services is, however, likely to be hindered by regulatory, standards, and tariff factors, as well as a reluctance by user organisations to abandon their existing private networks.

Centrex provides PABX-like facilities

A centrex service provides features and functions equivalent to a PABX, but with the switching equipment generally located within the local PTT telephone exchange. Unlike most PABX networks, direct inward dialling to specific 'extensions' is an integral feature of a centrex service. The principles of centrex are shown in Figure 3.2, overleaf. The advantages of centrex for user organisations are:

— Capital investment and floor-space requirements can be reduced.

— Less management effort is required to provide in-house telecommunications facilities.

— It is easy to expand or contract the size of the facilities, which is particularly useful if the number of staff is likely to change, or cannot be predicted.

— Services can be provided to several of an organisation's buildings in one area, from one exchange, so that all buildings appear part of the same in-house telephone system. (This is generally much more difficult and expensive to accomplish with a PABX.)

Centrex services have been available in North America for many years, but are comparatively new elsewhere in the world. Mercury Communications Limited, the second carrier in the United Kingdom, began to offer centrex in 1987 and now has several dozen organisations using the service. Telecom Australia is also expected to introduce a centrex service, known as CustomNet Spectrum, in late 1990.

Although large organisations may be reluctant to use centrex (because it means placing the management of their in-house telecommunications in the hands of a third party), Mercury's experience is that there is a market for this type of service in locations with limited in-house telecommunications expertise. Mercury has also found that its centrex service is being used to link several buildings in a metropolitan area, and in multi-tenant buildings. Other organisations are using centrex to overcome short-term capacity problems.

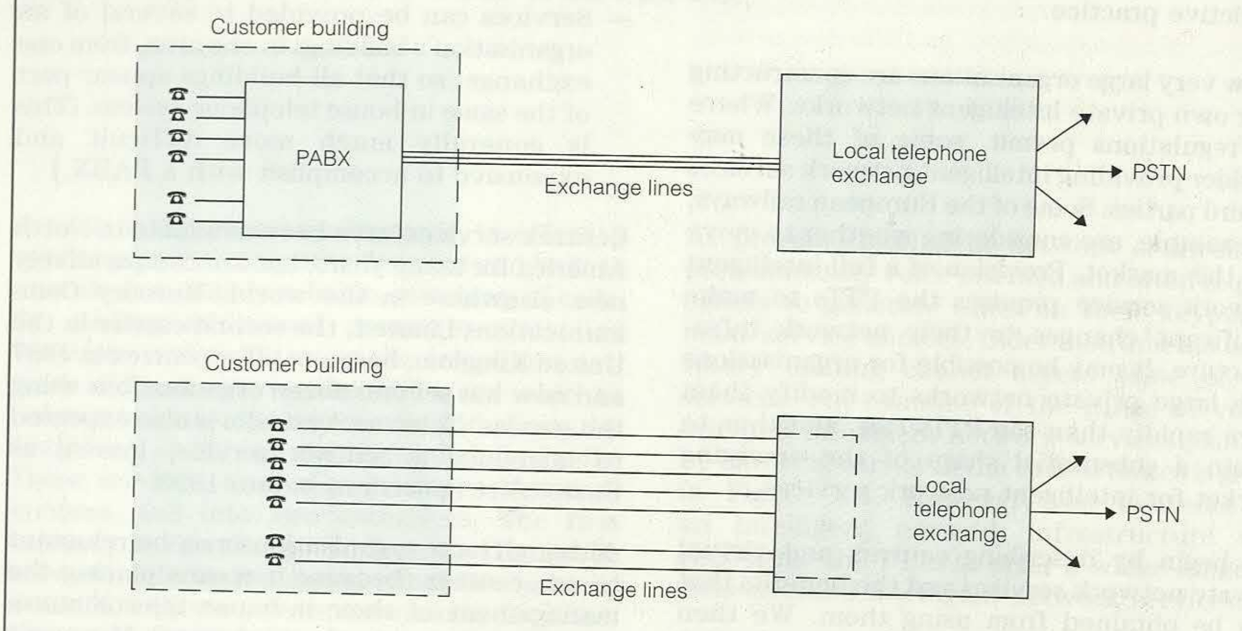
Centrex can be combined with virtual private network services to form a service known as wide-area centrex. With this service, the concept of a single telephone system for multiple sites, described above, can be expanded nationwide to include all of an organisation's sites. In this situation, much of the management effort for the entire in-house telephone service becomes the responsibility of the PTT, rather than the organisation's telecommunications staff.

Virtual private networks will provide a cost-effective alternative to private networks

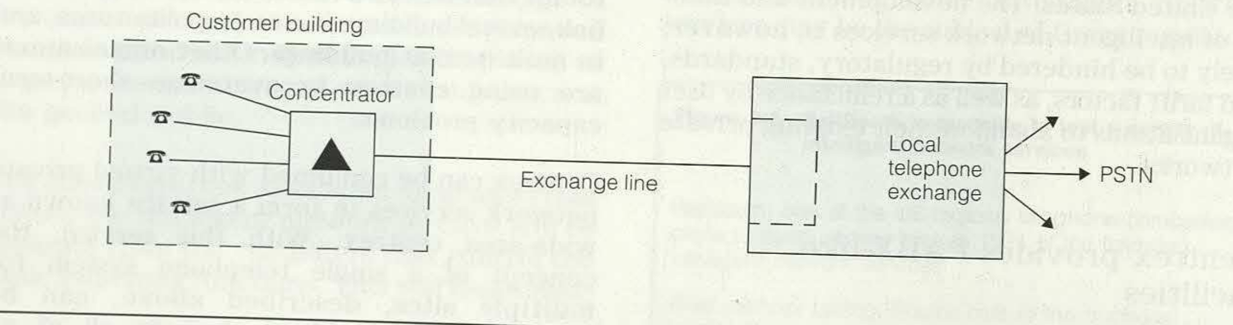
A virtual private network (VPN) is an intelligent network service that provides a business with

Figure 3.2 A centrex service provides PABX-like facilities, but without the need to install in-house equipment

Without centrex, the PABX switching equipment is located within the customer's premises.



With centrex, the switching equipment is generally part of the local telephone exchange (above) or a small concentrator could be located on, or near, the customer's premises (below).



many of the features associated with a private voice network (such as desk-to-desk short-code dialling between locations, and short call-set-up times), without requiring the use of private circuits. VPNs can be less expensive than private networks because tariffs for private circuits are based on the fact that they are available 24-hours a day, seven-days a week, even though 10 per cent or less of the total available capacity is typically used. With VPNs, the transmission capacity is provided on an as-required basis, and can be shared between customers, rather than being dedicated to one customer. VPNs can also provide additional features that are not always available with private networks. Furthermore, fewer staff are usually required to operate and manage a VPN than a private network, and less investment may be required in PABXs.

VPNs are common in the United States, but rare elsewhere

Private voice networks are widely used by large businesses in countries where private-circuit costs have been lower than the cost of using the PSTN — mainly the United States, Canada, the United Kingdom, and Australia. In countries where private-circuit costs have been high, it is rare to find a private voice network. However, in both the United States and the United Kingdom, the introduction of more competition into the market has reduced the cost of public network calls. Meanwhile, pressure from regulators to avoid cross-subsidisation between different telecommunications services has led to substantial increases in private-circuit tariffs (particularly for analogue private circuits). In the United States, this has created a substantial market for VPN services.

There were more than 750 VPN customers in the United States at the end of 1989, including many of the largest businesses. The main reasons cited for using VPNs are:

— Cost savings of 20 per cent or more compared with private voice networks, or using the PSTN.
— Improved flexibility and control over the voice network.

A typical US VPN configuration is shown overleaf in Figure 3.3.

The VPN services available in the United States enable an organisation to maintain a dedicated numbering scheme and to use other features normally provided only by a private network, while using the carrier's network on a non-dedicated basis for most calls. This means that a VPN service is cost-effective for smaller sites, typically where fewer than five private circuits would be required to link a site to a private network. (As private-circuit costs have risen, it has become less cost-effective to include these sites as part of the network.)

Another advantage is that a VPN can be accessed via any multifrequency-dialling telephone by an authorised user, who will have to key-in his personal identification number. Alternatively, a VPN can be accessed via a payphone that can accept a 'travel card' (a special telephone credit card issued to an organisation's staff; the cost of calls is billed to the organisation). Allowing VPNs to be accessed in this way means that the lower call charges can be extended to staff who are away from their 'office'.

The personal identification number could also be used to enable someone to have his calls diverted to any telephone that can access the appropriate intelligent network service. (This would work in a similar manner to the PABX 'follow me' facility.) Each time someone arrives at a new location, he must make a call to inform the intelligent network of the new location. Any subsequent calls to that person's telephone number would automatically be rerouted to the new location.

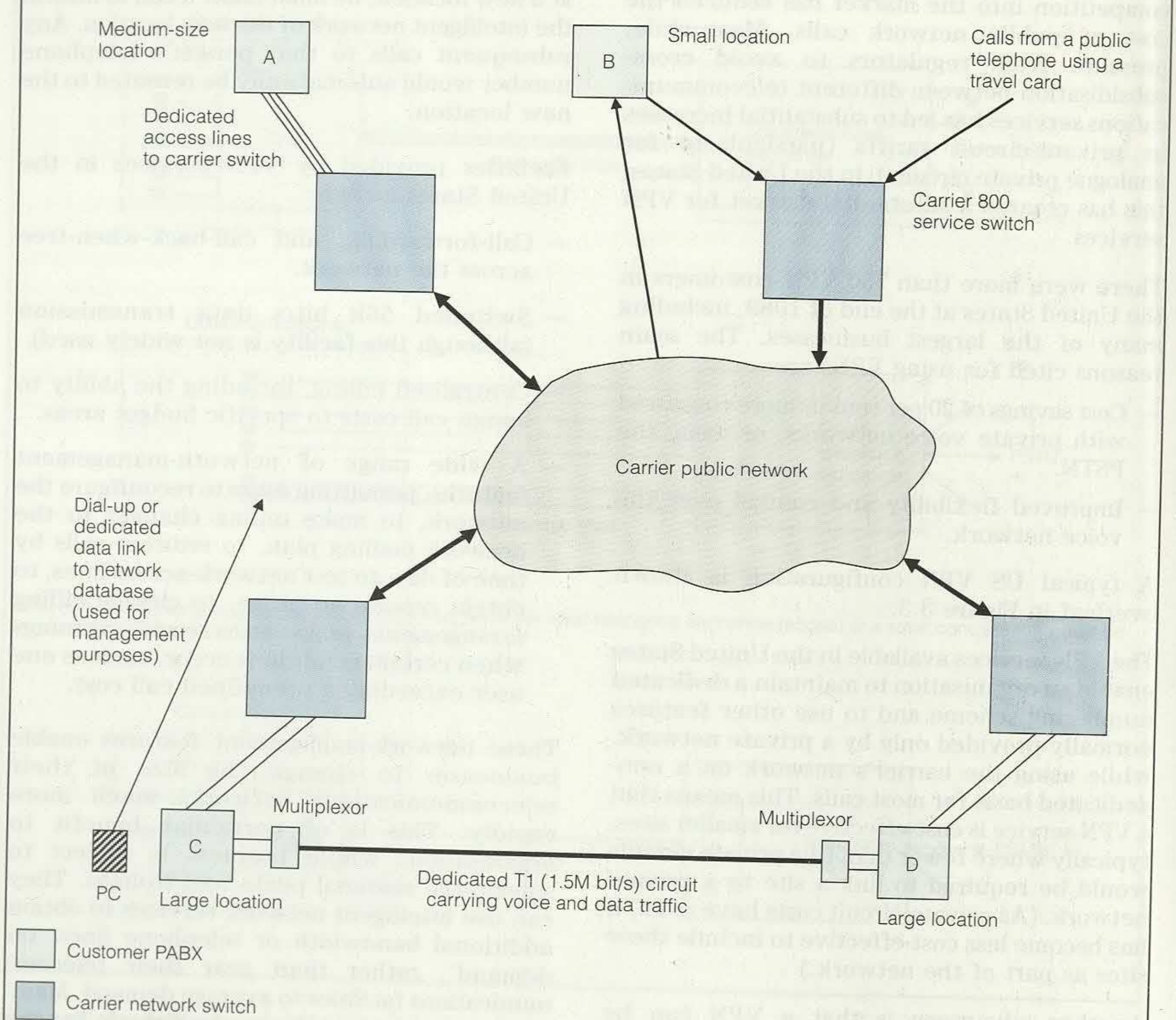
Facilities provided by VPN services in the United States include:

— Call-forwarding, and call-back-when-free across the network.
— Switched 56k bit/s data transmission (although this facility is not widely used).
— Centralised billing, including the ability to assign call costs to specific budget areas.
— A wide range of network-management features, permitting users to reconfigure the network, to make online changes to the network dialling plan, to redirect calls by time of day, to test network-access lines, to obtain reports on usage, to change billing arrangements, and even to receive warnings when certain conditions occur, such as one user exceeding a predefined call cost.

These network-management features enable businesses to change the size of their telecommunications networks much more rapidly. This is of particular benefit to organisations whose business is subject to substantial seasonal peaks and troughs. They can use intelligent network services to obtain additional bandwidth or telephone lines 'on demand', rather than gear their telecommunications facilities to average demand. Many of the changes can be made directly by the business's telecommunications staff, using online access to the intelligent network database, rather than having to wait for PTT staff to make the changes. Changes can therefore be made almost immediately, in response to changing business conditions.

Outside the United States, France Telecom was one of the first PTTs to provide VPN-like facilities with its Colisée service. This provided basic facilities such as volume call discount and a unified numbering scheme. Colisée will be superseded by France Telecom's intelligent-

Figure 3.3 A typical US virtual private network provides a variety of private voice network features



Notes:
Calls from sites A and B to other sites are routed over the carrier's network on a non-dedicated switched basis.
Calls from sites C and D to A and B are routed over the carrier's network on a non-dedicated switched basis.
Calls between C and D are routed over a dedicated high-speed digital circuit, which is also used for data.
For all sites except B, access to the carrier's network switch is via dedicated access lines.
At site B, access to the carrier's network switch is via a special 800 (freephone) number.
Company personnel who are out of the office can also access the VPN using any telephone and their travel card authorisation, dialling the special 800 number.

network-based VPN service, Transgroupe, which is scheduled to be introduced in 1992. VPNs are not yet offered elsewhere in Europe, although they will soon be available in the United Kingdom as part of a multi-site centrex service. In Australia, a VPN service called

CustomNet Horizon is expected to be available in late 1990.

US experience has shown that VPNs can bring cost savings and other benefits to organisations that do not have sufficient voice traffic to justify a private network. The service is particularly appropriate for retail and other organisations that have many small branches.

Global VPNs will overcome the difficulties of establishing international private networks

An organisation wishing to set up its own international private network encounters severe difficulties. At the design stage, these include establishing the true costs, and understanding differing national and regulatory environments and technical standards for transmission, signalling, and synchronisation. At the implementation stage, it will be necessary to deal with several PTTs and suppliers, each with its own way of doing business. Once the network is operational, the problem of managing it is compounded by the difficulties of dealing with many PTTs in different locations and in different languages. A global VPN would offer the same benefits as a purely national one, but with the additional advantages of relieving the user organisation of the burdens associated with designing, implementing, and operating an international private network.

US Sprint Communications (one of the long-distance carriers in the United States) and Cable & Wireless (the UK-based telecommunications company that operates the Mercury service in the United Kingdom and the Hong Kong telephone service) have announced a global VPN that will be marketed under the name Global Fon. This will enable users with offices in the United States, the United Kingdom, and Hong Kong to connect to the same VPN and enjoy the private-network-type features offered by centrex, such as 64k/56k bit/s end-to-end service, a common numbering plan, and call-back-when-free. Global Fon will not be able to offer all of the features available on US VPNs, however, because some of these are not supported in the other countries where domestic VPNs are not yet available.

It may be difficult for other independent suppliers to enter the market for global VPNs because they may be hampered by a lack of cooperation from the PTTs. The trend is for a PTT to open offices in other countries in a move to simplify the provision of international services by acting as the interface between foreign businesses and their national PTTs. These moves will reduce the potential market for global VPN services.

Intelligent network services will improve communications with customers and the public

The call rerouteing facilities available with intelligent networks will enable businesses to provide a more flexible telephone service for their customers and the general public. Indeed, some types of intelligent network service can be used to create new types of business aimed at the general public.

Call rerouteing will provide greater flexibility

Today, most businesses have to handle telephone calls from their customers at the specific location to which their telephone number is linked. This means that they must have staff available, at all times, in sufficient numbers, to handle the expected volume of calls. To achieve this, staff are often required to work shifts, and the only way to prevent staff being swamped by unexpected increases in call volumes is to overman the telephone-answering service most of the time. This problem can be overcome by using intelligent network services that make it possible to decouple a called number from a specific location.

Such services will make it possible to route a call to one of several locations according to predefined rules. Calls may be routed, for example, by time of day, so that outside business hours, all calls are handled by a centralised service, rather than at regional centres. Calls may also be rerouted to back-up numbers, if volumes exceed a preset limit. In this way, organisations can improve the service they provide to their customers without incurring excessive additional staff costs. Figure 3.4, overleaf, illustrates how call rerouteing facilities could be combined with an automatic call distribution (ACD) system to provide just such a flexible telephone-answering service.

Figure 3.4 Call rerouteing could be combined with an automatic call distribution system to provide a flexible telephone-answering service

One of the main services provided by organisations such as the Allgemeine Deutsche Automobil in Germany, and the Automobile Association in the United Kingdom, is a car breakdown and recovery service for their members. Members in need of assistance call a breakdown-service number, and the operator takes the relevant details and passes them on to the closest available repair man. The centre that receives the calls usually has an automatic call distribution (ACD) system that routes incoming calls to a free operator, while ensuring a fair distribution of the workload between the operators.

The volume of calls to a breakdown-service number can vary greatly according to several factors. A peak time for car breakdowns, and hence for requests for help, is a wet Monday morning. It is almost impossible to schedule rotas to have sufficient staff available to handle peak loads. (The high calling volume may last only for an hour or two.) When callers have to wait for a long time to have their calls answered, they often become irate, and calls can then take longer to handle.

The ideal would be for the car-breakdown organisations to bring in additional operators quickly when call volumes escalate. In future, this could be achieved by having part-time operators on standby at home. As the call volumes grow, the supervisor would call up some standby operators, ask them if they are able to take calls, and if so, use the call rerouteing intelligent network service to add home numbers to the ACD system. This solution would also be advantageous in bad weather conditions when staff cannot get into the office, and could provide more flexible working arrangements for part-time staff.

Some PTTs now provide universal number services that allow an organisation to advertise a single telephone number, with each call being routed to the organisation's office nearest to where the call originated. (Long-standing traditional versions of universal number services are the PTT-operator and the emergency services.) A typical use of a universal business number would be a national advertising campaign, with the calls being handled by each regional office. Telecom Australia, for example, has launched a service called CustomNet One 3, which provides a single nationwide telephone number for a business, as illustrated in Figure 3.5.

Automatic call-rerouteing will also be included in advanced freephone services. (Freephone services are now well established in many countries and are referred to in the United Kingdom and the United States as '800' numbers, and in France as Numéro Vert; the person calling is not charged, but the called party pays a higher charge.) Advanced freephone will, for example, enable calls to be rerouted according to the location of the caller, the time of day, or the number of calls currently being handled by the called party, and will provide details of customer calling patterns to the user organisation. Airlines use 800 numbers for their reservation and ticket-sales centres. With advanced freephone, it is possible to arrange for a call to be handled by a reservation centre in any part of the world, allowing a particular centre to be open only during local business hours. Thus, calls in Europe made outside local business hours could be handled by a centre in the United States. Using advanced freephone in this way will reduce staff costs, which are the most expensive part of any telephone-answering service.

Providing services such as these as part of an intelligent network infrastructure enables the user organisation to control the way the services are used. Thus, parameters can be set to specify how queued calls are to be handled, so that the organisation can respond immediately to a changing market or to an unexpected response to a marketing initiative.

Some intelligent network services will provide new business opportunities

Some types of intelligent network facilities can be used to provide new types of business services, aimed at the general public. Figure 3.6 describes how one UK financial institution plans to use freephone with an ACD system and a database system to improve a new sales channel. Two other examples of new business services are televoting and kiosk services (known in the United States as 900 numbers).

Simple televoting can be achieved without using intelligent network services. Callers are simply asked to dial one of a set of advertised numbers or to respond to voice prompts by pressing a keypad. An intelligent network televoting application would be more sophisticated, and could, for example, provide a demographic analysis of voting patterns.

With kiosk services, the user dials in to a particular information or entertainment service

Figure 3.5 Telecom Australia's CustomNet One 3 provides a universal business number service

CustomNet One 3 provides location-dependent routeing, time-of-day routeing, and local charges for callers.

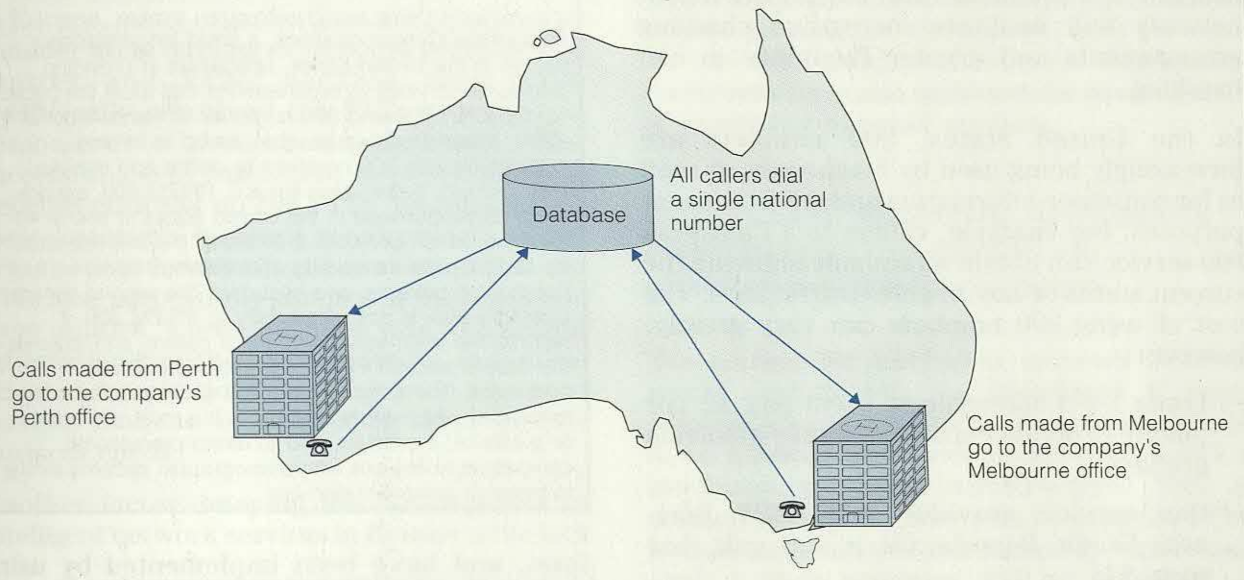


Figure 3.6 Freephone will be combined with an automatic call distribution system and a database system to enhance a new sales channel

Abbey National is a UK bank specialising in providing finance for house purchases. In mid-1989, it set up a telemarketing operation, known as Abbey National Direct, to sell financial services, primarily mortgages, over the telephone. Abbey National had been using a bureau service for telemarketing since 1985, but found that the service was limited because of restrictions in the sales script that could be used. Abbey National Direct was developed to provide a more customer-oriented service. Its objectives were twofold: to improve customer service to busy people who did not have time to visit their local branch during office hours, and to maximise cross-selling opportunities to these customers.

Demand has proved larger than expected, and Abbey National Direct now brings in the equivalent mortgage business of eight to ten branch offices. Moreover, volume of business is still growing in 1990 despite the downturn in the UK property market. Customers, or potential customers, call the Direct telephone number (which will be an 0800 toll-free number). The telesales agent handles the enquiry and either takes all the necessary details at that time, or arranges to call the customer back at a more convenient time (usually in the evening at the customer's home) to take the details. The details are entered into a customer database, and if a quote is required, a personalised letter and quotation is generated automatically. All the required paperwork can be completed without the customer entering the branch. Cross-selling of insurance policies or a savings account can be done during the initial sale, or via a targeted mailshot based on the customer database.

Abbey National Direct uses an ACD system connected to a special database system (called DMR) provided by Data General. The link between the two systems is not yet fully complete. When it is, all calls back to customers will be made automatically by the DMR system. When the customer answers, the call will be routed to a telesales agent, and the relevant information about the customer will be displayed on that agent's workstation.

Abbey National is very pleased with the success of this service and regards it as a new distribution channel. Customers like it, because they find the staff are very responsive, and they like the convenience of the telephone. Because the unit that runs the service is small and centralised, it can be used to market a wider product range, and new products can be introduced faster than via branch offices. The combination of computers, databases, and ACD has eased the administrative burden on telesales agents, and means that they can spend more time in direct contact with customers.

and is charged for using the service as well as for the cost of the call. The PTT invoices for both items and passes on the agreed amount to the service provider. Examples of kiosk services include prerecorded news stories, stock-exchange information, sports results, and entertainment, such as quiz games. Basic kiosk services are available now — one example is the

0898-500 Weathercall service in the United Kingdom that provides up-to-date regional weather forecasts. Calls to these numbers are charged at a premium rate, but an intelligent network will facilitate innovative charging arrangements and greater flexibility in call handling.

In the United States, 900 numbers are increasingly being used by businesses, as well as for consumer-information and entertainment purposes. For example, callers to a California 900 service can obtain a facsimile showing the current status of Los Angeles traffic jams. The cost of using 900 numbers can vary greatly, however:

— Lotus 1-2-3 spreadsheet users pay $2 per minute to obtain expert assistance in solving problems.

— One service provider sells TRW Business Credit Reports via a 900 call that costs $28.

— A tele-lawyer service provides legal advice over the telephone at a charge of $3 per minute.

A significant advantage for the service providers is that the telephone company handles the billing and debt collection. However, some concern has been expressed in the United States about the abuse of 900 numbers. An example of such abuse was a 'Call Santa' programme, where television advertisements told children who were too young to dial the number themselves to hold the telephone mouthpiece to the television screen, which emitted the tones to dial the 900 service.

With intelligent-network-based televoting and kiosk services, the network operator will also be able to provide comprehensive usage data to the customer. In principle, this could contain valuable marketing information about the demographic characteristics of the buying public. Figure 3.7 describes two such intelligent network services that have already been launched in the United States.

Figure 3.7 Telesphere Communications provides database services that help to define markets

Telesphere Communications, a small long-distance carrier in the United States, specialises in providing additional services to organisations that allow the public to dial in on 800 and 900 numbers. In the summer of 1990, it launched two services aimed at helping businesses with 800 numbers to define and analyse their markets better. One service, PRIZM 800, assigns each neighbourhood in the United States to one of 40 lifestyles, which provides a profile of the average citizen by factors such as reading and viewing habits, purchasing patterns, and attitudes. The second service, Directory 800, is complementary to PRIZM 800. It records the telephone numbers of callers, and matches the callers' numbers with residential names and addresses. The output from these services can be used to monitor which types of people are most interested in, or aware of, a product, and to direct promotional campaigns to regions with demographic patterns similar to those of current customers.

Intelligent network services will become available in Europe and elsewhere during the 1990s

Many of the services described earlier in this chapter are already available in a rudimentary form, and have been implemented by using conventional telecommunications technology in an innovative way. More advanced forms of the services, such as routeing options for advanced freephone, often require the PTT to install a special 'overlay' network. This is the approach adopted by British Telecom in the United Kingdom and by Telefónica in Spain. We expect other European PTTs to install overlay networks for the provision of intelligent network services during 1991/92.

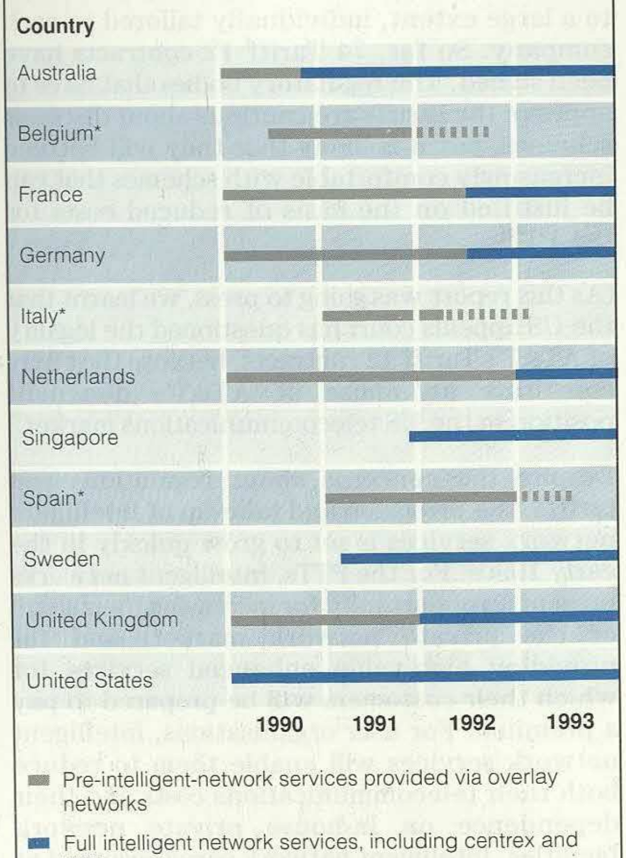
The problem for the PTTs is that to provide new services via overlay networks, they also have to modify the core network, which is a time-consuming and expensive exercise. This explains why the aim of the PTTs is to provide intelligent network facilities as an integral part of the telecommunications infrastructure. Such an infrastructure will enable new services to be developed in weeks rather than years, and without having to change any equipment or software in the telephone exchanges. Such a capability will facilitate rapid and opportunistic exploitation of niche markets for intelligent network services. User organisations should be aware of this new PTT capability; in the future, it may become economically viable for a PTT to develop a service for a single customer.

Intelligent network services are most developed in the United States, although some services are now becoming available in Europe and elsewhere. The current status of intelligent network services in Australia, Europe, Singapore, and the United States is summarised in Figure 3.8.

In Europe, many organisations are reluctant to consider using intelligent network services like centrex and VPNs because they have traditionally perceived the PTTs as being unresponsive to their business needs. The successful use of intelligent network services depends critically on the PTTs' understanding their customers' business requirements. Many organisations have yet to be convinced that the PTTs have successfully completed the transition from utilities, whose business was to transmit information over the public network, to service-oriented organisations able to provide advanced services that can be tailored to meet specific business needs.

Another factor delaying the development of intelligent network services in Europe is the lack of an intelligent network infrastructure. Without such an infrastructure, the PTT cannot justify the expense of developing an intelligent network service unless there is a large potential market demand for the service, as is the case for the 800 freephone services. Regulatory constraints have also inhibited the development of intelligent network services.

Figure 3.8 Intelligent networks are being implemented by most major PTTs



*Prototype intelligent network services planned

Regulations, standards, and tariffs could inhibit the growth of intelligent network services

The market for intelligent network services would undoubtedly be stimulated if independent service designers and providers were to be allowed unrestricted access to a PTT's intelligent network infrastructure. This is unlikely to happen, however, because the PTTs and the governments and regulatory bodies that control their activities will be reluctant to permit third parties to exercise control over what is regarded as one of a country's strategic resources.

Allowing third parties full access to the PTT infrastructure would also raise concerns about privacy. There would be a public outcry in most countries if there were a suspicion that information about people's locations, movements, buying habits, and acquaintances (all of which could be available within an intelligent network) were to be used for other purposes. The scale of the outcry can be gauged by the privacy concerns about itemised billing in some European countries, notably Germany. For these reasons, there will be regulatory constraints on the use of intelligent network services, particularly VPNs. The same types of restrictions that currently apply to the use of private networks are likely to apply to VPNs.

The development and take-up of intelligent network services will also be constrained by the lack of appropriate standards and by concerns about tariffs.

Standards are lagging behind the implementation of intelligent networks

New intelligent network services can be a major source of revenue for the PTTs, so they have been anxious to implement the services even though international agreement on relevant standards has not yet been reached. Instead, services have been introduced as quickly as possible by creating overlays to the existing network infrastructure. In the United Kingdom, for example, the first 800 services were implemented on Strowger exchanges, pending the installation of digital exchanges. This caused some difficulties because of the excessive delay before a caller heard the ringing tone.

Nevertheless, the PTTs are keen to establish standards for intelligent networks, because the existence of standards would enable them to migrate towards a coherent intelligent network infrastructure. Standards would also remove the need to make large service-specific investments that could become obsolete once standards have been agreed. The CCITT is working on standards for intelligent networks, although its aim to publish initial recommendations by the end of 1991 now looks unlikely to be achieved.

Take-up will depend crucially on tariffs

The tariffs set for intelligent network services, especially for VPNs, will be an important factor in determining the rate at which the services are taken up. VPNs will be adopted widely only if the cost of using them compares favourably with the cost of private circuits. The PTTs, however, will emphasise that a direct cost comparison is only part of the story; organisations using a VPN should also be able to reduce their own staff costs because they will no longer have to take on the responsibility for designing and operating a private network. Even so, some organisations that make intensive use of a private network may find that a VPN does not provide worthwhile savings. Much will depend on the level at which tariffs are set.

The PTTs, of course, also set the tariffs for private circuits and other alternative services such as ISDN. They may therefore choose to set the relative tariffs in a way that makes the use of private circuits unattractive. However, there is a trend, particularly in Europe, for tariffs to reflect more closely the costs of providing a service, and as competition in the telecommunications market becomes more common, cost-based tariffs will become the norm. The implication is that, in those countries where the PTT remains the monopoly supplier of telecommunications services, the cost of private circuits will continue to be high. Indeed, competition is no guarantee that the cost of private circuits will be reduced. British Telecom has recently increased the rental charges for its 2M bit/s MegaStream private circuits by a significant amount. The effect is to make services based on the public network more attractive.

There may, however, be scope for negotiating discounts on the published tariffs for VPNs. The use of a VPN means that an organisation is making a major commitment to purchase significant telecommunications services from the PTT. Because of this, it may well want to build a strategic alliance with the PTT and to negotiate appropriate discounts. AT&T's Tariff 12, for example, allows for volume discounts to be given to large customers, provided they sign a three- or five-year contract guaranteeing AT&T most of their telephone and data communications traffic, including both VPN and PSTN traffic . The tariff is, however, difficult to analyse and compare because it is, to a large extent, individually tailored to each company. So far, 74 Tariff 12 contracts have been signed. The regulatory bodies that have to approve the tariffs are cautious about discount schemes, but it is likely that they will become increasingly comfortable with schemes that can be justified on the basis of reduced costs for the PTTs.

(As this report was going to press, we learnt that the US appeals court has questioned the legality of AT&T's Tariff 12 contracts, because they may constitute an abuse of AT&T's dominant position in the US telecommunications market.)

Despite the concerns about regulations and tariffs, the provision and take-up of intelligent network services is set to grow quickly in the early 1990s. For the PTTs, intelligent networks present an opportunity for increasing their share of the private network market, and for providing high-value enhanced services for which their customers will be prepared to pay a premium. For user organisations, intelligent network services will enable them to reduce both their telecommunications costs and their dependence on in-house private network facilities. Intelligent network services aimed at enhancing communications with the general public will be of particular interest to all retail organisations and to companies engaged in telemarketing and information services.

While such services are designed to work in both analogue and digital environments, the combination of intelligent networks with ISDN (integrated services digital network) will form the basis of new and powerful voice and data services. We describe the development of ISDN in the next chapter.

Chapter 4

Integrated services digital network (ISDN)

In the past, the world's public telephone networks were based on analogue technology. Over the last three decades, much of the telecommunications infrastructure owned and operated by the PTTs has been gradually converted to digital technology, to form what has become known as the integrated digital network (IDN). One major part of the network has, however, been left out of this process of digitisation — connections between customers' premises and the adjacent telephone exchange (known in telecommunications jargon as 'the local loop'). In its initial form, ISDN is the means by which the PTTs will provide digital communication over the customer's connection. In doing so, it will be possible to integrate the delivery of all services (hence the 'S' in ISDN), voice and non-voice alike, over a single connection to the customer.

Analogue transmission over the local loop provides a single channel that can be used for one purpose at any one time — usually a telephone conversation. However, the channel can be used at other times for facsimile transmission, or via a modem, for data transmission. A basic ISDN connection will provide three digital channels — two of which can be used simultaneously for voice or non-voice transmissions, while the other is used mainly for PTT signalling. Thus, for example, ISDN will allow a subscriber talking on the telephone on one channel to use another channel to link his computer to an online database. It will also allow two separate telephone calls to be made simultaneously.

The end-to-end digital transmission facilities provided by ISDN will result in better voice quality, and shorter call-set-up times. ISDN will allow supplementary facilities, such as calling-line identification, automatic redialling when the called line becomes free, and direct dial-in to individual extensions, to be provided. It will also provide faster switched data communications. At present, the fastest data transmission rate that can be achieved over analogue connections is usually 19.2k bit/s. In its basic form, ISDN will permit data transmission at rates up to 64k bit/s.

In many cases, ISDN will use the same twisted pair cables currently used to connect subscriber premises to the local telephone exchange. The local exchange will, of course, have to be a digital ISDN exchange, and each subscriber will have either to replace the existing equipment connected to the public network with ISDN telephones and equipment, or to connect existing non-ISDN equipment via a special adaptor. In many countries, a significant proportion of subscribers is already connected to digital exchanges. These are, in effect, ISDN exchanges, although to start with, most subscribers will still be connected via the existing analogue links.

In this chapter, we describe the nature of ISDN, the types of applications that it will be suitable for, the PTTs' plans for introducing ISDN, and the difficulties that have to be overcome before it can come into widespread use. We conclude by providing advice about what Foundation members can do now to plan to exploit ISDN. We deal here with first-generation (or narrowband) ISDN — that is, ISDN services operating up to about 2M bit/s. Its expected successor, broadband ISDN, will not become available until the end of the century; we consider broadband ISDN briefly in the next chapter as a future development of metropolitan area networks.

The nature of ISDN

ISDN connections have two types of digital channels. B (or bearer) channels, each of

64k bit/s, are used for transmitting voice, data, text, or image communications. D (or delta) channels, whose bandwidth can be 16k bit/s or 64k bit/s, are used mainly to transmit the signalling information required to set up ISDN calls. However, the spare capacity in D-channels can be used for data transmission (X.25 packet-switched, for example). Several terminals can be connected to the same B-channel, allowing its capacity to be shared. B-channels can also be grouped to provide so-called wideband 'H' channels (384k bit/s and 1,920k bit/s, for example), although these will not be among the initial services provided by the PTTs.

Two types of ISDN connection are available:

- *Basic access* provides two B-channels and one D-channel of 16k bit/s, and is often termed 2B+D. It is also known as the basic rate interface, or BRI.
- *Primary access* provides 30 B-channels (23 in North America) and one D-channel of 64k bit/s, and is often termed 30B+D (or 23B+D). It is also known as the primary rate interface, or PRI.

Most PTTs are initially promoting basic-access ISDN because the standards for this type of connection are more mature. Basic access will, however, be more attractive to smaller organisations. The typical Foundation member will require primary-access connections for large sites, although basic access could be useful for small offices or for home workers. In addition to basic and primary transmission services (known in the ISDN jargon as bearer services), ISDN will enable the PTTs to provide supplementary services and teleservices.

Supplementary services are perceived mainly as enhancements to voice telephony. Typically, they are the types of features provided by PABXs, but operated on a network-wide basis. Examples include call diversion, ring-back when free, calling-line identification, and advice of charge. There is more emphasis on supplementary ISDN services in the United States than in Europe, because they can be used in conjunction with intelligent network services not currently available elsewhere, such as centrex and virtual private networking.

Teleservices, which are roughly equivalent to today's value-added network services, make use of ISDN's bandwidth and additional functionality. Examples include high-resolution image communications, compressed video-telephony, and commentary-quality voice (which uses more than twice the bandwidth of conventional voice telephony). Teleservices are distinguished from other forms of telecommunications service by the provision of some form of added-value function on the part of the service provider. Thus, point-to-point Group 4 facsimile in its basic form makes use of the basic (and perhaps supplementary) services, but store-and-forward facsimile would be a teleservice.

ISDN will make new telecommunications applications possible

During the early phases of ISDN, the emphasis will be on basic-access niche applications, particularly image applications, that are unlikely to be feasible with conventional telecommunications services. In the longer term, however, as the emphasis switches to primary-access connections, ISDN will be used for wider, more general applications.

The initial focus will be on niche applications

Much of the pioneering work on basic-access ISDN applications is being carried out in France. The French subsidiary of Philips (which manufactures domestic electrical equipment) is using ISDN to combine image servers and expert systems to provide after-sales-service support to small shops carrying out repairs on domestic televisions and hi-fi equipment. Securesys (a French company that provides security services) offers clients remote monitoring of their premises using video surveillance systems connected via ISDN to a central point. Glaxo distributes large files of medical information to its sales force in support of its pharmaceutical products, and two hospitals in Brittany use ISDN to exchange medical and radiological images to help diagnose complex illnesses. The Kipa press agency uses Numéris (the French ISDN service) to transmit photographic images to its clients, saving much time and expense. (Previously, motor cycle couriers were used to deliver hundreds of photographs.) Members of an agricultural cooperative in the north of France are using ISDN to pool accounting resources. We describe these last two applications in more detail in Figures 4.1 and 4.2.

A wide range of voice, data, text, and image applications is being proposed for ISDN. Many of these can be provided with a greater or lesser degree of efficiency (and often at lower cost) by using existing telecommunications services.

In general, however, we believe that until ISDN tariffs are reduced relative to those for existing services, the most attractive ISDN applications will have one or more of the following characteristics:

— A geographically dispersed network of small branch offices.

Figure 4.1 ISDN is used to distribute press photographs

Kipa, the fourth largest photographic press agency in France, produces daily some 2,000 photographs, about 200 of which are selected for onward sale to magazines and publications throughout the country. The manual process for doing this was lengthy and costly; photographs were first replicated in large numbers and either distributed to a salesforce in the Paris area or mailed to potential clients elsewhere. The process did not always meet the need for timeliness, particularly when the photographs were of topical news events.

Using Numéris, France Telecom's ISDN service, Kipa was able to transform the way it carried out its business. Apart from increasing its own efficiency, Kipa was better able to meet the needs of its clients and improve its competitive position. The solution involved three main elements:

— An image-database server at Kipa's head office.

— An image-messaging service operated by Image Directe.

— Image workstations provided at clients' premises by Image Directe.

The overall arrangement, which is illustrated below, shows the advantage of the image-messaging service.The client is able to access the image databases of all the agencies connected to the system. The operator of the messaging service also performs other value-added functions such as centralised billing and accounting, and terminal equipment supply and maintenance. Both these aspects help sell the system to press-agency clients.

The benefits derived by Kipa are numerous. Establishing an in-house image-database server enabled Kipa to implement its own electronic document-management system, and the costs of producing multiple copies of photographs were eliminated. More importantly, the time to deliver a photograph to a client was reduced to three minutes, enabling the agency to meet its clients' requirements for timely delivery of topical publication material. The database storage of images also enabled clients to carry out rapid searches on a given subject. Finally, Kipa's potential market was widened to include other businesses that make use of photographic images in the course of their work — book publishing, cinema casting, and so on.

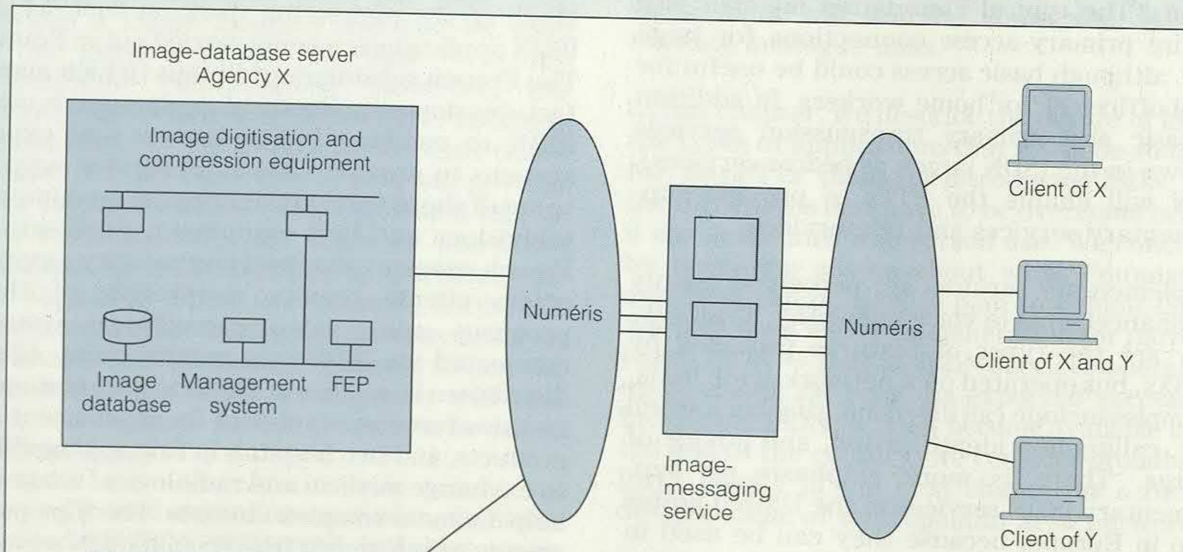


Figure 4.2 ISDN provides the basis for a centralised accounting service for farmers

Farming, just like any other industry, is in need of good management, cost control, administration, and accounting. The administrative burden of maintaining detailed accounting records often leads small farmers to seek the help of specialist third-party organisations. In France, over 100 Centres de Gestion et d'Economie Rurale (CGERs) offer general management advice and services to the agricultural community.

One of the more important is CGER 22, which serves the Côtes du Nord, and brings together most of the farming concerns in the province. Like the other centres, CGER 22 has a decentralised structure, operating through 20 branch offices. One of the branch-office activities is to operate an accounting service for farmers in its locality. This entails the collection of accounting data from individual farmers, associated data-entry work, the dispatch of formatted data to CGER 22 headquarters for processing, and the reception and redistribution of processed accounting information to the farmers.

Previously, the exchange of data between the branch offices and the headquarters was carried out by transferring diskettes, a process that was fraught with procedural problems, errors, and delays. ISDN proved to be the ideal replacement. The traffic characteristics suited ISDN switched services, and features such as calling-line identification provided added security to the operation. Faster, more reliable, and cheaper transmission of data were among the direct benefits. Indirect benefits included the better organisation of work procedures at the head office and capacity to increase the range of services offered to farmers.

— A strong common interest between the users — what would in other circumstances be termed a closed user group.

— A requirement to transmit large volumes of data occasionally in either direction — file transfer or high-resolution colour images, for example.

In the future, there will be four main categories of new ISDN applications

As the PTTs continue to install and implement their ISDN infrastructures and switch their emphasis to providing primary-access channels, and as ISDN tariffs are reduced in comparison with tariffs for existing telecommunication services, other types of applications will begin to have general appeal. We predict that by the mid-1990s, there will be four main categories of new ISDN applications.

Interconnections between PABXs and the public network

ISDN primary access will become the standard means of connecting all medium and large digital PABXs to the public network. The speed at which this happens will depend on the availability of primary-access connections from the PTTs, the maturity of signalling standards, and the support for such standards by PABX suppliers.

Connection of small branches to head offices

Once certain incompatibilities with private data network architectures have been overcome (these difficulties are described on page 33), many organisations will use ISDN to integrate into their corporate networks smaller branch offices that have low-volume communications requirements. ISDN will be attractive for doing this for three main reasons. First, the basic-access configuration can be used to provide a small local area network. Second, the low traffic volumes do not justify the provision of dedicated lines to such locations. Third, and perhaps most important, the parent organisation can delegate all responsibility for equipment maintenance at the branch office to the ISDN service provider — the PTT.

Provision of back-up and overflow capacity for digital leased circuits

Many of the organisations we spoke to in our research believe that ISDN has an important role to play in the provision of back-up facilities for digital leased circuits (in much the same way that dialled connections are used today to back up analogue leased lines). ISDN could also be used to provide occasional additional capacity during peak traffic periods, or pending the installation of digital leased circuits.

Customer service and telemarketing applications

The ability of ISDN to identify the calling number provides opportunities for improving customer-service and computer-supported telemarketing applications. Knowledge of the identity of an incoming caller can be used to access his files from a database so that relevant customer information can be displayed in front of the attendant handling the call. Several computer and PABX manufacturers are co-operating on the development of suitable interfaces. American Express has experimented with this type of application, but with mixed success — apparently, many people call from telephones other than their own. Even so, the experience suggests that identifying the caller and displaying relevant information provides significant benefits even if only 50 per cent of the callers can be identified.

A word of caution is necessary about these types of services. Calling-number identification may be prohibited in some countries by data protection legislation.

PTTs' ISDN marketing strategies could delay its take-up

Different PTTs are implementing ISDN at different rates and to different timescales. Although the projected growth rates in the number of ISDN subscribers may seem very impressive, it is important to place these in the context of the total number of subscribers to existing services.

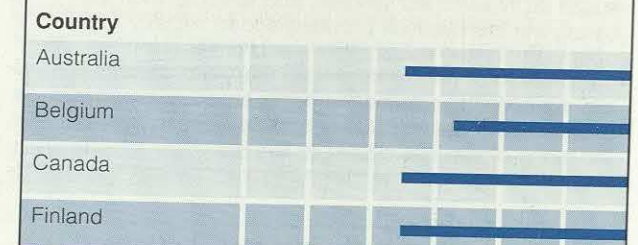
By 1995, ISDN connections will constitute only a small proportion of business lines, and a tiny fraction of total lines in any of the countries implementing it. The initial focus on providing basic-access connections to smaller organisations may have been the only alternative to waiting for the maturity of primary-access standards, but it has left the PTTs with the daunting problem of marketing a new concept to a wide population of unsophisticated users of telecommunications services. Some PTTs have recognised this and have decided to direct their marketing effort towards providing larger organisations with primary-access connections, but using proprietary or pre-ISDN standards.

ISDN is now becoming available

In most advanced countries, the PTTs have already started to implement ISDN, with several claiming to be the first. Many started with pre-ISDN pilot schemes based on 64k bit/s circuit-switched services. France, however, was the first country to introduce a commercial service (at the end of 1987), followed closely by the United States and Japan. Other countries, including Australia, Germany, the United Kingdom, Spain, Belgium, Sweden, and Italy are not far behind. Figure 4.3 gives our best estimate of the availability of a commercial ISDN service in most of the countries where there are Foundation members. (Note, however, that ISDN services will initially be available only in selected geographic areas. Nationwide end-to-end ISDN coverage will not be achieved for several years.)

Efforts are now being made to introduce international ISDN services between countries that are sufficiently advanced in their national programmes. This opens up the possibility of replacing existing international digital leased lines with alternative ISDN switched services, which is likely to reduce the cost of international digital communications. The cost of leasing an international digital circuit is extremely high, and political pressure is now growing for the tariffs for international *switched* services to be reduced to reflect the cost of providing the services. The PTTs will also wish to exploit the international ISDN infrastructure for managed and value-added network services.

Figure 4.3 By 1991, most advanced countries will have implemented initial commercial ISDN services



The initial focus on basic access will limit the take-up of ISDN

The PTTs' own projections of ISDN growth over the next five years indicate that only a small proportion of all business lines, and thus a minute fraction of all connections, will actually be using the service by 1995. France Telecom estimates that it will have 150,000 basic-access connections by 1992 and some 500,000 by the middle of the decade. In the United Kingdom, British Telecom hopes to have 90,000 ISDN connections by 1992, while in Australia, some 112,000 are expected by 1995. It is not always clear whether these estimates refer to connections available or to connections taken up by users, but it does not change the fact that they will represent only a small percentage of each country's business lines. Thus, ISDN will not, for the foreseeable future, be the standard method of access for business telecommunications users.

One of the reasons for the projected slow take-up by the business community is that the PTTs' initial marketing efforts are focused on persuading smaller organisations to adopt ISDN basic access. This marketing strategy was driven mainly by technical factors — the earlier completion of basic-access standards, and the suitability of the basic-access configuration to the telecommunications needs of smaller sites. We have already described some successful applications that have resulted from this strategy — notably, where there is a strong common interest among the users (as in a closed user group) and where image transmission is a significant requirement. On the whole, however, the PTTs seem to have underestimated the magnitude of the problems of selling and implementing a new idea to relatively unsophisticated and widely dispersed business users.

Some PTTs now recognise the need to promote primary access

We believe that a marketing strategy aimed at persuading large organisations to install primary-access ISDN connections would lead to a faster take-up of ISDN. Marketing (and installation) would be more concentrated and would be aimed at sophisticated, knowledgeable users. Primary-access connections could be positioned as a simple replacement for existing analogue (or digital) PABX trunks. The unbundling of supplementary services would allow existing or lower tariffs to apply, and every new PABX purchased by a large organisation would be a natural, if not an automatic, candidate for ISDN connection. This strategy would, we believe, lead to the rapid emergence of a sophisticated user base. It would then be possible to build an increasing repertoire of applications on this base, taking full advantage of the bandwidth and additional functionality available with ISDN.

The lack of maturity of the signalling standards associated with primary access is one of the reasons that has dissuaded most PTTs from pursuing such a marketing strategy. One of several exceptions is Telecom Australia, which has introduced its Macrolink primary-access service before launching its basic-access service, Microlink. To do this, Telecom Australia had to anticipate international standards for ISDN signalling (its version is called TeLinc), and the problem of migration to such standards will have to be addressed at some time. Other countries that started by providing only basic-access connections are now being forced to provide primary-access connections as well, again with proprietary signalling standards. Notable among these is British Telecom, which has integrated its existing digital access signalling system, version 2 (DASS-2) standard with its initial version of ISDN primary access.

Even though the growth in ISDN subscribers and usage in the next few years will be relatively slow, its long-term success is almost certain because it will be adopted by the world's PTTs as the standard means of access to public digital telecommunications facilities. ISDN is of strategic importance to the PTTs because it is the means by which the last element of the telecommunications infrastructure (the local loop) will be digitised. It can also be used to deliver advanced added-value digital services to subscribers, thereby generating additional revenue for the PTTs. There is little doubt that ISDN will gradually become the standard method of access for business and residential subscribers alike.

User concerns and standards and technical difficulties need to be addressed

Before ISDN can be widely adopted, user organisations must be convinced that the apparently higher tariffs can be justified by the benefits available from ISDN. There are also technical difficulties and difficulties relating to standards. Until these are resolved, the widespread adoption of ISDN will be slowed down.

User organisations are doubtful that ISDN will provide significant benefits

Our research showed that many user organisations believe that the benefits of using ISDN cannot be justified by the additional costs involved. ISDN costs arise in two areas: equipment (and associated software) costs, and usage tariffs. Equipment designed to connect directly to ISDN channels is expensive — ISDN telephones currently cost between $500 and $800, compared with around $20 for a conventional telephone; Group 4 facsimile machines cost $15,000 compared with a Group 3 price of less than $800; PC adaptor cards cost about $1,500, a substantial proportion of the price of the PC itself. ISDN usage tariffs are generally being set above those for conventional analogue telephony, especially for data transmission. The higher data rates available with ISDN, however, will in many cases result in lower transmission costs.

Figure 4.4 gives an example of the costs involved in France in using basic-access ISDN for transferring documents between two Macintosh/Appletalk local area networks. The costs fall into three categories:

- Once-off installation costs, which cover basic-access connection charges for each end of the link, terminal adaptors, cables, and software.
- A monthly subscription charge to the basic-access service. Each end of the link has to pay this charge. Even though ISDN tariffs in France are among the lowest yet announced, the monthly subscription is substantially higher than the analogue equivalent.
- Usage charges. The tariff is specified in terms of a charge per unit; for data transmission, the tariff is about 1.8 times higher than for voice. As with conventional telephony, the number of units is determined by the duration of the connection and the distance between the two ends of the link.

The figure shows that, despite the higher tariff for ISDN, the cost of transmitting a large file is significantly lower than it would be with the existing analogue PSTN because of the higher data transmission rate. This example illustrates that using ISDN can provide benefits. However, the case for using ISDN involves making a trade-off between the lower data transmission charges, and the additional costs for equipment and software and the higher subscription charges.

Standards are lagging behind implementation

Standardisation is essential for the widespread acceptance of ISDN. Without international agreement on standards for digitising the local loop, there is a danger that each PTT would choose a different technical solution (designed, in part, to support the interests of national suppliers of telecommunications equipment). Without international standards, end-to-end digital working from a subscriber's terminal in one country to a terminal in a different country would be very difficult.

Although PTTs are cooperating in an attempt to avoid national differences, there are still many problems to be resolved, particularly with regard to signalling. France, Germany, and the United Kingdom, for example, are each advocating different approaches. From the users' standpoint, this means that international ISDN services will be restricted initially to little more than voice communications and basic file transfer, because gateway translation of the different national ISDN variants would be required.

Uncertainties about standards are reflected in manufacturers' product developments. PABX suppliers are not waiting for the ISDN signalling protocols to be finalised, but are developing products that use proprietary or national protocols. Alcatel and Siemens have jointly specified a signalling protocol called ISDN PABX networking specification (IPNS), and British suppliers are conforming to the digital private network signalling system (DPNSS) and DASS-2 standards.

At present, equipment manufacturers can choose whether to conform with ISDN standards or to adopt an independent line. It is unlikely,

Figure 4.4 In France, once-off and subscription costs for ISDN are higher than for the PSTN, but usage charges can be considerably lower

Assume that there is a requirement to transmit information at peak-rate times between two Macintosh Appletalk LANs.

Once-off installation costs

For ISDN, the once-off installation costs would be:

2 x basic access charges (FFr 675)	FFr 1,350	
2 x ATS 64 terminal adaptors (FFr 10,900)	21,800	
2 x cables (FFr 200)	400	
2 x Easylink bridge software (FFr 2,900)	5,800	
2 x MacTell communications software (FFr 1,100)	2,200	
Total	**FFr 31,550**	**($6,150)**

For transmission over the PSTN, at 4800 bit/s, the once-off installation costs would be:

2 x analogue line charges (FFr 250)	FFr 500	
2 x modems (FFr 6,000)	12,000	
2 x communications software (FFr 1,000)	2,000	
Total	**FFr 14,500**	**($2,825)**

Monthly subscription charges

ISDN: 2 x FFr 300	**FFr 600**	**($115)**
PSTN: 2 x FFr 80 (Subscription for a normal analogue telephone line)	**FFr 160**	**($30)**

Usage charges (excluding VAT)

	Normal telephone tariff*	ISDN voice tariff*	ISDN data tariff*
Cost per unit	FFr 0.615	FFr 0.615	FFr 0.615
Time per unit for local calls (peak rate)	6 minutes	6 minutes	23 seconds
Time per unit for calls over 100 km (peak rate)	17 seconds	17 seconds	9 seconds

* Discounts are applied at off-peak times.

To transmit a 1 megabyte (8 megabits) file by ISDN, the usage costs would be calculated as follows:

Transmission time for 8,000,000 bit/s @ 64k bit/s	= 125 seconds
Time per unit (over 100 km) = 9 seconds; thus, number of units	= 14
Cost per unit = FFr 0.615; thus, total cost	= **FFr 8.61 ($1.65)**

To transmit the same file via the PSTN @ 4800 bit/s:

Transmission time	= 1,667 seconds
Number of units	= 99
Total cost	= **FFr 60.88 ($11.85)**

however, that any one PABX supplier is sufficiently dominant to maintain an independent line. As we emphasised earlier, the PTTs will ensure that ISDN becomes *the* access method for digital communications, and it is inevitable that equipment manufacturers will eventually have to conform with ISDN standards.

There are incompatibilities with private data networks and cabling schemes

ISDN cannot easily be integrated with existing private data network architectures. The difficulty stems from the fact that the basic unit of bandwidth chosen for ISDN is 64k bit/s. While there were good historical reasons for choosing 64k bit/s, advances in data-compression techniques mean that considerably less bandwidth is now required for high-quality digital voice transmission. There has been some recognition of this in the CCITT, which has considered including 32k bit/s voice transmission in the ISDN standards. Corporate users, however, will be looking for even more efficient use of bandwidth for voice communications, especially for international circuits. For mobile communications systems, for example, 4.8k bit/s voice transmission is a real possibility by 1993.

While 64k bit/s is too high for voice, it is often too low for data communications. Corporate networks are increasingly based on interconnected local area networks (LANs). The high transmission rates of LANs — typically ranging from 4M to 16M bit/s (and with the prospect of 100M bit/s when optical-fibre technology is introduced) — are in sharp contrast to the lower rates of narrowband ISDN. There are also fundamental differences in the natures of ISDN and LAN traffic. Because of its telephony origins, the design principles for ISDN assume continuous, non-bursty, circuit-switched traffic. LAN traffic is bursty and frames of data are generally routed in a 'connectionless' mode from source to destination.

A partial solution to this problem will result from the development of frame-relay services. Frame relay is one of several fast packet-switching techniques aimed at overcoming some of the deficiencies of existing X.25 packet switching, and at achieving more efficient use of bandwidth (and hence, lower transmission costs) for bursty data traffic. X.25 packet switching is limited to about 64k bit/s because of the 'overhead' needed to protect data as it is transmitted over error-prone analogue links. By removing much of the overhead, frame relay will enable data to be transmitted at up to 2M bit/s or more.

ISDN frame-relay services will eventually supersede X.25 packet switching and will be able to satisfy some LAN-interconnection requirements. The frame-relay technique will, however, first be implemented in non-standard proprietary products that combine it with data-compression techniques, so that voice and data transmissions can be integrated in the same point-to-point private circuit. We say more about fast packet switching in the next chapter.

There is also uncertainty about whether building wiring will be suitable for ISDN services. The PTTs will not guarantee that existing building wiring is suitable for ISDN services, and will demand that a different cable connector be used. User organisations, on the other hand, will be discouraged from using ISDN if they first have to modify their existing cabling schemes. In reality, many existing building-wiring schemes are likely to be perfectly adequate for ISDN services. In particular, any of the structured wiring schemes conforming to the ISO/CENELEC standards, which are derived from US EIA (Electrical Industries Association) standards, are likely to be adequate for ISDN services. Examples include the IBM Cabling System, AT&T's PDS, and Bull's BCS.

Foundation members should begin to take account of ISDN

Despite the initial slow take-up of ISDN, and the difficulties that still need to be resolved, we believe that Foundation members should now begin to take account of ISDN in their communications planning. The aim should be to ensure that, when the time is right, it will be as easy as possible to integrate ISDN into the corporate communications infrastructure. In those countries where ISDN is sufficiently advanced, members should now be considering potential ISDN applications and testing them with suitable pilot projects. Before embarking on an ISDN project, they should also determine if any financial assistance may be available, in the form of subsidies or assistance with development effort. Participation in ISDN user forums and groups should also be considered.

Take steps to integrate ISDN with corporate networks

There are some immediate steps that can be taken to prepare the ground for the eventual integration of ISDN with existing corporate networks. ISDN could be used to provide dialled back-up facilities for leased digital circuits. This could be implemented with minimal planning, and would provide early experience of using ISDN. Primary-access channels could be provided to all digital PABXs that have the appropriate ISDN software interfaces. In almost every case, ISDN primary access to large digital PABXs will be less expensive than any other alternatives. It would also be prudent to ensure that equipment and software procured for corporate voice and data networks conform as far as possible with ISDN standards.

Applications developers will also have to learn how to make the best use of ISDN facilities. Many existing communications applications, and most communications software and hardware,

are designed with low-speed and error-prone analogue communications links in mind. The continued use of these design principles in a comparatively error-free ISDN environment will lead to inefficiencies, because unnecessary 'overhead' information will be transmitted and the available bandwidth will be underused. Although communications software optimised for use with ISDN is now becoming available, a good deal of in-house expertise will be required to implement applications. It will therefore be necessary to ensure that development staff receive the proper training required to take full advantage of ISDN.

Consider potential ISDN applications

Earlier in this chapter, we identified several new application areas made possible by ISDN. These included niche applications involving image transmission, and customer-service and telemarketing applications. Organisations should consider whether there are areas of their business that could benefit from using ISDN in similar ways. Those organisations that have a large number of widely dispersed small branches should investigate the potential of ISDN to provide both a technical and an operational solution to their telecommunications requirements. Those considering the introduction of home working might select a few technically minded staff who could be used as a test bed for residential ISDN services.

In view of the various uncertainties and difficulties referred to earlier, carrying out a pilot project before committing to large-scale use of ISDN is a wise, if not essential, precaution. It is important that the pilot be structured so that its results can support a solid business case for deciding whether to adopt ISDN. The pilot must therefore be designed to compare the costs of using ISDN with the cost of existing telecommunications services, or to demonstrate the benefits of a new application that could not be implemented with existing services.

Take advantage of financial incentives and user groups

The PTTs recognise that they have an enormous task in persuading business users to switch to ISDN. Some of the more progressive PTTs have recognised the importance of applications in developing an early market for ISDN, and are participating in defining and promoting them. France Telecom pioneered the 'partnership' agreement, in which it contributes to the funding of approved applications that are developed jointly by the user and the software developer. To be considered for such funding, which can exceed 50 per cent of the costs, applications must meet three criteria. They must be innovative, have wide potential use, and be cost-effective.

Other PTTs are beginning to copy the French initiative, notably DBP Telekom in Germany. In addition, the European Commission is studying ways of promoting the use of ISDN, including providing subsidies for pioneering users. Foundation members would therefore be well advised to explore all possible means of external financial support before embarking on the development of ISDN applications.

In some countries — Australia and the United States, for example — ISDN user groups have been established as forums for exchanging knowledge about, and experience of, developing ISDN applications. As the pace of ISDN implementation quickens, user groups will no doubt be formed in other countries. Participation in such forums not only helps with decisions on implementation, but it also provides user organisations with a mechanism for influencing the way in which ISDN services are provided.

The original vision of ISDN was that it would provide a single unified network, which (being the integrated vehicle for all services) would subsume all other networks. This vision had its origins at a time when telecommunications was essentially a monopoly business, and before alternative data communications services had become firmly established. Today, ISDN is increasingly perceived as just one of several options for providing telecommunications services, and as a means of providing access to these options, rather than as an integral end-to-end service vehicle in itself. In particular, ISDN is threatened by technologies and services that bypass the traditional local loop, notably mobile communications and satellite services. We deal with these services in other chapters of this report.

Chapter 5

Metropolitan area networks

Narrowband ISDN will provide public switched services operating at up to about 2M bit/s. Metropolitan area networks (MANs) will provide public switched services for the transmission of data, voice, and video at rates ranging from 2M bit/s to 140M bit/s and beyond. MANs will be based on optical-fibre networks, each designed to cover an area equivalent to that of a major city. In each country, there will be just a few cities with MAN facilities. The economic and social consequences could be profound because businesses will be attracted to these areas by the high-bandwidth public telecommunications infrastructure. In time, however, MANs will be interconnected by wideband digital links to provide nationwide and international coverage, and will evolve to form part of a broadband ISDN infrastructure. Figure 5.1 illustrates the MAN concept.

In this chapter, we explain how the growing business demand for wideband wide-area communications — in particular, the need to interlink local area networks — is leading the PTTs to define and install MAN services. We describe the fast packet-switching technology that has been adopted by the Institute of Electrical and Electronics Engineers (IEEE) as the standard for MANs, and review the progress that is being made in installing MANs that conform with this standard. The chapter concludes with a brief look at the most likely evolutionary path from MANs to broadband ISDN.

MANs will be used to satisfy the growing demand for wideband communications

The business demand for wideband wide-area communications, particularly to interlink LANs, is growing, and this has led to the development of products and public services that can be used for this purpose. All of these solutions have drawbacks, however, and will be superseded by MANs.

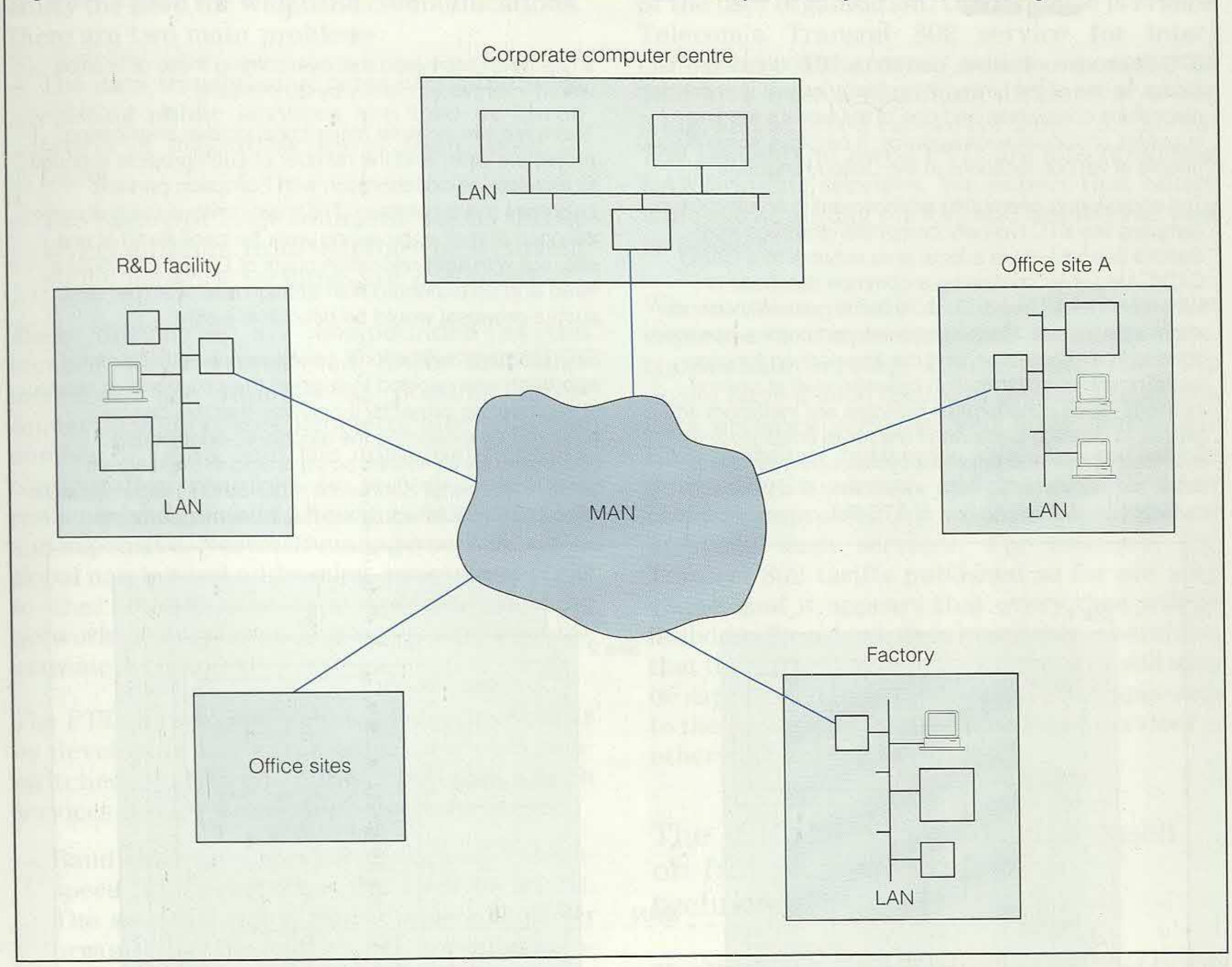
The demand for wideband services is growing

Much of the growing business demand for wideband wide-area communications facilities derives from the need to provide remote users of computer systems with the same performance as local users. At present, information can be transmitted within a site, via a local area network, at much higher rates than it can be transmitted between sites using existing public telecommunications facilities. MANs will provide the facility, for example, to transfer megabytes of data between sites in less than a second, and will enable remote users to access LAN applications with no loss of performance.

Once MANs have been installed, wide-area telecommunications networks will, for the first time, operate at the same speeds and with the same performance as mainframe computer environments. The prospect of the availability of abundant, and (if sensible tariff policies are adopted) inexpensive, bandwidth will fundamentally affect the way people and machines communicate and the way business is transacted.

Much of the communications traffic for MANs will be generated by image-processing applications. According to Telecom Australia, one Australian bank has calculated that using images for cheque processing could replace about 50 per cent of its manual handling. This would, however require high-speed communications for transmitting cheque images prior to electronic archiving. An average of 300,000 cheques per night are processed manually by the large banks in Australia. Electronic processing of cheque images is a specialised application of electronic document management, the subject of

Figure 5.1 MANs will provide wideband links between business locations, particularly for interconnecting LANs



Report 70. The growth in EDM applications described in that report will generate an increased demand for wide-area, broadband communications.

The use of high-resolution image databases in medicine and engineering is already widespread, but because of the high transmission rates required, users normally have to be at the same site as the database. In France, for example, the national electricity utility has two Cray supercomputers supporting its research activities. They are connected to high-performance workstations via a high-speed local network operating at 800M bit/s. Researchers can use these facilities to carry out complex simulations in areas such as flow analysis or metal fatigue. Currently, they have either to be permanently located at the computer centre, or to make frequent visits there. Use of a MAN would enable more of the researchers to be located away from the computer centre and would reduce travel costs. It would also enable the resources of the very expensive supercomputers to be available to a larger number of users than is possible at present.

In manufacturing companies, the development, engineering, and production sites are often distributed and far apart, usually for historical or political reasons. Such organisations have a need for broadband communications between their various sites. STC Telecommunications in the United Kingdom is a case in point. Its proposed solution, using MAN services, is described overleaf in Figure 5.2.

MANs will also be used to link an organisation's computer centres. As businesses become increasingly dependent on their computer systems, the need for additional security, back-up, and (in some cases) hot stand-by, will also

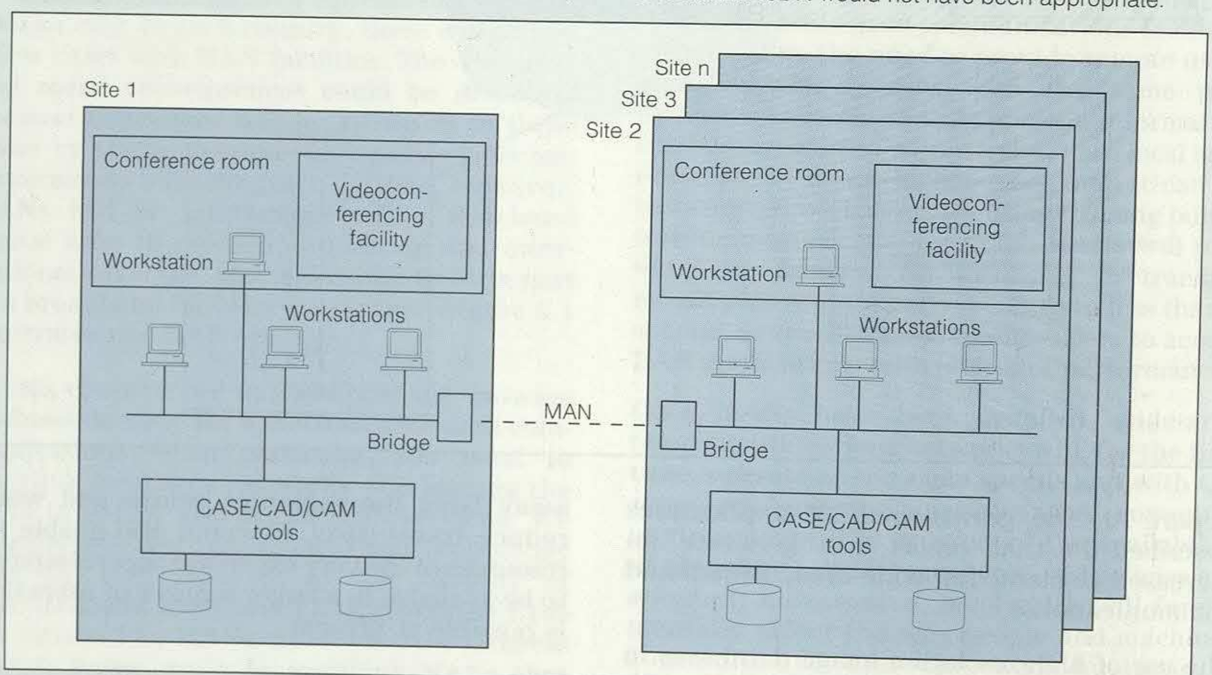
Figure 5.2 STC Telecommunications believes that it can support the collaborative nature of engineering developments using MANs

STC Telecommunications, part of the 36,000-strong STC Group, is one of the United Kingdom's largest independent electronics companies and one of the world's leading suppliers of transmission systems. It employs some 20,000 people at various locations in the United Kingdom

The engineering computing environment in an electronics company like STC typically comprises graphics workstations connected via a local area network to a CASE/CAD/CAM server containing a common database of information for all users. Such systems generally operate within a single site. Most electronics companies, however, operate from many sites, and the engineering function usually involves collaboration between staff at several locations. Such collaborative activities are inefficient and difficult to manage because of the travel costs involved, extended review and approval cycles, off-site working costs, the 'not-invented-here' syndrome, and poor communications. Within one part of STC Telecommunications, it has been estimated that overcoming these difficulties would improve efficiency by 20 per cent.

There are two or three major collaborative engineering projects a year, and the number of such projects is bound to increase as collaboration with European partners becomes more common. The most obvious solution was to propose that all engineering work be centralised at one site, but with staff relocation costs of £6,000 ($10,500) a head and an expected staff attrition rate of 25 per cent, such a proposal would be difficult to justify.

STC Telecommunications' conclusion was that a new approach was needed to support the collaborative nature of engineering projects. It believes that this can be achieved by extending the electronic-engineering environment with MANs, as illustrated in the diagram below. The overall bandwidth requirements were such that narrowband ISDN would not have been appropriate.



increase, particularly as realtime distributed applications and databases are implemented. Using MANs, organisations such as banks and mail order companies will be able to back up their transactions almost in realtime. Mass printing and telemarketing operations could be decentralised and located in low-cost areas.

For most Foundation members, however, the main significance of MANs is that they will greatly simplify the creation of wide-area networks based on the interconnection of dispersed local area networks. As we explain below, current methods for linking local area networks are inadequate, and MANs will provide a viable alternative.

Existing LAN-interconnection products and services have drawbacks

A variety of products (including gateways, bridges, routers, and 'brouters') now exist for interconnecting LANs via existing telecommunications services. Although these provide working technical solutions, they do not fully satisfy the need for wideband communications. There are two main problems:

- The data transmission rates available with existing public services are two or three orders of magnitude lower than those of LANs.
- The nature of LAN communications traffic is very different from that for which current public network facilities are optimised.

These difficulties are compounded as the number of interconnected LANs and sites increases. The number of possible interconnections increases geometrically with the number of LANs, and the minimum network configuration required to provide adequate resilience and reliability becomes more complex and expensive. Network-management issues — global naming and addressing, providing access to the network for new devices, defining network problems, and so on — also become extremely complex.

The PTTs have responded to these drawbacks by developing and introducing their own non-switched wideband public services. Such services usually come in one of two forms:

- Bandwidth-only services that provide high-speed 'pipes' between the LAN locations. The so-called 'dark fibre' (where the user organisation provides the optical transmission facilities) falls into this category.
- Those involving the provision of bridges and/or routers, as well as bandwidth, by the service supplier.

An example of such a service is British Telecom's Flexible Access Service (FAS), which is available in the financial district of London. This is an optical-fibre system that provides multiple users with wideband access to the local telephone exchange. France Telecom has a similar pilot service for six large organisations in La Défense, the new business district in Paris. Telecom Eireann is implementing a similar system (DASSNET) in Dublin, and Telefónica is considering a pilot system in Madrid.

Dark fibre and FAS are essentially items of PTT infrastructure and are thus service vehicles rather than services themselves. However, several European PTTs now offer LAN-bridging services that interconnect two LANs on behalf of the user organisation. One example is France Telecom's Transrel 802 service for interconnecting Ethernets, which operates at 10M bit/s over a maximum distance of about 5 km, and at lower rates over longer distances. The Danish and Swiss PTTs are also providing LAN-bridging services. We expect that others will follow, adding routers and brouters as well as bridges.

We question whether the PTTs have the expertise to implement and maintain data-transmission services such as these. The PTTs do not have a good record of providing complex data network services, and large multi-node LAN-bridging networks can be extremely demanding to design and manage. Another concern expressed by users is the high cost of using such services. For example, the Transrel 802 tariffs published so far are very vague, and it appears that every case will be individually priced. It is inevitable, therefore, that the current non-switched services will soon be superseded by a network-oriented approach to the provision of public broadband services — otherwise known as MANs.

The IEEE MAN standard is based on fast packet-switching technology

The IEEE 802.6 Committee has adopted DQDB (distributed queue dual bus) technology as the standard for MANs. DQDB is based on the cell-relay form of fast packet switching, where data is divided into small fixed-length packets, or cells. (The other form of fast packet switching is frame relay, where the packets are of variable length, much like those on a LAN; frame relay is already being implemented in proprietary products for use in private networks.) The two forms of fast packet switching are described in Figure 5.3, overleaf.

DQDB technology was developed in the mid-1980s by a team from the University of Western Australia. With the backing of Telecom Australia, the technology has been commercialised through a company known by the name of the technology's first acronym, QPSX (queued packet switch exchange). A MAN using the 802.6 DQDB standard will operate at up to

Figure 5.3 There are two forms of fast packet switching

Cell relay

The cell-relay form of fast packet switching splits the communications traffic into small packets (or cells) of fixed length as a means of minimising their throughput delays. The simple structure and small size of the cells enables them to be switched at very high speeds — hundreds of thousands of packets per second. There are two types of cell relay, DQDB (distributed queue dual bus) and ATM (asynchronous transfer mode). ATM is the technique currently favoured by the CCITT for the future broadband ISDN. The standards for the two are being aligned, and it seems likely that broadband ISDN will evolve through the interconnection of MAN 'islands' using the DQDB technique.

Frame relay

The frame-relay variety of fast packet switching (sometimes termed 'turbo X.25' or 'lightweight X.25') works in a similar way to a LAN by relaying variable-length frames from source to destination. Services based on frame-relay technology are being standardised by the CCITT for use with narrowband ISDN, although it will initially be used in private networks for the point-to-point transmission of voice, data, and image using non-standard formats. It could constitute an efficient method for accessing public MANs.

Several suppliers are developing frame-relay products, including AT&T, Digital, GPT (GEC Plessey Telecommunications), Vitalink (a Californian network products company), and Northern Telecom, and we understand that IBM is about to announce a new product. The first product on the market is IPX, however, from Stratacom (a Californian start-up company). (Telenet's fast packet switches are based on Stratacom's technology.)

155M bit/s and provide transparent interconnections between LANs. The key to DQDB is the use of short, fixed-length packets that can be processed at speeds that are appropriate for optical fibres. It is a *connectionless* service in that no pre-established logical connection between source and destination is required for the successful delivery of data from one to the other. Bellcore (Bell Communications Research) has already developed a RISC-based chip that can process DQDB packets at around one gigabit per second. This contrasts with the current maximum of about 64k bit/s for an X.25 line card. The principles of DQDB are described in more detail in Figure 5.4.

The electrical configuration of a DQDB MAN shown in the figure can be implemented in several physical layouts, one of which is shown in Figure 5.5, on page 42. The configuration is divided into customer-premises equipment (or clusters) and local-exchange clusters. The illustration shows a typical US implementation where point-to-point configurations suit the regulatory environment. Elsewhere, the dual buses are likely to originate *and* terminate in the PTT exchange. Access to a MAN can, in principle, be at any of the recognised digital transmission rates from 1.5M to 45M bit/s, and even 155M bit/s. (The maximum internal MAN transmission rate has now been upgraded to 155M bit/s as part of its alignment with broadband ISDN.) Access is via LAN-MAN bridges, which may be procured by the user organisation or by the service provider, depending on the regulatory regime of the country in question.

Before the IEEE 802.6 Committee standardised on DQDB for MANs, the FDDI (fibre distributed data interface) standard, or its planned successor, FDDI-II, was mooted as a possible candidate. FDDI is the *de jure* US standard and the worldwide *de facto* standard for optical-fibre LANs. We believe that the IEEE decision to standardise on DQDB will mean that FDDI networks will, in the main, be confined to a campus or a building, and may even lead to the abandonment of FDDI-II. Like DQDB, FDDI-II can accommodate circuit-switched services that need guaranteed bandwidth. However, shared use of an FDDI ring was not really envisaged in its design, and unlike DQDB, the lack of security features makes it unsuitable for use in a public service.

FDDI products are now becoming available and networks are starting to be implemented. Costs are still high — about $11,000 per connection — but we expect these to halve by 1993 as the volume increases. FDDI will appeal to organisations that wish to interconnect Token-Ring and Ethernet LANs or that need to link high-performance workstations to servers. The traffic generated by private networks such as these will be one of the prime sources of the traffic for public DQDB MANs.

We believe that most FDDI networks will be designed, implemented, and operated by a user organisation's own staff, sometimes helped by outsiders. A few organisations, however, will prefer the approach taken by British Airways (and described in Figure 5.6, on page 42). British Airways (in conjunction with British Telecom) has, in effect, constructed a private MAN at London's Heathrow Airport, using FDDI technology.

Figure 5.4 The DQDB metropolitan area network is based on the use of short, fixed-length packets that can be processed at speeds appropriate for optical fibres

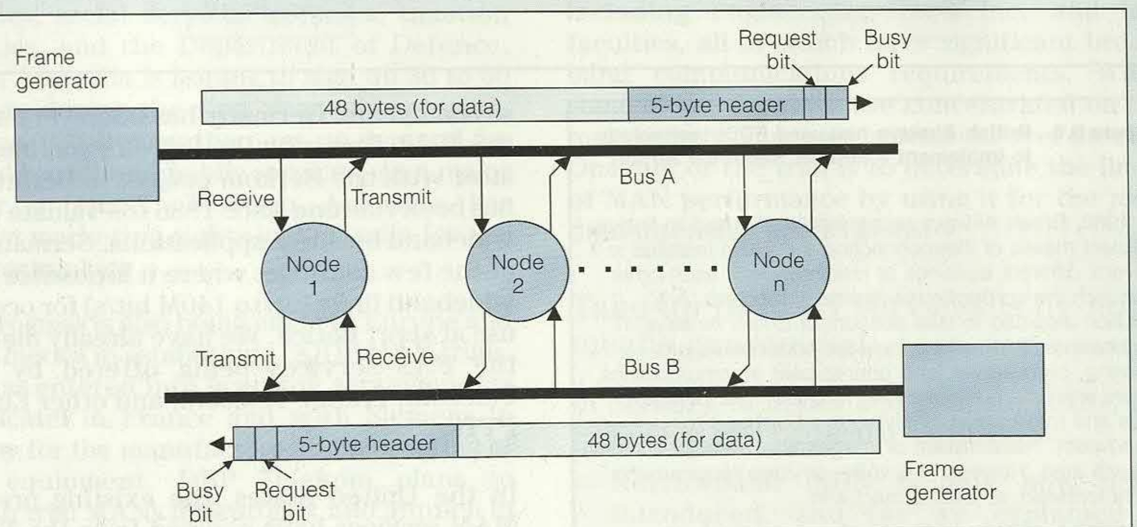
Unlike some LANs, DQDB (distributed queue dual bus) technology has a bus topology, actually made up of two parallel buses. Nodes are not serially connected, as in the case of ring topologies, but are merely 'suspended' between the two buses. This is important because it means that nodes do not interfere with the flow of packets along the bus, allowing both faster transmission and minimal impact from node failures. The key to DQDB technology is that each node can communicate with every other node by writing information on one bus and reading it on the other.

Accessing the buses in this way combines the speed of random access methods (for example, Ethernet) with the loading of controlled-access protocols (for example, Token Ring), but without the attendant delays. This is achieved by keeping each node aware of the overall load on the buses — in particular, of the place it occupies in the overall queue when it has a packet to transmit. The frame generators generate 53-byte cells (a 5-byte header and 48 bytes for data), which may be full of data or free. The header contains a 'busy' bit that indicates whether the cell is free, and a 'request' bit that indicates that a node has a packet ready to transmit.

Suppose Node 2 wishes to send a packet to Node n. It will clearly choose Bus 'A' to do so, but it will first send a request on Bus 'B'. If Node 2 were sending to Node 1, it would choose Bus 'B', but would first send the request on Bus 'A'. Each node counts the number of requests made and the number of busy cells that pass serving those requests. In our example, Node 2 would allow free cells to pass until all requests ahead of it in the overall queue are satisfied, whereupon it would seize the next free cell. Packets are therefore sent in the order in which they join the overall queue.

This arrangement is akin to a passenger waiting for a train at one station while others are waiting at other stations. In an ideal society, each passenger would wait to board a train until all other passengers who have arrived at other stations before him had already boarded. He would do this by checking markers placed on trains coming in the opposite direction.

However, time-dependent isochronous traffic (such as voice) cannot wait around for the next free cell, and so some slots are specially reserved for this type of traffic. It is claimed that this method guarantees the minimum access delay for all levels of traffic load on the bus up to 100 per cent, and that performance is independent of the bit-rate or physical extent of the network.



Switched MAN services will be introduced in 1991

The PTTs have recognised for some time that there will be a demand for public, wideband communications services. Indeed, in the early 1980s, there were some enthusiastic, if rather misguided, experiments of providing wideband services to homes, which involved laying many kilometres of optical fibre. In France, the Biarritz experiment (which began in 1984) illustrated the potential for combining the delivery of cable television services and advanced telecommunications services, but was widely acknowledged as being somewhat ahead of its time. (The perceived need to combine TV distribution with advanced communications forms the basis for much of the current thinking about the requirements for broadband ISDN.) A similar experiment was carried out in Canada when the provincial telephone company in Manitoba installed an optical-fibre network in two small villages (Elie and St Eustache) to test its suitability for rural telecommunications and TV distribution.

In some countries, pilot services for wideband business communications have existed for

Figure 5.5 The electrical configuration of a DQDB MAN can be implemented in several physical layouts

One option is illustrated in the diagram.

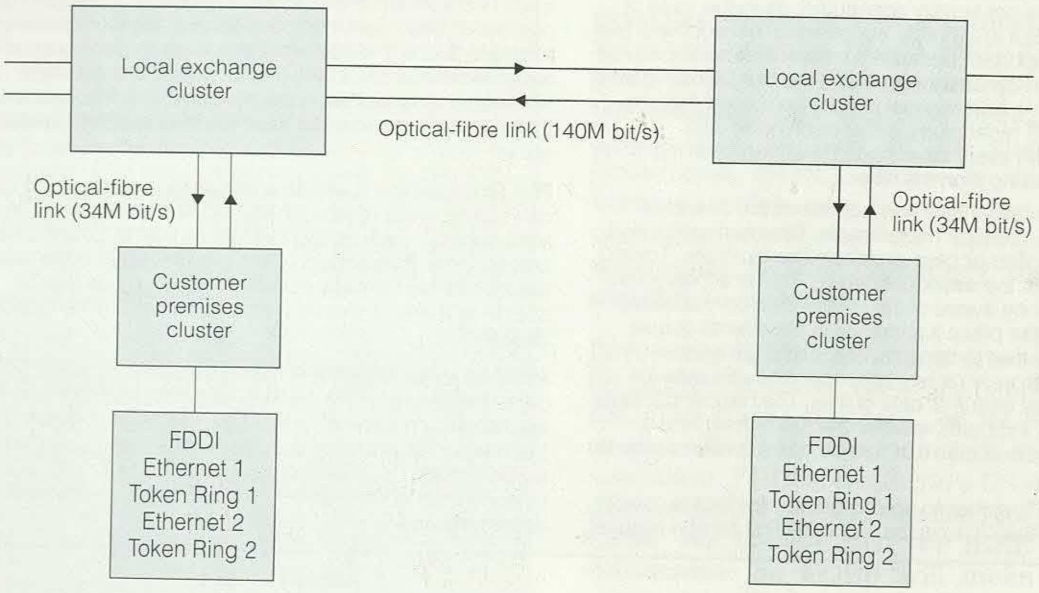


Figure 5.6 British Airways has used FDDI technology to implement a MAN at Heathrow Airport

In 1988, British Airways recognised that it had to find an efficient means of interconnecting the LANs installed in several different buildings at Heathrow with each other and with the corporate mainframe computers. Any solution also had to take account of British Airways' IT architecture, BAX, which includes cooperative processing, client/server, and peer-to-peer communications. There was also a requirement to share data between PCs and mainframes, implying a major need for bandwidth. Transmission of images was seen as another growth area. However, no voice or video requirements were foreseen, at least to start with.

An FDDI backbone LAN was chosen as the best technical solution, and British Telecom was selected as the supplier of an FDDI service to British Airways. In fact, the project is a joint development between British Airways and British Telecom, to provide a LAN-bridging service for British Airways' local area networks in the Heathrow area. British Telecom will provide the (Fibronics) FDDI nodes in each building and link them with 62.5 micron optical fibre in 'blown fibre' plastic tubing. Implementation started in June 1990 and the ring will be operational with 14 nodes by January 1991.

FDDI was chosen because there were products available that met the requirements, such as support for 16M bit/s Token Ring plus some niche Ethernet; there was also supplier commitment. DQDB technology was considered but rejected because there were too many 'futures', costs were much higher, and the 'pipe' approach with PC-based bridges could have caused bottlenecks.

several years. Germany has been very active in this field, first with the Bigfon experiment, and later with the Berkom project in Berlin, which has been running since 1986 to evaluate and test wideband business applications. Germany is one of the few countries where it is possible to lease wideband links (up to 140M bit/s) for occasional use at short notice. We have already mentioned the FAS services being offered by British Telecom, France Telecom, and other European PTTs.

In the United States, the existing pre-DQDB MAN services have evolved from the Teleport operations that provide local access to satellite hub stations. There are now a dozen local-access carriers providing high-speed communications services (up to 45M bit/s) via optical-fibre links in 20 cities. The fierce competition that they provide to the regional Bell operating companies has had a dramatic effect on tariffs. In a competitive environment such as the United States, MANs provide a means of bypassing the existing public telecommunications facilities.

Many PTTs have now announced their intention to carry out trials of DQDB MANs in 1990 and 1991. Not surprisingly, the first country to implement a DQDB MAN service will probably be Australia, where the concept was invented. A technical pilot is already underway within Telecom Australia, connecting some 20 LANs. The plan is for Telecom Australia to launch a commercial pilot of its Fastpac service with six major customers during the first half of 1991. If all goes well, a nationwide service, covering the capital cities in each mainland state, will be publicly launched in the third quarter of 1991. In each of these cities, Telecom Australia has already installed an optical-fibre network that passes within 50 metres of every major building. Common-access optical-fibre loops operating at 34M bit/s will be connected to the network.

Several interfaces are being provided, including those for Ethernet and Token-Ring LANs, and a range of services operating at 2M bit/s will be offered, such as ISDN primary-rate interfaces and 'H' wideband channels. Target customers for Fastpac are the top 500 telecommunications users in Australia, including banks, transport companies, social services agencies, taxation authorities, and the Department of Defence. Telecom Australia is hoping to sign up 30 to 50 customers during the first year of operation, reflecting, it believes, the pent-up demand for switched broadband public services. As a major investor in QPSX, Telecom Australia has exclusive marketing rights in Australia for the DQDB technology.

Rapid progress is also being made in Europe and North America in establishing DQDB MAN trials. QPSX has entered into licensing arrangements with Alcatel in France and with Siemens in Germany for the manufacture and marketing of DQDB equipment. DBP Telekom plans to establish trial MANs in Stuttgart and Munich in mid-1991; both Siemens and Alcatel will be supplying equipment for these trials. Many other European PTTs are considering MAN projects, including those in the Netherlands, Finland, Italy, and Spain. Telekom Finland plans to provide MAN services in three cities — Helsinki, Lappeenranta, and Tampere — with trials scheduled to begin at the end of 1990, and operational service in place early the following year. Telefónica plans to have a MAN in place for the Barcelona Olympic Games in 1992.

France Telecom has not yet committed itself to using DQDB technology, preferring to try out several alternative broadband schemes at different locations. Pilot networks are being used to link research organisations at the high-tech industrial park in Sophia-Antipolis, and to link various scientific and aerospace industries located in Toulouse. Other broadband networks are being constructed, and France Telecom expects to have between 15 and 20 in place by 1992.

In the United States, there are several projects to install switched MAN services based on the IEEE 802.6 standard. AT&T has specified its Switched Multimegabit Data Service (SMDS), but has broken off an intended joint venture with QPSX, and now intends to design and build its own version of the equipment. So far, three regional US carriers have announced SMDS trials — BellSouth, Pacific Bell, and Nynex. In addition, Bell Atlantic is working with QPSX to conduct a trial at Temple University in Philadelphia during the last quarter of 1990. (This will probably be the first US pilot project). Temple University has 14 schools and colleges, including engineering, medicine, and law faculties, all of which have significant broadband communications requirements. While some of the faculties are concentrated on the main campus, many are spread out over the city. One aim of the trial is to determine the limits of MAN performance by using it for the most data-intensive applications.

Take-up of MAN services is by no means guaranteed

In deciding to install and promote MANs, the PTTs face two particular difficulties:

- Narrowband ISDN is only now being introduced, and (as we explained in Chapter 4), the PTTs have their work cut out to persuade businesses to adopt ISDN. The availability of MAN services will only confuse the issue because the PTTs will, in effect, have to tell some users that they do not really need ISDN; instead, they need the new revolutionary MAN services, which are much more suited to their traffic patterns than ISDN. This may, of course, be true, but it does have rather important consequences for the narrowband ISDN service.
- Considerable investment will be needed. Given the immaturity of the technology, the PTTs will want to write off the capital costs in as short a time as possible.

These two factors suggest that the PTTs will take a cautious approach when setting tariffs for MAN services. Our view is that the tariffs set will not encourage a rapid take-up of MAN services.

As with any new product or service, the costs of providing MANs can be expected to fall as market penetration increases. While the trend towards wideband communications is clear, the rate at which public wideband services will be adopted is very uncertain. Before a critical mass of users is reached, the PTTs will expect the cost of providing MAN services to be met by a small number of large organisations. The implication is that, for some time, MANs are likely to exist as 'islands' of concentrated demand, with limited interconnection between the islands. This will not, however, meet the needs of multi-site organisations, which are often scattered around the country in a similar manner to that described in Figure 5.2. The lack of universal geographical coverage will be a serious obstacle to the widespread adoption of MAN services.

Another factor affecting the take-up of MAN services is the confusing set of options that are currently available for implementing networks based on interconnected LANs (these options were mentioned earlier in the chapter). Not all wideband communications will necessarily be satisfied by MAN services. Some traffic of a continuous, non-bursty nature will be better suited to dedicated wideband capacity. The most appropriate choice will be determined by the tariff structures. The PTTs will need to take careful account of the impact that tariff structures will have on positioning the various wideband services with respect to the potential market.

In the longer term, we believe that public MANs will play a significant role in corporate wide-area networks. Using MANs in this way can be seen as part of the overall trend in business towards delegating specialised tasks to third-party service providers. There will inevitably be less need for specialist in-house staff as these services are implemented, and Foundation members will need to take this into account in their long-term planning. Those members with significant wideband communications requirements, and who are prepared to take the risk of being a pioneer, should consider participating in one of the MAN trials.

The geographical coverage of MANs means that they have been conceived as a public service. There is no reason, however, to prevent the same technology being used for private networks. On a large campus, for example, a MAN, rather than an FDDI network, could form the backbone network. For wider coverage, it would be necessary to lease the so-called dark fibre from the PTT. It is likely to be easier to do this in the United States than elsewhere, because the regulatory constraints are minimal. In other countries, the monopoly (or in the United Kingdom, duopoly) PTTs are likely to be wary of the possibility that their existing services might be bypassed by private MANs. They are also in a position to discourage their major equipment suppliers from selling MAN systems direct to user organisations.

Nevertheless, a large private MAN is being constructed at Cambridge University in the United Kingdom. The network, called Granta, will provide voice, data, image, and video transmission for staff and students at 79 university sites scattered widely throughout the city. Cooperation with the local cable television company has enabled existing cable ducts to be used, and means that the MAN could be used to provide commercial services in the future. All technical options are being kept open by using different types of optical fibres and copper coaxial cable. FDDI-based services will initially be established, followed later by switched DQDB-based MAN services.

MANs will evolve to become part of broadband ISDN

The broadband ISDN concept represents the ultimate degree of integration for telecommunications services. Its objective is to transport and deliver all types of telecommunications traffic — voice, data, image, and video — within a single network. Broadband ISDN will evolve from today's MANs, but the evolution will not begin until the late 1990s.

Work is underway to facilitate such an evolution. The main aim of the European Commission's research programme into advanced communications in Europe is to create an integrated broadband infrastructure. Bodies such as the CCITT are developing technical standards; the technology currently favoured for broadband ISDN is ATM (asynchronous transfer mode, which is similar to DQDB technology — both are forms of cell-relay fast packet switching). Measures are being taken to align the two standards as far as possible, although one of the major outstanding differences is that, unlike DQDB, ATM is a connection-oriented service that requires the establishment of a logical channel between source and destination. The advantage of this is that ATM can accommodate time-dependent traffic, such as voice and videoconferencing.

Much work remains to be done to iron out the technical difficulties and to develop the systems that will function and transport data at gigabit rates. The most likely evolutionary path is that MANs will gradually be extended to provide national and international coverage, using conventional optical-fibre interconnections. ATM backbone links would then be added to create a true broadband ISDN.

The social and commercial issues surrounding the development of broadband ISDN are, however, likely to be more important than the technical difficulties of achieving a smooth migration from MANs. As we explained earlier, the broadband ISDN concept was conceived in the context of a residential service, which would include the delivery of TV transmissions. Some of the 'home of the future' scenarios developed to support the concept were little better than science fiction. Now that the provision of telecommunications services is becoming increasingly market-driven, it is more likely that business needs, rather than perceived residential demand, will be the dominant force in the development of broadband ISDN.

Chapter 6

VSAT satellite services

Satellites have been playing an increasingly important role in the provision of public telecommunications services for nearly 30 years, but they have only recently become significant in the context of private networks. This change has been made possible by developments in technology that have resulted in less complex and more compact terrestrial equipment. New satellite services are characterised by the use of a small antenna dish installed at a user's location, which can be used to receive or transmit information via a satellite.

Satellite services fall into three categories:

— VSAT (very small aperture terminal) services.

— Satellite mobile services.

— Satellite television broadcasting.

In this chapter, we describe VSAT-based telecommunications. Satellite mobile services were described in Chapter 2 along with other new mobile services, and satellite television broadcasting is outside the scope of this report.

Much of the early development of VSAT services has taken place in the United States, where the regulatory environment is more favourable. In Europe, and elsewhere, the take-up of such services is being hindered by the current regulatory restrictions. Nevertheless, we believe it is important that Foundation members are aware of VSAT services and the significant benefits they can provide. PTTs and governments will be under increasing pressure to relax the current restrictions, because European businesses will increasingly be at a disadvantage if they are not able to benefit from the flexibility and efficiency of VSAT services. Once the regulatory environment in Europe is more favourable, the use of these services is likely to grow quickly.

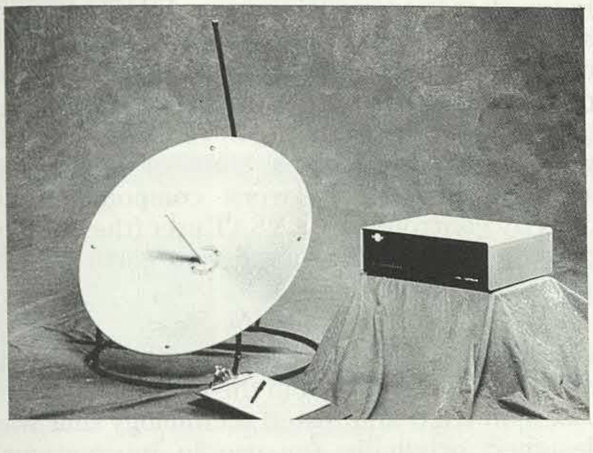
We begin by describing the characteristics of a VSAT service and the significant benefits that it can provide compared with terrestrial communications services. Next, we describe the types of applications (both broadcast and two-way) that are suitable for VSAT communications. We then provide information about the costs of using VSAT networks, identifying the sizes of networks that are likely to be cost-justified. Although VSAT services and networks are most advanced in the United States, they are becoming available in other parts of the world. We review what is on offer and becoming available, and describe the regulatory problems that are slowing down the take-up of VSAT services in Europe, indicating the progress that is being made in overcoming the problems. Finally, we review the main technical developments that will make VSAT services and networks a viable alternative for many corporate communications requirements.

Characteristics of a VSAT service

A VSAT-based communications network is used to carry video, audio, and data services to widely dispersed locations within a satellite's coverage area. The network can be divided into three components:

— The VSATs, each of which consists of an antenna dish ranging from under 1 metre to about 2 metres in diameter, depending on where the dish is located, and on what kind of service is being provided. The antenna (which is sometimes called a microterminal) is positioned on the ground, on a roof, or on an external wall. A small indoor unit provides the interface between the antenna and the user's equipment. Figure 6.1 is a photograph of Contel ASC's K-100 VSAT.

Figure 6.1 A VSAT consists of a small antenna connected by standard coaxial cable to a small indoor digital receiver/controller



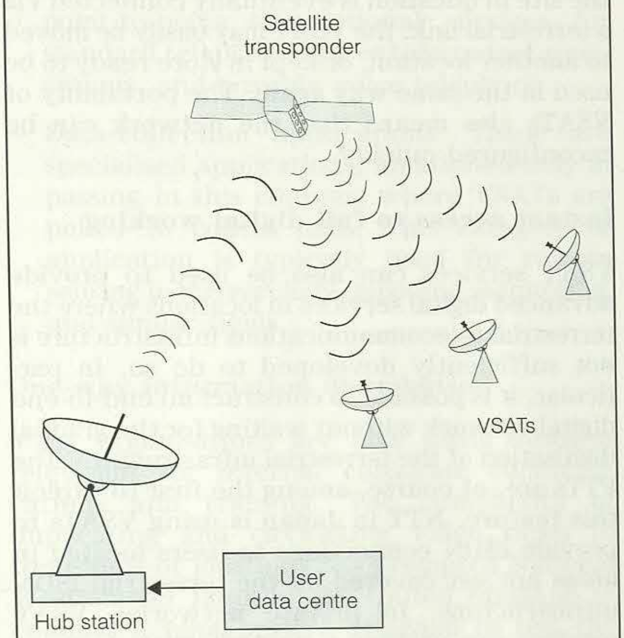
(Source: Contel ASC)

– A 'hub' earth station, which has a large satellite dish that is used to transmit all communications to VSATs from their point of origin. Because of their cost and complexity, VSAT hub stations are often operated by PTTs or third-party service providers and are shared by many users. Typically, the connection between the hub station and the user's host computer or other central facility is made via terrestrial leased lines.

– The satellite transponder capacity that is assigned to the VSAT network or service. Most domestic, regional, and international satellites are equipped with transponders that are suitable for VSAT services.

Figure 6.2 shows a typical VSAT network. There are two basic configurations: one-way broadcast mode and full two-way operation. The transmission capabilities of two-way VSAT networks are asymmetrical, capacity to the terminal being greater than that in the reverse direction. Typically, VSAT terminals have the ability to receive information at high transmission rates — equivalent to analogue television or 2M bit/s (and more) for data transmission. The asymmetrical nature of VSAT networks and their inherent broadcast capability make them particularly suitable for applications that require the same information to be distributed to a large number of sites. Nevertheless, two-way point-to-point applications are also feasible,

Figure 6.2 A typical VSAT network consists of a hub, VSATs, and a satellite transponder



and indeed, are regarded by many as a prerequisite for the growth of VSAT services.

VSAT services and applications provide significant benefits

Compared with terrestrial alternatives, VSAT services, and the applications based on them, can provide a wide range of benefits. Many of the benefits derive from the fact that VSAT networks remove the need to use conventional PTT terrestrial links. This means that VSAT networks can be installed rapidly and changed easily. They also provide immediate access to full end-to-end digital working and are very reliable. Users of VSAT networks can also apply end-to-end network-management controls.

Rapid installation

The main benefits of VSAT services derive from the ease and rapidity with which a network can be installed and changed. The small size and portability of VSATs means that a terminal can be installed and be operational at a new site in less than a day; an equivalent terrestrial link can often take months to establish, especially if it crosses international borders.

Where the regulations permit, a VSAT can be used to provide immediate service to a location, pending the installation of a leased line. When the site in question is eventually connected via a terrestrial link, the VSAT may easily be moved to another location, or kept in store ready to be used in the same way again. The portability of VSATs also means that the network can be reconfigured quickly.

Instant access to full digital working

VSAT services can also be used to provide advanced digital services in locations where the terrestrial telecommunications infrastructure is not sufficiently developed to do so. In particular, it is possible to construct an end-to-end digital network without waiting for the gradual digitisation of the terrestrial infrastructure. The PTTs are, of course, among the first to exploit this feature. NTT in Japan is using VSATs to provide ISDN connections to users located in areas not yet covered by the terrestrial ISDN infrastructure. In private networks, VSAT services can provide a cost-effective form of back-up to terrestrial digital leased circuits, using the satellite 'occasional use' facility, which allows usage charges to be incurred only during the period when back-up is required.

In Europe, VSATs will present multinational organisations with the first real opportunity to establish coherent, reliable pan-European digital networks. The European Commission has identified the potential of VSAT networks in its STAR (special telecommunications action for regional development) Programme, which is concerned with the provision of business communications services to less developed regions of Europe.

The prospect of updating the telecommunications infrastructure of east European countries following the dramatic events in late 1989 could also provide opportunities for using VSATs. For example, discussions between the PTTs of the two parts of Germany have included consideration of VSAT networks to overcome the problem of rapidly integrating their business communications infrastructures. German banks and other organisations are already installing VSATs in the eastern part of the country. Even Tass, the Soviet news agency, is planning to install a VSAT network, using technology supported by Contel ASC, a major US supplier of VSAT services.

Improved network management and reliability

Another major benefit arises in the area of network management. Because VSAT networks are self-contained, users of VSAT services are in a better position to apply end-to-end network-management controls, with the result that the quality and reliability of VSAT services is generally superior to that of terrestrial alternatives. The network components not directly controlled by a VSAT user (the satellite transponder and any shared 'hub' earth station) are highly reliable.

The high reliability of transponders and hub earth stations stems from the fact that they are based on tried and tested technology that was designed originally for use in international public networks. Through careful design that takes account of climatic factors such as dust and rainfall, this high level of reliability can be extended to the entire VSAT network. The mean time between failures of VSATs is typically 25,000 hours, allowing unmanned operation and minimal maintenance. The resultant overall end-to-end availability to users is in excess of 99 per cent, which is somewhat better than that typically achieved with equivalent terrestrial links.

VSAT applications have specific characteristics

Applications that require identical information to be broadcast to many widely dispersed locations are natural candidates for initial VSAT applications, particularly if video transmission is involved. Certain types of interactive applications will also be suitable for VSAT services, and in the United States, these now represent the area of fastest growth. A representative list of applications for major industry sectors is given in Figure 6.3. In the United States, the automotive industry is the largest user, followed closely by the retail and financial sectors. Although the range of VSAT applications is very wide, all of them have one or more of the following characteristics:

— The management structure and computing environment of the user organisation are predominantly centralised.

Figure 6.3 VSAT applications suit many industry sectors

Industry sector	Application
Petrochemicals	Oil rig communications Pipeline monitoring Point-of-sale credit-card authorisation Audio to filling stations
Utilities	Control/monitoring at remote sites
Construction	Communications to project sites
Retail	Point-of-sale credit-card authorisation Price list downloading to stores Audio for music/advertising Video for training/corporate communications
Banking	Electronic funds transfer Online banking ATM networks Financial information services
Insurance	Online quotations
Press/media	News/picture/video distribution
Automobile	Dealer networks
Transportation	Consignment tracking

(Source: European Space Agency)

- There is usually a large number of locations, each performing the same function or task, that need to be connected to the network. The typical number of locations in the United States is between 200 and 300, although it is lower in Europe.
- Network services need to be provided over large distances, often over water or difficult terrain.
- The network often needs to be reconfigured at frequent intervals.
- The communications traffic is usually asymmetric, with a much greater volume of information being transmitted to the periphery than is received at the centre.

In general, VSAT applications fall into three categories:

- One-way information-distribution applications. These applications are used to broadcast video, audio, or data from a central point to a large number of locations. Business television, business audio, financial-information services, news-agency services, and electronic publishing are typical applications.
- Interactive applications. These are two-way point-to-point transactional services for standard teleprocessing or telecontrol applications, and possibly voice telephony.
- Data-collection applications. These are specialised applications, mentioned only in passing in this chapter, where VSATs are polled to collect data. This category of application is typically used for remote sensing in meteorology, pipe-line monitoring, and similar fields.

One-way information distribution

Many organisations are now using business television for internal corporate communications and training. The complexity of duplicating and circulating video tapes to thousands of locations has prompted National Westminster Bank in the United Kingdom to conduct a pilot project designed to test the feasibility of VSATs. Its plans are described in Figure 6.4, overleaf. Other examples of VSAT-based business television include the transmission of videos showing details of late-availability holidays to travel agents' shops, and the live broadcasting of horse races to betting shops.

Business audio broadcasting, particularly in the retail industry, is also common. Euromarché, for example, transmits music and advertisements to 65 stores in France via its own Radio Decibel, helping both to improve the company's image and to target the marketing of given product lines. We describe this VSAT application in Figure 6.5, overleaf.

Several organisations use teletext broadcasting techniques for one-way distribution of data, using the spare lines of the television signal. Because of the capacity limitations inherent in terrestrial data-broadcasting techniques, growth in demand for this type of application will be met by VSAT services. Financial information-service providers, such as Reuters and McGraw-Hill, are also using VSATs as an alternative to terrestrial links for distributing their services to subscribers. Other organisations, including the UK Post Office and British Rail, are using VSAT systems to display topical advertising and news to their waiting customers.

Figure 6.4 National Westminster Bank has conducted a pilot scheme to test the functionality of VSATs

With around 3,000 branches, a major task for National Westminster Bank has been to communicate effectively with its staff across the country. The bank has devised a pilot scheme using the DataVision VSAT satellite service to deliver both video and data to ten trial locations around the United Kingdom. DataVision is the business communications subsidiary of British Satellite Broadcasting (BSB), operator of the United Kingdom's direct broadcasting satellite.

At present, videoed training material is duplicated and distributed around the country by video cassettes. The bank spends about £60 million ($115 million) a year on training and some £350,000 ($650,000) on distribution. The VSAT network will allow the training material to be broadcast via satellite to any number of sites simultaneously for immediate viewing or for automatic recording.

Using the same equipment, the bank will also be testing the feasibility of controlling and updating microcomputer programs, and of distributing data files, via VSATs. (At present, programs and data are distributed on diskettes.) National Westminster Bank will initially be using 9.6k bit/s and 19.2k bit/s links, but these may be increased to 64k bit/s during the trial. Each receiver will have a unique individual address, and will receive and decode a transmission only if it has been specifically addressed and authorised.

Two of the bank's main offices in London will be connected via landline to DataVision's data hub in central London. From here, the information will be sent by dual optical-fibre links to BSB's earth station near Southampton on the south coast, whence it will be transmitted to the satellite. In the event of a failure in one of the terrestrial links, the other will automatically take over to provide a failsafe system.

Derek Wanless, General Manager of the bank's UK branch business, said, "As we put more and more computer power into branches, we need to establish a reliable distribution network. The trial gives National Westminster the opportunity to test the latest satellite technology to assess whether it meets our needs."

(As this report was going to press, BSB was being merged with Sky Television to form British Sky Broadcasting. The intention is to use Sky, rather than BSB, technology, which would have an impact on the way in which data transmission services are delivered.)

Figure 6.5 Euromarché's Radio Decibel serves to improve the company's image and to target marketing

As in many supermarkets, shoppers in any of Euromarché's 65 branches in France are soothed by the sounds of soft music, interspersed with the occasional announcement of a special offer, a new product, or a lost child. At Euromarché, however, the quality of sound, the selection of music, and the professionalism of the announcements is superior to that of its competitors.

All music and announcements are broadcast from a central source via Radio Decibel, Euromarché's own private radio channel. Radio Decibel has all the characteristics of a standard FM radio channel. It is on the air for 13 hours a day, six days a week. There is the usual mixture of music, advertisements, games, and competitions; commercial breaks do not exceed 16 minutes an hour. The music is carefully selected to create the optimum conditions for encouraging the purchasing of goods, and the announcements direct customers towards the products that Euromarché wishes to promote at any particular time.

Radio Decibel was established for Euromarché in 1986 by a French start-up company, COM 4. It transmits from studios in the south of Paris, via France Telecom's Telecom 1C satellite, to roof-top VSAT antennae located at each supermarket. All programming is completely automatic, prepared one week in advance on computer-activated tape recorders. Publicity announcements may be applicable to all branches, or they may be directed to specific outlets. Announcements are stored locally in digital format, having been sent overnight when the radio is not transmitting. Each supermarket can be addressed individually so that it receives announcements tailored to its needs, even to the extent of referring to the branch shelf layout. The announcements are triggered by an inaudible tone transmitted over the satellite link at the appropriate moment.

The radio channel changed to satellite transmission in 1988, replacing a network of 25,000 km of analogue leased lines, with the attendant cost and reliability problems. However, that was not the only reason for the change. It was realised that satellite distribution permitted additional services to be carried at the same time and over the same link, with little incremental cost. The distribution of inventory-control lists and updating of prices are two examples.

Euromarché is also considering the use of hypermedia product promotions in an effort to cut the cost of periodic sales conferences. Under this scheme, high-resolution images of new product lines would be accompanied by suitable text and audio commentary, allowing branch product managers to make decisions on the spot.

A VSAT-based facsimile broadcast service has recently been launched in the United Kingdom for sending messages to individual subscribers. Although the messages are broadcast to all the subscribers, their equipment decodes only the messages addressed specifically to them. This type of service could evolve to allow customised editions of national newspapers to be delivered electronically direct to households. A Finnish publisher is already using conventional facsimile to transmit a newspaper to tourists in 50 hotels in southern Europe, and is investigating the possibility of using VSATs to extend the service.

One-way information distribution to business users is likely to grow faster than consumer-oriented systems, however. Thus, vital medical information could be transmitted via VSATs simultaneously to hospitals, medical centres, and doctors' surgeries. Police notices could be sent instantaneously to all airports in a country or continent. There are VSAT pilot schemes under way in the United Kingdom for both of these applications.

Interactive applications

There are not, as yet, many examples of two-way VSAT systems in Europe because of the regulatory restrictions. (In many countries, two-way satellite working is currently prohibited.) In Germany, however, Daimler Benz is installing a two-way VSAT network, which is described in Figure 6.6.

Evidence for the latent demand for two-way VSAT services is provided by trends in the United States. In 1985, only 15 per cent of VSAT revenues came from two-way systems; today, a quarter of VSATs are two-way, representing nearly 75 per cent of total revenues. One of the most publicised two-way VSAT applications in the United States is the network being implemented by K Mart Corporation. This major

Figure 6.6 Daimler Benz is in the process of installing a two-way VSAT system to improve links with eastern Europe

The Daimler Benz group comprises four divisions — Mercedes Benz (the car manufacturer), AEG (the electrical manufacturing group), DASA-Dornier (the aerospace group), and debis — Daimler Benz Interservies (the group's new systems and services provider). Since the beginning of 1990, debis has been responsible for nearly all of the group's systems activities, and eventually aims to offer its services outside the group as well. The group's worldwide data network is already one of the biggest operated by any German company.

At the beginning of 1990, having conducted an earlier feasibility study, the board decided to test VSAT communications in a real operating environment. The main objective is to create VSAT links to Mercedes' subsidiaries in western and southern Europe. Sixteen VSAT stations are planned. The hub of the network is the PTT hub in Hameln in western Germany, and the satellite system used is Eutelsat. While it is subject to the normal regulatory controls, the project is unusual in that all the participants are part of the same group — the terminals are provided by Dornier, the network service is operated by debis, and the user is Mercedes Benz.

As a result of the political developments in eastern Germany, the objectives of the project were revised, to provide VSAT links with new subsidiaries and partners in eastern Germany, and to some extent, to third parties. Links to other east European countries that have only limited telecommunications services are also planned. The only part of the original objective that has been realised is the creation of links with Mercedes Benz subsidiaries in Belgium and Switzerland.

The results so far are very encouraging. In particular, communications links have been established very quickly — at present, it takes about eight weeks to get a VSAT station operating, about seven of which are taken up sorting out administrative matters and gaining regulatory approvals. Actual installation takes only a matter of days. There have been no problems with the availability of equipment, nor with the quality of the VSAT network.

The regulations allow the VSAT transmission capacity to be resold to third parties for all types of services in western Germany. Daimler Benz uses network-control procedures that allow the 64k bit/s channel to be shared by up to 20 users, depending on the applications, each of whom believes that he has a dedicated 9.6k bit/s channel. In this way, Daimler Benz would be able to resell the channel capacity at a profit. Its view is that only a few companies will be able to generate sufficient communications traffic to justify a 64k bit/s transmission allocation.

Daimler Benz stresses that its cooperation with DBP Telekom has been vital. Without DBP Telekom's authority to negotiate with PTTs in other countries, the project would have had to be limited to Germany only. Furthermore, the relationship with DBP Telekom gave Daimler Benz access to Eutelsat, with all the facilities that that provides.

Eventually, Daimler Benz plans to offer its services to third parties. It sees its main business deriving from establishing communications links with eastern Germany and other east European countries, Turkey, and south European countries, such as Spain.

supermarket chain is nearing the completion of a four-year, $40 million VSAT network project aimed at improving inventory control and speeding up credit-card authorisation at more than 2,100 stores, regional offices, and distribution centres.

The largest two-way VSAT network implemented to date is that connecting Chrysler Motor Corporation's offices and manufacturing sites to over 6,000 dealerships in North America. The applications supported by the network include:

- Providing mechanics at local dealerships with help for difficult repairs.
- Allowing showroom sales staff to place orders and give projected delivery dates to car purchasers.
- Providing video training sessions on topics such as sales or repairs.
- Using video to show forthcoming merchandise to store managers.
- Providing video communications facilities at national and regional sales conferences.

It is even rumoured that Lee Iacocca, chairman of Chrysler, will give motivational speeches over the network, an aspect of VSATs that has not escaped the notice of other corporate chiefs.

Carefully selected VSAT applications can be cost-justified

According to a 1988 OECD report, the telecommunications bills of US VSAT users are about 25 per cent lower than they would be for conventional terrestrial communications. Calculations for data-only applications show that US networks with more than 200 locations cost less if they are implemented with VSATs. These calculations are based on the assumption that the data transmission rate from the hub to the VSATs is 1.5M bit/s. If a lower data transmission rate is required (about 512k bit/s), the hub costs are reduced, and VSATs become viable for networks with as few as 100 locations.

Within a single European country, distances are smaller, and our view is that a national VSAT network would be viable for about 300 locations. The cost of international leased lines in Europe is, however, substantially higher than the cost of leased lines in the United States. Thus, a VSAT network would be cost-justified for a small number of locations, if these are scattered across Europe.

For VSAT networks, the cost elements comprise the charges for the space component (satellite transponder), hub-station costs, and the cost of the terminals. The critical parameters are clearly the number and geographical dispersion of locations to be served. The cost of expensive common items such as satellite capacity and hub-station facilities will be shared across each location, and the cost per terminal of these shared items decreases as the number of VSAT terminals increases (the marginal increase in satellite capacity required by adding VSATs to an existing network is small). Moreover, unlike terrestrial links, the cost of satellite links does not increase with distance.

VSAT services in Europe are provided mostly by the PTTs or their subsidiaries. The tariffs are often set to ensure that VSAT services do not compete too strongly with existing PTT terrestrial services. The tariff structure consists of a once-off 'downlink' charge, typically in the range $3,500 to $7,000, and a monthly charge based on the data transmission rate. The Swedish PTT's subsidiary, Vesatel, charges about $13,000 a month for a 1.2k bit/s circuit, while Polycom (a joint venture between France Telecom, Matra, and the French Press Agency) charges just over $40,000 a month for its 19.2k bit/s service.

The case for using VSATs is particularly strong when there is a need to distribute video transmissions. The inherent broadcast capabilities of VSAT networks and their comparatively wide bandwidth make them particularly suitable, and cost-justifiable, for one-way video-distribution applications. Moreover, the growth of direct satellite television broadcasting to homes is bringing down the cost of video-reception equipment.

Some organisations will be able to justify the use of VSATs on the basis of a single application, especially where a VSAT network is the only means of implementing it. Oil companies, utilities, and construction companies, for example, may find that VSATs are the only way to serve locations not otherwise covered by the terrestrial network, given that alternative radio systems, other than line-of-site microwave, are inadequate for data transmission. Another example is where the basic requirement is to transmit business television.

Experience to date, however, suggests that once established, the use of a VSAT network is quickly extended to other applications. Such extension first takes the form of additional applications making use of the same service. For example, a retail chain could initially use a VSAT network for a credit-card authorisation application, and then use it to download price lists, inventory-control information, and program updates. Later, topical advertising displays could be transmitted via the network, with advertising space being sold to individual product suppliers.

Adding applications to a VSAT network in an incremental manner such as this may make good operational sense. However, we believe that the business case for using VSAT services will be stronger if all the potential applications are considered at the outset.

VSAT services are becoming available around the world

In the United States, the growth in the use of VSAT networks was a direct result of the break-up of AT&T. The new regulations meant that organisations with interstate networks had to deal with several of the newly formed regional telephone companies, which they were reluctant to do. The regulations also allowed users to bypass the regional companies. The result was that a market opportunity was created for VSAT service operators. Today, there are some 70,000 VSATs in use in the United States. In contrast, the number of VSATs in Europe is less than 15,000, all except a handful being one-way receive-only terminals. Furthermore, 12,000 of these are used in one application — TV transmission of live horse-races to UK betting shops.

The United Kingdom has licensed seven new specialised satellite service operators, although many experts believe that this is too many. By restricting them to one-way broadcast systems, it is unlikely that there will be sufficient business for them all to survive. Germany has authorised the use of two-way VSAT systems, but only for data rates of up to 15k bit/s (to prevent them being used for voice services). Italy, through its satellite carrier, Telespazio, operates the largest number of European VSAT networks (about a dozen to date, with more being planned). These are used mostly by government departments, although there are a few private users. In France, Polycom operates a commercial VSAT service that is used mainly to distribute news reports and financial information from the Paris Stock Exchange to users in France and elsewhere. The Swedish PTT's subsidiary, Vesatel, also operates an international VSAT service for carrying financial and information services for McGraw-Hill and others.

Vesatel would like to extend its operations to provide worldwide coverage, and to this end, is cooperating with other carriers, such as OTC in Australia. OTC operates Satnet, which is aimed at Australian companies with branches in Pacific Rim countries and beyond. It also believes that Satnet could be used by European companies needing to transmit information to their subsidiaries in the Pacific area. The viability of such a service would depend on the costs of getting the communications traffic to Australia for onward transmission via the satellite. There are also two competing domestic VSAT services, both using the Australian satellite system, Aussat. Telecom Australia operates the ITERRA service and sees its ability to mix-and-match with terrestrial facilities as a competitive advantage. Aussat itself markets the STARNET service, which it can price aggressively because, unlike Telecom Australia, it has no alternative revenues to protect.

In Canada, the domestic carrier, Telesat, which operates the Anik satellite system, offers TV broadcast and VDI (voice/data/image) services. Anikom 100 is a one-way, low-speed data broadcast service, and Anikom 200 is a two-way interactive data service using shared-hub facilities in Toronto (real or virtual hubs are planned for Montreal and Calgary). There are also high-speed point-to-point voice and data services (Anikom 500 and 1000) operating at transmission rates ranging between 56k bit/s and 1.544M bit/s. Services are provided to a wide range of users in the banking, retail, insurance, hotel, government, utilities, minerals, and petroleum industries.

International VSAT services are offered both by Intelsat (with IBS — International Business

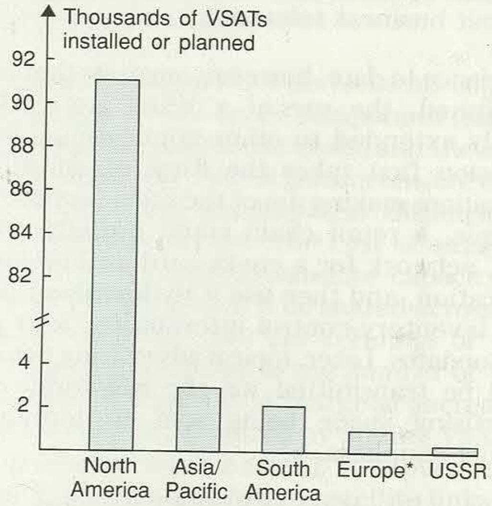
Service — and Intelnet) and by Eutelsat (with SMS — Satellite Multiservice System). These services, however, are always channelled through the PTTs, and the tariffs are set at a level to ensure that they do not compete with equivalent terrestrial services.

Growth will be constrained until regulatory problems are resolved

In a move of great foresight, the United States introduced in 1972 its 'open skies' policy, which allowed any technically and financially qualified organisation to apply for a licence to operate a domestic satellite system. This policy, coupled with developments in technology and the market conditions created by the impending break-up of AT&T, led to the first VSAT services in 1983. A liberal policy such as this was easier to introduce in the United States because of its limited impact on international communications traffic.

Because of the lucrative revenues derived from international services, and the monopoly status of most PTTs, no such 'open skies' policy has been introduced in Europe or elsewhere. As Figure 6.7 illustrates, the strict regulations governing the use of VSATs outside the United States have resulted in much slower growth in other parts of the world.

Figure 6.7 Restrictions on VSAT networks have stilted their growth outside North America



*Excludes receive-only TV antennae

(Source: Financial Times)

The patchwork of regulations across Europe gives rise to many examples of restrictive practices. Even the two most liberalised countries, Germany and the United Kingdom, still impose restrictions on user organisations. We have already mentioned the restriction on two-way use in Germany. In the United Kingdom, users are not permitted to establish networks themselves; apart from the duopoly suppliers (British Telecom and Mercury), only the seven licensed satellite operators may do so, and then only for transmission in one direction. Other countries allowing private companies to own and operate VSAT networks are Belgium, Finland, and the Scandinavian countries. Other service providers, such as Polycom (France), Telespazio (Italy), Telefónica (Spain), OTE (Greece), and the Swiss PTT are all monopolies that insist on owning and operating VSAT networks in their territories. Until recently, these operators have been providing domestic services only, although some are now beginning to extend their operations into adjacent countries. Obtaining permission to transmit into another country is very difficult and often entails much paperwork and bureaucracy. These difficulties are compounded by a lack of concerted PTT action on standards for VSAT networks and a general disregard for the European Commission's liberalisation directives as they apply to the competitive and independent provision of VSATs.

US-based VSAT service providers, such as Microspace and PanAmSat, are outside European jurisdiction, and can afford to take a more relaxed attitude to their pursuit of business in Europe. They operate on the fringes of legality by first installing the equipment and then worrying about the paperwork. Some PTTs respond to these tactics by demanding that 'illegal' roof-top antennae be dismantled, and cutting off the telephone service if they are not.

There are signs, however, that the regulatory strait-jacket on the use of VSATs in Europe may be loosening. Pressure is mounting from users, who complain that they are being denied the benefits already available to North American businesses. The European Commission is also pressing for reform, and has recently published a VSAT supplement to its 1984 Green Paper on Telecommunications. PanAmSat is suing Comsat and Intelsat in an attempt to dismantle anticompetitive practices. It is also lobbying for the abolition of current restrictions that prevent the PanAmSat system interconnecting with the public switched network. Even though anti-competitive clauses are still included in the intergovernmental agreements that established Eutelsat and Intelsat, they have been weakened over the years by challenges from other domestic and regional satellite systems, and are now used mainly as a means of delaying the implementation of competitive services.

In view of the current regulatory problems, a great deal of tenacity is required to implement a VSAT network. Those organisations that have embarked on pilot VSAT projects usually have a 'champion' of the technology who is able to convince management of the benefits and to work with an appropriate service provider to implement a system. Organisations should not hesitate to make direct contact with the various agencies specialising in satellite communications, international or domestic. These include bodies such as Intelsat, Eutelsat, Aussat, Telesat, and the European Space Agency. They are likely to be supportive of any plans to implement VSAT networks.

New developments will widen the appeal of VSATs

Advances in technology are continually improving (and reducing the cost) of both the terrestrial and the space components of VSAT networks. Before VSATs can have a wider appeal, it will be necessary to reduce terminal and hub costs to a level where they can be considered for most private network applications, including point-to-point networks, as well as point-to-multipoint. This would require current costs to be at least halved. Such reductions can be achieved only through mass-production of terminals using advanced electronics and manufacturing techniques. The cost of the antennae will also be reduced as flat-panel technology, rather than dishes, is introduced. The beams transmitted from the satellite are focused electronically with this technology, rather than by the shape of the dish.

Satellite technology is also developing, although the lead times for implementing new developments are lengthy. Higher-power satellites are now becoming available, and in the late 1990s, even higher transmission frequencies will be used. This will open up the possibility of providing multi-megabit services that could compete with terrestrial MANs and broadband ISDN.

Current technology is based on general-purpose satellite transponders that can be used for a wide range of telecommunications services — from high-definition television to low-speed data transmission. As the volume of satellite use increases, it will become feasible to dedicate a transponder to a particular type of service, which will make it possible to introduce additional functions on the satellite that will simplify and enhance the capability of ground terminals. These include the transfer of switching functions, normally implemented on the ground, to the satellite, and the use of scanning spot-beams, where the satellite's power is concentrated in a small beam that scans the target coverage area for traffic.

Another advance will be the implementation of wideband inter-satellite links, which will extend the effective coverage area of satellites, increase operational flexibility, and avoid so-called satellite 'double-hops' (where a transmission has to go up to and down from two separate satellites). Inter-satellite links also open up the possibility of basing mobile communications networks entirely on satellite links. Other advances (in signal processing, data compression, and modulation) will be applied to both the terrestrial and space components of a VSAT network, and these will widen the range of services that VSATs can economically provide, and lead to simpler and more automated network-control subsystems.

In this chapter, we have reviewed the state of development of VSAT services and networks. Although their use outside the United States is at present limited (mainly because of regulatory constraints), we do not believe that this situation will persist for long. VSAT-based communications systems provide significant benefits compared with terrestrial facilities, and can be used for a wide range of applications. Pressure from users, and from the European Commission, is growing for VSATs to be made more freely available. It is only a matter of time before communications managers in most Foundation members' organisations will need to consider where VSATs fit into their overall communications strategy.

Chapter 7
The impact of the new services

Some of the new services described in this report make it possible for even more of the corporate telecommunications infrastructure to be subcontracted to a specialist third party, often the local PTT. Thus, centrex and VPNs could replace privately owned PABXs, switched MAN services could remove the need for wideband digital leased circuits, and ISDN frame-relay services could replace private packet-switched networks. Subcontracting to a third-party public service provider has three particular advantages:

- The economies of scale available to the service provider should mean that the service is cheaper, provided the supplier operates in a competitive or a properly regulated market.
- There will be less need to employ scarce and expensive in-house telecommunications specialists.
- Expenditure on services is incurred as and when use is made of them, thus reducing the requirement for capital investment in private network facilities.

The reduced need to invest in capital equipment is especially useful in times of rapid growth and technological change, when there is a risk of taking the wrong course of action, and the consequences are far-reaching. Because of the long lead times associated with establishing a communications infrastructure, inappropriate choices cannot easily be changed.

Use of public services will grow slowly, first for voice services, then for data services. The rate of progress will depend partly on how fast the new services are implemented in each country and partly on the confidence that customers have in the suppliers' ability to deliver a reliable and responsive service. Competitive offers from alternative service providers will encourage the use of public services. The use of public services will also be promoted by the increased emphasis on electronic forms of communication, with both suppliers and customers using electronic document interchange (EDI) services, for example.

The need for private networks will not disappear completely, however, and Foundation members need to decide on the most appropriate balance between public and private networking facilities in the light of their particular needs, and in view of the opportunities presented by new services. In this chapter, we consider the future of public networks and give our view of how corporate network services might be provided in, say, five years from now. We conclude with a brief review of how the greater emphasis on public services is likely to change the role of the telecommunications function.

Fully integrated public networks will not be available until well into the 21st century

In the past, it has been necessary to create separate networks for different types of communications traffic, and this situation will continue, at least in the public domain, throughout the 1990s. Early public switched telephone networks (PSTNs) were unsuitable for data communications, and this led to a proliferation of public-data services in the 1970s and 1980s, ranging from specially conditioned analogue leased lines, through packet- and circuit-switched networks, to today's digital leased lines. The original intention was that ISDN would rationalise this situation by integrating all telecommunications services under a single network infrastructure.

Those who devised the narrowband ISDN concept lacked foresight, however. As we explained in Chapter 4, its switching technique is different from those used by corporate data networks, its transmission rates are too low, and the implementation timescale is too long. Furthermore, the original architects of ISDN did not foresee the tremendous growth of services, such as mobile telephony, mobile data, and VSAT satellite services, that could effectively bypass it.

There is no doubt, however, that narrowband ISDN will not only survive, but will prosper and develop. The determination of the PTTs to provide all subscribers with digital access will guarantee its eventual place as the standard method of accessing public networks both for residential and business subscribers, although this stage will not be reached until well after the mid-1990s. As Figure 7.1 illustrates, however, narrowband ISDN will be just one element in the three-stage evolution of public networks; MANs and broadband ISDN will also be significant, albeit in the medium to long term:

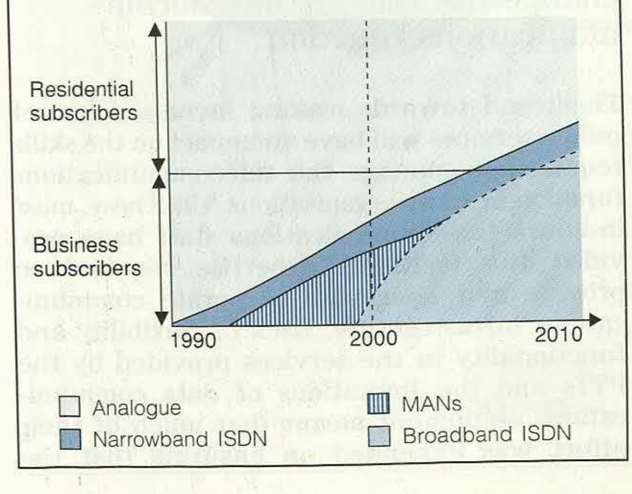
— The first stage is represented by the *avant garde* use of narrowband ISDN by businesses, and will be driven by the PTT marketing initiatives now under way. We believe that this stage will continue until the more advanced MAN services become available on a general basis towards the mid-1990s.

— During the second stage, narrowband ISDN will be the standard means of making all new business connections to the public network. Taking a slightly optimistic view, we can expect this stage to begin during the latter half of the 1990s.

— The final stage may consist of several different phases that last until well into the next century. A logical sequence of events would be to begin by connecting all new residential lines via ISDN, and to accompany this by a phased programme of converting analogue business lines to ISDN. Replacing analogue residential lines would be the final phase in the process, but this would not occur until well into the next century when capital and operating costs clearly favoured the phasing out of analogue telephony.

Figure 7.1 By the end of the century, most businesses will have digital access to the public network

As the 1990s progress, more and more business subscribers will replace analogue connections to the local exchange with narrowband ISDN digital connections. Residential subscribers will not begin to use ISDN until well into the next century. In the mid-1990s, business subscribers will also begin to use MANs. Eventually, broadband ISDN will become the common form of access to the public network, first for business subscribers, and much later, for residential subscribers.



During this time, MANs, and later broadband ISDN, will be making inroads into large businesses. As we emphasised earlier in the report, they will be required to satisfy the need for wideband communications that will arise from the requirement to interconnect high-speed LANs and to handle image applications. There will be interworking between narrowband and broadband ISDN, principally to ensure that a consistent range of services can be provided to large and small businesses, and eventually, to homes.

Business requirements will drive this evolution, but the penetration of broadband ISDN into the residential environment may be aided early next century by its convergence with cable television systems. A liberalised telecommunications environment would tend to accelerate this process as cable television operators move to set up competitive local-access networks.

ISDN will also support intelligent network and frame-relay services, the former initially for voice, the latter for fast packet-switched data. Mobile GSM and PCN services will complement, and be integrated with, intelligent network services and the fixed terrestrial network.

Mobile cellular networks contain significant intelligence, enabling the network to know where the mobile instrument is at all times, so that incoming calls can be routed correctly. By building links between the intelligence in mobile networks and the intelligent network facilities provided in the fixed public network, the 'personal number' concept will become a reality. This concept describes the situation where a dialled number that is unique to an individual will be routed to a mobile telephone or to a fixed telephone, according to which is switched on. Moreover, the fixed telephone to which the call is routed could be varied by using the 'intelligence' in the fixed network.

Corporate networks will be provided by a mix of public and private facilities

As we illustrate in Figure 7.2, corporate communications infrastructures in the 1990s will be made up of a hybrid, but flexible, mix of public and private facilities. While data and image communications will be handled by the same transport mechanism, voice will continue to be dealt with separately. The functional differences between voice and data, and continuing architectural incompatibilities, will limit their integration to the sharing of multiplexors and transmission capacity.

Today, intelligent multiplexors are used to integrate voice and data on wideband private circuits. These will evolve into devices based on proprietary frame-relay techniques. Unlike ISDN frame relay, proprietary frame relay will integrate voice and data and will use statistical multiplexing and data-compression techniques to achieve optimum bandwidth efficiency. Large organisations will therefore have the choice of meeting wideband requirements either by using a proprietary frame-relay approach or by opting for public MAN services. By the mid-1990s, smaller branches of the organisation could use ISDN frame-relay services for data transmission, and basic-rate ISDN circuit-switching for voice and image traffic. PABXs would be connected to the public network by primary-access ISDN.

Figure 7.3, on page 60, shows that narrowband ISDN and MANs will be used by different types of organisations and to satisfy different bandwidth requirements. Eventually, broadband ISDN will satisfy all types of organisations and all communications requirements — but that will not occur until well into the 21st century.

Many staff will also have mobile communications requirements for both voice and data. Inside buildings, PABX add-on modules will facilitate the use of cordless telephone extensions. Eventually, PABX products will include cordless telephony as an integral part of their design. Other mobile communications requirements will be met by subscribing to one of the new digital mobile services (PCN, or for vehicles, GSM or similar). Transportation companies will make use of satellite mobile services. Many companies will use VSATs, initially to distribute information to widely dispersed branches, subsequently to back up terrestrial links, and ultimately to support a wide range of two-way interactive applications. Very large organisations will own and operate their own VSAT systems, but most will opt for third-party provision of these services.

Thus, corporate networks in the mid-1990s will be a complex mix of public and private facilities. The most appropriate mix at any one time will depend on the current availability and development of the different services described in this report, and on the tariffs set by the PTTs both for the new services and for private facilities. The availability of the new services, and their tariffs, will therefore have to be kept constantly under review, placing new demands on the management of corporate networks.

Increased use of public services will change the role of the telecommunications function

The trend towards making increased use of public services will have an impact on the skills required to manage the telecommunications function in many organisations. Until now, most in-house telecommunications staff have provided the technical expertise required to provide and operate a corporate communications infrastructure. Lack of flexibility and functionality in the services provided by the PTTs and the limitations of data communications equipment meant that much of their effort was expended on ensuring that the

Figure 7.2 In the mid-1990s, corporate networks will be a mixture of public and private facilities

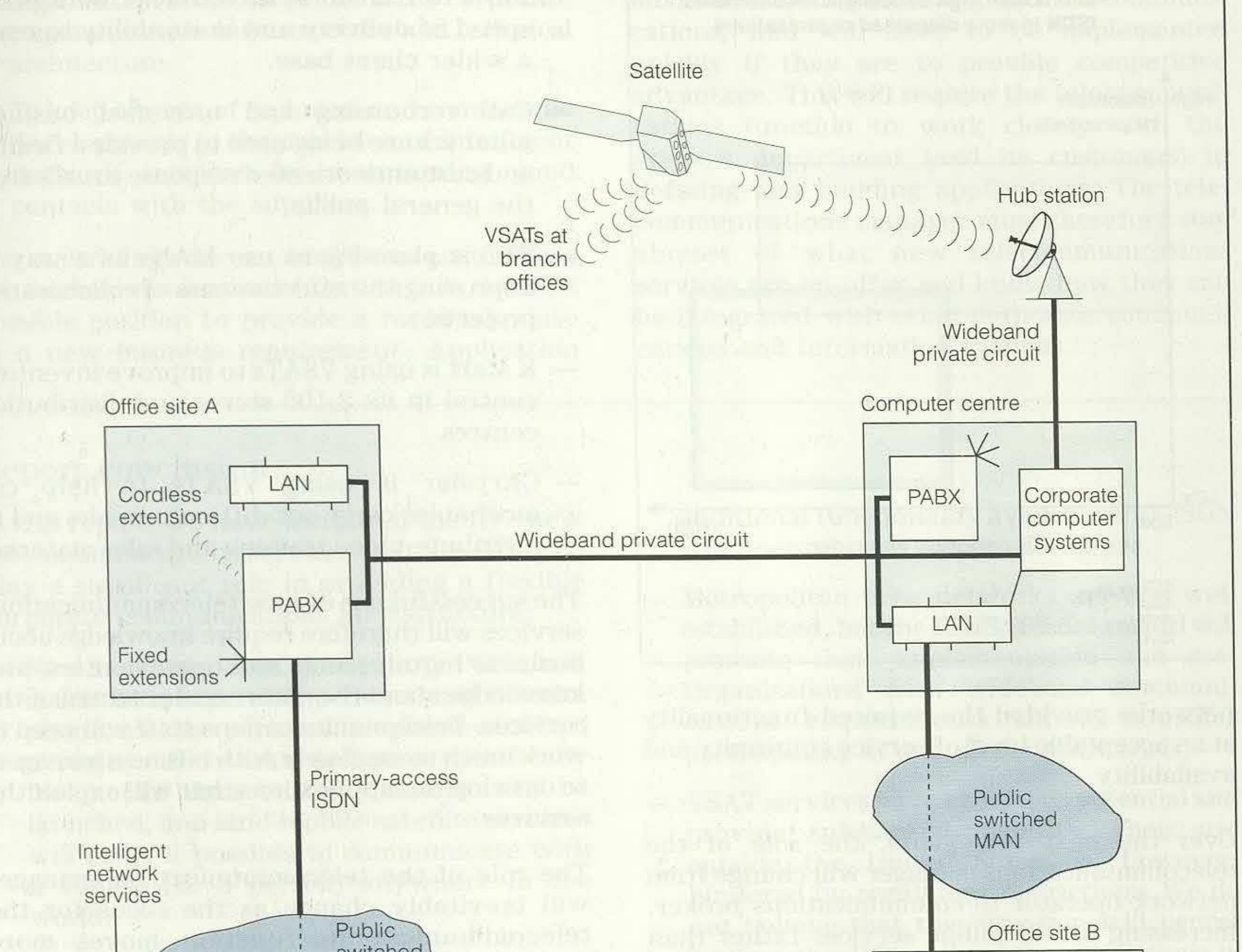
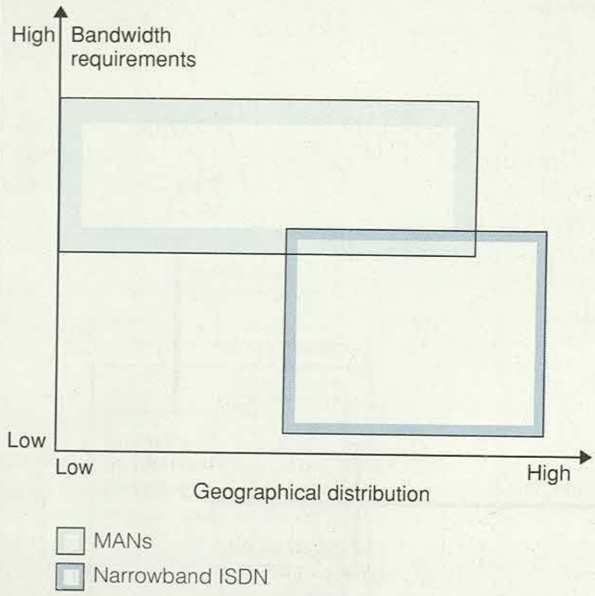


Figure 7.3 MANs will be used in centralised organisations with high bandwidth requirements, ISDN in more dispersed organisations



networks provided the required functionality at an acceptable level of service continuity and availability.

Over the next few years, the role of the telecommunications manager will change from network operator to communications broker. Increasing use of public services rather than private networks will mean that communications staff will spend more time analysing costs, comparing and selecting services and suppliers, monitoring the level of service provided to users, and acting as the interface between the organisation and external suppliers, rather than being involved in day-to-day operational matters. In particular, the use of intelligent network services will provide many opportunities for telecommunications staff to work with business managers and service providers to devise and deliver new business applications.

We have provided many examples in this report of how the services can be exploited to provide specific business applications:

- Philips in France is using ISDN to combine image servers and expert systems to support small shops carrying out repairs to televisions and hi-fi equipment.
- The Kipa photographic press agency is using ISDN to transform its business, both in the speed of delivery and in its ability to reach a wider client base.
- Call rerouteing and universal business numbers are being used to provide a flexible and customer-oriented response to calls from the general public.
- STC is planning to use MANs as a way of improving the effectiveness of collaborative projects.
- K Mart is using VSATs to improve inventory control in its 2,100 stores and distribution centres.
- Chrysler is using VSATs to help car mechanics carry out difficult repairs and to distribute video training and sales material.

The successful use of new telecommunications services will therefore require knowledge about business requirements and opportunities, *and* knowledge about the nature and potential of the services. Telecommunications staff will need to work much more closely with business managers to develop the applications that will exploit the services.

The role of the telecommunications manager will inevitably change as the focus for the telecommunications function moves more towards providing an infrastructure that supports all business applications. In order to fulfil this new role, the telecommunications manager must exploit existing strengths and acquire new skills, so that he is in a position:

- To negotiate and monitor service-level agreements with external suppliers such as the PTTs.
- To market his skills and expertise to business managers throughout the organisation.
- To understand the new role of the network and telecommunications as a vehicle for improving business effectiveness and achieving competitive advantage.
- To ensure that the organisation's technical architecture includes the most relevant telecommunications components.
- To specify telecommunications guidelines and standards that will ensure that all

equipment and software procured by the organisation is consistent with the corporate communications infrastructure and technical architecture.

— To keep abreast of technical and commercial developments in the provision of intelligent network services by maintaining good contacts with the suppliers.

The overriding concern must be to ensure that the telecommunications function is in the best possible position to provide a rapid response to a new business requirement. Application systems will increasingly involve a complex mixture of data processing and telecommunications, and will need to be implemented quickly if they are to provide competitive advantage. This will require the telecommunications function to work closely with the systems department (and its customers) in defining and building applications. The telecommunications manager must therefore stay abreast of what new telecommunications services are on offer and know how they can be integrated with other corporate communications and information systems.

Report conclusion

In this report, we have identified the five new telecommunications services that are likely to play a significant role in providing a flexible corporate communications infrastructure:

— New mobile services, particularly PCNs, will make the inexpensive personal mobile telephone, and the personal telephone number, a reality. Networks designed specifically for mobile data communications will be launched, and land-mobile satellite services will make it possible to communicate with a vehicle (or a person) anywhere in the world.

— Public intelligent network services such as centrex and virtual private networks will remove much of the need for private voice and data networks. Call rerouteing and advance freephone will provide greater flexibility for communicating with customers and the general public.

— ISDN will slowly but surely become the standard (digital) means of accessing the public network. The bandwidth and additional functionality available with ISDN will open up new application areas.

— Metropolitan area networks are less well established, but the IEEE 802.6 standard will promote their implementation and use. Organisations with wideband communications requirements should consider participating in one of the MAN trials.

— VSAT services have enormous potential and provide substantial benefits. Their use outside the United States is, however, hindered by regulatory restrictions. We do not believe that this situation will persist beyond the 1990s. Once the restrictions in Europe and elsewhere are eased, the use of VSAT services will grow very quickly.

Each of these new services can, by itself, have a powerful impact on business success. The challenge facing systems directors and telecommunications managers is knowing when to exploit them, singly and in combination. This report has highlighted the important issues to consider.

Appendix
National telecommunications regulations

In this appendix, we review briefly the current status of telecommunications regulations in most of the countries where there are Foundation members, and indicate the most likely developments in the period up to the end of 1995. For regulatory purposes, most countries classify telecommunications services at three levels:

— *Basic transport*: the telecommunications network infrastructure (cables, manholes, buildings, switching and terminal transmission equipment, microwave radio systems, and the like), and the transmission of information through this infrastructure from source to destination without modification.

— *Value-added networks*: these add switching, processing, and network-management functions to the basic transport of information. Typically, public data networks (for example, X.25 packet-switched services) and managed data-network services (such as Infonet and GEIS) would fall into this category. Although voice telephony is a switched service, it is generally regarded by policy makers as part of the infrastructure, and is therefore not considered to be a value-added network.

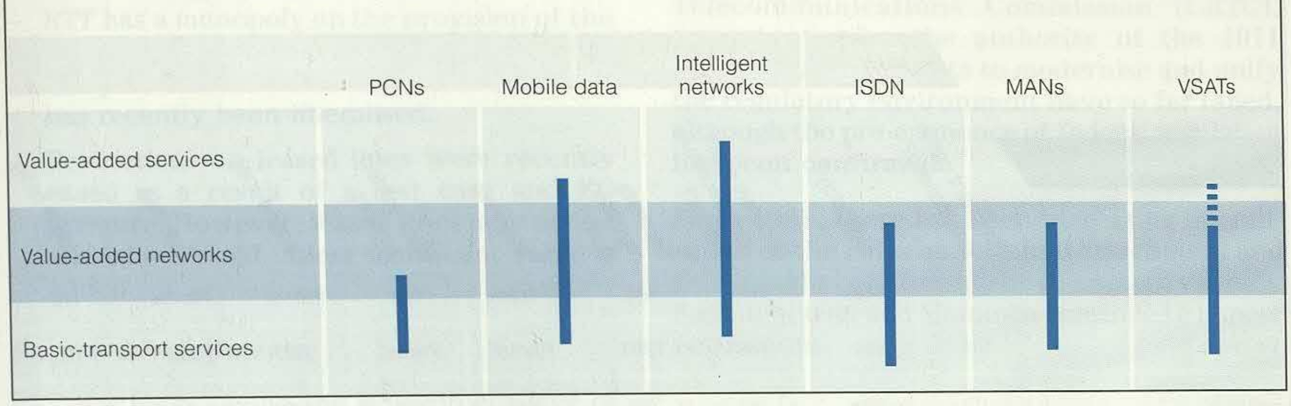
— *Value-added services*: these are applications that make use of the facilities of the other two levels. They have so far tended to be specific to particular industry sectors (for example, EDI for the insurance industry, or financial information services). Facilities management — the establishment and operation of corporate network services by a third party — represents the ultimate value-added service.

Different degrees of competition may be permitted for each service level. Typically, basic-transport services and voice telephony may be 'reserved' for monopoly carriers, whereas value-added networks may be open to limited competition. Value-added services are now widely regarded, even by the PTTs, as being suitable for provision in a fully competitive environment.

Because they combine transport and management functions, the new telecommunications services described in this report do not fit well with the three-layer regulatory model described above. Figure A.1 shows the new services straddling the boundaries of the traditional categories. Some countries — Japan and Canada, for example — attempt to overcome this difficulty by defining facility-based and non-facility-based service carriers, with the intention of limiting competition in the former, and opening it in the latter. Either way, the increasing pace and complication of telecommunications deregulation has kept a generation of lawyers busy in the United States, and could well do the same for the legal profession in Europe and elsewhere.

European deregulation is heavily influenced by the European Commission's Green Paper published in June 1987, which sets out guidelines for harmonising the provision of telecommunications services in the 12 member states in the single market that will exist from 1992. The paper itself represents a compromise between the Commission's wish to promote a framework for competition in accordance with the provisions of the Treaty of Rome, and the reluctance of many member states to relinquish monopoly control of the supply of telecommunications goods and services. PTT pressure thus led to the Green Paper's including the notion of a continued monopoly of basic and so-called 'reserved' (voice telephony) services, although value-added networks and services must be

Figure A.1 The new services straddle the boundaries of the categories that have traditionally formed the basis for telecommunications regulations



opened up to competition within a specific timeframe. (Ironically, less developed countries — those with most to gain from an injection of healthy competition — have managed to have this timeframe extended to well into the 1990s.)

A key recommendation of the Green Paper is the requirement to separate the regulatory and operating arms of the telecommunications industry, a principle now accepted by all member states. However, many countries are maintaining a government monopoly for basic services, which reports to the same government minister as the regulatory body; this conforms with the letter, rather than the spirit, of the Green Paper.

The guarantee of free, open, and equal access to basic-transmission services by competitive third-party service providers is an important feature of the regulatory environment in those countries where limited competition is being introduced. The relevant policies, known as open network provision (ONP) in Europe and open network architecture (ONA) in the United States, cover technical and commercial-interface standards. By guaranteeing all value-added service providers equal access to the infrastructure, ONP/ONA ensures that a monopoly carrier cannot gain an unfair advantage by using his own transport infrastructure on more favourable terms than those of his competitors. In most cases of this type, regulatory authorities require an additional safeguard by insisting that the monopoly carrier creates a separate, arms-length subsidiary for the provision of value-added services.

Figure A.2, overleaf, summarises the main deregulation indicators for each of the countries. It shows whether basic services are provided by a nationalised or a monopoly carrier, whether the postal and telecommunications services are organised separately, and whether there is a separate regulatory body. The five right-hand columns compare the degree of liberalisation in each country for terminals, value-added services, leased lines, satellite services, and mobile radio services. We give more detail for each country below.

Australia

Current situation

The Telecommunications Act of 1989 set in motion the deregulation of the industry by establishing a new regulatory body, Austel, and by giving Telecom, the dominant carrier, corporation status, with 100 per cent of the shares currently owned by the government. There are two other monopoly carriers: Aussat provides domestic satellite services, and the Overseas Telecommunications Commission (OTC) provides external services, either via satellite or via submarine cable. The three carriers may compete in areas where their services overlap.

The 1989 Act also provided for the following:

- PABXs and the first telephone set in customer premises, previously a Telecom monopoly, may now be provided by competitive third parties.
- Value-added services can be offered by third parties, subject to Telecom guidelines.

Figure A.2 The regulatory situation varies from country to country

Country	Basic services: Dominant carrier nationalised?	Basic services: Monopoly?	Organisation: Separate posts and telecomunications?	Organisation: Separate regulatory body?	Liberalisation?: Terminals	Liberalisation?: Value-added services	Liberalisation?: Leased lines	Liberalisation?: Satellites	Liberalisation?: Mobile radio
Australia	Yes	Yes	Yes	Yes	Partial	Yes	Partial	Partial	No
Belgium	Yes	Yes	Yes	1991	Partial	Partial	No	No	No
Canada	(1)	Yes	Yes	Yes	Yes	Yes	Partial	No	Yes
France	Yes	Yes	1991	Yes	Yes	Yes	Partial	No	Yes
Germany	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Italy	Yes	Yes	Yes	No	1991	1992	No	No	No
Japan	(2)	*De facto*	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Netherlands	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	No
New Zealand	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spain	No	Yes	Yes	Yes	Partial	Partial	No	No	No
Sweden	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
United Kingdom	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
United States	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(1) Varies with province
(2) Partly privatised

Common user groups, as defined by Telecom, are allowed to share networks. Leased-circuit capacity may not be resold to third parties. Telecom can (and does) provide value-added services in competition with third parties.

Future developments

The Telecommunications Act left many potentially competitive areas (including mobile radio, switched data services, and leased circuit provision) in monopoly hands, but it is expected that changes will be made to improve competition and solve the intractable problem of Aussat's profitability. Based on recent announcements, we expect:

— Telecom Australia and OTC to form a single carrier.

— Aussat to be sold off to a newly established private-sector organisation that will compete in all areas with Telecom.

— A second mobile telephony operator to be licensed.

Belgium

Current situation

RTT (Régie des Télégraphes et des Téléphones) is the state-owned monopoly provider of all telecommunications network services in Belgium:

- RTT has a monopoly on the provision of the first telephone handset and small PABXs. The provision of mobile telephone handsets has recently been liberalised.
- Restrictions on leased lines were recently eased as a result of a test case and EC pressure. However, leased lines may not be shared or resold unless significant value is added.

Future developments

RTT has been among the least progressive of European PTTs, in spite of its playing host to the European Commission. The Belgian government is now planning a series of structural reforms to redress the situation. In the light of these, it is expected that:

- RTT will be split into regulatory and operational arms. The Institut Belge des Télécommunications (IBT) will be the regulatory arm, and Belgacom the operator.
- A second mobile operator will be licensed.
- The EC Green Paper recommendations will be respected.

Canada

Current situation

More than 90 per cent of conventional domestic voice services are provided by nine major carriers operating on a monopoly basis. Each province is served by its own carrier (except Quebec and Ontario, both of which are served by Bell Canada). Telecom Canada, the carrier for long-distance switched voice services, is basically a consortium of the provincial carriers who share the facility-planning tasks and the revenues among themselves. Telecom Canada is in competition with Unitel for long-distance leased-circuit and non-voice switched services. Telesat Canada, 50 per cent owned by the Federal Government, provides domestic satellite services. Teleglobe Canada is responsible for overseas communications; since its privatisation in 1987, it has been a subsidiary of Memotec Data.

The fragmented nature of telecommunications in Canada means that there are federal and provincial regulatory bodies. The federal regulatory body is the Canadian Radio-television and Telecommunications Commission (CRTC), operating under the authority of the 1911 Railway Act. Attempts to modernise and unify the regulatory environment have so far failed, although the pre-eminence of federal regulation has been confirmed.

Since 1981, there has been increasing liberalisation of the rules on terminal attachment and the resale of leased-line capacity; only Saskatchewan and Manitoba continue to impose restrictions.

Future developments

There will be a negotiated rather than a judicial settlement of the regulatory situation, placing the CRTC firmly in charge. An aborted attempt, made in 1985 by Unitel, to compete for long-distance switched voice services will be successfully revived in 1992. Other organisations, notably public utilities with extensive telecommunications facilities, will challenge this duopoly.

The market for terminals will be fully liberalised, and the rules on terminal attachment and on the resale of leased-line capacity will be relaxed in all provinces.

France

Current situation

Separation of postal and telecommunications services will take place on 1 January 1991, as a result of the PTT reform law passed in July 1989. The law reinforces France Telecom's role as the state-owned monopoly carrier for basic and most value-added network services, reporting to the Ministry of Posts, Telecommunications and Space (PTE). A new regulatory body, La Direction à la Réglementation Générale (DRG), also reporting to the PTE Minister, was established by government decree earlier in 1989. It will gradually take over the activities of other bodies currently exercising regulatory functions on an interim basis. Other features of the regulatory situation are:

- Limited competition has been introduced in certain sectors (mobile radio, cable TV, and videotex).

— Terminal attachment and supply liberalisation has been effective in France since 1987. The body responsible for approvals is the Commission d'Agrément des Installations Terminales Privées (CAITP).

— Leased-line restrictions prevent resale of capacity to third parties, except where significant value-added (85 per cent) can be demonstrated.

Future developments

A second reform law will be adopted at the end of 1990 to define a new regulatory framework. The law will introduce competition (under licence) in value-added services. The licence conditions will be subject to scrutiny by the European Commission to ensure fair play. Conditions will also be imposed to protect France Telecom's existing interests in the provision of value-added network services, referred to as 'support services'. In the longer term, we expect that, after the 1995 presidential election, a further reform will bring about a more competitive environment, fewer restrictions on value-added services, the right to resell leased-line capacity, and ultimately, the privatisation of France Telecom. The value-added services market will be completely liberalised, with removal of the 85 per cent value-added criterion and other restrictions.

Germany

Current situation

During 1989, the Deutsche Bundespost (DBP) was divided into independent postal, banking, and telecommunications organisations. DBP Telekom is the state-owned monopoly carrier of basic services and voice telephony. The 1989 law requires that it be run as a 'privatrechliche' business — that is, as a private company in a regulated environment. Regulatory matters are handled by the Ministry of PTT, although the Länder (the individual states in Germany) can make recommendations. Telekom's board is made up of representatives from industry, users, staff, and the ministry. In the current regulatory environment:

— All services other than basic transport and voice telephony are open to some form of competition.

— The provision of the first telephone handset was liberalised in July 1990.

— Two-way VSAT services up to speeds of 15k bit/s are permitted.

— A second mobile operator was licensed in 1989.

Future developments

The pace of deregulation in what was the Federal Republic has been faster than elsewhere in Europe over the last five years, and has been given new impetus by the unification of Germany. An example is the use of two-way VSATs for voice services to the eastern part of the country, where deficiencies in the terrestrial infrastructure make it difficult to provide normal service.

Telekom cannot be privatised under the current German constitution, but there is no reason that it cannot be subject to competition in the provision of basic services at some time in the future. We expect that Germany will introduce full liberalisation and competition in non-terrestrial network services such as mobile and satellite services. Competition in the provision of international telecommunications services is also likely.

Italy

Current situation

Telecommunications services are currently provided by at least five different bodies under licence from the Italian government. The need to rationalise this structure has a higher priority than any moves towards liberalisation. The Super-Stet project (the consolidation of SIP, Italcable, Telespazio, and Azienda di Stato) has been initiated in an effort to improve the current fragmented situation, to define a competitive market for value-added services, and to remove the restrictions on leased circuits.

Future developments

Within the next five years, the market for the first telephone handset and for terminals will be opened up to competition, the provision of value-added networks will be liberalised, and a second mobile operator (either Fininvest or Omnitel) will be licensed.

Japan

Current situation

Despite the introduction of competition into the provision of basic (so-called Type 1) services, NTT controls 98 per cent of the Japanese market. Competition in the provision of international services has been successfully introduced, however, with the two new carriers taking 35 per cent of the traffic from KDD, the original international carrier. Regulatory authority rests with the Ministry of Posts and Telecommunications (MPT).

Future developments

Despite an agreement to postpone consideration of the break-up of NTT for at least five years, the Ministry of Posts and Telecommunications is insisting on a reorganisation of NTT that might facilitate such a break-up. The reorganisation will separate local and long-distance operations, establish a separate subsidiary for mobile communications, end cross-subsidisation and collusion between divisions, and facilitate equal access to competitors through an ONP concept.

The Netherlands

Current situation

The PTT was divided into separate postal and telecommunications organisations in 1989. PTT Telekom BV was 'privatised', with the government retaining ownership of all its shares. The organisation has a *de jure* monopoly of basic transport and a *de facto* monopoly on voice telephony services. The provision of value-added networks and value-added services is open to competition.

Regulatory responsibility is with the Ministry of Transport and Public Works through an organisation known as the HDTP. There is a fully liberalised terminal-attachment policy, for which the HDTP is the approvals body. Simple resale of leased-line capacity is not allowed.

Future developments

Telekom shares are to be sold to the public, and competition will be introduced in basic-transport and voice services, probably based on the large cable television infrastructure in place in the Netherlands. Municipalities will introduce competitive MANs. A second mobile operator will be licensed, and restrictions on the resale of data and voice capacity will be lifted.

New Zealand

Current situation

Telecom NZ is the dominant service provider. A second carrier is being established by a consortium of Broadcasting Communications Ltd (the 'long lines' television operator), New Zealand Railways, Bell Canada, MCI, and the Todd Group (a New Zealand investment company). In addition:

- The markets for PABXs and the provision of value-added networks are competitive; there is a defined interconnect agreement for third-party service providers.
- There are six major value-added service suppliers.

Future developments

A second, and possibly a third, basic transport carrier will be created, and these will capture 20 per cent of Telecom's business traffic. Private VSAT operators will provide communications to remote areas.

Spain

Current situation

Telefónica, Spain's privatised monopoly carrier, operates through a concession from the government. The 1987 Telecommunications Law (Ley de Ordenación de las Telecommunicaciones — LOT) renewed this concession for a further 30 years, and generally confirmed the pre-eminence of Telefónica in the provision of basic-transport, voice, and data services, but opened up value-added services and terminal attachment and supply to competition. Regulatory authority lies with the Ministry of Transport, Tourism and Communications. Leased-line capacity may be shared or resold only where value-added services are involved.

Future developments

Within the next five years, a second mobile operator is likely to be licensed, competition in the provision of value-added networks may be introduced, and restrictions on the use of leased lines will be lifted.

Sweden

Current situation

There is currently much parliamentary debate about the complete liberalisation of the public network following the separation of regulatory and operational activities. As far as basic services are concerned, only cable TV and mobile radio have been liberalised. Shared use, resale, and private-to-public network interconnection is allowed only for domestic leased circuits.

Future developments

Within the next year, the restrictions on leased lines will be lifted, and the market for terminals will be completely liberalised. Televerket will be privatised but will retain its monopoly on the provision of basic-transport services.

United Kingdom

The United Kingdom was the first European country to introduce *de jure* competition in the provision of basic-transport and switched voice services. British Telecom and Mercury are the two privatised Public Telecommunications Operators (PTOs). The regulatory body is the Office of Telecommunications (Oftel), an independent government body advising the Secretary of State for Trade and Industry. The Department of Trade and Industry has the responsibility for developing telecommunications policy.

There is competition in the provision of mobile and satellite services. Cable television companies are restricted to providing subscriber access for the PTOs. Shared use, resale, and private-to-public network interconnection are allowed according to a Network Code of Practice.

Future developments

The duopoly on the provision of basic services is currently under review. It is probable that several licences will be issued to competitive suppliers of trunk services, and that cable television companies will have the restrictions on the provision of switched services lifted. For the time being, British Telecom will continue to be denied the right to provide cable-based television services. Additional mobile operators will be licensed.

United States

Current situation

The break-up of AT&T (the Bell System) in 1985 resulted in each local Bell company (regional Bell operating companies — RBOCs — or Baby Bells, as they are sometimes called) becoming an independent monopoly. There was also an increase in competition in the provision of long-distance services. Terminal liberalisation is total. The provision of leased lines is competitive and their use is uncontrolled.

Future developments

Current debate centres on four points — extension of the 'price cap' regulation to all players, revenue restrictions on business lines by the RBOCs, switched access charges for value-added services, and open network architecture (ONA) pricing. In the very competitive inter-exchange long-distance market, AT&T's dominant-carrier status may be rescinded, in which case regulatory provisions preventing abuse will be removed. The RBOCs will continue to enjoy *de facto* monopolies in the provision of local switched voice services, and through ONA, they will start to compete in the value-added services market. With restricted growth potential at home, RBOCs will become active overseas.

BUTLER COX FOUNDATION

The Butler Cox Foundation

The Butler Cox Foundation is a service for senior managers responsible for information management in major enterprises. It provides insight and guidance to help them to manage information systems and technology more effectively for the benefit of their organisations.

The Foundation carries out a programme of syndicated research that focuses on the business implications of information systems, and on the management of the information systems function, rather than on the technology itself. It distributes a range of publications to its members that includes Research Reports, Management Summaries, Directors' Briefings, and Position Papers. It also arranges events at which members can meet and exchange views, such as conferences, management briefings, research reviews, study tours, and specialist forums.

Membership of the Foundation
The Foundation is the world's leading programme of its type. The majority of subscribers are large organisations seeking to exploit to the full the most recent developments in information technology. The membership is international, with more than 400 organisations from over 20 countries, drawn from all sectors of commerce, industry, and government. This gives the Foundation a unique capability to identify and communicate 'best practice' between industry sectors, between countries, and between IT suppliers and users.

Benefits of membership
The list of members establishes the Foundation as the largest and most prestigious 'club' for systems managers anywhere in the world. Members have commented on the following benefits:

— The publications are terse, thought-provoking, informative, and easy to read. They deliver a lot of message in a minimum of precious reading time.

— The events combine access to the world's leading thinkers and practitioners with the opportunity to meet and exchange views with professional counterparts from different industries and countries.

— The Foundation represents a network of systems practitioners, with the power to connect individuals with common concerns.

Combined with the manager's own creativity and business knowledge, Foundation membership contributes to managerial success.

Recent Research Reports
58 Senior Management IT Education
59 Electronic Data Interchange
60 Expert Systems in Business
61 Competitive-Edge Applications: Myths and Reality
62 Communications Infrastructure for Buildings
63 The Future of the Personal Workstation
64 Managing the Evolution of Corporate Databases
65 Network Management
66 Marketing the Systems Department
67 Computer-Aided Software Engineering (CASE)
68 Mobile Communications
69 Software Strategy
70 Electronic Document Management
71 Staffing the Systems Function
72 Managing Multivendor Environments
73 Emerging Technologies: Annual Review for Managers
74 The Future of System Development Tools
75 Getting Value from Information Technology
76 Systems Security
77 Electronic Marketplaces
78 New Telecommunications Services

Recent Position Papers and Directors' Briefings
Information Technology and Realpolitik
The Changing Information Industry: An Investment Banker's View
A Progress Report on New Technologies
Hypertext
1992: An Avoidable Crisis
Managing Information Systems in a Decentralised Business
Pan-European Communications: Threats and Opportunities
Information Centres in the 1990s
Open Systems
Computer Support for Cooperative Work

Forthcoming Research Reports
The Role of Information Technology in Transforming the Organisation
1991 Technology Review: Technical Architecture
Managing the Devolution of Information Technology
The Future of Electronic Mail

Butler Cox

The Butler Cox Foundation is one of the services provided by the Butler Cox Group. Butler Cox is an independent international consulting company specialising in areas relating to information technology. Its services include management consulting, applied research, and education.

Butler Cox plc
Butler Cox House, 12 Bloomsbury Square,
London WC1A 2LL, England
☎ (071) 831 0101, Telex 8813717 BUTCOX G
Fax (071) 831 6250

Belgium and the Netherlands
Butler Cox Benelux bv
Prins Hendriklaan 52,
1075 BE Amsterdam, The Netherlands
☎ (020) 75 51 11, Fax (020) 75 53 31

France
Butler Cox SARL
Tour Akzo, 164 Rue Ambroise Croizat,
93204 St Denis-Cédex 1, France
☎ (1) 48.20.61.64, Télécopieur (1) 48.20.72.58

Germany, Austria, and Switzerland
Butler Cox GmbH
Richard-Wagner-Str. 13, 8000 München 2, Germany
☎ (089) 5 23 40 01, Fax (089) 5 23 35 15

Australia and New Zealand
Mr J Cooper
Butler Cox Foundation
Level 10, 70 Pitt Street, Sydney, NSW 2000, Australia
☎ (02) 223 6922, Fax (02) 223 6997

Finland
TT-Innovation Oy
Meritullinkatu 33, SF-00170 Helsinki, Finland
☎ (90) 135 1533, Fax (90) 135 2985

Ireland
SD Consulting
8 Clanwilliam Square, Dublin 2, Ireland
☎ (01) 764701, Fax (01) 767945

Italy
RSO Futura Srl
Via Leopardi 1, 20123 Milano, Italy
☎ (02) 720 00 583, Fax (02) 806 800

Scandinavia
Butler Cox Foundation Scandinavia AB
Jungfrudansen 21, Box 4040, 171 04 Solna, Sweden
☎ (08) 730 03 00, Fax (08) 730 15 67

Spain and Portugal
T Network SA
Núñez Morgado 3-6°b, 28036 Madrid, Spain
☎ (91) 733 9866, Fax (91) 733 9910