OPPORTUNITIES IN ISDN TECHNOLOGIES

WESTERN EUROPE 1991 - 1996

INPUT

SEPTEMBER 1991

OPPORTUNITIES IN ISDN AND OTHER EMERGING TECHNOLOGIES WESTERN EUROPE

1991-1996

INPUT®

Picadilly House, 33/37 Regent Street, London SW1Y 4NF, UK +71 493 9335
24, avenue du Recteur Poincaré, 75016 Paris, France +33 1 46 47 65 65
Sudetenstrasse 9, D-6306 Langgöns-Niederkleen, Germany +49 6447 7229

Researched by
INPUT
Piccadilly House
33/37 Regent Street,
London SW1Y 4NF
England

Published by
INPUT
1280 Villa Street
Mountain View, CA 94041-1194
U.S.A.

Network Services Programme—Europe

Opportunities in ISDN and Other Emerging Technologies, Western Europe, 1991-1996

NETO1 • 1991

Abstract

The growth in the importance of the network to the corporate and professional computer user is set to continue over the next five years. From the standpoint of the end user, the network will replace the computer as the mainstream information infrastructure with which users interact during their working lives.

The application of technology, both hardware and software based, is increasing the number of options available to communications planning managers, both to economise on networking costs by using the latest techniques, and to mix and match different types of networking technology to support new or existing applications. The dynamism of the networking sector is at the same time creating opportunities for network services vendors to offer either transitional or long-term services to assist users in this increasingly complex environment.

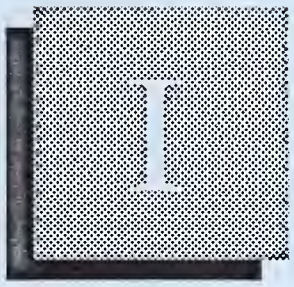
This study examines the rate of growth of new technologies—for fixed or mobile networks, for terrestrial or satellite links, for wired or wireless types of transmission and for different protocol-based services such as ISDN, frame relay, or fast packet switching—against INPUT's layered model of the network services sector. The implications for services offered at the various levels in the model will be described and the new service opportunities highlighted.

The study draws on INPUT's ongoing research programme among users and vendors. It is 60 pages in length and contains 28 exhibits.

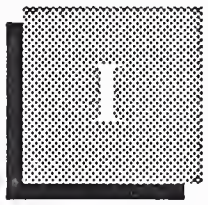
Table of Contents

Table of Contents (Continued)

Exhibits



Introduction



Introduction

A Objectives

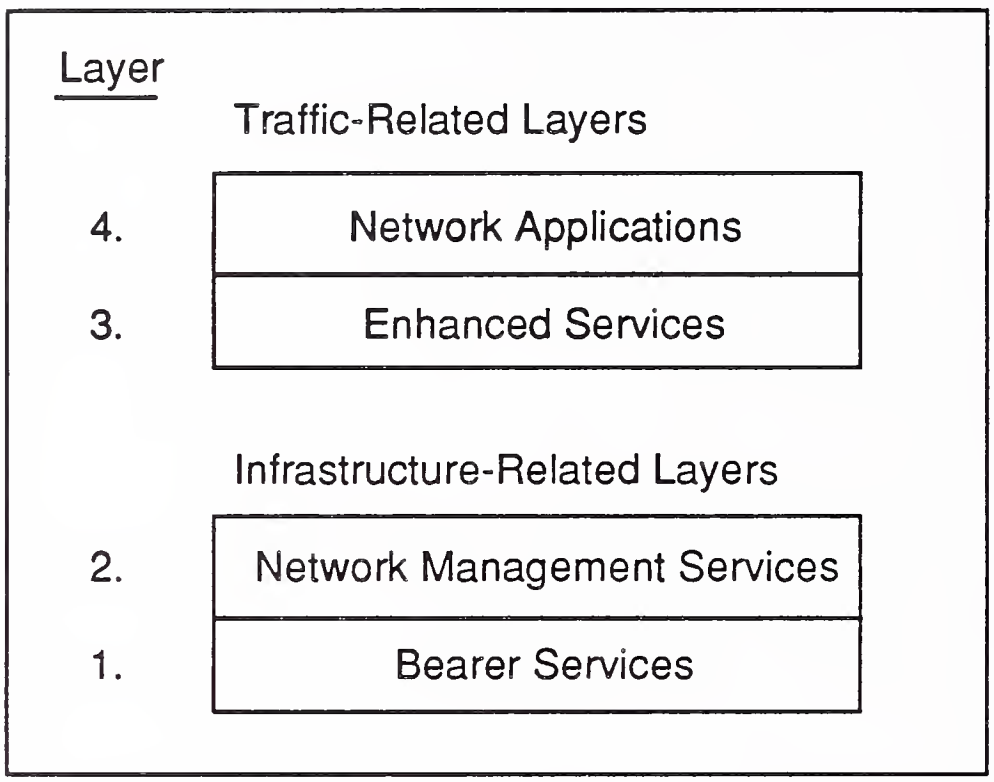
This study is produced as a result of work done during 1991 for clients of INPUT's Network Services Programme—Europe. The objectives of the work are to:

- Examine the various technological initiatives being undertaken in the networking field.
- Show what types of service opportunities are emerging.
- Offer guidelines for how these opportunity markets should be addressed, at both strategic and tactical levels.

The opportunities and market strategies described are all related to INPUT's four-layer model of the network services sector, which is shown in Exhibit I-1.

EXHIBIT I-1

INPUT's Four-Layer Model for the Network Services Industry



B

Scope and Methodology

In previous years INPUT has produced in-depth reports on the Western European market for software and services. These reports include analyses of the markets under review by delivery mode, by industry sector and by country. The reports have been sold as standalone products to individual client purchasers and as part of the overall package delivered to our subscription programme clients.

In 1991 the emphasis has been changed to reflect the changing needs of INPUT's client base.

- A need for access to information from studies on a regular, ongoing basis during the year.
- Access to this information during the intermediate phases of a study, even before the full analysis has been completed or all the conclusions drawn.
- Ability to update easily the information on important topics relating to a particular programme, such as the top-level numbers and forecasts, the profiles of the leading vendors, or important technology initiatives.

To satisfy the changing emphasis in the requirements of our client base, INPUT is now producing its research material as a set of loose-leaf bound volumes, which are structured to provide conclusions and recom-

mendations on the topics chosen as studies for the current year, in the same way as the traditional report did but in a more flexible and modular way.

The chosen topic for this study is the market opportunity being offered to network services vendors by new networking technologies, such as ISDN. This topic involves an assessment of the interaction between different waves of technology all claiming to bring added benefits to the network user, many of which offer competing types of solutions. This competitive element among technologies means not so much the 'survival of the fittest,' but rather that only a few will thrive. The remainder will only be adopted by minority groups of users, those perhaps with specialist requirements.

The geographic scope of this topic extends to all Western European countries and INPUT recommendations and conclusions include analyses of the differences in opportunity levels in the different country markets. Our work has not involved quantitative analysis of opportunity markets across the different countries.

The research on the topic has involved considerable desk research on technology developments affecting user and vendor alike.

- Integrated services
- Specific protocols
- Transmission technology for trunking in terrestrial networks
- Satellite opportunities
- Technologies affecting the local loop—e.g., cable, fibre, traditional copper, wireless connection
- Mobile communications

Desk research has been supplemented by INPUT's ongoing programmes of user and vendor research:

- Consultant level in-depth interviews
- Structured and focussed telephone interviews

C

Structure of the Topic Coverage

The study is structured as a number of published loose leaf sections. The following sections are included:

- Chapter II is an Executive Overview of the whole topic.
- Chapter III describes the INPUT model of the network services market.
- Chapter IV covers the current and emerging technologies in each of the areas listed above in subsection B.

Exhibit I-2 summarises the aims of the study.

EXHIBIT I-2

The Technologies at Work in the Marketplace

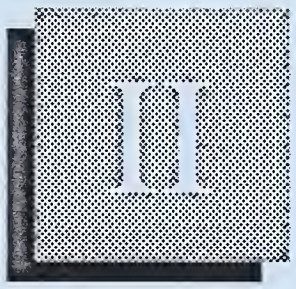
- Examine: current, near future, far future
- INPUT's layered model
- Technology streams
  - Basic network - trunking - ISDN
  - Terrestrial - satellite - broadcast
  - Local loop - cable, LANs, PCNs
  - Mobile communications
- Regulation affects opportunities

D

Related Topics

Readers may find it useful to refer to a number of other INPUT publications which relate to this topic:

- Reports:
  - *The Network Services Market, Western Europe, 1990-1995*
  - *Managed Network and Messaging Services, Western Europe, 1990-1995*
  - *EDI and X.400*
- Studies:
  - *User Issues in Network Services, 1991-1996*



Executive Overview

II

Executive Overview

A

Large Users Build Their Own ISDNs

The concept of ISDN was born some 15 years ago in the mid-1970s when members of the CCITT decided to build a set of standards, which when implemented world-wide would bring into being a new public switched network environment capable of supporting data, text, voice and image communications.

This environment was envisaged as international and application independent. It would appear to the user very much like the present day PSTN, which provides seamless end-to-end voice communications for most countries of the world.

Like the PSTN, it would be charged for on a triple basis:

- An initial installation fee based on the number of lines connected.
- A regular rental also based on the number of lines.
- A regular usage fee based on the time connected and the distance between the network points linked.

Unlike the PSTN, it would not be optimised for one type of information but would be designed to handle all types equally well as digitalised bit streams.

Because of the difficulties and delays associated with the production of the agreed international standards, ISDN is still, 15 years later, not fully implemented and therefore regarded as a thing of the future by many potential users. Moreover, many large organisations, which are significant users of networking, believe they have gone beyond the point when the initial stage of ISDN can be of use to them. The initial stage of

ISDN, called narrowband ISDN, is based upon a 64 Kbps quantum of transmission capacity. This unit was decided upon as being sufficient for most of the user applications envisaged at the time of the design stage of ISDN.

In the absence of ISDN as a complete network, the large users have gone ahead and developed their own integrated voice and data private networks, using existing technologies as these have become available. Nevertheless, the demand for ISDN remains and many large users regard the next set of ISDN standards (for broadband ISDN) as the level of public network capability which they will aim to use.

Network technology is in a state of constant improvement and this situation is forecast to continue into the next decade. Users of all types and size of organisation are faced with continually upgrading their networks to support their evolving business plans. This requires a regular re-evaluation of the 'make or buy' decisions associated with network strategy and design.

At the same time, technology keeps changing the economics of different aspects of the networking business:

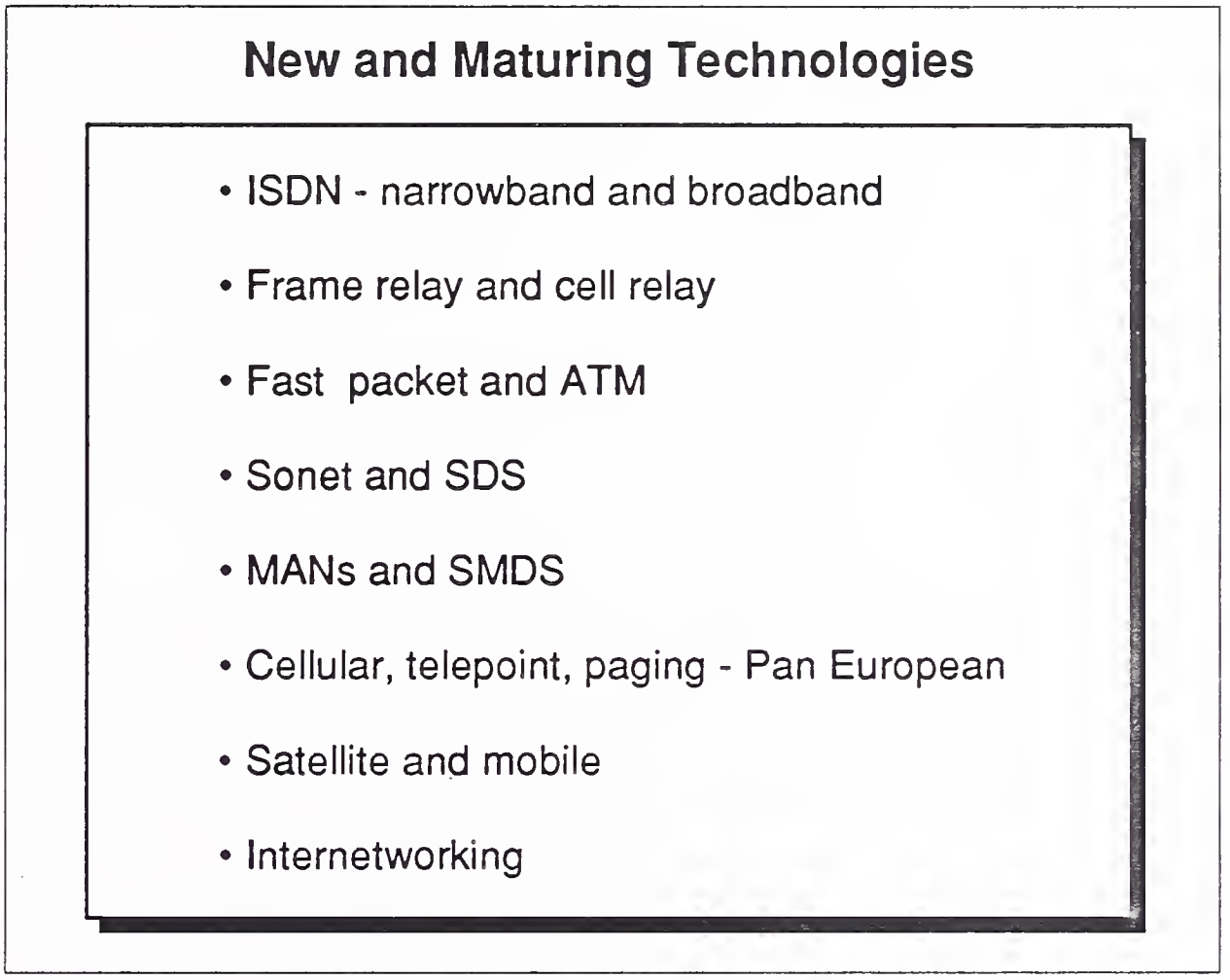
- Interconnection of LANs appears a user-friendly and cost-effective way of linking working groups.
- EDI, once implemented, impacts system development strategies and an organisation's external gateway requirements.
- Both large and medium-sized users are now contemplating the possibility of outsourcing significant parts of their networks from services vendors.

This study reviews and analyses the impacts of certain key technologies, as well as that of ISDN, in order to:

- Explain the emergence of opportunity areas for service providers
- Create some insight into the ways the evolving environment will migrate into the new ISDN-based world
- Allow vendors to formulate migration strategies for their users.

The technologies reviewed are listed in Exhibit II-1.

EXHIBIT II-1



B

Technology Increases Contention for Market Share

Traditionally, a number of different types of players have been active in the network services area:

- Network equipment vendors supplying both the public networks and the private user,
- PTOs and common carriers providing the basic transport services,
- Independent service providers servicing the higher level applications in cross-industry and industry-specific modes,
- Professional services vendors assisting with the implementation and operation of both private and public services,
- Computer equipment suppliers supporting the activities of all the other players and often active in the areas of network applications and systems integration as well.

Each type of vendor has had a slightly different 'centre of gravity' with respect to the whole spectrum of layered services, and, therefore, their prospects and opportunities have been differently focused. Exhibit II-2 shows INPUT's market forecast for the network services sector, segmented into four layers, three of which are regularly tracked as part of the Network Services Programme in Europe.

EXHIBIT II-2

Western European Market Network Services, 1991-1996

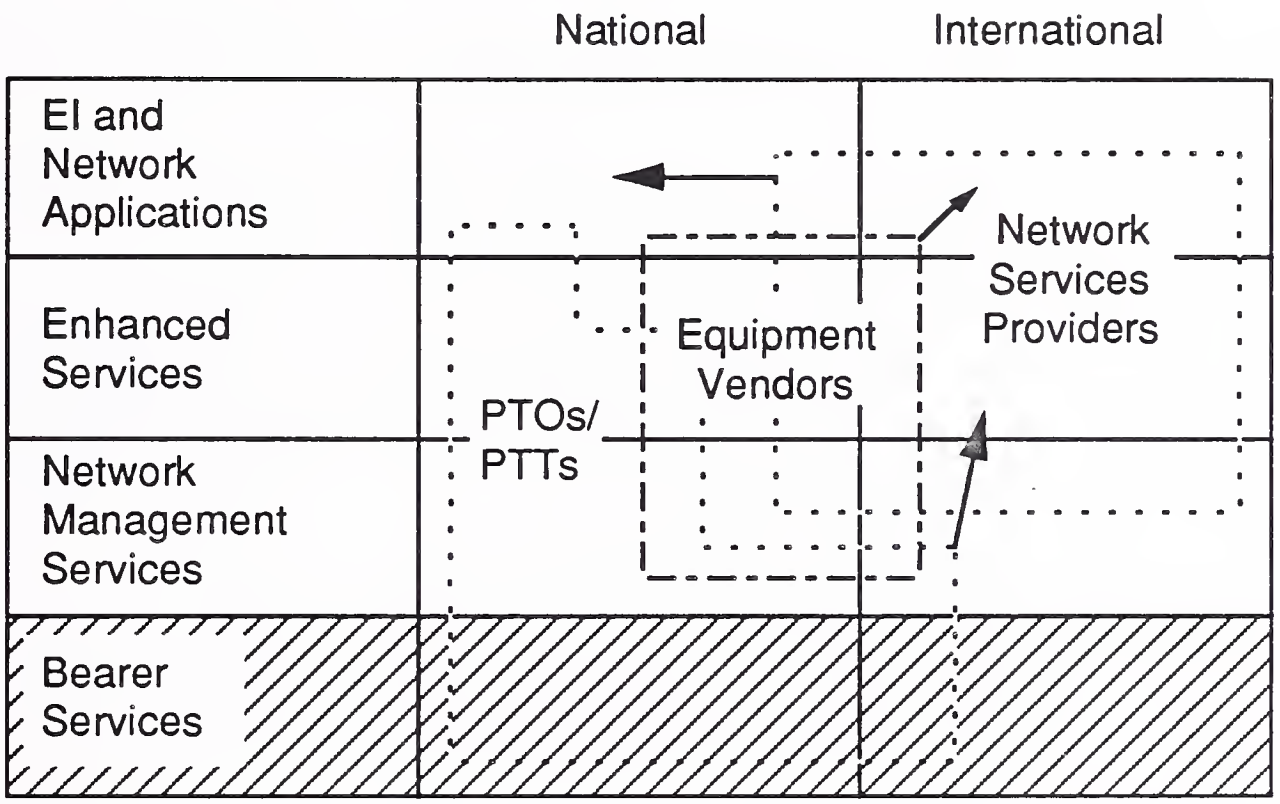
Subsector	User Expenditures ($ Billions)		
	1991	1991-1996 CAGR (Percent)	1996
Electronic Information Services (EI)	3.1	20	7.7
Network Applications	0.6	46	3.7
Enhanced Services	0.2	25	0.6
Network Management Services (including MNS)	0.5	29	1.8
Total	4.4	26	13.8
Bearer Services*	8.6	13	16.1

*Not included in INPUT's Network Services Programme

Exhibit II-3 shows the strategic positioning of the important players in the sector and indicates in which directions they are heading to improve their market coverage in parts of the market in which they are not currently so active.

EXHIBIT II-3

Strategic Positioning



= Current positions

= Long-term goals

= Not normally included in INPUT's Network Services Programme

C

Long-term Impact of ISDN

ISDN enables a number of sophisticated networking applications. It does this principally by offering:

- Multi-media communications
- Separate bearer and signalling lines, allowing flexibility of control
- Internationally agreed standards, enabling regional and eventually global networks to be built

The current deficiencies in the world-wide implementation of narrowband ISDN are:

- Partial coverage of the standards:
  - In the U.S., common carriers offer ISDN, but very few corporations have adopted it for their networks.
  - In Europe, France's NUMERIS network covers the majority of the country and has a reputed 6,000-plus user base.
  - Germany and the U.K. are next in terms of coverage, but each has around 2,000 users or less, and Germany is more intent on seizing world leadership in the application of broadband ISDN through development of city-wide metropolitan area networks (MANs) in its major conurbations.
  - Other countries are even less penetrated.
- Differences in implementation of the agreed standards between different PTOs, putting difficulties in the way of users wishing to establish international private networks.
- Differences in tariff structures and rates, making it difficult for users to construct the business case for ISDN.
- A divergence of user loyalties between the narrowband and broadband ISDN standards, split which burdens the PTOs investment prioritising activity and decisions.

In spite of these problems, ISDN facilities are required if the majority of trading entities are to be able to network internally and with their trading partners. EDI and electronic commerce will be much easier if and when the unevenesses described above have been ironed out. This is basically a requirement for the small and medium-sized user that cannot easily acquire the in-house capability to develop sophisticated electronic networking.

Exhibit II-4 lists the areas of networking application which can be enabled through ISDN, under the two headings of narrowband and broadband.

EXHIBIT II-4

Application Areas for ISDN

- Narrowband
  - Leased line back-up
  - LAN interconnection - up to medium volume
  - CNI applications, e.g., ACD
  - Multi-media messaging
  - Telemetry and surveillance
  - ATM networks
  - APIs (Application Programming Interfaces)
- Broadband
  - Telemedicine, telediagnostics
  - Telepublishing
  - GIS (Geographic Information Systems), city planning
  - LAN interconnection - up to high volume
  - Videoconferencing

On the marketing side, the most important need for ISDN is to be able to shake off its "technology" image. In this context, the key questions are:

- Is ISDN a technology or a set of services?
- Under either heading, do users really know what ISDN is?
- What vehicle or vehicles are needed to give ISDN the lift-off it requires to move up from the level of having only approximately 10,000 users in Europe?

The situation is similar to that which existed in the early days of videotex, with two major exceptions:

- Vendors can now learn from the mistakes and difficulties in trying to build an international videotex environment.
- The need for ISDN stems from the increasing hunger for bandwidth, whereas videotex was conceived as a way of encouraging use of an underutilised resource, the PSTN—i.e., it was driven by vendor need rather than user requirement.

D

Immediate Solutions Require Intermediate Technologies

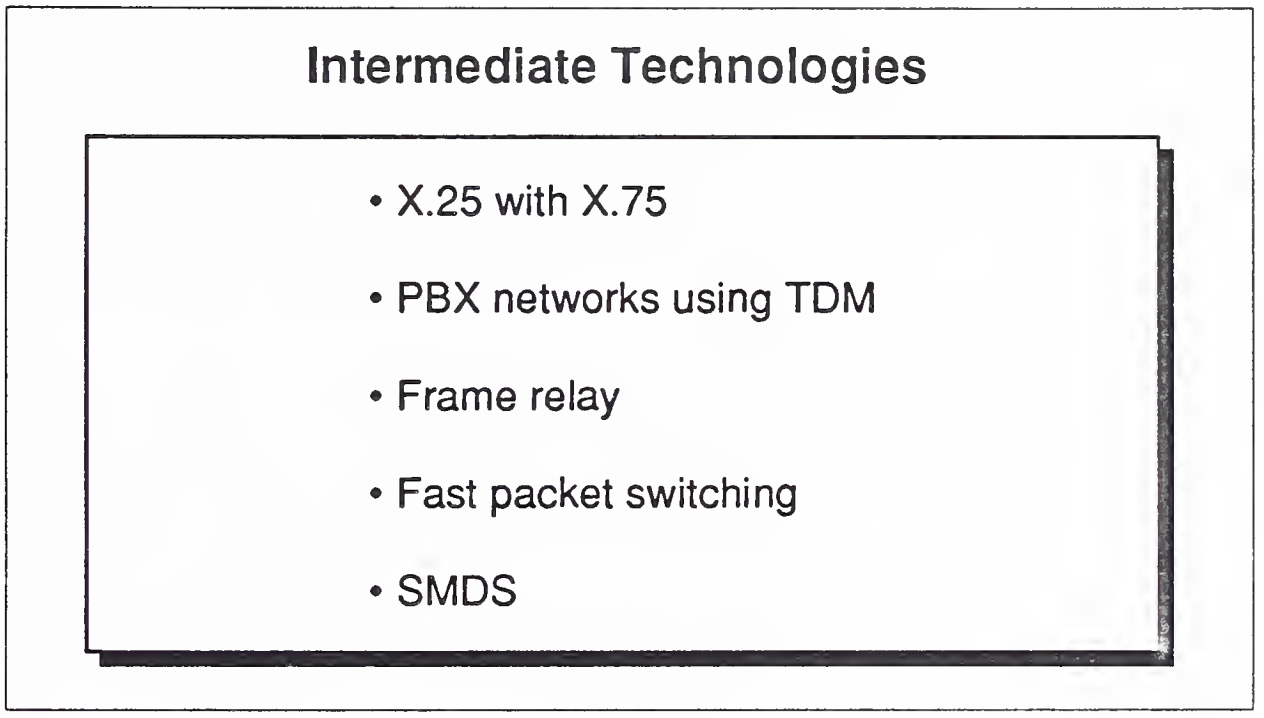
To paraphrase Voltaire, if ISDN did not exist, it would be necessary to invent it, hence the interest of large networking users in building their own integrated corporate networks based on digital techniques. Exhibit II-5 lists some of the technologies used by major organisations to implement digital networking. These can be implemented individually or together:

- One technique may be more suitable for data than voice or vice versa.
- Migration of applications may require the use of more than one technology at a time.

Key characteristics of the 1991 corporate networking environment are:

- Integration as a bandwidth management tool (saving transmission costs) rather than to support multi-media applications,
- Integration of logical networks across one physical backbone,
- Popularity of the TDM backbone with its heavy emphasis on voice,
- Increasing use of X.25 packet switching, even alongside SNA, as a data application protocol,
- Increasing interest in frame relay as a new technique to optimise networking for both data and voice,
- Growing requirement to interconnect LANs, now router technology has come to market,
- Increasing interest in the outsourcing of networks from competent external service providers.

EXHIBIT II-5



It is impossible to predict the long-term future of the adoption of networking technology except to say that many technologies will remain in use at the same time:

- Narrowband ISDN needs applications and agreed application interfaces (to facilitate application development) before its take-up level will increase greatly.

- Broadband ISDN will become of increasing interest to large users if it becomes widely available.

- The use of the public network services (at different levels of capability—managed, enhanced and tailorable) will become of increasing importance in implementing enterprise-wide networking through hybrid (private/public) solutions.

- Frame relay, fast packet switching and metropolitan-area network services will become part of vendor offerings from PTOs, independent VANS providers and systems operations vendors.

Some of these new technologies are examined in detail in this study and their implications for services assessed.

E

Convergence of the Fixed and Mobile Networks

The market for mobile communications has expanded significantly during the 1980s:

- Up to that time the state of mobile wireless technology had restricted the market to distinct classes of users, notably: utilities, public services and taxi cabs as vertical sectors; and chairmen, chief executives and VIPs as a cross-industry sector. Applications were restricted to telephony.

- The advent of cellular technology has expanded the range of vertical and horizontal sectors which can make use of mobile communications. This has happened because cellular has lowered the cost of entry to around and now below $1,000 per voice terminal, expanded the geographic coverage to the national network level and at the same time made internetworking between the mobile network and the PSTN a standard feature.

- Applications involving the use of voice, data and image (fax) are now emerging, which require the development of vertical sector products and services, including:

  - Specialist data networks with store and forward capability tailored to the requirements of transportation sectors,
  - Network integration projects designed to enable easier and faster data capture from field workers of various types: service engineers, construction workers, sales forces.

INPUT forecasts that the 1990s will see the emergence of many combined voice/data applications using new mobile communications technologies. The applications will require a whole range of software and services projects to manage their implementation and to support their operations.

Exhibit II-6 lists some of the applications which are currently emerging across Western Europe to fulfil the requirements. Because of the multimedia nature of the majority of these products and services—e.g., alphanumeric paging, in vehicle messaging, mobile access to online databases—they are fuelling the long term need for the ISDN public network.

EXHIBIT II-6

Applications in Mobile Communications

- Alphanumeric paging including voice messaging
- Mobile data systems/services with store and forward
- Vehicle location and messaging via satellite links
- Pan-European services
  - Cellular
  - Paging
  - GSM
  - EUROMESSAGE, ERMES
- In-vehicle ISDN terminals, e.g., emergency systems
- Public access systems and PCNs

F

Complementarity of Terrestrial and Space Communications

The use of telecommunications satellites to handle long distance network trunking needs—e.g., transatlantic links between New York and the European capitals—expanded dramatically during the 1960s and 1970s to such an extent that this new technology threatened to supplant the century old technology of communication by submarine cable. Increasing use of satellite technology went hand in hand with a decreasing price curve. Between 1970 and 1980, for example, Intelsat's per circuit annual leasing rates fell from $20,000 to $5,000, but then stabilised at around that level.

The deployment of optical fibre cable in place of traditional copper cable has altered the balance of market forces back towards favouring the fixed terrestrial network as the principal long distance transmission medium. A number of forces are currently at work:

- Costs, including insurance costs, of satellite launching have increased due to the growing sophistication of the requirements.
- Geostationary satellites introduce an annoying 0.25 second delay into all transmissions.

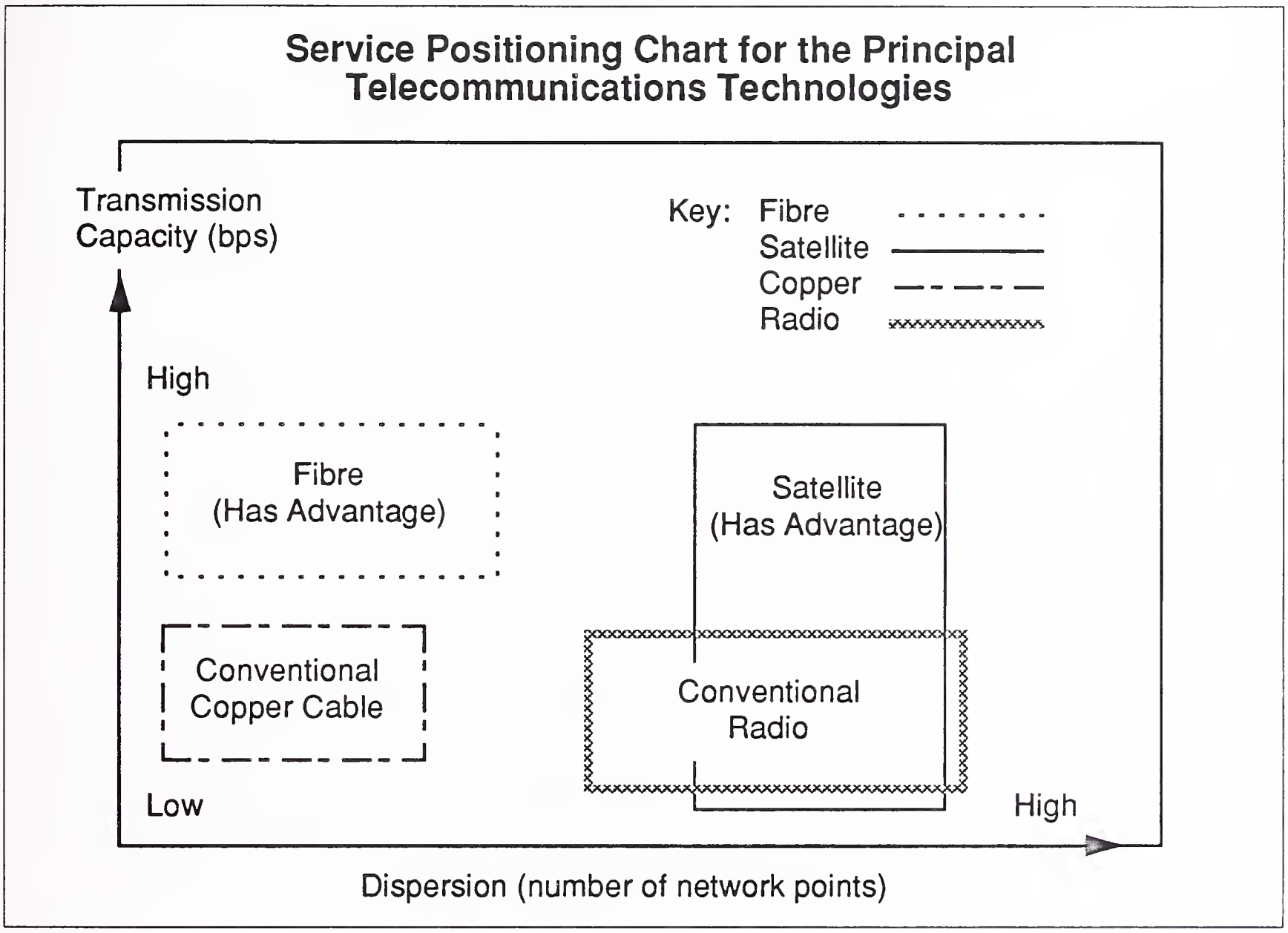
- Deregulation of the terrestrial networking environment in the U.S., the U.K., and Japan and (to a lesser extent) continental Europe threatens to cause an increase in the number of competitive offerings using submarine fibre optic cables across the Atlantic and other transoceanic routes. This competition will increase still further, and by the mid-1990s, overcapacity and consequent price decline will threaten the profits of the transoceanic cable operators and service providers.

- There has as yet been little liberalisation of the satellite telecommunications field in Western Europe, although service providers are pursuing a strong policy of opposition towards the regulatory situation which currently favours the PTOs, and the European Commission is demanding reform.

INPUT predicts that further liberalisation of the satellite market (particularly allowing independent vendors to provide up links as well as down links) will come about by 1995. This will stimulate the emerging markets for VSAT two-way links and services, which will form "by pass solutions" for large corporate networks and for the mobile communications applications being integrated into them.

Exhibit II-7 illustrates the sector positioning of the major transmission media available to corporate network managers and service vendors during the 1990s. Although there are areas of competitive overlap, the amount of complementary between technologies will come to be increasingly important as global networking grows to require a higher degree of resilience.

EXHIBIT II-7



G

Conclusions and Recommendations

1. Conclusions

The traditional role of the network has been to support the operations of any organisation. This role is continuing, but at the same time evolving into a more positive role as an enabler allowing applications to be supported which could not otherwise have been achieved. EDI, for example, supports JIT manufacturing, but acts also as an innovator forging closer links with trading partners and allowing for full electronic commerce and totally paperless transactions.

The new technologies are both hardware and software based. They have in common the objective of faster transmission of data. As data transmission speeds increase, multi-media applications become a commercial possibility for the average business. In particular, image and graphics data storage and transmission can be handled cost effectively. Some multi-media applications have been developed, but the field is still the

province of the specialist. More applications are required before the sector for multi-media communications can be expected to grow to a significant size.

ISDN was conceived to handle various information media, and to support multi-media and cross media applications. Public ISDN services have been under development for the last 15 years and have still only been implemented in a minority of countries and usually only over part of a particular country's geography. Private integrated networks in large corporations make use of tailored ISDN-like facilities, thus demonstrating the requirement for ISDN.

Technology impact is stimulating competition. The network services market contains a number of layers of service corresponding to the sophistication of the user needs:

- Basic transport,
- Managed network services,
- Enhanced service or VANS (value-added network services),
- Applications services and electronic information services.

Increasing competition is intensifying the fight for market share. Boundaries between different types of vendors are beginning to get distinctly blurred, and some market segments are increasingly mature and even becoming saturated. INPUT's research is tracking the performance and prospects for five separate vendor groups:

- Public telecommunications operators (PTOs) and other common carriers (these latter are mainly of U.S. origin),
- Computer equipment vendors,
- Value-added network service (VANS) suppliers,
- Networking equipment suppliers,
- Independent systems integrators and professional services vendors.

It is still unclear which type of background is most suitable for each of the emerging sector markets:

- ISDN applications,
- Combined voice/data messaging applications,

- Network management services,

- Enhanced transport services.

INPUT's study, *User Issues in Network Services, 1991-1996,* contains an analysis of user perceptions of vendor suitability. However, the market is open for the seizing of leadership positions. Exhibit II-8 summarises these conclusions.

2. Recommendations

It is imperative that large vendors from each of these five groups should go for the leadership role in the global market context. All vendor types have much to contribute. Alliances of a strategic nature will, however, be required. No one vendor can cover every angle of the future global network services market.

Adopting the correct positioning stance must go hand-in-hand with understanding the user perceptions of their current positions. Even the largest vendors can only change user perceptions slowly.

Emerging markets based on new technologies will divide between two different approaches:

- The systems operations approach will be suited to network management and maintenance contracts.

- Systems integration skills will be in demand at key decision points as technologies get brought to market. These areas will be of interest to a wider range of players.

It is, therefore, vital that vendors decide on both the positioning of their services and make a choice between a systems operations and a systems integration focus.

EXHIBIT II-8

Conclusions

- Role of the network:
  - Supportive (traditional)
  - ENABLING (lead role for the 1990s)
- New technology:
  - Faster transmission
  - Multi-media
- ISDN—private and public
- Convergence competitive
- Leadership role available

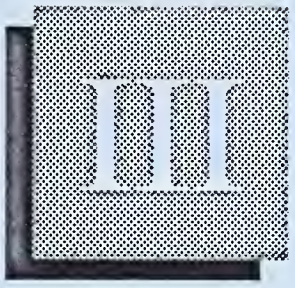
Understanding the position and status of the individual network manager functions within large organisations will be key to the account selling success achieved with these users. Understanding the status of networking within the industry sector will be the key to repeat sales among medium-sized companies. In both cases, the emerging role of the network as a business application enabler means that the marketing accent should be placed firmly on the business consultancy strengths of a firm's operations.

Exhibit II-9 lists INPUT's vendor recommendations.

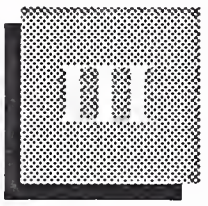
EXHIBIT II-9

Recommendations

- Perceived positioning
- Systems operations vs. systems integration focus
- Account knowledge and industry expertise
- Emphasise business consultancy



Market Analysis and Forecast



Market Analysis and Forecast

A Introduction

The convergence of computing and communications technologies and the strong impetus towards the deregulation of national telecommunications monopolies have led to the opening up of many new network services. However, the relative newness of some of the technology being used and of the liberalised or semi-liberalised environment within which it must operate has created a confused and potentially chaotic situation for both users and vendors.

The network services sector is currently a high growth and competitive market offering a plethora of new business opportunities. Networks provide the highways for carrying the information which will become increasingly important for future development within Western Europe.

The whole economic environment is becoming more demanding and challenging. In the more competitive conditions, networked electronic intelligence is becoming increasingly important as a strategic tool. The growing uses and capabilities of network services are being further enhanced by the wide availability of powerful personal computers with communications capabilities as well as by the acceptance of open system standards in place of proprietary.

On the supply side, the activities of many leading national and international vendors are providing considerable market stimulus. The level of merger and acquisition activity and the development of strategic alliances is developing market presences both nationally and on a pan-European basis.

The impact of new technology on network services supply and demand has been pervasive: digitalisation, fibre optics, mobile communications and satellite technology are all the access to sources of information—databases, knowledge and image banks, for example—and thus expanding the available range of services that can be provided.

It is therefore particularly important at this time to define the components and structure of the network services market as precisely as possible. Only by developing a good understanding of the principal service elements can vendors fully exploit the fast growing opportunities available.

B

Market Definition

The overall hierarchical structure of the network services market as defined by INPUT is shown in Exhibit III-1. The network applications services (NAS) sector comprises the following types of services:

- Value-Added Network Services (VANS). VAN services, sometimes referred to as enhanced services, are network transport services which provide such functions as automatic error detection and correction, protocol conversion and store and forward message switching in addition to the provision of basic network transmission facilities. Protocol conversion, error correction, packet switching, store and forward, system monitoring/management are the principal types of services defined in this category.

- Electronic Data Interchange (EDI). Application-to-application exchange of standardised business documents between trade partners or facilitators.

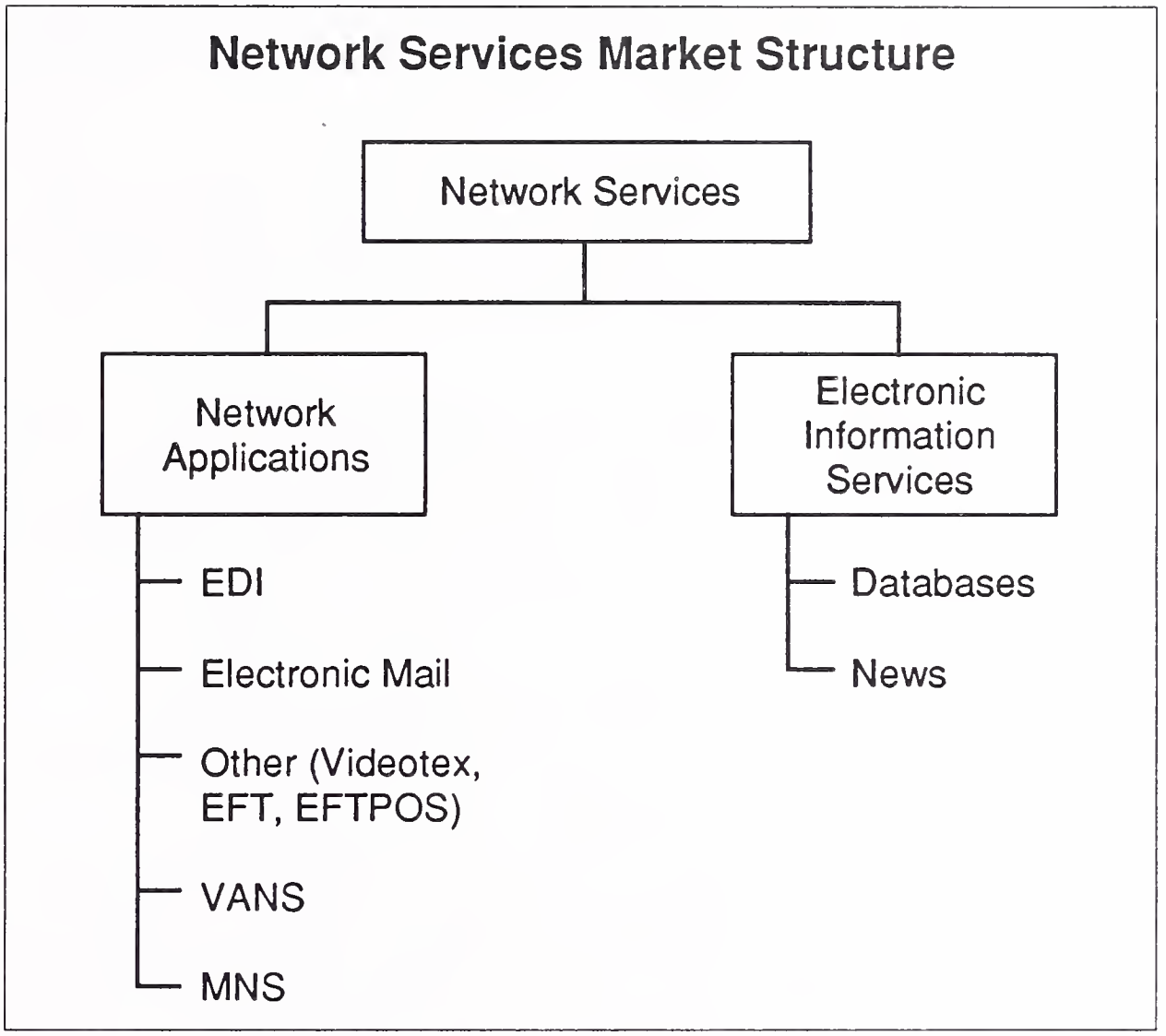
- Electronic Mail (E-mail). Also called electronic information exchange (EIE), the E-mail application involves the transmission of messages across an electronic network managed by a services vendor. It is increasingly being supplemented by services involving other media, e.g., fax, telex and teletex, and voice messaging. This class of service is now dealt with under the general title of messaging or message handling services.

- Other Network Services. This category includes videotex and other specialist or proprietary interchange services such as EFT or EFTPOS.

  - Videotex is more a delivery mode than an application. Its prime focus is on the individual as a consumer or in business. Videotex services provide interactive access to databases and offer the inquirer the capability to send as well as receive information for such purposes as home shopping, home banking and travel reservations.

  - Network management services included in this category must involve the vendor's network and network management system as well as people. People-only services, or services that involve the management of networks as part of the broader task of managing a user's information processing functions are included in the systems operations sector. Network management services are specific functions related to the management of the physical network itself and not to the traffic (data) transmitted across it.

EXHIBIT III-1



The Electronic information services (EI) sector comprises databases that provide specific information via terminal-based inquiry, including items such as stock and equity prices, legal precedents, economic indicators, periodical literature, medical diagnosis, airline schedules, automobile valuations, etc. The terminals used may be computers, such as communications servers or personal computers. Users typically inquire into and extract information from the databases. Although users may down-load extracted data into their own computer systems, they cannot update the vendor's databases.

The two kinds of electronic information services are:

- On-line Databases - Structured, primarily numerical data on economic 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 networks, there is a growing trend towards the use of CD-ROM or optical disks to support or supplant on-line services. These optical disk-based systems, together with other off-line access media used to transfer

electronic information from vendor to user, such as magnetic tape and magnetic diskette, are included in the definition of EI under this delivery mode.

C

The Layered Market Model

Increasingly, INPUT is aware of a trend in the systems market towards the separation of the computer systems platforms and the applications that run on them.

As large systems particularly become more complex and more layered, and as the user interface becomes more standardised, this trend is likely to increase. Exhibit III-2 is a diagrammatic representation of this layering of the user's perspective on the information services element of the company's business. Four levels or layers of activity are identified, working from the bottom upwards:

- The basic computer equipment platform.
- The operating system software required to provide the processing environment.
- Applications enabling software, such as languages, system development tools and database management systems.
- The applications software, either developed in-house or purchased as a product.

The first two layers comprise the more easily defined and more easily standardised part of the systems. Together these two form an area which can be considered as an environment or 'virtual platform.'

Analogous to the separation of the functions into layers for the information services element, as shown in Exhibit III-2, is that for networks. The equivalent separation for networks is expressed diagrammatically in Exhibit III-3.

In the case of a network, the distinction is made between the network infrastructure and the traffic that passes through the network. There are again four levels of activity in total:

- The basic platform consists of the bearer services, essentially the physical communications pipelines that are operated by the authorised telecommunications operator.
- Network management is the set of functions concerned with the establishment, integration and control of the network itself and not the traffic that is transmitted over it. These services have been traditionally measured by INPUT as the managed network services (MNS)

sector. They may be provided by PTO or independent provider networks.

- Enhanced services add value in some specific way to the basic transmission activity, e.g., store-and-forward, error connection and protocol translation. They are essentially related to the traffic using the network, since they are normally provided for individual customers to support particular applications. They may be provided by PTO or independent provider networks.

- The network applications are concerned with the fundamental objective or purpose for which traffic is transmitted—for example, electronic mail, electronic data interchange (EDI), or electronic information services (EI).

Exhibit III-3 also:

- Numbers the layers, in accordance with a convention used in this programme, from 1 to 4.

- Gives a gross market size for the anticipated user expenditures in Western Europe on each layer (level) in 1991.

- Shows a short-term (1990-1991) sector growth rate for each service layer.

EXHIBIT III-2

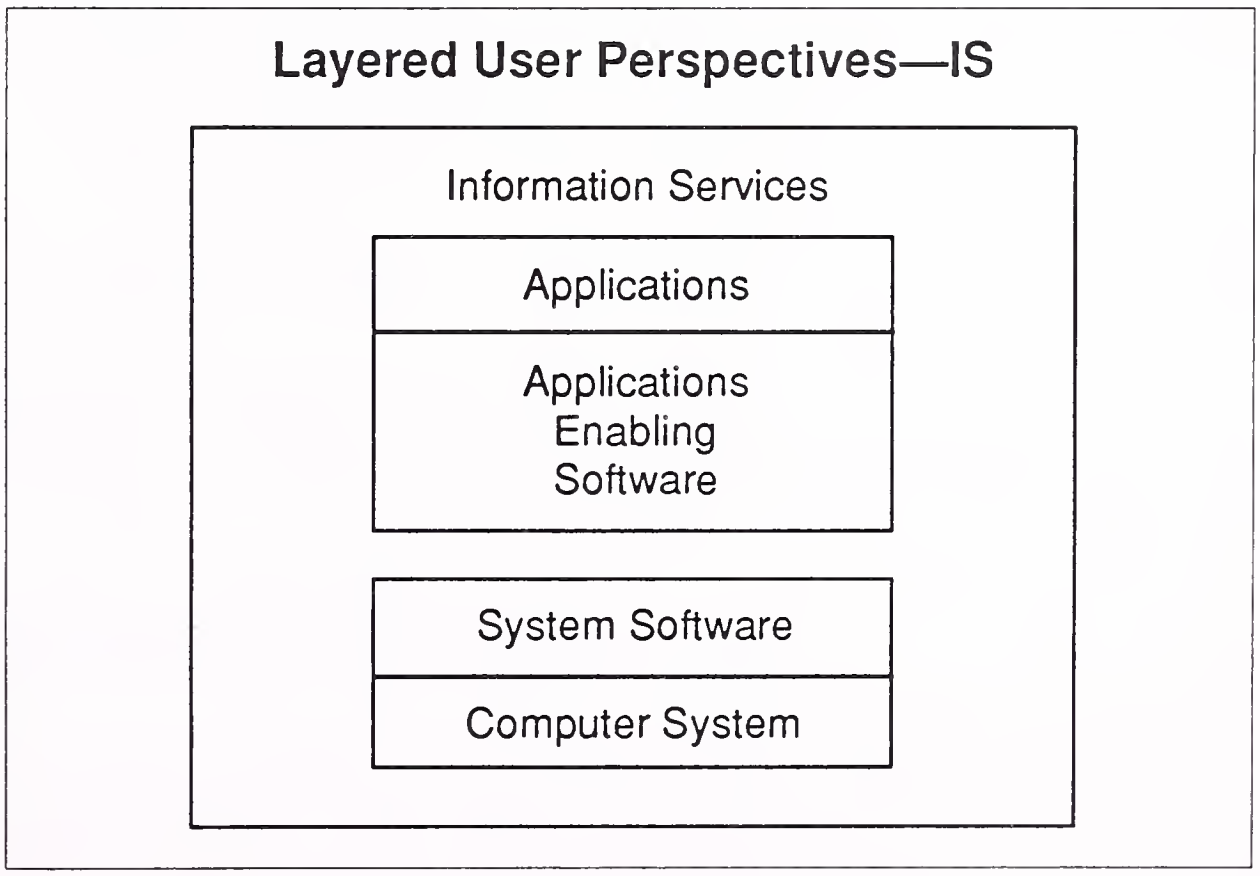


EXHIBIT III-3

A Layered Market Model for Network Services

Layer	Market Size 1991 ($B)		1990-1991 Growth Rate (Percent)
		Traffic-related	
4.	3.7	Network Applications/EI	25
3.	0.2	Enhanced Services (VANS)	20
		Infrastructure-related	
2.	0.5	Network Management Services (MNS)	28
1.	8.6	Bearer Services	13

D

Network Services Market Growth

The table shown in Exhibit III-4 gives INPUT's latest market forecast for each of the major service subsectors included in the scope of the Network Services Programme, as well as for the lowest level of service (Bearer Services - layer 1), which is currently excluded from the programme.

The major points of interpretation from this chart are:

- The upper layer (layer 4) is dominated by the reasonably mature EI subsector. Due to the much higher growth rates forecast for the established but still immature sectors—such as E-mail, EDI and EFTPOS—forecast during the five-year forward period, EI will lessen its hold on this level of the market.

- Enhanced services (VANS) will remain the smallest sector due to the enterprise-specific nature of the services rendered to companies by this submode.

- Network management services will remain in its current third place in terms of sector size, but having the second-highest growth rate (of around 29% pa), it is obviously a significant sector to address. A major inhibitor to this sector could well prove to be the lack of services considered viable in users' eyes. The demand/requirement is certainly there.

- Bearer services are largely the preserve of the PTOs (and traditionally provided on a monopoly basis). In spite of the wave of deregulation (which is creeping rather than sweeping across Europe), the publicly owned telecomms operators will, for the forecast period, remain the largest players in this sector. However, over the next five years and beyond, the bearer services market, being the largest sector, will continue to engage the majority of the resources of its traditional vendors.

EXHIBIT III-4

Market Forecast Network Services, 1991-1996

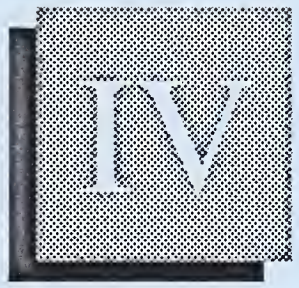
Subsector	User Expenditures ($ Billions) 1991	1991-1996 CAGR (Percent)	1996
Electronic Information Services	3.1	20	7.7
Network Applications	0.6	46	3.7
Subtotal Layer 4 (NAS)*	3.7	25	11.4
Enhanced Services (VANS)	0.2	20	0.6
Network Management Services (including MNS)	0.5	29	1.8
Subtotal Layers 2-4 (NSP)**	4.4	26	13.8
Bearer Services	8.6	13	16.1
Total	13.0	18	29.9

*NAS = Network Application Services

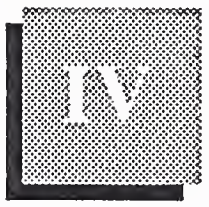
**NSP = Network Services Programme coverage

The technology analyses given in later sections of this document will all be related back to the growth opportunities in each layer in the INPUT model, as well as to those in any associated service areas, such as:

- Professional services,
- Software products,
- Processing services.



The Emerging Technologies



The Emerging Technologies

A Introduction

The objective of Chapter IV is to cover the range of new and emerging technologies which are appearing in the network bandwidth market and which will come to dominate the networking scene during the 1990s. The struggle to extract the maximum bandwidth from current and future technologies, coupled with the desire to maximise the usage of the existing installed network bandwidth, is key to the decisions facing both network managers and their superiors in general and IS management.

Two terms are clearly visible and tend to oppose each other:

- Heavy data communication loads are anticipated from new applications, such as LAN interconnections and image processing.

- Increased capacity and competition for business in certain routes, key to the profitability of many major vendors, are likely by mid-decade to be causing over-supply with consequent price collapse.

Bandwidth management will remain the key issue during the forward five-year forecast period, to be replaced during the second half of the decade by the need for more effective bandwidth marketing as over-capacity on key international routes, such as the transatlantic routes, starts to exert an influence on global networking prices.

Solutions based on a variety of technologies, new and old, will maintain the heterogeneity of most large user networks.

This feature is not opposed by network managers for two reasons:

- Dealing with a variety of systems from a number of suppliers has been traditional in the networking field,

- Network managers have seen the vulnerability of their IS colleagues who become locked in to a single proprietary set of solutions.

Nevertheless, the push towards the adoption of open systems standards has been endorsed by the user community with two important reservations.

- It is the IS management which needs open standards, in order to enable easy implementation of new applications,

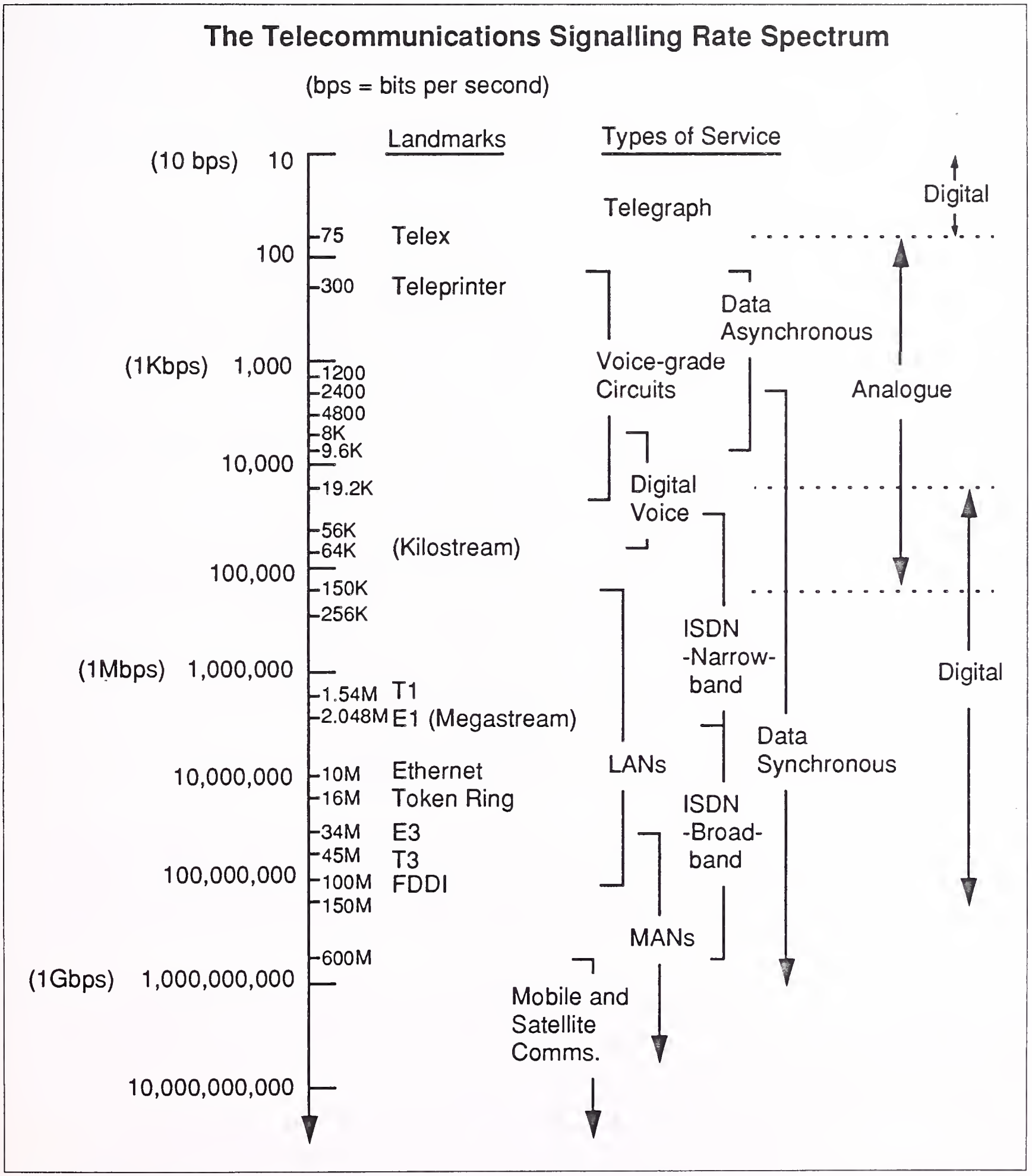
- Network infrastructure managers know that immediate solutions are required of them. There is not time to postpone projects while standards-making catches up with today's requirements.

Exhibit IV-1 illustrates the bandwidth spectrum within which the various solutions compete for user attention:

- Wide-area networks (WANs) operate across this spectrum from the slowest telegraph channel connections right up to the giga-herz frequencies of mobile and satellite communications,

- LANs and MANs have tended to work in comparatively restricted parts of the spectrum. These network types and their applications are, however, what is driving the quest for increasing bandwidth provision.

EXHIBIT IV-1



B

The Basic Network and ISDN— The Challenge of a New Infrastructure

The world's business community has become used to the presence of a basic global voice network—the telephone network or PSTN (public switched telephone network) to give it its usual acronym. Although less developed countries in the world can sometimes only be reached by the older digital telegraph technology of Telex (the only other truly global switched network), most business men (and households too) have come to regard the PSTN as a fact of life. Commercial life would be unthinkable without the immediate person-to-person interconnection which its existence implies.

For the first 20 years after computer communications were conceived, this basic network has also been used as a major carrier vehicle for many data communications. Because of its basic deficiencies as a medium for non-voice communications, however, technologies, both hardware and software based, have emerged to offer the data comms user a better set of tools:

- Leased lines dedicated to individual customers have grown in numbers and usage, such that they now account for over a third of PTO revenues world-wide.

- Digital signalling has been introduced to replace the obsolescent analogue techniques. It is now available on leased lines and in the trunking links of all major public switched networks. Digital switches are the standard for modern public network exchanges.

- Specific signalling and switching products, e.g., X.25, have emerged to cater to the particular needs of the data communications user.

The growth of computer-based communications has consequently had two key results for the evolution of the PSTN:

- On the one hand, the data comms user community has migrated away from the PSTN as the main-stream network for data—either into leased line private networks or onto specialised public data networks (PDNs) or into use of a combination of these two solutions (the hybrid network solution, as it is known).

- On the other hand, the viability and efficiency of the PSTN have undergone steady but slow improvement, but not such as to allow it to break out from its main role as the carrier of basic person-to-person voice communications.

In the mid-1970s, the CCITT (Comite Consultatif International des Telephones et Telegraphes), as the world body responsible for international wired telecommunications, conceived the idea of a new global switched network provided by the PTOs in the same manner as the PSTN. The new network was to be designed to overcome the limitations

of the existing voice network. This new network concept was given the name ISDN (integrated services digital network).

Since that time, ISDN has advanced slowly towards its goals:

- To provide a world-wide public network capable equally well of handling all information media—voice, text, data and image—in an integrated bandwidth pipe,

- To provide a network which is capable of eventually replacing the existing PSTN,

- To do all this in such a manner as to allow for easy migration of applications to the new network,

- To price the new network in an equivalent (though not necessarily equal) way to the PSTN charging mechanism, i.e., with an exchange line installation cost and a call cost, dependent on zoned distance.

Exhibit IV-2 summarises the features which have emerged through the many thousands of man-hours expended by the committees of the standards-making bodies during the past 15 years. Important features to note are:

- ISDN has, as a concept, already spawned a further stage of development beyond its initial implementation. This is known as broadband ISDN or B-ISDN for short.

- Current implementations of ISDN are thus known now as narrowband ISDN and are based on the key quantum of signalling spectrum set at 64kbps.

- Two levels of service have been defined for narrowband ISDN:

  - Basic rate service (known in acronym form as 2B+D) provides 2 x basic transmission or bearer channels (the Bs) which each offer 64 kbps speed and l x data signalling channel (the D) operating at l6 kbps.

    Besides undertaking its role as a carrier of network control signals, the D channel can fulfil a number of data transmission roles. The D channel, for example, can support packet-switching and is expected to be useful for small-volume on-line applications, such as credit card authorisation or slow speed telemetry.

  - Primary rate service (known as 30 B+D) provides more channels, again each of 64 kbps—this time 30 x transmission channels and l x data signalling channel.

- The major problem with the introduction of ISDN is encapsulated in the phrase "chicken and egg":
  - ISDN needs intelligent or 'smart' network applications to justify its investment to the infrastructure supplier and user alike.
  - Users need vendors to have supplied the infrastructure before they embark on ISDN applications, while vendors need to be assured of user demand before making the infrastructure changes needed.
  - The market is thus caught between the three-pronged requirement of the user, the vendor and the software applications.

EXHIBIT IV-2

Key Market Features

- ISDN is an advanced public switched network
- Not just for voice, but for data, image, text, video and any combination
- Current commercial offerings are narrowband:
  - Basic Rate (2B + D)
  - Primary Rate (30B + D)
  - 1B = 64 kbps
  - 1D = 16 kbps
- Principal European coverage:
  - France (NUMERIS is the ISDN (or RNIS) network)
  - Germany
  - U.K. (ISDN2)
- Requires "smart" applications, e.g., cross media
- Key strength: same usage charge structure as the PSTN

Exhibit IV-3 lists the main drivers and inhibitors affecting the narrowband ISDN market. INPUT believes that the main protagonists of the technology have seriously underestimated the marketing effort required to launch ISDN services.

The major country PTOs in Europe have made serious commitments to the eventual full implementation of ISDN services, but—with the exception of France, where the basic rate NUMERIS network has almost complete national coverage, and the U.K. with the ISDN 2 service—the implementation is patchy in geographic terms, being confined to areas of the countries where demand is estimated to be highest:

- The U.K. is on a second generation of system—ISDN 2 and ISDN 30—but its features have not yet enticed many business users to enter the IDSN camp.

- Germany has limited coverage around major conurbations and cities, but appears more interested in MANs (metropolitan-area networks) and wide area packet switching, with the leadership in B-ISDN coverage a clear target for DBP Telekom.

- Other countries in Europe have prepared useful ISDN programmes, e.g., the Netherlands and Italy.

- The EEC sees ISDN as a key strategic application enabler and is actively encouraging ISDN take-up as part of its ONP (open network provision) programme.

EXHIBIT IV-3

Key Market Forces

Drivers	Inhibitors
• Need for voice/data integration	• Complete range of new standards to be agreed
• CEPT, EEC, CCITT & ISO backing	• Coverage uneven
• Migration strategy in-built	• Gaps in tariffing
• Levels of service	• Technical talk
- Narrowband	• Hype
° Basic rate access	• Alternative in-house solutions
° Primary rate	
- Broadband	
• Stress simplicity	

In Exhibit IV-4, INPUT compares the main characteristics of ISDN and the PSTN it replaces. The key feature, mentioned earlier in this analysis, is that ISDN provides for end-to-end (or desk-top to desk-top) digital characteristics.

Applications which can benefit from ISDN are:

- Digital back-up for leased lines in order to ensure no session service breaks occur.
- Interconnection of local area networks for file transfer when the volume of traffic is low to medium-low.
- Applications requiring calling number identification (CNI) such as automatic call distribution (ACD) and similar sales and telemarketing orientated applications.

- Teleconferencing involving data, voice and video.
- Group 4 fax (a popular application of ISDN in Japan).
- ISDN can also act as a messaging and EDI enabling technology, particularly useful to smaller businesses in which partial computerisation causes a need for conversion from one medium to another, e.g., from EDIFACT coded messages into fax or into voice, even for voice-message archiving of EDI associated E-mail transmissions.
- Low speed telemetry and surveillance applications.
- ATM networks.

EXHIBIT IV-4

Comparison of Main Network Features

ISDN—Narrowband	PSTN
• Digital to the desktop	• Analogue user interface
• Standard 64 kbps or multiples/submultiples	• Voice grade circuits up to 19.2 kbps maximum
• Circuit-switched or packet-switched	• Essentially circuit-switched
• Designed for multiple media	• Designed for voice
• Growing coverage	• "Universal" coverage
• Needs to be here	• Needs to be superseded

Benefits which accrue to the user of ISDN are:

- Quicker call connection and set up.
- Cleaner lines end-to-end, even for straightforward voice communication, since ISDN implies digital lines end-to-end.
- Savings in PABX hardware through the elimination of analogue circuitry. One supplier estimates this could eventually be as high as a 30% savings.

- A single intrabuilding wiring system for all types of connection, hence savings in wiring costs and building space.

- International internetwork switching.

- Improved administration and billing in the public network.

Drawbacks to the use of ISDN and delays in offering services have dragged out its implementation over 15 years since the mid-1970s. Its extensive use is still being postponed (by the forecasts of industry specialists) well into the mid- and even late 1990s. Areas of difficulty which occur are:

- Coverage by PTOs is restricted initially to the geographic areas in which they estimate take up will be most rapid and, therefore, most profitable.

- Different national interpretations of the CCITT and ISO standards have emerged as some PTOs have raced to pre-empt the standards making exercise by de facto on-the-ground services.

- Different levels of service are priced differently in each country implementation.

- ISDN features are required by the marketplace, but not all users are willing to wait for standards and tariffs to be laid down. Hence, alternative in-house solutions have inevitably evolved and are now being implemented instead of ISDN.

- The development of higher bandwidth transmission and switching standards under the broadband ISDN (or B-ISDN) label have caused some users to plan for the later broadband technology, relegating narrowband ISDN to the level of a technological cul de sac.

INPUT believes that the main goal of the ISDN initiative (to provide end-to-end digital networking for all subscribers) is a commendable goal and will be eventually implemented through a combination of routes and via an uneven patchwork of intermediate services. The opportunity to offer small business and even single-line subscribers the facilities of ISDN will be one of the last objectives to be satisfied. In the meantime, other technologies and non-ISDN standards will be of interest to the corporate network managers, with public ISDN of minor influence only, but increasing as ISDN coverage becomes significant.

The types of service offered to users during the continuing period of growth of the ISDN network will depend on the background of the supplier:

- PTOs involved in ISDN implementation should market to users and end users a range of professional services products aimed at establishing ISDN migration strategies: consulting on and designing individual ISDN network applications, assisting users in the design of ISDN application programming interfaces (APIs), furthering application possibilities and market awareness by education and training products, as well as promoting the development of standard APIs as part of their standard setting work.

- Network and computing equipment suppliers should be developing specific software solutions for ISDN applications, using alliances and joint ventures with software product suppliers and software publishers. In this way, they will be able to market total solutions to a wide range of existing and potential users.

- The independent network service (or VANS) providers have the ability to offer ISDN-like facilities ahead of the PTOs through judicious use of emerging technologies to provide customised VPNs (virtual private networks) and interconnection between these and other technologies. VANS providers will be presented with a range of market opportunities to assist users in migration between one generation of network and another. These migration facilities should include:

  - Testing of new networks.

  - Network management during user transition periods.

  - Alliances with PTOs to assist in coverage of areas in which ISDN is not yet available.

  - Education and training products for ISDN applications.

  - Professional services to back up the other products.

- Professional services and FM (facilities management) vendors will have greatest flexibility in being able to offer ISDN and non-ISDN solutions to corporate users and end users. They will be able to address the transition and migration requirements of users that know what type of solution they require. They are also in a position to offer total solutions to the type of user that looks to an outsourcing supplier to take over technical and operating problems in their entirety.

All vendors must start to see ISDN in terms of applications and solutions, instead of marketing its benefits purely from the technical angle.

C

Developments in Trunking Technology

ISDN was conceived within the CCITT to allow users to gain access to the new and improved digital services of the future. The implementation of this design was to be achieved through the establishment of a set of standards covering the user access interface to these services. The services would then be able to evolve behind the agreed access interface.

Inevitably, the implementation could not be achieved as harmoniously as the original designers might have wished. Standards are always difficult to agree and while disagreement lasts, local variants flourish.

Quite apart, however, from the access standards issues, there has been an added stimulus to the development of the trunking technologies which were needed to handle ISDN type services—whether on public or on private leased-line networks. Two types of developments have been taking place, with a number of important objectives:

- To allow much higher speed transmissions on terrestrial links, i.e., at least up to 600 Mbps and even up to 2.5 Gbps using fibre optic cable.

- To handle high-volume, bursty data (such as occurs during datafile transfers) as easily as delay sensitive data (such as occurs in digital voice communication).

- To improve bandwidth utilisation, bearing in mind that as much as 60% of a normal voice conversation is in fact silence and that the equivalent figure for data communications can go as high as 90%.

The two development areas can be classified into:

- Developments in transmission links that are hardware based—such as the use of microwave line-of-sight techniques, satellite links and increased submarine cable capacity across transatlantic and other transoceanic routes in which fibre optic technology is now replacing coaxial cable and thus lowering both cable and repeater costs.

- Developments in protocols and switching techniques that are initially software based, but may later come to be reimplemented in silicon once the algorithms have been established as robust enough to warrant the increased speed, cost and risk.

Exhibit IV-5 lists some of the characteristics of the current market place which result from the impact of these technology improvements.

The area in which greatest confusion reigns is that of switching technology. As this impacts both public and private networks, it is of concern to all market players. The main stream of development is in the direction of fast packet switching, a term which is used loosely and thus can itself be one of the causes of confusion.

INPUT sees a technological convergence between the two hitherto opposing techniques of:

- Circuit switching, particularly TDM (time division multiplexing), which has evolved for voice and been latterly used widely for backbone networking in integrated voice and data networks in the private network sector.

- Packet switching, which is now largely centred on the X.25 protocol, the CCITT standard which has been accepted both for public data networks (PDNs) provided by the PTOs and for large scale data networks in the private enterprise sector.

EXHIBIT IV-5

Impact of New Trunking Technologies on Corporate and Public Networks

- Confusion between technologies caused by developments/interactions at different levels of the OSI model.
- Traditional vendor boundaries breaking down—WAN to LAN and vice versa—PABX to data transport.
- LAN/MAN/WAN boundaries breaking down—e.g., FDDI can cover up to a 200 km area.
- Migration strategies important
- Support for "hybrid" (private/public) networking
- Improved error performance—digital circuits

This convergence is caused by the need to find a trunking protocol which (for the integrated networks of the future) combines the advantages of circuit and packet switching, while at the same time avoiding their individual disadvantages.

Fast packet switching is the technique which promises to reconcile these opposites most easily. However, as a piece of terminology it is being confused with the terms *frame relay* and *cell relay*, which are essentially switching architectures, i.e., they define the layout of transmission formats, while a switching technique defines how the formats are processed by the switches in the network nodes.

Exhibit IV-6 compares the basic features of the three switching techniques. Fast packet switching differs from traditional packet switching in a number of ways.

- All packets relating to one session or message are routed on the same route—the virtual circuit principle.
- Switching is simplified (and thus the delay in each node is minimised) by reducing it to a simple decision as to whether to pass the packet (or frame) to the next node in the circuit or to prepare it for output from the network at or via the current node/switch.
- Error correction is undertaken at the end points of the circuit by the higher level protocols.

EXHIBIT IV-6

Comparison of Switching Techniques

Features	Circuit Switching	Packet Switching	Fast Packet Switching
Main Application Area	Voice	Date	Voice, Data or Image
Bandwidth Utilisation	Medium	Low-Medium	High
Speed range (per channel)	Up to 2 mbps	300-64 kbps (or 1,000 packets per sec)	100,000 packets per sec (or up 600 Mbps)
Channel/port use	Dedicated	Shared	Shared
Users	Private networks, some public services (e.g., Transfix, Datex-L)	Private data networks, VANS, IVANS, PDNs (e.g., PSS)	VANS, IVANS, some private networks (U.S.)

This simple switching technique has led to the use of the term *relay*, i.e., pass the packet on or finish with it:

- In the frame relay architecture, packets (or frames) are of variable length and the relay technique can be applied by software.

- In the cell relay architecture, packets (or cells) are short and fixed length (48 bytes is the proposed standard). In this case, the switching can be performed through firmware-based special-purpose hardware with a resulting increase in transmission speed.

Cell relay systems are still at the development stage, but are expected to achieve through-put speeds of up to one million packets per second, due to the low delay overheads in the switches. Frame relay systems are now being installed in certain large users in the U.S. as well as by the independent VANS suppliers and certain PTOs. Frame relay bridges the gap in the throughput spectrum between packet speeds of 1,000 per second up to the lower threshold set for future cell relay systems at 100,000 packets per second. It is effectively an intermediate technology designed to improve network throughput until ISDN trunking standards are fully established. As such, some proprietary frame relay standards are evolving to fulfil immediate user requirements.

Key to the implementation of any fast packet switching is the superior reliability of the all-digital circuitry in modern networks. Without the low error rates of digital circuits, the strategy of postponing error correction to the higher level protocols operating at the end points would be untenable, and this postponement is vital to the achieving of the low switching delays.

Exhibit IV-7 summarises the main performance parameters of the three packet architectures:

- X.25
- Frame relay
- Cell relay

EXHIBIT IV-7

Comparison of Packet Switching Architectures

Features	X.25	Frame Relay	Cell Relay
Packet Length	Variable (up to 128 bytes standard)	Variable (up to 4k bytes standard)	Fixed at 48 bytes
OSI Layer	Levels 1 to 3	Levels 1 & 2	Levels 1 & 2
Error Correction	Done by X.25	Done by higher level of protocols	
Protocol Handled by:	Software	Software	Hardware
Circuit Type	Analogue or Digital	Digital	Digital
Traffic	Data or Text	Voice, Data or Text	Voice, Data, Text or Image
Users	Private data users, VANS & PDNs	VANS, ISDN, some private users	ISDN, PSTN

Exhibit IV-8 compares ISDN—narrowband with frame relay, highlighting the key differences.

Developments are also taking place in what is called the high-order transmission structures. These are part of, and will affect mainly, the PTOs' public networks, in which the physical trunking links will be serving a number of different logical networks and/or leased line channels. SONET (synchronous optical network) and SDH (synchronous digital hierarchy) are two sets of emerging standards whose proponents are working together (SDH is the CCITT version of SONET which started life in North America) to produce a transmission structure capable of forming the basis of a world-wide broadband networking technology. These standards are designed to handle transmission in units of 155 Mbps multiplexed up to speeds of 2.5 Gbps. They will only affect services at the bearer service level of the INPUT market model.

The significance of the new technologies in the switching area differs for users and vendors:

- For users, there will be a number of solutions evolving at different levels in their network structures over the course of INPUT's current five-year forecast period, and beyond to the end of the century. These changes will be occurring in the public networks principally, but they will also offer possibilities for private network builders. The changes will, therefore, affect the trade-offs between private leased line costs and use of the public switched services. This make or buy type of decision is going to become more difficult and riskier. The attraction of an externally managed network service or the use of one of the new breed of virtual private networks (VPNs) is forecast to grow, as a form of counter-measure to the increasing risks involved in running a private or hybrid network.

- For vendors, the market impact of new technologies will be a function of vendor type:

  - PTOs are being forced to upgrade their technologies to cope with the ongoing traffic increase. If voice and data traffic continue to rise at the current rates of 5% pa. and 20% pa. respectively, data (and the new image processing applications) will require the same amount of bandwidth as voice applications at some time in the second half of the decade. Currently, voice accounts for between 70% and 90% of traffic, depending upon which country is under discussion.

  - VANS providers must upgrade their networks to be able to compete with the PTOs in the areas of managed services and network applications. GEIS has already announced its intention to install Stratacom frame relay switches progressively into its network and to mount services which allow users to be migrated across onto this more competitive type of infrastructure while at the same time retaining compatibility with X.25 and SNA protocols.

  - Network equipment vendors, such as Alcatel and Northern Telecom, will need to be actively involved in funding investment of the new hardware and software required to implement the technologies. Profitability will be key to their ability to keep up with the market demands.

  - Computer equipment vendors are liable to be by-passed by the new technology developments because they are not directly affecting their current business areas. Their users, however, will be anxious to acquire better technology to solve the increasing LAN interconnection problem. There is an opportunity here for computer vendors to establish alliances with smaller specialist equipment vendors in order to stay close to this fast changing business.

- Independent systems integrators and professional services companies and consultancies will be offered a range of opportunities including:

  - Consultancy assignments to assist in assessing technology impact,
  - Implementation of hybrid solutions,
  - Advisory work on the take up of new technologies and new products.

- Software product vendors will be given opportunities to develop ISDN applications and access module utilities. In the first instance, they should work closely with and market their product potential to the network and computer equipment vendors.

EXHIBIT IV-8

Comparison of ISDN and Frame Relay

ISDN—Narrowband	Frame Relay
• Essentially a switched network	• Essentially a transmission technology
• Suitable for large, medium-sized and small users	• Useful for private and public networks
• Intermediate to B-ISDN	• Intermediate to cell relay
• Could supersede the PSTN	• Supersedes X.25 and TDM
• Impacts switching, user interfaces and cabling	• Impacts switching and error correction

D

The Impact of Mobile Communications

1. Introduction

Mobile communications is one of the fastest growing sectors of the telecomms industry. The last decade has seen the introduction of a number of new services; most important of these is the cellular network systems which have been successful in the U.K., Scandinavia and, to a lesser extent, in Italy, France and Germany.

Most recently there has been a second wave of new developments:

- The specification and imminent launch of the pan-European cellular service (GSM),
- The ERMES pan-European paging project,
- Second-generation cordless (CT2) phones and Telepoint services,
- A specification for a European cordless system (DECT),
- The award of licences to would-be operators of PCNs (personal communications networks).

2. Cordless Telephony

Cordless telephony (CT) is one of the most recent of these developments and Telepoint services based on this technology have been launched. Earlier (CT1) technology used analogue transmission on a pre-set frequency; CT2 technology, developed over the last decade, uses digital transmission in the 864-868 Mhz range at a power of 100kw.

The initial focus of attention was the potential offered by the business/office market; but for this to become reality some form of cordless PBX is required. Attention has now turned to the public sector and to the domestic/residential market, although in the longer term the business sector will yield the greater number of service opportunities.

Telepoint offers the mass market a public mobile personal communication service, or at least a portable service. Forecasts by technology consultants encouraged all those working in the field, and particularly Ferranti, in the belief that considerable potential exists for a public cordless phone system.

In the U.K., licences were initially awarded to consortia consisting of a variety of major names in the communications field:

- Phonepoint - with BT, STC, NYNEX, France Telecom, Deutsche Bundespost,
- Zonephone - with Ferranti Creditphone on its own,
- Callpoint - with Mercury Communications, Shaye, Motorola,
- BYPS - with Barclays, Philips, Shell.

Since the start-up of the services in late 1989:

- Callpoint and BYPS have announced their intention to merge,
- Hutchison Telecom (U.K.), a cellular radio service provider, will be the vehicle for the acquisition of BYPS by its Hong Kong-based parent, the Hutchison Whampoa group controlled by Mr. Li Ku-Shing. Hutchison also has interests in paging,
- Ferranti has announced that it is abandoning the Zonephone project.

Telepoint has obviously not yet become a viable service product.

The development of PCNs threatened to give added impetus to these developments if only as a result of the enthusiasm and commitment from the various consortia that see this as a way of printing money. Unfortunately for these future service providers, the heyday of cellular services growth is now past. A much more competitive climate exists and will exist through the first half of the decade.

3. Cellular Evolution

Mobile communications have evolved rapidly since the 1950s. The early days of private mobile radio and paging have given way to a range of products and services that encompass:

- Wide-area paging,
- Public-access mobile radio,
- Short range radio,
- Satellite communications,
- Cordless telephony in its various forms.

It has been recognized for some time that the radio spectrum, particularly in the lower frequencies, was a scarce resource. One way of overcoming this problem was to limit the power of the transmissions so that exactly the same frequency could be reused some distance away. This is the basis for cellular radio: the same radio frequencies can be used many times across an area or region without interference between users.

In Europe, the Scandinavians were the first to take advantage of this market opportunity, launching the Nordic Mobile Telephone (NMT) Service in 1981. This was a fully automatic cellular system and has grown rapidly to become the model for many other countries. Because of their early experience, the Scandinavians have been very successful in exporting their technology, and NMT systems have been established in Spain, Austria, Switzerland, Belgium and the Netherlands. Ericsson and Nokia have been the two companies able to take commercial advantage of this situation by supplying equipment and services for the infrastructure in these countries.

The systems established in other countries vary. The U.K. and Ireland have imported a U.S. technology called TACS; the German system has been developed by Siemens, that in Italy by Italtel and the system in France by Matra.

In the U.K., the Government licensed two operators, Cellnet and Racal Vodafone, to provide cellular radio services. These became operational in the London area in 1985, and for the first time in the U.K. there was a mobile communications service generally available to the public.

The demand for cellular services has come principally from the business market. Nevertheless, the systems are designed to provide coverage of most of a country's surface area and, therefore, also represent a consumer opportunity.

Since the launch of a national cellular service, progress in the mobile communication field has been rapid both within the U.K. market and within the larger European arena. Over the last few years developments have been gathering pace:

- The development of a pan-European cellular network to an agreed specification drawn up by a European consortium, Groupe Speciale Mobile (GSM). Cellnet was hoping to be the first operator in Europe to launch a digital pan-European service in July 1991 amidst growing doubts that full GSM implementation would be feasible by the self-imposed target date of 31st December 1991. However, the German system will be the first to introduce a service, in late 1991.

- The development of satellite communication. Use of satellites in non-geostationery orbits for mobile communications in moderate latitudes has led to a series of land-based tests of IMMARSAT's Standard-C satellite communications systems. Its relatively low cost text-based satellite messaging system currently used by small ships is being adapted to support France Telecom's Euteltracs service, aimed at heavy goods vehicle operators.

- The proposed implementation of the ERMES project, a pan-European paging service with roaming facilities.

- The launch of the four-nation (France, Germany, Italy and the U.K.) EUROMESSAGE service, which is a pan-European adjunct to the existing national services, and is designed to fill the gap until ERMES is in place.

- The development of a specification for the planned Digital European Cordless Telephone (DECT) standard, separate and distinct from the U.K.'s CAI (Common Air Interface) specification for Telepoint services.

- The announcement of the award of two PCN licences in the U.K.

- The launch of services from the U.K.'s Telepoint licencees.

4. Telepoint Service

Telepoint is the generic name given to the public cordless telephone service now being introduced in a number of European countries. Using a CT2 handset, callers can make outgoing calls via a publicly located base station as long as they are within some 100-150 metres of it.

The Telepoint base stations are connected to the fixed wire network in a similar way to any residential station. The main difference from a residential base station is that the Telepoint system can identify subscribers and through multiplexing is able to take more than one call at a time. Billing functions and network management are carried out by each network's operating support systems.

The concept of a mass market public mobile personal communications service is essentially a laboratory development. The Telepoint experiment in the U.K. is the first opportunity to test the technology in commercial terms.

The licences issued by the U.K. authorities contain two clauses of particular interest: the Common Air Interface and Inter-System Roaming:

- Common Air Interface (CAI). It had been stipulated that from 1991 all handsets will have to operate on all base stations; until then each of the four licencees had been allowed to operate its own proprietary system. However, pre-CAI users must be fully supported in the transition to CAI.

- Inter-System Roaming. The intention is to allow all Telepoint users to use all public base stations but only subscribing and paying call charges to one operator. This of course raises questions as to the systems to be used and of course the agreements to be reached between operators on such issues as billing, credit control and user authentification. The whole subject of system management then starts to become a major issue.

These same problems apply to PCN systems.

The U.K. remains optimistic regarding the acceptance of the CAI standard by other European PTTs, which would in essence establish it as a de facto European standard. Lack of agreement on frequency allocation, however, could seriously hinder the success of trying to transplant the U.K. initiative into Europe. Moreover, it is increasingly felt that the DECT standard may never get off the ground. It is argued that the CAI

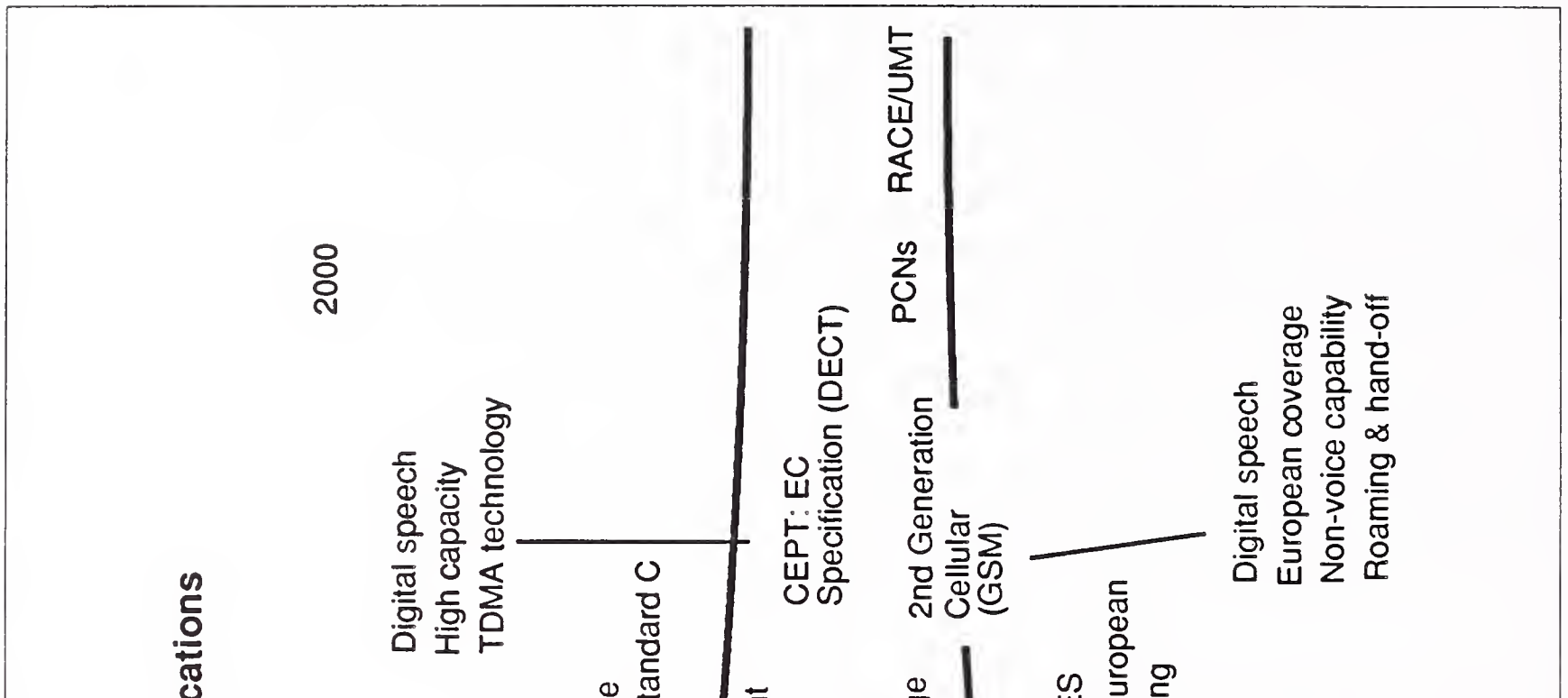
standard can be upgraded to comply with the European DECT standard, and can incorporate future-proofing features. Interestingly, all the manufacturers involved have stated that their long term strategy is to use the 1.6 GHz operating frequency as defined by DECT. According to some industry observers, a 1.6 GHz CT2 product will not be technically feasible before 1995.

It must be borne in mind that the focus for setting standards is increasingly shifting to Europe to take into account the importance of international perspectives in data communications and telecommunications, and the increasing dependence of the business community on reliable and efficient telecommunications networks. This implies considerable cooperation at the supranational level regarding not only the harmonisation of product standards, but also the interworking of networks and the allocation of frequency spectrum for multiple mobile services.

There is no doubt that cordless telephony will ultimately lead to the development of the personal portable communicator. It is the precise evolutionary path that is in doubt.

Exhibit IV-9 illustrates the likely evolution and convergence of mobile communications systems up to the end of this century.

EXHIBIT IV-9



5. Mobile Service Products of the Future

Any mobile communications service (voice, data or a combination) in general fits within an increasingly complex web of communications services which includes:

- Cellular
- Public Mobile Radio/Band III
- Public Access Mobile Radio Networks (PAMR)
- Satellite
- Paging Services
- Payphones
- Voice Messaging

These services revolve around use of either the existing fixed network (wire and optical fibre) or radio frequencies, or any combination of the two.

The process of innovation has led to an overlap of competing services which address particular market requirements. These services have developed along different evolutionary paths, allowing increased application functionality to be built into systems and services.

The situation in the U.K. is different to the rest of Europe, in which the continuance of an uncoordinated policy regarding frequency allocation and product standards has severly impeded the growth of mobile services. Initiatives are, however, under way to rectify this.

Second generation paging, cellular and cordless telephony products and related services open up a whole new array of application areas, primarily due to the performance improvements achieved by the use of digital technology.

- En-route communication with better signal quality than analogue systems.

- In conjunction with the public Telepoint service business, users can combine on-site mobility with the occasional need for off-site PSTN connection.

- Wireless PABX environments to allow mobility within the office environment.

- Complementary facilities between cordless telephony, paging and voice messaging with eventual integration to allow for two-way communication as a possibility.

- In the business environment, it offers a new form of access at the personal level to a whole range of potential information services based on either voice-activated and voice-coded output, or traditional data services via simple telephone key-pads or in conjunction with mobile notebook-size terminals and fax machines.

Two-way messaging services, based on hand-held data terminals incorporating backlit LCD character displays, are already being announced in the U.K.—notably the service being prepared for autumn 1991 launch by the Cambridge-based company, Cognito.

It is argued that cellular system pagers and cordless telephony will converge into personal communications. It is generally thought that the telepoint concept will not pose any significant challenge to cellular. Alphanumeric paging systems and specialist two-way mobile data services (with store and forward capability) will, however. INPUT foresees integration of corporate mobile facilities with in-house networks as an increasing priority for the telecomms manager, as mobile data capture units turn from batch to on-line working. Racal Vodafone's network in the U.K. already offers corporate IS managers the opportunity to take a digital feed from the Vodafone network for voice or data. Exhibit IV-10 shows the keys features of the impact of convergence between fixed and mobile communications.

EXHIBIT IV-10

Key Aspects in Mobile Communications

- Convergence of mobile with fixed link applications
- Development stages
  - Separate private networks - go public
  - Interconnection to PSTN
  - Additional access mechanisms
  - Telepoint - paging - mobile terminal
  - PCN - interconnection to ISDN
- Voice input/output developments

E

Satellite Technology

The markets supported by satellite-based technologies have been undergoing transformation over the course of the last few years.

- The principal market thrust of satellite services for the commercial user has been to provide an alternative long-haul transmission technology, particularly suitable because of its apparently "limitless" capacity for transoceanic communications where it rivals submarine cable systems. This market thrust, which fuelled satellite's initial growth period, gave ground to other areas under the twin impacts of:

  - A levelling off of satellite channel costs following a steep fall between the years 1970 to 1981.

  - The need to find other markets to counter loss of market share to optical fibre technology which came to market 10 years after satellite.

- The new market thrust for satellite technology gathered strength during the late 1980s due to further technological developments in the earth segment, notably very small aperture terminals (VSATs) which opened the way to the incorporation of satellite links into private network structures.

Exhibit IV-11 lists the main applications for satellites in civil applications and segments them by chronological generation. The areas of most importance for new services are associated with vehicle location, and store and forward messaging for mobiles. This requirement is, of course, promoted by the increasing use of mobile communications and the less than satisfactory service levels provided for data transmission to and from mobiles by existing land-based techniques. The data and video broadcasting application for private and public sector organisation is a continuation or extrapolation of television broadcasting in the entertainment market.

Second generation applications, such as basic telecomms transport and television emissions, remain the most important users of satellite transponder time, accounting for 65% and 25% of use respectively.

EXHIBIT IV-11

Satellite Applications for Business

Application Area	Generation of System
• Navigation/rescue of ships/aircraft	1st
• Remote sensing—meteorology, agricultural, etc. • Basic telecommunications transport: • Short messages, telex • Low-speed data transmission • Telephony, fax and TV • High-speed data transmission	2nd
• Location of terrestrial mobiles • Combinations of location and messaging for different types of vehicle—land/sea/air • Private network data and video broadcasting	3rd

Exhibit IV-12 lists some of the major satellite services available in Western Europe. The principal applications for satellites can be gauged from the chart:

- Two satellites are supplied by world-wide telecomms operators and have systems with world-wide accessibility.
- Two more are dedicated to television for entertainment purposes.
- Four satellites are mainly European and all four have vehicle location applications soon to be launched. These are the ones that are looking for the new user base.

These new application areas operate at the network applications level of the INPUT market model and imply new services combining generic applications like store and forward messaging with industry-specific features marketed commercially, internationally and in conjunction with industry and trade associations. In the past, satellite applications have tended to be at the bearer service or enhanced services levels. Satellite, therefore, represents a new technology which traditional network services vendors need to know and use, when appropriate. Currently, except for the PTOs, the majority of new market entrants are new to the network services sector.

Terrestrial data broadcasting can cover some of the same applications, namely:

- Private network data transmission at competitive rates,
- Broadcast VPNs (virtual private networks),
- News gathering and distribution,
- Consumer applications such as bulletin boards and software distribution.

Satellite, however, is more suitable for the higher bandwidth applications.

The leading industry sectors requiring satellite and terrestrial broadcasting and two-way data transmission are:

- Financial services, especially for dealing applications,
- Automobile, with dealer and distributor communications the main requirement,
- Travel and tourism, in which reservation systems are the bandwidth hungry areas.

During the 1990s, the new roles of satellite technology will grow in importance based upon a user requirement to gain alternative sources of bandwidth to those provided by the ground-based network operators. Complementarity of services will evolve in spite of the to-be-expected regulatory obstructiveness coming from the PTOs.

Satellite and broadcast data offer complementary facilities in a number of areas:

- Back-up and resilience to the ground networks,

- Ability to install networks speedily in what was previously the Eastern bloc of countries,

- As a component of the growing portfolio of mobile communications services.

EXHIBIT IV-12

Western European Satellite Services

Satellite	Main Shareholders	Services	No. of Satellites	Comments
EUTELSAT	28 European PTOs	Euteltracs	1	Service launch: 1/7/91 Application: vehicle location and messaging
LOCSTAR	British Aerospace Daimler Benz, MAN, Matra, Thomson-CSF	-	1	Service launch: 1/9/92 Application: as for Euteltracs
PRODAT	ESA	-	0	Looking at transportation applications
INMARSAT	International ownership	Ship-to-ship and ship-to-shore	Now on -B	Traditional voice and messaging Ambitions: terrestrial
INTELSAT	International	Long-haul transmission	Now on no. VI	Principal provider of transoceanic links
KOPERNIKUS	DBP Telekom	DAVID DIVA Bearer services, especially East-West	2	BAeCom lease transponders VSATs for overseas and domestic links
ASTRA	SES owned by institutions	Television broadcasting	2	25 million homes in Europe served 2 more satellites planned by 1994
BSB	BSkyB	Television broadcasting	1	Merger of Sky and BSB Problematic future

Exhibit IV-13 positions the four main transmission technologies according to their ability to serve dispersed fixed/mobile sites and their transmission capacities. The extent of the relevant domains of each technology can include considerable overlap in specific circumstances.

The major challenges for vendors in the satellite sector are:

- The growing importance of direct broadcast by satellite (DBS) as the dominant application.
- The waning importance of long-haul basic transport, although it remains the single largest application. Overcapacity on transatlantic and other transoceanic cable systems will impact satellite channel pricing.
- The extended length of the distribution chains, both physical and commercial.
- The two sets of regulatory bodies involved for radio (in the space segment) and wired communications (in the earth segment).

EXHIBIT IV-13

Service Positioning Chart for the Principal Telecommunications Technologies