MANAGED NETWORK AND MESSAGING SERVICES

WESTERN EUROPE

1990 - 1995

INPUT

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Abstract

This report analyses the managed network and messaging services sectors in the network services market for Western Europe and their growth potential over the period 1990-1995.

The managed network services market encompasses the current offerings of international network services suppliers and support for other international network services. These range from the comprehensive facilities offered by firms such as EDS to the one-stop shopping, security and performance management services offered by IBM.

The messaging services market covers all forms of generic message storage and transmission, including: electronic mail, telex and teletex, fax and image data transmission, as well as voice messaging.

The report covers all of the major European countries and reviews some of the third-party vendors selling managed network services and/or messaging services.

A network market analysis and forecast is included for these basic network applications and is segmented into two categories:

- Managed network services
- Messaging services

The report identifies the leading vendors in the two subsectors in each major Western European country.

Profiles of leading vendors are used to illustrate different marketing and service strategies. Challenges facing vendors for the 1990s in the network services market are identified and an overall commercial and management assessment of the market's future development is included.

This report contains 99 pages, including 38 exhibits.

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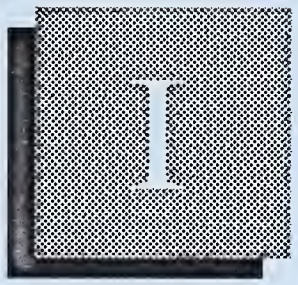
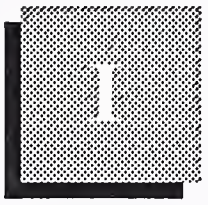


Introduction



Introduction

A

Objectives

This report is produced as part of INPUT's Network Services Programme —Europe. Included in this report are descriptions of issues, trends and events affecting this segment, five-year forecasts of the country markets, a description of the driving and inhibiting forces, a discussion of leading vendors, their market shares, and opportunities and recommendations for vendors.

The objectives of this report are to:

- Create a clear picture of the current structure of the Western European managed network and messaging services market
- Understand the major forces that are affecting this sector, in particular the Single European Act legislation of the European Commission and its likely repercussions
- Identify the major actions being taken by vendors as a result of these forces and the resulting changes to the competitive environment over the next few years
- Research the current attitudes of vendors and end users in this sector

The European managed network and messaging services market is large and dynamic. Currently, vendors are looking to adopt different pricing and service strategies in different country markets as the uneven pace of deregulation across Europe continues to create uncertainty.

B

Scope

This report reviews the network services market for Western Europe for the period 1990 to 1995, broken down into two distinct sectors:

- Managed network services
- Messaging services

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The report covers a number of vendor types under review, any of whom may be selling the services:

- Independent service vendors
- Public telecommunications operators
- Computer equipment suppliers
- Software and professional services vendors

In forecasting the size of the Western European network services market, INPUT includes only end-user revenues gained by external suppliers and excludes any revenues gained from parent organisations which can be defined as captive revenues. INPUT defines captive revenue as that gained by a vendor from a parent organisation which owns more than 50% of the vendor.

Exhibit I-1 illustrates INPUT's definition of the structure of the network services market. This market is divided into two major segments:

- The first, Network Applications, includes managed network services, electronic messaging services and electronic data interchange (EDI);

- The second, Electronic Information Services, includes on-line databases and news databases.

The fundamental criterion for services in both these categories is that the network itself must play an important enabling function—i.e., without the network the service could not be provided.

Geographically, this report divides Western Europe into the following main countries and regions:

- France
- U.K.
- Germany
- Italy
- Spain

- Benelux countries:
  Belgium
  Holland

- Scandinavia:
  Sweden
  Denmark
  Norway
  Finland

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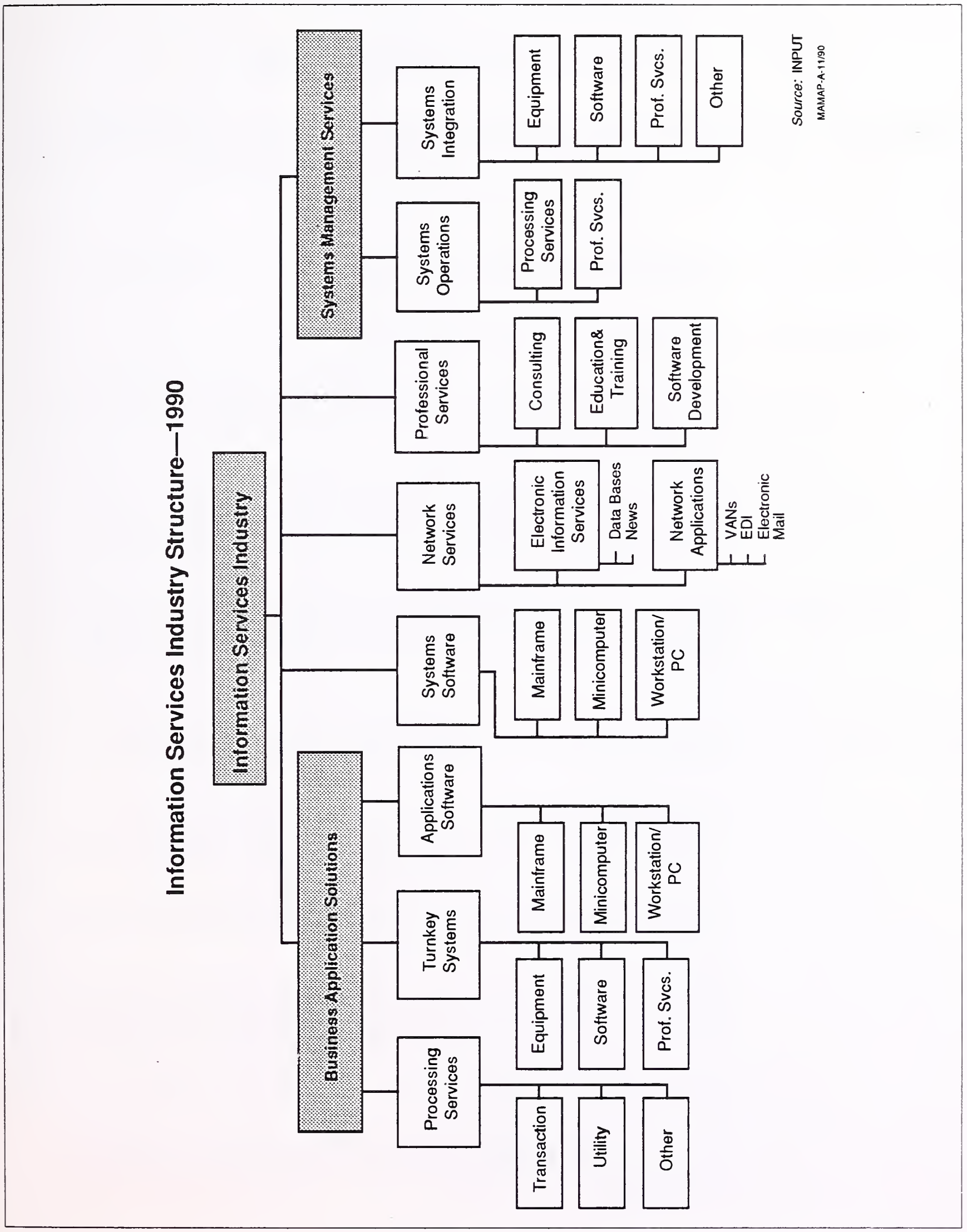
EXHIBIT I-1



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- The Rest of Europe
  Switzerland
  Austria
  Other countries, i.e., Greece, Ireland and Portugal

C

Methodology

To obtain an in-depth appreciation of the structure, issues and opportunities, INPUT carried out the following research programme:

- Ten in-depth, structured interviews
- An additional 10 informal interviews with vendors, concentrating on specific niche products, services and issues
- Fifteen structured interviews with users

This tiered approach to the vendor research has allowed INPUT to interview an acceptable cross-section of vendors in the managed network and messaging services market.

Market forecasts are based on non-captive end-user expenditures. These are defined by INPUT as those expenditures made externally by any organisation with some third-party vendor, and exclude those made within the organisation itself.

Inflation effects are included in both historical and future growth rates of market size estimates. INPUT estimates of inflation rates are given in Appendix B.

D

Report Contents

The report is organised into seven chapters and five appendixes as follows:

- Chapter II is an Executive Overview of the complete report. It is designed for the executive or individual who wants to quickly identify the salient points of the report without reading it in its entirety.
- Chapter III reviews the dynamics of the managed network and messaging services market in Western Europe.
- Chapter IV assesses the structure of the market and forecasts the size of the Western European network services market for the period 1990 to 1995 by major geographic region and by industry-specific sector.
- Chapter V reviews some of the leading vendors in the market.
- Chapter VI summarises what INPUT sees as the prime challenges for vendors in the 1990s and gives an overall commercial and management assessment.

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- Appendix A gives INPUT's definition of terms.
- Appendix B lists the exchange rates used in compiling this report and the inflation assumptions.

E

Related INPUT Reports

Readers may find it useful to refer to the following INPUT reports which relate to the findings of and set the context for this report:

- Overall West European market reviews:
  - *The Western European Market for Computer Software and Services—1989-1994* (December 1989)
  - *The Challenge of the Single European Market—1992 and Beyond* (December 1989)
- Network services reviews included in the 1990 programme:
  - *Western European Network Services Market, 1990-1995*
  - *Financial Network Services, Western Europe—1990-1995*
  - *EDI: The 1990s and Electronic Trading*
  - *Western European Electronic Information Services—1989-1994*

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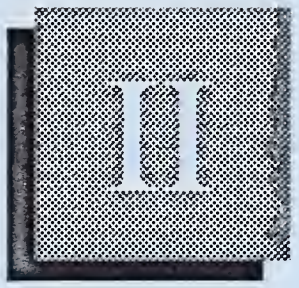


Executive Overview

II

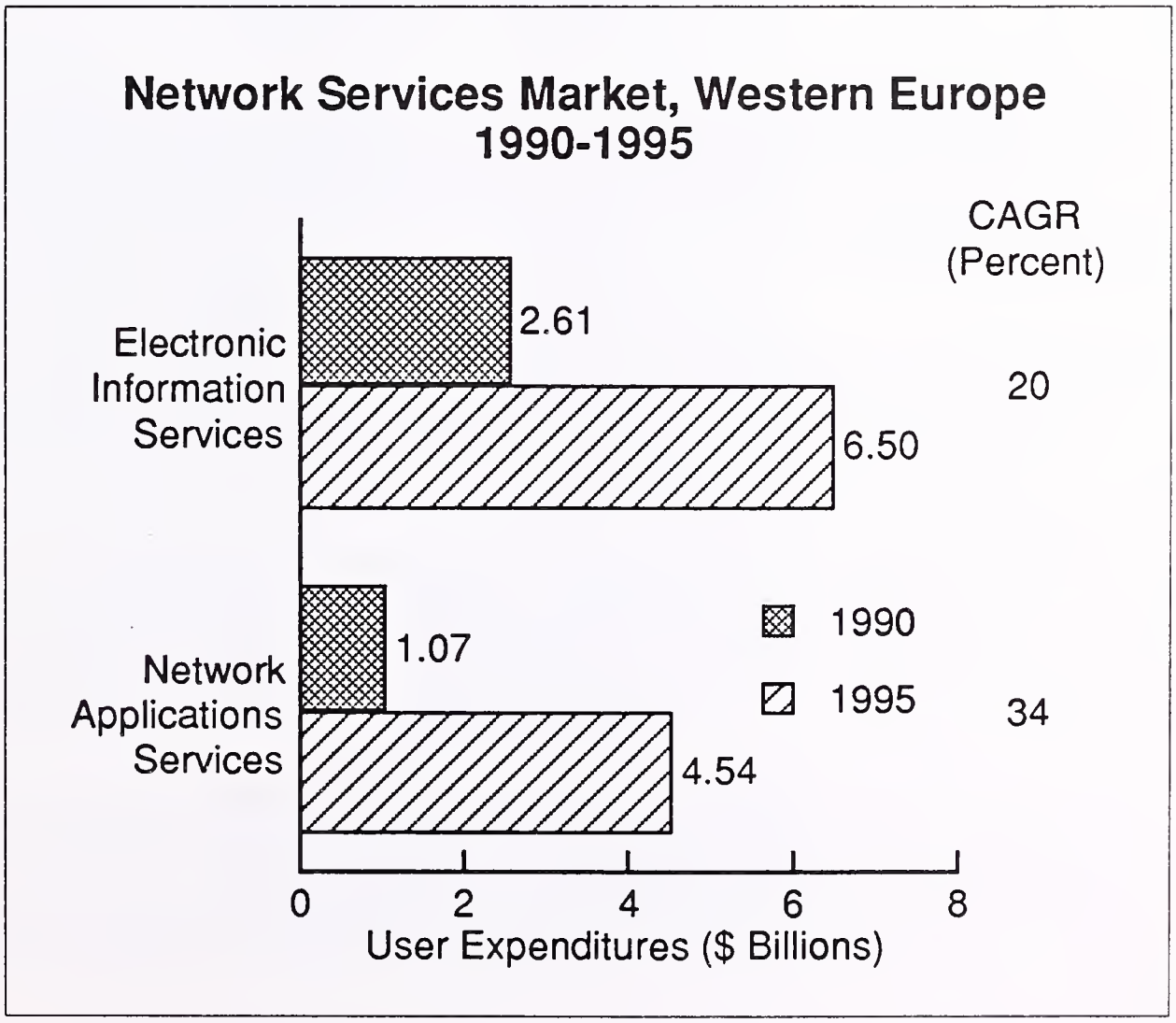
Executive Overview

A Network Application Services—Explosive Growth

Managed Network Services provide the user with an independently managed alternative to public service. Messaging Services offer the user an opportunity to interconnect with disparate private mail systems.

There are a number of reasons for the dynamic growth of the network application services market which, as Exhibit II-1 shows, will grow at a CAGR (Compound Annual Growth Rate) of 34% over the forecast period.

EXHIBIT II-1



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One of the primary driving forces is the number of personal computers in business. The potential demand for these PCs to link into networks and access on-line information sources and services is still largely untapped. The majority of PCs are still used on a standalone basis only; network-based services are used by only a small percentage.

Integrated Services Digital Networks (ISDN) will develop over the forecast period from the European PTTs and others that are keen to exploit the potential of the network services market. ISDN provides integrated voice/data networks that facilitate transmission of information and may accelerate multimode communications available to run under an ISDN environment. The bulk of these are voice operated but some relate to packet-switched interfaces and services. The latter present an opportunity for network services vendors to adapt their managed network services to include such capabilities.

Wide-area networking is the logical extension of local-area networks (LANs). Wide-area networks will tie LANs together in tactical communications systems within an organisation and between separate organisations. Wide-area networks will promote network services growth over the forecast period.

Businesses are increasingly in need of immediate information which can often be best accessed through electronic databases. This is one of the reasons for the rapid growth of fax.

The European PTTs (principally via Infonet but also independently) are looking to develop expertise in the network services market. They are looking to provide gateways and networks to facilitate access to EIS.

The complexity of communications networks is increasing rapidly. Few organisations possess the knowledge to operate and maintain these networks by themselves. Business opportunities exist in providing network management skills and control in a variety of ways, such as remote network management services, software, and professional consulting services.

The global economic system is a significant contributor to network services growth. As more business transactions become internationally orientated, a network services capability to support these transactions and their underlying relationships becomes more crucial.

Finally, the development of a global network communications infrastructure in the 1990s will itself stimulate demand for such capabilities. The capacity for rapid transmission of data, voice and images across continents will emerge in the mid-1990s as a powerful impetus for person-to-person and business-to-business use of such facilities.

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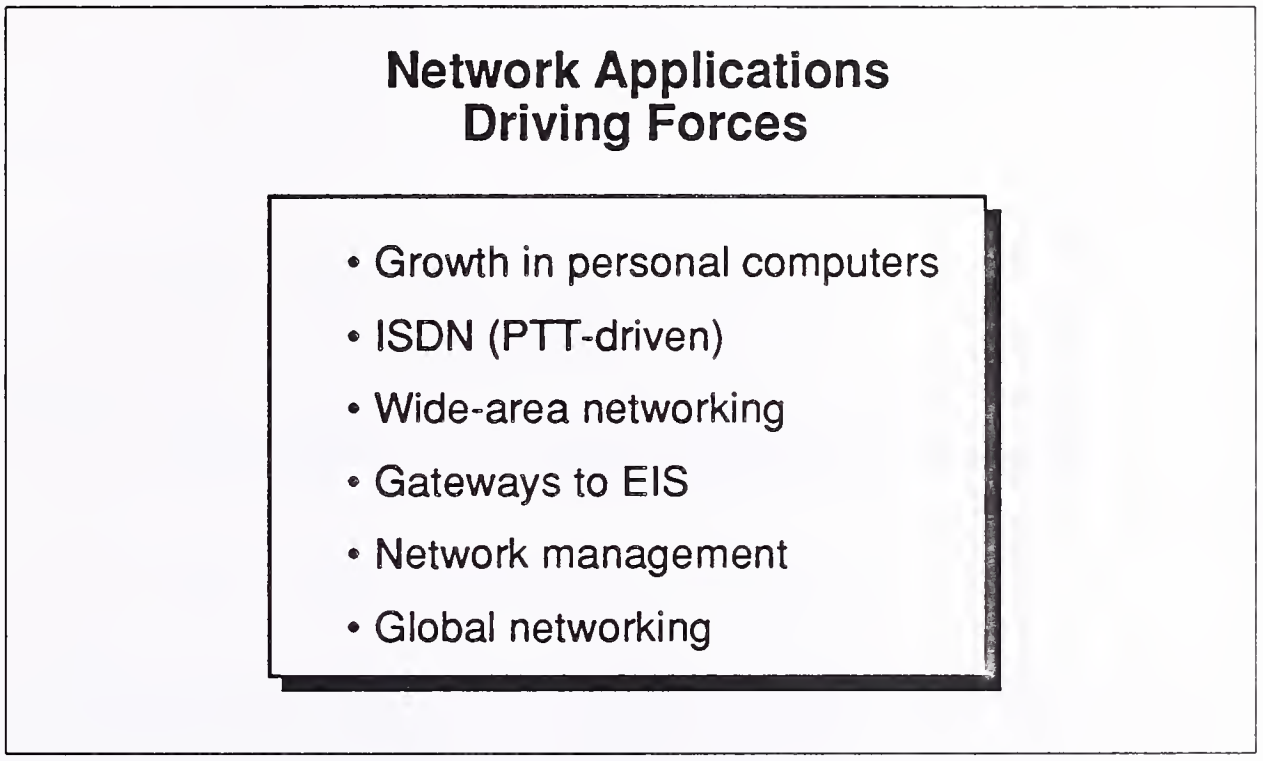
As a result of the above-mentioned forces and other considerations, the markets for managed network and messaging services will grow at rates above the overall information services market, i.e., at rates of 25% and 42%, respectively, and at a combined rate over the forecast period of 32%. These driving forces are summarised in Exhibit II-2.

EXHIBIT II-2



B

The Technological Case for Private Networking

Network services vary in the kinds of value they provide, often serving market segments other than those for which regulation is intended. Private network operators can meet the specific needs of customers to a degree which public network operators, with their statutory requirements for universal provision, are unable to do.

Liberalisation allows private operators to meet specific market demands at competitive prices. Yet numerous private networks can result in too many standards, each with its own protocols. As a result, widely accepted industry standards have been slow to emerge and most manufacturers have been reluctant to provide the necessary software to support the entire range of network access protocols. This situation has provided part of the impetus for developing public and private Integrated Services Digital Networks (ISDNs) which integrate the communications of a range of equipment through a single network.

The issue of managing pan-European open networks has been overshadowed by the development of interworking of national X.25 networks through X.75 gateways at level 3 in the OSI model and generic applications of electronic mail (X.400) and directories (X.500) at Layer 7 of the OSI Model.

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Effective management of a managed network service requires:

- Diagnostic data to be collected during each of the processes
- Effective database handling and management of the data collected
- Reporting of statistics and trends
- Interactive management of the network at the session and application levels

The management of the network processes at the network level 3 is rudimentary in open networks (including the X.25 public data networks in Europe). Management at higher levels is non-existent and has not yet been specified in the OSI Model. The management issue is further complicated in that multi-level management will be needed within international networks as the traffic load increases.

Provision of a private managed network service using a limited set of computer equipment is understood, yet the implementation task is complex. Provision of a public managed network service based upon a proprietary architecture such as an IBM network can be achieved with difficulty. IBM has spent ten years building its network.

Provision of an open network (whether public or private) managed network service above the X.25 level 3 area is not well understood by vendors, is extremely costly and involves long delays in implementation. The major issues, summarised in Exhibit II-3, to be addressed in building an open managed network service are:

- Administration
  - Billing/accounting across national boundaries
  - Configuration control
  - Directory maintenance
  - User network management administration
- Technical Management
  - Session management enabling host computer-to-host computer switching
  - Applications management enabling switching between applications irrespective of logical host

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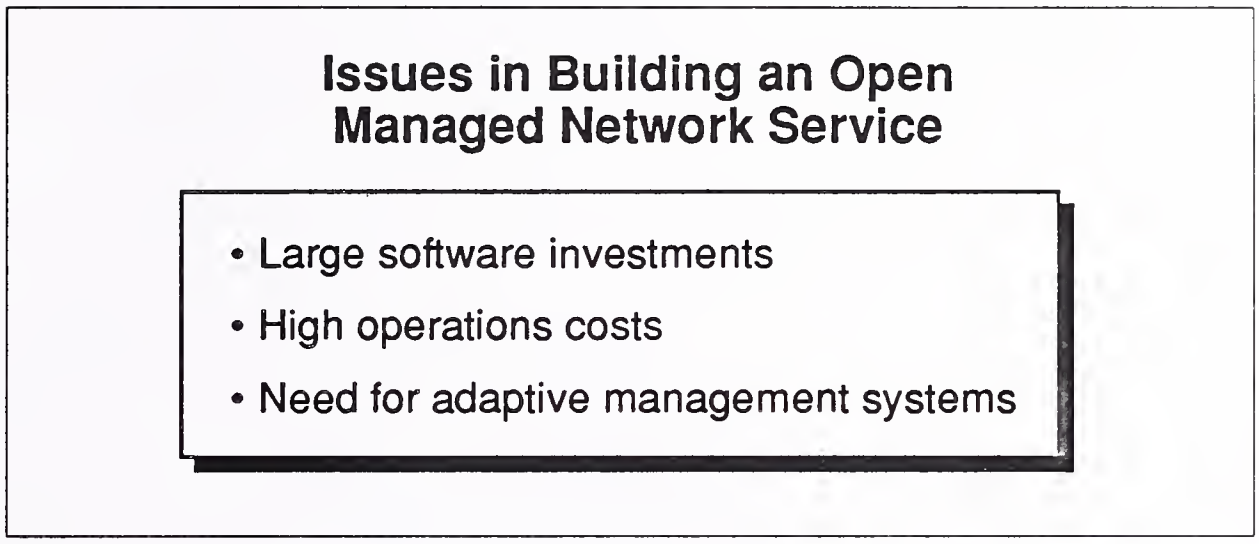
- Cost of achieving an open managed network service
  - Large software investments
  - Large operating costs
  - Need for adaptive management systems

EXHIBIT II-3



C

Strategic Challenges

With the liberalisation and deregulation of European telecommunications in 1993, it is network-based services which will provide the most effective means of introducing competition and new services, particularly at an international level.

Technically, network services represent the convergence of communications and information technology and thereby foster innovative new products and services. Furthermore, network services offer immediate opportunities for commerce and industry to directly exploit and benefit from the technological as well as the political advances.

Although services such as databases, managed network services and messaging services have contributed to significant growth, network services as a whole have not yet realised their full potential. However, there are a number of trends which indicate that network services will see significant growth over the forecast period. The major ones are summarised in Exhibit II-4.

- Vendors that have traditionally been single product providers are beginning to seek broader, more flexible sets of services. They are working to leverage their network capabilities or databases through these services.

- Videotex services have been long believed (at least by France Telecom) to represent significant opportunities. High costs, access limitations and alternative delivery methods for comparable information have limited growth. However, cost-effective PCs and declining access costs will change the situation.

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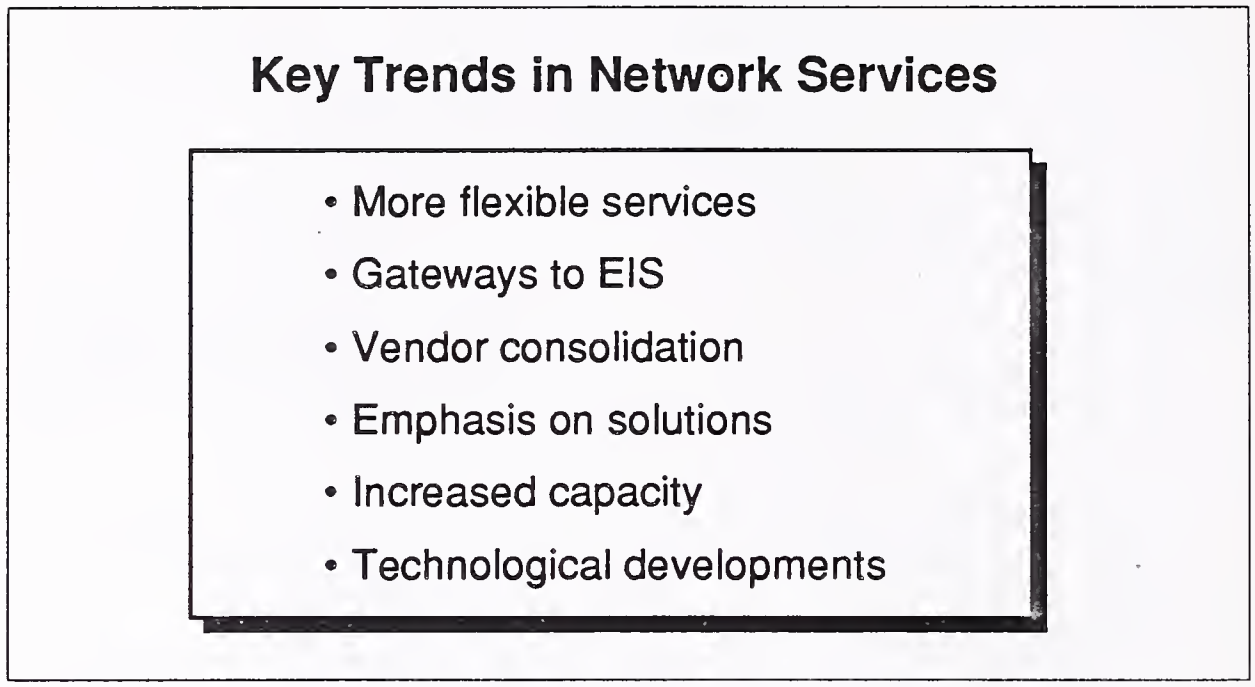
EXHIBIT II-4



- As the regulatory environment becomes more liberal, the number and cost effectiveness of gateway and customer-specific services will increase.

- The industry is consolidating: Telenet has been fully incorporated into Sprint, British Telecom has acquired Tymnet, and Infonet is owned by MCI plus several PTTs.

- Emphasis on solutions continues to dominate corporate thinking. Organisations increasingly recognise that acquisition of a solution, even at a somewhat higher cost, is frequently more cost-effective than attempting to develop corporate services in-house.

- Ample bandwidth will be slowly made available for future services—among other factors, due to the increased use and capacity of fibre optics networks. The price of the information transportation function as a commodity will decrease rapidly in the 1990s.

- Technology is creating significant "enablers" for solutions not yet developed. The revolution in cellular telephones and fax in the last few years will have an enormous impact on the market for services.

Of these, the corporate emphasis on "solutions" is the most significant for network services vendors. Providing specific solutions to corporate requirements under the umbrella of a specific, proprietary standard will no longer suffice. Inter-connectivity is becoming increasingly important.

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D

Vendor Issues and Concerns

The major trends highlighted in the previous section indicate that the network applications sector will experience tremendous growth. In addition, the co-ordination of international standards has been successful. The adoption of X.25 in 1976 opened the door to network services suppliers by providing a standard network access protocol for packet-switched networks and an economical data communications alternative to conventional leased lines. Most networks in Europe are constructed on the basis of packet switching networks and with X.400 and EDIFACT, the application layers are now well served.

However, there are also a number of issues that need to be addressed in order for the European industry to realise this potential. Key issues are highlighted in Exhibit II-5.

EXHIBIT II-5

Vendor Issues and Concerns

- The development of ISDN
- Technological uncertainty
- Standards differences
- Regulation environment
- Costs of new services

- The availability of cost-effective ISDN-based services remains an issue. Although services are touted as available, marketable ISDN-based service sets are only really available in France and to a lesser extent in Germany. This reinforces vendor concern that ISDN represents a PTT-service, geared to retain their privileged position.

- Technology is changing rapidly and vendors recognise that significant investment must be made in order to provide unique products and services.

- The diversity of standards has an inhibiting effect in investment in new technology. With many technology features based on embedded software, organisations are reluctant to make investments that will need to be changed, causing reinvestment.

- The European regulatory environment continues to have an inhibiting effect on the availability of new services. With uncertainty prevailing in the minds of telecommunications services vendors, many are proceeding cautiously rather than adopting an aggressive approach to new products and services.

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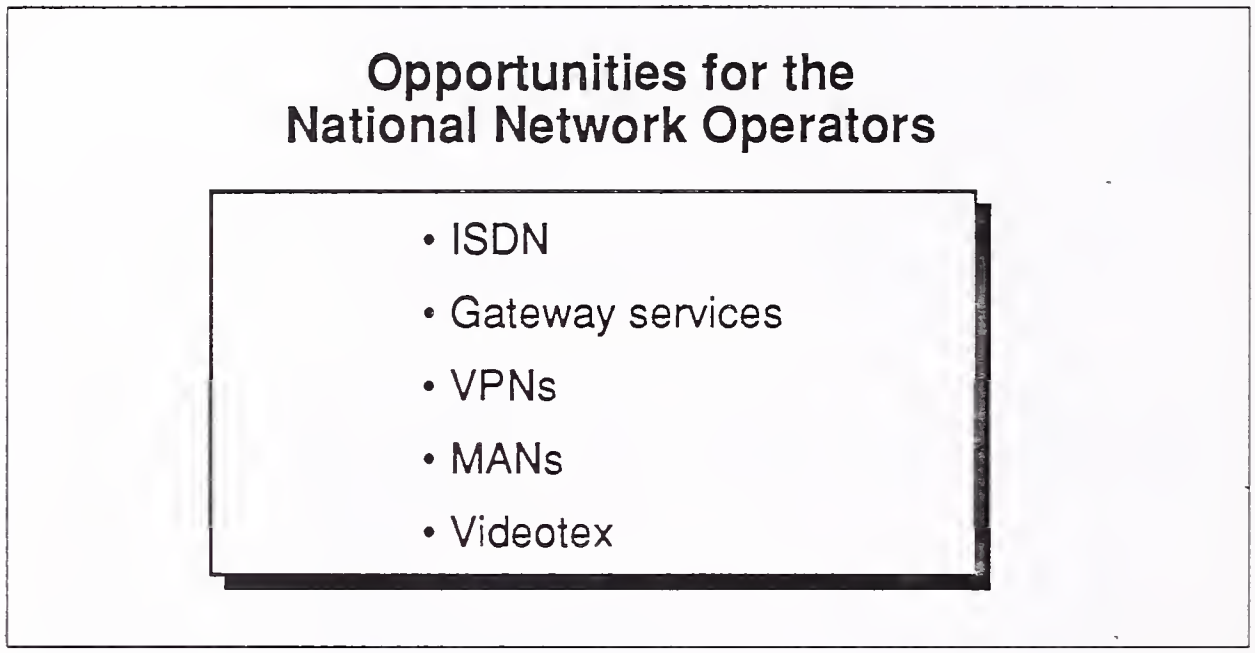
- Costs associated with introducing new services are high. Many vendors elect to proceed cautiously. Substantial investments will continue to be made but services that might otherwise become available quickly will be introduced over a longer period of time.

E

Dealing with the Changing Environment

Whilst a changing regulatory environment will inevitably create major challenges for independent vendors, the European telecommunications administrations are positioned to make significant inroads into the future managed network and messaging services markets. The opportunities are diverse and are summarised in Exhibit II-6.

EXHIBIT II-6



- ISDN continues to be a major focus for the PTTs but will be slow in developing, due to the slow introduction of ISDN technology throughout the country. To be effective, digital capability must be available to at least 70-80% of the local exchanges in Europe and the PTTs must be able to identify and price marketable sets of services.

- The PTTs will continue to seek opportunities to provide gateway services. However, following their initial entry into the area, progress may proceed slowly as questions about permissibility continue to be raised.

- The provision of digital-based virtual private networks (VPNs) will offer significant opportunities. Initial efforts will be to provide software, since providing services will require the establishment of relationships with local vendors. Infonet is ideally placed to exploit this market.

- The provision of digital-based metropolitan-area networks (MANs) may prove to be a means of curtailing the migration to bypass networks. Reasonably priced virtual private metropolitan-area networks

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have the potential to reduce costs associated with maintaining a private network as well as being a test bed for national virtual networks.

- The development of consumer-orientated, mass-market videotex services.

F

Network Applications Submodes

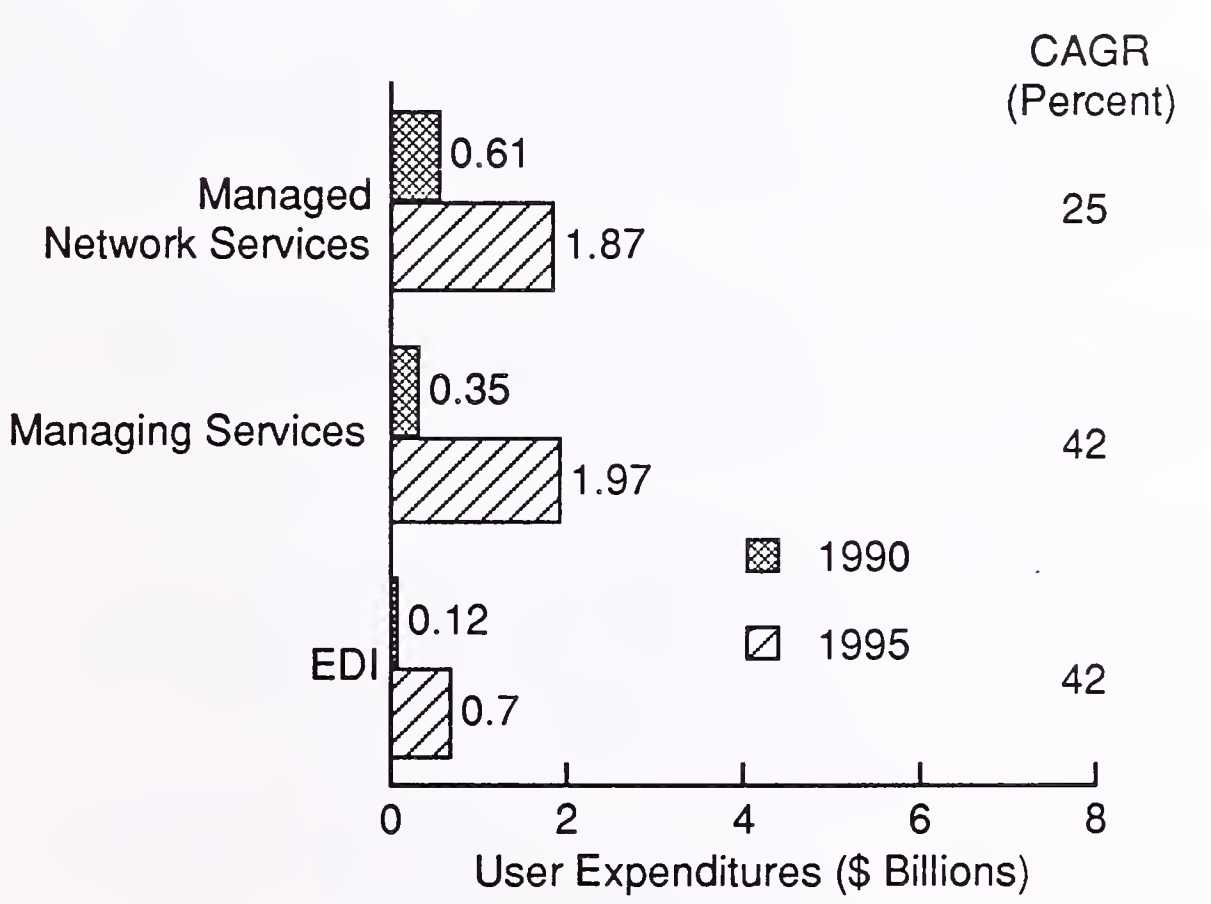
Network applications are services which assist the movement of the customers' own data and information through telecommunications networks. The sector includes three submodes, two of which are reviewed in this report:

- Managed Network Services
- Messaging Services

Both submodes under review in this report will grow rapidly over the next few years, as shown in Exhibit II-7. This reflects the increasing importance of communications relative to processing in the 1990s.

EXHIBIT II-7

Network Applications Services Market 1990-1995



Videotex and video-conferencing are currently included in the Managed Network Services market forecast. Videotex for the home and small business will become a major information delivery vehicle in the 1990s, particularly when high bandwidth communication becomes easily available.

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1. Managed Network Services (MNS)

Vendors such as BT Tymnet, Sprint-Telenet, and IBM IN have achieved significant growth through the provision of classical message store-and-forward and packet-switching capabilities. However, the arrival of PTT-sponsored ISDN and the emergence of digital-based virtual private networks in the early 1990s will complicate MNS strategies, though offering leverage for new MNS services that utilise or interface with ISDN. Although there has been growth in the MNS market, competitive pricing and falling costs passing through to customers will cause market growth to be restrained, when compared with the market for messaging services. One consequence has been the push by network vendors into higher value-added applications, as opposed to lower value-added protocol, terminal and system interface business.

The market for MNS will grow from $0.6 million in 1990 to $1.9 million by 1995. Network services targeted at vertical industries will grow faster than generalised services. MNS companies will also receive revenue growth from support of EDI and electronic messaging services as well as on-line database and news services.

2. Messaging Services

Electronic messaging has long been a service looking for a market. Implemented primarily to meet the needs of intra-organisational communications, the market has grown moderately, fostered by the availability of MNS. The situation is likely to change dramatically over the forecast period.

The globalisation of business, the emergence of EDI and the increasing ability to interconnect services are changes that will result in an increasing use of electronic mail services. Information transmitted that is associated with EDI transactions, such as delivery schedule inquiries, for example, is regarded as electronic messaging.

The forecast for the electronic messaging market is robust, for the simple reason that the increased capability to interconnect disparate systems using X.400 will result in a rapid globalisation of the market. It may well be that the 42% CAGR quoted for the forecast period will prove to be conservative!

G

Market Opportunities

To summarise, there are three key factors producing rapid growth in network applications services:

- The widespread growth of personal computers within the corporate environment

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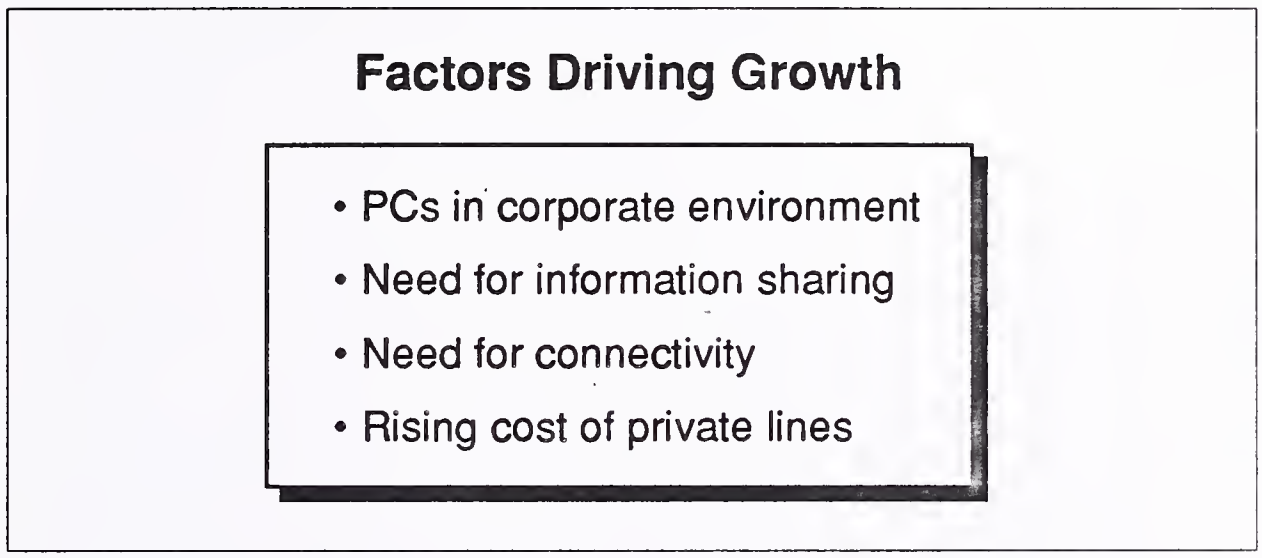
- The need for information sharing and connectivity among dissimilar services

- The rising cost of private lines

These factors will continue to propel the market throughout the forecast period, with the greatest potential lying in application services. These factors are listed in Exhibit II-8.

EXHIBIT II-8



Much of the projected growth will come from the increased role of the network operators (the PTTs) in the network services market. Many network operators currently offer packet-switching services and are expanding their offerings by implementing intelligent network offerings that enable them to customise services more precisely. This new competition presents a considerable challenge to the established independent vendors.

Faced with new competition and the loss of processing services contracts, these established vendors are investing heavily in developing applications and services. As a result, vendor consolidation is likely, with only brand leaders retaining their market positions.

The outlook is particularly bright for vendors that can merge their rapidly evolving network capabilities into a global communications structure and can manage the marketing of timely information over that structure. If any single trend stands out, it is the rapid growth of the world network infrastructure during the forecast period. This linkage will stimulate demand for information, and communications-orientated services, functions and capabilities are certain to follow.

Finally, probably the most important outcome of the evolution of intelligent networks will be the development of sophisticated Virtual Private Networks (VPNs). These are advanced, end-to-end digital networks, fully tailored to the requirements of their users but owned, managed, maintained and operated by public network operators. VPNs will be a

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new stage in network-based communications, narrowing the gap between public and private networking. Whilst not offering dedicated communications, VPNs will relieve users of complex and expensive day-to-day network management, and of the need to update their equipment whenever technology changes. Thus the aim of the VPN is to offer a flexible, user-friendly mixture of private network security alongside the ubiquitous access and economies of a public network. An important gateway into intelligent VPNs will be ISDNs, thus highlighting the importance of the current investments being made by the national European network operators.

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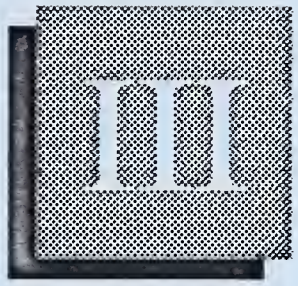
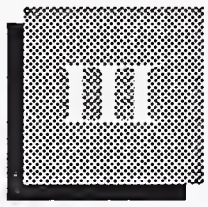


Market Dynamics



Market Dynamics

A Overview

Advanced public network infrastructure and liberalised public service environments are important catalysts in the development and utilisation of network services. Initiatives such as the EC's STAR support programme and Open Network Provision (ONP) proposals are relatively new, but agreement was reached at the end of 1989 by the Council of Ministers on the terms of the EC's ONP Framework Directive and Services Directive. These measures are likely to pave the way for complete liberalisation of network services provision in all Common Market countries during 1990 and for harmonisation of access conditions to the underlying transmission networks for service providers.

It is likely that the future of telecommunications in Europe will be determined by politics rather than technology. The stumbling block is the development of the "data highways" in order to harness technology's full potential. It cannot be left to private enterprise alone to plan and build a national network that will attract multinational investment and be part of the European economy, but national governments cannot predict either the rate of technology development or that of demand, much less requirements.

INPUT's research indicates that 70% of respondents believed that there was a general industry move towards open systems and of those, half thought that it would take place over the next five years. The majority of respondents considered that UNIX would be the most important operating system in ten years' time; however, this is a considerable period of time, especially considering that 70% of those surveyed considered that they were locked into their current suppliers and operating systems in some way.

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Personal computing is at a crossroads: DOS may be a operating system that has had its day, but it has the widest range of applications software developed for it. OS/2 still has limited applications, whilst UNIX still has a long way to go. Whilst bridges and routers have their place, it is application gateways that users really need to interconnect dissimilar networks—through protocol conversion—until standards are finalised.

For example, X.400 cannot become a standard until there is a standard communications infrastructure in which it can operate. There are still a number of issues to be resolved before a single standard is adopted. Electronic messaging has the potential to provide companies with the paperless office, yet the business community worldwide is not yet populated with sufficient connectable terminals.

Telex (including teletex) remains the prime method of inter-organisational electronic messaging as well as the only form of electronic document used by lawyers, for example.

Telex may have been written off as a technology, but there are two million telex numbers in use around the world and recent telex investments by British Telecom alone amount to more than £30 million. Telex is the only efficient method of telematic communications between the Third World and industrialised countries. It is the only way to gain access to over 200 locations in the Third World and Eastern European countries. Fax is another example: Technologies such as X.25, LANs, ISDN, and X.400 are being left behind by fax, a technology in which electronics is relegated to the medium by which messages are transmitted and not the complete environment by which they are prepared, transmitted and stored.

Messaging markets do not develop in parallel around the world. Only where there are high quality telephone lines can fax be used. EDI, for example, has developed much faster in the U.K. than in the rest of Europe. Many of these communications problems have solutions available via the message switch. The message switch tends to be overlooked because it is solving existing rather than new problems and it is not considered because the majority of such switches are single-function machines based on proprietary equipment and operating systems. Yet these switches are performing a job that X.400 is only claiming it can do. However, with the increasing pressure on IS departments to liaise with communications departments to provide inter-connectivity between the user's own community and the outside world, it is possible that the message switch will assume a new importance—particularly if it is based on industry-standard equipment and operating systems.

A true message switch, by definition, provides many advantages over an X.400-based system. Message management, security and audit, fail-safe/non-stop operation, electronic mail and filing functions are standard

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message switch features. They are as important to the message switch as is the ability to convert communications protocols and formats. A prime justification for an EDI standard is to remove the need for protocol and format conversion. However, it assumes that the business community will remove, at a stroke, almost a century of telecommunications infrastructure.

Nevertheless, there is pressure to adopt the X.400 standard, which in turn will stimulate demand for EDI, whether or not a standard exists. There exists a nascent EDI community essentially using message switch technology. There is the future promise of an international standard message format and in the interim, whilst some users are migrating to evolving standards, others are employing message switching. After all, the message switch has tackled every protocol or format presented to it in the past and will tackle X.400 in whatever guise it may come. It provides the solution for today's businesses which must communicate electronically and the bridge to the seamless electronic messaging world of the future.

1. The European Environment

CEPT has concluded a four-year project aimed at finding ways to remedy the poor state of Europe's X.25-based public packet-switching networks. The 26 CEPT countries agreed to continue operating their public data networks for at least ten years. With or without ISDN, they plan to expand services on their existing networks for at least four years. This expansion includes:

- Early availability of X.32 dial-up access from the public switched telephone network to the public data network on an international basis
- Publication of quality-of-service statistics in all the CEPT countries
- A suggestion for reverse charging between countries
- The widespread deployment of one-stop shopping between countries
- X.25 packet-switching access in the D-channel of ISDN in 18 CEPT countries by 1992
- Experimental networks for packet-switching at 2 mbps
- Alignment of all national X.25 networks with the EC's plan for Open Network Provision (ONP)

CEPT estimates that the number of data connections will grow about 35% over the next few years, rising to over 500,000 by 1992. A breakdown of X.32 access is given in Exhibit III-1.

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EXHIBIT III-1

Dial-Up (X.32)* Access to the Public Data Network

Currently Available	Scheduled Available End 1990	Scheduled Available End 1991
Finland	Belgium	Switzerland
France	Denmark	
Portugal	Germany	
Spain	Italy	
Sweden	Ireland	
	Norway	
	United Kingdom	

* X.32 access to the X.25 public data network via V.22 bis (1.2-, 2.4 - Kilobit - per second) and V.32 (9.6 kilobps) modems

Source: CEPT

Since the advent of X.25 packet-switching, the history of European data communications has proved problematic: inadequate international gateway connections have increased costs and transit delays; restricted throughput has led to failure rates of up to one in three. Incompatibility among national X.25 networks and different sets of optional user facilities have resulted in users not being able to get a complete and uniform service between countries.

Likewise, different network management architectures and data formats have meant that overall network management for an international user cannot be provided. Meanwhile the cost penalties attached to existing billing and tariff policies have been a significant disincentive for use. For leased circuits, for example, the only charge paid for having 24-hour disposal of the circuits is one based on distance, but for X.25 networks both distance and volume-based charges must be paid. At the same time, the reluctance of most administrations to set up an effective international reverse charging mechanism has undoubtedly retarded the growth of many new network services in Europe.

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However, rather than correct this situation, the PTTs have acted in a draconian manner, forcing users to migrate from their private leased line networks to the public data networks through regulation. Increasingly, the quickening growth and diversity of data communications is making the task of enforcing such regulation almost impossible. As the grip of regulation loosens across Europe to allow for the resale of third-party traffic, and as competition takes hold, the administrations are realising they must improve their offerings.

Simply, Europe needs its public packet-switched networks to be able to communicate with one another. Thus, the moves to publish quality-of-service data, to improve international connections, to offer high-speed interconnection, to introduce reverse charging and one-stop shopping and to make dial-up access from the public-switched telephone network universally available are encouraging.

CEPT and ETSI's work in high-speed data communications is laying the foundation for Europe in the 1990s. Currently, the channels on leased circuits in Europe are usually limited to 2 mbps, much lower than the 4, 10 and 16 mbps offered by conventional local-area networks (LANs) or the 100 mbps promised by the emerging LAN standard for fibre distributed data interface (FDDI). Leading players in the metropolitan-area network (MAN) field in Europe and the U.S. are listed in Exhibit III-2. These vendors will be able to capitalise on the features of the new infrastructure being built.

EXHIBIT III-2

Leading MAN Players Worldwide

- Europe
  - CEPT
  - ETSI
  - European Railways Consortium
- U.S.
  - ANSI
  - IEEE
  - Alternative Access Carriers
- MAN = Metropolitan-Area Network

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B

Managed Network Services

Managed Network Services provide functionality over and above the basic transport supplied by the PTT as a common network facility and, in particular, provide a strong element of network management and control. Managed network services do not, however, provide applications to the end user. Functions are summarised in Exhibit III-3.

EXHIBIT III-3

Managed Network Service* Functions

Services	Protocol support and conversion Speed conversion Gateway services - Telex - Videotex - X.400 - Tax LAN support Multimode terminals
Technical management	Network management Session management Configuration control databases On-line documentation User network management
Administration	Accounting Single point billing Directories (X.500) User facilities management Help desk

* A managed network service can be a public network offering from a PTT or from a commercial service provider, or it can be a private service operated for the sole use of an organisation or closed user group

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There are undoubtedly definition problems in separating a basic transport backbone with private switched capability, managed networks such as those operated by IBM and Infonet, and a network offering very limited applications capability, particularly where the applications are generic ones such as X.400 and X.500 directories.

However, the definition of a boundary between the basic transport backbone and a managed network service is only really important from a regulatory perspective. The demand for managed network services has been particularly driven by the lack of international data services available to those corporate users that wish to process and access data internationally.

1. The European Electronic Network

With the size and complexity of networks growing rapidly in the major European market, many corporates are concerned with improvements to the flow of intra- and inter-organisational information over their networks. With the emergence of workstations and personal computers forming local-area, wide-area and branch networks, many companies are concerned about the high cost of carrier services.

With networks being increasingly viewed as a strategic asset in the context of deregulation, organisations are seeking to integrate their networks whilst at the same time looking to free communications staff to focus on the imperatives of strategic planning.

In many organisations, the lack of skilled personnel to managed large integrated networks is a problem. Add to this, the fact that deregulation has led to increasing complexity and costs, complicating the decision-making process. Companies are in need of a simplified environment, not an environment that requires increased corporate resources to manage.

The development of the managed network services market depends on a confluence of factors, and vendors need to be able to offer the following:

- Expertise in all types of networks—voice, local-area and long-distance data circuits
- Experience
- Broad technical and managerial capability
- Service orientation

There are a number of forces driving the growth of the managed network services market. These can be summarised into three categories, as shown in Exhibit III-4.

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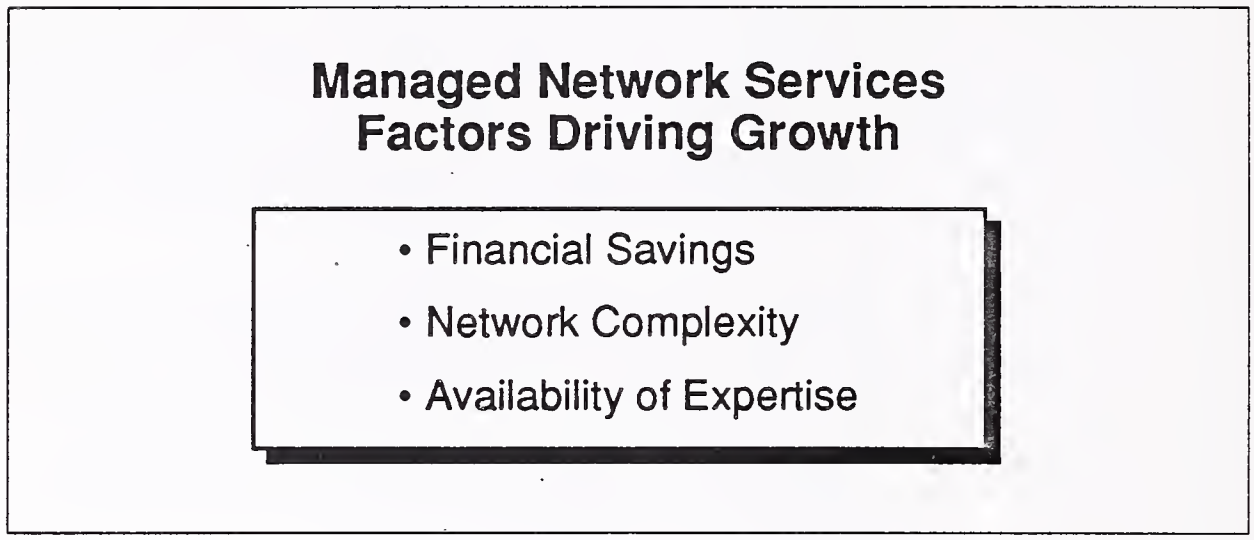
EXHIBIT III-4



The costs of managing networks have grown steadily over the past few years and although there are continuous efforts being made to hold or reduce costs, organisations recognise that management of large integrated networks is becoming increasingly costly. As a result, companies are considering alternatives to either achieve savings or hold costs down.

Another key factor is the increasing complexity of networks: Whilst many large European organisation have developed expertise and processes to manage integrated voice and data networks, introduction of LANs into the environment increases the complexity significantly. The requirement to increase the volume of international business is a further consideration. As a result, many large organisations are having to conclude that they do not possess the expertise to successfully manage fully integrated telecommunications services.

2. Managed Network Service Providers

a. Public

In effect, many managed network services operators provide network services over the same network. When compounded with a confused regulatory position in different European countries, it is not surprising that there have been difficulties in ascribing market shares. The market leaders in the provision of public managed network services are:

- IBM IN
- Infonet
- GEIS
- EDS
- Sprint Telenet

These providers account for 75% of the European market. With the exception of Reuters and Dialcom, the other managed network services offerings are too new to have achieved significant market share. The

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PTTs entry into this market, however, will be significant in creating new services. The leading European public managed network services suppliers are shown in Exhibit III-5.

EXHIBIT III-5

Major European Public Managed Network Service Companies

Provider	Service	Target Sector	Basic Transport	Coverage
BT	Tymnet	All	X.25, packet switched	World
IBM Europe	IN	All	SNA	Europe
MCI/European and other PTTs	Infonet	All	Packet switched	World
GEIS	Mark* Net	All	PSTN, PDN, SN	World
EDS	EDS* Net	All	X.25	World
Mercury/C&W	Mercury 5000	All	PSTN	U.K.
Mercury/ICL	MDNS	All	PSTN	U.K.
Reuters	IDN	Financial	PSTN	World
U.S. Sprint	Telenet	All	Packet Switched	World
Nordic PTTs	Scantel	All	X.25	Scandinavia

b. Global Providers

No one managed network service can offer true global coverage in terms of access points in every country. A limited number of operators, however, can offer services into 60 or 70 countries. These include:

- IBM IN
- Infonet
- GEIS
- BT Tymnet
- Sprint Telenet

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c. Private

Within the private sector, managed network services provision is considered to include operation and management of the network on behalf of a group of users and excludes solely the turnkey provision of a network which is then operated by that group of users. The major providers of private managed network services are listed in Exhibit III-6.

EXHIBIT III-6

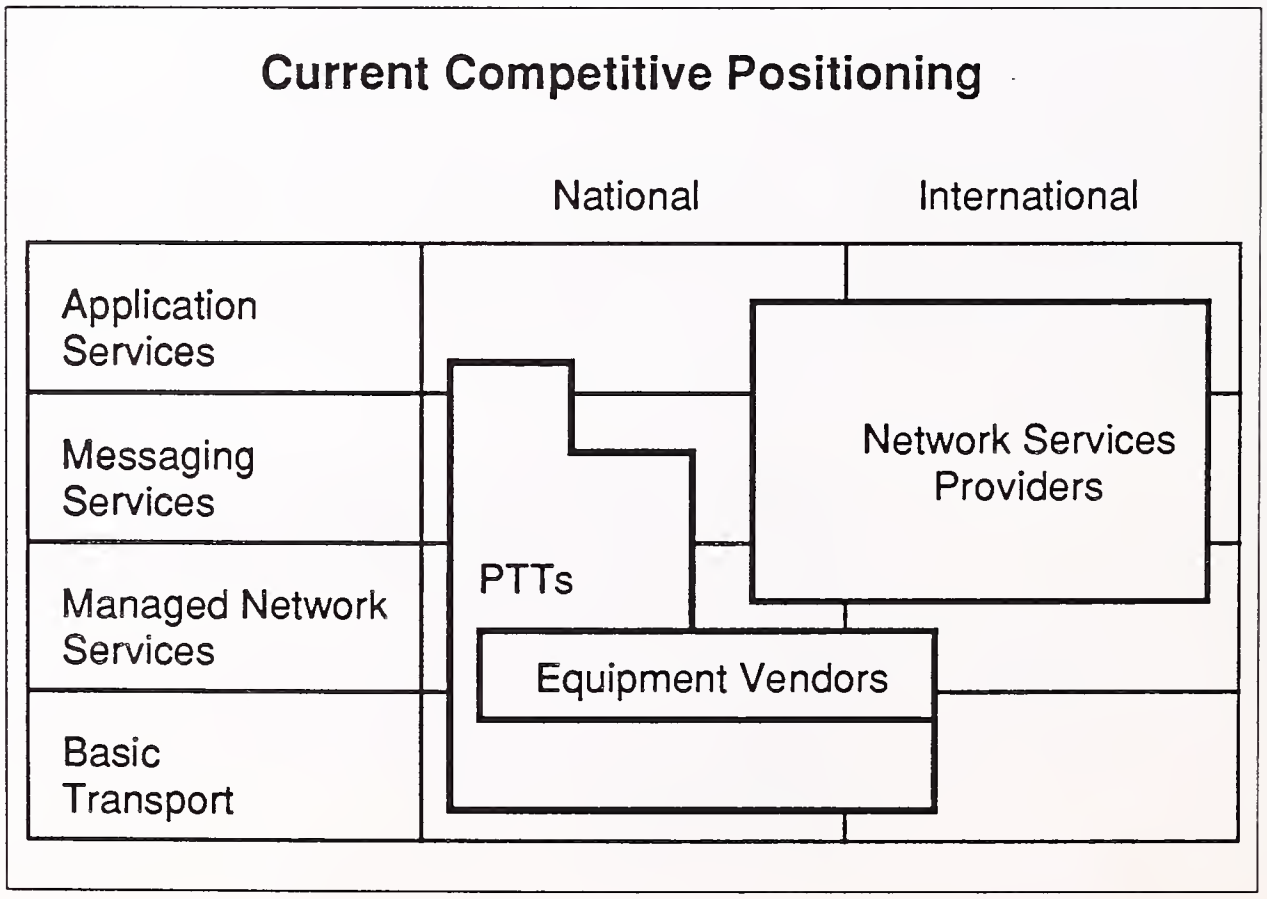
Major European Private Managed Network Services Companies

Supplier	One-stop Shopping Service	Consultancy	FM
BT International	✓		✓
EDS	✓	✓	✓
CSC	✓	✓	✓

d. Competitive Positioning

The PTTs, the service providers and the equipment vendors have different starting positions and existing product and market strengths in seeking to enter or maintain a position in the managed network service market. Their relative positions are outlined in Exhibit III-7.

EXHIBIT III-7



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The list of leading vendors is not expected to change significantly over the next few years due to the high cost of entry into the business.

Network services vendors are targeting these services at selected vertical markets, such as the oil and gas industry, medical supplies industry and telecommunications interchanges. Traditional MNS such as Tymnet and Telenet are being threatened by companies that are reselling a portion of their private networks. Examples include SITA and Amadeus.

New marketing techniques are being tried in an effort to promote increased networking services. Some vendors have tried value-added reseller programmes. This reinforces the vertical marketing approach in which VAR organisations with industry expertise create applications and/or focus on new important markets such as insurance, travel, medical and distribution.

MNS vendor management is working to increase sales and enhance services with:

- Improved price/performance for nodes
- Improved software to support IBM protocols, faster devices and X.25

The major vendors' private network sales have been affected by the emerging T1 box vendors such as Digital, Network Equipment Technologies and Timeplex. Users are able to lease T1 facilities, buy the T1 equipment and, in effect, build a network to their custom requirements.

e. Potential

Many suppliers see the market for managed networks services clarifying. Large companies are grappling with the problems of setting up and managing their own networks. However, the "network" business is affecting their core businesses and because telecommunications are alien to their core business, it is logical to buy in services. X.25 can act as a systems integrator, as demonstrated graphically in Exhibit III-8.

Vendors see the key parameters to be price and grade of service. Managed network services offer a compromise between end users managing all their own facilities and networks, and full facilities management, where even users' data processing facilities and applications software come under third-party management. (EDS offers these latter services.) Sharing the costs with other users through a managed network services initiative, with the service provider dealing with the regulatory issues, is attractive to many users.

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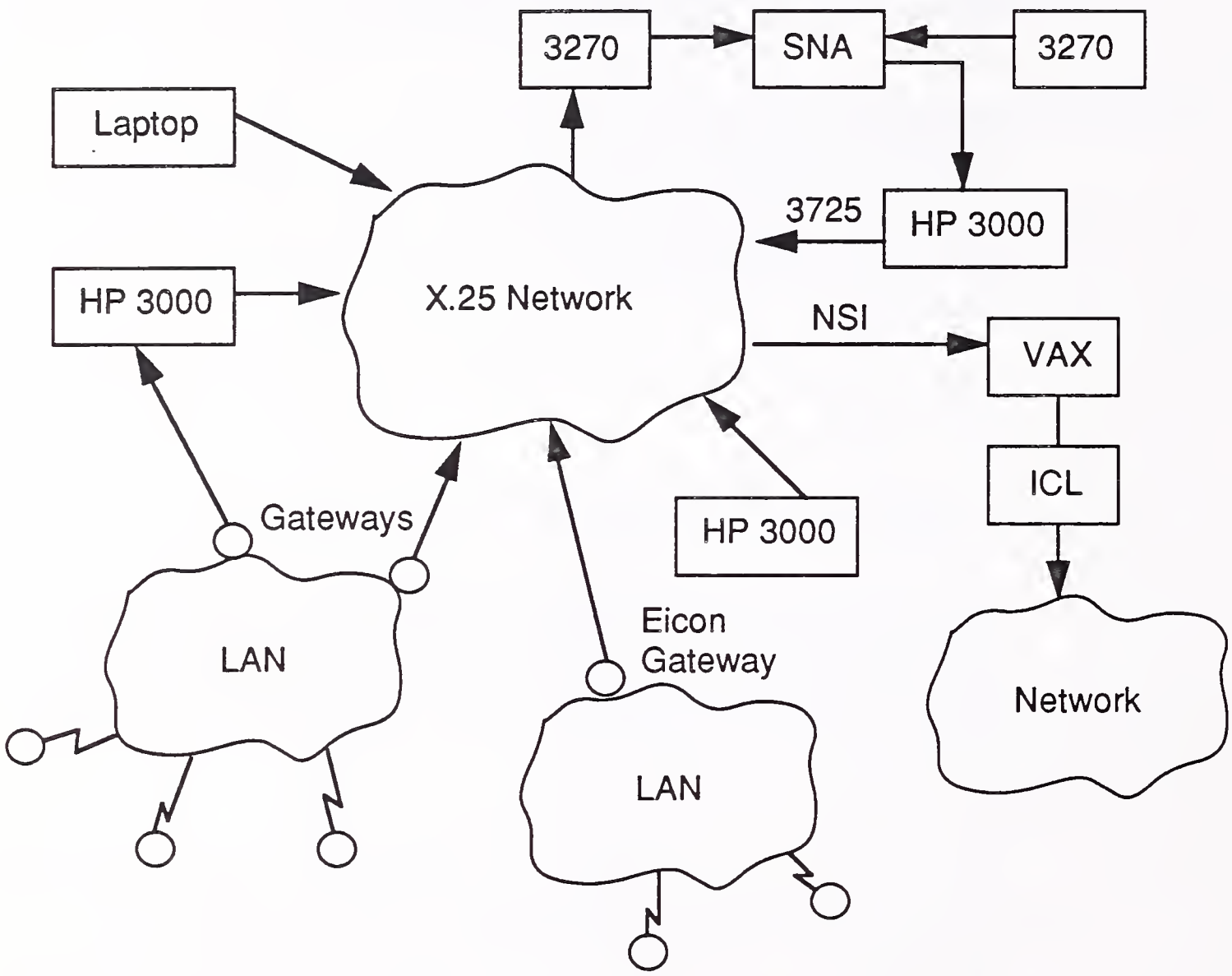
EXHIBIT III-8

Private X.25 Network as Systems Integrator



X.25 is the only networking scheme feasible for international networks because it provides universal connectivity and remains cost-effective in countries where bandwidth is expensive. Whilst service providers such as British Telecom, AT&T and MCI have strong public networks and substantial private-line offerings, they have not yet been major players in the international network services market.

The service providers are differentiating themselves along three lines:

- Geographical reach
- Transport for all types of applications
- Services geared to specific applications or industries

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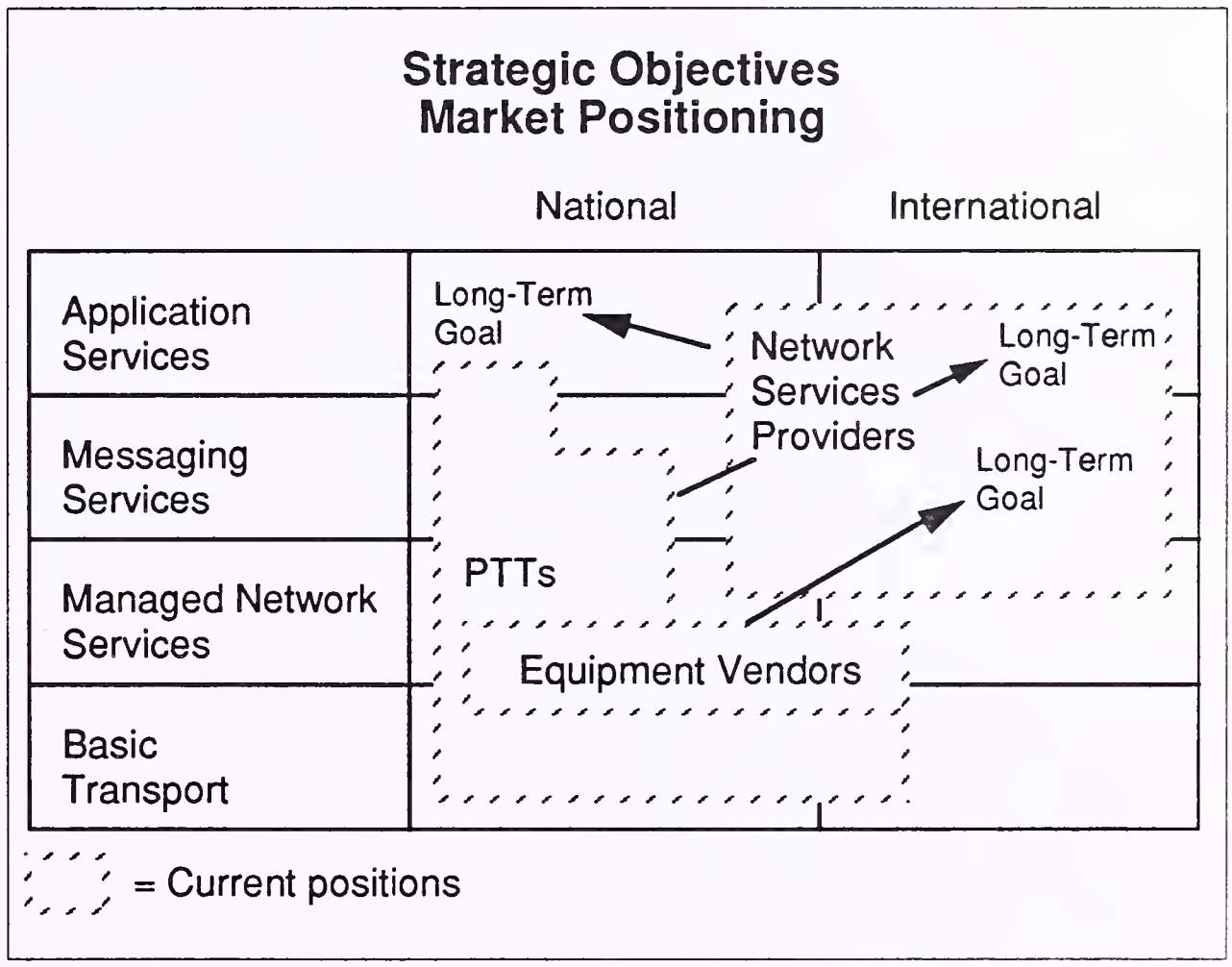
The application services in strong demand are:

- Managed network services
- X.400
- EDI

Whilst EDI is perhaps the most important application, X.400 has potential for message handling and may well result in EDI, currently carried out with a variety of proprietary implementations, being handled through X.400. As far as managed network services are concerned, these enable a service provider to oversee an entire network, manage parts of it for certain periods or supply temporary network administrators. Exhibit III-9 shows how vendors should move from their current positioning in order to take strategic advantage of the long-term trends in network services.

EXHIBIT III-9



3. Market Developments

AT&T has strengthened its ability to win managed network services contracts with its purchase of Istel for $280 million. Istel's position as a system integrator that also manages data centres and networks and offers EDI and videotex services, made it a perfect fit. British Telecom made a similar move in its $355 million purchase of Tymnet, a leading service provider with a record of managing customers' networks.

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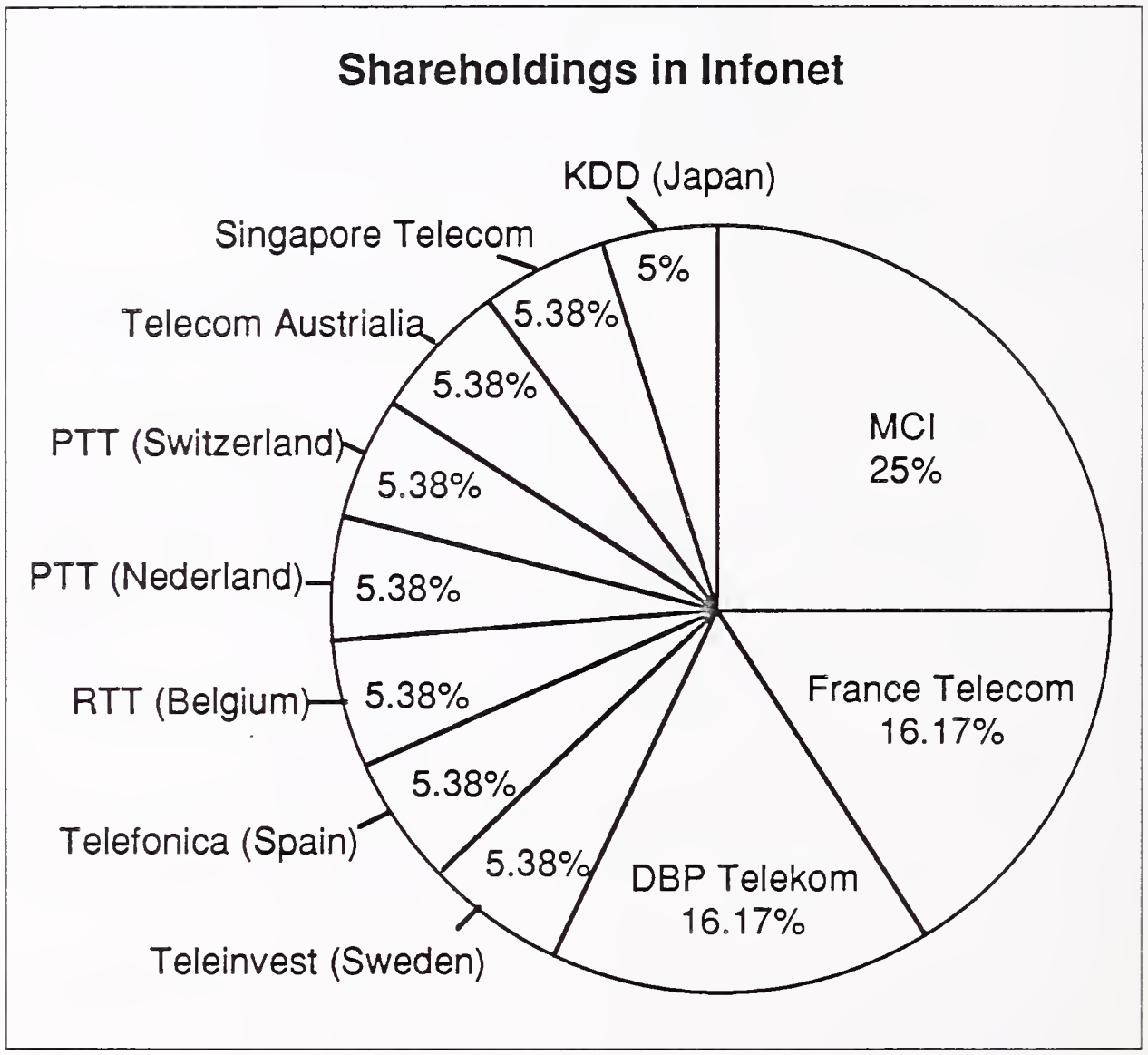
MCI obtained an international network with strong ties to the PTTs around the world when it bought 25% of Infonet for $27.5 million. Interests in Infonet are shown in Exhibit III-10. MCI holds the largest stake and Infonet has agreements to supply global EDI services through agreements with PTTs and other suppliers around the world. The purchase of Infonet by MCI and the PTTs is the best example of a long-distance carrier establishing local network connections for its customers' international traffic and of the PTTs establishing international distribution for their traffic.

EXHIBIT III-10



Furthermore, MCI has also joined forces with British Telecom and KDD of Japan to form a new international network for voice, data and fax. Customers will be offered an "off the shelf" private networking service, giving customers access to data, voice, fax and messaging facilities. The service is called Comm by MCI, Port-Plan by KDD and the British Telecom element is called Primex. It is designed as an alternative to private leased lines and became available in June 1990.

The network, available from anywhere in the Far East, the U.S. and Europe, is based on three control centres in London, Tokyo and New York. System nodes are housed via the carriers' operating sites and

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linked to customer locations by digital channels via the carriers' combined satellite and fibre optic links. Network management will be provided by the three carriers, in the respective regions of the globe.

By selecting the optimum number and type of ports, customers can construct a network which can incorporate international and domestic circuits from an external supplier and connect them to the user's own telecomms and system ports. As users can have access to the full support systems of the foreign carriers, the length of time needed to install an international private network will be drastically reduced. MCI suggests that 50% of customers will be using their service as an interim measure before installing their own equipment.

Fixed monthly charges will be based on port charges and trunk charges, whilst terminal equipment can be rented. Customers make a commitment of one, three or five years and additional ports and trunks can be installed as traffic volume grows. As yet, the carriers are not offering services over the network themselves; however, this is possible in the future. In addition to this agreement, MCI is also to connect its Vnet virtual private network service to British Telecom's planned Featurenet.

The other U.S. carrier expanding into Europe is US Sprint Communications. US Sprint owns Telenet, a major network in the U.S. but with less strength internationally. It combined the old Telenet operations with its own and then reorganised the whole business along international and domestic lines. The international division is called Sprint International: with a network node in West Germany and nodes being installed in London and Amsterdam, Telenet has the weakest presence in Europe of all U.S. networks.

In July 1989, Info AG bought from Sprint International an $11 million packet-switching network that supports both X.25 and SNA. Info AG is expected to team up with Sprint International to become the alternative network to DBP Telekom. DBP Telekom has already teamed up with Graphnet, a network that provides messaging services to financial institutions. It has since expanded into fax and EDI after being spun off by its parent two years ago. Graphnet and DBP Telekom will jointly market teletex and EDI services to more than 80 countries.

GEIS is improving its network as a consequence of the rapid development of the market. It is introducing dial-up access over 9.6-kbit/s V.32 connections supporting X.25 standards. Until now, GEIS has only offered dedicated access. GEIS is also planning to have installed 10 to 20 more nodes in 1990 in Europe, including IBM 3745 switches and X.25 packet switches.

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Motorola and Arthur Andersen have introduced a managed data network service in the U.K. with plans to expand it worldwide. Equipment is being installed for SigmaNet which will be based on an X.25 network and will offer other network services such as EDI and X.400. The service will be run by Motorola's Codex Corp subsidiary and Andersen Consulting. The service will be expanded worldwide and has attracted interest from Andersen Consulting and Codex's existing client base. Codex is a leading supplier of datacommunications and network services, with 1,000 customers in the U.K.

Both companies already have global data networks, but through collaboration, hope to become a major player in the market against competition from IBM and EDS. SigmaNet will be offering a customised solution as opposed to the more generic offerings of its parent partners. Service will be more expensive but there will be an overall price rather than charging line by line.

Managed networks like SigmaNet will be popular with companies that wish to avoid incurring heavy fixed investment costs and/or need to link up their existing data centres quickly and cheaply. They will help to resolve the problems of recruiting staff to manage privately owned networks and, by offering communications managers facilities such as systems integration and end-to-end control, will be able to cope with multivendor environments.

C

Messaging Services Market

There is little doubt that the arrival of fax has applied a brake on the development of electronic messaging; however, the requirement for editing has meant that file transfer has experienced steady growth over the past two years. There are several other reasons why INPUT forecasts rapid growth in this submode.

- The first is the increasing ability to interconnect systems. Major providers of software and services have realised that to be truly effective, there must be a means to send electronic mail between systems and services.

- Electronic mail has received a big boost in that several major vendors agreed to interconnect networks using the X.400 standard.

  Furthermore, with X.400 capabilities, public networks will be easy to access from corporations' internal electronic mail networks. Immediate beneficiaries of X.400 interconnect capabilities are the aerospace and oil industries.

- The globalisation of business has increased the demand for electronic mail-type services. Geographic and time differences have made the use of timely text communications increasingly necessary.

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In addition to the agreement by electronic mail vendors to use X.400, another important event has been British Telecom's purchase of McDonnell Douglas Information Services, including Tymnet's On Tyme electronic mail service. Adding On Time to its earlier acquisition of Dialcom, BT has become one of the largest players in the combined public/private electronic messaging market.

The growth of electronic mail is still inhibited by the popularity of other methods of exchanging information, such as fax and voice mail. However, INPUT foresees a coalescing of these methods of communication so that users may employ integrated electronic mail, voice mail and computer-managed fax services. Each method of communication has its own advantages and disadvantages - the combination becomes very powerful. Voice recognition technology will also play an important part in electronic mail.

Some companies use electronic mail to accomplish the equivalent of EDI. They use electronic mailboxes for deposit of transaction information; the difference from EDI is that the mailbox owner still has to enter the transaction into his application system, whereas in EDI the transaction is deposited into the application directly.

Electronic bulletin boards are just beginning to be used in a business, as opposed to a personal environment. One rapidly growing application area is in support services; customers leave inquiries for the supplier, typically about the use of a product. The advantage is that inquiry can be left for a particular individual to be answered when the person is available. The leading provider of facilities to support bulletin boards and teleconferencing is the U.S. company CompuServe, which has recently entered the European market.

In Europe, an increasing number of companies are using public electronic mail services to transfer large documents such as data files, graphics, software programs and spreadsheets. Vendors report that typical applications include the transmission of orders and call reports from sales staff and of financial and month-end reports from managers and accountants. The advantages are speed, economy and retention of formatting. File transfer is without doubt the fastest growing area of electronic mail.

1. Acquisition Activity Boosts Messaging

Acquisition activity has helped messaging developments. AT&T's acquisition of Istel, BT's of Tymnet and the sale of Infonet by CSC will fuel X.400's development in Europe. AT&T currently links up to a number of overseas countries via X.400 through its electronic mail service, ATTMail, and an X.400 link between ATTMail and Istel is inevitable. BT's purchase of Tymnet will lead to an X.400 link between Tymnet's On Tyme electronic mail service and the international network of Dialcom licenses.

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Added to this, a group of 10 electronic mail vendors have formed a Directory Services Consortium to promote the development of universally accessible interconnected messaging directories. The companies are AT&T, BT Tymnet, CNCP Canada, GEIS, IBM, MCI, Pacific Telesis, Teleglobe Canada, Sprint and Western Union.

MCI's decision to buy into Infonet was based on the recognition that the capability to offer global managed network services is rapidly becoming the key to obtaining and keeping multinational user accounts. Purchasing a 25% stake in Infonet for $27.5 million was a relatively inexpensive way to become a major player when set against the $355 million that British Telecom paid for Tymnet or the $280 million that AT&T paid for Istel. Furthermore, Infonet will benefit from MCI's interest because of the significant number of U.S.-based multinationals. Infonet provides MCI with the capability to manage all of the data network services for these customers worldwide.

Another member of Infonet, Deutsche Bundespost Telekom (DBP Telekom) has opened offices in Paris, London, New York, Brussels and Tokyo to monitor the local market for equipment and services.

Recent manifestations of DBP Telekom's international drive include its trial of pan-European satellite services for the manufacturing sector and its forging of a bilateral agreement with British Telecom International for one-stop shopping between Germany and the U.K. Both strategies are open-ended. DBT will enter one-stop shopping arrangements whenever there is adequate market demand. The development of industry-specific satellite services to very small aperture terminals (VSATs) is expanding into additional market sectors through partnerships with a bank and an oil company.

2. New Corporate Systems

Although X.400 has not taken off as quickly as predicted, major equipment vendors and network services vendors will have to take electronic messaging very seriously in the 1990s. In order for electronic mail to be sent between two different systems, both have to be running X.400 software. Initially, there was a problem with too few products. However, with in excess of fifty X.400 products available in Europe, the potential spread of X.400 will cause existing networks of electronic mail users to expand as they link up with others. Office systems which offer electronic mail, such as Digital's All-in-One and IBM's PROFS, will continue to be used for messaging despite the advent of X.400, but increasingly such systems will be linked together within companies.

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Even companies which have written electronic mail systems in-house will be able to connect to an X.400-based messaging system following the specification of the X.400 Gateway AP1 standard, released in August 1989 by the U.S.-based Application Program Interface Association (APIA). Digital, Dialcom, BT, AT&T and others are members.

Large companies are looking at enabling messaging between their own incompatible systems before looking to send messages to their customers and suppliers. However, an important feature of X.400 is that electronic mail can be sent between dissimilar systems of different companies. The easiest way to do this is via a public X.400 service. However, private X.400 links, by-passing the public electronic mail vendors, are also increasingly possible, representing a threat to the public services.

3. X.400

EDI differs from electronic messaging in that electronic mail messages are unstructured and person to person, whilst EDI is concerned with the transmission of structured messaging from one application to another. Throughout Europe there are a number of competing public EDI networks and standards which, with electronic mail added, make interworking difficult.

However, just as X.400 promises to link dissimilar public and private electronic mail systems, it could also provide a common standard for EDI networks because EDI messages can be sent over X.400. Many of the European PTTs are developing X.400 networks and some are planning to link them to provide EDI across Europe. Electronic mail vendors are looking for a share of the lucrative EDI market as EDI services are used more frequently and for larger volumes of information. Their support for X.400 will put them in a good position to offer one-stop shopping for EDI and electronic mail (as Transpac is doing in France). However, it must be said that many electronic mail vendors are taking a long time to offer EDI over X.400 or even to offer proprietary EDI.

Many electronic mail vendors believe that EDI will develop out of messaging, as many companies perform ad hoc EDI messaging. Examples are the use of British Telecom's Telecom Gold in car rental and haulage applications where vehicle manifests need to be sent to a central point. The regional offices can then contact the central point to make sure there are enough vehicles available before accepting any new business.

Within the next year, electronic mail vendors will offer EDI over X.400 and EDI services will be offering X.400 services. The major benefit of X.400 is that it makes international messaging between dissimilar systems easier. The problem is that public X.400 services have been slow to forge links with international counterparts.

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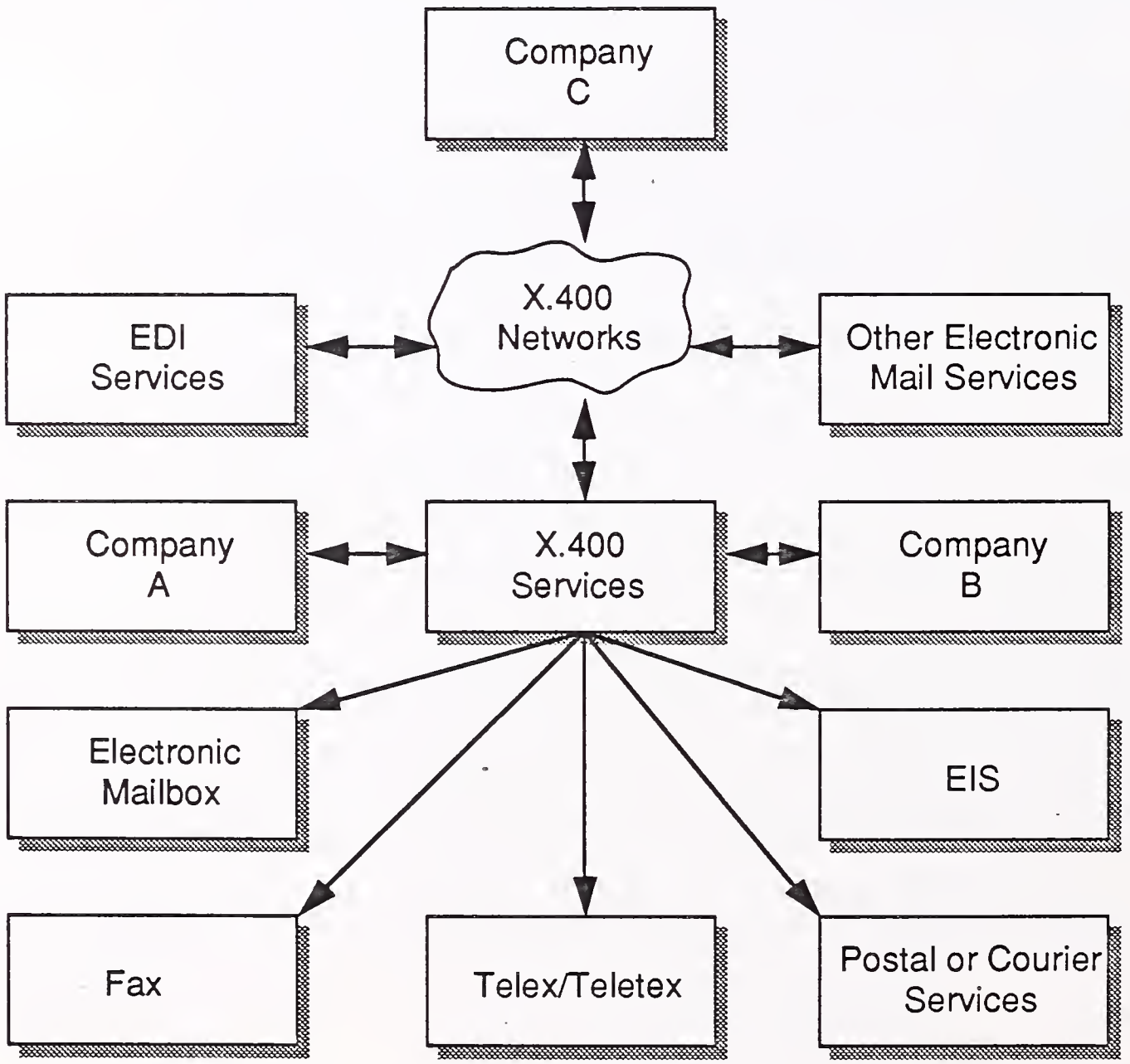
The interconnection between national systems will continue to increase. BT's Gold 400 has links to Finland, Sweden, Denmark, and the Netherlands, and AT&T and Dialcom in the U.S. Transpac's Atlas 400 is linked to AT&T and Messavia (Japan) as well as to other European countries. Denmark is connected to Teledelta of Sweden as well as to the Finnish PTTs' electronic mail service.

Leading edge developers are looking to powerful X.400 "engines", driving backbone networks that deliver store-and-forward messaging for a range of applications, including text, graphics, voice and video. A prevailing view of X.400 is that it will enable disparate electronic mail systems to be tied together so that they appear to be one common messaging environment. The role of X.400 is given in Exhibit III-11.

EXHIBIT III-11

The Role of X.400



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There has been considerable activity in 1990 with many U.S. vendors delivering X.400 services; these companies range from the major equipment vendors such as IBM, Digital, Hewlett-Packard and AT&T to the OSI-orientated software companies such as Reftix and Touch Communications. These companies (in the U.S.) are focusing on the PC LAN environment with X.400 gateways that link multiple LAN-based electronic mail systems.

X.400 is proving popular on two counts. Firstly, it is an international standard that enjoys widespread acceptance in the U.S. and Japan as well as Europe. As a result, vendors that want to sell products to a global market see X.400 as a platform with worldwide appeal. Secondly, X.400 has no functional equivalent in the proprietary world of electronic messaging, since private electronic mail gateways do not have its multivendor compatibility.

Whilst X.400 presently defines a way to exchange only interpersonal messages, in the near future it will be possible to exchange other types of documents, among them EDI messages. An X.400 system is commonly referred to as a message-handling system or MHS (see Exhibit III-12), comprising several software modules, a user agent (UA), a message transfer system (MTS) or message store (MS) and message transfer agent (MTA). The UA is an application process that interacts with the MTS, preparing the message for routing to the MTA, including editing, addressing, directory look-up and preparation of distribution lists. The UA also stores and retrieves messages in logs and fields.

The MTA receives messages from UAs and provides a store and forward mechanism for routing messages to other MTAs. It also performs error checking and format validation. The UA and MTA can be located on the same machine or the UA can be placed on the user workstation. The MS is a functional entity associated with the UA, storing messages that will later be forwarded to the recipient. A database of X.400 names and addresses is contained within the MHS and consists of a directory user agent that resides in the MTS and a directory system that is usually maintained on a separate computer. The directory stipulated on the CCITT standard requires the OSI X.500 global directory service, although as a result of the evolving nature of X.500 technology, some of the X.400 vendors have fully developed this standard. The directory contains the names and addresses of X.400 users and systems.

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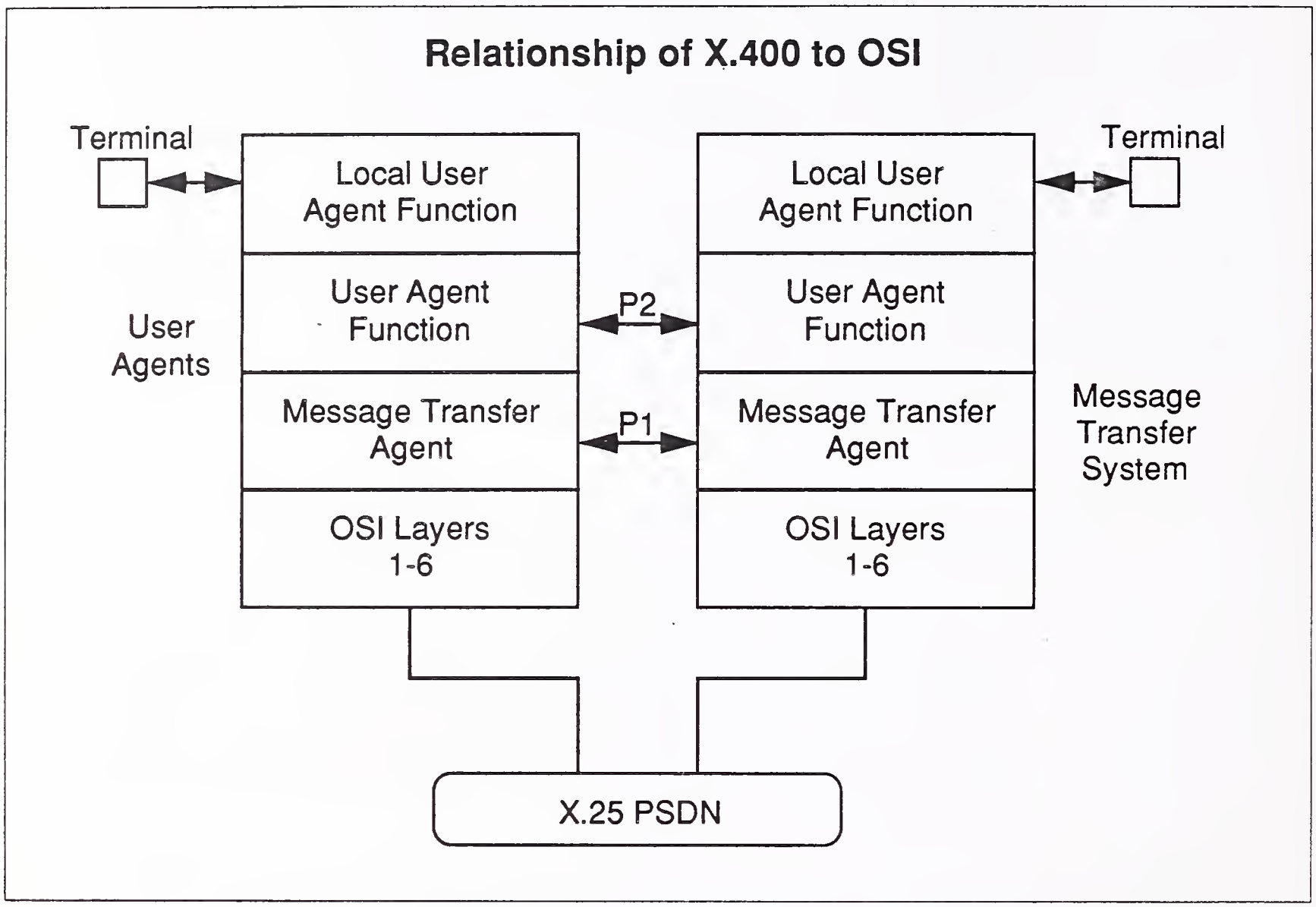
EXHIBIT III-12



The key point with X.400 is that it clearly distinguishes between the envelope and the content; furthermore, it is suited for a variety of store-and-forward messaging applications, including EFT, EDI and digitised voice transmission. Its open-ended address format allows X.400 based systems to support practically all technologies from earlier generations of messaging systems, including private electronic mail systems, facsimile and telex.

Whilst public X.400 services are available and a number of X.400 gateways have opened up over the past few months, the missing element has been the lack of application programme interfaces (APIs) to X.400 messaging systems. APIs will help the development of applications that can be run on LANs or PCs that can easily interconnect with the X.400 systems and service now being provided by equipment vendors, software companies and independent service providers. This lack has been addressed by the X.400 Application Program Interface Association, a consortium of 24 vendors from the electronic mail and messaging industry that has developed the X.400 gateway API and X.400 Application API. A joint effort of the APIA and X/Open (London) has resulted in the

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Object Management API and the X.500 Directory Service API. X/Open comprises the major equipment and software vendors in the U.S. and Europe. Its objective is to "promote existing and emerging standards" in order to realise a comprehensive set of X.400 APIs.

4. Voice Messaging

With over 500 million telephones in Europe, there is enormous potential for voice messaging and processing. The developments of ISDN and the process of digitisation of Europe's network infrastructure will aid this process. However, there are still obstacles to overcome:

- Standards—The perennial bete noire of the communications industry. Incompatibility between disparate systems has retarded developments in the U.S., despite the market being much further advanced than in Europe.

- PABX quality—from the standpoints of functionality and of availability.

Developments in the U.K. are strongest in voice mail bureau services where cellular radio and paging users are combined and the market consists of over 60,000 users. However, Sweden's decision to offer voice messaging services free of charge is resulting in this country rapidly catching up. The revenue increase from telephone bills far outweighs the costs of providing the free facility to subscribers, according to Telecom Radio; additional revenue from voice mail is in the region of 30% per telephone.

A voice messaging system architecture is given in Exhibit III-13.

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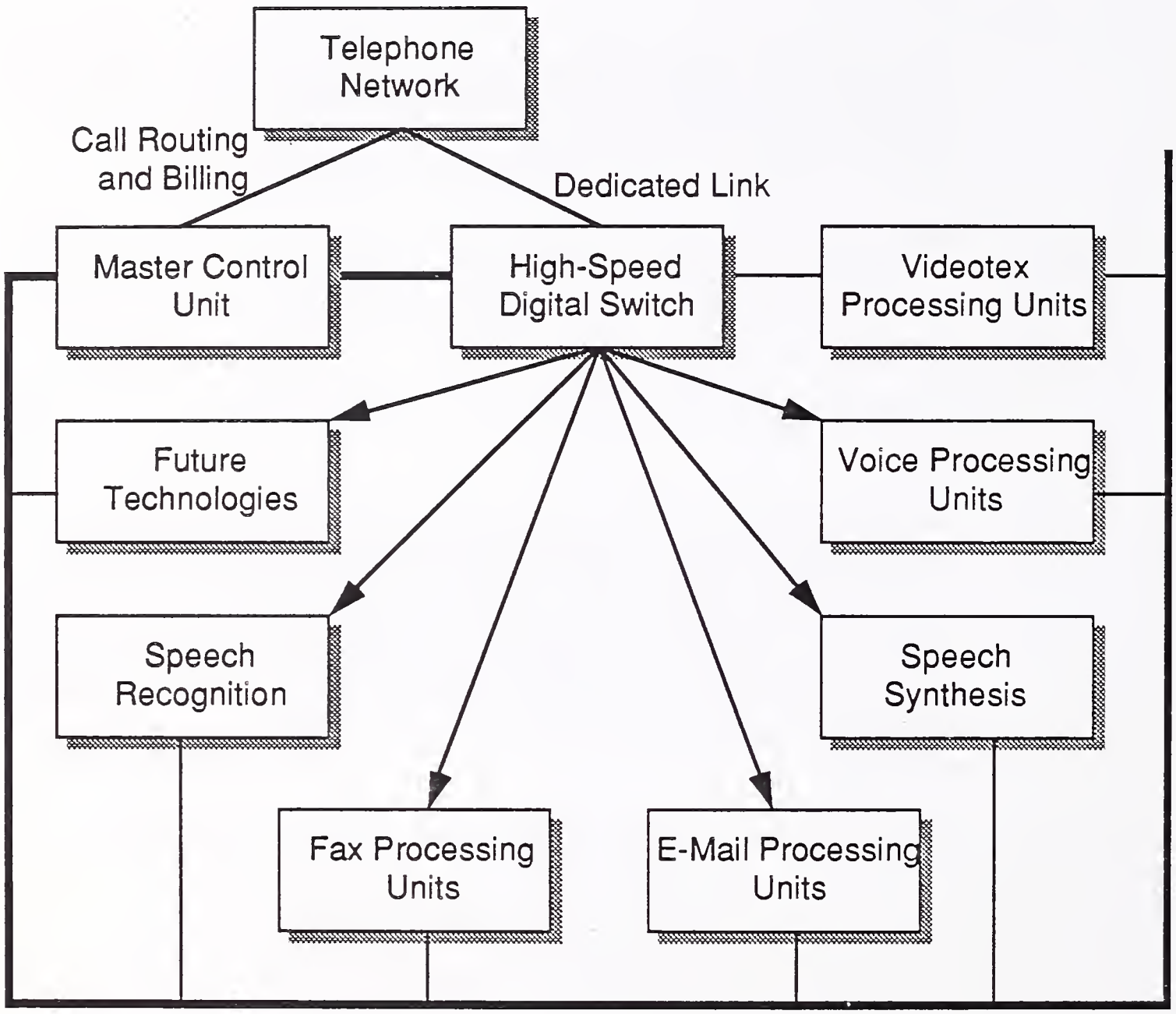
EXHIBIT III-13

Voice Messaging System Architecture



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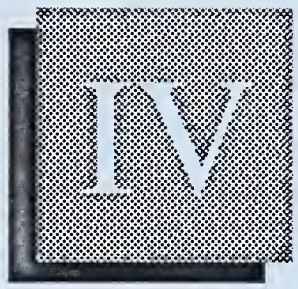
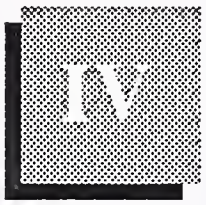


Market Analysis



Market Analysis

A Market Definition

The lowest level of network services consists of packet-switched networks, which enhance transmission by enabling incompatible systems to be interconnected and in which operators lease network capacity to other companies. This level encompasses the basic common carriers in the U.S., such as AT&T, MCI and the RBOCs. To the extent that they convert from one medium of transmission to another (such as from telex to viewdata) through the X.25 standard, this group also includes publicly owned packet-switching networks such as Transpac in France. In the U.K., British Telecom's MultiStream service adds value through protocol conversion to allow the interconnection of incompatible data systems via PSS (Packet Switch Stream), whilst Teletel videotex services are available over Transpac. Other examples include encryption or speed conversion.

The more commonly known managed data networks provide electronic messaging services such as:

- Database storing
- Database access
- Voice store-and-forward

Private companies such as GEIS, IBM, Infonet and Telenet provide this type of service and operators can sell their networks directly to end users, or sell capacity to other service suppliers who provide enhancements for further resale. This last technique can be used to create a closed user group.

The number of network applications being offered on these networks is increasing rapidly. The addition of software and organisational features to managed data networks enables companies:

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- To transmit in structured formats, such as generic EDI and its specific applications
- To provide software-enhanced transitional services, such as accelerated international trade payments, credit card verification, etc.

B

Market Overview

The demand for network applications services in Europe in 1990 is estimated to be $1.1 billion with 100,000 companies using the services. These figures will grow to $4.5 billion and over two million companies by 1995.

However, the overall network services market is dominated by the use of electronic information services (EIS) which are well developed and relatively easy to implement. Whilst this is forecast to remain the largest service in demand, by far the largest growth will come in the more complex messaging types of services especially for electronic mail and EDI. Whilst EDI is discussed in this report, particularly with reference to X.400, more detailed market analysis is provided in the 1990 Network Services Programme report, *EDI in Europe: 1990-1995*.

In value terms, the most important sector is the financial sector, which comprises 48% of the market, and INPUT has released a separate report (*Financial Network Services—Europe, 1990-1995*) as part of the Network Services Programme. Although small in employment or GDP terms, the financial sector has been a leading exponent of information technology and has been among the first sectors to benefit significantly from inter-company trading and electronic services. A similar development can be expected in manufacturing over the forecast period.

Growth should be strong due to a number of factors:

- EDI will become increasingly important. Many organisations will opt for obtaining services rather than making major investments until many of the standards issues become more settled. However, customers that set up their own EDI activity will often use an MNS to provide network support.
- The demand for EIS will continue to grow. Many vendors, especially the smaller ones, will use MNS as their distribution vehicle.
- There will continue to be a need to tie disparate geographic locations together. The national (and international) capability of MNS provides a logical means of connecting local-area networks with one another.
- Videotex services will be of increasing interest in the latter part of the forecast period. Some of these will be provided through MNS services.

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C

Market Forecasts

1. Overview

Traditionally, the growth of telecommunications markets in Europe has been controlled by national bodies, usually the public network operators. In France, Italy and Sweden, private network services operators have been able to make use of public networks, but elsewhere in Europe, the network services have been severely restricted, with many European PTTs reluctant to allow outside network operators to provide enhanced services to clients across their networks. The French government's attitude has been significant; essentially interventionist to support a strong industrial base, telecommunications is considered to be a highly important part of the state-owned infrastructure.

Private network services providers have argued that the public network operators have used tariffing as a counter-measure against the threat of competition. The picture is further blurred by the fact that most European network operators offer enhanced services of their own, sometimes in conjunction with private service providers. For example, most PTTs offer electronic mail services, often licensing these services from Dialcom or Easylink. They also offer a wide range of videotex services. In addition, they also offer such services as packet-switching with protocol conversion.

Whilst the global growth of network services has been impaired to an extent by the monopoly provision of telecommunications in Europe, the development of network services is determined primarily by the development of network technologies, rather than by whether the network operator is privately or publicly owned. As public networks become increasingly sophisticated, the range and types of services offered by the network operators will also increase.

On the supply side, there are, excluding videotex, almost 1,500 network services of which 90% are marketed on a national basis only. Whilst at the national level, the U.K., France and Germany provide more than 75% of the total, the dominant influence at an international level is from the U.S. which currently provides 50% of the international services. In financial terms, some 30% of the total revenues are accounted for by the U.S. owned or operated network services.

The overall Western European market for managed network services is estimated to be worth $609 million in 1990 and will grow to $1.9 billion by 1995 at a CAGR of 25%. The messaging services sector will grow at an even faster rate, from $346 million in 1990 to $2.0 billion in 1995. These forecasts are portrayed graphically in Exhibit IV-1.

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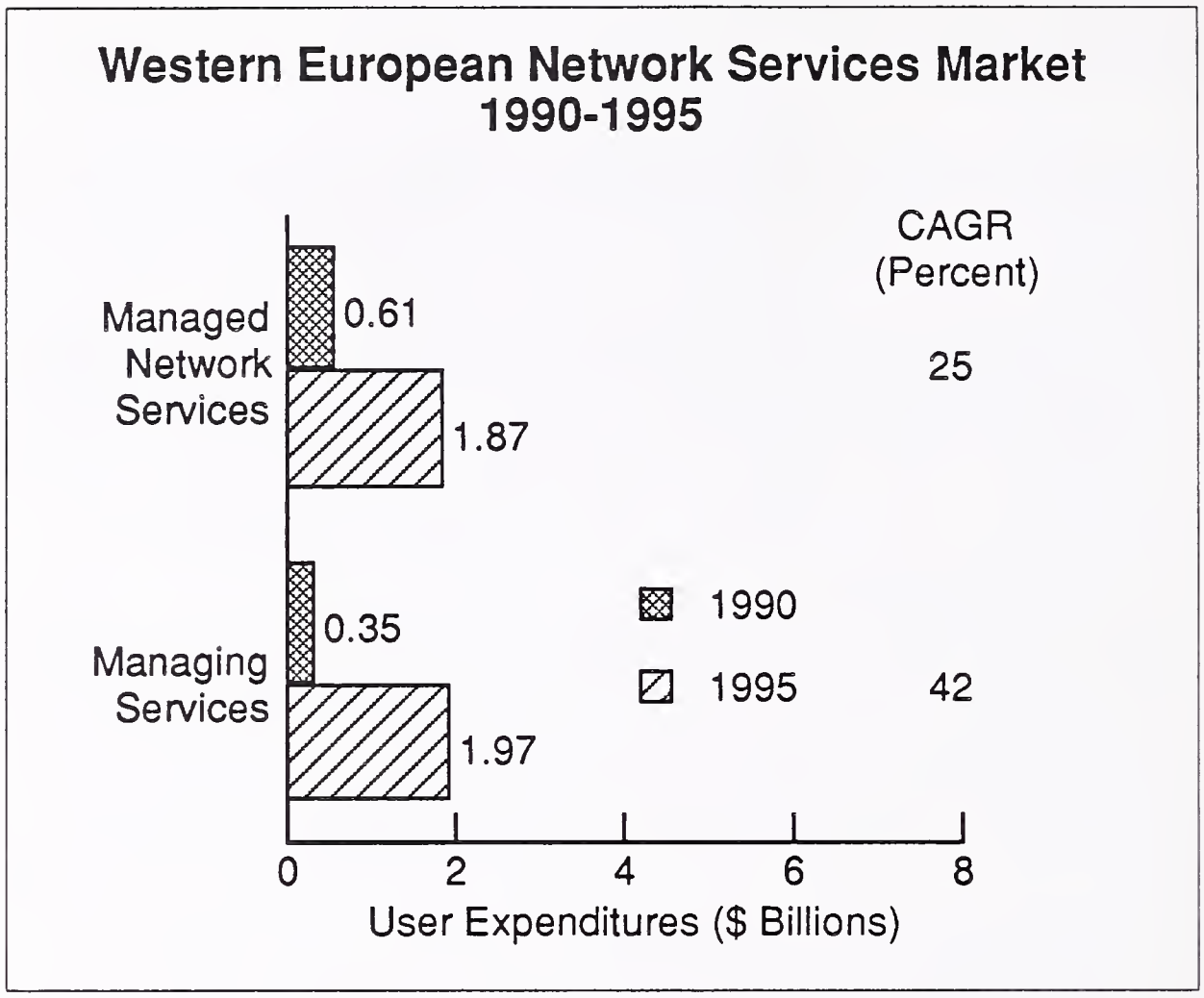
EXHIBIT IV-1



2. Market Analysis and Forecast—France

a. Market Developments

Network services based on switched telecommunications, such as those using Transpac, have not been subject to any regulatory constraints in France, one of the contributory factors explaining the massive growth in videotex services. The innovative France Telecom has achieved great success by developing electronic telephone directories, to underpin videotex, both consumer and professional, and to encourage the use of other more advanced communications networks, aimed primarily at the business community.

Emerging network services providers include GSI and Eucom. GSI (Generale de Service Informatique) Transport-Tourisme acts as an electronic clearing house for some 30 million airline tickets a year. In 1989, Eucom (Eucom Gessellschaft fur Telekommunicationsmehrwertdienste GmbH) announced the purchase of a 34% stake in GSI. This web of cross-ownership was further increased when France Telecom upped its share of Infonet to 16%. The first move by Eucom has been to set up a consortium, in which it will have the majority holding to establish a Europe-wide reservation system based on integrated services digital networks (ISDN); the other members of this

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Paris-based consortium, to be known as Eurotop, are GSI, IBM France, and two travel agents, TUI in Germany and Thompson in the U.K. However, most of the French-managed network services are offered over Transpac, with only small amounts offered through other third-party-operated networks.

In a significant development, France Telecom recently beat IBM and EDS to win two facilities management contracts running the data networks of two of France's biggest banks, the BNP and the CIC. The contract with BNP is worth 100 million FF and the CIC contract worth FF80 million. France Telecom will set up and run the data networks for both banks using X.25, thereby enabling the networks to evolve to other standards as they become available.

The contracts also involve France Telecom's new ISDN service, Numeris, which offers end users access to both data and image databases simultaneously. Clearly, the banks and other financial services sector players see ISDN as the means of integrating their data and voice networks.

A further development, highlighting the global nature of the banking business, is that BNP has also awarded France Telecom a second contract to manage the bank's international network, although this will be based on AT&T's Accumaster network management system. The network will use high-speed digital links between seven nodes: Paris, London, and Madrid in Europe; New York and San Francisco in the U.S.; and Tokyo and Singapore in the Far East, thereby linking BNP's operations in more than 80 countries worldwide.

BNP chose France Telecom in preference to EDS and IBM on account of its standards-based service; the contract is for five years and France Telecom is guaranteeing that the software will cope with expected traffic levels and the bank's security and recovery needs.

Another company expanding rapidly is the Segin subsidiary, Netsys, which in less than three years is already generating 25% of its revenues outside of France (up from 3% in 1988). The Netsys approach can be divided into five main areas:

- Systems engineering
- Translation
- Standards and harmonisation consultancy
- Network processing
- An EDI server centre (which complies with X.400)

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Netsys' profitability enables it to reinvest over 25% of its turnover into research and development, thereby ensuring strong product development. Its 350 clients include:

- France Telecom
- GAN (France's third largest insurer)
- Banque de France
- The International Stock Exchange (ISE)
- Michelin, which has installed Pelican file transfer software at all its sites to create a worldwide information interchange network.

Meanwhile, AT&T recently launched its own ISDN service in France, which it intends to use as the centre of its global strategy on account of France Telecom's announced ISDN strategy. Applications targeted by AT&T for its international ISDN service are:

- Video-conferencing
- LAN interconnections
- Group IV (high-speed and high-resolution) fax transmission

Whilst the new service is initially targeted at the large multinationals, as ISDN becomes more international prices will change and this may ultimately herald a return to a public switched network. As more sophisticated services become available on public networks—at a fraction of the costs of leased lines—the requirement for leased lines will be lessened.

France Telecom's well publicised Minitel services (now over 15,000) will result in a 42% CAGR over the forecast period for messaging services, as shown in Exhibit IV-2. Most of the growth in Minitel services is coming from professional users who pay higher rates—and this no longer means by members of the world's oldest "profession" using what came to be known as "messagerie rose." This group now accounts for over 50% of usage as opposed to the 30% it held in 1986. Approximately 10,000 users a month are signing up to rent the more advanced Minitel terminals, which incorporate memory and answering facilities. France Telecom is charging for this generation of terminal at an annual rate of between FF1,000 and FF2,000.

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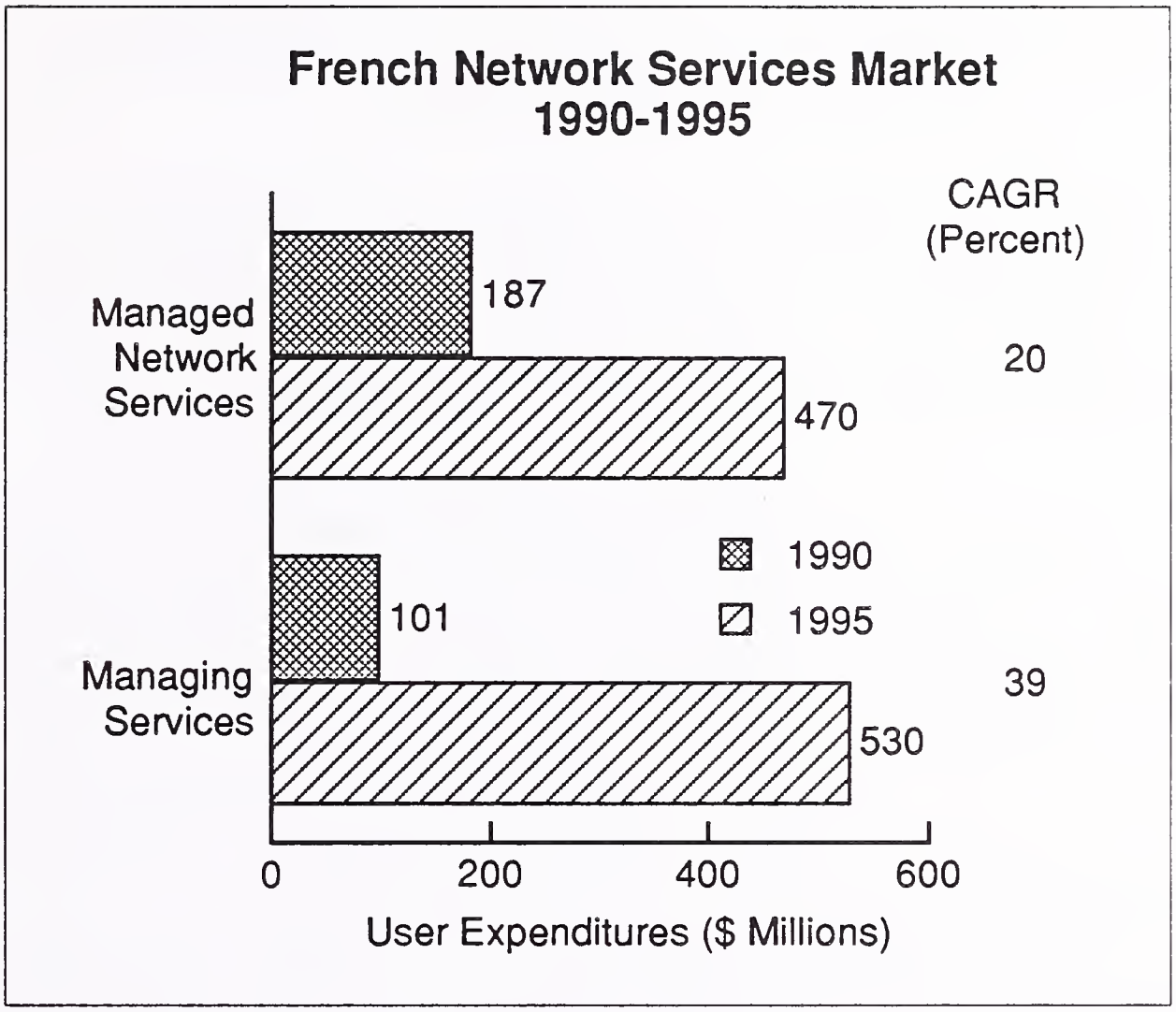
EXHIBIT IV-2



Minicom, France Telecom's electronic mail service currently launched nationwide, has benefited from a start-up position of over five million mailboxes, thereby overcoming at a stroke the problem of most electronic mail services - the low number of users and the codes. With Minicom, the mailbox number is the same as the telephone number and France Telecom anticipates that Minicom traffic will exceed Minitel's computerised directory enquiry service (currently 20% of all traffic) by the end of the forecast period.

France Telecom is also developing an EDI service on the back of Minicom. Whilst Atlas X.400 already offers such capabilities, the advantage of an EDI service transmitted over Minitel is that it would reach smaller customers who would only be charged when they use the service, i.e., on a demand basis. An EFT service is also planned; whilst Minitel can be used for ordering goods and services and for accessing bank accounts, the transfer of money has up to now had to be dealt with separately. Currently, France Telecom is hoping to start such a service next year.

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3. Market Analysis and Forecast—U.K.

a. Market Developments

The DTI (Department of Trade and Industry) defines value added services as data transmission services that store data for a finite period of time (voice store-and-forward, messaging and electronic mail services), or process data entering into a network to yield a discernible result (processing services), or change data into another form for transmission (protocol conversion or translation services).

Although U.K. providers vary greatly in size and product line, major private companies are targeting this sector of the market. Mercury joined with ICL (now owned by Fujitsu) to form a national data carrier. The network, called Mercury 5000, has established a customer base in those companies that already used ICL's data services. Mercury manages the network, leaving ICL to develop application services.

British Telecom and Mercury have interconnected their public data networks. Links conform to the X.75 protocol and will allow subscribers to either network to access the services of the other.

US Sprint's private networks and international arm, Sprint International, has set up in London with the new division Sprint International Northern Europe, aiming to provide local customer support. Sprint International was formed in January 1990 out of a combination of US Sprint's international voice division and its former Telenet Communications Corp.

Forty percent of Sprint International's foreign revenues come from Europe and 40% of that figure from the U.K.—this added to the fact that 60% of Sprint's total world traffic is over the U.K.-U.S.-Canada-Japan quadrangle—meant that the U.K. was the obvious choice for a North European base. Sprint is seeking to take part in the U.K. mass telecommunications market in a supportive role, possibly to Mercury Communications. The move into Northern Europe follows the announcement of a joint venture with Cable & Wireless that will see Mercury Communications supporting the U.K. end of US Sprint's GVPN (Global Virtual Private Network).

The new 5000 CDN Corporate Data network was launched by Mercury's Data Network Services division and is the result of an £8 million upgrading of the Mercury 5000 data network. The new service integrates Mercury 5000, the 5100 international service and the corporate clients' existing private network to provide a company-wide information service. Unlike the original 5000 service the key billing feature is a maximum total fee arranged in advance which will attract large users. There will be a monthly fee for network management and a volume charge for data

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traffic on top of that—fixed to a maximum level with discounts available for high traffic accounts. The client must have a minimum of five data links.

Charges range from £40 per month per 2.4 Kbps data link to £200 per month per 64 Kbps. In return, Mercury takes responsibility for network design, consultancy, implementation, commissioning of all lines, modems and all other network components up to and including the client's on-site nodes and management and support of all equipment and lines. Within the same tariff structure, Mercury supports SNA, X.25 and asynchronous protocols.

Mercury and BT have signed an interconnect agreement allowing data traffic to pass between their respective data networks and services. This arrangement will allow services to be accessed on each other's fibre-optic digital trunk lines. By conforming to the CCITT X.75 interface protocol for public packet-switching networks, they will interconnect the Mercury 5100 service, BT's X.25 Packet Switch Stream service (PSS) and the IPSS international network, which covers 80 countries.

The Government Telecommunications Service (GTS) is a project to integrate voice and data communications networks using OSI standards. U.K. government spends $1 billion/year on communications and has played a pivotal role in promoting the use of IT using OSI. Central government departments' spend on telecommunications has risen to £280 million per year, with voice accounting for 90%. Data services are currently provided by public and private networks. Increasingly, however, departments are making use of the new Government Data Network (GDN), supplied and managed by a Racal-led consortium. Network management has been key to vendor selection for the GDN. This is in common with the experience of many other large corporate network users whose level of use of network management techniques has been to date, in the U.K. at least, fairly unsophisticated.

The process of upgrading government communications began with GDN, an X.25-based system thought to be the biggest network of its kind in Europe. The GDN now supports 25,000 users in 600 offices from 15 government departments. Racal expects to tie in some 70,000 government terminals by 1992. The CCTA (Central Computer and Telecommunications Agency) has given Racal the first opportunity at the next stage, the GTS ISDN, without competitive tendering. The GTS is expected to bring cost savings by linking voice and data on digital lines, reducing the amount of traffic going via BT and Mercury's networks. The government could eliminate up to 6000 access lines by integrating voice and data access to the network.

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It is likely at least that 50% of all data networks in the U.K. will support over 1,000 terminals. The size of orders involved here means that one-stop stopping for all of a user's data communications requirements is a lucrative prospect for the network operators and service vendors. To gear up for this prospect and to prepare for further liberalisation of the U.K. market, British Telecom recently embarked upon a massive reorganisation into six divisions:

- A Personal Communications Division, which will deal with residential customers

- A Business Communications Division, which will deal with business customers, drawing on resources from its BT Tymnet and Dialcom subsidiaries

- A Special Business Division, which will cover BT activities that do not relate directly to any of the above (e.g., mobile communications and shareholdings in cable television franchises)

Supporting these divisions will be:

- A worldwide products and network services group that embraces most of BT's former Communications Systems Division, including BT data communications, local-area networks and terminals businesses

- A worldwide networks group responsible for the maintenance and upgrading of BT's domestic and international networks

- A development and procurement group, including the company's research laboratory

BT's motive is to move away from regional organisation to prevent any future AT&T-style regional divestiture which might occur as part of the government's plans to liberalise the U.K. market still further.

British Rail has formed its own company to exploit the potential of the telecommunications network running alongside its tracks. BRT (British Rail Telecomms) will have DTI approval by the end of 1990. BR believes that it is in an excellent position to offer an alternative network linked to independent operators or to set up a full telecoms service itself.

The U.K. messaging services market has around 200,000 public electronic mail users with the largest share (60%) going to Telecom Gold and the rest being divided between Istel (Comet and Inet), Mercury Link 7500, Telemail, One to One and GEIS.

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EXHIBIT IV-3

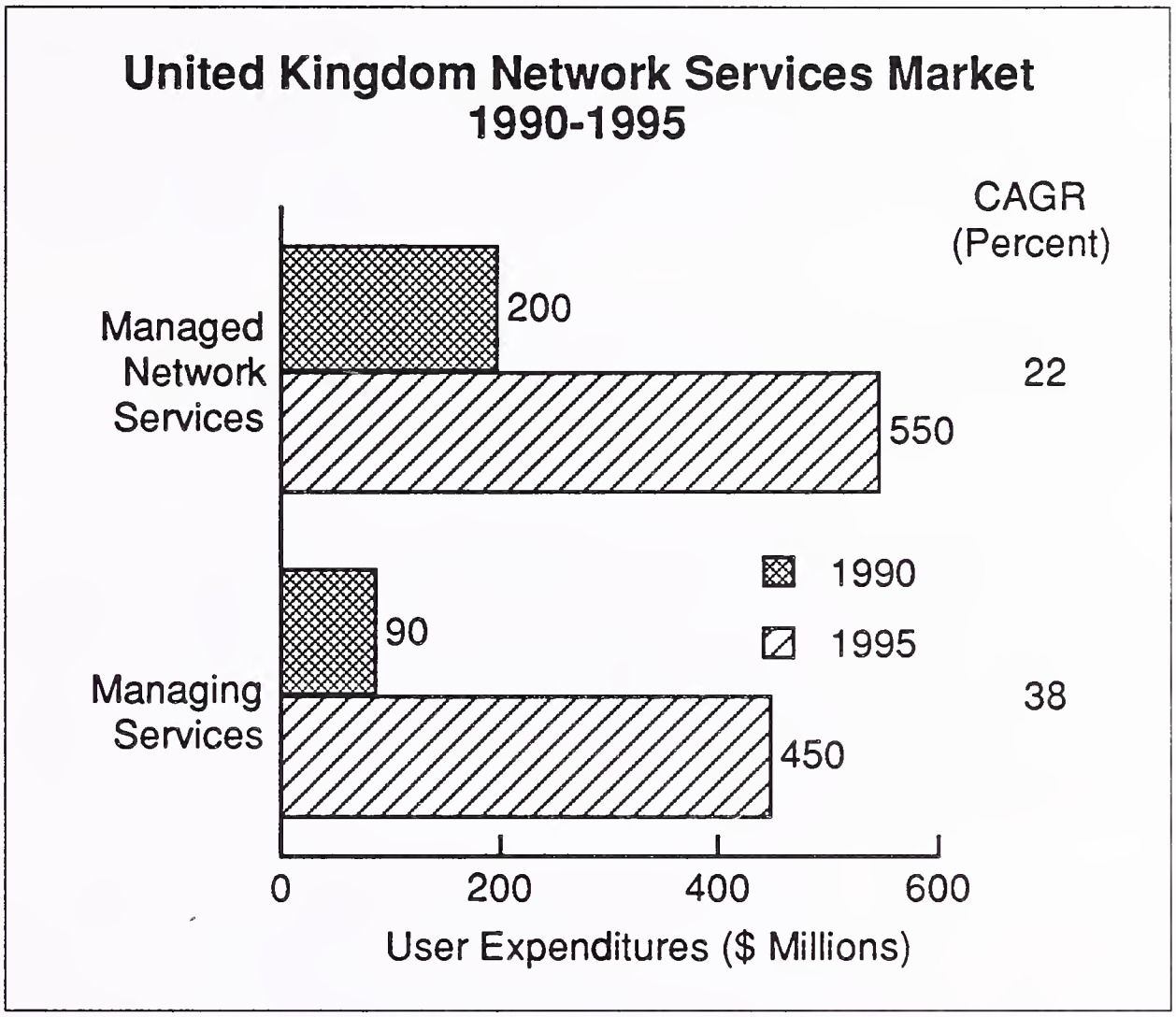

Exhibit IV-3 shows the breakdown of the two submodes in the U.K. market. These forecasts should be treated with caution, as the duopoly review in the U.K. may well alter the balance of the market over the forecast period. If a third national operator is permitted, the U.K. will prove a testing ground for many U.S. strategies.

4. Market Analysis and Forecast—Germany

a. Market Developments

Germany has traditionally been one of the most conservative countries in its retention of a public monopoly in telecommunications services but can, despite that (because of it the Germans might say!), claim to be a country with an advanced telecommunications network run by the PTT. As elsewhere, hundreds of private network services providers operate on leased lines, but few offer third-party services over the public networks.

In the recent past, high tariffs for leased lines and regulatory restrictions have held back development of German network services, but in September 1988, liberalisation opened the way for greater competition.

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This opening up of competition has led to several private companies moving into the market. For example, in 1989, Siemens launched Vascom Gesellschaft fur Telekommunikationsdienste GmbH (Vascom) to exploit the company's existing international corporate network, which covers 80,000 terminals and 400 nodes in 50 countries. During its short existence, Vascom was claiming to be Germany's largest network operator.

With this liberalisation of Germany's market for private data networking services, there have been a number of new players entering the market at the same time, with the result that prices are starting to fall.

Deutsche Bundespost Telekom (DBP Telekom) will be offering substantial reductions in leased line tariffs, whilst at the same time, banks and insurance companies, the main users of existing German network services, are developing alternative offerings of their own that carry lower tariffs. Info AG (Hamburg) and MegaNet (Cologne) are two organisations that plan international services via collaborations with U.S. networks.

Info AG started offering X.25 services in 1989, with 14 nodes. This will be increased to 30 by the end of 1990. The company offers two types of tariffs. Its volume-dependent offerings cost DM500 ($304) per month for 19.2 kbit/s service; and DM1500 ($911) per month for 64 kbit/s service. DBP Telekom's monthly rentals by comparison are DM14,100 ($8,559) for a 64 kbit/s line and DM5,852 ($3,552) for a 9.6 kbit/s line. The company's revenues in 1989 were $70 million.

Info AG offers a number of special security features, such as closed user groups, call-back and access authorisation. The company is using equipment from US Sprint's Telenet subsidiary to develop its X.25 network. As a result, it will be compatible with Sprint's international network.

MegaNet is a private company owned by a number of shareholders, including a bank (Westdeutsche Landesbank Girozentrale Dusseldorf); a cabling company (DAT, Deutsche-Atlantische Telegraphengesellschaft); and a number of insurance companies (Magdeburger Versicherungen AG, Colonia Versicherung AG and Gerling Konzern Zentrale Verwaltungs AG). MegaNet was founded in August 1988 when it had 28 nodes in 20 cities. It has 50 customers and expects to make about DM10 million ($6.07 million) in revenues this year.

Customers can choose the speed they require on the leased line. The tariffs are distance-dependent, not speed-dependent. The tariffs are also much lower than DBP Telekom's. MegaNet's monthly rental on a line between, for example, Cologne and Munich, is DM 4,000 ($2,428). MegaNet has recently introduced X.25 services on a second network which will have 20 nodes by the end of the year.

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One of the largest existing network service providers in Germany is IBM, which offers a service called Connect, an SNA-based network service, used mostly for electronic mail and EDI. More than 200 private company networks are linked to Connect. The pricing for the connection depends on the type of machine. For PC connection the charge is DM1,000 ($607) a year in advance.

GEIS is the largest network services provider in Germany, with over 700 customers in banking, insurance and manufacturing. GEIS currently sees its main competition coming from the data processing centres in large companies.

Vascom, the Siemens subsidiary, found in its difficult early period that most of the network services offered by the company were being used by Siemens' in-house, i.e., by its own departments and divisions. As a result of this, and the fact that the service only attracted 10 external customers, the third-party service will be integrated into the new Siemens Nixdorf-Informationsgesellschaft AG (SNI) resulting from Siemens' acquisition of Nixdorf Computer. The in-house business will be retained as part of Siemens' internal operations.

Siemens' switch in strategy has resulted in:

- The MegaNet service (founded by a group of banks and insurance companies, as described earlier) being marketed by Siemens.

- And in reverse, MegaNet using Siemens' worldwide internal network to offer its international connections and the Siemens data centre hosts to support its new services, such as databases, EDI, and a computer-based language translation service

For MegaNet, with 40 customers and estimated revenues of DM10 million, the deal with Siemens is one of a number of planned collaborations.

DBP Telekom's recent moves include:

- Purchase of a stake in Infonet

- Collaboration with Graphnet, another U.S. network services provider which is active mainly among financial institutions

In the field of managed network services, DBP Telekom unveiled Telekom-Datennetz, which provides the equivalent of a private network for major companies. The tariffs are much lower than the normal leased line tariffs.

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It is also planning a cashless shopping project with IBM (see INPUT's report *Financial Network Services, Western Europe 1990-1995*).

Many PTTs have invested in provision of services which are peripheral to their main business, i.e., the telephone service. With the demise of the telegram as the fast delivery service for short documents, all PTTs have continued to offer a telex service. When, in the 1960s, commercial organisations needed the capability to transfer data from computers to peripheral equipment at remote sites, the PTTs were able to lease dedicated switched circuits to these organisations at favourable tariffs.

The network services debate in Germany can be compared to the situation of centralised and decentralised data processing. German executives tend to view communications as a strategic factor and are reluctant to delegate this area to third parties; the high cost of operating on a leased line basis is also a factor, however.

Some sectors, such as the automotive industry, which have embraced network services, have encountered delays. The various German automotive manufacturing associations, having developed their own protocols, have still to agree on EDI standards.

DBP Telekom is looking to gain a strong position in the market; its Telekom-Datennetz service can offer the large corporates a tailored service of 'one-stop' network solutions for all German offices. Furthermore, DBP Telekom has already set up an X.25 network for the Deutsches Forschungsnetz, a German research network association whose members include research institutes, universities and, most importantly, manufacturers.

The current DBP Telekom portfolio includes:

- The Datex-P packet-switching service
- BTX (short for Bildschirmtext - the German version of 'videotex') that will be provided with remote database access for teleshopping and home banking
- Telebox, an electronic mailbox service
- Temex, a generic network service for remote system contacts
- Teletex, a 'super-telex' service by which users can send telex messages directly from computers over the Datex-L circuit switched data network

DBP Telekom is also planning an additional service to expand its activities in customer-orientated network management.

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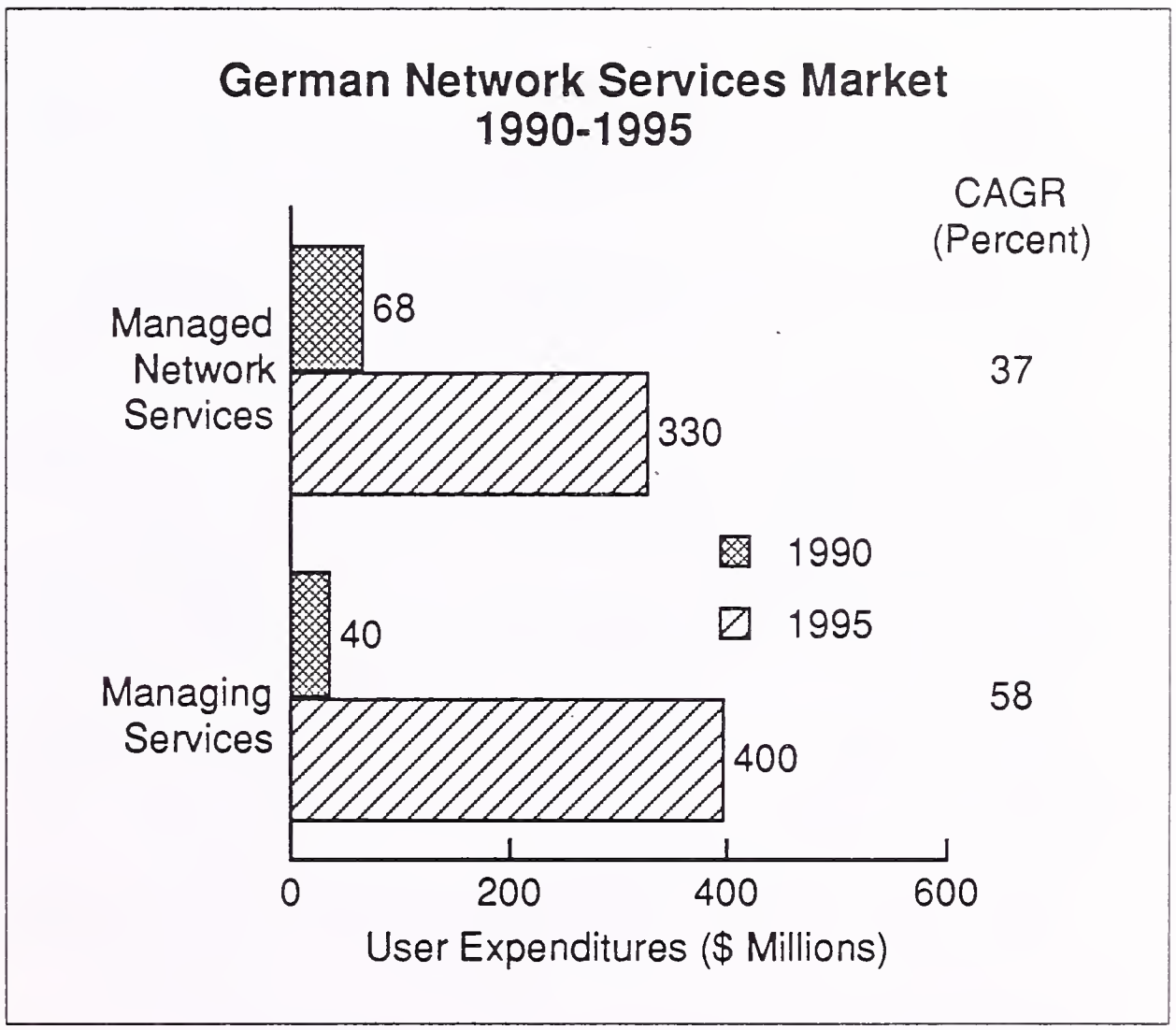
However, the private network operators are looking to capitalise on DBP Telekom's major perceived deficiency, customer service. GEIS, IBM and Siemens via MegaNet are looking to become leading players. The coverage of Datev (the cooperative of accountants and tax consultants) and the initial successes of MegaNet confirms INPUT's view taken in 1988, when it suggested that the market in Germany would be orientated towards industry-specific solutions.

It is likely that in Germany the market will expand rapidly if competing companies, such as those in the transport and manufacturing sectors, start offering their own customers network services based on the private carriers, as an extra set of added-value services. The German market forecasts are included in Exhibit IV-4.

EXHIBIT IV-4



The major companies offering X.400 software for electronic mail are listed in Exhibit IV-5.

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EXHIBIT IV-5

X.400 Electronic Mail Vendors (Germany)

Product/Vendor	Operating System	Other Communications Possible
Control Data - Mail/VE	NOS/VE	SMTP, Bitnet
Danet - Ositel/400	UNIX	SMTP, UUCP
Data General - CEO	AOS/VS	SMTP, UUCP, VMS-Mail, DISOSS, PROFS, All-in-1, X.500, BTX
Digital - All-in-1	VMS, MS-DOS	SMTP, UUCP, VMS-Mail
GMD - Komex	BS2000	BSMTP
ICL - ICL Office Power	UNIX V.2	UUCP
Hewlett-Packard - HP Open Mail	UNIX	SMTP, X.400 under HP Desk
Mannesman Kienzle - Mail UX	UNIX V.3	SMTP, UUCP, VMS-Mail, X.400
Motorola - X.400 MNS	UNIX V.3.2	X.25, TCP/IP
NCR - NCR OSI X.400	UNIX	No
Rank Xerox - Xerox X.400	Services 11.2/11.3 Viewpoint 2.0	SMTP, VMS/Mail, DISOSS
Siemens - Mail 2000	BS2000	No

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DBP Telekom, the new private carriers and a group of major German companies are all planning to implement their own private X.25 networks, believing that the public services are having difficulties offering sufficient functionality. Following liberalisation and the increased demand for flexible, cost-effective data-switching services, DBP Telekom is facing increased competition from private network companies in selling its public packet-switched network services to private users.

DBP Telekom has modernised more than half of the Datex-P node digital EWSP-based switching systems supplied by Siemens at a cost of DM20 million. DBP Telekom aims to boost its capacity to 100,000 lines from its current 45,000 when the second half of the modernisation programme is completed. However, DBP Telekom is experiencing difficulties convincing German manufacturing and service industries to sign up for Datex-P.

For example, the German banks are planning to establish their own private packet-switching networks. Commerzbank is running a test installation of a private X.25 network and plans to invest between DM15 million and DM20 million for network equipment. Dresdner Bank is studying how to set up its own private packet-switching network as well as negotiating with DBP Telekom and other service providers. Both banks are seeking a neutral, open network architecture, independent of product make and application.

Deutsche Bank, Germany's largest private financial institution, is planning to integrate its present X.25 network into an ISDN-capable PBX system and is testing Siemens-made integrated voice/data ISPBX systems in two German cities. Germany's state-owned national railway, the Deutsche Bundesbahn (DB), has completed the first phase of its private X.25 network based on the same EWSP packet-switching technology as installed for DBP Telekom. To overcome the problem of having to operate separate lines for its data communications, traffic signalling and energy control, the Bundesbahn began to install a private X.25 network in 1985. Following the successful test installation of three nodes in 1987, a total of 18 nodes went into operation at the end of 1989. The second phase of the network calls for an additional 10 nodes.

Siemens, Germany's major supplier of public and private X.25 equipment, is capitalising on the country's emerging data communications competition. Apart from supplying the DBP Telekom and other big name private users with data switching systems, Siemens is modernising its own private X.25 network. With the increasing trend to integrate engineering systems, which are usually graphics-based, into general, commercial applications for manufacturing in order to build effective CIM systems, Siemens believes that more companies will be struggling to move more data over the lines than they have in the past, thus creating demand for cost-effective, flexible packet-switching services.

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5. Market Analysis and Forecast—Italy

Italy's non-existent telecommunications policies and the uncertain levels of investment in the public switched services have resulted in a backward state of that country's telecommunications. Double figure inflation combined with a block on tariff increases from 1974 to 1980 to virtually halt network development. For example, Italy still has a telephone penetration rate of only 35%, whereas France and Germany have 46%.

The situation has improved somewhat with the news that Alcatel FACE Spa, the Italian subsidiary of Alcatel NV, has won a contract from SIP to supply the equipment for and to build Italy's new national X.25 packet-switched network. This network is planned to cover the entire country by 1991 and to double the subscriber capacity to 200,000 by 1993, using 100,000 access points. Alcatel DPS 2500 packet switches as used by Transpac in France will be installed at the nodes and the network will be controlled overall by an Alcatel 8300 multiprocessor.

In May 1990, Italian telecommunications industry leaders urged widescale improvements in the country's telecommunications infrastructure. Furthermore, Italy's market structure is in direct conflict with the provisions of the EC's market liberalisation programme. For example:

- Its telecommunications ministry also operates telecommunications services.
- A customer's first telephone set is still provided on a monopoly basis by SIP.
- There is no competition in the mobile or satellite markets.
- Whilst the Italian market for network services is ostensibly open, the fact of the matter is that there are actually no legal provisions enabling network services providers to connect to the public network.

Tariff anomalies abound:

- Italy's international tariffs are amongst the highest in Europe.
- Italian rates for local consumer service are by contrast among the lowest, whilst business users have to pay far more for the same service.

STET officials are looking to replace this situation with price-capping, rebalanced local and long distance rates, and redistributed consumer and business rates. Users, vendors and STET itself are all looking for a set of rules to govern private networks and competitive services, especially since there is an on-going element of "illegal" competition—in that there is no law to define a "private network", yet there are many in existence.

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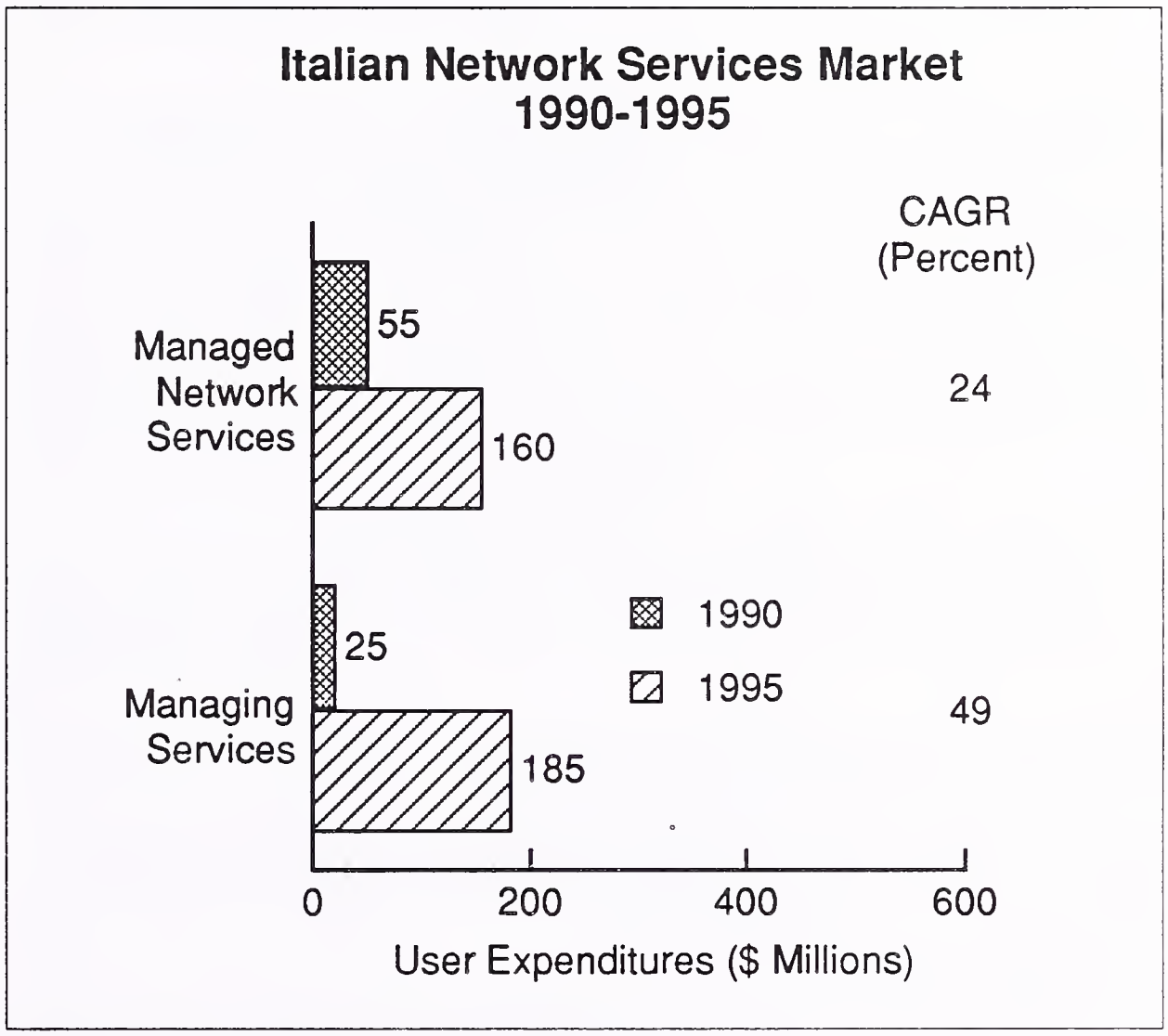
Italy's leading messaging services vendors include Italcable, Teleo and XCOMS International.

The Italian market forecasts are included in Exhibit IV-6.

EXHIBIT IV-6



6. Market Analysis and Forecast—Spain

Swedish Telecom and Telefonica (Spain's PTT) has signed a cooperation agreement covering harmonisation of national network development, VANs, data network interconnection and other areas.

The Spanish market forecast is included as Exhibit IV-7.

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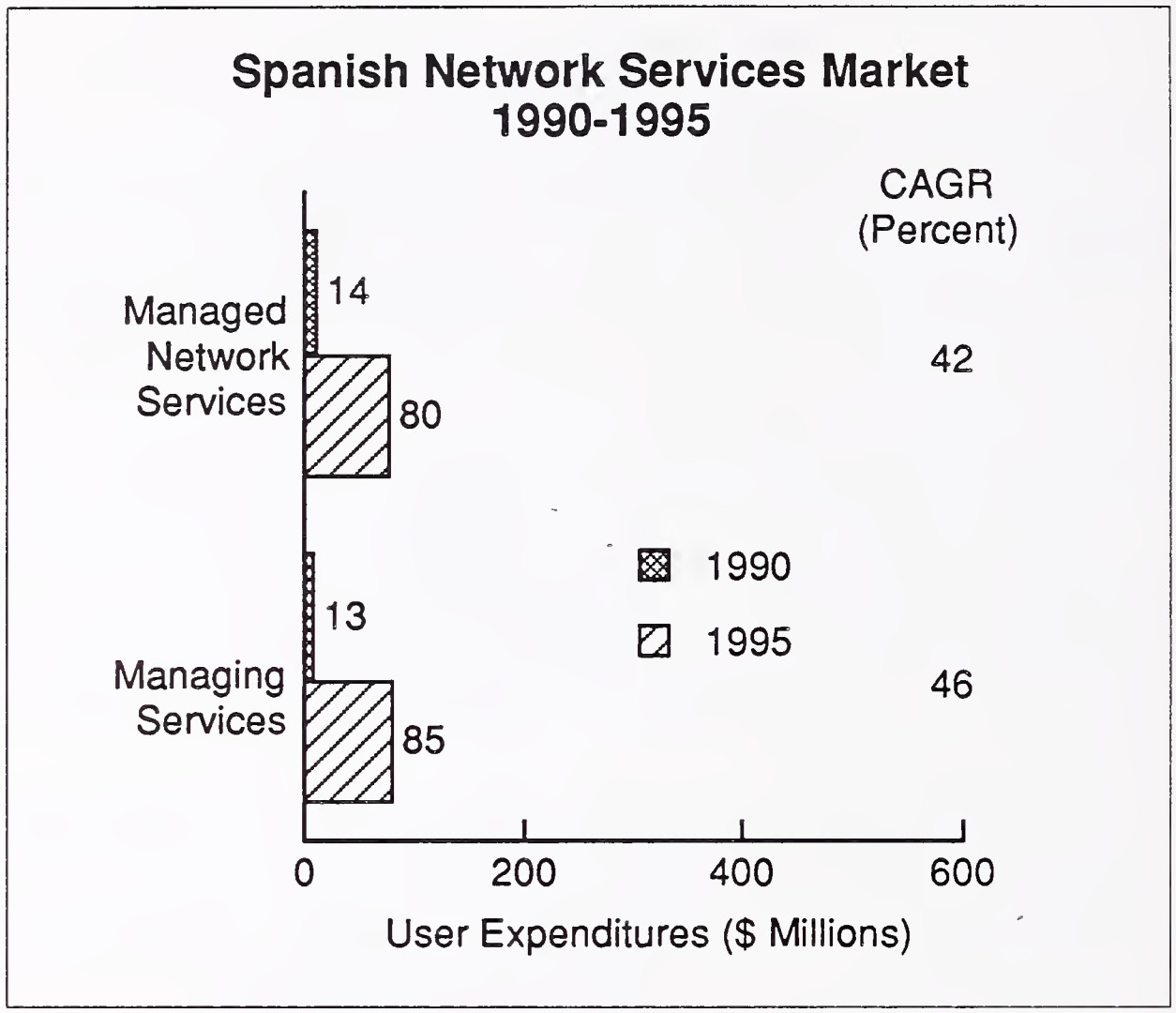
EXHIBIT IV-7



7. Market Analysis and Forecast—Benelux

a. Belgium

Historically, Belgium has had one of the most illiberal telecommunication regimes. The proposed liberalisation reforms will grant the RTT (or the Regie, as it is more familiarly known) public company status, but it will retain its government ownership. This was felt to be necessary since the RTT had been hit by a series of complaints from service providers. For example, GEIS has made the point that it has been denied the right to use lines to send data. Whilst GEIS eventually withdrew the complaint when the RTT unveiled reform plans early in 1990, the exact ruling on what comprises a "value-added" service remains unclear. Connection to an international node is one qualification for a service to be "value-added", but encryption or multiport modem connection, for example, have not been sufficient to qualify.

Five service providers have now been approved to run services: GEIS, Sabena, SITA, SWIFT and Infonet. Each of the five has qualified under the rule that its network had to have an international link. Thus a new network to run EDI services in the port of Antwerp for shippers and port authorities would not get approval until it set up a link with the port of Rotterdam in the Netherlands.

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The RTT owns 95% of Infonet's Belgian operation and supplies its general manager. Competitors queried the role of Infonet and its close RTT links, out of concern that Infonet would get preferential treatment for running EDI services. Indeed, the RTT had plans to market Infonet's EDI software for PCs, although it is not suitable for international working.

In May 1990, the RTT took a 40% stake in Expercom alongside Telindus, which is a France Telecom subsidiary and the leading Belgian telecommunications supplier. Operating in the network services sector as Eftel, Expercom had threatened the RTT with a French presence in the Belgian market, although Expercom is purely a consultancy specialising in the marketing of existing networks, ranging from private wide-area networks to metropolitan and public RTT networks. The company is expected to grow to BF500 million by 1992. Eftel's first-year turnover in 1989 was only BF21 million.

Expercom is now being run by a Telindus marketing manager, offering services for LANs, WANs, MANs, and teleports as well as text, data, voice, and image VANs. Facilities management will also be offered to private companies.

The RTT has invested BF120 million into boosting videotex. The service was showing an increase of 50% in new subscriptions in 1989, but a massive fall-off in subscriber use, due to the fact that the service lacked applications for both professional and general public users. New technology has enabled videotex to be run over the widespread cable networks in Belgium and to link with the German and French videotex services. The latter gives access to 9,000 databases on the French system (a considerable increase on the 200 in Belgium).

b. Netherlands

The first eighteen months of liberalisation in the Dutch telecommunications markets have seen PTT Telecom lose only a small market share in private switching. The PTT, which is still government-owned, retained control over most network operations when it was put onto a more competitive footing at the start of 1989.

The Dutch PTT is developing network services in competition with the private sector. IBM had offered prior to liberalisation to set up a joint venture with the PTT, but nothing came of it and instead the PTT has strengthened its links with BSO, a software company. The network services market in the Netherlands is growing 30% a year, compared to an overall increase in traffic over the infrastructure of 5% per year. GEIS, IBM, EDS, SITA, and SWIFT all have major nodes in the country.

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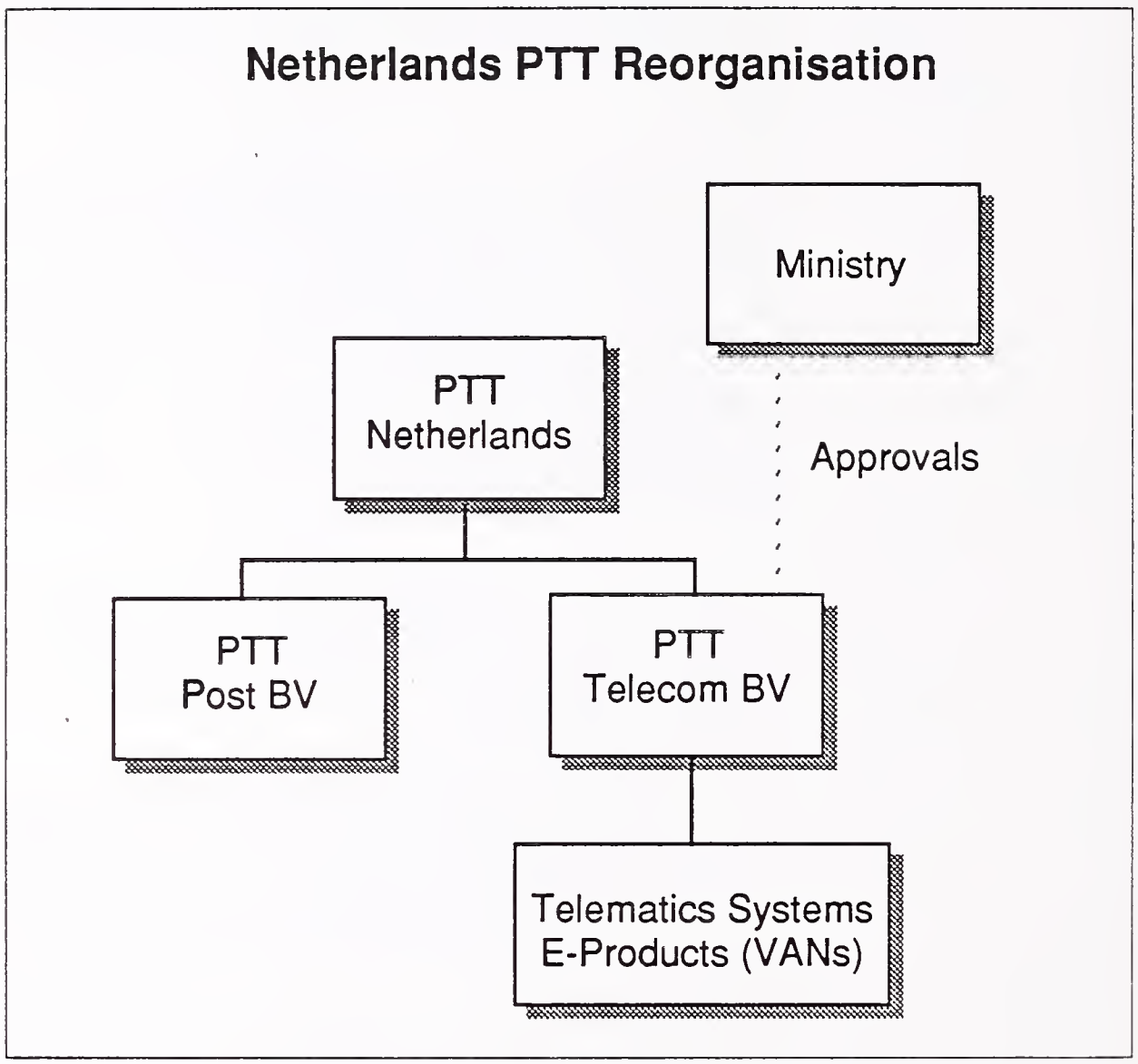
The PTT has been restructured with the separation of postal and telecommunications organisations into two private companies under Royal PTT Nederland NV, a state-owned public company (see Exhibit IV-8).

EXHIBIT IV-8



A significant development was the setting up in September last year of a joint company with the Dutch cable TV operators and other organisations to run a videotext service, thus causing some political debate with opposition to PTTs taking over cable companies, although it certainly has a long-term logic if broadband communications linking telecommunications and cable technology takes off as predicted.

The Benelux market forecast is included as Exhibit IV-9.

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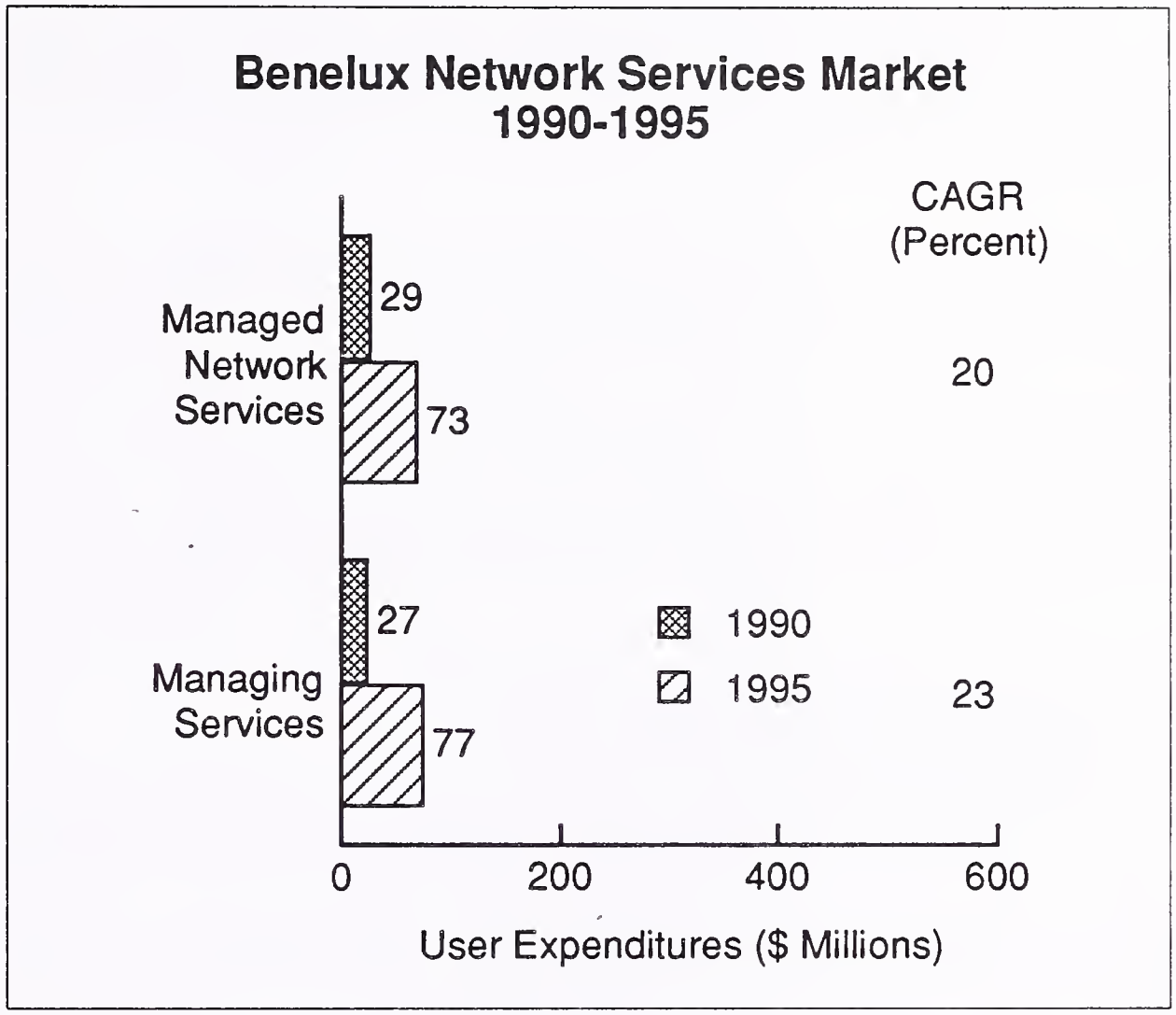
EXHIBIT IV-9



a. Market Developments

Sweden is set to abolish all restrictions on the resale of leased circuit capacity by October 1990, thereby making Sweden the only country outside the U.K. and the U.S. to allow resale for both voice and data services. Market conditions in Sweden have in theory always been the most open in the world and in contrast with other European countries there has never been a monopoly on the provision of telecommunications services. Televerket operates on a concession from the government and has never had any link with the postal service and has strict separation from the state budget.

Televerket, which approached the government two years ago to allow resale, already faces competition from the privately owned Kinnevik group technology subsidiary, Comvik, in satellite connections and mobile cellular radio. There is also a Scandinavian consortium, Nordictel, composed of SAS, Volvo, Custodia and Pharos which has been established to compete with Comvik.

The introduction of open resale will bring a fresh wave of competition.

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The introduction of open resale will bring a fresh wave of competition. Sweden's national railway plans to enter the market by opening up its internal fibre optic network to users. Swedish multinational companies are also expected to take advantage of this relaxation.

STS (Scandinavian Telecommunications Services AB), the joint international carrier set up by five Nordic telecommunications administrations in 1987, was abandoned in March 1990, six months after the collapse of the MDNS project supported by 22 members of CEPT (Conference of European Postal and Telecommunications Administrations). STS was intended to meet the demands of international business users for one-stop shopping, network management and hybrid networking. Its failure can be attributed to the growing competition amongst the administrations and difficulties with the varying legal and regulatory changes within the member countries. Whilst Finland, Denmark, Norway and Iceland will continue to use the "Eurostream" leased line network established by STS, they will be looking to form separate alliances for the delivery of application services.

Swedish Telecom International, established in January 1990, paid an undisclosed sum to the other Nordic administrations for the remaining 52% stake of STS that it does not own. Televerket had sold its stake to the other Nordic administrations in 1987. The move formed part of a comprehensive restructuring of Televerket's interests in Swedish Telecom International. The new company is focusing on providing a portfolio of voice and data services to business users worldwide, and has integrated the four previously separate units within Televerket:

- Interpak, the Swedish arm of the Infonet data networking consortium
- V-Sat Tel, the satellite business services arm
- Teledelta, a unit of Televerket that provides enhanced services
- STS

ICL has won an order from Norwegian Televerket for its X.400 message handling system, Carrier 400. The order is worth £750,000. The system will be used to provide a platform for EDI services.

In 1991, Denmark, Sweden, Finland and Switzerland will be starting a joint 2mbps network service called Meganet (not to be confused with the German MegaNet service). The technology for Meganet was developed jointly by Bang & Olufsen and the Jutland Telephone Co, both from Denmark. The service has been tested in Denmark over the past two years and it was offered commercially there at the start of 1990, at which point Ericsson took a 50% stake in the joint venture company and its name was changed to Diax Telecommunications.

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The Danish end of the service has 30 customers and is being used for video-conferencing, transmission of high-fidelity audio, radio and data communications applications such as remote LAN interconnections and back-ups for leased lines. Call set-up time can be as low as 300 milliseconds.

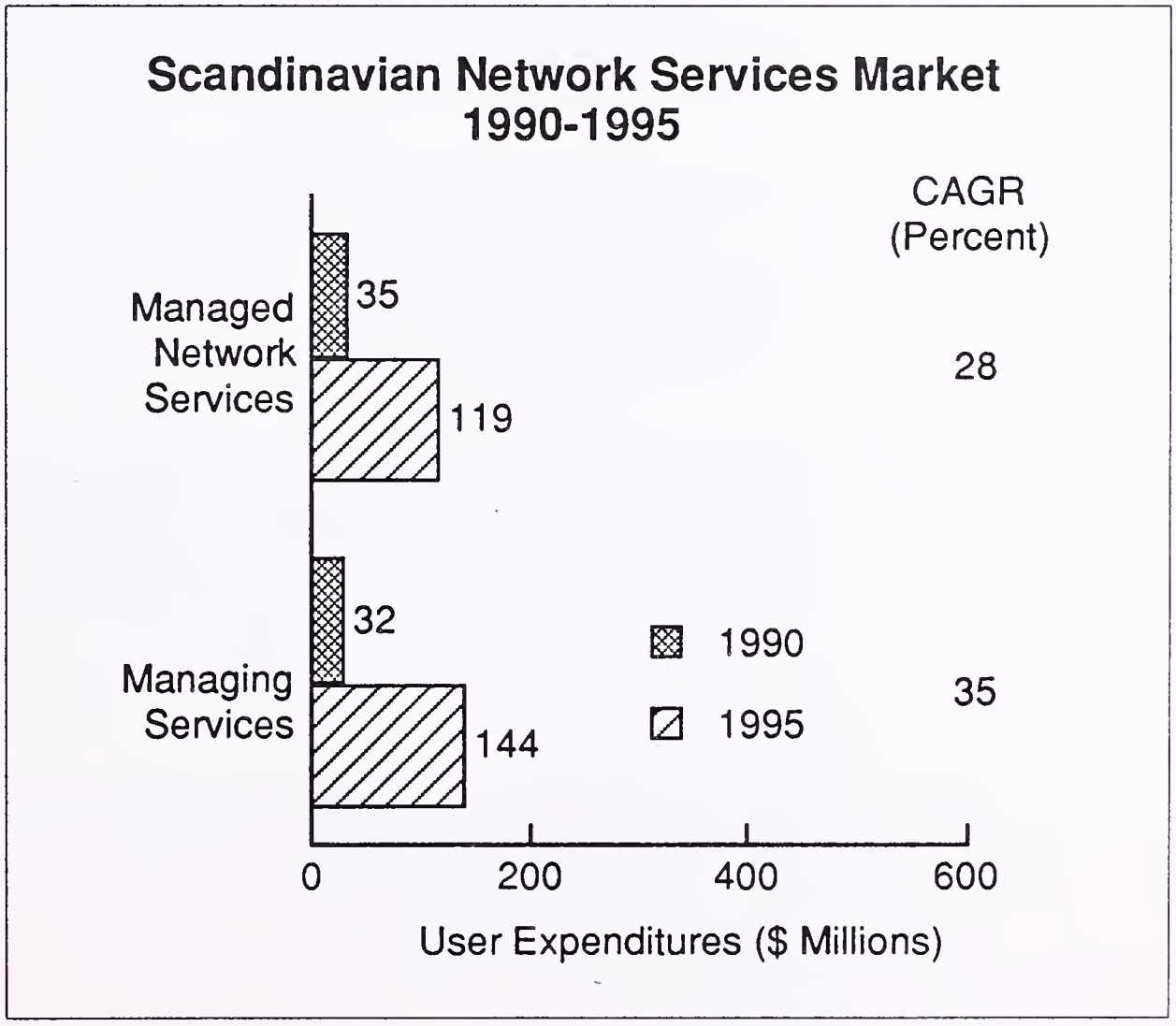
Meganet's installation charge is $500, with annual rental charges of $3,000; local calls are priced at 4.34 DKR/minute, regional calls at 6.56 DKR/minute and country-wide calls at 8.69 DKR/minute.

ICL's new Carrier 400 message handling system will provide a platform for EDI as well as allowing the implementation of P7 protocol support for PCs, an integrated message store, a full range of X.500 Directory Services and access units for interfacing with existing message services such as fax and telex.

The Norwegian Telecommunications Administration (NCA) will call the new service Telemax 400 and it plans to become a leading provider of message handling services. It chose ICL's product because of its conformance to X.400/X.500, powerful flexible equipment and ICL's participation in MNS on an international level.

The Scandinavian market forecast is included in Exhibit IV-10.

EXHIBIT IV-10



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9. Market Analysis and Forecast—Rest of Europe

a. Austria

Austria's Post and Telegraphy Administration (PTV) is looking to invest ASch67.6 billion (Austrian schillings) in its telecommunications systems. This sum will represent 94% of current PTV investments in Austria. However, the base level from which the country is starting is much less impressive, as Austria has just over 3 million public telephone lines.

Austria's programme entails spending ASch18 billion towards the development of the digital network. This began in 1987 with the installation of OES public digital switching technology. Nine switches were installed in the first year and another 18 in 1988. By the end of 1990, Austria was looking to have 600,000 telephone lines (18% of telephone subscribers) supported by digital switching technology.

The development of text and data networks will receive in the region of ASch3.5 billion.

Just over 1 billion ASch will be devoted to the development of Austria's integrated services digital network (ISDN) and a further ASch3.5 billion is to be applied to the expansion of Austria's digital broadband network, O-Netz, which represents Austria's response to the increasing demand for high-speed data and video image transmission. Some ASch1.7 billion is going towards the laying of fibre optic cable.

Austria's PTV estimates that the number of modems in use in Austria is only just over 50,000, with 26% of these using dial-up connections over the public telephone network, 50% using decommissioned telephone or telegraph connections, 12% using ISDN and another 12% using the Austrian Bildschirmtext, i.e., videotex service.

In 1988, the PTV introduced the capability to relay alphanumeric data from telex terminals or from terminals attached to its videotex service to text radiopagers. It has also enabled users to access its telephone number directories from their Bildschirmtext terminals. As another innovation for 1988, the PTV introduced a new 2kbits/s dedicated data service, DS-2000.

b. Switzerland

Switzerland is currently undergoing a major legislative programme for telecommunications. It intends to liberalise a number of areas of Swiss telecommunications, although the PTT will retain a considerable amount of control. Its current monopoly already extends beyond that of most

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other European national telecommunications administrations, covering all telecommunications networks with the exception of the railway, military and certain transport companies' networks.

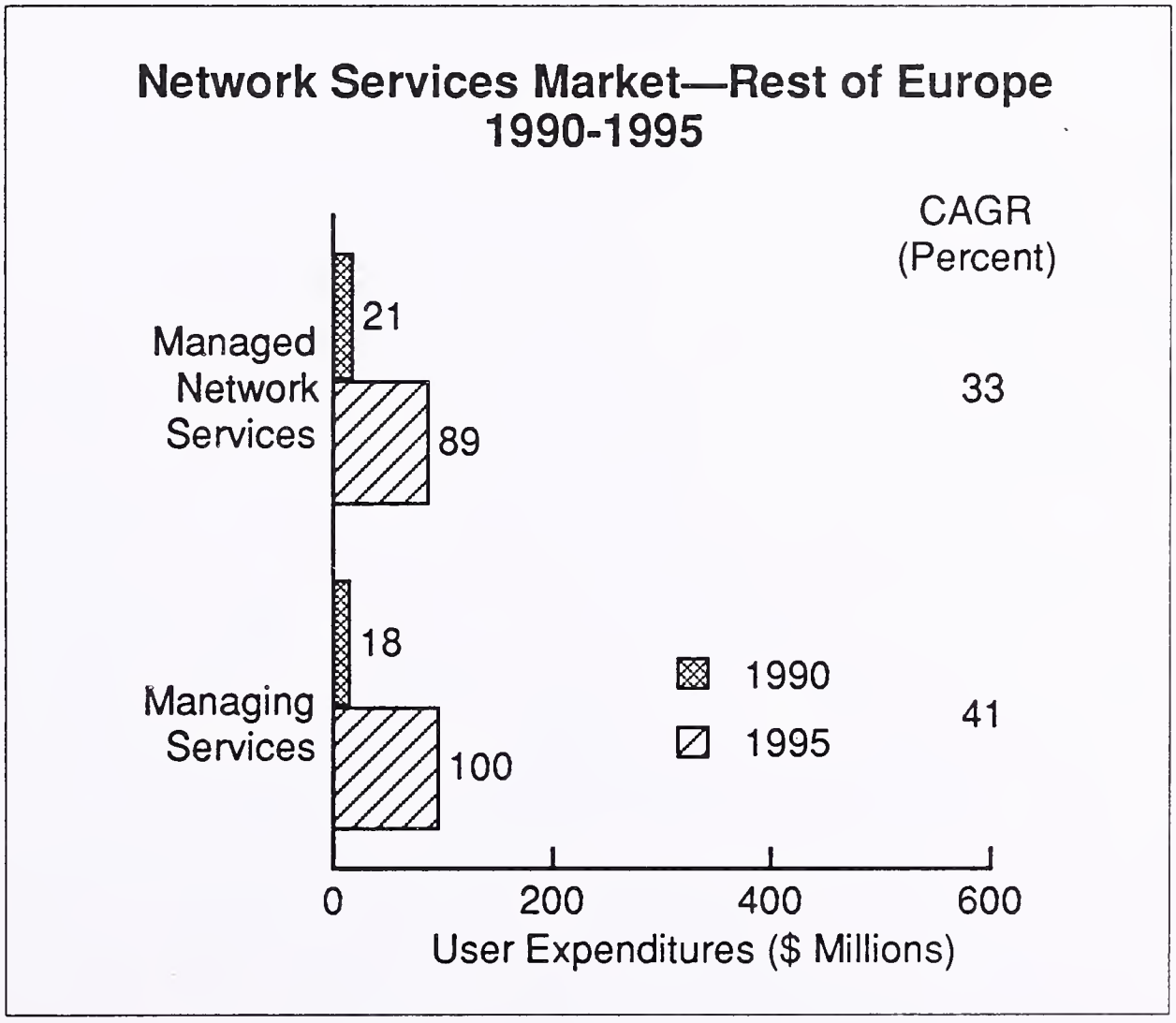
Any services not directly operated by the PTT still require a PTT licence. The PTT also has a contract to manage the Lichtenstein telecommunications network, for which it charges a set fee. As the manager of the Swiss telephone network since 1886, the PTT holds the distinction of providing the first fully automatic public telephone network in the world with the withdrawal from service of the country's last manual public telephone exchange taking place in 1959. Seventeen regional telecommunications directorates oversee the day-to-day running of the Swiss network, as well as the building and maintenance of new installations in their own areas.

Despite the restrictive structure of the PTT, even as a monopoly it has offered innovative services such as:

- Omnitel, a call forwarding service
- Cashless public telephony

The market forecast for the rest of Europe is given in Exhibit IV-11.

EXHIBIT IV-11



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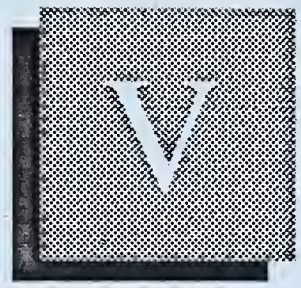
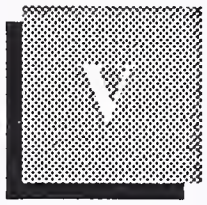


Service Providers



Service Providers

A Corporate Market Overview

INPUT's research revealed that there are three distinct classes of service provider in the corporate market:

- The network operators
- The equipment vendors
- Individual enterprises in different market sectors

The market is not surprisingly dominated by the innovative equipment vendors and enterprises in the financial sector, primarily targeting industry-specific markets for services such as electronic information services (EIS), electronic funds transfer and electronic messaging.

A number of trends indicate that this picture is likely to change over the forecast period. The general maturity of the market and the acceptance in numerous sectors of the basis for trading information directly, coupled with the regulatory freedoms created by ONP is accelerating the penetration of industry-specific services to new sectors. Moreover, as the services themselves become stable and standards are adopted for their use, they then move from being targeted at industry-specific sectors to a very much more horizontal market orientation. This pattern follows a classic market development, with initial slow and specialised introduction followed by rapid take-up, and eventually saturation with demand maturing to a steady level.

Whilst individual enterprises are likely to continue to dominate the industry-specific services, for the managed network and messaging services sector, because of its more horizontal appeal, it will be the network operators who will benefit from the market's development.

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B

BT Tymnet

1. Background

BT Tymnet Inc. is an international value-added network provider and one of the world's largest suppliers of shared, dedicated and hybrid network solutions. The company operates the TYMNET public packet data communications network, which offers protocol conversion, error protection, enhanced security features, electronic messaging, card services, and electronic data interchange (EDI).

- The TYMNET data network originated in 1969 to deliver remote computing services to a widely dispersed population of Tymshare clients. In 1977, the company—then called Tymnet, Inc.—became an FCC-regulated specialized common carrier, and two years later, installed its first private network. Tymnet was acquired by McDonnell Douglas in 1984 and was subsequently renamed McDonnell Douglas Network Systems Company (MDNSC).

- Effective November 20, 1989, British Telecom plc purchased MDNSC and certain other McDonnell Douglas network services for $355 million in cash. The purchase included Tymnet's interest in Network Information Service Ltd (NIS), a valued-added service provider in Japan. The acquired operations now trade as BT Tymnet, a wholly owned subsidiary of British Telecom.

  - British Telecom operates one of the largest communications networks in the world, has annual revenue of almost $19 billion, employs about 247,000 staff and has over 100 offices in 30 countries.

  - BT Tymnet President and CEO, Mark Baker, was previously Marketing Director of British Telecom International. He now reports to Anthony Booth, a Corporate Director of the British Telecom Group and Managing Director of British Telecom International.

BY Tymnet's operations support all of the TYMNET network products and services for shared, hybrid and dedicated customer applications, including Dialcom (acquired by British Telecom during 1986) electronic mail services, Payment Systems card authorization services, and EDI*Net. Overseas, the operations of BT Tymnet and British Telecom will be integrated to maximise regional strategies, with BT Tymnet policy and product developments being directed from the U.S.

INPUT estimates that BT Tymnet's 1989 revenues reached nearly $300 million, including about $30 million in revenue from Dialcom. BT Tymnet currently has approximately 1,500 employees, of which 95% are in the U.S.

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Competitors include the following types:

- Value-added network providers: Telenet, CompuServe, INFONET, GE Information Services, and IBM Information Network
- Packet-switch equipment vendors (for private networks): Bolt Beranek and Newman, Telenet, and Northern Telecom
- EDI services providers: GE Information Services
- Card services: National Data Corporation, MasterCard, and VISA
- Electronic messaging service providers: Telenet, Western Union, and MCI

2. Products and Services

INPUT estimates BT Tymnet's 1989 revenue was derived approximately as follows:

Network Services

Value-added networks	56%
Electronic mail	14%
EDI	2%
Subtotal	71%
Transaction Processing	13%
Private Networks	15%
TOTAL	100%

TYMNET is BT Tymnet's public packet-switching data communications network, consisting of intelligent communications processors connected by a network of leased telephone lines, microwave links, and satellite channels to provide interconnection between remote terminals, micro-computers, and host computers worldwide. TYMNET provides low value-added services such as error protection, protocol conversion and data security.

- The number of companies supported on the network has grown from 30 in 1972 to over 2,500 today.

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- Local dial-up access is available from over 800 U.S. locations and from over 80 countries. The network serves over 23,050 local exchanges via 3,243 communications processors and supports over 10,000 simultaneous users during peak hours. There are currently over 13,600 local access ports.

- The network supports various protocols, including asynchronous, X.25, X.75, 3270 bisync, 3270 SDLC, RJE HASP, Burroughs Polled-Select and UTS. For interfacing personal computers to networks, the X.PC and MNP asynchronous error-protection protocols are used.

- The Outdial service allows mainframes, minicomputers, microcomputers and terminals connected to the network to dial out to attended or unattended terminals from the nearest TYMNET Outdial port, saving users 30% of comparable WATS charges. Outdial is now available in 125 cities in the U.S.

- Most major public databases and information services are accessible on the network, including TRW Information Services, Delhi, Dow Jones & Company, and the National Computer Network of Chicago.

- Recent announcements include the following:

  - In October 1989, the company announced that it would expand its 9600 bps service - TymDial 9.6 - to 51 new access locations. The total of 69 local high-speed access locations will also be supported on inbound WATS services.

  - Also in October 1989, the company announced that it would expand its X.25 dial-up service, TymDial X.25, to 36 additional access locations. All of the synchronous locations will also be supported by an inbound WATS service. The X.25 service supports 2400 bps and 9600 bps using the CCITT X.32 Dial-In recommendations.

The principal EDI service, EDI*Net, is a third-party, value-added communications service for computer-to-computer exchange of such business documents as purchase orders, invoices, and bills of lading.

- EDI*Net supports all public exchange standards and offers asynchronous, bisynchronous, and leased-line access.

- EDI*Net clients are found in the transportation, grocery, electronics, telecommunications, aerospace, oil, and warehousing industries. There are currently over 1,000 of them.

Card services provided by BT Tymnet include credit card authorization and related services at electronic point-of-sale terminals across the U.S. These services generated an estimated $40 million in 1989 revenue.

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- Authorization services are provided for all major credit cards, including VISA, MasterCard, American Express, Discover, Diners Club, Carte Blanche, and private label card programmes.

- A related service, electronic draft capture, electronically captures credit card transactions for later transmission to a retailer's bank and enables the bank to process card sales electronically, rather than with paper drafts.

- Card processing services are supported from data centres in Irvine and Fremont (CA) and Rockville (MD).

- Card services are currently provided to over 500 banks.

BT Tymnet also provides private and hybrid data networks and associated support services. These services contributed an estimated 16% to 1989 revenue.

- Private network customers may chose from various hardware and service options, including a range of packet switches (called Tymnet Engines), and network management provided by BT Tymnet or by their own staff.

  - In August 1989, the company announced it had been awarded a contract to build a private packet-switched network for the Coors Brewing Company in Golden (CO) to streamline communications within the Coors campus in Golden by linking dissimilar computers and local-area networks. Future plans call for connecting the campus network to regional and division sales offices across the country as well as other Coors companies.

  - The company has supplied 42 private networks with a total of over 3,000 nodes worldwide to clients in banking, petrochemical, database services, publishing, electronics, postal telephone and telegraph authorities (PTTs), and Regional Bell Operating Companies (RBOCs).

- Hybrid networks combine both shared and dedicated equipment.

  - In August 1989, the company announced a $2 million hybrid agreement with Ford Motor Company, which is in addition to an existing contract worth $8.5 million for TYMNET VAN services. Ford purchased various TYMNET packet switches, software, network management services, facilities management, and hardware and software maintenance.

- In May 1989, the company introduced Small-Scale Distributed Networks (SDNs), a hybrid, private network built on either standard X.25 links or connections to public data networks.

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- Network software available from BT Tymnet includes the following:

  - netFUSION, introduced in January 1989, is a UNIX-based network management system for BT Tymnet networks built around a Sun Microsystem server and access workstations. The product supports the life cycle of the network, from planning and requirements, through installation, daily operation, and expansion, and accommodates the integration of many vendors' equipment, as well as the integration of other network management systems, such as Netview. Pricing for the software is between 10% and 20% of the overall network costs.

  - TymView, introduced in 1988, is a software interface that allows BT Tymnet network equipment to be managed by Netview.

3. Industry Markets

BT Tymnet's revenue is derived from clients from most industries. BT Tymnet's public, private, and hybrid networks are used by information services firms, manufacturers, oil companies, banks, security firms, consulting firms, libraries, publishing firms, research organisations, government agencies, and hospitals, as well as other common carriers.

- Most of the RBOCs use TYMNET to provide access to AT&T host computers, which provide applications programs and database information needed by the RBOCs.

- More than one-third of the Fortune 100 industrial companies are BT Tymnet customers.

4. Geographic Markets

Approximately 90% of BT Tymnet's 1989 revenue was derived from the U.S. and 10% from international sources.

BT Tymnet staff operates in more than 50 locations worldwide. The majority of its employees are in San Jose (CA).

Users have local access to TYMNET from more than 850 cities in the U.S. and more than 80 foreign countries.

- BT Tymnet owns and operates network access in the U.S., Italy, Spain, the Netherlands, Belgium, Hong Kong, Sweden, Australia, Japan, the UK, Canada, West Germany, and France. During 1987, the company's Japanese affiliate, NIS, implemented with TYMNET a direct connection to the Japanese VAN.

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- The company has access to some 80 other countries through network switches operated by the local telecommunications administrations (PTTs). These include South America, the Caribbean, Saudi Arabia, Malaysia, and access via international packet working with the other countries on the international packet-switching networks.

C

Infonet

Infonet, now owned by MCI and a group of PTTs, has benefited from the sale of CSC shares in the company. It is a significant player in the market on account of its international presence and has recently placed a $20 million contract with Siemens for packet switches, hoping to build up an open systems interconnection base to complement its other services. Infonet had been using NCR Comten 3695 front-end packet switches, but the Siemens equipment ostensibly offers more functionality.

1. Background

While many of the European PTTs were working towards building a European Managed Data Network Service through CEPT, Infonet was also building a relationship with many of the same European PTTs, and has succeeded in providing many of the solutions to international network management that they were looking for. Infonet's competition, mainly Tymnet and Telenet, have been building relationships with one or two strategic players, but Infonet appears to have gone one step further. Infonet aims to make many of its services available to large corporate users through the national PTTs who are also shareholders.

The company can be considered a truly international network service provider. In 1988, Infonet was formally established as Infonet Services Corporation. In January 1990, the founder of Infonet, Computer Sciences Corporation (CSC), sold off its remaining 30% share ownership. MCI of the U.S. purchased 25%, and the remaining 5% was split among other shareholders. Through 1988 to the end of 1989, Infonet's clear strategy to form business partnerships with worldwide telecommunication administrations has resulted in a shared ownership which now includes 10 international telecommunications operators.

The January 1990 announcement that MCI would purchase the 25% stake (reportedly worth $27.5 million) finally gave Infonet the press coverage it has deserved for some time. MCI will now be able to move in the direction of integrated voice and data messaging, and will benefit from Infonet's worldwide network, particularly in its continuing bid to break down AT&T's walls. In 1989, AT&T bought Istel, the U.K. network supplier. Because Infonet has some business alliances with Istel for running VN projects, the two companies are likely to meet under new circumstances. AT&T has, apparently, left Istel very much on its own since it took over the company. MCI's entry into international VANs may cause AT&T to pay closer attention to its own ventures.

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Prior to the MCI buy-in, Infonet followed a determined path in building its relationship with PTTs. Together with the distribution of shares among PTTs, Infonet has also established major business partnerships with specific agencies, usually for a particular project. These partnerships highlight the variety of services available through Infonet.

Revenues are generated for Infonet in a number of ways. For example, by teaming up with national service providers in the supply of electronic data interchange (EDI) facilities, Infonet expects to take in approximately 20% of the total international EDI revenues. Associated service providers will take a share of Infonet's total revenues, according to the amount of business they bring in. If, as some market research reports suggest, the total EDI market for 1990 is worth $300 million, then Infonet's projection of having 20% of the market would yield revenues of approximately $60 million to share with its EDI service partners.

2. Market Position

Infonet claims to support over 37% of the total international VANs data transport market, Telenet had 18%, and Tymnet had 13%. Competitors such as GEIS and IBM Information Network gain most of their revenues from traditional computer processing services, as opposed to Infonet's focus on international transport services. Also, companies such as Istel in the U.K. concentrate on providing domestic VAN services. Infonet has agreements with many of the national VAN services as well as the international record carriers (IRCs).

3. The Network

The Infonet network provides international packet-switched data communications services for terminal/host transmissions, and directs support for those services in 34 countries. Its backbone network in the U.S. uses 56K bps lines between nodes. Available from 100 countries, Infonet predicts revenues in the region of $102 million for 1989 compared to $93 million in 1988.

The variety and scope of Infonet network operations and services is limitless in the sense that each customer can receive a customized product. Infonet claims to provide an end-to-end service, and in this respect, customers can go to Infonet and ask for consultancy, training, and management services. Although no longer a part of Computer Sciences Corp, Infonet maintains that it will continue to provide services in alliance with CSC, which has a history of successful, large computer system and software implementation, and data processing solutions.

At the hub of Infonet's networking solution is the Network Control Centre (NCC) in California. The NCC constantly monitors the entire Infonet system, with technicians having access to a real-time view of

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network performance. The Infonet Support Centre (ISC) provides 24-hour service and co-ordinates with the Network Control Centre for problem solving. Infonet claims that 80% of problems reported to the ISC are solved with a single client call.

Users can connect to Infonet's network via public or private ports. For a fixed monthly fee, Infonet will provide a dedicated host link, including two modems, a leased line, and a private port to connect the host computer or front-end processor to the network.

Optional administrative services include network access control, providing for user and project accounting; billing supplements, reporting network use by user ID and project ID; session tapes, with details of each session held; zone of access verification, the ability to specify which of the 64 types of incoming calls the host computer will accept; and network access security.

4. Network Services

Infonet's offerings comprise two main categories: network services and enhanced services. Network services include the provision of worldwide data transport services, with local service and support. A middle ground, between network service and enhanced service, includes the capability of managing interconnectivity and interoperability across the network, increasing the number of different systems and applications which can be accommodated. Enhanced services use the networking infrastructure to provide users with global applications over the network.

An example of the enhanced services is Infonet's NOTICE service. For example, NOTICE provides the infrastructure for the distribution of spreadsheet applications to users. Infonet provides international X.25 packet switched data communications services for terminal/host transmissions. Its backbone network in the U.S. is tied in with nodes world-wide, supported in particular by PTT shareholders, and offers transmission speeds of up to 9600 bps. Enhanced services with dedicated facilities linking host locations permit speeds up to 19.2K bps.

Infonet manages and monitors customers' data end-to-end. It claims a network effectiveness record of 99.9 percent up-time because no single point of failure exists in the network topology—the backbone network design provides multiple (a minimum of two) independent transmission paths between each backbone node. Infonet states that the probability of a network data error is less than one in every 10 billion transmissions. It uses CRC-16 polynomial checking on all internal links and compatible external links.

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Both dial-up and dedicated services are available. Terminal connections to the network are made through public dial ports, private dial ports, and dedicated access facilities. Public dial ports are available at Infonet switch locations on a continuous basis and can be used as needed. Dial-up service is provided through the local exchange company (local service) or the interexchange telephone network (InWATS service). Through its PTT subsidiaries, including Transpac in France and Deutsche Bundepost in West Germany, Infonet services are even more accessible to end users.

a. Dial X.25 Service

In 1989, Infonet announced that it had broadened the scope of its Dial X.25 service. With the service now available in locations including Los Angeles, New York, London, Paris, and Tokyo, Infonet hopes to attract customers who are transmitting small amounts of data in packet switched form. Infonet's director of U.K. operations has stated that the Dial X.25 service will mean that a new group of customers will have access to the global packet-switching service.

b. X.25 Access

Infonet supports the CCITT X.25 recommendation through its dedicated and dial-up service offerings. Dedicated X.25 facilities for users who wish to link host locations and/or sites with a large number of terminals are available at any Infonet node locations. Access is available at speeds ranging from 2,400 bps to 19,200bps, with higher speeds available as well. DTEs are provided with X.25 packet-switched services through Permanent Virtual Circuits (PVCs) or switched Virtual Circuits (CVs).

Dial X.25 facilities are also available. Infonet Dial X.25 supports both V.22 bis and V.32 access, offering speeds of 1,200 bps to 9,600 bps. Infonet's network architecture supports the 7-layer Open Systems Interconnection (OSI) Reference Model. At the first level (physical), Dial X.25 supports X.21 bis or RS-232 for data rates up to 20K bps. It does not support X.21.

At level 2 (the link level), Infonet supports LAPB (link access procedure balanced); LAP is not supported. Framing is in conformance with the HDLC protocol. At the packet level (level 3), Infonet offers virtual circuits and full LCN Assignment 1 - 4095, specifiable at subscription. A virtual circuit is one in which no single physical circuit is established between the sending and receiving stations. Instead, the network dynamically establishes the route of least delay for each packet of data. A logical circuit, an electronic circuit used to complete a logical function, is maintained for the length of the virtual call. The output of the logical circuit depends on the state of the input. As each packet is physically transmitted, a temporary physical link is established through the network to the receiving station.

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A permanent virtual circuit is a single dedicated path connection chosen for a particular transmission. The network is aware of a fixed association between two stations; permanent logical channel numbers (LCNs) are assigned exclusively to the permanent circuit, and devices do not require permission to transmit to each other. A new connection between the same users may be routed along a different path. Packet size is selectable at subscription. Bit values available are 64, 128, 256, and 512; the default size is 128. All packets are supported except DTE RJE and Diagnostics.

c. Managed Data Network Services

Infonet's managed data network service strategy, called EDNS (Enterprise Defined Network Services), was announced in late 1989. The service will integrate private and hybrid network solutions by the provision of a number of specific support services. EDNS will make it possible for customers to have access to Infonet's network management services. One solution that Infonet offers through EDNS is to house companies' private network equipment itself. By maintaining and managing the equipment, customers will be able to implement flexible internal systems as, and when, needed. In this way, Infonet can offer support to companies that grow too quickly to maintain the necessary internal system. Similarly, EDNS will support companies that need to send large amounts of data, and simply cannot take on the management of a large system.

d. Interpac

In 1985, CSC and two French companies formed a joint venture company to cooperate in international data communications. The partners included Transpac, S.A., which operates the French public data network, and France Cables et Radio, S.A., a supplier of telecommunications equipment and services. CSC interconnected its worldwide Infonet network with the Transpac network. The joint venture company performs marketing and technical support in France for the integrated communications service.

e. Software Services

In March 1986, Simware software products were used in conjunction with the Infonet data network. Under an agreement with Simware, Inc of Canada, the Infonet division used the Simware software packages to expand CSC's current 3270 Infonet network service to include asynchronous access to 3270 hosts. This allowed clients to integrate personal computers from locations around the world into existing IBM environments.

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In late 1989, it was announced that Infonet was to market and support Network-Orion from Orion Network Communications. Orion is part of Pi Holdings, a specialist communications software company. The agreement will allow Infonet to offer networking services such as E-mail, fax and telex to IBM users.

f. Minitel

New York and Los Angeles were linked with the French Minitel videotex network via Infonet. The service was the first U.S. connection with the French service. Infonet has referred to itself in its press releases, etc., as an IVAN, meaning International Value-Added Network service provider.

g. Database Services

In 1987, CSC CompuServe Inc announced an agreement to offer CompuServe's corporate electronic communications systems and business related databases to companies in Europe and parts of the Far East. The five year agreement called for Infonet to market and support a wide range of CompuServe products, including corporate videotex systems, news services and travel information.

In 1988, CSC signed a similar agreement to market Quotron Systems' QUOTDIAL financial information service to individual investors and brokerage firms outside the U.S. The service, available from Infonet, allowed global investors to access price and market information.

5. Strategic Challenges

The most important tactical challenges facing the project team included:

- Implementing effective communications support for voice, data, text, and images
- Creating a network that could provide sufficient speed and capacity without being too complicated to manage and control effectively
- Providing connectivity among the different protocols and standards of the U.S., the U.K., Australia, and Asia
- Making sure that the network could meet the needs of different levels of users with varying management responsibilities and technical competence
- Providing for anticipated increases in volume and complexity of use
- Ensuring reliability and cost efficiency

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6. MCI's Role

MCI decided to buy into Infonet because like other public carriers it recognises that the ability to offer global managed data network services has become the key to getting and keeping multinational user accounts. Purchasing a 25% stake (largest shareholder) is an inexpensive way to catch up with the competition. The $27.5 million paid for the Infonet shares represent only a fraction of the $355 million BT paid McDonnell Douglas for Tymnet or the $290 million AT&T paid for Istel. Infonet will gain from MCI because of the significant number of U.S.-based multinationals being brought into Infonet. MCI gains because the big customers need a robust data offering—full-period leased lines as well as packet-switched facilities. Infonet gives the ability to manage worldwide all of the data network services for these larger customers.

MCI does not believe that Istel, for example, has the international infrastructure for transporting data and view BT Tymnet, US Sprint's Telenet and GEIS to be the principal international competitors. The deal gives MCI as well as the PTTs the chance to broaden their relationship on public switched voice as well as on data networks. Without doubt, the deal puts MCI ahead of AT&T and firmly up against Tymnet and Telenet. MCI will benefit Infonet by helping to secure a prime U.S. customer base. Infonet is currently number three behind Tymnet and Telenet. AT&T maintains it can already offer sophisticated applications such as EDI through Istel, while MCI will have to catch up. Finally, it may be that CSC comes to regret its decision to sell for $500 million all its shares in Infonet. As FM becomes more important, CSC may be required to network its computers to user sites, thus reinventing Infonet.

D

Network Equipment Technologies Inc.

Network Equipment Technologies Inc. (Network Equipment), based in California, was set up in 1983 to take advantage of both the advent of high-speed T1 digital lines and the deregulation of RBOCs. The company has the largest share of the U.S. T1 multiplexing business and is targeting the largest users of communications equipment, of which it serves 200.

Twenty-five percent of its $200 million turnover comes from IBM, following a distribution and product development agreement made in June 1987, whereby IBM, sells Network Equipment products on a non-exclusive basis worldwide to large mainframe customers and has licensed Network Equipment's protocols so that it can emulate them. In return, Network Equipment receives research and development funding from IBM and has the right to take IBM technology and incorporate it into devices.

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Having established a high profile in the U.S., Network Equipment set up a European base in the UK in 1988. Currently, 10% of the company's revenue comes from Europe, but it aims to increase this to 30%. It already has 50 networks operating in Europe, with 50% of these being extensions of U.S. networks for companies such as American Express and DuPont. The other 50% are new European contracts with organisations such as Credit Suisse. Ultimately, Network Equipment wants to network companies operating in the U.S., Europe and the Far East.

Network Equipment has equipment installed in all major European countries with support centres in France, Germany, Italy and Norway, besides the U.K. The attraction of Europe is due to the Europe-wide amalgamation of businesses, which is currently being undertaken, and the liberalisation of the European telecommunications scene. If this deregulation follows the same pattern as it did in the U.S., then transmission bandwidth will become inexpensive and a potentially huge number of users will add applications such as video conferencing onto their networks.

One market sector where this is particularly likely to occur is in manufacturing and design. This sector is likely to follow the pattern of financial services in the networking of information. Large multinationals such as Ford, IBM and Peugeot have already implemented a 24-hour-a-day design programme to shorten product lead times.

E

Digital Equipment Corporation

Digital Equipment Corporation (Digital) is seeking to establish network services alliances with European PTTs, the first taking place in Denmark providing electronic mail and EDI for Danish manufacturing and transport companies. The retail sector will be next. The joint venture is with Siemens and three Danish telecommunications operators (in Jutland, South Jutland and Funen).

Digital's approach is to avoid the Siemens strategy adopted with Vascom, i.e., to sell its own internal network capacity. Instead, it is basing its capability on a small number of highly-focused industry-specific application services:

- Digital will install and operate an electronic mail and EDI network spanning 27 countries for the 5,000 transportation companies of the Baltic International Maritime Council, whose members transport more than 50% of the world's shipping tonnage.

- Digital is already running a service in the UK for the financial services industry.

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F

SITA (Societe Internationale de Telecommunications Aeronautiques)

SITA is building a global network services operation and will offer services to related industries, such as air transport. ITS (International Network Services BV), the SITA subsidiary, will compete with service providers and PTTs in providing EDI, virtual private networks, sophisticated messaging and other services.

The problem for SITA is how to diversify into third-party services without damaging the organisation's bid for project status or threatening the favourable tariff arrangements it is granted in some countries. SITA's network covers 184 countries and territories - which is far more than any other network services provider. However, it is limited by its charter only to serve airlines. SITA, in order to get around this limitation, will spend $20 million over the next three years to build a separate network on which to place third-party services, and which will eventually interconnect with its existing backbone network.

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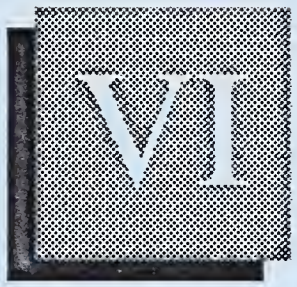
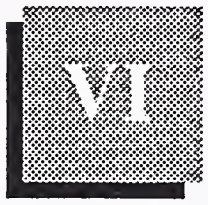


Facing The Future



Facing The Future

A

Introduction

European companies need to operate and control their activities on a pan-European scale to exploit the opportunities of 1992 and beyond, whilst non-European companies will need to establish bases in Europe. The provision of effective business communications through in-house and publicly available services will be essential to success post-1992. Electronic messaging via open systems such as X.400 will play a key role in achieving a competitive edge.

B

Key Issues

The large international companies are driving the development of pan-European and even global electronic messaging and other network services. However, for many companies which already own private communications networks, the installation of a private message handling service based on the X.400 and related standards may well prove more cost-effective. Corporate IT departments are now faced by a huge number of choices such as that of subscribing to public PTT and network services or instead implementing private corporate message handling services. Some of the issues to be addressed are as follows:

- Levels of security
- Cost effectiveness of a private corporate MHS system when pan-European corporate data communications already exist
- The impact of deregulation on the provision of corporate transitional services

More immediately however, companies have to decide what addressing schema should be adopted for complex multiple businesses, each of which is operating internationally in its own right. Clearly there is a need for concerted action from standards bodies, PTTs and independent service providers to ensure evolution towards unified global message handling services.

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INPUT research indicates that there are typically four major categories of electronic message transfer (covering both free form and structured text):

- Document transfer (of both final and revisable or draft form documents, including those with a composite multi-media structure)
- Image transfer (of still and moving images)
- Bulk file transfer (of large volumes of text, data or image)
- On-line access (menu-driven access to corporate and external facilities)

Formal core communications services are being defined to support not only intra-business communications, but also links to trading partners, public databases and home-based or mobile workers. Interfaces to public services and external parties based on international standards such as X.400 for messaging between trading partners are essential if companies are to maintain their competitive advantage.

In many organisations already working in multi-vendor environments, the use of internationally agreed open systems standards has become the norm. Adoption of standards is seen as a necessary first step towards building integrated corporate communications systems and connecting worldwide to a variety of trading partners.

The CCITT X.400 recommendations, used in conjunction with the X.500 series, the office document architecture (ODA) as well as the Edifact standard, will offer the corporate user enhanced functionality, for his message handling system (MHS). As shown in Exhibit VI-1, this can be achieved by:

- Multi-vendor electronic messaging and its integration with telex and fax
- Transfer of final form (FF) and reversible form (RF) documents, including graphics and small image structures
- Transfer of PC text, binary and graphics files, directly or via a message store (mailbox)
- Support for EDI forms transfer
- Directories
- Security service management

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EXHIBIT VI-1

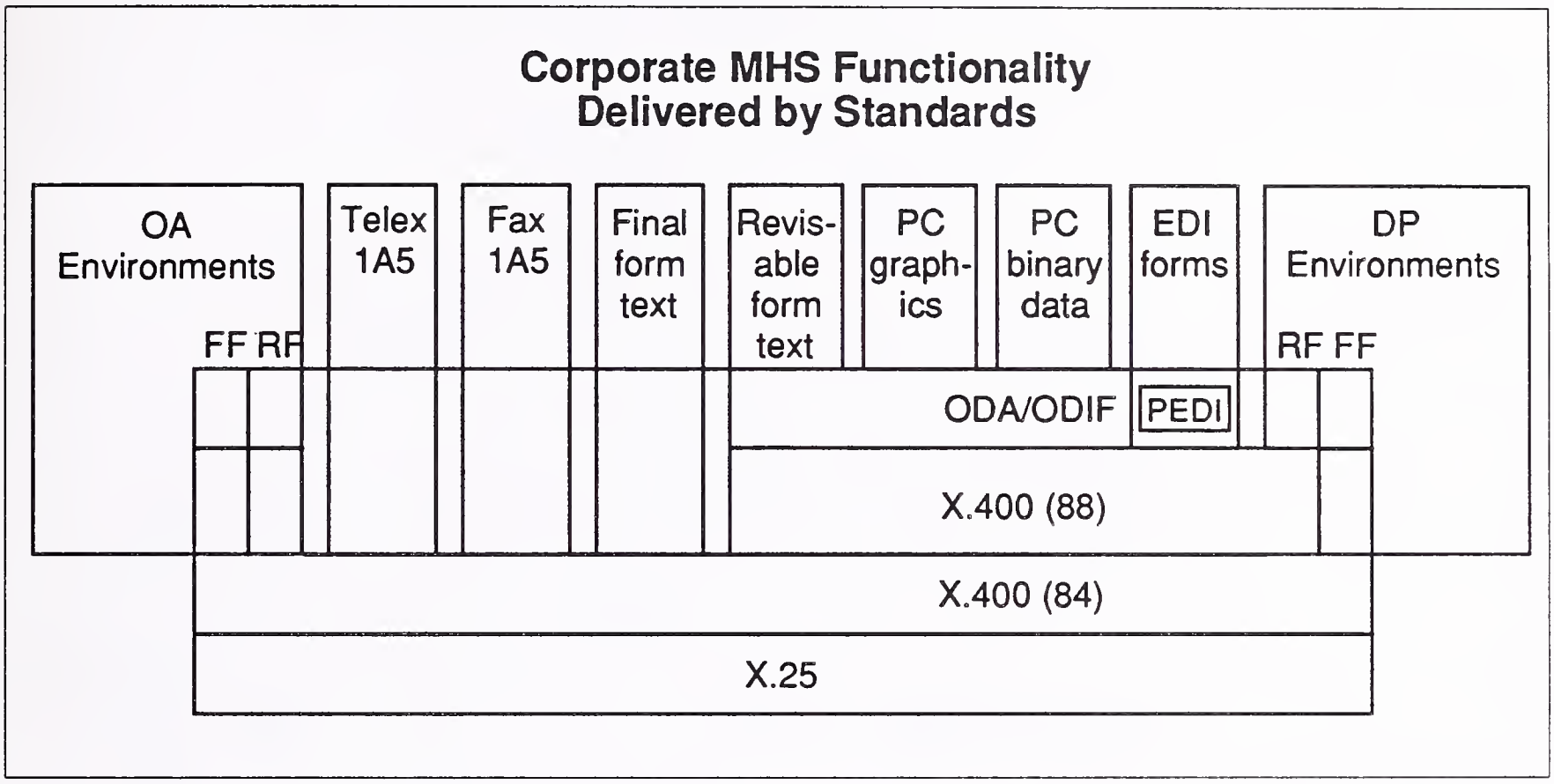

Exhibit VI-2 shows how the integration of disparate proprietary electronic messaging, telematic services and other environments is performed through the use of X.400 gateways and access units. The support of access to external organisations is through the use of managed gateways to public services.

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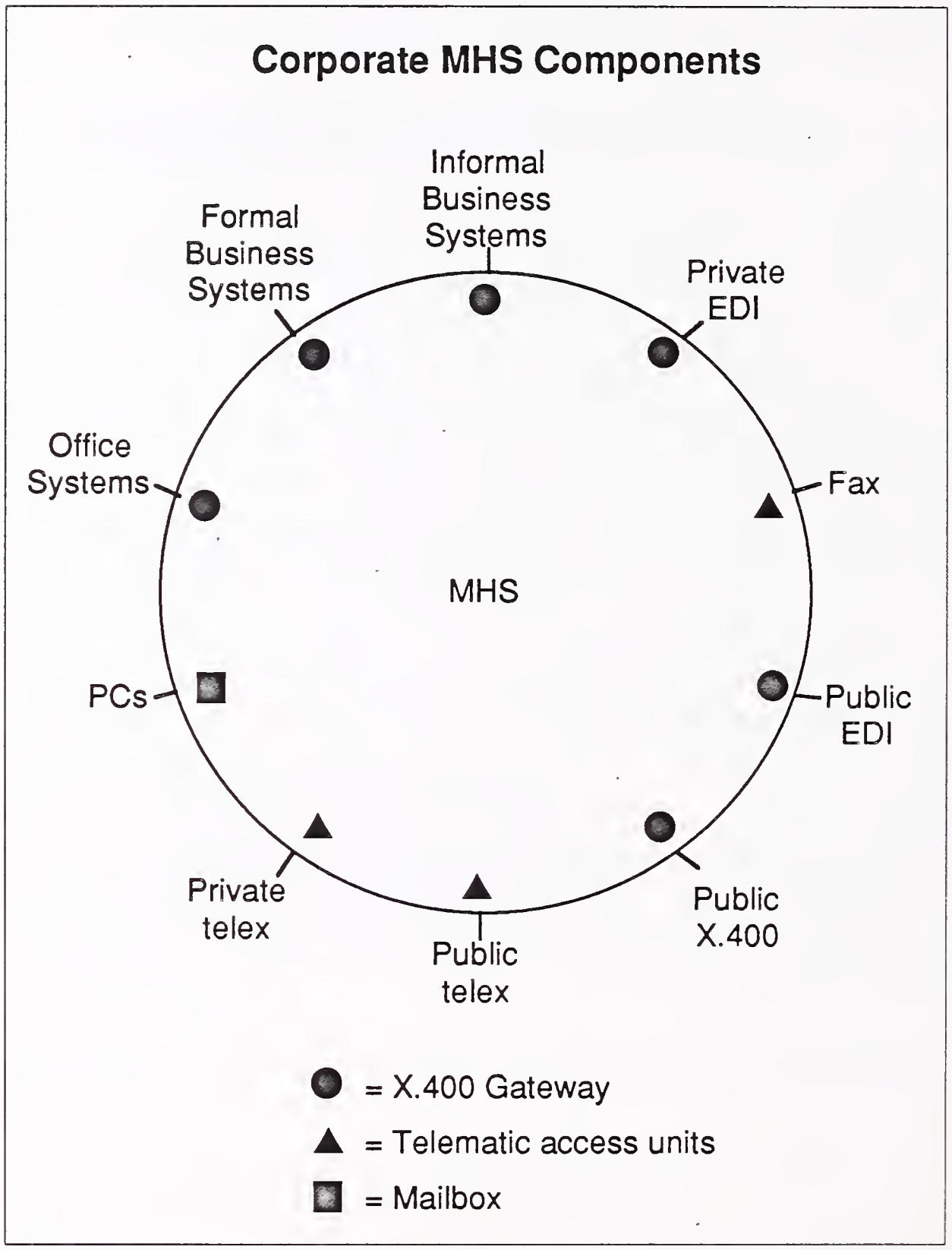
EXHIBIT VI-2



C

Future Directions

If X.400 and EDIFACT, for example, prove durable, IT managers will be able to establish a corporate MHS running over national and international private telecommunications networks and use public services only for communication to external parties. Alternatively, they could use public operator services exclusively for both internal and external traffic, or thirdly, use a hybrid private network.

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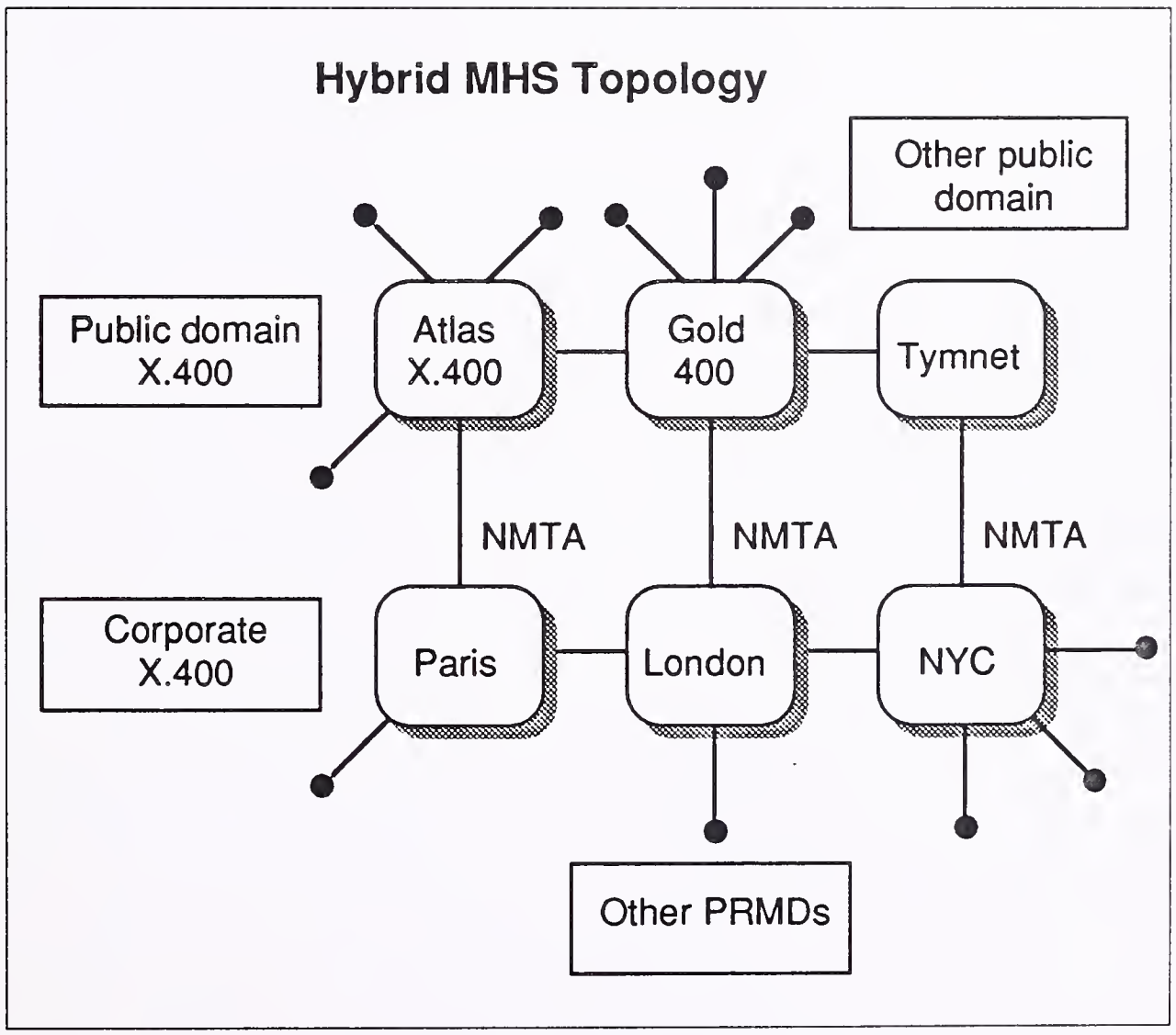
However, INPUT has identified that the trend among large companies is to interconnect their corporate networks into international private networks on which a variety of corporate services, including messaging, could be provided. Public services will be used predominantly as "clearing houses" between corporate MHS, for access to remote corporate locations and by smaller companies which cannot justify a private MHS.

A possible scenario for the corporate MHS is the implementation of a distributed system, based on a resilient backbone of X.400 switches, installed in key business or geographical locations as shown in Exhibit VI-3. The switches act as main national routing nodes between the message transfer agents (MTAs) supporting businesses inside a country and as major international routing nodes between MTAs in businesses in different countries. They would be the repositories of national user directories and national message stores (mailboxes) for PC users, as well as gateways to national public services offered by PTTs and network services providers.

EXHIBIT VI-3



Open Network Provision (ONP) will have a decisive effect on the network services market and will stimulate competitive provision of X.400-based services. Germany, France, Spain, Portugal, Italy, Ireland, Luxembourg and the Netherlands are positioned politically to fully accept the

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terms and constraints of ONP. The U.K. and Denmark will be on the liberal wing, with the U.K. in particular at variance with the rest of the EC in that it allows competition in basic telephony and basic data transmission services. The relevance of ONP to corporate MHS implementations can be summarised as follows:

- Telex traffic, electronic mail (FF text), fax and composite documents will be freely routed and exchanged within transnational corporation.
- The PTTs will, collectively, become major network services providers in Europe with several X.400 services being announced.
- EDI document transmission to trading partners will be possible via private network-to-private network connection or via public networks.
- Telex traffic will remain subject to PTT service provision for the foreseeable future.

X.400-based EDI, high-speed fax (G4), electronic mail and processing services, through competitive supply from the private sector, will become common in Europe in the 1990s.

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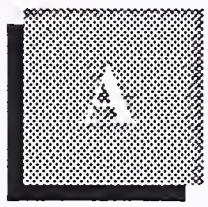
Appendixes



Appendix: Definition of Terms

A

Overall Definitions and Analytical Framework

Information Services - Computer/telecommunications-related products and services that are oriented towards the development of use of information systems. Information services typically involve one or more of the following:

- Processing of specific applications using vendor-provided systems (called **Processing Services**);
- A combination of hardware, packaged software and associated support services which will meet a specific application processing need (called **Turnkey Systems**);
- Packaged software (called **Software Products**);
- People services that support users in developing and operating their own information systems (called **Professional Services**);
- Bundled combinations of products and services where the vendor assumes responsibility for the development of a custom solution to an information systems problem (called **Systems Integration**);
- Services that provide operation and management of all or a significa-tion part of a user's information systems functions under a long term contract (called **Systems Operations**);
- Services associated with the delivery of information in electronic form - typically network-oriented services such as value-added networks, electronic mail and document interchange, on-line data bases, on-line news and data feeds, videotex, etc. (called **Network Services**).

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In general, the market for information services does not involve providing equipment to users. The exception is where equipment is bundled as part of an overall service offering such as a turnkey system, a system operations contract, or a systems integration project.

The information services market also excludes pure data transport services (ie. data or voice communications circuits). However, where information transport is associated with a network-based service (eg, EDI or VAN services), or cannot be feasibly separated from other bundled services (eg, some systems operations contracts), the transport costs are included as part of the services market.

The analytical framework of the **Information Services Industry** consists of the following interacting factors; overall and industry-specific business environment (trends, events and issues); technology environment; user information system requirements; size and structure of information services markets; vendors and their products, services and revenues; distribution channels, and competitive issues.

All **Information Services Market** forecasts are estimates of **User Expenditures** for informations services. When questions arise about the proper place to count these expenditures, INPUT addresses them from the user's viewpoint: expenditures are categorised according to what users perceive they are buying.

By focussing on user expenditures, INPUT avoids two problems which are related to the distribution channels for various categories of services:

- double counting, which can occur by estimating total vendor revenues when there is significant reselling which the industry (eg, software sales to turnkey vendors for repackaging and resale to end users);

- missed counting, which can occur when sales to end users go through indirect channels such as mail order retailers.

Market Sectors or markets are groupings or categories of the users who purchase information services. There are three types of user markets:

- *Vertical Industry* markets, such as Banking, Transportation, Utilities, etc.

- *Functional Applications* markets, such as Human Resources, Accounts, etc. These are also called "Cross-Industry" markets.

- *Generic* markets, which are neither industry nor application-specific, such as the market for systems software.

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Specific market sectors used by INPUT are defined in Section D, below.

Captive Information Services User Expenditures are expenditures for products and services provided by a vendor that is part of the same parent corporation as the user. These expenditures are not included in INPUT forecasts.

Non-captive Information Services User Expenditures are expenditures that go to vendors which have a different parent corporation than the user. It is these expenditures which constitute the information services market.

Delivery Modes are defined as specific products and services that satisfy a given user need. While *Market Sectors* specify *who* the buyer is, *Delivery Modes* specify *what* the user is buying.

Of the eight delivery modes defined by INPUT, five are considered primary products or services:

- Processing Services
- Network Services
- Professional Services
- Applications Software Products
- Systems Software Products

The remaining three delivery modes represent combinations of these products and services, bundled together with equipment, management and/or other services:

- Turnkey Systems
- Systems Operations
- Systems Integration

Section B describes the delivery modes and their structure in more detail.

Outsourcing is defined as the contracting of information systems (IS) functions to outside vendors. Outsourcing should be viewed as the opposite of *insourcing*: anything that IS management has considered feasible to do internally (eg. data centre operations, applications development and maintenance, network management, training, etc.) is a potential candidate for outsourcing.

IS has always bought systems software, as it is unfeasible for companies to develop it internally. However, all other delivery modes represent functions of products that IS management could choose to perform or develop in-house. Viewed this way, outsourcing is the result of a make-or-buy decision, and the outsourcing market covers any product or service where the vendor must compete against the client firm's own internal resources.

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B

Network Services Definitions

Network Services typically include a variety of network-based functions and operations. Their common thread is that most of these functions could not be performed without network involvement. Network Services is divided into two major segments: *Electronic Information Services*, which involve selling information to the user, and *Network Applications*, which involve providing some form of enhanced transport services in support of a user's information processing needs.

- *Electronic Information Services (EIS)*

Electronic information services are data bases that provide specific information via terminal-based inquiry, including items such as stock prices, legal precedents, economic indicators, periodical literature, medical diagnosis, airline schedules, automobile valuations, etc. The terminals used may be computers themselves, such as communications servers or personal computers. Users typically inquire into and extract information from the data bases. Although users may load extracted data into their own computer systems, the electronic information vendor provides no data processing or manipulation capability. and the users cannot update the vendor's data bases.

The two kinds of Electronic Information Services are:

- *On-line Data Bases* - Structured, primarily numerical data on economical and demographic trends, financial instruments, companies, products, materials, etc.

- *News Services* - Unstructured, primarily textual information on people, companies, events, etc.

While electronic information services have traditionally been delivered via network, there is a growing trend towards the use of CD ROM optical disks to support or supplant on-line services, and these optical disk-based systems are included in the definition of EIS under this delivery mode.

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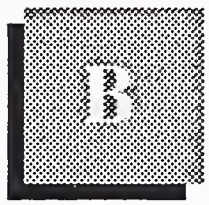

Appendix: Forecasting Assumptions and Exchange Rates

The market forecasts provided in this report cover the period 1990-1995 and include assessments for the base year of 1989. The forecasts have been formulated in local currency and converted into U.S. dollars for aggregation and comparative purposes. The U.S. dollar exchange rates used are listed in Exhibit B-1.

The forecasts have been expressed in actual monetary terms and they therefore include an allowance for inflation. The general inflation assumptions made by INPUT in formulating these forecasts are listed in Exhibit B-2. This exhibit also shows the assessment of the systems operations market for comparative purposes.

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EXHIBIT B-1

U.S. Dollar and ECU Exchange Rates 1990

Country	Currency	U.S. Dollar Exchange Rate	ECU Exchange Rate
France	FF	6.17	6.87
Germany	DM	1.81	2.05
United Kingdom	£	0.631	0.74
Italy	Lira	1,336.00	1,502.00
Sweden	Sek	6.39	7.41
Denmark	DK	7.05	7.80
Norway	NK	6.85	7.94
Finland	FM	4.21	4.84
Netherlands	Dfl	2.05	2.30
Belgium	BF	38.06	42.29
Switzerland	SF	1.61	1.80
Austria	Sch	12.77	14.39
Spain	Ptas	115.80	129.70
Rest of Europe	$	1.00	0.83

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EXHIBIT B-2

Inflation Assumptions

Country	Assumption 1989-1994	Assumption 1990-1995	Change
France	4.0	4.5	+0.5
Germany	2.5	4.0	+1.5
United Kingdom	5.5	7.0	+1.5
Italy	6.0	7.0	+1.0
Sweden	6.0	7.0	+1.0
Denmark	6.0	5.0	-1.0
Norway	4.0	5.0	+1.0
Finland	6.0	6.0	0.0
Netherlands	2.0	3.0	+1.0
Belgium	3.5	4.0	+0.5
Switzerland	2.5	5.0	+2.5
Austria	3.0	4.0	+1.0
Spain	5.5	6.5	+1.0
Rest of Europe	8.0	10.0	+2.0
European Average	4.5	5.5	+1.0

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