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Management Consulting

Future Policy for Telecommunications Infrastructure and CATV Networks

A Path Towards Infrastructure Liberalisation

Prepared for:
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Directorate General for Telecommunications (DG XIII)

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Preface

The liberalisation of the telecommunications industry in Europe is now a reality. The evolution of technology, the current state of development of the networks, customer pressures and liberalisation elsewhere have combined to render the traditional monopoly obsolete. Yet, the transition between monopoly and competition is a difficult one for the Operators. Many of the European Operators must still complete their restructuring programmes and gain stronger commercial cultures and skills. These changes take time. Furthermore, in the transition period, the local Regulators must strike a careful balance between preventing monopoly practices by incumbents and effecting a statutory transfer of wealth to the newcomers. Many of the European local Regulators are only now preparing themselves for such a sensitive task.

This Mercer Management Consulting report seeks to identify the various considerations that must be taken into account during the transition towards full liberalisation to effect a fair outcome. Ultimately, however, it is in the hands of the Regulatory Authorities and the Operators themselves to build the detailed checks and balances that will enable a strong and competitive telecommunications industry in Europe. We hope that this report makes a substantial contribution to this process.

Executive Summary

The European Commission retained Mercer Management Consulting (Mercer) to *explore the implications of infrastructure liberalisation.* The Commission defined five objectives for the study:

1. *To compile an inventory of the available infrastructures in the member countries;*
2. *To compile an inventory of the regulatory frameworks in the member countries;*
3. *To review the current and expected developments associated with service and infrastructure convergence, including developments in the US and Japan;*
4. *To examine the service potential for the various types of telecommunications and CATV infrastructures;*
5. *To identify the financial and strategic implications of the removal of restrictions on infrastructure use.*

The report is organised into eight chapters. After a review of background and issues in Chapter 1, we review the infrastructures available in the EU in Chapter 2. Chapter 3 describes the regulation of these infrastructures, and Chapter 4 reviews the technical convergence that is taking place. Chapter 5 describes the changes that have occurred in the US, Japan and Sweden. Chapter 6 details the discussion that is currently taking place in the EU on infrastructures and reflects the findings of our interviews of industry stakeholders. Chapter 7 proposes a path towards liberalisation. Chapter 8 briefly sums up the report and recommendations.

In the course of working with the various stakeholders in the telecommunications industry worldwide on a range of projects, Mercer has analysed the economic drivers of the telecommunications industry and has developed tools and methodologies for evaluating its financial attractiveness for both existing businesses and new entrants. For this report, we have applied this experience and these tools to illustrate the potential effects different regulatory scenarios may have on the most important telecommunications and CATV businesses in the EU.

Chapter 2: Inventory of Infrastructure in the Member States

In Chapter 2, we describe the existing telecommunications and CATV infrastructures in the Member States of the European Union. For each country, we describe the existing networks (for illustrative purposes, we have highlighted certain countries) and we analyse telephony and CATV penetration, network modernisation and infrastructure ownership.

Today, northern Continental European countries tend to have better telephony networks and more developed CATV networks; southern and peripheral Member States have networks that are less developed.

The Member States all differ in the combination of customer mix, demand evolution, upgrade versus greenfield economics and ownership constraints, and the impact of infrastructure liberalisation varies with these differences. In all countries, liberalisation should foster the emergence of alternative long-distance and international infrastructures, but the impacts are likely to be more varied for local infrastructures.

In particular, the lack of CATV infrastructure in southern and peripheral Member States will provide opportunities to build successful and profitable alternative "CATV cum telephony" infrastructures there. In the northern Continental Member States, the existence of well-developed telephony *and* CATV infrastructures side by side may reduce the financial incentive to develop additional new infrastructures or even to upgrade existing ones.

Chapter 3: Survey of Regulatory Frameworks in Member Countries

In Chapter 3, we summarise the results of our survey of regulatory frameworks in the Member States. This survey is based primarily on a questionnaire mailed to the regulatory authorities of all Member States, subsequently complemented with additional research and interviews.

From this survey it is clear that major legislative changes have been taking place in every country in recent years. The trend is overwhelmingly towards increased liberalisation of infrastructure to support the liberalisation of service provision. Among the current Member States, the most remarkable example is the UK, where infrastructure deregulation began more than 10 years ago. After a duopoly period, new long-distance and local Operators have been licensed, and local CATV Operators are gaining telephony share in their markets.

Elsewhere in the EU, the Netherlands is in the process of launching a second Operator, TeleNed, in 1995; France has begun a slow and very gradual deregulation; and Spain has announced the selection process for CATV Operators that will be allowed to provide telephony.

Chapter 5: Experience in the US, Japan and Sweden

In Chapter 5, we consider the deregulation experience in the US, Japan and Sweden. In the US, the liberalisation of infrastructure, initiated in the long-distance market, is expected to extend into the local loop soon, despite delays caused by the legislative process. The Markey-Fields Bill is symptomatic of a general willingness to break the barriers to competition that had been set up as "safeguards" in the early 1980s, but which now appear increasingly artificial. The current US regulatory framework must be revised to accommodate recent advances in technology and the fact that local, long-distance and CATV Operators are now able to compete with each other.

In Japan, the long-distance and international markets are effectively open and alternative infrastructures already exist. Furthermore, new regulations introduced in December 1993 have allowed CATV networks to provide telephony services. However, Japan's liberalisation process is now being slowed by the inability of local Regulators to act decisively against monopolistic practices. In particular, lengthy disputes over interconnection and frequency availability have, for the moment, hampered the emergence of a truly competitive local loop. The Japanese experience serves as a reminder that unless a strong Regulator oversees the liberalisation process, the initial step of infrastructure liberalisation will not be sufficient to guarantee the ultimate objectives of the liberalisation process.

The Swedish market has always been open. Price levels, service offerings and productivity are all very competitive. The leading Operator has a 75 per cent share and, with the exception of one year, has been consistently profitable since 1980.

Overall, the experience of countries that have introduced full infrastructure competition constitutes an invaluable source for assessing the impact of liberalisation on consumers, businesses, Operators and shareholders. That experience also constitutes a set of benchmarks for developing liberalisation scenarios for the European Union.

Chapter 6: The Infrastructure Discussion

In Chapter 6, we highlight the results of our interviews with incumbent and new Operators, investors, consumers, business customers and Regulators. Overall, infrastructure liberalisation is accepted by the great majority of stakeholders. This reflects not only the success of the deregulation experiments in the UK, the US and other countries, but also the recognition that the economic characteristics of the telecommunications business have changed radically in the last 20 years. For example, ratios of investment/revenues, assets/revenues and depreciation/ cash costs for the telecommunications industry are no longer much different from those found in competitive industries such as oil and bulk chemicals, forestry and paper. In these sectors,

The second stage of liberalisation should introduce competition in infrastructures supporting voice services, with a simultaneous rebalancing of prices. Price caps for local tariffs may be considered. It can be expected that, in an environment in which they will have been given the time to adjust, incumbent Operators will have made sufficient efficiency gains and pricing reductions so that their stability and the provision of Universal Service would not be in danger.

With regard to the actual emergence of competition, we believe that the economic characteristics of the long-distance and international market will attract many new entrants. The attractiveness of local infrastructure is more variable, depending on local conditions.

In all countries where deregulation has taken place, the soundness of the incumbent Operators has not been undermined by competition. Also, in each situation a number of "provisions" or "contingencies" have helped throughout the process. To smooth the introduction of further competition in the European Union, we recommend the following safeguards:

- Universal Service Provision: As a way to develop competition, new entrants could be exempted from any Universal Service obligation for a given period; beyond that, we recommend aiming for an auction system, in which the Operator requiring the least financing to operate in a specific remote access is given exclusive licence there.
- Regulation and time frame: Strong and effective Regulators will be required to manage the transition process. The ways in which Member States Regulators co-ordinate should be decided. The possibility of appointing a "Euro-Regulator" should be considered. Such a Regulator should have the power to "manage" the liberalisation process by allowing incumbent Operators to rebalance their pricing structure as competition is introduced, by speeding up deregulation, or by lowering price caps if an existing step of deregulation is not effective enough.
- Regulators will have to prevent cross-subsidisation, in particular in countries where telephony and CATV networks are under common ownership or operation.
- Regulators will also have to rule on inter-operability standards, access charges, access to scare resources and reciprocity for non-EU companies.

There is no doubt that these and other issues will be the subject of debate over the next few months. Together with the various stakeholders, the Commission and the local Regulators must now answer the remaining questions to assure that all elements are put in place in advance of infrastructure liberalisation to guarantee a fair competitive environment to both incumbent and new Operators. The case for infrastructure liberalisation is, in our opinion, sound. However, it is only through its balanced implementation that the telecommunications industry and the telecommunications users in Europe will benefit. Upon a successful implementation lays the health of the future European telecommunications industry.

Chapter 1: The Emerging New Telecommunications Industry

1.1. The Telecommunications Revolution

The Telecommunications Revolution is under way. Not only are the rules for competition in the telecommunications industry changing everywhere, but the importance of this industry for our business and private lives is growing through a combination of accelerating technological innovation, price declines, new product introduction, competitive rivalry and regulatory change. The telecommunications industry has permanently changed from a quiet *utility* to a vibrant driver of economic growth.

No matter how we look at this industry, the facts suggest a rapid increase in the importance of telecommunications in developed countries. Between 1982 and 1992, *direct* spending for telecommunications in the US increased from 2 per cent to 3 per cent of Gross Domestic Product (GDP)[1] (see Exhibit 1). However, these figures understate the importance of an industry that permeates all aspects of business and private life. With total spending on information technology growing at two to three times the rate of the overall economy, the economic significance of the telecommunications industry will only increase.

Perhaps the most remarkable development in the telecommunications industry is the extent to which telecommunications already influences private life. In the US, the country with the highest consumption of telecommunications services in the world, 1.7 per cent of disposable income is currently spent on telecommunications. This figure increases to 2.5 per cent if Cable TV (CATV) and personal computers are included. Seven per cent of the population use a mobile phone, and by the year 2000 this figure is forecast to reach 25 per cent.[2] (In Scandinavian countries, mobile phone use is already at more than 10 per cent of the population). In the US and worldwide, Internet reaches several million users (some estimates put that figure at 25 million) – many of them private users – and this number is doubling every year. By 2003, telecommunications

spending in the US, including interactive, could reach US$1,800 per household[3] (see Exhibit 1.2).

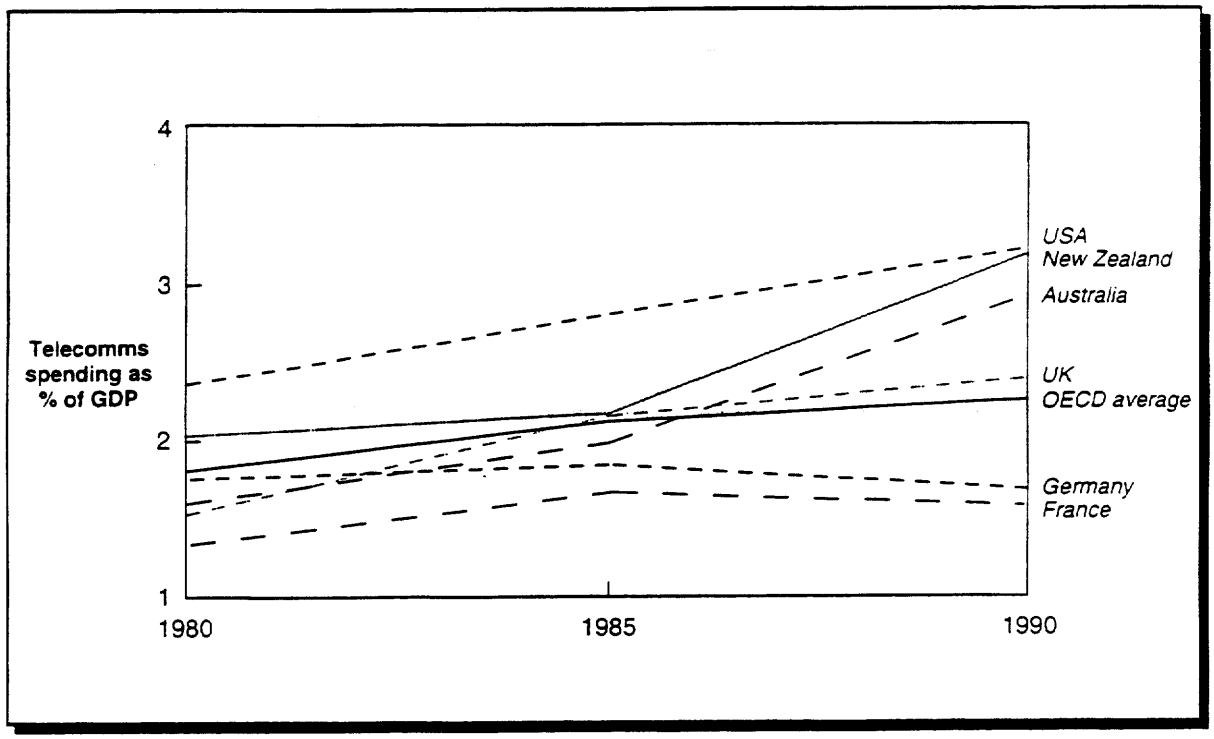
Most recently, the media have been heralding stories telling us how interactive multi-media will change our lives. The growth of computers and game consoles for home use and the continued expansion of CATV around the world are evidence of some of these changes. In 1993, spending on interactive multi-media hardware and software worldwide was projected to exceed ECU billion 62 and grow by 45 per cent.[4] At the same time, leading European and US telecommunications providers have initiated technical and market tests in preparation for the deployment of interactive capabilities into residential markets. Although commercial demand for interactive applications is still uncertain – the cost economics of these technologies are not yet sufficiently favourable, and attractive new services have yet to be developed – telecommunications providers are already laying the groundwork for the expected boom.

A quieter revolution is taking place in the business markets. Benefiting from declining telecommunications tariffs and the introduction of new services and competition, corporations have been able to afford more and more telecommunications traffic. For example, between 1985 and 1993, long-distance and international traffic in liberalised markets such as the US, Japan, New Zealand, Australia and the UK has been growing at rates ranging from 10 per cent to 12 per cent per annum (despite the recession). In non-liberalised countries, those figures were usually below 9 per cent (see Exhibit 1.3). During this period, long-distance call rates on major US routes dropped by more than 60 per cent (see Exhibit 1.4). Overall, call costs for business customers in liberalised markets have dropped by an average of 30 to 60 per cent. The evolution of the industry in other European countries that remain under monopoly regimes follows the same general pattern, although in some cases it lags significantly behind the evolution taking place in the fully liberalised countries (see Exhibits 1.5 and 1.6).

Changes in mobile telephony have been even more marked. With tariffs responsible for more than two-thirds of the difference in rates of penetration of mobile services across countries, price declines are transforming an exclusive niche service into a booming consumer market. For example, between 1990 and 1994, tariffs in most European countries dropped by more than 5 per cent per annum and the subsidised price of equipment dropped by more than two-thirds (see Exhibits 1.7 and 1.8). In countries where more than two mobile Operators are licensed, or where the Operators have pursued a policy of widespread service penetration, price declines have been particularly significant. For example, in the UK tariffs declined by more than 25 per cent during that period, and in Scandinavian countries tariffs have declined by more than 40 per cent. In the US, the picture is virtually the same, with the imminent building of PCS networks and widespread competition promising increased availability and continuing price declines.

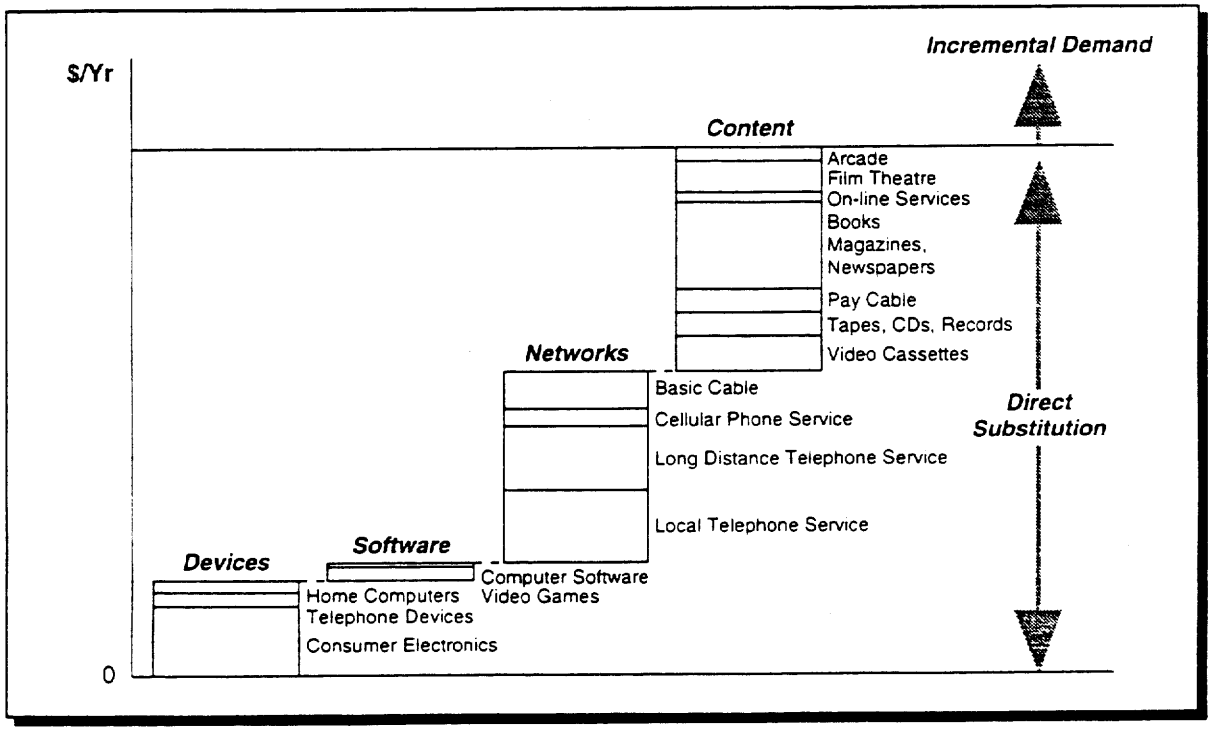
At the same time, many new services have been introduced, especially in the most liberalised markets. For example, in a survey carried out in 1993, Mercer identified a *"service*

Exhibit 1.1: Evolution of telecommunication spending as a percentage of GDP



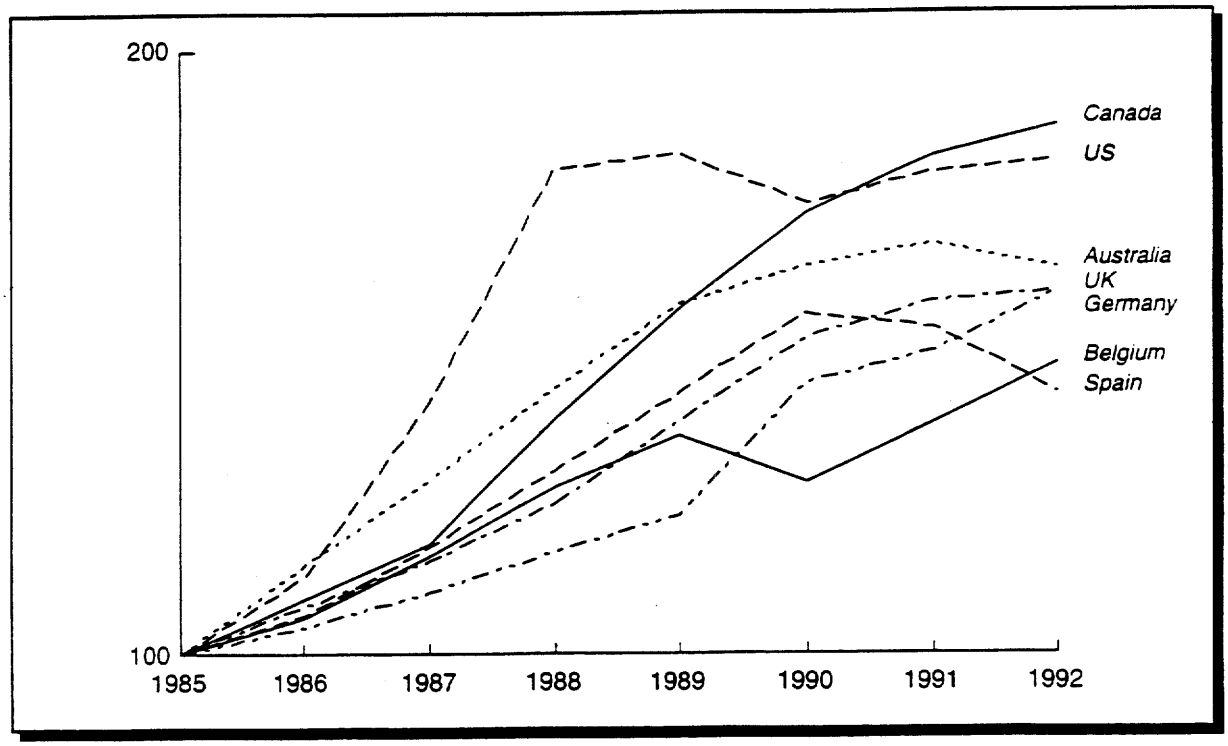
Source: OECD; Mercer Management Consulting research

Exhibit 1.2: 1992 consumer spending on converging markets



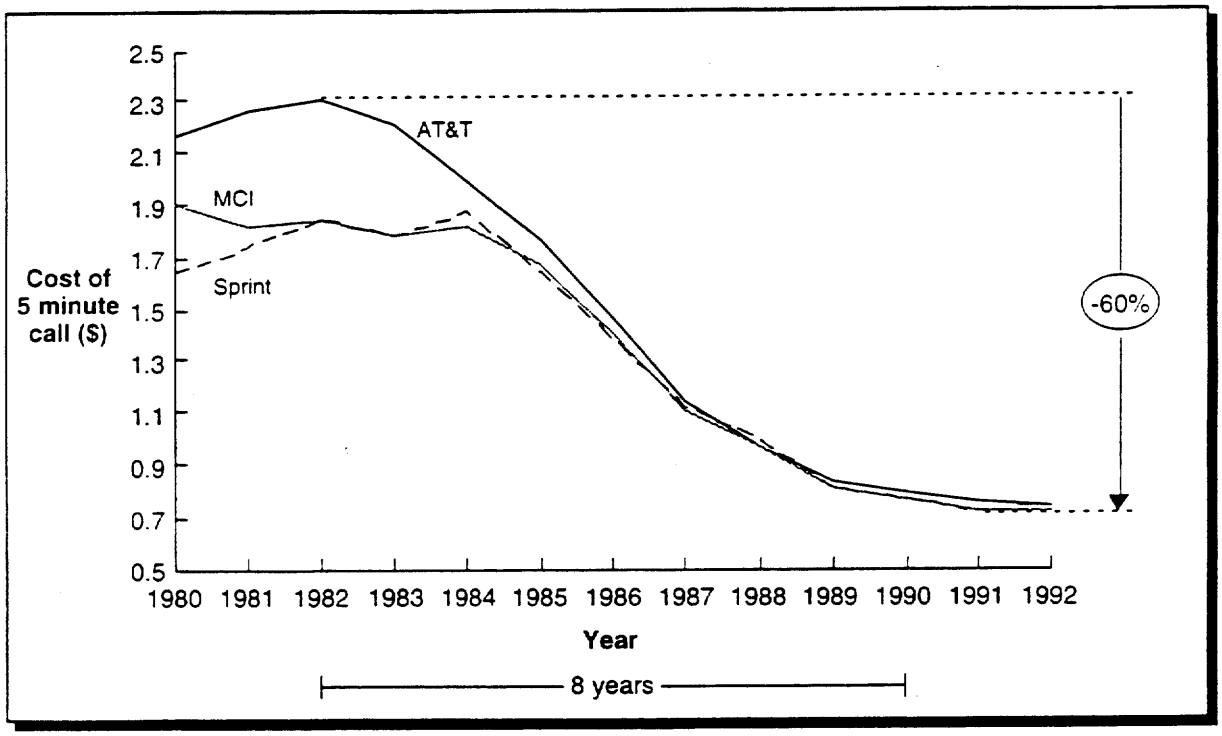
Source: Mercer Management Consulting research

Exhibit 1.3: Evolution of long distance traffic volumes in selected countries (index: 100 in 1985)



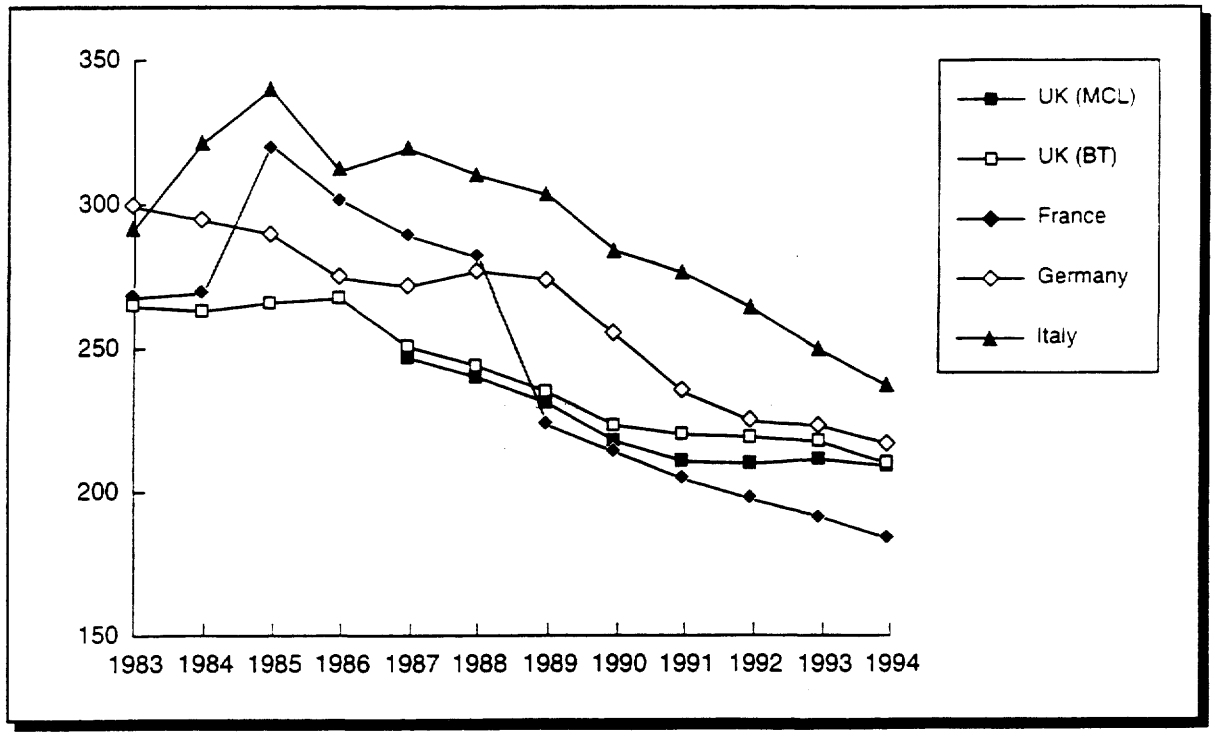
Source: ITU

Exhibit 1.4: Evolution of US long distance call rates (New York-Los Angeles)



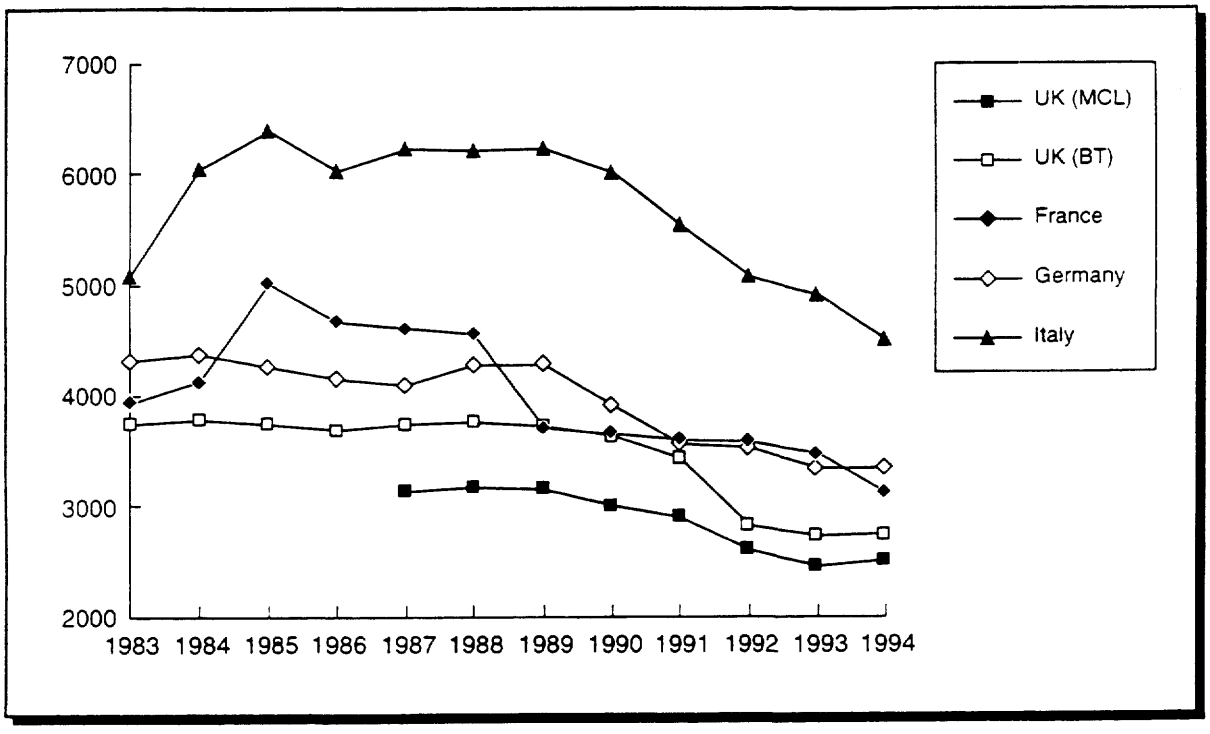
Notes: (1) All calls made at peak time
(2) First minute includes set-up charge plus 4 standard minutes
(3) Costs deflated to 1980 prices
Source: Federal Communications Commission; Mercer Management Consulting analysis

Exhibit 1.5: Average cost per line for an average residential customer (in UK£)



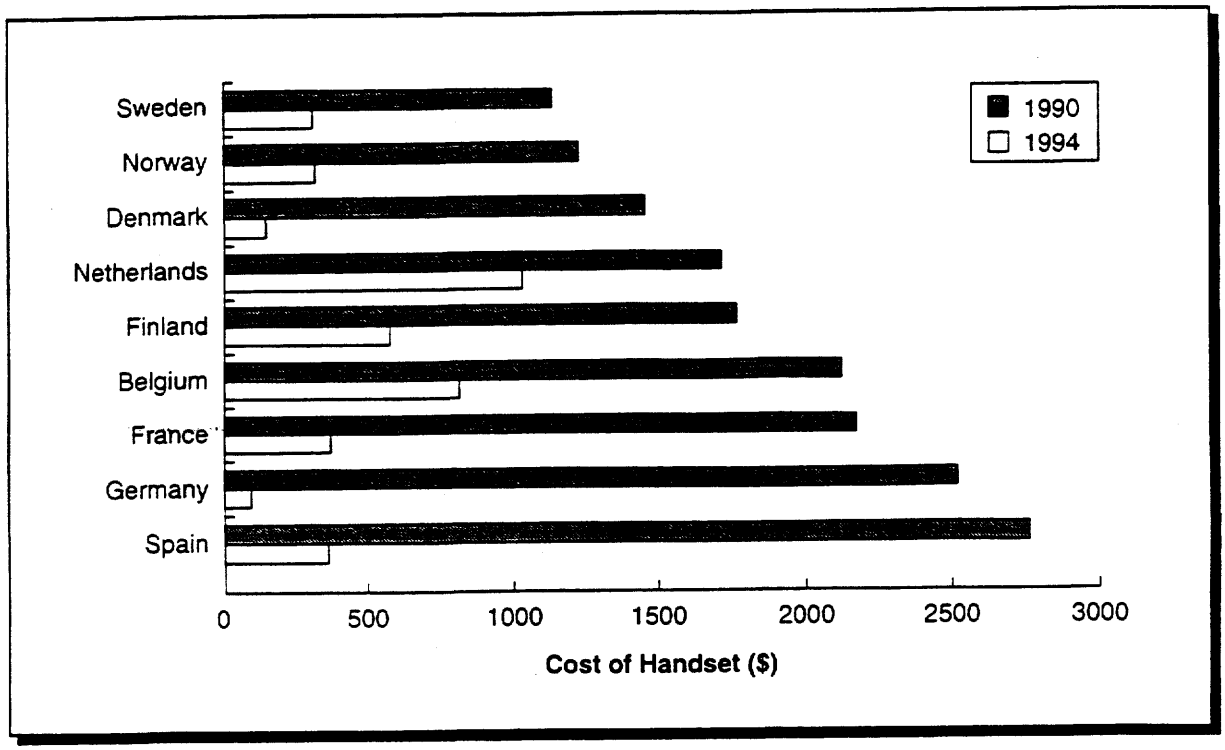
Source: Analysys

Exhibit 1.6: Average cost per line for a 50 line business customer (in UK£)



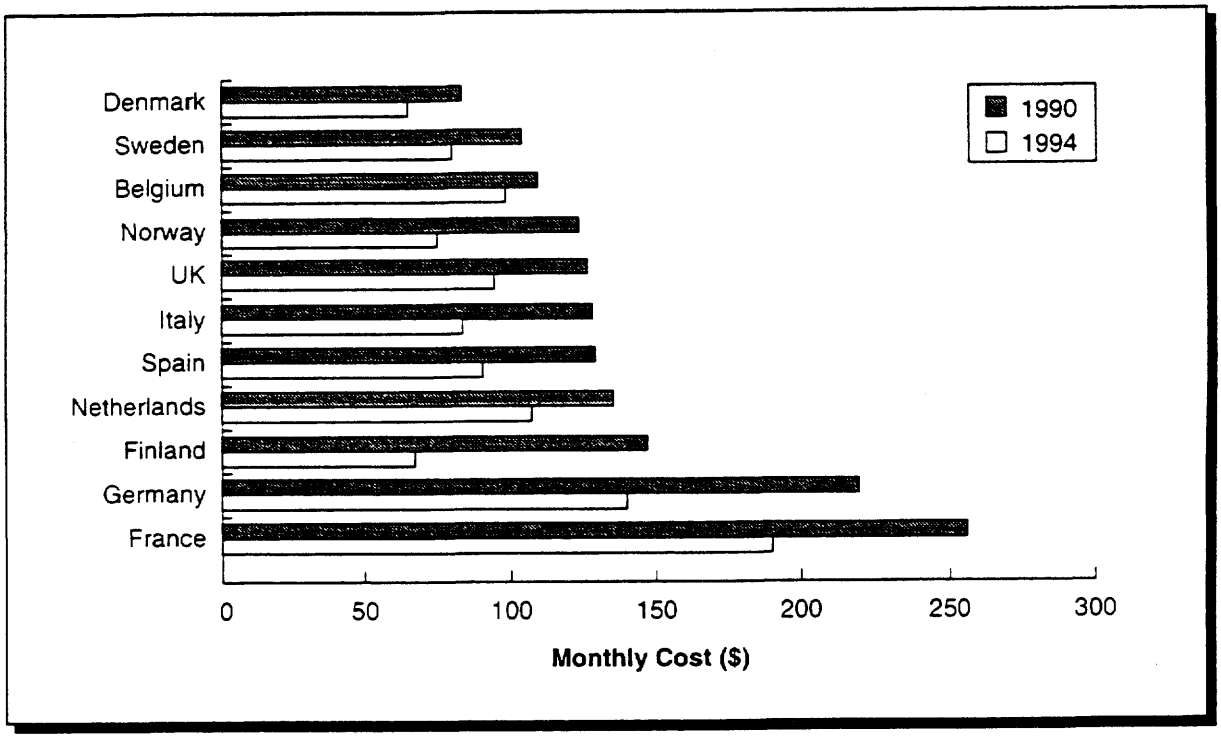
Source: Analysys

Exhibit 1.7: Cost of mobile handsets 1990-94



Source: FT Mobile

Exhibit 1.8: Average costs of mobile telephony 1990-94

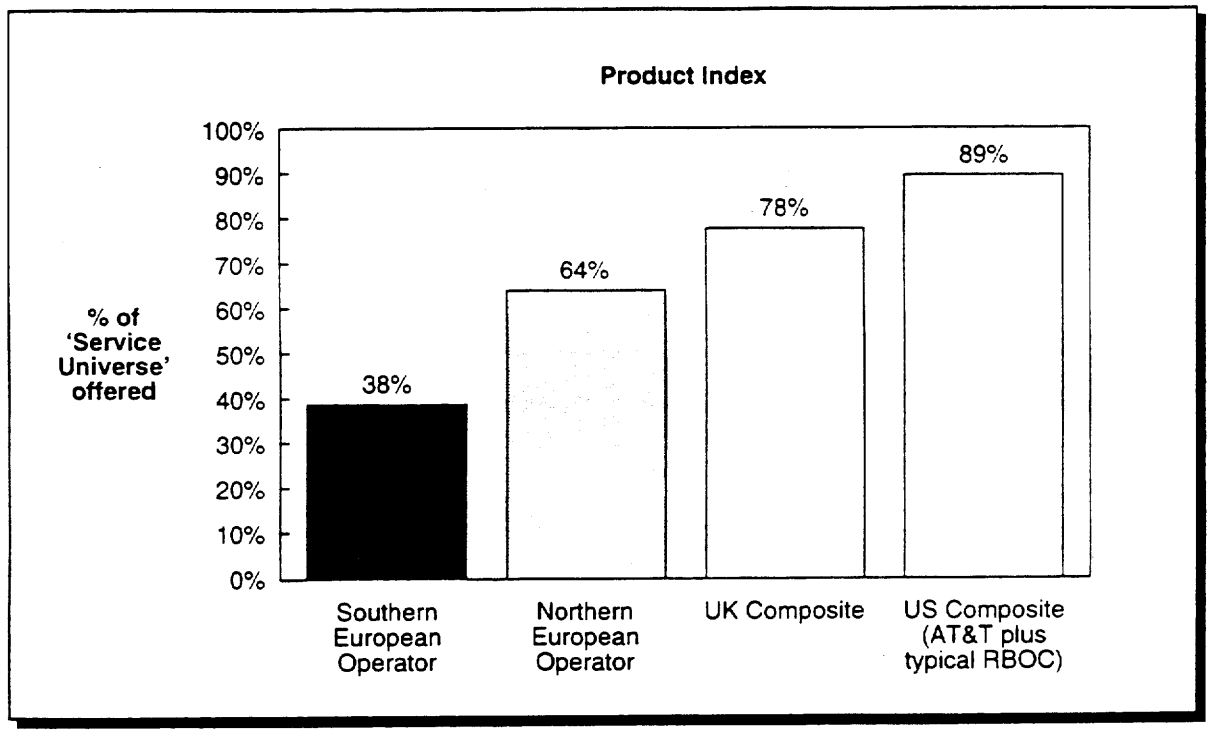


Notes: (1) Connection fee is amortised over 12 months
(2) Calculation assumes 160 call-minutes per month/80% peak rate, 20% off-peak
(3) Nominal prices
Source: FT Mobile

universe" composed of approximately 330 *distinct* services offered by the most developed Operators around the world. In a similar survey just completed, Mercer identified nearly 70 new services introduced in the past year – a 20 per cent growth rate. Our data suggest that US long-distance Operators tend to be the most innovative, although some of the European Operators are rapidly catching up in terms of product offerings and rate of innovation (see Exhibit 1.9). Service quality levels are also improving across Europe (see Exhibit 1.10).

In a market-driven industry, service innovations respond to customer needs and also create new business opportunities (see Exhibit 1.11). For example, pricing packages, such as the well-known *Friends and Family* package introduced by MCI in the US, allow for lower rates between specific individuals who will most appreciate lengthy, inexpensive phone calls. Although competition have reacted with packages that sometimes are even more favourable, MCI's pricing packages have significantly boosted its recent market share and profitability growth (see Exhibit 1.12). Another example is bypass data services, such as those offered by MFS or Teleport in the US and now also developing in Europe; these services respond to the financial community's need for extreme reliability and responsiveness in a local network. Traditional local Operators could not always meet these demands, and their shortcomings in service and network specification led Merrill Lynch to co-found New York Teleport in 1985.

Exhibit 1.9: Comparison of services offering in various liberalised and non-liberalised environments

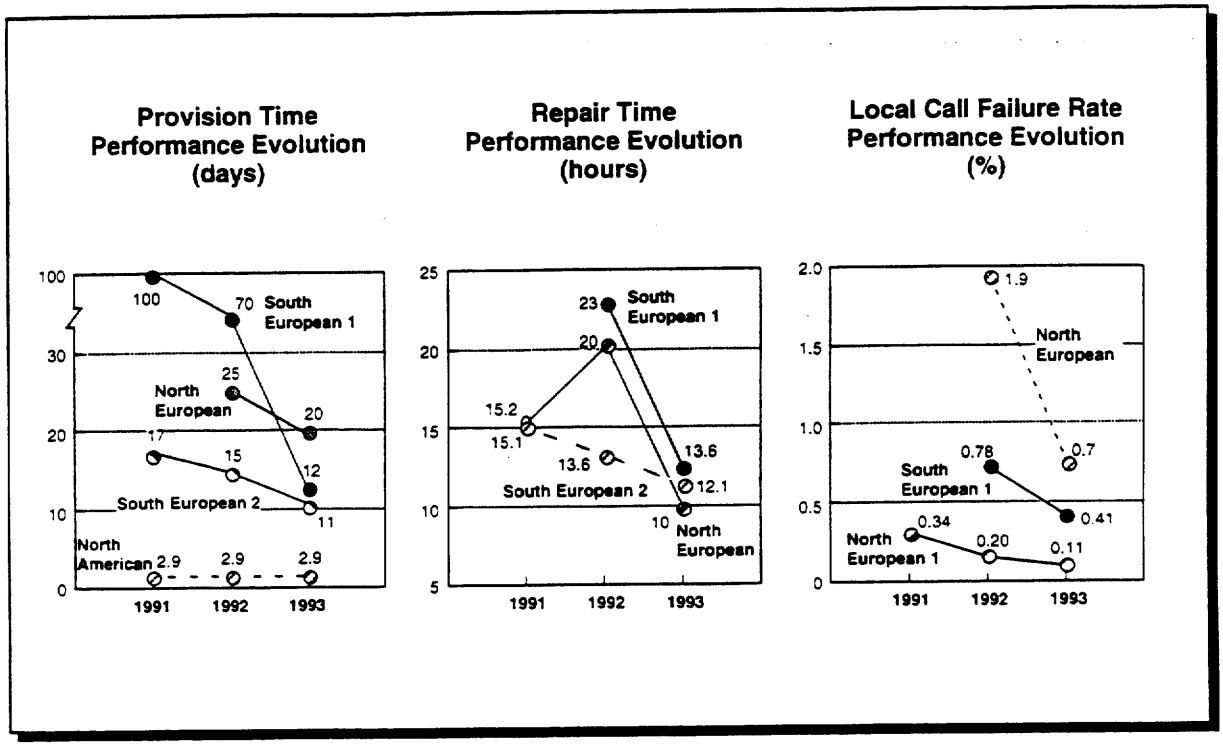


Source: Mercer Management Consulting 'Service Universe' survey

Tariff declines and the introduction of new services have been primarily assisted by three factors: the lower operating costs associated with digital switches and fibre optics; the

declining costs of digital equipment due to the effects of the experience curve and widespread excess manufacturing capacity; and the increase in competitive rivalry as more and more markets are liberalised. For example, while the maintenance and operating costs for an analog switch will average ECU 25 per annum, those same costs for a digital switch will average only ECU 5 per annum – a ratio of five to one. In terms of digital equipment, in 1993 alone, prices for GSM network equipment dropped by more than 30 per cent.

Exhibit 1.10: Evolution of service quality levels in selected European countries



Source: Mercer Management Consulting research and analysis

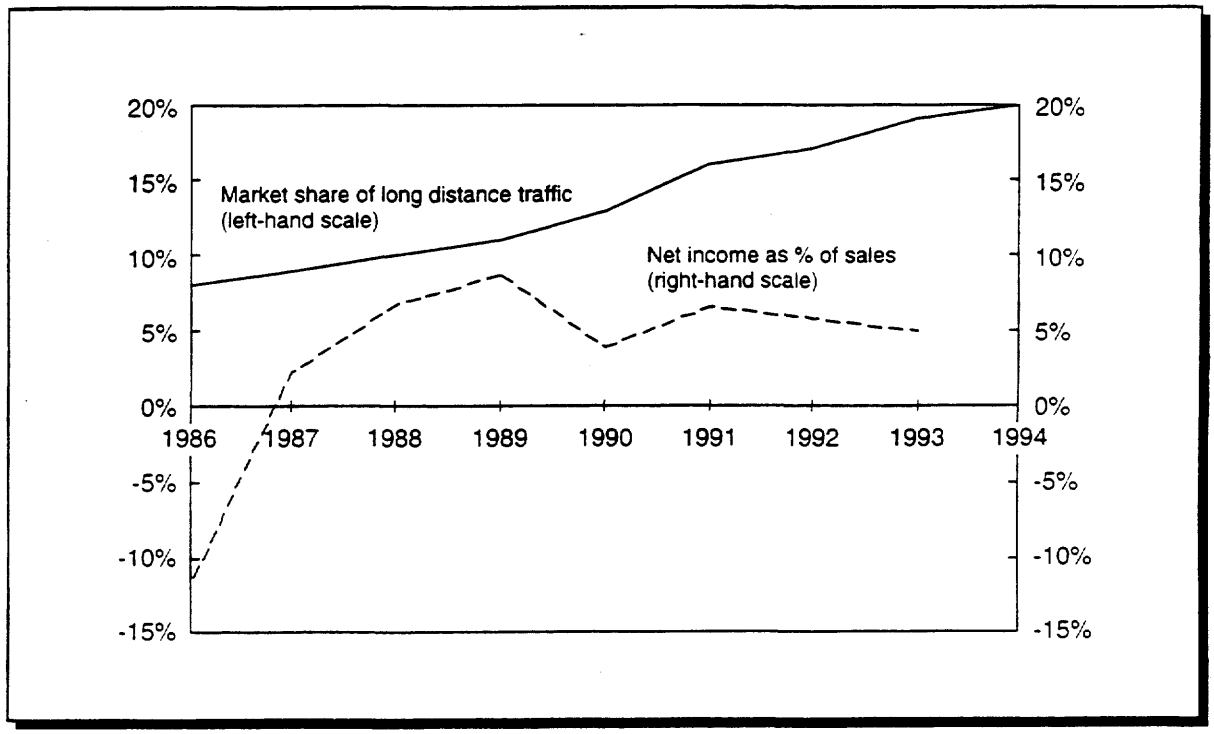
Exhibit 1.11: A few competitive moves in the US

New Pricing	New Products	New Services	Move into Local Services
Call plans • MCI's *Friends and Family* • AT&T's *Reach Out America* • US Sprint's *Priority Plus*	Calling cards Credit cards Affinity cards Fibre-optic networks	Message toll services Customised services • 800 and 900 service AT&T's *Easy Reach 700* service Collect call services Services guarantees	Sprint acquires Centel (1993) AT&T acquires McCaw (1993) MCI invests in Nextel (1994)

Source: Mercer Management Consulting research

In the increasing number of markets that are open to new entry and competition, a large part of the cost savings resulting from new technology and declining equipment prices has been immediately passed on to the customer in the form of lower tariffs – like any other open consumer product, durable good or service. In other words, in the liberalised markets, the telecommunications industry has lost the *narrow product characteristics of a utility* and has become a mixed market of *consumer and industrial products* open to variety, scrutiny and choice.

Exhibit 1.12: Market share and financial performance of MCI



Source: Federal Communications Commission; Disclosure Worldscope; Annual report; Mercer Management Consulting analysis

Nothing illustrates this point as well as the changes witnessed by multinational companies. Whereas before such customers would have to deal with several Operators around the world and resolve the difficulties imposed by various standards and ways of doing business, now those same customers can choose among various competitive offerings from *global service providers*, which are beginning to serve the global telecommunications needs of all multinational corporations. In addition to multinationals enjoying an array of choices, residential and local businesses in liberalised markets from New Zealand to Sweden also have access to more than one service provider with, on average, lower tariffs and a wider product choice than in countries where competition is still denied.

1.2. The Regulatory Background

On 22 July 1993, the European Council set 1 January 1998 as the date for full liberalisation of voice telephony services for the general public, subject to transitional agreements for some Member States. On this occasion the Council also asked the Commission to publish before 1 January 1995 a Green Paper on the future policy for telecommunications infrastructure and CATV networks.

Whilst a number of service areas are now subject to competition, all Member States, with the noticeable exception of the UK, have kept a monopoly on the provision of infrastructure for liberalised services. At the EU Telecommunication Ministers Council meeting in Brussels on 17 November 1994, agreement was reached on the full liberalisation of telecommunication infrastructures with the same 1 January 1998 deadline.

In the UK, Government authorities had licensed a second Operator, Mercury, as early as 1984, and several additional Operators following the duopoly review process of 1991. There are currently more than 15 Operator licence owners in the UK, ranging from AT&T and Sprint to Telia and MFS (see Exhibit 1.13). The progressive attitude of the UK Regulator has rendered this market arguably the most important test-bed for new services, technologies and regulatory practices in Europe. UK telephony prices have decreased by more than 35 per cent to establish some of the lowest prices in the European Union (see Exhibit 1.14). Furthermore, the widespread introduction of competition following the duopoly review and the continuing price declines mandated by the Regulator have forced the incumbent Operator, BT, to initiate a far-reaching programme of cost reduction and reorganisation which is yielding further tariff reduction opportunities and higher customer responsiveness, to the obvious benefit of consumers in the UK.

It is worth noting that the possibility of keeping the telecommunications *infrastructure* under a monopoly regime was discarded early on by the UK Regulator as an excessive and unacceptable constraint on alternative providers of services. This constraint is demonstrated by mobile telephony Operators. The costs and interconnect charges they pay for fixed infrastructure services amount to about 20 per cent of their revenues in countries where infrastructure has been liberalised and 40 to 50 per cent in countries where there is still an infrastructure monopoly. Furthermore, since network capabilities are a key service attribute, no Operator can fully control its service or quality of service without owning its infrastructure. This is especially true in regard to the quality and reliability of signal transmission as well as to the speed and efficiency of fault repair. Furthermore, the differences in quality in the infrastructures available across Europe make it difficult for a service provider to offer a pan-European service with uniform quality, price and service guarantees. A recent consultative paper from the UK Regulator, OFTEL, entitled "A Framework for Effective Competition," has offered encouragement to competitive service

providers by proposing the reform and possible removal of access deficit charges (ADCs) which alternative providers must pay to BT to subsidise its local network.

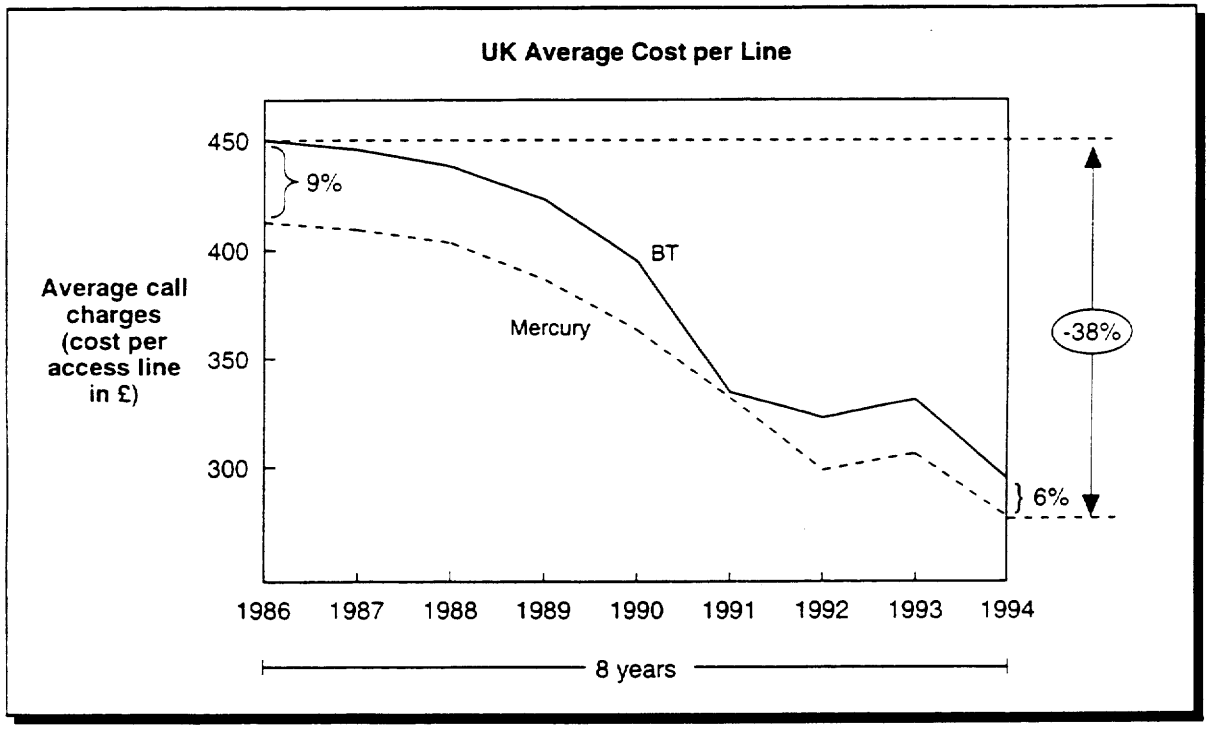
Exhibit 1.13: Licenses awarded and applied for in the UK (as of 1/4/94) (List is not exhaustive)

	Interna-tional	National Long Distance	Local	Launch Date
BT	X	X	X	–
MCL	X	X	X	1984
Energis	X	X	X	1994
Telstra	X	X	X	1994
IDB Worldcom	X	X	X	1994
MFS Communications	X	X	X	1994
ACC	X	X	X	1994
Sprint	X		X	1994
Telia	X		X	1994
Esprit Telecom	X			1993
Colt	X			1994
Norweb				1994
Scottish Power				1994
Torch Comms.				1994
Videotron				1994
Ionica				1995
Scottish Hydro-Electric				n/a

	Interna-tional	National Long Distance	Local	Application Date
British Rail Telecom	X	X	X	1992
AT&T (licensed 8/94)	X	X	X	1993
Premium Phone Serv.	X	X	X	n/a
Incom	X	X	X	n/a
Int. Exchange Network	X	X		n/a
Transline (Europe)	X	X		1991
Liberty Comms		X		1993
Racal Network Services				1994
Fibreway				1992
Atlantic Comms				1993
East Midlands Telecom				

Source: OFTEL; Mercer Management Consulting research

Exhibit 1.14: Evolution of UK prices



Note: Cost per line is based on a basket of local and national calls (excludes international calls)
Source: Analysys; Mercer Management Consulting research

In other words, European Operators are currently moving towards a new environment which is more competitive and more open and which provides more growth opportunities. By 1998, competition in voice services will probably be seen as just one of a number of milestones along the road toward the full liberalisation of all aspects of the telecommunications business, including infrastructure.

1.3. The Mercer Management Consulting Study

Given the above background, the European Commission has asked Mercer Management Consulting (Mercer) to explore the implications of infrastructure liberalisation, in particular with regard to telecommunication and CATV networks.

In the course of this study, we reviewed the most important economic issues faced by the telecommunications, CATV and related businesses. In particular, we researched the determinants of the financial attractiveness of the various businesses to identify the likely behaviour of current and potential Operators in the context of infrastructure liberalisation.

We thank the many people who took time to meet with us and provide information for this study. Their names are provided in the "Acknowledgements" section at the end of this report. Responsibility for this report and the opinions expressed herein rests with Mercer only.

Chapter 2: Inventory of Infrastructure in the Member States

2.1. Overview

In this chapter, we describe the telecommunications and CATV infrastructure in the Member States. The information is based on the interviews (and associated questionnaire) we have conducted with a large number of European Operators. We have highlighted certain countries, as our objective is not to provide a complete description of Europe's infrastructures, but rather to give a number of relevant examples. In this report, we only provide information that is public or that we have been allowed to make public.

In summary, as shown below and in the adjoining tables, existing infrastructure varies significantly across Member States:

- Telephony and Cable TV penetration levels vary significantly from country to country.
- Some networks are very up-to-date, while others are older; the digitalisation rate of exchanges varies as does the deployment of fibre optic cables.
- There are significant differences in the ownership of infrastructures.

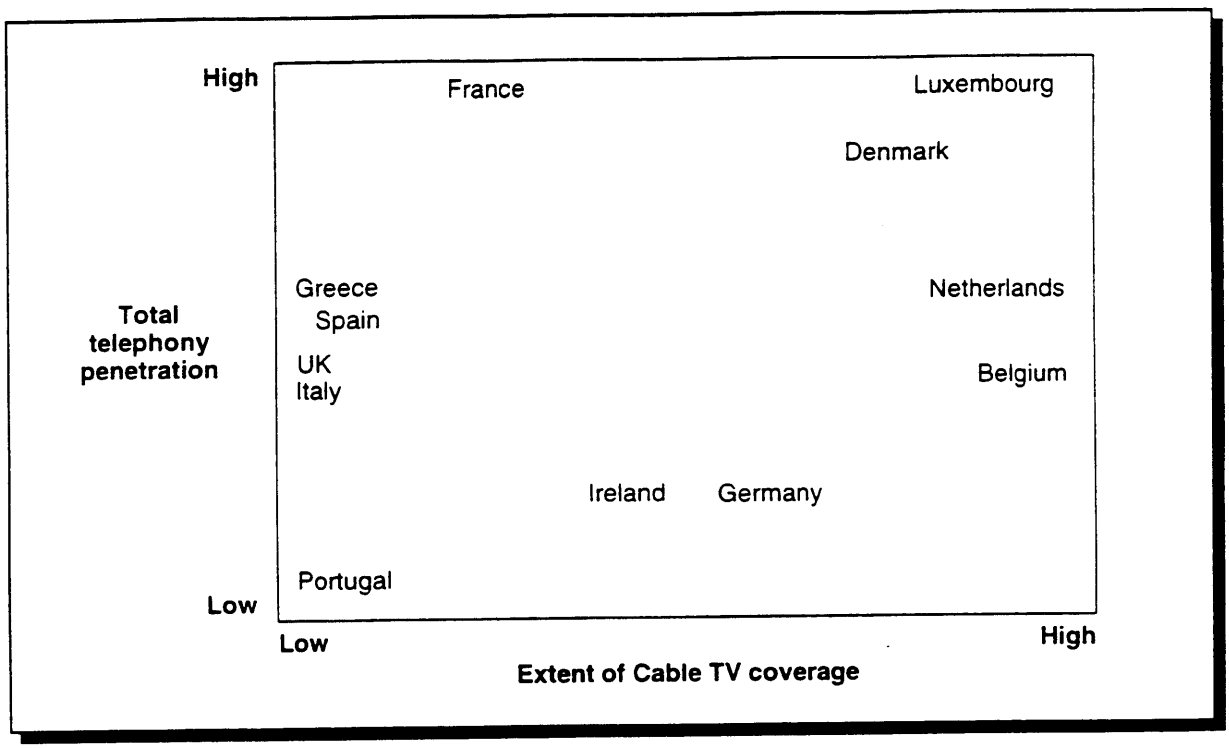
More specifically, differences in telephony and CATV penetration, degree of network modernisation and infrastructure ownership suggest major differences in the way the liberalisation of the telecommunications infrastructures will affect the various EU countries. Below, we summarise these differences and subsequently characterise in some detail the infrastructures in each Member State.

Telephony and Cable TV Penetration

Exhibits 2.1, 2.2 and 2.3 show that telephony and CATV penetration are not homogenous across Member States:

- Italy, Spain, Greece and Portugal have virtually no CATV infrastructure.
- Ireland and Portugal have below-average telephony penetration.
- Spain, the UK, France and Ireland have limited CATV infrastructure; in the UK, telephony services are provided over a number of competing infrastructures including CATV with telephony overlay.
- Germany, Belgium, Netherlands, Denmark and Luxembourg have significant CATV infrastructure and medium or high telephony penetration (Germany has lower penetration because of the Eastern Lander).

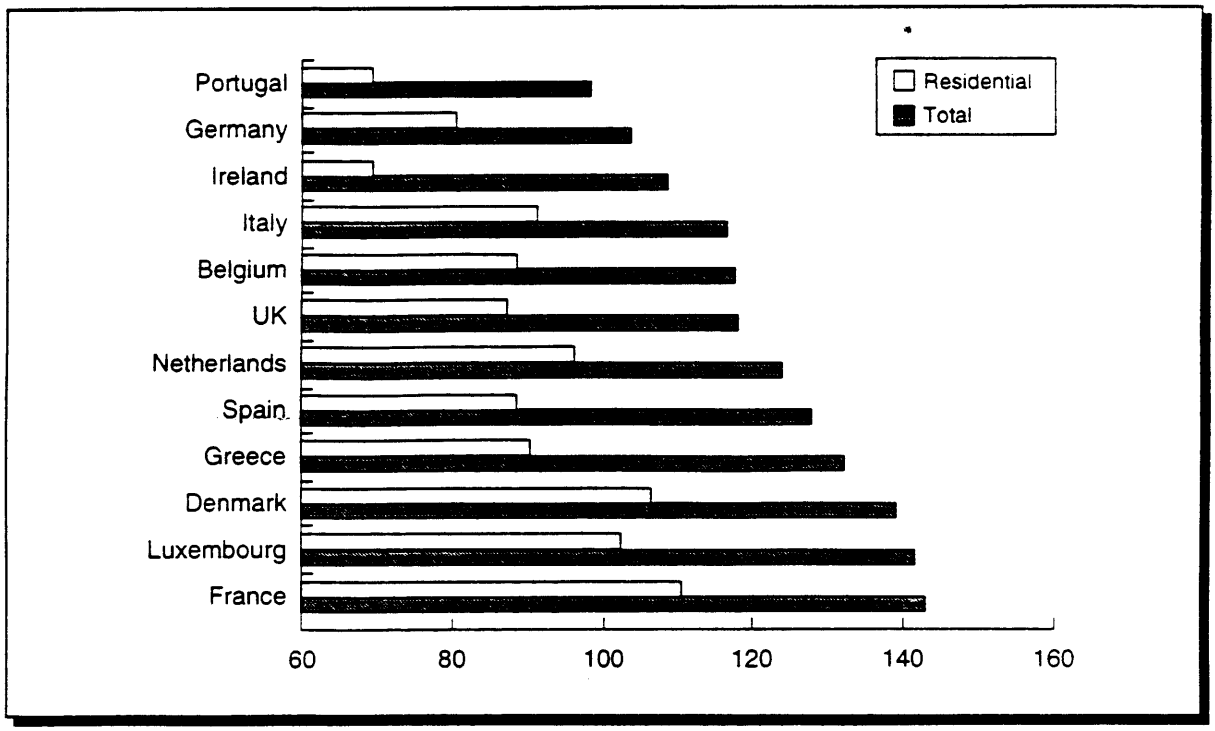
Exhibit 2.1: Member State segmentation



Source: Mercer Management Consulting research

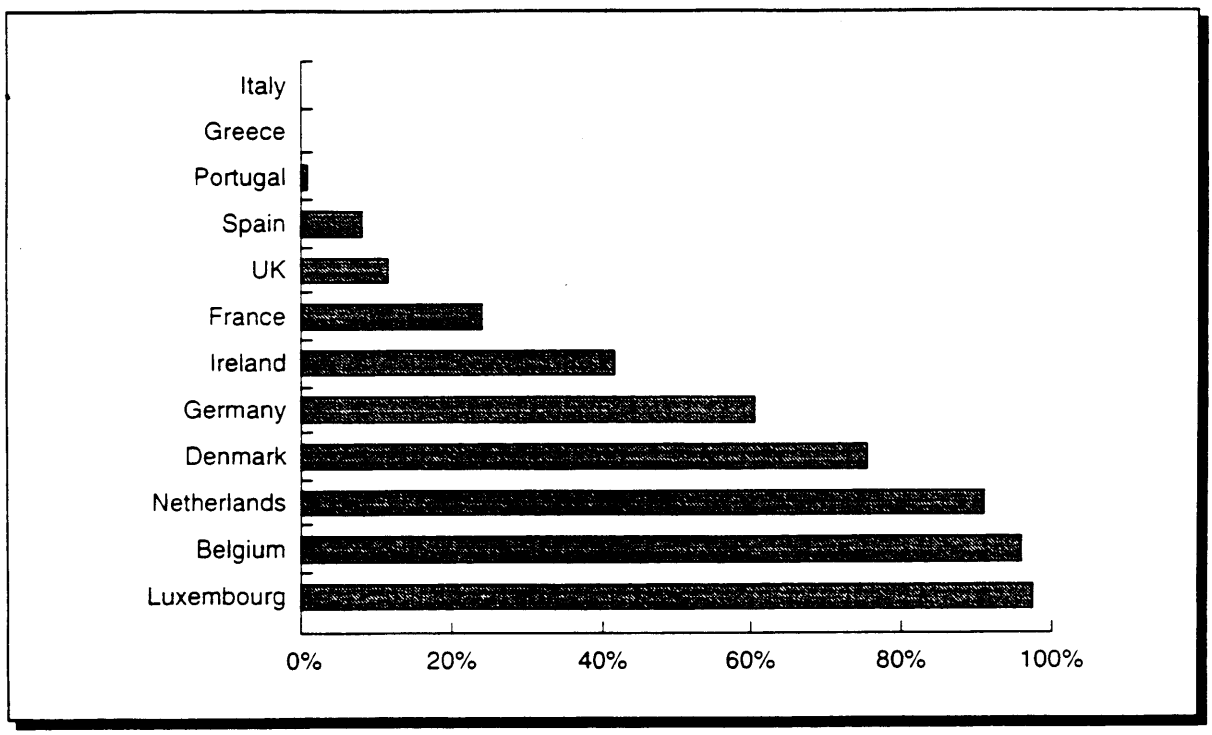
These differences currently influence the diversity of services on offer to citizens of the various Member States. We will also see later that these differences strongly influence the financial attractiveness of future infrastructure developments as a result of liberalisation. The corollary is that *infrastructure liberalisation will not yield equally strong incentives for the development of the telecommunications industry across all Member States*. In particular, we will see in Chapter 7 that the level of CATV penetration and its ownership strongly influence the incentive for a second local access Operator to develop.

Exhibit 2.2: Total and residential telephony penetration (total and residential lines per 100 households)



Source: Infrastructure Questionnaire; Mercer Management Consulting research

Exhibit 2.3: Cable TV infrastructure penetration (% of households passed)

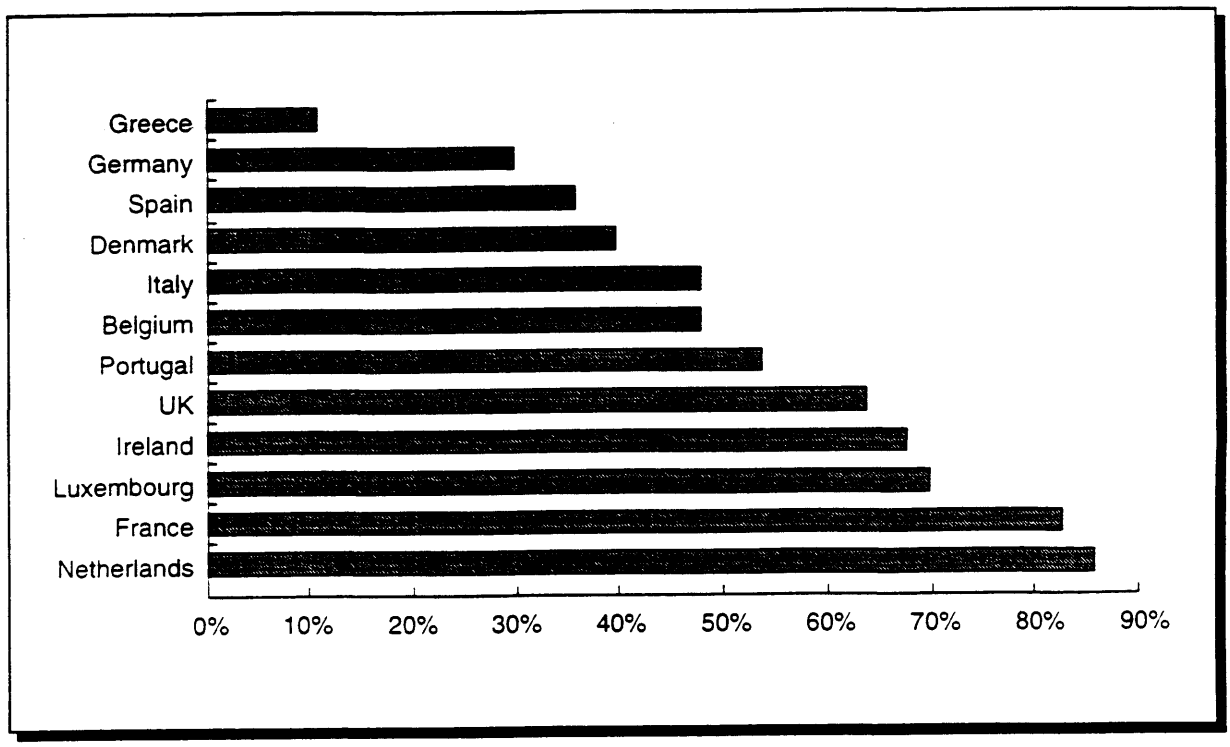


Source: Infrastructure Questionnaire; Mercer Management Consulting research

Network Modernisation

As shown in Exhibit 2.4, telephony Operators in France and the Netherlands have a high proportion of digital switches. The UK, Switzerland, Norway, Italy and Belgium are closer to the average while the Spanish, German and Greek Operators are somewhat lagging.

Exhibit 2.4: Digitalisation of incumbent networks (% of switches being digital)



Source: Annual Reports; Mercer Management Consulting research

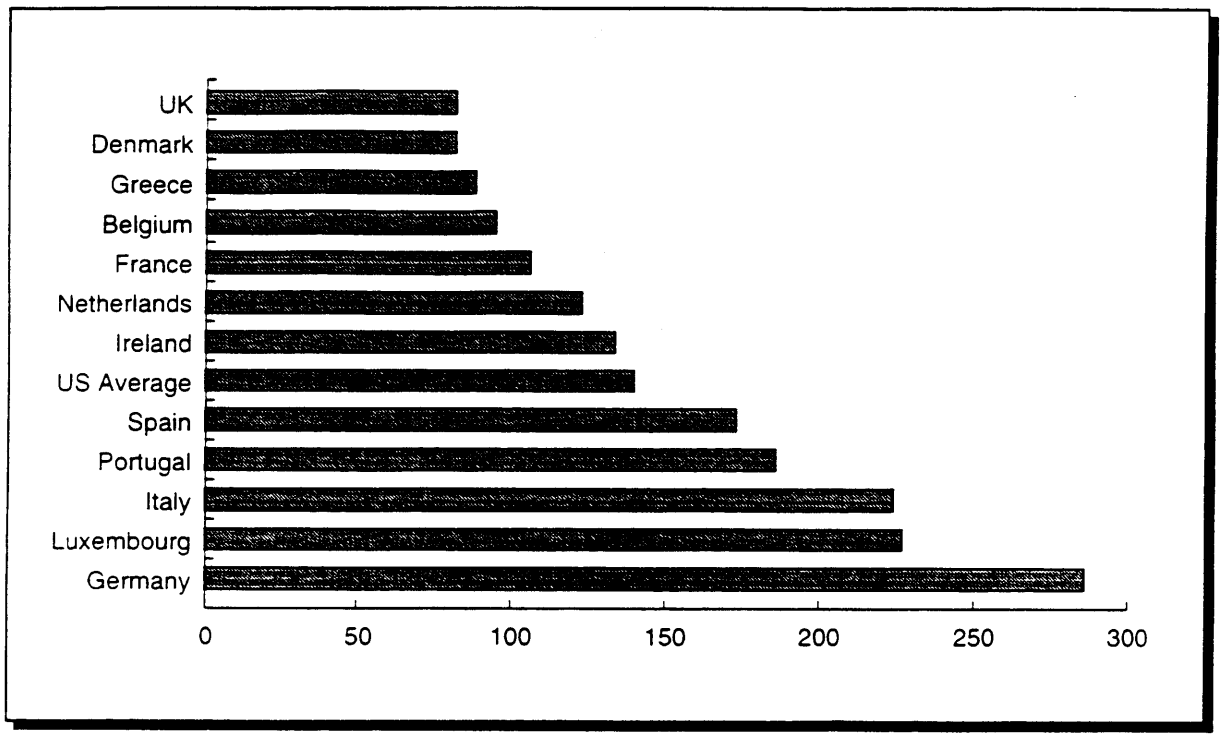
Local loop length is a key characteristic which helps to understand the ability of a local infrastructure to support high-bandwidth services and the costs associated with the corresponding upgrade. In the EU, the average local loop length appears to range from 1.2 km to 3.1 km, as shown in the country reports. It varies according to the density of the country considered and the local network architecture used. Most Operators are in the process of restructuring their local architecture. This usually implies bringing optical fibre closer to clients' premises. In high-density areas, fibre rings are deployed so as to ease the deployment of SDH technology and increase the flexibility of the network in terms of bandwidth.

European telecommunications have relied heavily on underground cabling. Overhead cables have been solely used in low-density areas. (This is in contrast to the US situation were overhead installations are more common in medium-density areas – such as city suburbs.) Ducts are used by most European Operators for underground installations although some install cables with no protection. In a typical local network, public works represent 40 per cent to 70 per cent of total investment.

Most European Operators' levels of investment per line appear comparable to those of US Operators, as shown by Exhibit 2.5. They are highest in Germany (because of the Eastern Lander) with Italy and Luxembourg also showing above-average levels.

The trunk networks of European Operators tend to be generously over-dimensioned but, because of national borders, largely more fragmented than that of US long-distance Operators. This occurs despite projects such as "METRA" (Manless European TRAnsmission network) and "GEN" (General European Network). Because they use a high proportion of repeaters, multiplexers/demultiplexers, European networks, in general, have a higher number of intermittent failures than would be experienced in a less fragmented network. For companies, the availability, price and quality of leased lines, in particular international leased lines, are much less favourable in Europe than in the US

Exhibit 2.5: Investment per main line of incumbent operators (1992£)

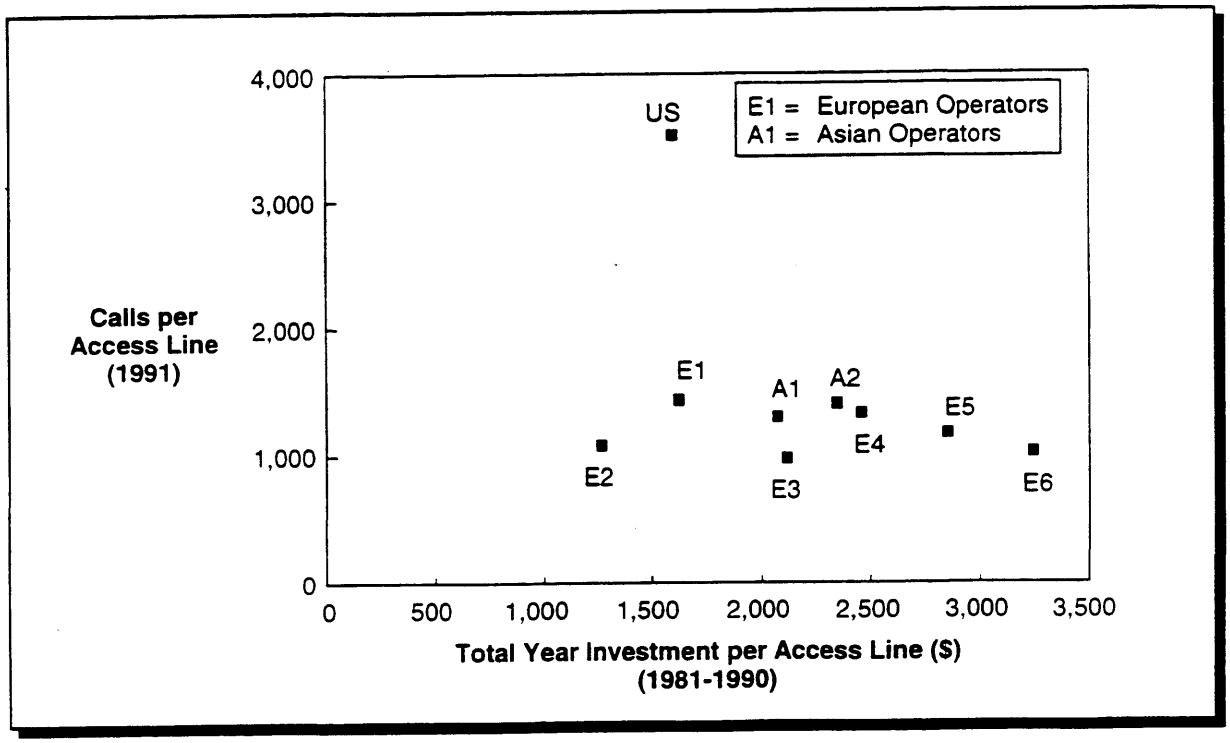


Source: Disclosure Worldscope; Mercer Management Consulting research

The quality and structure of CATV networks vary widely across Europe. In some countries, like the UK, US RBOCs and other players are building modern, COAX cable networks with telephony overlay (the total investment programme in the UK is worth over £10 billion). In other countries, like Belgium, some networks are one-way "tree and branch-type" networks, whose ability to support telephony services is questionable. In between there is a range of networks that offer, to varying degrees, the potential for a telecommunications infrastructure.

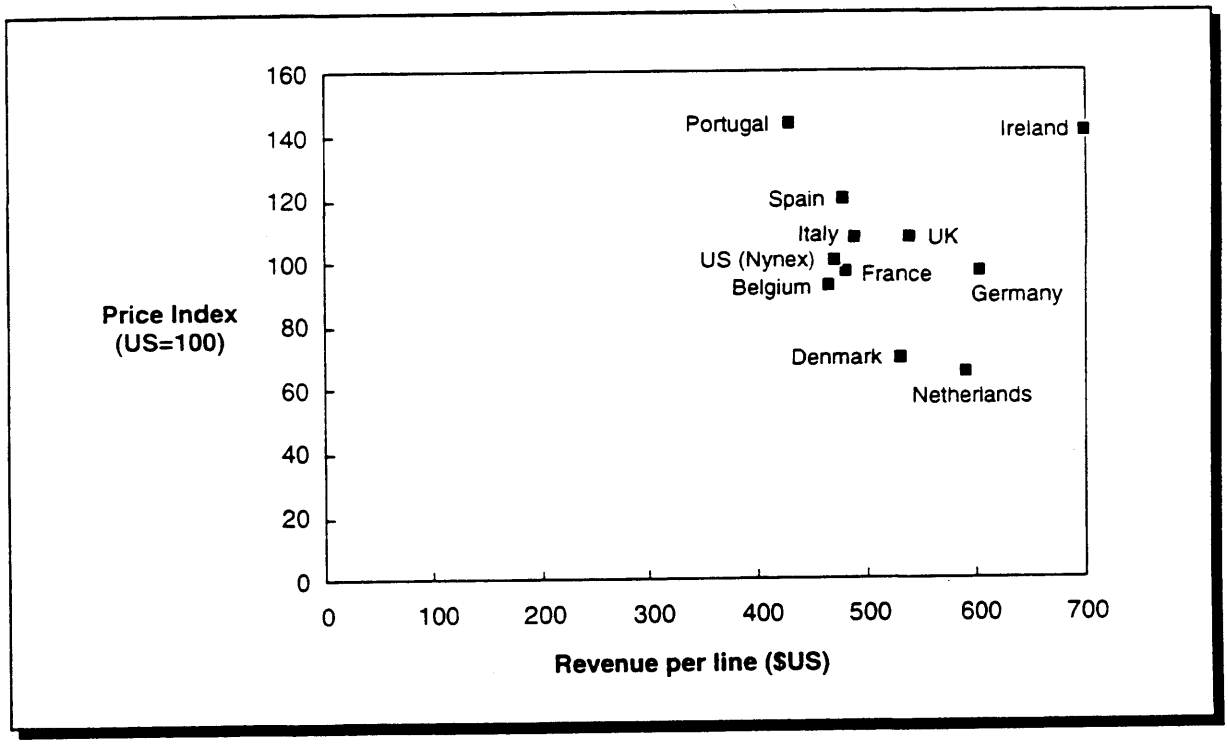
Revenues

Exhibit 2.6: A comparison of investment efficiency by country makes the US stand out in terms of calls per access line



Source: Mercer Management Consulting research

Exhibit 2.7: Revenue per line/price of telephony for incumbent operators



Source: ITU; Annual reports; Mercer Management Consulting research

As shown in Exhibit 2.6, the traffic "volume" per line of European telecommunication Operators tends to be lower than that of most US Operators: the best European Operators are only at the level of the least performing US ones. Prices in Europe are higher than in the US. Therefore, when revenues per line are compared, European Operators have revenues per line comparable or above those of the US Operators (see Exhibit 2.7).

Infrastructure Ownership

Exhibits 2.8 and 2.9 describe the ownership of the main alternative infrastructures and of CATV Operators. In Exhibit 2.9, countries are ranked based on the extent to which telecommunication Operators also own CATV infrastructures.

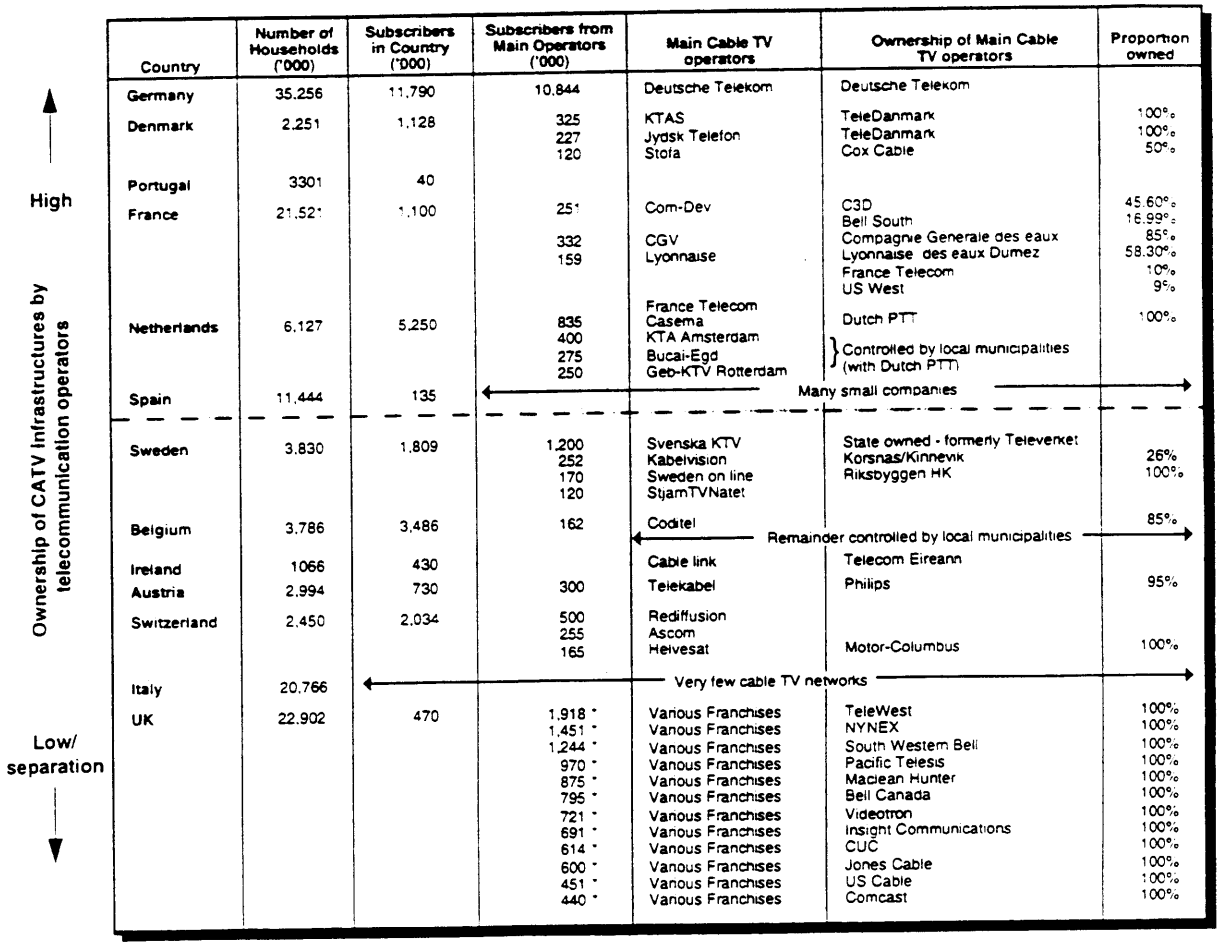
Exhibit 2.8: Ownership of the main alternative infrastructures, 1994

Country	Local Loop		Long Distance	
	Private	Public	Private	Public*
Belgium	Coditel Other local CATV operators	–	–	SNCB Utilities
United Kingdom	TeleWest NYNEX cable General cable Other local CATV operators	–	Energis	British Rail Utilities
Denmark		–	–	–
France	CGV Communication-Développement (1) Lyonnaise Communications Other local CATV operators	France Télécom (CATV) EDF (CATV)	–	SNCF Utilities Highways
Germany	Small operators (CATV)	DBP Telekom (CATV)	–	RWE Bayernwerk Deutsche Bundesbahn VEBA Other Utilities
Ireland	Cable-Link	–	–	Electricity board
Italy	–	–	–	FS (Rail) Utilities Highways
Greece	–	–	–	N/A
Luxembourg	Small operators (CATV)	–	–	–
Netherlands	VECAI Other local CATV operators	–	–	Enertel
Portugal	–	Portugal Telecom (CATV)	–	Railways
Spain	–	–	Megared - BT	Railways

Note: *(1) To be sold in 1995*
* *Including semi-public companies*
Source: *Mercer Management Consulting research*

In Germany and, to a lesser extent, Denmark, France, Portugal, Ireland and the Netherlands, the Telecom Operator owns all or much of the CATV infrastructure. This makes competition between telephony and CATV infrastructures in these countries less likely.

Exhibit 2.9: Overview of main European cable TV operators, 1994



Ownership of CATV infrastructures by telecommunication operators: High ↑ / Low/separation ↓

Country	Number of Households ('000)	Subscribers in Country ('000)	Subscribers from Main Operators ('000)	Main Cable TV operators	Ownership of Main Cable TV operators	Proportion owned
Germany	35.256	11,790	10,844	Deutsche Telekom	Deutsche Telekom	
Denmark	2.251	1,128	325	KTAS	TeleDanmark	100%
			227	Jydsk Telefon	TeleDanmark	100%
			120	Stofa	Cox Cable	50%
Portugal	3301	40				
France	21.521	1,100	251	Com-Dev	C3D	45.60%
					Bell South	16.99%
			332	CGV	Compagnie Generale des eaux	85%
			159	Lyonnaise	Lyonnaise des eaux Dumez	58.30%
					France Telecom	10%
					US West	9%
				France Telecom		
Netherlands	6.127	5,250	835	Casema	Dutch PTT	100%
			400	KTA Amsterdam		
			275	Bucai-Egd	} Controlled by local municipalities	
			250	Geb-KTV Rotterdam	} (with Dutch PTT)	
Spain	11,444	135	← Many small companies →			
Sweden	3.830	1,809	1,200	Svenska KTV	State owned - formerly Televerket	
			252	Kabelvision	Korsnas/Kinnevik	26%
			170	Sweden on line	Riksbyggen HK	100%
			120	StjarnTVNatet		
Belgium	3.786	3,486	162	Coditel		85%
			← Remainder controlled by local municipalities →			
Ireland	1066	430		Cable link	Telecom Eireann	
Austria	2.994	730	300	Telekabel	Philips	95%
Switzerland	2.450	2,034	500	Rediffusion		
			255	Ascom		
			165	Helvesat	Motor-Columbus	100%
Italy	20.766	← Very few cable TV networks →				
UK	22.902	470	1,918 *	Various Franchises	TeleWest	100%
			1,451 *	Various Franchises	NYNEX	100%
			1,244 *	Various Franchises	South Western Bell	100%
			970 *	Various Franchises	Pacific Telesis	100%
			875 *	Various Franchises	Maclean Hunter	100%
			795 *	Various Franchises	Bell Canada	100%
			721 *	Various Franchises	Videotron	100%
			691 *	Various Franchises	Insight Communications	100%
			614 *	Various Franchises	CUC	100%
			600 *	Various Franchises	Jones Cable	100%
			451 *	Various Franchises	US Cable	100%
			440 *	Various Franchises	Comcast	100%

Note: * *Homes passed not subscribers*
Figures most recent available
Source: *Mercer Management Consulting research*

In Austria, Switzerland and the UK, the CATV industry has been able to develop with some strong owners (Philips, Alcatel, US RBOCs). In Belgium, ownership is very fragmented, even though the Tractebel group is involved in the *operation* of networks accounting for 56 per cent of subscribers. The Spanish CATV industry is both emerging and fragmented. Italy, Portugal and Greece have few cable networks. In these countries, a strong alternative infrastructure providing telephony and other services may be able to develop.

In most Member States, railways, utilities and large industrial concerns have themselves built large telecommunications infrastructures for they private use. These private Operators will play an essential role in supporting the emergence of new public telecommunications Operators. Furthermore, in many countries there is some complementarity between cable, mobile and alternative long-distance networks that is conducive to the emergence of alliances of alternative covering wide geographies and capable of offering broad portfolios of services.

More specifically, the situation of infrastructure development in the various Member States is the following:

2.2. Belgium

The incumbent TO, Belgacom, has a wide-ranging monopoly on the provision of telecommunications infrastructure. It operates 4.4m access lines (including 14,700 public pay phones) representing a penetration of 44 lines per 100 population (data in Exhibit 2.10). These values for penetration are close to the EU averages. The line density in Belgium is 144 lines per square kilometre and line growth from 1982 to 1992 was 60 per cent. The average monthly bill (rental + usage) for a PSTN line is ECU 44. Belgacom has average productivity, with 172 lines per employee.

Euro-ISDN (Integrated Services Digital Network) services started at the end of 1993, and Belgacom forecast that there will be 20,000 Basic Rate Access (BRA) equivalent connections by the end of 1994. At the end of 1993 there were about 115,000 leased lines, of which around 2 per cent were digital. The average monthly cost for a 2Mbit leased line in Belgium is ECU 6,482. Other data transmission services include X25 (8,500 connections) and videotex services (11,000 subscribers). Belgacom is one of the few EU Operators to offer Centrex services.

The call failure rate is 0.4 per cent on local calls and 2.5 per cent on national calls. Fifty-four per cent of local exchanges have been digitalised. From 1992, Belgacom decided to divide the existing local networks into sub-networks served by LDCs (Local Distribution Centres). The LDC will play the role of a sub-exchange for the sub-network. Each LDC is connected to the main exchange with an optical fibre. This progressive introduction of fibre in the access network will decrease the distance to the customer and facilitate the introduction of new services.

Ninety-five per cent of Belgacom's long-distance network has been converted from analog to digital technologies. The local network and the remaining analog components of the long-distance network are based on symmetrical pairs, co-axial cables and some radio links; it should be completely phased out by 2000. The digital network is being set up in two phases:

- Deployment of COAX cables equipped with 140 Mbps and, in some cases, 565 Mbps line systems. Some multi-mode fibres and radio links were also installed.
- A mono-mode fibre network interlinking all the transit exchanges, to be completed by the end of 1996. The transmission systems use 565 Mbps PDH equipment. SDH equipment will be deployed gradually from 1995-1996.

Belgacom is participating in the pan-European ATM trial and is planning the introduction of user-controlled ATM networks between 1995 and 1996.

Mobile services are provided exclusively by Belgacom Mobile (Belgacom 75 per cent, AirTouch 25 per cent), which operates an analog network based on NMT 450 technology that covers 95 per cent of the population (60,000 subscribers) and a GSM network that covered

Exhibit 2.10: Country statistics summary for Belgium

Belgium

Demographics

Population (m)	10
GDP per Capita (ECU)	18,175
Area (km^2)	30,519
Population Density (per km^2)	328
Number of Households (m)	3.724
Number of Households with Television (m)	3.575

Tariffs*

	ECU	Index[2]
Average Monthly Bill for PSTN	44	112
Average Monthly Bill for Mobile-Analogue	168	200
Average Monthly Bill for Mobile-GSM	157	183
Average Monthly Bill for Leased Line (2.0 Mbits)	6,482	220

Incumbent Network

Belgacom	
Main Lines (m)	4.395
Lines per 100 Population	44
Lines per 100 Households	118
Lines per km^2	144
Public Pay Phones	14,700
Digitalisation of Trunk Network (%)	95
Fibre Optic in Network (km)	N/A
Employees	25,643
Lines per Employee	172
Average Local Loop Length (km)	1.3
Call Failure Rate – Local %	0.4
Call Failure Rate – National %	2.5
Fault Rate – Faults/Line/Year	N/A
Mobile Networks	
Total Subscribers ('000)	130
Penetration (per 100 of population)	1.2
Total Growth '93-'94 (%)	95

New Service Testing

ATM	• Participating in pan-European ATM trial • Planned introduction of user-controlled networks and services in 1995-1996
SDH	• Gradual deployment planned from 1995-1996 – Single-mode fibre operating at up to 565 Mbit/s
VOD	• Belgacom considering trials

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	3,560	97	99	1,988	1:1.2
Railway	0	0	0	N/A	0
Electricity	0	0	0	N/A	0
Other	0	0	0	0	0
Total	**3,560**	**97**	**99**	**1,988**	**1:1.2**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

90 per cent of the population at the end of 1994 (70,000 subscribers). Belgacom also offers a paging service, which had 215,000 subscribers as of May 1994. The total penetration of mobile telephony in Belgium is 1.2 per cent. The average monthly bill is ECU 168 for an analog mobile telephone and ECU 157 for a GSM telephone.

The Belgian CATV industry is the most mature in the EU. Unlike the telecommunications industry, which is regulated at the national level, the CATV industry is regulated on a regional basis (Flemish, Walloon and Brussels). More than 95 per cent of homes are passed (3.6m), and 94 per cent of households are connected (the highest penetration level in the EU). The ratio of CATV lines to telephone lines in Belgium is 1:1.2. Less than 1 per cent of households have satellite receiving equipment.

Ninety per cent of the CATV networks are controlled by consortia of city authorities with or without involvement from private companies. This structure is due to the public service nature that cable distribution has always had in Belgium. Tractebel, via Electrabel and Coditel (Exhibit 2.11), is involved in 56 per cent of the market (measured as a percentage of the connected customers), mostly as a network Operator on behalf of the local consortia.

The cable networks are old, dating back to the 1960s and 1970s; they are based on a tree-and-branch architecture and COAX/COAX technology. Their ability to support telephony services is questionable. The CATV Operators seem to be more interested in gaining more freedom in their service offerings (i.e., programming) and in their pricing than in offering telephony services.

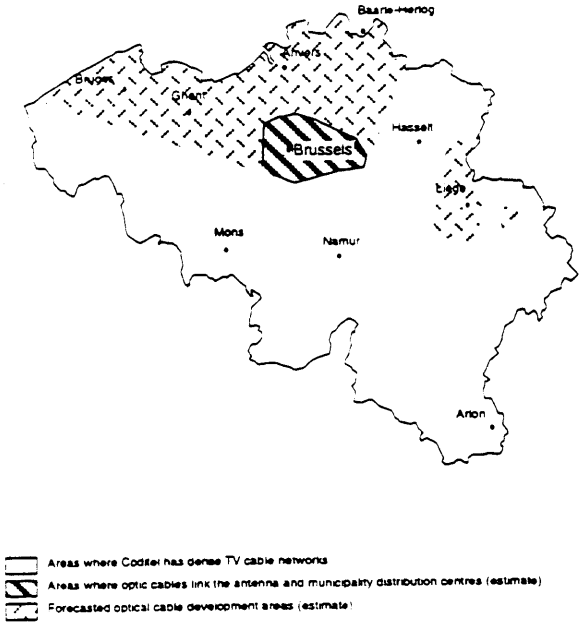
Besides CATV networks the main alternative infrastructures include the following, as shown in Exhibit 2.12:

- SNCB (railway) owns a dense long-distance network (PSTN and X25 in addition to signalling applications), which is currently used solely for its own internal purposes (Exhibit 2.13). Optical fibre deployment is limited at the moment. SNCB's serious financial problems may limit its abilities to develop a state-of-the-art network on its own.
- Electrabel (electricity production, electricity and gas distribution) has an electricity distribution grid covering most of Belgium (see Exhibit 2.14). It owns the rights-of-way along its overhead high power electricity lines.

Other alternative infrastructures in place are owned by waterways, highways and regional transport companies (see Exhibit 2.12).

Exhibit 2.11: The Coditel (Cable TV) infrastructure

Country	Category	Company	
Belgium	Cable TV	Coditel	



Current Features

General Considerations
- Coditel network is a one way TV network - it is a delivering system from the reception antenna to the customers TV set
- The cable network used is mainly a copper COAX network
- The whole network has been renewed since 1992

Cable
- Coditel has available capacity for Telecom purposes with several channels available
- The network is built on a tree basics with the possibility to quickly implement interactivity
- The existing optic cables are always a reception antenna to municipalities distribution centres

Duct
- The majority of TV cables are aerial (95%)

Current use
- TV programmes transmission

Localisation
- Optic fibres where mainly laid in the Bruxelles area and only few in Flanders region

Specifics
- Until today the Coditel network is very heterogeneous

Network Improvements (Ongoing or Planned)
- The next implementation of optic links will finish the planned programme in the Bruxelles area and start in the Flanders region - the South as the population density is smaller will be concerned much late

Ownership
- The infrastructures including the telecom network are owned by Coditel

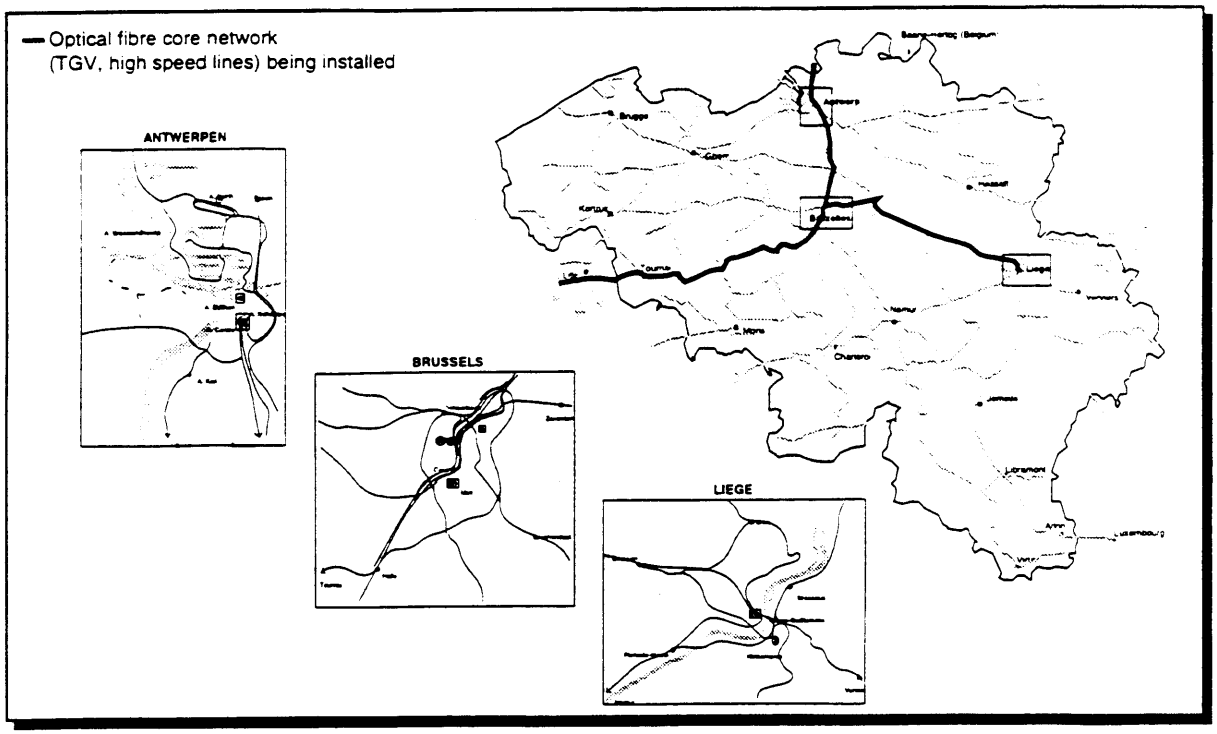
Source: Mercer Management Consulting research

Exhibit 2.12: Main alternative infrastructures in Belgium

Category	Name	Location	Comments
Long distance :			
Railways	• SNCB	Nationwide	Societé Nationale de Chemins de Fer Belges
Electricity	• Electrabel	Nationwide	Tractebel Group
Gas Pipelines	• Electrabel	Nationwide	Tractebel Group
Oil Pipelines			
Waterways	• Dep Leefmilieu en Infastructuur Administratie	Flemish Region	
	• Direction Générale des Voies Hydrauliques	Wallon Region	
	• NV ZeeKannal en H. Van Brussel	Brussels Region	
	• Brussels Port	Brussels	
Highways	• Direction Générale des Autoroutes et des Routes	Wallon Region Flemish Region	
	• Dept of Environment and Infrastructure		
Local :			
Local transport	• VVM	Flemish Region	Vlaamse Vervoermaatschappij
	• SRWT	Wallon Region	Societe Regionale de transport
Cable TV	• Coditel		Tractebel Group
	• Brutele		
	• ALE-Teledis		
	• Interelectra		
	• Integan		
	• Electrabel		Tractebel Group
	• Electrabel		Tractebel Group
Local Public Utilities			
Teleport	–		

Source: Mercer Management Consulting research

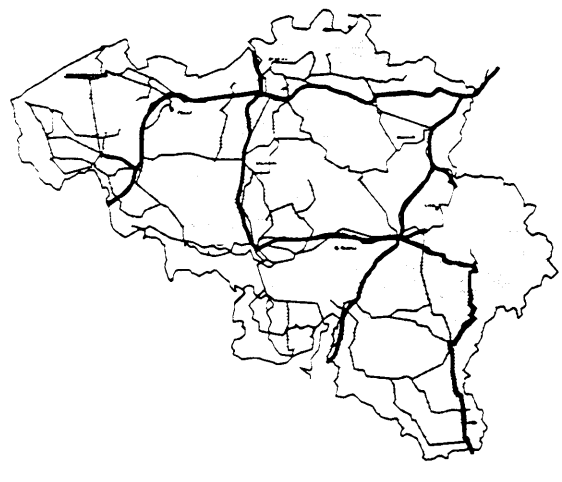
Exhibit 2.13: Example: Société Nationale des Chemins de Fer Belges (Railways) network



Source: Mercer Management Consulting research

Exhibit 2.14: The Electrabel (electricity utility) telecommunication infrastructure

Country	Category	Company	
Belgium	Electricity	Electrabel	



Main Activity

Features
- Electrabel is active in two fields:
  - Electricity generation and transmission
  - Operating and managing networks of public - utility services: electricity, natural gas, CATV, steam and water
- Electrabel provides 94% of Belgium's total electricity production; the remainder is provided by public sector production and by in-plant generators.

Ownership
- Electrabel owns its whole high power production and transport infrastructure

Telecom rights of way

Ownership

TV network
- The companies performing the operations and the management of the TV cables own the right of way implicitly
- It has to be given ones by the municipalities

Telecom network
- Tractebel owns the right of way along its overhead high power electricity lines
- If the lines are underground Electrabel owns still the right of way for any new cable installation as long as no digging works are needed

Legal authorisations

TV network
- All municipalities are represented in the mixed companies; this situation allows them to be directly informed about all new developments and take decisions according to it

Telecom network
- Electrabel has a right of way for a specific number of cables along its power lines - as long as a cable is replacing an existing cable there is no problem - if the allowed number of cables has to be increased a legal authorisation is necessary

Technical authorisations

TV network
- No specific technical constrains to plan cable installations

Telecom network
- To get the legal authorisation to increase the number of cables on a high power line a technical feasibility authorisation is necessary

Source: Mercer Management Consulting research

Exhibit 2.15: Country statistics summary for Denmark

Denmark

Demographics

Population (m)	5.1
GDP per Capita (ECU)	23,189
Area (km^2)	43,093
Population Density (per km^2)	120
Number of Households (m)	2.24
Number of Households with Television (m)	2.20

Tariffs*

	ECU	Index[2]
Average Monthly Bill for PSTN	48	122
Average Monthly Bill for Mobile-Analogue	85	101
Average Monthly Bill for Mobile-GSM	59	69
Average Monthly Bill for Leased Line (2.0 Mbits)	2,006	68

Incumbent Network

Tele Danmark	
Main Lines (m)	3.12
Lines per 100 Population	59
Lines per 100 Households	139
Lines per km^2	71
Public Pay Phones	N/A
Digitalisation of Trunk Network (%)	100
Fibre Optic in Network (km)	N/A
Employees	16,845
Lines per Employee	182
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	1.2
Call Failure Rate – National %	1.9
Fault Rate – Faults/Line/Year	0.14
Mobile Networks	
Total Subscribers ('000)	514
Penetration (per 100 of population)	10
Total Growth '93-'94 (%)	80

New Service Testing

ATM	• Participating in the pan-European ATM trial • KTAS and Telecom working with Siemens in Copenhagen
SDH	• Deployed in long-distance network in 1993
VOD	• N/A

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	1,250	76	74	N/A	1:25
Railway	0	0	0	2,000	0
Electricity	0	0	0	N/A	0
Other	0	0	0	0	0
Total	**1,250**	**76**	**74**	**2,000**	**1:25**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

2.3. Denmark

Tele-Danmark has a monopoly on the provision of telephony services and infrastructure in Denmark. The regional telephone networks (KTAS in Copenhagen, JTAS in Jutland, TS in the South Jutland Peninsula and FT on the Fyns Island) are all subsidiaries of Tele-Danmark. Forty-nine per cent of Tele-Danmark was privatised recently. There are 3.06m access lines in operation, representing a penetration rate of 59 lines per 100 population (data in Exhibit 2.15). Penetration per 100 households is at one of the highest levels in the EU. The line density in Denmark is 71 lines per square kilometre, and line growth between 1982 and 1992 was the lowest in the EU at 30 per cent. The average monthly bill (rental + usage) for a PSTN line is ECU 48. Tele-Danmark has average productivity, with 182 lines per employee.

Advanced services offered include ISDN and X25. There are 2,354 ISDN subscribers, 97 per cent of whom are basic rate subscribers. In 1992 there were 3,020 X25 subscribers and 29,400 leased line subscribers. Seven per cent of these leased lines were digital. The current average monthly cost for a 2Mbit leased line is ECU 2,006. Frame relay services were launched in the spring of 1993.

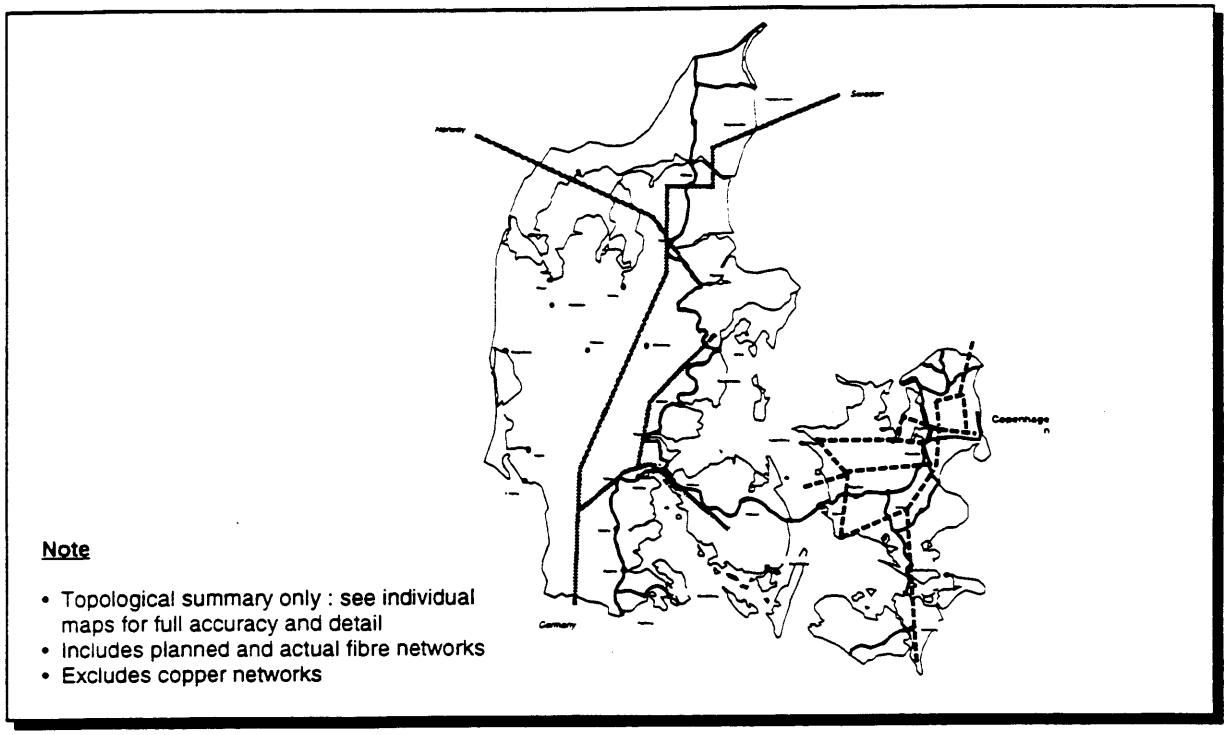
The trunk network is 100 per cent digitalised, and 46 per cent of local exchanges have been converted to digital switches. The call failure rate is 1.2 per cent on local calls and 1.9 per cent on national calls. The number of faults reported per line per year is 0.14.

Exhibit 2.16: Main alternative infrastructures in Denmark

Category	Name	Location	Comments
Long distance:			
Railways	• DSB	Nationwide	Danish State Railways
Electricity	• ELSAM Group	Jutland	Includes the 7 regional companies of Jutland
	• SEAS A/S	Sealand	
	• NESA A/S	Sealand	
	• ARKE	Sealand	
	• NVE	Sealand	
Gas Pipelines	• Dangas (Dong)	Nationwide	Dansk Oil & Naturgas
Oil Pipelines	• Doras (Dong)	Nationwide	Dansk Oil & Naturgas
Highways	• State owned	Nationwide	
Local:			
Local transport	• No subway, DSB trains	Copenhagen	
Cable TV	• KTAS	Copenhagen	Kopenhagen Telefon AS
	• JTAS	Jutland	Jutland Telefon
	• STOSA		
	• Fyns Telefon		
	• TS		
Local Public Utilities	–		Strongly atomised
Teleport	–		

Source: Mercer Management Consulting research

Exhibit 2.17: Summary map of the alternative long distance infrastructure in Denmark



Source: Mercer Management Consulting research

Tele-Danmark is participating in the pan-European ATM trial. SDH equipment is being deployed into the long-distance network. Experiments have been conducted with fibre-in-the-loop, with plans for the cabling of all major business areas in the next few years.

Mobile telephony is provided by Tele-Danmark and a private competitor, Sonofon. Thanks to favourable demographics, low prices and effective marketing, penetration stands at 10 per cent, one of the highest rates in the world. There are 514,000 subscribers, of which 46 per cent are connected to analog networks. The total growth in mobile subscribers between 1993 and 1994 was 80 per cent. The average monthly bill is ECU 85 for an analog subscriber and ECU 59 for a GSM subscriber. Tele-Danmark will launch a paging service using the ERMES standard in the first half of 1995.

The CATV industry is very fragmented, with more than 10,000 networks in operation. The number of homes passed is 1.7m (76 per cent of all homes), of which 1.25m are connected (56 per cent of all homes). The ratio of CATV lines to telephone lines is 1:2.5. Tele-Danmark (via its regional companies) has about 50 per cent of all CATV subscriptions. Its networks are also the largest in the country and generally the most technically advanced. Tele-Danmark has conducted technical tests of multi-media services. However, plans for the introduction of these services have not been revealed. Tele-Danmark has nevertheless announced its intention to invest in the upgrade of its network starting in 1996.

Most other CATV networks are owned by the municipalities, which operate their own networks if they are large enough. Otherwise, the operation and management of the networks is sub-contracted to specialist companies.

The largest CATV Operator other than Tele-Danmark is Stofa, which manages (but does not own) approximately 25 networks countrywide with an estimated customer base of 120,000 households (20 per cent market share). This consortium includes Cox Enterprises and GN Store Nord A/S.

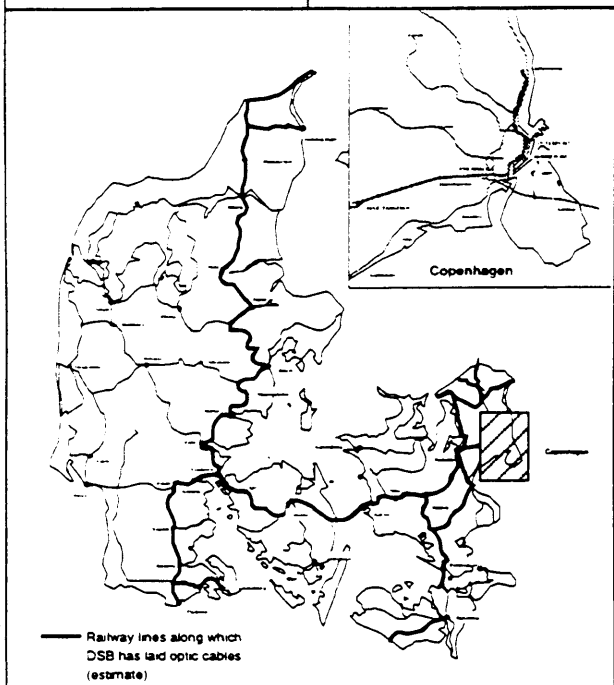
Penetration of DTH reception equipment is estimated at 6 per cent, with most users concentrated in rural areas where CATV networks are not economically viable.

Apart from the CATV networks, the main alternative telecommunications infrastructures include (see Exhibits 2.16 and 2.17):

- DSB (railway), with an extensive long-distance network on the mainland and on the main island. DSB owns the rights-of-way along the tracks (see Exhibit 2.18).
- ELSAM (electricity distribution), which is the Operator of the national electricity grid (see Exhibit 2.19).
- NVE, NESA and SEAS (electricity distribution), which have geographically limited networks mainly in Sealand. They have formed a company, ELKRAFT, which will manage the power and telecommunication links of the companies to Germany and Sweden (see Exhibit 2.20).

Exhibit 2.18: The DSB (Railways) telecommunication infrastructure

Country: Denmark	Category: Railway	Company: DSB	



Current Features

General considerations

- DSB has a concentrated and efficient optic fibre network

Cable

- No information is available concerning the cable capacities

Duct

- DSB's network is mainly based on buried cables

Current Use

- The current network utilisation is mainly:
  - Operation and railway management
  - Data transmission

Localisation

- Very developed

Network Improvements (Ongoing or Planned)

- Complete the optic cable installation in the whole network as fast as possible (DSB is considering the probable 1997 deregulation very seriously)
- DSB wants to be able to have a core optic line crossing Jutland north to south and linked to a Sealand equivalent line

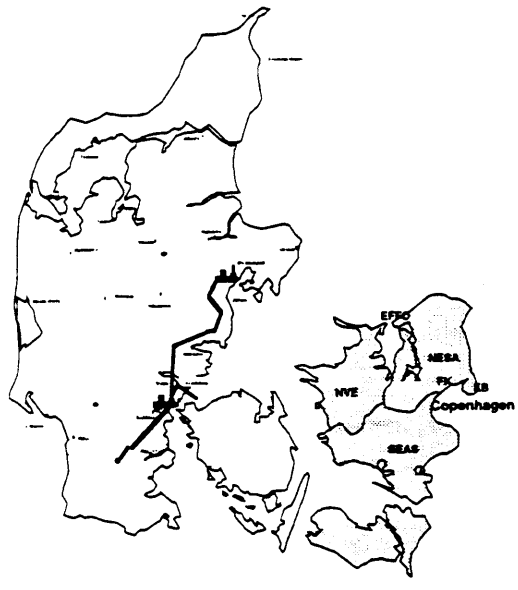
Ownership

- DSB owns the infrastructure and has the full concession of the ground which is the Danish State's property

Source: Mercer Management Consulting research

Exhibit 2.19: The ELSAM (Electricity utility) telecommunication infrastructure

Country	Category	Company	
Denmark	Electricity	ELSAM Group	



Current Features

General Considerations
- The current ELSAM network is mainly a radio link network
- Optic cable were installed in some places between power utilities and sub-stations like transformers (small 7-20km distances)
- An ongoing ten year project will allow ELSAM to have a optic cable network North to South Jutland

Cable
- The current optic cable network has 70km representing the first steps of the Jutland 10 years project
- The optic cable used contain 12 fibres of which only 2 to 6 fibres are really used for ELSAM operation needs
- The current transmission system is PDH with 8 to 32 Megabits capacity – it seems that ELSAM is able to upgrade it very easily to very high capacity (540 megabits) at low costs

Duct
- Most optic cables were laid on high power lines (400kw) integrated in a steel earthwire

Duct (cont)
- The environment pressures tend to favour underground installations for high power lines and telecom cables
- The ELSAM underground conduits have often room for several cables

Current Use
- Remote control of power stations
- Teleprotection
- Internal operation telephone
- Data transmission

Localisation
- The first steps of the Jutland project was about 70km between Fiskerbaek and Horsens
- The other existing links are between power stations and sub-stations:
  - Odense power utility to sub-station outside the town (16 km)
  - Fiskerbaek power utility to sub-station outside town (7km)
  - Other very small links from power plants to transformers

Network Improvements (Ongoing or Planned)
- The current 10 years project has the ambition to link all power production plants from North to South Jutland between themselves and in a second stage with German, Swedish and Norwegian lines – this project will bring ELSAM and ELKRAFT to work together for the Jutland/Sealand link
- ELSAM is using each opportunity to lay optic cables (cable replacement, new lines, reconstructions....)

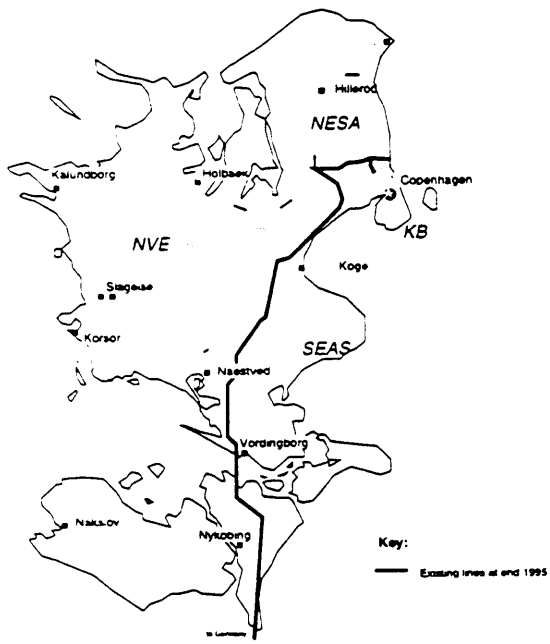
Ownership
- ELSAM has a State concession but owns its infrastructures

Source: Mercer Management Consulting research

Exhibit 2.20: The NESA (Electricity utility) telecommunication infrastructure

Country	Category	Company	
Denmark	Electricity	NESA	

Sealand's Optic Network



Current Features

General Considerations
- The NESA telecom network is always along high power lines
- Most of the network is still copper cable with a 2 Megabit transmission capacity

Cable
- NESA currently has a 60 km optical cable network
- Optic fibres per cable range from 12 to 24 (for the most recently installed), but only 1-2 fibres are currently being used
- The transmission capacity is 8 Megabits to 34 Megabits

Duct
- 80% of the cables are overhead and 20% buried
- NESA prefers aerial cables because installation is cheaper and faster
- The buried cables were not laid in conduits but directly in the ground
- Environment pressure could increase the % buried

Current Use
- Data processing and transfer
- Internal telephone
- Electricity operation needs
- Control systems

Localisation
- Middle Sealand form Hellerup to south Copenhagen
- Optic cables were installed in some places between power utilities and sub-stations like transformers (small 7-20 km distances)

Specifics
- Legal limitation make cable installation a slow procedure – it can only be justified through electricity power lines improvements or new needs and construction

Network Improvements (Ongoing or Planned)
- The network programme (ELKRAFT) involving SEAS NESA and NVE will link South and North of Sealand (about 180 km) to Germany (70 km) and Sweden (40 km) with optic fibres and should be achieved in 2004
- This project is managed by ELKRAFT (a common company to NESA, SEAS, and NVE) and the southern part should be finished with a link to Germany at the end of 1995

Ownership
- ELKRAFT owns the optic network from Copenhagen to Germany. The ELKRAFT company was created by the three main Sealand power distributors SEAS, NESA, and NVE, to link Sweden, Germany and Sealand with a high power electricity line and an optic "data & control" network (the current telecom network)
- NESA is fighting to keep ownership of the optic fibre section crossing its action area (the North of Sealand)

Source: Mercer Management Consulting research

2.4. France

All the public telecommunications infrastructure is owned and operated by France Telecom. The CATV infrastructure is concentrated and controlled by four main players.

France Telecom's network is the second largest in Europe, with a total of 30.8m access lines (including 184,000 public pay phones) (see Exhibit 2.21). This represents a penetration of 54 lines per 100 population, the highest level of penetration per household in the EU. The line density in France is 57 lines per square kilometre, and line growth between 1982 and 1992 was 58 per cent. The average monthly bill (rental + usage) for a PSTN line is ECU 50. France Telecom has above average productivity, with 198 lines per employee.

The total number of leased lines was 480,000 at the end of 1993, of which 77 per cent were analog. The average monthly cost of a 2Mbit leased line is ECU 6,193. There were 310,000 Basic Rate Access equivalent ISDN connections and 110,000 connections to packet-switched networks. The packet-switching offering has been complemented since 1993 by a frame-relay service, and 6.5 million Videotex (Minitel) terminals are in operation with more than 10,000 service offerings on the network.

France Telecom has installed 55,000 km of fibre optic cable in the network, including 17,000 km in the long-distance network. At 85 per cent, the digitalisation rate is one of the highest in the EU. The PSTN network has a hierarchical structure with five main switching centres and 67 secondary transit switching centres.

France Telecom started regional trials of SDH in 1993. It plans an extensive deployment of SDH systems on its national backbone network by 1998, to be followed by a complete deployment at all levels by about 2010.

France Telecom is a participant in the pan-European ATM trial and already offers high-speed interconnection services based on this platform in Paris, Grenoble and Nice. A deployment to all major cities is due to take place in 1995. Furthermore, France Telecom recently announced the offering of international ATM-based services in cooperation with Deutsche Telecom.

The recent publication of the "Théry Report" on the information super-highway has re-launched debate on future policy for advanced infrastructure. The report estimates total spending for full coverage with broadband infrastructures at ECU billion 30 to 35 over a 20-year period. Small-scale experiments are being discussed currently at Government level and requests for proposals for these experiments may be issued in the next few months.

Although France Telecom has reacted with scepticism to the Report and questioned the economic feasibility of the investment programme, it has expressed its willingness to participate

Exhibit 2.21: Country statistics summary for France

France

Demographics

Population (m)	56.7
GDP per Capita (ECU)	19,290
Area (km^2)	543,965
Population Density (per km^2)	104.9
Number of Households (m)	21.521
Number of Households with Television (m)	20.90

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	50	128
Average Monthly Bill for Mobile-Analogue	194	231
Average Monthly Bill for Mobile-GSM	148	172
Average Monthly Bill for Leased Line (2.0 Mbits)	6,193	211

Incumbent Network

France Telecom	
Main Lines (m)	30.8
Lines per 100 Population	54
Lines per 100 Households	143
Lines per km^2	57
Public Pay Phones	184,000
Digitalisation of Trunk Network (%)	85
Fibre Optic in Network (km)	55,000
Employees	155,300
Lines per Employee	198
Average Local Loop Length (km)	<3
Call Failure Rate – Local %	0.5
Call Failure Rate – National %	0.5
Fault Rate – Faults/Line/Year	0.08
Mobile Networks	
Total Subscribers ('000)	807
Penetration (per 100 of population)	1.5
Total Growth '93-'94 (%)	59

New Service Testing

ATM	• France Telecom is participating in the pan-European ATM trial • Regional deployment in Paris, Grenoble, Nice • Extending to all major cities in 1995
SDH	• France Telecom started trials in 1993 • Plans for extensive deployment on national backbone network by 1998 and deployment at all levels by 2010
VOD	• France Telecom & Lyonnaise Communications trialling pay-per-view film service

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	1,260	25	24	N/A	1:24
Railway	0	0	0	23,000	0
Electricity	0	0	0	N/A	0
Other	0	0	0	N/A	0
Total	**1,260**	**25**	**24**	**23,000**	**1:24**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

in the forthcoming trials. Furthermore, it has announced the cabling in the short term of 5,000 buildings with fibre optic systems.

Mobile telephony services are provided by France Telecom and the Société Française du Radiotéléphone. A third competitor, led by Bouygues, will begin offering PCN services at the end of 1995. Combined penetration stands at 1.5 per cent of population with a total of 807,000 subscribers (46 per cent to digital networks), with subscriber growth of 59 per cent in the past year. The average monthly bill for an analog mobile telephone is ECU 194 and for a GSM telephone ECU 148.

The construction of CATV networks began in 1986 with the Plan Câble, although some older networks had been built to provide improved television reception in remote areas. The Plan Câble project, built by France Telecom, covered the 64 largest urban areas. Private Operators manage programming and sales, and since 1986 have been allowed to build CATV infrastructure as well.

At the end of 1993, the total number of homes passed was 5.3m (25 per cent of all households), and 1.3m homes were connected (6 per cent of all households). The infrastructure is split between old networks (3 per cent of homes passed), Plan-Câble networks (65 per cent of homes passed) and privately built networks (32 per cent of homes passed). The ratio of CATV lines to telephone lines is 1:24.

Eighty-five per cent of the market is controlled by four Operators:

- Compagnie Générale des Eaux (CGE): 28 per cent of homes connected
- Communication-Développement: 18 per cent of homes connected (Communication-Développement has announced its intention to sell its networks)
- Lyonnaise Communication (LC): 28 per cent of homes connected
- France-Telecom: 9 per cent of homes connected. By increasingly taking stakes in the Operators of Plan-Câble networks, France Telecom has become the fourth-largest network Operator.

The large water companies (CGE and LC) have expressed interest in offering telephony services. However, the control of France Telecom over the Plan-Câble networks and the various technical standards used for these networks limits the likelihood of local access competition in France in the short term.

Other significant alternative infrastructures include (see Exhibits 2.22 and 2.23):

- The SNCF (railway) has a PSTN network with 450 switches, of which 70 per cent are digital, and an X25 network with 95,000 internal users. Its long-distance network operates at 140 Mbps. (See Exhibit 2.24.)

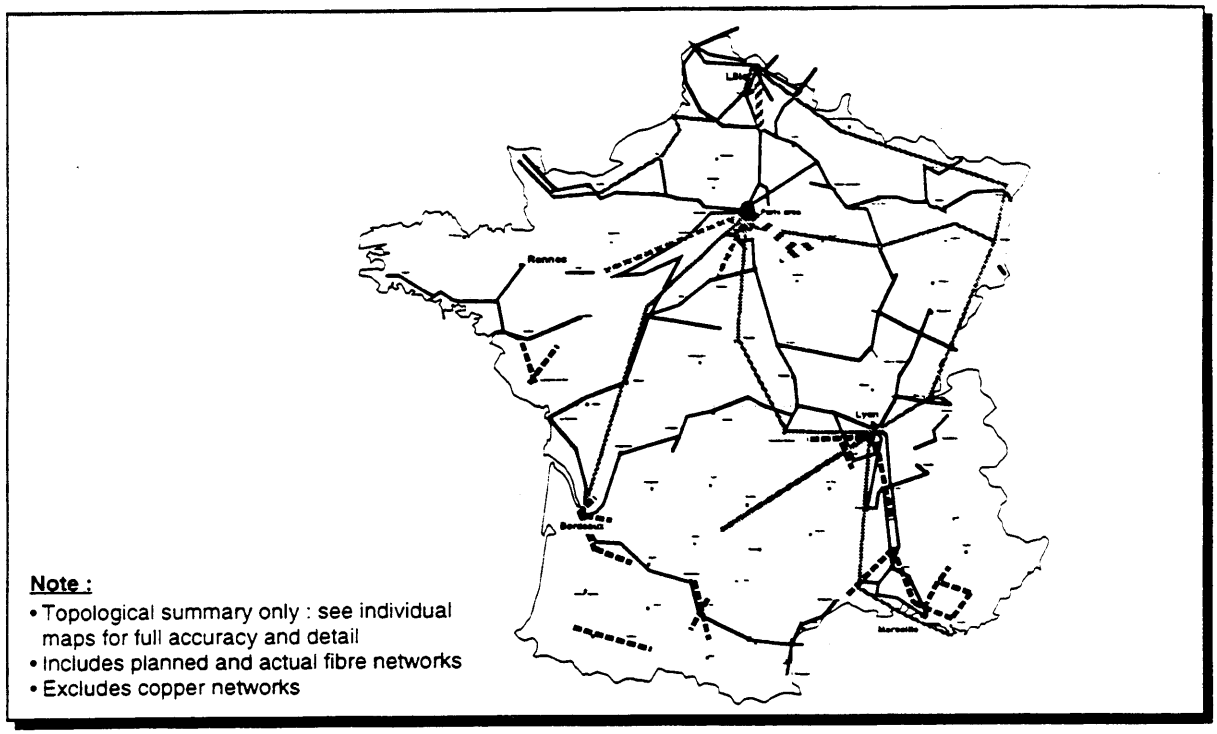
- EDF (electricity production and distribution) has a significant long-distance optical network, partially operated by France Telecom. Furthermore, EDF operates CATV networks in medium-sized cities via its Vidéopole subsidiary (190,000 homes passed). (See Exhibit 2.25.)
- In the Paris region, the local transportation company RATP operates extensive PSTN, X25 and video networks for train controls and tele-control of stations. It has rights-of-way along rail and underground tracks.
- Motorway companies all have significant long-distance infrastructures. Their operations are usually restricted to a region and they do not systematically own the rights-of-way. (See Exhibits 2.26-2.29.)

Exhibit 2.22: Main alternative infrastructures in France

Category	Name	Location	Comments
Long distance :			
Railways	• SNCF	Nationwide	Société Nationale des Chemins de Fer Français
Electricity	• EDF	Nationwide	Electricité de France
	• CNR	Rhône area	Compagnie Nationale du Rhône
Oil Pipelines	• TRAPIL	Northern France	Société des Transports Pétroliers par Pipeline
	• SPMR	Rhône area	Société du Pipeline Méditerranée - Rhône
Gas Pipelines	• GDF	Nationwide	Gaz de France
	• SNGSO	SW of France	Sté Nationale du Gaz du Sud Ouest
Waterways	• VNF	Nationwide	Voies Navigables de France. 100% state-owned
	• CNR	Rhône area	Compagnie Nationale du Rhône
	• Port Autonome de Paris	Paris region	
	• Port de Nantes	Bretagne, Loire	
Franchised Highways	• Cofiroute	East of France	Compagnie Financière et Industrielle des Autoroutes
	• ASF	South of France	Société des autoroutes du sud de la France
	• SANEF	NE of France	Société des autoroutes du nord et de l'est de la France
	• SAPRR	East of France	Société des autoroutes Paris-Rhin-Rhône
	• SFTRF	East of France	Société Française du tunnel du Fréjus
	• Villexpress		Villexpress has no franchised highway for the time being
	• STMB	SE of France	Société du tunnel sous le Mont-Blanc
Local :			
Local transport	• RATP	Paris area	Régie Autonome des Transports Parisiens
	• TRANSPOLE	Lille	Transports en Commun de Lille
	• RTM	Marseille	Régie des Transports de Marseille
	• TCL	Lyon	Société Lyonnaise des Transports en Commun
Cable TV	• France Télécom		
	• Lyonnaise Communication		
	• Com-Dev (Caisse des Dépots)		Communication & Developpement
	• CGV		Compagnie General de Videocommunications
Local Public Utilities	• Lyonnaise-Dumez		
	• Générale des Eaux	Paris	
	• CPCU	Paris	
Teleport	• Paris Ile-de-France	Paris	Compagnie Parisienne du Chauffage Urbain
	• Euroteleport de Roubaix	Paris	
	• World Teleport of Marseille Provence	Roubaix (Lille)	
		Marseille	
	• Teleport Cote d'Azur	Nice	Sofia-Antipolis
	• Teleport Avignon	Avignon	
	• Teleport Metz	Metz	

Source: Mercer Management Consulting research

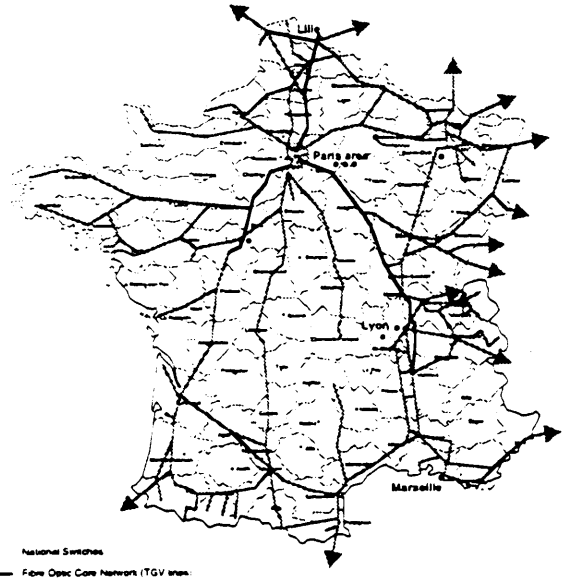
Exhibit 2.23: Summary map of the alternative long distance infrastructure in France



Source: Mercer Management Consulting research

Exhibit 2.24: The Société Nationale des Chemins de Fer Français (Railways) telecommunication infrastructure

Country	Category	Company	
France	Highway	SNCF	



Current Features

Cable

- SNCF has 4700km of optic cables with an average of 20 fibres (which represents 80,000km of optic fibres.)
- The fibre's capacity is 140 Megabits monomode – totally identical to France Telecom network features with high potential for capacity improvement
- 25% of the fibres are available and not used by SNCF
- Development of SDH is forecast and can be implemented by changing the existing line terminal systems

Duct

- SNCF lays the cable either in conduits beside the tracks or underground: it depends mainly on the nature of the ground and the potential rework frequency along the line
- The underground installations have room for a second cable which means all the work has to be done again when laying new cables
- Aerial laying will be considered in the future

Current Use

- Operation and coordination
- Data transmission/Video conferencing
- Technical links between specific points
- Telecontrol/surveillance of equipment
- Radio connections (lines end-to-end)

Localisation

- All new railway links built since 1986 were equipped with optic cables: North links: South West towards Bordeaux and Nantes
- The high speed links built between 1977 and 1986 have progressively been changed to optic fibres, primarily along the Paris-Lyon route
- The next planned links are Paris-Strasbourg (end 1995) and Valence-Marseille (end 1998)

Specifics

- 15%-20% of the optical network is co-owned with France Telecom

Network Improvements (Ongoing or Planned)

- The SDH system should start to be installed end of 1994 / mid 1995 and will then be generalised progressively to the whole optic network
- The optic cable programme will be followed until 2000/2005

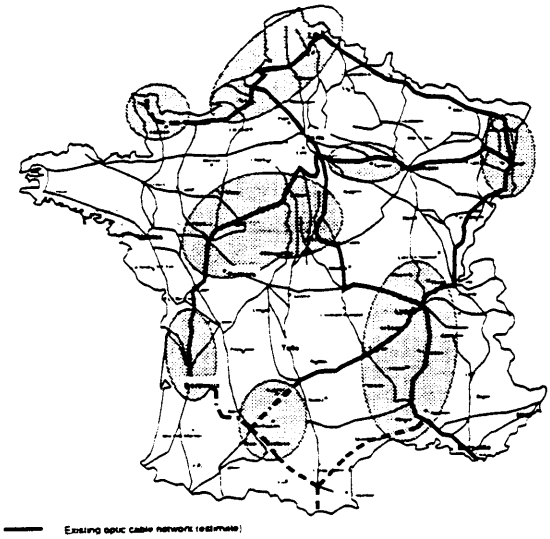
Ownership

- The land is SNCF's property
- All new developments have to meet feasibility constraints concerning the railway traffic and security needs

Source: Mercer Management Consulting research

Exhibit 2.25: The Electricité de France (Electricity production and distribution) telecommunication infrastructure

Country: France | **Category:** Electricity | **Company:** EDF



Existing optic cable network (estimate)
Potential extensions of the network (estimate)
Areas of high density optic cable links (estimate)
Main electricity links

Current Features

General Considerations

- The current network is mainly COAX
- Until now the EDF network has had a low % of optic fibres installed

Cable

- The optic cables installed have a 2 to 34 Megabits capacity
- The % of available fibres not used by EDF is low
- EDF is not allowed to install higher capacities than its real operation needs

Duct

- The whole network (COAX as well as optic fibre) is aerial and supported by the high voltage pylons

Current Use

- The current network is used exclusively for EDF's electricity operating purposes
  - Security systems
  - Operating needs related to electricity production and transport
  - Internal telephone needs
  - Data transmission

Localisation

- Optic fibres are currently located around EDF nuclear production units and main headquarters in Lyon and La Défense in Paris

Specifics

- The network is based on PDH multiplexing

Network Improvements (Ongoing or Planned)

- A major programme of optic cable installation between major French towns has been launched
- Links with Germany and Spain are priorities

Ownership

- The pylons and the whole electricity infrastructure and equipment is owned by EDF
- The French Government and local authorities keep the ownership of the land supporting the pylons and allow the concession to EDF
- The EDF concession has no limits in terms of potential new developments as long as EDF keeps all cables on the existing pylons
- At the entrance of large towns there are more restrictions as more local authorisations are required

Source: Mercer Management Consulting research

Exhibit 2.26: The SANEF (Highways) telecommunication infrastructure

Country: France | **Category:** Highway | **Company:** SANEF

SANEF's existing optic cable
SANEF's highway potential for further optic cable installations
Other French highways

Current Features

General Considerations

- SANEF wants to optimise its current installations based on radio wireless communication
- Its radio system has a 4x2 Megabits capacity with potential to increase it to 16 Megabits

Cable

- SANEF has only 60km of optic fibre
- The cables installed contain 10 fibres with 34 Megabits capacity of which only 8 Megabits are currently used

Duct

- SANEF laid its optic cables in underground conduits leaving room for 1 or 2 cables more
- The aerial installation was technically less reliable and thus not retained

Current Use

- Current highway operating needs:
  - Emergency calls
  - Electronic signalisations
  - Traffic management

Localisation

- From Combles (A1/A2 junction) to Fresnes (near Arras)

Specifics

- SANEF is very sensitive to the marginal profitability of its developments – this was not favourable to optic cable network installation until now

Network Improvements (Ongoing or Planned)

- No cable network implementation was planned until now
- The investment required for optic cable installation is large given the company financial resources and current legal constrains on third part participation

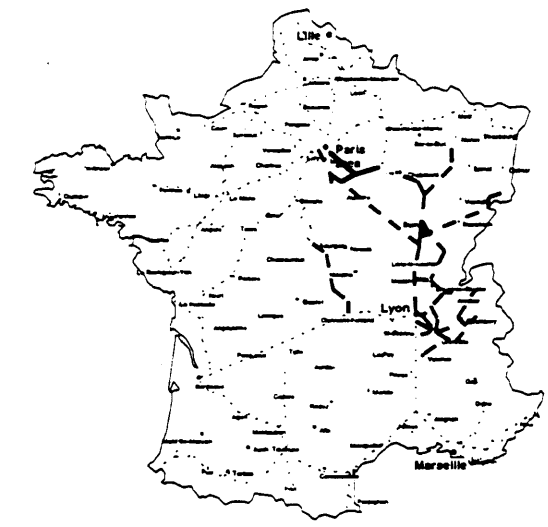
Ownership

- The company's ownership of the infrastructure terminates at the end of its concession with zero consideration or recompense

Source: Mercer Management Consulting research

Exhibit 2.27: The SAPRR (Highways) telecommunication infrastructure

Country: France | **Category:** Highway | **Company:** SAPRR



Current Features

General Considerations
- The current network is 1500 km copper COAX
- The optic cables represent approximately 300 km

Cable
- The cable contain an average of 10 to 15 optic fibres of which 50% is fully used
- The transmission capacity is 34 Megabits

Duct
- 50% of cables are buried and 50% in conduits
- The ducts have always enough room for one or more new cables
- The current installation are mainly done in conduit but it is more expensive
- Aerial solutions are not used very often

Current Use
- Urgency calls network
- Tollgate information transfer
- Traffic information transmission
- Electronic information board management

Localisation
- The optic cables were installed on recent highway constructions
- They are concentrated along the highway A5 (Dijon-Dôle) and A39 (Francilienne-Troyes

Specifics
- The remaining capacity was forecasted for telesecurity/surveillance based on camera systems planned in the original highway projects. If this is implemented the current optical cable network will be fully used

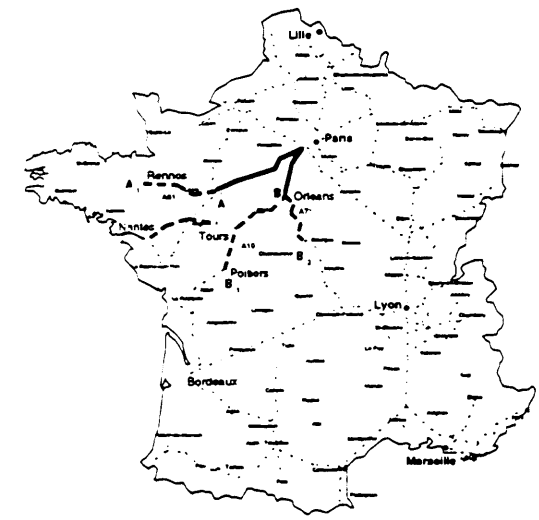
Network Improvements (Ongoing or Planned)
- The company planned to install SDH multiplexing equipments for mid 1995, the current system used is the France Telecom Trans-fix system
- Optic cables are systematically installed during new highway developments or maintenance works
- With an appropriate investment potential the whole network could be change to optic fibres in less than five years
- A special use of the highway company Telecom network has to be approved by Government services "DGPT" and could get the approval only if all users are specifically mentioned and identified

Ownership
- The land is the French Government property and the highway company has a management concession for 7 to 15 years
- The Telco infrastructure is the company property
- Until today the telco network can only be used for the company own needs

Source: Mercer Management Consulting research

Exhibit 2.28: The Cofiroute (Highways) telecommunication infrastructure

Country: France | **Category:** Highway | **Company:** Cofiroute



Current Features

General Considerations
- The Cofiroute optic cables go across regions of high density of population

Cable
- The current optic cable network has about 350km
- The optic cables contain 10 fibres
- 50% of the fibres capacity is available
- The transmission capacity is 8 to 10 Megabits

Duct
- Codrel installed underground conduits for its optic cables
- The conduits have enough room to lay new cables

Current Use
- Traditional highway operations needs
- Data transmission
- In the future it could be that these cables will be used as it was initially forecasted for telecontrol/surveillance along the highways

Localisation
- The operating optic cables lay between Abis (A10/A11 crossroad) LeMans and Orleans

Specifics
- It seems that the most recent cables laid contain much more than 10 fibres (double) with high transmission capacity already

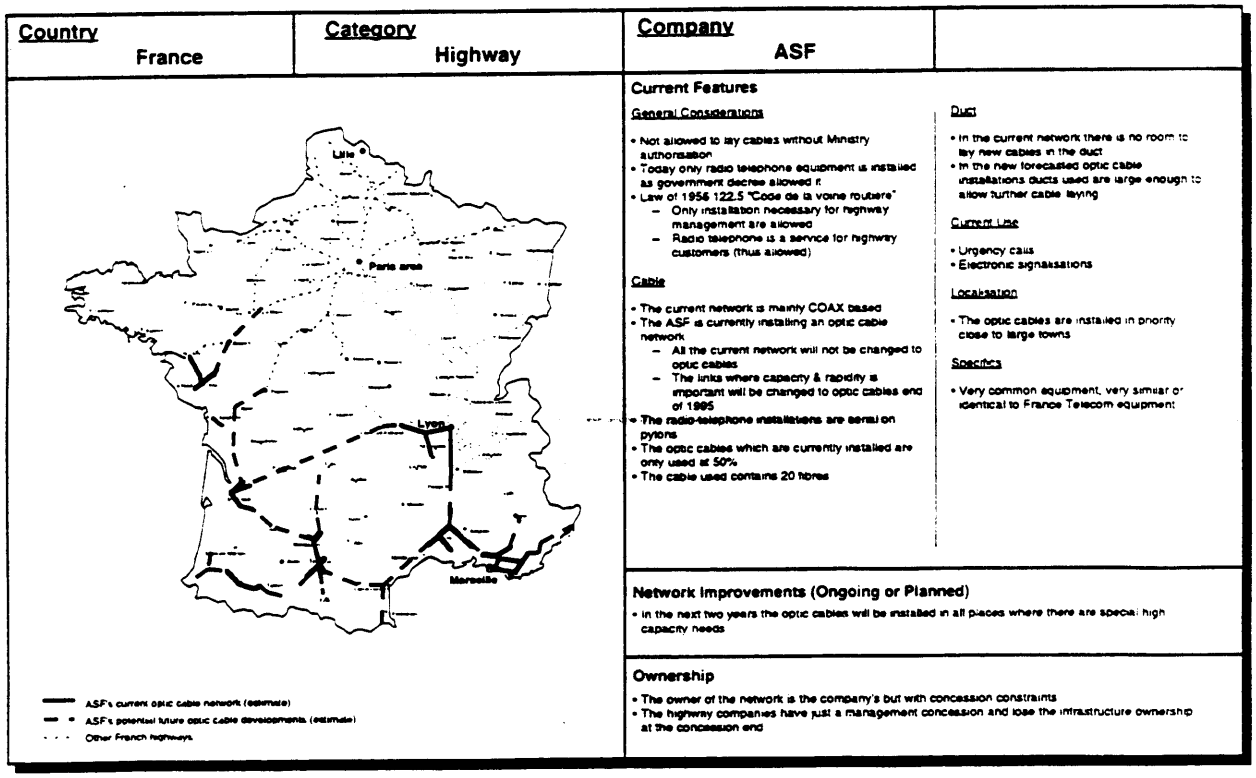
Network Improvements (Ongoing or Planned)
- The optic cable implementation programme will take place until 1996/7 with the following deadlines:

– end 1995/mid 96	Link from LeMans to La Gravelle (Vitre-Rennes)	320km
– end 1996/mid 97	Link Orleans-Pontier	215km
– end 1997	Link Orleans-Bourges	120km

Ownership
- As all the other highway company's Cofiroute owns the highway and Telecom infrastructures but has to give them back to the French State for nothing at the end of the concession

Source: Mercer Management Consulting research

Exhibit 2.29: The ASF (Highways) telecommunication infrastructure



Source: Mercer Management Consulting research

2.5. Germany

All public telecommunications and CATV infrastructures are owned and operated by DBP Telekom. This common ownership and operation of infrastructures has resulted in certain cost savings, such as in civil works.

Germany is the largest telecommunication and CATV market in the EU (see Exhibit 2.30). At the end of 1993, there were a total of 36.7 million PSTN access lines, representing 23 per cent of the EU total. The number of public pay phones was 180,000. The penetration of telephony is 46 lines per 100 population, one of the lowest levels in the EU, due to the low telephony penetration in the former East Germany. The line density in Germany is 103 lines per square kilometre and line growth from 1982 to 1992 was 63 per cent. The average monthly bill (rental + usage) for a PSTN line is ECU 51. DBP Telekom has below average productivity, with 159 lines per employee.

The total number of leased lines at the end of 1993 stood at 920,000, of which 81 per cent were analog. The average monthly cost for a 2Mbit leased line is ECU 27,662, which is 9.4 times the cost of a similar line in the UK. There were 86,500 packet-switch connections and 420,000 Basic Rate Access equivalent ISDN connections. As ISDN is being positioned and priced as an advanced substitute for telephony services, the number of ISDN connections is expected to total more than 2 million by 1998.

Exhibit 2.30: Country statistics summary for Germany

Germany

Demographics

Population (m)	79.6
GDP per Capita (ECU)	18,814
Area (km²)	356,854
Population Density (per km²)	223.5
Number of Households (m)	35.256
Number of Households with Television (m)	34.55

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	51	132
Average Monthly Bill for Mobile-Analogue	122	145
Average Monthly Bill for Mobile-GSM	122	142
Average Monthly Bill for Leased Line (2.0 Mbits)	27,662	941

Incumbent Network

Deutsche Telekom	
Main Lines (m)	36.7
Lines per 100 Population	46
Lines per 100 Households	104
Lines per km²	103
Public Pay Phones	180,000
Digitalisation of Trunk Network (%)	N/A
Fibre Optic in Network (km)	56,200
Employees	231,000
Lines per Employee	159
Average Local Loop Length (km)	2
Call Failure Rate – Local %	N/A
Call Failure Rate – National %	N/A
Fault Rate – Faults/Line/Year	N/A
Mobile Networks	
Total Subscribers ('000)	2,334
Penetration (per 100 of population)	2.9
Total Growth '93-'94 (%)	50

New Service Testing

ATM	• DBP member of pan-European ATM trial • Datex M (SMDS) service deployed in 20 cities
SDH	• Large scale trial by DBP in all major cities plus a parallel deployment of SDM rings in access network
VOD	• Testing of ADSL VOD system in Berlin is planned for the end of 1994

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	13,730	61	64	N/A	1:2.7
Railway	0	0	0	4,000	0
Electricity	0	0	0	30,000	0
Other	0	0	0	0	0
Total	**13,730**	**61**	**64**	**34,000**	**1:2.7**

Notes: *(1) All data is for 1993/94 unless otherwise stated*

(2) BT = 100

* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*

Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)

Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

SDH equipment has been on trial and installed primarily in the access network. Two large-scale trials have taken place (SYNET and VISYON) in all major cities, with the parallel implementation of SDH rings in the access network. In addition, DBP Telekom used optical fibre access systems extensively during the upgrade of the access network in Eastern Germany. Testing of an ADSL video-on-demand system is planned for the end of 1994.

DBP Telekom is a participant in the pan-European ATM trial and already offers ATM-based services (Switched Multi-Megabit Data Service, called Datex M) in about 20 cities, although fully developed services are not expected before 1996. DBP Telekom and France Telecom have announced cross-border services based on ATM, which are due to start in 1995.

The total number of mobile network subscribers in Germany was 2.3m in November 1994, representing an overall penetration of 2.92 per cent of the population. De-Te Mobil operates two networks: a C-450 analog network launched in 1985, which currently has 734,000 subscribers (9 per cent lower than November 1993); and a GSM network launched in 1992, which has 799,000 subscribers (120 per cent growth in the last year). Other Operators are Mannesmann, which launched a GSM network in 1992 that has about 785,000 subscribers (104 per cent yearly growth); and E-Plus, which launched its network based on the DCS 1800 system in May 1994 and now has about 16,000 subscribers. The average monthly cost of owning either an analog or GSM mobile telephone in Germany is ECU 122.

The construction of CATV networks began in 1982 and coverage of the country has grown rapidly. At the end of 1993, the German CATV network represented about 50 per cent of the homes passed in the EU. By the end of 1994, DBP Telekom plans to have passed 22.8 million homes with CATV infrastructure (66 per cent of all homes). Of the homes passed now, 13.7m are connected (39 per cent). The ratio of CATV lines to telephone lines in Germany is 1:2.7.

The two infrastructures (PSTN and CATV) are largely one and the same at higher levels and share most of the same local network infrastructure. The local CATV distribution network uses a COAX/COAX architecture. There are upgrade plans to increase its capacity by digitalising the signals.

The only non-terrestrial alternative to DBP Telekom for CATV services are the Direct-To-the Home (DTH) satellites. DTH systems have a penetration of about 15 per cent, mostly in the eastern part of the country where terrestrial television signals were difficult to receive after re-unification.

Significant alternative infrastructures include (see Exhibits 2.31 and 2.32):

- Deutsche Bahn (railway), which operates a PSTN network (more than 200,000 users), an ISDN network and an X25 network (more than 10,000 users). It owns the

rights-of-way along the tracks and has expressed an interest in offering public telecommunications services (see Exhibit 2.33).

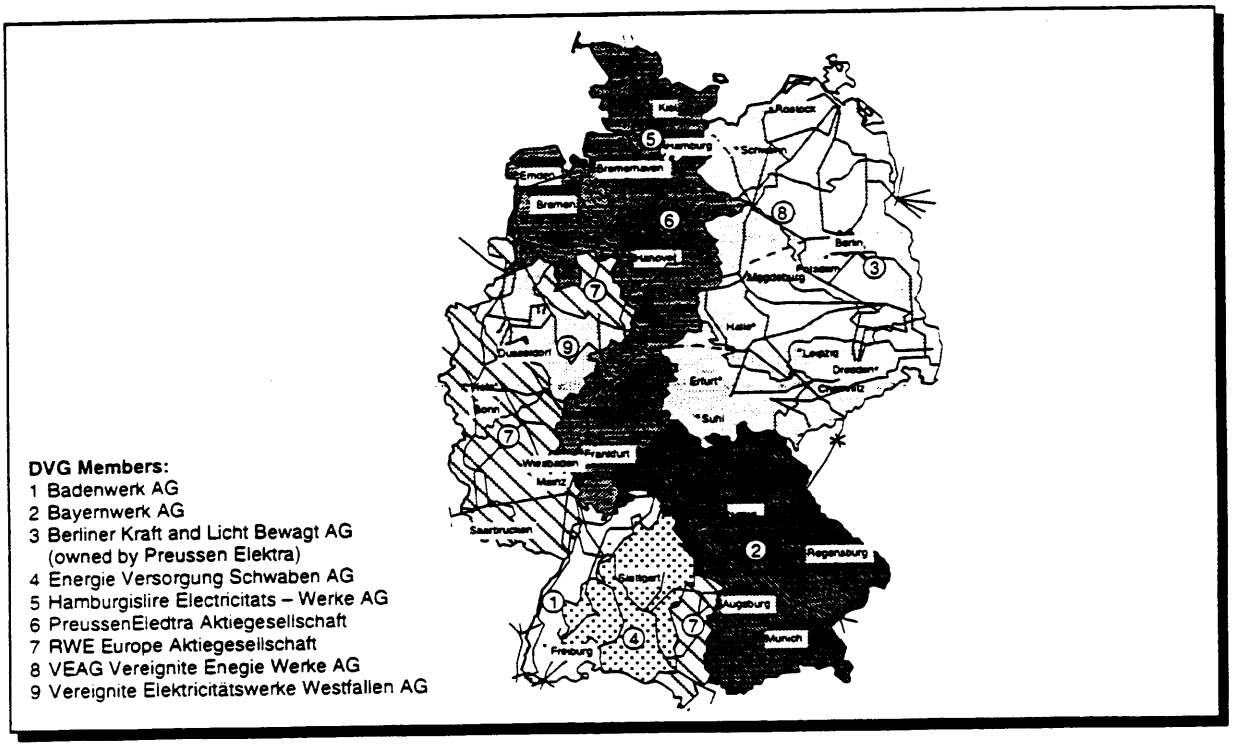
- RWE (an electric company), which operates a network which covers the western part of Germany. It announced in January 1994 the formation of CNI in association with Deutsche Bank and Mannesmann (see Exhibit 2.34).
- Bayernwerk (an electric company), which has an extensive network in Bavaria, including rights-of-way (see Exhibit 2.35).

Exhibit 2.31: Main alternative telecommunication infrastructures in Germany

Category	Name	Location	Comments
Long distance :			
Railways	• Deutsche Bundesbahn	Nationwide	Ownership shared with regional governments (Lander) in certain cases
Electricity	• RWE	Regional	
	• Bayernwerk/Viag	Regional	
	• VEW	Regional	Vereinigte Elektrizitätswerke Westfalen Aktienges ellschaft
	• VEBA	Regional	
	HEW	Hamburg	
	• Isar-Amperwerk	Munich	
	VEAG	Berlin	Vereinigte Energiewerke Aktiengesellschaft
	• Badenwerk		
	• Energie Versorgung Schwaben	Baden-Wurtemberg	
Gas Pipelines	• Ruhrgas AG	Nationwide	
	• Wintershall AG/ Wingas	Nationwide	
	• GVS	Baden-Wurtemberg	Gasversorgung Süddeutschland GMBH
Oil Pipelines			
Waterways			
Highways	• State & Länder		Project to create the Deutsche Autobahn AG
Local :			
Local Transport	• BVG	Berlin	Berliner Verkehrs-Betriebe
	• SWM	Munich	München, Verkehrs betriebe
		Hamburg	Hamburger Hochbahn Aktiengesellschaft
		Frankfurt	Stadwerke Frankfurt/Main
		Stuttgart	Stuttgarter Strassenbahnen Aktiengesellschaft
Cable TV	• DPB Telekom	Nationwide	Deutsche Bundespost Telekom's monopoly
	Urbana		
	Anga		
Local Public Utilities			
Teleport	• Teleport Europe GmbH	Hannover	
	• Media City Leipzig AG	Leipzig	
	• Rostock Teleport	Rostock	
	• Skanska	Hamburg	
	• Teleport Bremen	Bremen	
	• Teleport Mediapark Cologne	Cologne	

Source: Mercer Management Consulting research

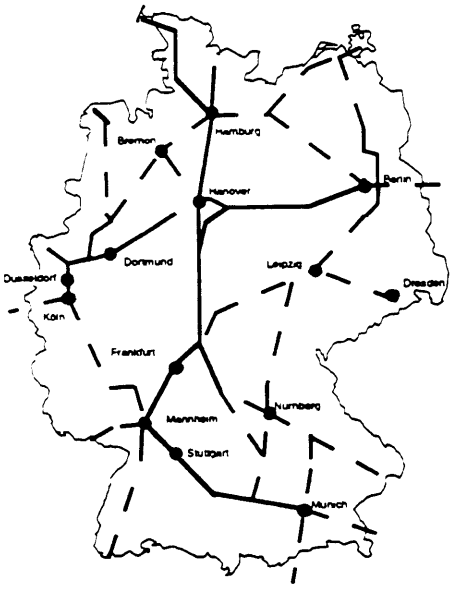
Exhibit 2.32: The Deutscher Verbund Gesellschaft network (National Electricity Grid) telecommunication infrastructure



Source: Mercer Management Consulting research

Exhibit 2.33: The Deutsche Bahn (Railways) telecommunication infrastructure

Country	Category	Company	
Germany	Railway	Deutsche Bahn AG	



Current Feature

Cable

- Current DB's optic network has about 1000 km with 12 to 24 optic fibres
- The current transmission capacity is 34 Megabits and could be improved easily up to 622 Megabits
- Some installations already have 622 Megabits transmission capacity
- DB is using for its own purposes about 2 to 3 fibres

Duct

- The ducts are mainly underground: only 10% are overhead cables along the railway lines
- The conduits have usually room to lay further cables

Current Use

- Specific railway information exchange
  - Data transmission (Packet switching data network)
  - Electronic boards information exchange
  - Management of the traffic indicators
  - Signalling (80,000 boxes)
- Internal telephone needs (210,000 lines)

Localisation

- The current optic network is mainly along the high speed railway lines of the ICE
- It is linking already 20 major German towns
- The very highly populated regions were considered as priorities

Specifics

- The current multiplexing system is the SDH
- DB has an advanced telephone network - ISDN

Network Improvements (Ongoing or Planned)

- The current network will be extended until 4,000 km in the next 4 years
- DB will link Eastern and Western Germany as well as the Southern and Northern part

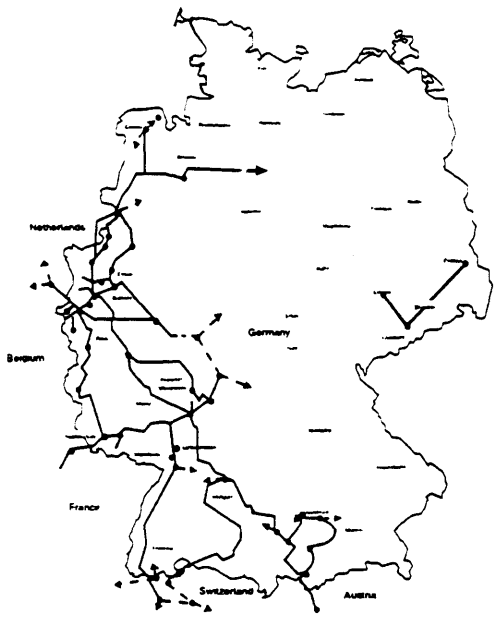
Ownership

- As DB owns its network it allows the company to lay any amount of cables without having to get any authorisation or approval

Source: Mercer Management Consulting research

Exhibit 2.34: The RWE (Electricity utility) telecommunication infrastructure

Country: Germany | **Category:** Electricity | **Company:** RWE



Current Features

General Considerations

- The RWE network is covering the most densely inhabited German regions which represent close to 17 million people
- The material used is manufactured by Siemens and Ericsson

Cable

- RWE has by now 3600km optic cables already installed in West Germany - end of 1996 the planned network should reach 4300km - in East Germany 1000km are installed and it should be doubled until 1996
- The cables laid contain 30 fibres of which only 2 to 4 are currently used by RWE
- The transmission capacity is an average of 622 Megabits and on some lines even 2.5 Gigabits (Essen to Köln)

Duct

- All RWE cables are aerial (95%) supported by the electricity power pylons
- The remaining 5% are laid in underground conduits

Current Use

- Internal telephone and operation telephone needs
- Telecontrol/surveillance
- Data transmission for electricity operation needs

Localisation

- West Germany:
  - Rhein/Ruhr area: Dusseldorf-Köln-Essen-Deutz
  - Rhein/Main area: Ludwigshafen-Mannheim-Stuttgart
- East Germany:
  - Leipzig-Chemnitz-Cottbus

Specifics

- The multiplexing system used is SDH on the whole network

Network Improvements (Ongoing or Planned)

- The optic cable installation are planned until 1996 to have the whole network coverage - this means 700km more in West Germany and 1000km more in East Germany until 1996
- RWE is currently trying to find the way to organise the final user connections to its network

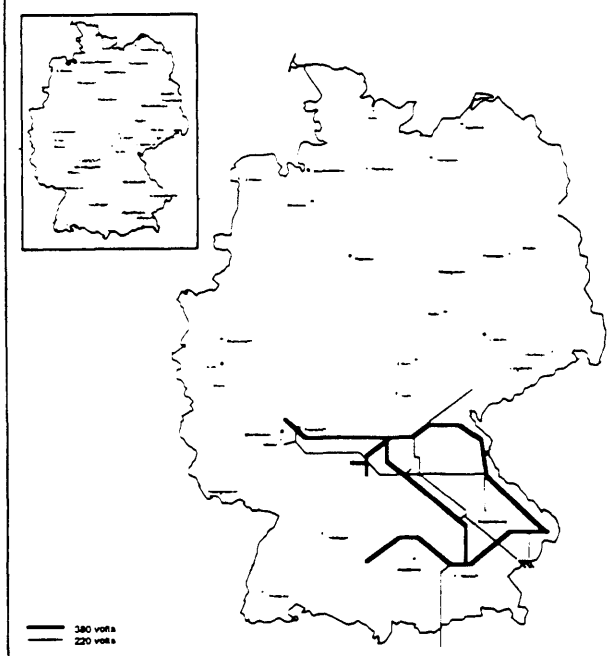
Ownership

- RWE owns the land and the telecom infrastructure as it is a part of the electricity transportation infrastructure
- RWE is the sole owner. It invested and installed the whole network

Source: Mercer Management Consulting research

Exhibit 2.35: The Bayernwek (Electricity utility) telecommunication infrastructure

Country: Germany | **Category:** Electricity | **Company:** BAYERNWERK / TB&D



Main Activity

Features

- Bayernwerk is the West Germany's third largest supplier of electricity and, through equity interests in regional distributors, provides Bavaria with most of its requirements in electricity
- In the new states, Bayernwerk is active at both the supraregional as well as the regional and local level, above all in Thuringia. At the supraregional level, this takes place as part of the management at the affiliated company VEAG Vereinigte Energiewerke AG
- Bayernwerk operates a network of high and highest tension transmission lines with length of approx. 5500 km mainly overhead
- RWE Energy and Preussen-Elektra are Bayernwerk main partners in Germany

Ownership

- Bayernwerk is the owner of all the electricity infrastructure but has not the ownership of the ground supporting the pylons
- The company has a concession from all potential owners as the Länders, regional authorities or even the farmers

Telecom Rights of Way

Ownership

- Bayernwerk owns the rights of way along its overhead high power lines
- There is a limited number of cables for which Bayernwerk owns the right of way - to lay more cables special authorisations and justifications could be necessary

Legal Authorisations

- Bayernwerk does not need any legal authorisation in the limits of its previous agreements to lay cables along its high power lines
- Special authorisation could be necessary for underground installations if it is necessary to dig as the existing ducts do not contain enough room for new cables

Technical Authorisations

- The technical authorisations are mainly necessary when the aerial installations reach the limits - then it is necessary to have a technical assessment to lay more cables on the same pylons

Source: Mercer Management Consulting research

Other alternative infrastructures include other electric companies (VEW, VEBA, VEAG, etc.), gas pipeline companies (Ruhrgas, etc.), highways, local transport companies (BVG in Berlin, SWM in Munich, etc.) and several teleports (Bremen, Köln, Hamburg, Hannover, etc.).

2.6. Greece

In Greece, OTE is the sole provider of reserved services and sole owner of the public telecommunications infrastructure (see Exhibit 2.36). It operates 4.6m access lines, representing a penetration of 44 lines per 100 population. The levels are relatively high by international standards. However, there are large differences between Athens (with high penetration) and the rest of the country. Furthermore, the quality of service (in terms of fault rate, call failure rates or waiting time for a connection) tends to be low compared with most other international Operators. The line density in Greece is 34 lines per square kilometre and line growth between 1982 and 1992 was 77 per cent. The average monthly bill for a PSTN line is ECU 74. OTE has average productivity, with 168 lines per employee.

Data transmission is supported by leased lines (mostly analog), a packet-switching network, currently under expansion and a high-speed data link service in the largest cities. In 1992, there were 12,300 leased line connections and 500 packet-switched connections. The average monthly cost for a 2Mbit leased line is ECU 6,882.

The penetration of mobile telephony in Greece stands at 1.3 per cent of the population, with a total of 135,000 subscribers. This figure rose from about 12,000 subscribers the previous year. Mobile services are offered by two consortia which are setting up GSM networks across the country. Panafon is a joint venture of France-Telecom, Vodafone and the Kokkalis. Its network was launched in 1993 and now covers Athens, Thessaloniki, Patras and Crete. It has 73,000 subscribers (940 per cent yearly growth). The other network is a joint venture of STET and NYNEX called Stet Hellas. It was also launched in 1993 and has 62,000 subscribers (1,146 per cent yearly growth).

CATV networks are limited, with only a few thousand subscribers. CATV Operators face very strong competition from the many private terrestrial TV channels which have emerged since the television market was deregulated in 1990.

Exhibit 2.36: Country statistics summary for Greece

Greece

Demographics

Population (m)	10.1
GDP per Capita (ECU)	6,332
Area (km^2)	131,957
Population Density (per km^2)	77.8
Number of Households (m)	3.449
Number of Households with Television (m)	2.76

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	74	191
Average Monthly Bill for Mobile-Analogue	N/A	N/A
Average Monthly Bill for Mobile-GSM	119	138
Average Monthly Bill for Leased Line (2.0 Mbits)	6,882	234

Incumbent Network

OTE	
Main Lines (m)	4.58
Lines per 100 Population	44
Lines per 100 Households	133
Lines per km^2	34
Public Pay Phones	55,093
Digitalisation of Trunk Network (%)	N/A
Fibre Optic in Network (km)	N/A
Employees	26,716
Lines per Employee	168
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	N/A
Call Failure Rate – National %	N/A
Fault Rate – Faults/Line/Year	N/A
Mobile Networks	
Total Subscribers ('000)	135
Penetration (per 100 of population)	1.3
Total Growth '93-'94 (%)	1,025

New Service Testing

ATM	• N/A
SDM	• N/A
VOD	• N/A

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	0	0	0	0	0
Railway	0	0	0	N/A	0
Electricity	0	0	0	N/A	0
Other	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

2.7. Ireland

Ireland's national Operator, Telecom Eireann, has a monopoly on all national telecommunications infrastructures. The CATV networks have been established since the early 1970s. The largest network, Cablelink, is in Dublin and Telecom Eireann is a major shareholder.

The total number of access lines is 1.16m (see Exhibit 2.37). Ireland has one of the lowest telephony penetration levels in the EU with 32 lines per 100 population. The density of lines in Ireland is the lowest in the EU at 16 lines per square kilometre, but line growth between 1982 and 1992 was the highest in the EU at 95 per cent. The average monthly bill for a PSTN line is relatively high at ECU 73. The number of lines in operation per employee is low – only 88 lines per employee.

There are about 19,000 leased lines in service and the average monthly cost for a 2Mbit line is ECU 4,069, which is 1.4 times the cost in the UK. Telecom Eireann offers packet-switched transmission as well as services based on X25 (Videotex, EDI, E-Mail, etc.). In 1992, there were 1,020 packet-switch connections. ISDN trials have been completed and ISDN services are now being deployed on an overlay basis.

Network digitalisation stands at 71 per cent and is expected to reach 100 per cent by the year 2000. There are approximately 70 Digital Switching Units in service in the network handling local, trunk and international telephony, mobile telephony and other services. The long-distance network architecture is designed with three levels, and 74 per cent (as a percentage of system-km) of long-distance transmission now uses optical fibre. SDH trials are taking place with a view towards deploying SDH technology in ring structure, using STM4 and ultimately STM16. The call failure rate on local calls is 0.7 per cent and on national calls 1.6 per cent. The number of faults recorded per line per year is 0.21.

Mobile telephony is provided by Telecom Eireann with both TACS-900 and GSM services. Penetration stands at 1.7 per cent of the population; growth in the past year has been 42 per cent. The Eircell analog service was launched in 1985 and now has 71,500 subscribers, compared with 52,600 in November 1993. The GSM service was launched in 1993 and now has about 3,800 subscribers.

At the end of 1993, CATV penetration stood at 42 per cent of homes passed (0.45m) and 40 per cent of homes connected. The ratio of CATV lines to telephone lines is 1:2.6. Networks are concentrated in a few large cities as it is not economical to provide service in remote rural regions. Older networks, such as the Cablelink network in Dublin, are being upgraded to a COAX/COAX tree-and-branch structure so they can broadcast 50 to 60 channels, compared with 15 to 20 channels at the moment. These networks could be easily upgraded subsequently for higher capacity and/or interactive services.

Exhibit 2.37: Country statistics summary for Ireland

Ireland

Demographics

Population (m)	3.5
GDP per Capita (ECU)	11,427
Area (km^2)	70,283
Population Density (per km^2)	50.1
Number of Households (m)	1.066
Number of Households with Television (m)	1.045

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	73	188
Average Monthly Bill for Mobile-Analogue	100	119
Average Monthly Bill for Mobile-GSM	162	188
Average Monthly Bill for Leased Line (2.0 Mbits)	4,069	138

Incumbent Network

Telecom Eireann	
Main Lines (m)	1.16
Lines per 100 Population	32
Lines per 100 Households	110
Lines per km^2	16
Public Pay Phones	6,280
Digitalisation of Trunk Network (%)	71
Fibre Optic in Network (km)	N/A
Employees	12,790
Lines per Employee	88
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	0.7
Call Failure Rate – National %	1.6
Fault Rate – Faults/Line/Year	0.21
Mobile Networks	
Total Subscribers ('000)	75.3
Penetration (per 100 of population)	1.7
Total Growth '93-'94 (%)	42

New Service Testing

ATM	
SDH	•Telecom Eireann has 422 trials underway
VOD	

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	430	42	96	N/A	1:27
Railway	0	0	0	N/A	0
Electricity	0	0	0	N/A	0
Other	0	0	0	0	0
Total	**430**	**42**	**96**	**N/A**	**1:27**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

It is estimated that Direct-To-the Home (DTH) satellite systems are installed in 3 per cent of all households.

2.8. Italy

Italy has kept a monopoly on the provision of infrastructure for telecommunications purposes. Outside Telecom Italia, only some public bodies, such as public transportation or energy companies, are allowed to operate their own infrastructures.

The number of access lines in operation is 24.2m and telephony penetration stands at 42 lines per 100 population, which is average by EU standards (see Exhibit 2.38). This contrasts with a higher than average mobile telephony penetration (at 3.5 per cent of the population). The line density in Italy is 79 lines per square kilometre, and line growth between 1982 and 1992 was 61 per cent. The average monthly bill for a PSTN line is ECU 59. Telecom Italia has high productivity, with 271 lines per employee.

Data transmission services are offered by Telecom Italia with leased lines, packet-switching (45,000 connections) and ISDN services. In 1992 there were 242,000 leased line connections, of which 79 per cent were analog. The average monthly cost of a 2Mbit leased line is ECU 13,036.

Digitalisation of the trunk network stands at 48 per cent. The call failure rate in Italy is high by EU standards: 3.9 per cent on local calls and 4.8 per cent on national calls. The fault rate is similar to other EU countries at 0.12 faults per line per year.

Telecom Italia started trials of SDH/STM1 in 1992. SDH is currently deployed in the national backbone network and in the distribution network with metropolitan SDH rings being installed. Telecom Italia is participating in the pan-European ATM trial. It is also planning an ADSL video-on-demand trial for the end of 1995 for 1,500 users in Milan.

Mobile penetration is 3.5 per cent with a total of 2m subscribers. Total yearly growth from 1993 to 1994 was 84 per cent. Services are offered by Telecom Italia through an RTMS system launched in 1985 which has about 17,500 subscribers, a TACS-900 network launched in 1990 which has about 2m subscribers and a GSM network launched in 1992 with about 52,000 subscribers. A second GSM licence was awarded in April 1994 to a consortium led by Olivetti, with service to start in 1995.

There are no significant CATV networks in Italy. None have been licensed and the market is unattractive due to heavy competition from terrestrial channels. For similar reasons (in addition to poor satellite coverage of large parts of the country), penetration of satellite DTH equipment is low.

Exhibit 2.38: Country statistics summary for Italy

Italy

Demographics

Population (m)	57.7
GDP per Capita (ECU)	15,430
Area (km^2)	301,277
Population Density (per km^2)	191.7
Number of Households (m)	20.766
Number of Households with Television (m)	20.56

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	59	151
Average Monthly Bill for Mobile-Analogue	106	126
Average Monthly Bill for Mobile-GSM	145	169
Average Monthly Bill for Leased Line (2.0 Mbits)	13,036	443

Incumbent Network

Telecom Italia	
Main Lines (m)	24.23
Lines per 100 Population	42
Lines per 100 Households	117
Lines per km^2	79
Public Pay Phones	400,187
Digitalisation of Trunk Network (%)	48.4
Fibre Optic in Network (km)	1,100,000
Employees	87,370
Lines per Employee	271
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	3.9
Call Failure Rate – National %	4.8
Fault Rate – Faults/Line/Year	0.12
Mobile Networks	
Total Subscribers ('000)	2,005
Penetration (per 100 of population)	3
Total Growth '93-'94 (%)	84

New Service Testing

ATM	• Participating in the pan-European ATM trial
SDH	• SDH technology currently deployed in national backbone network and also in distribution network
VOD	• Telecom Italia is planning an ADSL VOD trial for the end of 1995 for 1,500 users in Milan

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	0	0	0	0	0
Railway	0	0	0	N/A	0
Electricity	0	0	0	N/A	0
Other	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

Large and modern alternative telecommunications infrastructures are used by the national railways and the highway companies, among others.

2.9. Luxembourg

The Luxembourg PTT has the monopoly rights to operate a telecommunications infrastructure for public services.

Luxembourg is characterised by a high proportion of international traffic and a heavy geographical concentration of its large customers.

There are 206,000 access lines in operation serving a population of 390,000 (see Exhibit 2.39). This means the country has the second highest telephony penetration in the EU with 53 lines per 100 population. Line density is 80 lines per square kilometre and line growth between 1982 and 1992 was 48 per cent. The average monthly bill for a PSTN line is the lowest in the EU at ECU 26. The PTT has high productivity with 260 lines per employee.

The PTT had 1,080 packet-switched connections as of 1992. There were also 8,430 leased lines in operation, of which 98 per cent were analog. The current average monthly cost of a 2Mbit leased line is ECU 4,273.

Mobile telephony services are provided by the PTT. Penetration is 2.5 per cent of the population and yearly growth between November 1993 and 1994 was 177 per cent. The PTT offers both an NMT-450 service, which has only 256 subscribers (60 per cent less than 1993) and a GSM network, which has 11,000 subscribers. The average monthly cost is ECU 200 for the analog service and ECU 151 for the GSM service.

Ninety-eight per cent of all households are passed by a CATV network (142,000 homes) and 81 per cent of all households are connected (117,000 homes). The ratio of CATV lines to telephone lines is 1:1.8. The main Operators are Eltrona, Coditel, Siemens and R. Klein.

Exhibit 2.39: Country statistics summary for Luxembourg

Luxembourg

Demographics	
Population (m)	0.389
GDP per Capita (ECU)	22,918
Area (km^2)	2,586
Population Density (per km^2)	151
Number of Households (m)	0.145
Number of Households with Television (m)	0.142

Tariffs *	ECU	Index[2]
Average Monthly Bill for PSTN	26	66
Average Monthly Bill for Mobile-Analogue	200	238
Average Monthly Bill for Mobile-GSM	151	176
Average Monthly Bill for Leased Line (2.0 Mbits)	4,273	145

Incumbent Network	PTT
Main Lines (m)	0.2055
Lines per 100 Population	53
Lines per 100 Households	142
Lines per km^2	80
Public Pay Phones	381
Digitalisation of Trunk Network (%)	N/A
Fibre Optic in Network (km)	N/A
Employees	736
Lines per Employee	260
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	N/A
Call Failure Rate – National %	N/A
Fault Rate – Faults/Line/Year	N/A
Mobile Networks	
Total Subscribers ('000)	11
Penetration (per 100 of population)	2.5
Total Growth '93-'94 (%)	177

New Service Testing	
ATM	• N/A
SDH	• N/A
VOD	• N/A

Alternative Networks	Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
	CATV	117	98	82	N/A	1:1.8
	Railway	0	0	0	0	0
	Electricity	0	0	0	0	0
	Other	0	0	0	0	0
	Total	**117**	**98**	**82**	**N/A**	**1:1.8**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

2.10. Netherlands

There has traditionally been a monopoly on the provision of infrastructure for public telecommunications services in the Netherlands. However, in June 1993, the Dutch Government laid down a timetable for allowing a second Operator to set up an alternative infrastructure. This decision was influenced by the fact that PTT services to business customers were seen as lagging behind services available in other countries.

Following this decision, and at the suggestion of the Government, NS, the publicly owned Dutch railway company, joined with 12 Dutch gas, electricity (Enertel) and CATV companies to create an integrated telecommunications infrastructure in the Netherlands, to be completed in 1995. A company called TeleNed was set up to exploit the commercial possibilities of existing telecommunication and CATV infrastructures. This alternative network would provide a full range of network services, possibly with the co-operation of a foreign Operator.

According to TeleNed, at least Fl. 3 billion (ECU billion 1.2) will be needed to upgrade the telecommunications networks. The initial investment would provide for links between the alternative long-distance networks and the local CATV infrastructures, thus creating a single network for public telecommunications traffic. Many questions remain, however, regarding the technical and political feasibility of this operation, given the state of the access network (CATV systems) and the fact that most of the companies involved are state-owned.

PTT Telecom has 7.6m access lines in operation with a penetration of 50 lines per 100 population, which is close to the EU average (see Exhibit 2.40). The line density in the Netherlands is the highest in the EU at 224 lines per square kilometre, and line growth between 1982 and 1992 was moderate at 44 per cent. The average monthly bill for a PSTN line is ECU 59. PTT Telecom has one of the highest levels of productivity in the EU, with 221 lines per employee.

At the end of 1993 there were 6,900 Basic Rate Access equivalent ISDN connections, 490,000 analog leased lines and more than 4,000 digital leased lines with a capacity above 2 Mbps. The average cost of a 2Mbit leased line is ECU 7,576. In 1992 there were 14,410 packet-switched connections.

PTT Telecom is pursuing an extensive programme of deployment of optical fibres in the access network, substituting primary cables with optical links and concentrators.

PTT Telecom is participating in the pan-European ATM trial and is planning a trial of video-on-demand for 100 users in the west of the country in late 1994 or in 1995.

Mobile telephony services are provided by PTT Telecom. Penetration is 2 per cent of the population and yearly growth between November 1993 and 1994 was 45 per cent. The PTT offers both NMT and GSM services. The NMT-450 service, launched in 1985, has

Exhibit 2.40: Country statistics summary for Netherlands

Netherlands

Demographics	
Population (m)	15.2
GDP per Capita (ECU)	17,992
Area (km^2)	33,938
Population Density (per km^2)	447
Number of Households (m)	6.127
Number of Households with Television (m)	6.01

Tariffs *	ECU	Index[2]
Average Monthly Bill for PSTN	33	86
Average Monthly Bill for Mobile-Analogue	159	189
Average Monthly Bill for Mobile-GSM	N/A	N/A
Average Monthly Bill for Leased Line (2.0 Mbits)	7,576	258

Incumbent Network	PTT Telecom
Main Lines (m)	7.6
Lines per 100 Population	50
Lines per 100 Households	124
Lines per km^2	224
Public Pay Phones	14,100
Digitalisation of Trunk Network (%)	N/A
Fibre Optic in Network (km)	N/A
Employees	34,359
Lines per Employee	221
Average Local Loop Length (km)	
Call Failure Rate – Local %	N/A
Call Failure Rate – National %	N/A
Fault Rate – Faults/Line/Year	N/A
Mobile Networks	
Total Subscribers ('000)	299
Penetration (per 100 of population)	2
Total Growth '93-'94 (%)	45

New Service Testing	
ATM	• PTT participating in the pan-European ATM trial
SDH	• N/A
VOD	• PTT planning a trial for 1994-1995 for 100 users in West of country

Alternative Networks	Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
	CATV	5,390	91	96	N/A	1:1.4
	Railway	0	0	0	N/A	0
	Electricity	0	0	0	N/A	0
	Other	0	0	0	0	0
	Total	**5,390**	**91**	**96**	**N/A**	**1:1.4**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

23,000 subscribers (13 per cent less than 1993) and the NMT-900 service, launched in 1989, has 226,000 subscribers. The GSM network was launched in July 1994 and already has over 50,000 subscribers. The average monthly bill is ECU 159 for the analog service. A second GSM licence will be awarded in the next few months.

There are approximately 900 CATV networks in operation in the Netherlands. Most of them are limited to a city with the municipality keeping some control of the networks even when the operations are handled by a private company. The largest Operator is Casema (controlled by PTT) which has a market share of 15 per cent and is the only Operator with a share of more than ten per cent. Other major Operators are: KTA (which operates in Amsterdam), EGD/BICAI (Groeninge, Drente), Geb-KTV Rotterdam and subsidiaries of the utility companies. Many Operators are currently upgrading their networks to be in a position to offer complete interactive services and possibly provide local access to a second Operator.

Ninety-one per cent of households (5.6m) are passed by a CATV network and 96 per cent of these (5.4m) are connected. The ratio of CATV lines to telephones lines is 1:1.4.

DTH satellite systems have reached a significant penetration of 3 per cent mainly due to the limited capacity of some of the existing CATV networks.

2.11. Portugal

Portuguese regulation has kept a monopoly on the provision of telecommunications infrastructure. Only a few utilities and transportation companies are allowed to operate a telecommunications infrastructure for their own use.

Portugal Telecom (resulting from the merger of Telecom Portugal and TLP in 1994) is the national telecommunications Operator. The number of access lines in operation is 3.25m, line density is 35 lines per square kilometre and line growth between 1982 and 1992 was 51 per cent (see Exhibit 2.41). Telephony penetration is the lowest in the EU at 31 lines per 100 population. The average monthly bill for a PSTN line is one of the lowest in the EU at ECU 28. Portugal Telecom has below average productivity, with 160 lines per employee.

Non-telephony services include leased lines (analog and digital), ISDN and packet-switching services. The total number of leased circuits in operation is 15,600 and the average monthly cost for a 2Mbit line is ECU 7,780. The number of packet-switched connections in 1992 was 4,530.

The digitalisation rate of the local switches is 61 per cent and the digitalisation rate of the Telecom Portugal trunk network is 76 per cent. MAN services are due to be launched in Lisbon and Oporto soon, with available rates of 2 Mbps and 34 Mbps. Links between the

Exhibit 2.41: Country statistics summary for Portugal

Portugal

Demographics

Population (m)	10.4
GDP per Capita (ECU)	6,724
Area (km^2)	92,389
Population Density (per km^2)	106.6
Number of Households	3.301
Number of Households with Television (m)	3.202

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	28	72
Average Monthly Bill for Mobile-Analogue	114	136
Average Monthly Bill for Mobile-GSM	126	147
Average Monthly Bill for Leased Line (2.0 Mbits)	7,780	265

Incumbent Network

Portugal Telecom	
Main Lines (m)	3.25
Lines per 100 Population	31
Lines per 100 Households	98
Lines per km^2	35
Public Pay Phones	19,900
Digitalisation of Trunk Network (%)	63
Fibre Optic in Network (km)	N/A
Employees	20,300
Lines per Employee	160
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	N/A
Call Failure Rate – National %	N/A
Fault Rate – Faults/Line/Year	N/A
Mobile Networks	
Total Subscribers ('000)	163
Penetration (per 100 of population)	1.5
Total Growth '93-'94 (%)	92

New Service Testing

ATM	• Participating in the pan-European ATM trial
SDH	• Current trials in Lisbon and Oporto
VOD	• N/A

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	40	2	80	N/A	1:81
Railway	0	0	0	N/A	0
Electricity	0	0	0	N/A	0
Other	0	0	0	0	0
Total	**40**	**2**	**80**	**N/A**	**1:81**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

two cities will also be provided. Portugal Telecom is participating in the pan-European ATM trial and SDH is on trial in Lisbon and Oporto.

Mobile services are provided by TMN (controlled by Portugal Telecom) and Telecel (a private consortium with Espirito Santo Group and AirTouch as the main partners). The total number of subscribers is 163,000 and combined penetration stands at 1.5 per cent of population. Subscriber growth over the year to November 1994 was 92 per cent. The average monthly cost for an analog subscriber is ECU 114, and for a GSM subscriber ECU 126.

TMN operates a C-450 network which was set up in 1989 and now has 30,000 subscribers, and a GSM network set up in 1992 which has 59,000 subscribers. Telecel only operates a GSM network and has 74,000 subscribers.

Cable TV networks were not legalised until 1991. Since then, a few licences have been awarded but penetration is still low and fewer than 2 per cent of homes (0.05m) have been passed. About 80 per cent of the homes passed are connected. The lack of Portuguese language programmes is slowing down the emergence of a significant CATV infrastructure.

2.12. Spain

Spanish regulation has kept a monopoly on the provision of telecommunications infrastructure with Telefónica and Correos y Telegrafos (telex and telegraphy only) having the monopoly on infrastructure used for public telecommunications services.

The number of access lines in Spain is 14.64m, and telephony penetration is 36 lines per 100 population (lower than the EU average) (see Exhibit 2.42). Due to Spain's geography, line density is low by EU standards at 28 lines per square kilometre. Line growth between 1982 and 1992 was the second highest in the EU at 78 per cent. The average monthly bill for a PSTN line is slightly higher than the EU average at ECU 55. Telefónica has above-average productivity with 192 lines per employee.

Other services include leased lines, ISDN, packet switching, videotex and videoconferencing services. There are 76,288 packet-switched connections and 481,600 leased line connections. The average monthly cost for a 2Mbit leased line in Spain is ECU 26,394, nearly nine times the cost in the UK. There are 640 BRA equivalent ISDN connections.

In the trunk network, 22,056 km of optical fibre has been installed, and the digitalisation rate is 86 per cent. Of the local exchanges, 41.4 per cent have been converted to digital. Quality levels are average by EU standards: the call failure rate on local calls is 0.41 per cent and on national calls 1.02 per cent; the fault rate (faults reported per line per year) is 0.28.

Exhibit 2.42: Country statistics summary for Spain

Spain

Demographics

Population (m)	39.1
GDP per Capita (ECU)	10,832
Area (km^2)	504,782
Population Density (per km^2)	77
Number of Households	11.44
Households with Television (m)	11.3

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	55	142
Average Monthly Bill for Mobile-Analogue	101	120
Average Monthly Bill for Mobile-GSM	N/A	N/A
Average Monthly Bill for Leased Line (2.0 Mbits)	26,394	897

Incumbent Network

Telefónica	
Main Lines (m)	14.64
Lines per 100 Population	36
Lines per 100 Households	128
Lines per km^2	28
Public Pay Phones	44,801
Digitalisation of Trunk Network (%)	86
Fibre Optic in Network (km)	22,056
Employees	74,340
Lines per Employee	192
Average Local Loop Length (km)	3.1
Call Failure Rate – Local %	0.41
Call Failure Rate – National %	1.02
Fault Rate – Faults/Line/Year	0.28
Mobile Networks	
Total Subscribers ('000)	374
Penetration (per 100 of population)	1
Total Growth '93-'94 (%)	54

New Service Testing

ATM	• Participating in the pan-European ATM trial
SDH	• Testing started by Telefónica in 1993
VOD	• Possible forthcoming trials in Barcelona and Madrid

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines
CATV	150	8	16	N/A	1:98
Railway	0	0	0	0	0
Electricity	0	0	0	0	0
Other	0	0	0	0	0
Total	**150**	**8**	**16**	**N/A**	**1:98**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

Telefónica is participating in the pan-European ATM trial. SDH testing started in 1993. There are possible forthcoming trials of video-on-demand in Barcelona and Madrid.

Mobile services are provided exclusively by Telefónica with NMT 450 and TACS 900 networks. There are 37,000 subscribers to the NMT network (28 per cent p.a. decline) and 338,000 subscribers to the TACS network (76 per cent rise per annum). Total penetration stands at 1 per cent of population and the average monthly bill is ECU 101.

There is currently no regulation of the CATV industry, but a draft law will soon be submitted to the parliament. Only 8 per cent of households (0.94m) are passed by CATV systems and only 1 per cent of households are connected (0.15m). The ratio of CATV lines to telephone lines is 1:95. Many of the CATV networks in operation are so-called community systems which connect households in a very limited area. These systems are often of poor quality and could not be easily upgraded to offer advanced or interactive services.

Megared-BT is an alternative private long-distance infrastructure.

2.13. United Kingdom

UK regulation has been the most innovative in the European Union. The present regulatory regime in the UK was set up in 1984, with the passing of the Telecommunications Act.[5] At that time, the Government decided to pursue a "duopoly policy." It licensed Mercury Telecommunications Ltd. to compete with BT for the provision of basic telecommunications services over fixed links, both domestically and internationally.

This duopoly policy was reviewed at the end of 1990, when it was decided to abandon it and open domestic telecommunications markets to full competition. As a result, the UK Government agreed to consider any licence application on its own merits and since 1991 97 applications (as of September 1994) have been made for wireline infrastructure licences; 54 of these have been granted.

A new national long-distance network, Energis, has been recently launched in competition with BT and Mercury. It has built a 3,500 km SDH-based network at a cost of ECU 250m using the rights-of-way and the pylons of its parent company, the National Grid Company. A number of regional competitors are also setting up or are planning to set up networks. In the access network, the major competition to BT is coming from the CATV franchisees, as Mercury only has a limited number of directly connected customers (mostly in the business market).

Virtually all of the non-cable entrants outside London are electricity companies. NORWEB (electricity company for the northwest of England) has been awarded a licence to

offer nationwide services, although it will initially focus on its own region (planned investments over the next five years: ECU 30m). Torch Telecom (50 per cent owned by Yorkshire Electricity) is planning to offer switched voice and data services to business customers in the Yorkshire area, while East Midlands Electricity has applied for a licence to offer telecommunications services in its region. SWEB Telecom has similar plans in the Bristol-Plymouth area (investments so far: ECU 20m) and Manweb is considering applying for a licence. In Scotland, both of the electricity companies plan to get involved: Scottish Power plans to open a trunk network offering voice, data and video services between Edinburgh and Glasgow and Scottish Hydro-Electric is planning a local service.

At the local level, besides the CATV companies, the City of London has been the target of the most significant network investments recently: MFS (Metropolitan Fiber Systems) has built a 75 km fibre grid at a cost of ECU 30m and COLT (City of London Telecommunications) has built a 60 km fibre infrastructure covering large portions of Central London. Videotron is also constructing a telephony network for business customers in London.

Other Operators granted PTO status are Sprint and Telstra (to provide local, long-distance and international resale) and Worldcom International (to provide national and international resale). In addition, two mobile network Operators, Vodafone and Cellnet, have been granted licences to provide fixed services over their wireless networks.

From 1995 on, Ionica will offer an alternative to BT and the CATV Operators with the deployment of a fixed wireless access network operating at 3.4 GHz. According to some sources, the investment required to capture 5 per cent of the residential market will be around ECU 160 million.

Overall, BT still claims 85 per cent of the UK telecommunications market. The combination of competition and price-caps has substantially reduced UK tariffs (as shown in Chapter 1, Exhibit 1.14) and improved service offerings and customer responsiveness.

The telephony penetration figures for the UK are close to the EU average at 48 lines per 100 population, 88 residential lines per 100 households (see Exhibit 2.43). BT, with 26.6m lines, is by far the largest provider of local telephony access. CATV companies now have about 600,000 telephony customers with a net monthly growth of 40,000 customers (compared with 60,000 for BT). Line density in the UK is 110 lines per square kilometre and line growth between 1982 and 1992 was the second lowest in the EU at 34 per cent. The average monthly bill of a PSTN line is lower than the EU average at ECU 39. BT has average productivity, with 171 lines per employee.

BT offers X25, leased lines and ISDN services. The number of packet-switched connections (as of January 1992) was 84,650 and the number of leased lines was 771,930, of

Exhibit 2.43: Country statistics summary for United Kingdom

United Kingdom

Demographics

Population (m)	57.5
GDP per Capita (ECU)	14,326
Area (km²)	242,429
Population Density (per km²)	237.8
Number of Households (m)	22.9
Households with Television (m)	22.2

Tariffs *

	ECU	Index[2]
Average Monthly Bill for PSTN	39	100
Average Monthly Bill for Mobile-Analogue	84	100
Average Monthly Bill for Mobile-GSM	86	100
Average Monthly Bill for Leased Line (2.0 Mbits)	2,933	100

Incumbent Networks

BT	
Main Lines (m)[3]	27.4
Lines per 100 Population [3]	48
Lines per 100 Households [3]	120
Lines per km²	110
Public Pay Phones	122,000
Digitalisation of Trunk Network (%)	75
Fibre Optic in Network (km)	2,570,000
Employees	156,000
Lines per Employee	171
Average Local Loop Length (km)	N/A
Call Failure Rate – Local %	0.11
Call Failure Rate – National %	0.14
Fault Rate – Faults/Line/Year	0.14
Mobile Networks	
Total Subscribers ('000)	3,016
Penetration (per 100 of population)	5
Total Growth '93-'94 (%)	69

New Service Testing

ATM	• BT is participating in the pan-European ATM trial
SDH	• SDH deployed by Energis in its long-distance network • Also deployed by Mercury and COLT
VOD	• ADSL & ATM trialled by BT as a way of delivering VOD in early 1994 • A commercial trial of 2,500 users in Colchester is planned for early 1995

Alternative Networks

Infrastructure Operator	Household Connections ('000)	% of Home Passed	Take-up Rate %	Fibre in Network (km)	Ratio of CATV lines to incumbent lines	Cable Layout
CATV	3,500	15	21	N/A	1:1.8	In-duct
Railway	0	0	0	4,500	0	In-duct
Electricity	0	0	0	3,500	0	Aerial
Other	0	0	0	0	0	N/A
Total	**3,500**	**15**	**21**	**8,000**	**1:1.8**	**N/A**

Notes: *(1) All data is for 1993/94 unless otherwise stated*
(2) BT = 100
* *PSTN – assumes 360 call minutes per month (25% long-distance, 75% local, all at peak-time) + monthly rental + connection fee amortised over 12 months (Source: Eurodata)*
Mobile – assumes business tariff at 160 call minutes per month (80% peak, 20% off-peak) + monthly rental + connection fee amortised over 12 months (Source: FT Mobile Markets)
Leased line – monthly rental charge for a composite leased line in range 2-200km (Source: OECD)

Source: *Infrastructure Questionnaire; Mercer Management Consulting interviews and research*

which 30 per cent were digital. The average monthly cost for a 2Mbit leased line is ECU 2,933. The number of Basic Rate Access equivalent ISDN connections is 330,000.

BT has installed 2,577,000 km of fibre optic cable in its network and the digitalisation rate of its trunk network stands at 75 per cent. Recorded quality levels for BT are some of the best in the EU, with a call failure rate on local calls of 0.11 per cent and of 0.14 per cent on national calls. The fault rate (faults reported per line per year) is 0.14 per cent.

BT is participating in the pan-European ATM trial and is also trialling ADSL as a way of delivering video-on-demand. A commercial trial of 2,500 users in Colchester is planned for early 1995.

Mobile telephony is offered by four competing Operators: Vodafone, Cellnet (60 per cent owned by BT), Mercury One-2-One (owned equally by Cable and Wireless and US West) and Orange (owned by Hutchison Telecom). The total number of subscribers is more than 3m and combined penetration stands at 5.2 per cent. Total subscriber growth in the year to November 1994 was strong at 69 per cent. The average monthly bill for an analog mobile telephone is ECU 84 (the lowest in the EU) and for a GSM telephone ECU 86 (second lowest in the EU).

Vodafone operates both an analog TACS-900 network (1.4m subscribers) and a GSM network, which was launched in 1992 and now has 78,000 subscribers. Cellnet also offers a TACS-900 network (1.3m subscribers) and a GSM network (17,500 subscribers) launched in 1994. The other two networks are the only DCS 1800 PCN networks in the EU: Mercury One-2-One (155,000 subscribers) was launched in 1993 and covers only the London area and Orange (43,000 subscribers) was launched in April 1994 and covers about half of the UK population.

The penetration of CATV infrastructure in the UK is much lower than for some other EU countries, reflecting the fact that licences were not awarded until 1991. However, CATV Operators are allowed to offer combined telephone and television services, which are highly profitable. This has resulted in rapid growth in infrastructure construction. The DTI has granted 125 licences to CATV Operators to provide both broadcast entertainment and telecommunications services. CATV Operators have invested ECU billion 2.5 since 1991 and are planning to invest a further ECU billion 10. CATV companies have a monopoly on the broadcast of entertainment video programmes over cable until at least 1998 and possibly until 2001.

CATV is currently available to 15 per cent of UK households (3.5m) and 746,000 of these have been connected (about 600,000 households are connected to cable telephony services and an increasing number of subscribers are taking only the telephony service). The ratio of CATV lines to BT telephone lines is 1:36.

2.14. Impacts and Trends

This short overview of Member States' existing infrastructures allows us to conclude that deregulation is likely to produce comparable effects across Member States for long-distance infrastructures, namely: it will be economical to use existing alternative infrastructures or to build new ones to provide services. The situation is more contrasted in the local loop. Here, the differences in penetration and ownership of CATV networks across Member States will have a significant impact on the actual effects of infrastructure liberalisation.

In France, Italy and Spain, CATV networks are underdeveloped due to regulatory restrictions or poor profitability. An incentive for a wider coverage of the CATV infrastructure would be to separate ownership where required and to allow CATV Operators to provide services other than TV broadcast. New customers are likely to be gained at the expense of incumbent Operators, but customers will benefit from a wider choice of providers and lower prices.

In the Netherlands, Denmark and Luxembourg, both CATV and telephony infrastructures are well developed. Competition at the local level may not bring much new investment unless one of the players (CATV or incumbent TO) feels confident it can capture significant market share from its competitors.

CATV is well developed in Germany and mature in Belgium, while telephony is still below its potential (with a strong East/West imbalance in telephony penetration in Germany). In these countries, liberalisation under ownership separation may lead to CATV Operators upgrading their networks to provide telephony. This would allow them to capture both new customers and customers from incumbent Operators, hence stimulating the markets. Otherwise, common ownership structures may be obstacles to the development of local network competition.

In the past, the UK had average telephony penetration levels and limited CATV infrastructure. Liberalisation has meant that CATV Operators could offer combined entertainment and telephony services and this has fuelled recent investments in new CATV infrastructures.

In Portugal, Ireland and Greece further investment in the modernisation or growth of the telephony network is needed. Rapid liberalisation may lead to the most remote and least profitable areas of these countries being neglected as the fight for the most profitable sections of the telephony/entertainment markets intensifies. Great care should be taken to finance some form of universal service in these countries.

Across countries, different "starting positions" regarding CATV are thus likely to lead to different outcomes from liberalisation.

Today, northern Continental European countries tend to have better telephony networks and more developed CATV networks than southern countries and peripheral Member States.

However, the combination of customer mix, demand evolution, upgrade versus "greenfield" economics and ownership constraints makes the impact of infrastructure liberalisation highly variable. In countries with well developed infrastructures, liberalisation is likely to foster the emergence of alternative long-distance and international infrastructures, but no local infrastructures.

As indicated before, civil works represent 40 to 70 per cent of the total investment in a local network. As a consequence, it could be argued that a new entrant reducing its initial investment by sharing duct space or poles with the incumbent Operator would be instrumental in the rapid development of alternative local networks. This policy would have the added advantage of reducing the environmental impact associated with the construction of completely new installations.

However, two issues may make this policy impractical in many instances, namely: free duct space is not readily available in most networks (even if available it may not be sufficient to draw new cables); and, more important, sharing ducts or poles will lead to a significant loss of control over the operation of the network. Many new entrants that we interviewed were sceptical over their ability to control the quality of the services they offered under these conditions. When interventions on the network were involved they would have to rely on their competitors to ensure that their customers got quick and efficient service. Therefore, they would rather build their own ducts in support of an independent alternative infrastructure.

In summary, significant differences in degree of development of infrastructures and of their ownership result in different service portfolios, quality and service levels across the various Member States. The liberalisation of the telecommunications industry, by allowing the emergence of pan-European Operators, will tend to equalise the extent and quality of services available in all Member States as long as adequate financial incentives are present. The latter are, however, strongly dependent on the degree of development and on ownership situations that characterise the existing infrastructures in the various countries. Consequently, any liberalising policy that seeks to establish fair competition in all countries must recognise that infrastructure liberalisation, on its own, may not be sufficient to effect the desired outcome.

Chapter 3: Survey of Regulatory Frameworks in Member Countries

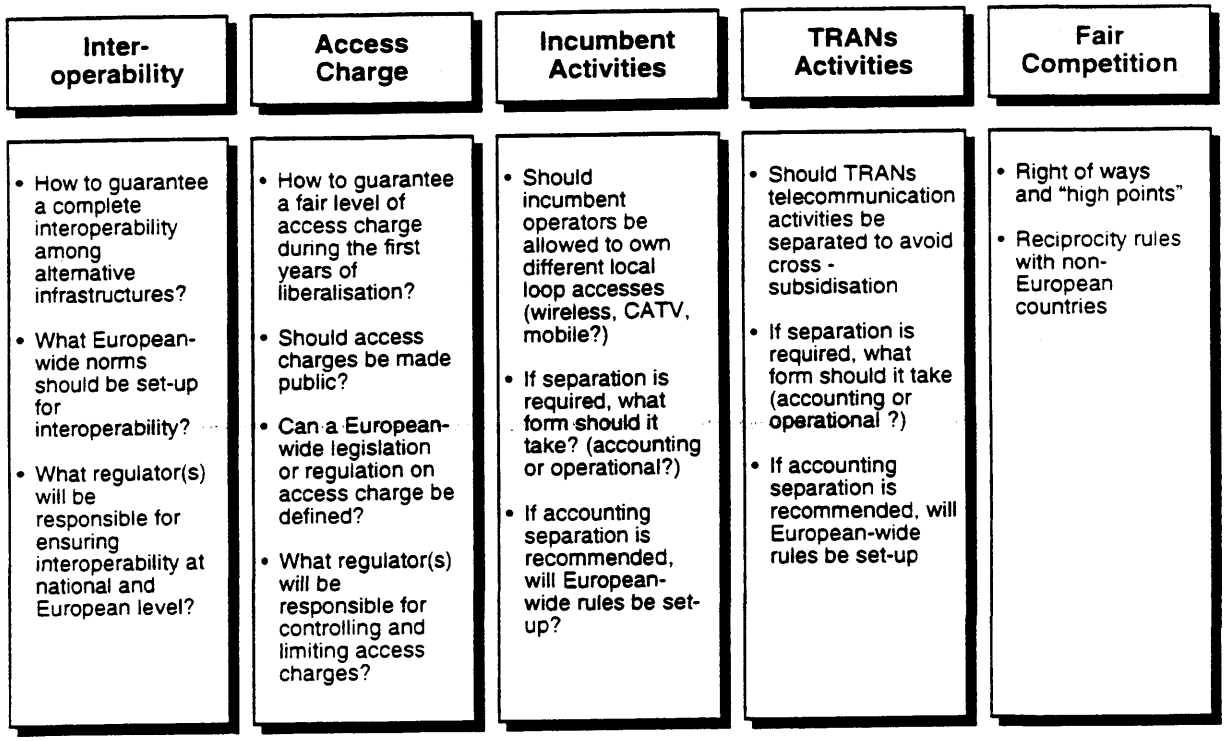
In the course of this study, Mercer asked each country's regulatory body to complete a questionnaire on the current regulatory status (see Exhibits 3.1 and 3.2). Descriptions based on the answers received from the regulatory authorities are footnoted; when no answer could be obtained, we used information compiled from various public sources.

Exhibit 3.1: List of information collected in the regulation questionnaire

Section	Questions
1. Regulator	• Name and role of regulatory bodies • Main laws and regulations
2. Service regulation overview	• Service reserved to incumbent PTOs • Serviced restricted for incumbent PTOs • License granted
3. Wireline infrastructure regulation	• "Infrastructure" definition • Monopoly and restriction to monopoly • Rights for TRANs • Rights of way regulation
4. Wireless infrastructure regulation	• Monopoly and restriction to monopoly • Rights to mobile operators • Direct interconnection regulation
5. Cable TV networks	• Service restriction • Direct interconnection regulation
6. Satellite	• Service restriction • License granted
7. Service, accounting and operational obligations	• "U.S.O" definition and responsibility • Accounting separation • Leased line pricing regulation

Source: Mercer Management Consulting Regulation Questionnaire

Exhibit 3.2: Issues associated with infrastructure liberalisation



Source: Mercer Management Consulting research

3.1. Belgium[6]

Regulatory Framework Overview

The national regulatory body of Belgium is the Belgian Institute for Postal Services and Telecommunications (BIPT). The BIPT is responsible for strategic, operational and regulatory issues related to postal services and telecommunications, including general telecommunications policy, licensing, approvals, control and management of the radio spectrum, interconnection, numbering, publication of technical specifications, ONP directives, implementation of EU directives, representation of Belgium in international bodies such as ITU and CEPT and the control of the incumbent PTO, Belgacom.

The legal regime governing telecommunications in Belgium was changed on 21 March 1991 by a law aimed at transforming the RTT into a legally independent, 100 per cent state-owned company called Belgacom and totally amending the regulatory environment in the field of telecommunications in Belgium. According to Belgian law, public telecommunications is defined as:

- The establishment, maintenance, modernisation and running of the public telecommunications infrastructure;

- The supply of reserved services to third parties. The reserved services include the following: voice telephony; telex, paging and mobile systems (the BIPT is changing the law to liberalise GSM service); telegraphic services; and the establishment, maintenance and running of those installations destined for telecommunications that are publicly accessible.

The provision of public telecommunications is the exclusive right of Belgacom. All other telecommunications services are liberalised. According to Article 88 of the above-mentioned law, public telecommunications infrastructure must be used to exploit a non-reserved service that crosses the public domain.

Article 92 (1) states that a reserved service must be used to connect two telecommunications installations in two or more buildings if partly or entirely used by different persons or if it crosses the public domain. Article 92 (2) states that the Minister can determine in which cases and under what conditions exceptions can be made to the above-mentioned rules. Article 92 (4) provides for the possibility of a fee to be paid to Belgacom in such cases.

According to Article 91, Article 92 is not applicable to installations used for military or public security purposes, or that are established and operated by services under the Minister of National Defence, the Minister of the Interior, NATO or the Allied Forces.

The state, communities, regions, provinces, municipalities, railways, public transport companies (bus, underground), distributions companies for electricity and gas, and water, radio and TV companies may install telecommunications infrastructures only for their own use.

Services Regulation Overview

The services reserved for the incumbent Operator are:

- Voice telephony
- Telex, paging and mobile systems
- Telegraphic services
- Provision of leased lines
- Public telephones

Broadcasting services and CATV may not, by law, be offered by Belgacom. Belgacom has been granted a licence to operate a wireline X25 service.

Wireline Infrastructures

According to Article 68 (5), the public telecommunications infrastructure is the set of equipment and means that crosses the public domain and is destined for telecommunications,

with the exception of the means destined for radio broadcasting and CATV networks. The network termination points are included.

The issue of access charges will be addressed when the telecommunications infrastructure is liberalised. The regulation regarding the provision of rights-of-way for telecommunications infrastructure is described in Chapter 9 of the 21 March 1991 law.

Wireless Infrastructures

Mobile Operators are prohibited from building or buying their own wireless infrastructures (for interconnecting their base stations with their switches). The general rule in Article 88 applies. Direct interconnection of wireless networks is not allowed.

Cable TV Infrastructures

Under the current regulation, only regional public CATV Operators are permitted. The CATV Operators may be allowed to provide non-reserved services on their networks, but only after the publication of a Royal Decree. Direct interconnection of CATV networks is forbidden.

Satellite Infrastructures

The 21 March 1991 law does not explicitly mention telecommunications via satellite. Terrestrial stations and hubs are considered part of the public infrastructure. VSATs (considered as terminals) and SNG (Satellite News Gathering) have been liberalised.

Service, Accounting and Operational Obligations

The concept of Universal Service Obligations (USO) is not explicitly mentioned in the telecommunications law; however, it is viewed as an important issue by the BIPT.

According to public service principles, Belgacom is obliged to deliver telephony services at one price to all. No accounting or operational separation obligations currently exist for the incumbent telecommunications Operator; however, negotiations with Belgacom regarding obligations for leased lines are under way.

3.2. Denmark

Regulatory Framework Overview

The National Telecommunications Agency (Telestyrelsen) is responsible for telecommunications legislation in Denmark on behalf of the Ministry of Communications.

The Telecommunications Act 1990/743 (TA) set the framework for telecommunications provision. According to Article 1, a concession is provided to the public Operator, Tele-Danmark, defining monopoly rights on voice telephony, telex, mobile and paging services, data transmission services (until 31 December 1992), telegraphy and the provision of leased lines. Tele-Danmark is entitled to provide local access services through its subsidiaries KTAS, Jydsk Telefon, Fyns Telefon and TeleSonderjydsk. According to the Act, rules on infrastructure and service provision may not be changed before 1994, and a one-year notice is required before changes may be implemented.

Tele-Danmark is permitted to operate CATV networks and may also provide broadcasting services.

Wireline Infrastructures

Under the TA, provision of inter-site infrastructure facilities is reserved for the public network Operator organisations. This applies to the infrastructure facilities for radio and TV programs as well.

Networks operated by the following (exclusive for their own internal use) are not considered to be of public nature and may incorporate privately-provided transmission facilities:

- National and local Government bodies
- Military/security installations
- Railway Operators
- Single enterprises (between own sites)
- Closed user groups

Privately-provided infrastructures are permitted for closed user groups under the following conditions:

- Fewer than 10 enterprises;
- Less than 22.5 km;
- Tele-Danmark has not established suitable networks in the relevant area.

Cable TV Infrastructures

Under the TA, provision of infrastructure facilities for radio and TV programs is limited to the public network Operator organisations (i.e., Tele-Danmark and its subsidiaries). However, Article 5 of the Act provides that the Ministry for Communication may licence the installation and operation of CATV infrastructure to other entities. This is limited to municipal (local) networks; the monopoly still governs the provision of cross-municipal infrastructures.

Tele-Danmark (through its subsidiaries) has a nation-wide licence; private Operators are awarded local licences.

The Danish cable industry is very fragmented. At the end of 1992 there were more than 10,000 networks. However, only telephone companies, municipalities and non-profit organisations may own CATV networks.

Legislation has recently been passed in Denmark legalising pay-per-view services.

Wireless Infrastructures

Operation of radio installation requires permission from the regulatory authority.

The GSM Act of 1990 established that the Ministry of Communications may licence the provision of one additional network that would compete with the primary Operator, Tele-Danmark. The Ministry awarded this licence to DanskMobilTelefon for five years. The Act did not permit discretionary licensing of further Operators.

For other public mobile communications, the TA established and confirmed a monopoly concession for Tele-Danmark.

Satellite Infrastructures

Supply and provision of receive-only earth stations for telecommunications, satellite services and network operations are within the monopoly concession granted to Tele-Danmark.

Discretionary licensing for transmitting earth stations (requiring approval from Telestyrelsen) is possible in association with the distribution and broadcasting of radio/TV programs.

3.3. France

Regulatory Framework Overview

The French telecommunications regulatory authority, the Direction de la Réglementation Générale des Postes et Télécommunications (DGPT), is responsible for all declaration and licence procedures.

French telecommunications law is contained in the Code des Postes et Télécommunications (CPT). This Code integrates the legislative and regulatory acts relating to telecommunications and was modified by the law of 29 December 1990.

Telecommunications services are defined as services that include the transmission or routing of signals, or a combination of both functions, by telecommunications processes. Audio-visual telecommunications are not included in this definition, as they are regulated by the 1986 Law No. 1087. Telephony and telex services and the installation of public phones can be supplied only by the public Operator, France Telecom. Other services are licensed by the Ministry of Telecommunications after specific conditions have been fulfilled. France Telecom has a general licence.

Wireline Infrastructures

The CPT establishes an exclusive right of France Telecom to provide the general public infrastructure. It also permits discretionary licensing of certain independent network infrastructures, subject to authorisation by the Regulator.

Independent networks are permissible only for private or shared internal use by a closed user group. They may be interconnected with the public network under certain conditions and only to support use within the original group of parties; nevertheless, such interconnection is widely authorised for private use by a single corporate entity and shared use by several entities who are members of a closed user group.

No licence is required for local independent networks such as local area networks (LANs) and low-power wireless networks.

Networks for state security and military purposes are excluded from the CPT licensing requirements. No special provisions are made for civil Government bodies, public utilities, or public transport organisations.

Cable TV Infrastructures

Cable TV networks are excluded from the CPT licensing requirements. Cable networks may provide data transmission services when authorised by the DGPT. Générale des Eaux Group (CGV) was granted a licence in October 1993 to provide data transmission services for the Nice municipality on its cable television network (144 Kbps to 2 Mbps). Private networks were authorised by a law passed in 1986.

Wireless Infrastructures

The competitive provision of radio mobile services to the public is subject to discretionary licensing by the Ministry of Telecommunications; appropriate authorisation for the use of the radio frequencies is also required. France Telecom may establish networks under its basic authorisation, although it does not have an exclusive right. France Telecom is also obliged to obtain radio frequency licences.

The licences, which may be granted provided there is no hindrance to the public service obligations of the primary public Operator, are for individual network Operators; the specifications may include public service conditions concerning characteristics, coverage and availability of service.

In addition to France Telecom, a mobile voice telephony service is operated by Société Française de Radio-Téléphone (SFR). Both have established analog networks and GSM services. They are soon to be joined by a consortium formed around Bouygues to provide PCN-type mobile communications. Radio paging services are provided by France Telecom through its subsidiary, Télécom Systèmes Mobiles and Télédiffusion de France.

Mobile networks, under the licences granted by the DGPT, may build their own wireless infrastructures, under the following conditions:

- Serve public interest through the provision of services not provided by France Telecom
- Compatibility with France Telecom network and pricing structure
- Payment of usage fees for radio spectrum
- Payment of additional fees for national R&D

Satellite Infrastructures

The supply and provision of earth stations for telecommunications is unregulated. Operation of these stations in a telecommunications network is subject to special licensing requirements; for independent networks supporting a closed user group of organisations, licences are granted by the Ministry of Telecommunications, but interconnection with the public network is authorised only in exceptional cases.

3.4. Germany[7]

Regulatory Framework Overview

Germany's main regulatory body is the Federal Ministry for Post and Telecommunication (Bundesministerium für Post und Telekommunikation). Its main functions are:

- Approval of tariffs for reserved services
- Issuing of licences
- Management of radio frequencies
- Determination of service obligations

The main telecommunications laws and regulations are:

- Law concerning the constitution of the German Bundespost; 08/06/90 (PostVerfG)
- Law about telecommunications equipment; 21/07/89 (FAG)
- Decree on telecommunications; 24/06/91 (TKV)
- Administrative decree on infrastructure and service monopolies of the German Bundespost Telekom; 19/09/91 and 13/07/92, respectively
- Authorisation concept on corporate networks; 01/93

The Post Reform II will change the regulatory and legal framework in Germany starting 1 January 1995.

Services Regulation Overview

The following services are reserved for the German Bundespost Telekom (DBP Telekom):

- Wireline telephony
- Wireless (but not mobile) telephony
- Radio communications

All telecommunications services may be offered by the DBP Telekom.

Wireline Infrastructures

The Federal State has the exclusive right to build and operate the transmission network (the so-called Network Monopoly "Netzmonopol"). This exclusive right has been transferred to the DBP Telekom in §1.2 of the FAG.

The FAG provides for discretionary licensing by the regulatory authority of individual telecommunications installations for certain routes or districts. The Regulator may stipulate any conditions, including restrictions on service provision or interconnection with public networks.

The Regulator is required to grant public utilities licences for wireline telecommunications networks used for service purposes, provided that the operational interests of DBP Telekom are unaffected. The rule does not apply to radio installations.

Certain wireline network infrastructures, exclusively for internal use, may be operated without a licence by the following:

- Local civil Government bodies
- Water management organisations

- Transport companies
- Single enterprises (between sites, in limited areas)

Single enterprise networks are limited to a span of 25 km. They may be formed by a single owner or by a group, providing that traffic exclusively concerns the linked premises and there are no commercial charges. Radio-based networks are not included in this exemption. Interconnection charge calculation rules have not been defined by law.

DBP Telekom has the right to use public rights-of-way (aerial, terrestrial and underwater) as long as the other public uses of the communication infrastructure are not permanently restricted.

Wireless Infrastructures

Licensed Operators are allowed to build infrastructure for the provision of mobile services (cellular services, PMR, data radio services, paging, aeroplane telephony). In a few cases, interconnection between networks has been allowed.

Cable TV Infrastructures

Cable TV infrastructure used to be part of the Network Monopoly transferred from the State to DBP Telekom. However, competition is now emerging since private companies may now obtain licences to build municipal (local) CATV networks.

Satellite Infrastructures

The supply and provision of earth stations for telecommunications is open to competition. DBP Telekom may operate satellite-based transmission links under its network monopoly; other satellite transmission Operators require a licence from the Ministry of P&T. Switched voice services may not be provided by satellite. Earth stations intended for transmission of low-rate data (up to 15 Kbps) must be granted a licence, including authorisation for interconnection with the public network and provision of services (excluding telephony) to third parties.

Service, Accounting and Operational Obligations

The Federal Government can determine which services DBP Telekom is obligated to provide and under what conditions.

Regulatory Framework Overview

The Legislative Decree 165 (1973) defined OTE's role as Greece's public telecommunications Operator. The major telecommunications law is the Framework Law on Telecommunications (FLT) of 1973. Under its monopoly rights, the public Operator OTE provides telephony, telex, telefax and data-transmission services. Regulatory functions lay within the Ministry of Transport and Telecommunications.

Wireline Infrastructures

Under the FLT, exclusive rights for general infrastructure provision are granted to the public Operator, OTE. However, apart from networks for military/security purposes, the law also allows the following organisations to construct and run networks for internal use without reference to OTE:

- Civil aviation authorities
- Railway companies (on own track routes)
- Electricity companies (on own supply/distribution routes)

No specific authorisation is at present required for provision of such infrastructure networks, but as publicly owned or controlled organisations, their operation is subject to individual regulation. Only internal traffic may be carried and OTE agreement is required for any interconnection with the public network.

Cable TV Infrastructures

Information not available.

Wireless Infrastructures

The broad monopoly for telecommunications services granted to OTE extends to public mobile telephony service and public radio paging. A presidential decree has been issued to authorise additional providers of mobile telecommunications (with public network interconnection). Greece bypassed the development of an analog cellular network and has issued two licences for 20 years to STET and Panafonto to operate GSM digital cellular systems. OTE operates a city-based paging service.

Satellite Infrastructures

The supply and provision of satellite earth stations comes effectively within the monopoly privilege of OTE. Operation of any satellite-based telecommunications networks also falls within OTE's exclusive area and there is no regulation authorising alternative infrastructure facilities, except in the case of certain public utilities.

3.6. Ireland

Regulatory Framework Overview

Ireland's regulatory functions lie with the Department of Communications. The Telecommunications Act (TA) of 1983 gives the public Operator, Telecom Eireann (TE), a monopoly on basic services, with the exception of international services. TE also has an exclusive licence for all services to and from the Republic with the exception of data communication.

Wireline Infrastructures

Under the TA, provision of physical infrastructure between premises is the exclusive right of Telecom Eireann. However, the regulatory authority has power to issue discretionary licences to others to provide facilities or services within TE's exclusive area, after having consulted TE. No such licences have been granted in practice.

Services (and supporting network infrastructure) provided and maintained by a business for use between employees for the purpose of the business and not rendering a service to any other person do not require authorisation. These networks would be required to seek approval for any radio installations and any interconnection with the public network would require agreement from TE.

Cable TV Infrastructures

Information not available.

Wireless Infrastructures

Provision of mobile radio telephony and paging services remains within TE's exclusive rights, according to the Postal and Telecommunications Services Act. The regulating Minister may grant discretionary licences to others.

Under its monopoly, TE provides analog and GSM cellular mobile telephony services and a radio paging service (through a joint venture with Motorola). Regional companies operate wide-area paging networks.

Satellite Infrastructures

TE has a monopoly on the supply of earth stations for telecommunications; no discretionary licences have ever been granted. However, a network exclusively to serve the employees of one organisation might fall outside the monopoly.

3.7. Italy[8]

Regulatory Framework Overview

The Ministry of Post and Telecommunications is in charge of the regulation and control of the telecommunications sector in Italy. The main laws are the Postal and Telecommunication Code of 1973 (DPR 29.3.1973), the Convention for the Public Telecommunication Operators (DPR 13.8.1984) and the ONP provisions that have been put into Italian law (particularly Law No. 55 of the 9.2.93).

Under the Postal and Telecommunications Code of 1973, telecommunications networks have operated as a monopoly. Licences for telecommunications services, valid for 20 years (the last licences were awarded in 1984), were awarded to SIP, ITALCABLE and TELESPAZIO (provision of satellite equipment only). All are now part of Telecom Italia, and they have pointed out that any changes to the monopoly situation would be contrary to licence rights.

Services Regulation Overview

Currently only value-added services are liberalised. The incumbent Operator may not broadcast radio and TV programmes.

Wireline Infrastructures

In addition to public licensing schemes for the authorisation of public telecommunications Operators, the 1973 Code provides for private licences to set up and run telecommunications systems.

Some utilities and transport companies (for example, the National Railways and the Electricity Board) have the right to own and operate a telecommunications infrastructure for their internal use. They are not allowed to lease capacity or provide rights-of-way to any other

Operator. The Regulator is currently studying the procedures for calculating interconnection charges to the public network.

Wireless Infrastructures

According to its 20-year licence from 1984, the public Operator SIP has exclusive rights to provide radio mobile telephony. SIP has provided analog cellular mobile telephony services and a digital radio paging service since 1985. However, a second licence (GSM) for the operation of a mobile network has been granted to a private consortium led by Olivetti. The only other exceptions to Telecom Italia's monopoly are:

- Operators of broadcast networks can operate their own infrastructure.
- Private concession can be given to companies for the operation of radio links between premises provided that there is no public service (or facilities are inadequate) between points to be linked.

Cable TV Infrastructures

The Code allows Telecom Italia to operate CATV networks, but the regulations have not been put in place. Consequently, there is no CATV Operator in Italy. Discussions are taking place as to the award of CATV franchises and the range of services that will be offered by CATV Operators.

Satellite Infrastructures

TELESPAZIO (now part of Telecom Italia) has the monopoly on satellite telecommunications services and reception infrastructure, with the exception of TV satellite reception equipment. There are no current procedures for others to be licensed or provide satellite based networks or services.

Service, Accounting and Operational Obligations

The only explicit universal service obligation is related to radio-maritime services.

3.8. Luxembourg

Regulatory Framework Overview

The 1990 Regulation on General Measures for Public Telecommunications Services (RGM) establishes the monopoly rights of the public Operator.

Wireline Infrastructures

The RGM grants the P&T Administration exclusive rights to establish the general infrastructure of public transmission facilities.

Wireless Infrastructures

The P&T Administration is the only provider of public mobile telephony and radio paging services at present, which consist of analog cellular telephone services and radio paging services.

The operation of private radio links may be licensed on a discretionary basis by the regulatory body. These licences are limited as to the types of communications traffic that may be transmitted over the link. Interconnection with the public network may be authorised by the public Operator, but only where the service is in the public interest. Applicants for radio installation licences must be based in Luxembourg.

Satellite Infrastructures

Satellite terminal networks may be established and operated only with a limited, discretionary licence from the Minister responsible for communications; interconnection with the public network is prohibited unless approved by the public Operator.

3.9. Netherlands[9]

Regulatory Framework Overview

The regulatory body for telecommunications is the Ministry of Transport, Public Works and Water Management (Telecommunications and Post Department).

The primary law, the 1988 Telecommunications Act (TA), is currently being revised. Parliament has passed the Mobile Telecommunications Law (MTL), which came into force on 1 September 1994. The MTL amends the TA and grants GSM licences.

Services Regulation Overview

Under the current regulation, voice telephony, telex, telegraph and the provision of leased lines are reserved to Royal PTT Nederland NV (PTT). PTT is completely unrestricted in the kinds of telecommunications services it can offer.

Wireline telecommunications value-added services may be provided by any company, without a licence. Provision of basic telephony is allowed only within closed user groups.

Wireline Infrastructures

The TA defines "telecommunications infrastructure" as "a system of installations and appurtenant facilities intended for telecommunications crossing public land either fully or partly, such system being limited by the appurtenant connecting points and including connections with foreign telecommunications installations." Under the TA, provision of wireline infrastructure is reserved to PTT with the following exceptions:

- GSM services can be provided using leased lines from third parties that have leased lines from PTT, licensed holders of fixed regional or national networks or licensed holders of CATV networks.
- A licence may be granted to a demanding party if the incumbent Operator is unable or unwilling to install the required infrastructure under reasonable conditions and within reasonable time.
- Companies (e.g. national utilities, railway systems, CATV Operators) that traditionally maintain networks for their own use may retain them.
- Companies may set up their own internal PABX and closed user groups.

In the near future licence holders of fixed networks may be able to offer leased lines to third parties. An additional licence will be required for this purpose.

The Government is planning to issue a licence for a second national infrastructure supplier. The intention is to issue one national licence to a consortium of specific companies (Dutch Railways, regional electricity companies and certain CATV licence holders). The consortium would be allowed to compete in all telecommunications services – except basic voice telephony – starting January 1995. Competition in basic switched voice telephony would be introduced in 1998, in accordance with the EU timetable. If the consortium is not able to establish itself within a few years, other infrastructure suppliers may be designated.

Infrastructure suppliers other than PTT will have a restricted obligation to supply digital leased lines as set forth in the EU ONP Directive on leased lines. In this initial phase, time-specific asymmetric conditions may be included in licences.

Current regulation does not explicitly address the issue of interconnection charges. However, the incumbent Operator has an obligation to make available to licensees (i.e., mobile Operators licensed to provide voice and data services) the necessary provisions for connecting their networks to the PSTN infrastructure under non-discriminatory conditions. It is expected

that all future providers of fixed public infrastructure will have both the right and the obligation to interconnect – on request – their networks.

Apart from the PTT, there are numerous rights-of-ways for the local CATV licensees (ca. 1,000), whose territory is confined to the municipalities. Each municipality can regulate the rights-of-ways in its own "public" territory according to its own regulations.

Wireless Infrastructures

The MTL has removed almost all forms of mobile communications from PTT's telecommunications concession and has created the possibility of several national licences for GSM, DCS 1800, HERMES and other analog services. For the latter category, a licence will normally be granted if sufficient frequencies are available.

Direct interconnection between licensed wireless networks is not allowed.

The second GSM licence will be issued before 1 April 1995. The licensee must acquire leased lines from third parties. They can be supplied by PTT, by certain permit holders, or by third parties with existing leased lines. If PTT refuses or is unable to provide such leased lines within a reasonable time or under reasonable conditions, the licensee can obtain permission from the Minister to install and maintain its own cables.

Cable TV Infrastructures

A licence is required to operate and own a CATV network. It is restricted to the territory of a municipality. Only one is issued per municipality. To provide interactive services (video-on-demand, pay-per-view, home-shopping, etc.) an additional licence is needed. Currently, data-transmission services between individual subscribers may not be provided by a CATV network. Direct interconnection of CATV networks and data transmission between individual subscribers is anticipated in 1995.

Satellite Infrastructures

Ownership and operation of VSAT terminals, VSAT hub stations and satellite earth stations for so-called Satellite News Gathering have been liberalised, provided these earth stations meet certain requirements for transmission capacity and frequency range.

Service, Accounting and Operational Obligations

PTT is obliged to deliver certain specified services at regulated prices to everyone on equal terms. These services include the supply of leased lines, fixed voice telephony service,

telegraph and telex services. Other ancillary activities are also mandatory: repairing faults, connecting subscribers, setting tariffs and publishing telephone directories.

3.10. Portugal[10]

Regulatory Framework Overview

The Communications Institute of Portugal (ICP) is the telecommunications sector Regulator in Portugal, under the supervision of the Minister of Public Works, Transport and Communications.

Its main duties are cooperation in the definition of communications policy; advising the Government in its supervisory activities; representing the Portuguese State in international bodies; approving materials and equipment; managing the radio spectrum; licensing Operators; preparing studies for coordination between civil, military and paramilitary communications, as well as between public sector communications Operators and media Operators; and undertaking any study necessary for the infrastructure coordination of the various civil telecommunications systems, including broadcasting.

The main laws relating to the telecommunications and CATV infrastructure are:

- Law No. 88 of 11 September 1989: Basic Law of Telecommunications
- Decree-Law No. 320/88 of 14 September 1988: Radio communications equipment, stations and networks
- Decree-Law No. 292 of 13 August 1991: Governs the activity of public cable television distribution Operator

Services Regulation Overview

Services reserved to the incumbent Operators are the following:

- Subscriber telephony
- Public pay-station telephony
- Fixed telex service
- One-way switched data transmission services
- Leased lines services
- Telegraphy services

According to the Portuguese legal framework, entertainment radio and television broadcasting may not be provided by the Operators.

Two companies (COMNEXO and AT&T) have licences to offer fixed complementary services (e.g. data transmission, E-Mail and EDI). Sixteen companies have licences for value-added services.

Wireline Infrastructures

The legal definition of telecommunications infrastructure in Portugal is wide-ranging and encompasses switching and transmission equipment as well as cable and radio-transmission equipment. The following telecommunications infrastructures are exempted from the Operators' exclusive rights:

- Infrastructure used exclusively for the emission, reception and transmission of broadcasting services
- Infrastructures used exclusively for private telecommunications, namely those belonging to the State and those established by the armed and security forces, railway companies and civil protection agencies
- Transport and distribution of electric power
- Complementary telecommunications infrastructures, such as base stations, base station controllers, master control centres, switching exchanges, concentrators and network supervision and management systems

Alternative infrastructure owners, such as railways and electrical power companies, are not allowed to lease or sell capacity of their own infrastructures to other single or corporate bodies.

The current regulation does not address the issue of interconnection charges. However, specific rules of accounting for settlements between Operators and complementary telecommunications services Operators (e.g. land mobile, paging and trunk Operators) for the use of parts of the Operators' basic telecommunications network have been set out by convention. In this context, Operators are obliged to offer a discount of at least 35 per cent off the fixed telephone service tariff rates.

The ICP is preparing a legal draft that will allow for private networks intended to provide communications for closed user groups.

Wireless Infrastructures

The establishment, management and operation of wireless infrastructures is authorised for private telecommunications or for radio and television broadcast. Direct interconnection of wireless networks is not allowed under the current regulation.

Cable TV Infrastructures

CATV distributors need a licence from the Member of Government in charge of communications. Licences can be granted only to:

- Public, state or municipal corporations
- Private business corporations
- Non-profit corporations, provided that the network is intended exclusively for their associates

Nine licences have been issued so far. The cable distribution networks are only able to transmit simultaneous television channels. Transmission of radio programmes should soon be allowed. Cable Operators may not interconnect their networks.

Satellite Infrastructures

The company that has been granted the exclusive right to operate satellite telecommunications systems in Portugal is CPRM under the terms of its concession contract.

Service, Accounting and Operational Obligations

Universal service in Portugal is defined as "the complex of specific obligations inherent to the provision of public use telecommunications services aiming to cover the communications needs of citizens and the economic and social activities within the national territory, in terms of equality, continuity and fair pricing, bearing in mind the requirements of harmonious and balanced economic and social development."

The national telecommunications legal framework, namely the Portugal Telecom concession contract, obliges the TO to cover these universal service obligations. Currently, universal service obligations apply only to Telecom Portugal.

Telecom Portugal is obliged to use an analytic system of accounting that allows accurate distinctions between direct or indirect profits and losses associated with service provision and with the management and exploitation of telecommunications infrastructures under its exclusive responsibility. The current legislation does not foresee operational separation obligations for either the incumbent telecommunications Operator or the other telecommunications infrastructure owners.

3.11. Spain[11]

Regulatory Framework Overview

Spain's basic regulatory body is the Dirección General de Telecomunicaciones (DGT). It was set up in 1985 and its functions are detailed in Royal Decree 989/1992. Its main duties are:

- Study and proposal of laws and regulations; application of regulations; and licensing and authorisation of all telecommunications services. In some cases, this function stays with the Ministry (Ministerio de Obras Publicas, Transportes y Medio Ambiente) or the Council of Ministers;
- Technical specifications, equipment approval and laboratory certification;
- Regulation and technical control of telecommunications systems and networks;
- Management of the radio spectrum, technical control of radio emissions;
- Control and inspection of telecommunications services;
- Strategic planning of telecommunications networks and services;
- Study and information on service tariffs (approval hinges on the Government);
- Monitoring and follow-up of plans agreed to between the State and Telefónica;
- Representation in international bodies.

The Director General is simultaneously Delegate of the Government at Telefónica and as such supervises the fulfilment of Telefónica's licence.

The only area not governed by laws and regulations is the CATV sector. The DGT is working on a draft law it will submit soon to the Spanish Parliament.

Services Regulation Overview

Reserved services:

- Telefónica: basic telephony and public pay phones (in streets or public locations)
- Correos y Telegrafos: telex and telegraphy

Services that Telefónica cannot offer:

- Radio and TV broadcast

Licences given for data services:

- Megared (BT), Unisource, Cable & Wireless, Telemedia (STET), IBM, France Telecom, IGR, Telefónica.

There are many value-added service providers. Each must obtain a licence from the DGT to ensure it does not interfere with reserved services.

Wireline Infrastructures

The provision of wireline infrastructure for telecommunications services is reserved for Telefónica, Correos y Telegrafos and Retevision (referred to in this text as "the three Operators").

Alternative telecommunications infrastructure owners cannot use their infrastructures to offer services to outside clients. The problem of a lack of interconnection charges has not been solved yet, particularly in regard to the deficit resulting from universal service obligations.

The three Operators have the right-of-way on all public areas and rights of passage on private grounds. The evolution of wireline regulation will depend on EU Council discussions after the publication of the Green Paper on infrastructure.

Wireless Infrastructures

Wireless Operators may operate their own base stations. Between base stations and between switching centres they can operate their own infrastructure if the offers from the three Operators are not reasonable. The DGT determines whether an offer is reasonable.

Interconnection with international Operators must generally pass through one of the three Operators, but the DGT can authorise direct international interconnections.

Cable TV Infrastructures

As mentioned above there is no law, but a law is in preparation. The following points apply only to the *draft* law:

- Franchises will be granted following a selection process. There may be limits to cross-ownership between franchisees and to the number of franchises to be granted.
- The draft stipulates that all liberalised services could be carried over the CATV networks.
- Interconnection between networks will be allowed only through one of the three Operators.

Satellite Infrastructures

There is no detailed regulation of satellite communications. There is only a mention in the Telecommunication Law (Ley de Ordenacion de las Telecomunicaciones, "LOT") granting concessions of satellites services to the three Operators. Liberalisation of satellite services and of access to space segments is expected.

Service, Accounting and Operational Obligations

Universal service is defined in the LOT for both networks and services (telephony and telex) as the provision of: national coverage, uniform quality, continuity and compatibility, non-discriminatory access, inter-operability, uniform tariffs (affordable and cost-oriented) and privacy of communications.

Telefónica has the obligation to provide universal service. Beyond 1998 it has not been decided yet how this obligation will be shared with new entrants. The DGT is planning to define and quantify universal service obligations. It also plans to check whether this will involve a deficit and determine who should cover this deficit and how. There is an accounting separation at Telefónica between reserved and non-reserved services.

3.12. United Kingdom

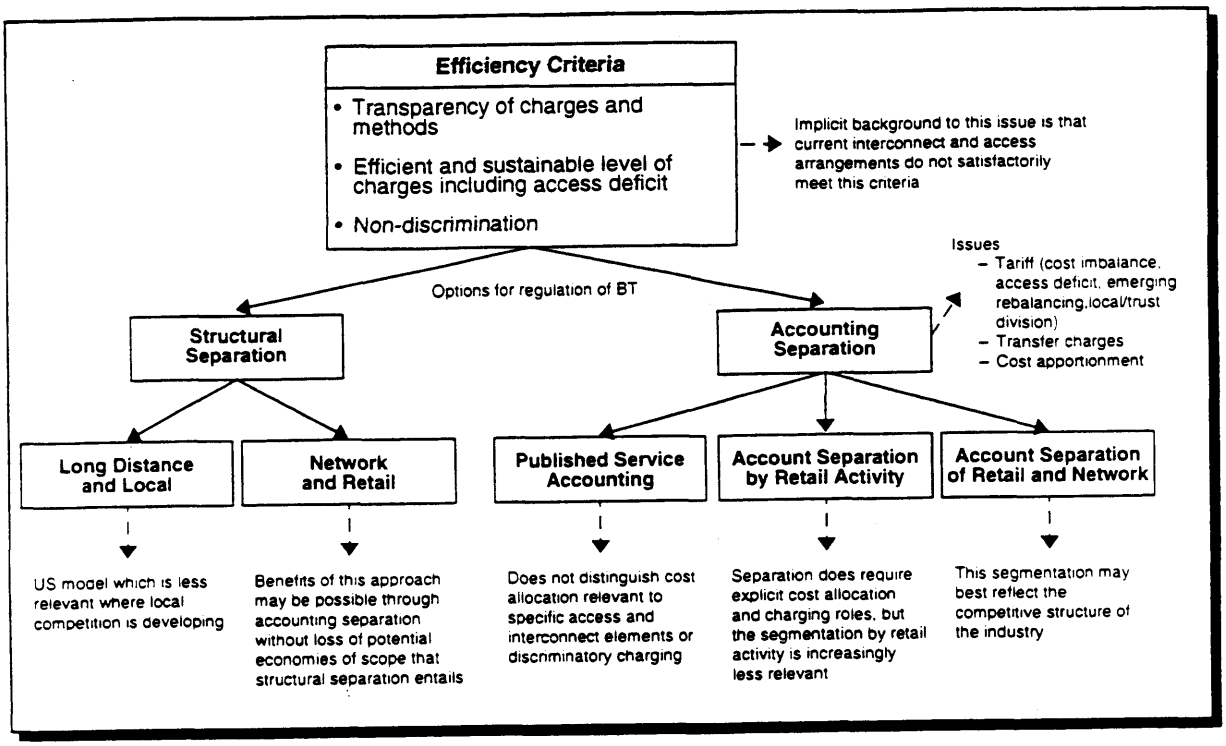
Regulatory Framework Overview

Control of telecommunications is vested with the Department of Trade and Industry (DTI) acting in collaboration with an independent regulatory body, OFTEL. OFTEL advises the DTI on granting licences, enforces licences and has the sole ability to propose licence changes either by agreement with licensees or following a favourable reference to the Monopolies and Mergers Commission (acting effectively as an independent appeals body). There is no monopoly provision of telecommunications networks in the UK. The policy of the Government is to licence a range of competing networks.

In the White Paper, "Competition and Choice: Telecommunications Policy for the 1990s," the Government announced that in addition to the fixed link duopoly of BT and Mercury, additional network Operators would be permitted. The Telecommunications Act 1984 (TA) establishes a regulatory system applying to all forms of telecommunications. It is complemented by the Wireless Telegraphy Act 1989 for radio transmission telecommunications and the Broadcasting Act 1990 for broadband cable systems.

The TA establishes a system in which all telecommunications systems must be licensed. Detailed conditions and obligations are included in the licences and not in the TA. For a public telecommunications network, an individual licence application is required, which is assessed by OFTEL and the Secretary of State. The licences of such Operators contain obligations to publish charges and to not discriminate. All network licensees must permit interconnection with other network Operators (see Exhibit 3.3). Most private networks are covered by class licences, which do not require application, but may however be used to provide services to third parties. In December 1994, Oftel published a consultative document entitled "A Framework for Effective Competition." The publication is part of a consultative process continuing until March 1995 which will lead to a definitive statement from Oftel in mid-1995. The main conclusion arising from this document is that the UK telecommunications market will become less regulated in the long term.

Exhibit 3.3: Regulatory issues concerning access and interconnect charges (UK example)



Source: OFTEL; Mercer Management Consulting research

Wireline Infrastructures

Currently, four Operators, BT, Mercury, Energis and the City of Kingston-upon-Hull, run public fixed-wire networks. Since the Duopoly Review, 97 applications for new licences have been received and of these 54 have resulted in the issue of a licence (as of September 1994). Successful applicants include many of the regional electricity companies, foreign Operators (such as Telstra and Sprint) and Ionica to provide a fixed wireless network. The Government's intention is not to licence further international Operators at present.

Under their licence, BT (see Exhibit 3.4) and Mercury are granted so-called "Code Powers" to dig up the streets and fly wires. These powers are also generally granted to new Operators in the areas where they are licensed to operate with certain limitations designed to prevent environmental disruption.

Exhibit 3.4: Regulation of BT

<table>
<tr><th colspan="2">Financial Controls</th><th rowspan="2">Licence Controls</th></tr>
<tr><th>Interconnection Charges</th><th>Retail Charges</th></tr>
<tr><td>Operator Separation
• Accounting separation will be introduced for BT for the 1994/1995 year of account
• Separation will be between network, access and retail accounts to reveal internal transfer charges and the funding of the access deficit</td><td>Tariff Reductions
• BT is subject to an Oftel determined RPI-X price cap for a basket of its main telephone services
• The cap has evolved as follows:
1984 RPI - 3% | 1989 RPI - 4.5% | 1991 RPI - 6.25% | 1993 RPI - 7.5%</td><td>Universal Service Obligation
• BT is obliged by its licence to provide telecommunications services wherever there is a reasonable demand, in particular services in rural areas, emergency services, public call boxes & ship to shore
• Mercury was required to provide near national coverage within five years</td></tr>
<tr><td>Costing Methodology
• Costing process is carried out by BT under guidelines from Oftel
• Costs are calculated on a fully allocated historic basis
• Depreciation is calculated on a straight line basis with varying asset lives appropriate to the asset
• Geographically averaged function costs are used
Activity based costing is required</td><td>• It will next be reviewed in 1997
• The basket of services comprises: exchange line rentals, local and national non-payphone calls, directory enquiries, outgoing international calls, operator charges, connection charges
• The contents of the basket have been extended over time and this has increased the level of X
• A tariff basket model is used</td><td>Restrictions on service provision
• BT is forbidden from providing broadcast entertainment services over its network until 2001, however, this will be reviewed in 1998 in the light of the penetration achieved by new competitors
• No competitor may directly operate a fixed line and a cellular network</td></tr>
<tr><td>Charging Methodology
• Traditionally BT has negotiated charges with each operator, but these are now published
Costs are based on four network segments
• Charges are made primarily on a per minute basis
• From Jan 1995 a standard price list of services will be produced based on about 12 network components</td><td>Tariff Restrictions
• BT has a specific cap of RPI + 2% cap on residential charges to limit rebalancing
• BT must offer low user tariffs to offset the effects of rebalancing and encourage penetration
• Access Deficit Contributions have been calculated to compensate BT for its Access Deficit</td><td>Network Access Provision
• BT is obliged to provide open network access to any licensed telecommunications operator
• Indirect access to other networks including Mercury is via 'easy access' using a 3 digit prefix
• Number portability using call forwarding is currently being introduced between BT and the cable operators</td></tr>
<tr><th colspan="3">Competitive Stimulation</th></tr>
<tr><td>• BT has not been required to provide services at less than cost nor pay for connection equipment in order to stimulate competition
• The regulator's objective has been to develop interconnection charges which fairly reflect the costs incurred</td><td>• New entrants are free from price restrictions
• Access deficit contributions waivers are granted on a case by case basis to new entrants
• All entrants have so far been granted waivers for the local, national or international call markets as follows:
0-10% share of relevant market: 100% waiver
10%-25%share: waiver on first 10% share of volume
Over 25% share: no waiver</td><td>• New entrants since the duopoly review have no universal service obligations and are allowed to provide service in any region
• Universal service contributions to BT are not required
• Entrants must provide open access to all operators
The licence restriction preventing ownership of a wireline and a wireless network applies to all operators</td></tr>
</table>

Source: OFTEL; Mercer Management Consulting research

BT and Mercury are permitted to provide a full range of services, including all forms of fax, voice and data. Under the current licence, Operators are not directly allowed to operate mobile networks (with the exception of associated companies). The Oftel document, "A Framework for Effective Competition," mentioned above points to a shift in thinking from UK Regulators regarding access deficit contributions (ADC's). Currently, competitors to BT have to compensate the Operator for losses it incurs maintaining its local network. Oftel proposes in the document the eventual removal of ADC's, a factor which could save Mercury, for example, £60m a year. The document also suggests that the price capping of BT may come to an end after 1997 and a rebalancing of BT's tariffs may be allowed through the increase of line rental charges.

Cable TV Infrastructures

125 licences have been granted under the TA for the construction and operation of local CATV networks to provide broadcasting and telecommunications services. The 1991 White Paper removed the need for these Operators to seek specific approval before they could provide voice telephony services.

The 1991 White Paper also announced the decision that the Government did not intend to remove the current restrictions on BT from either conveying or providing broadcast entertainment services in their own right until 2001, although there is scope, from 1998, for the Director General of Oftel to advise the Government to remove these restrictions. By 2001, it is forecast that the cable Operators' broadband networks will largely be completed, providing a competing access network to BT's.

Wireless Infrastructures

To provide a public mobile telephony service, an individual licence is required under the TA, together with an appropriate radio licence under the Wireless Telegraphy Act. Telecommunications licences are issued on a discretionary basis by the DTI, advised by OFTEL.

Four cellular Operators have been licensed: Vodafone and Cellnet in 1985 and the PCN Operators, Mercury One-2-One and Orange, in 1991. Vodafone and Cellnet each operate two networks: analog TACS networks and GSM networks.

Vodafone and Cellnet were first licensed only to sell their services to the public through an intermediate tier of retailers called service providers. Since 1993 they have been granted new licences which allow them to sell airtime direct to the subscribers as the PCN Operators have been allowed to do since they started. All Operators must continue to provide, on request, wholesale airtime to service providers for resale.

The licences also allow self-provision of long-line fixed links. From April 1995, Vodafone and Cellnet will be able to self-provide local fixed links between their base stations and the local switching centre. The PCN Operators can already self-provide local fixed links.

The licences are similar to those for fixed-wire networks and contain the same limitations on cross-subsidisation. The service obligation on Vodafone and Cellnet (and One-2-One and Orange from 2000) is to cover 90 per cent of UK population. The Regulator currently has no power to control prices. Cellular systems Operators may provide only mobile services and the public Operators may operate only mobile networks through separate subsidiaries.

Nation-wide paging licences are authorised by individual licences, granted on a discretionary basis similar to public mobile telephony licences but with fewer conditions and obligations. There are currently four national wide-area paging licensees operating together with a number of regional paging companies.

Satellite Infrastructures

Until 1984, BT had a monopoly on the provision of telecommunications services via satellite in the UK. Mercury's licence introduced competition but Mercury decided not to develop the provision of satellite services.

In 1988 the Government awarded six licences for the provision of one-way, point to multi-point specialised satellite services to Specialised Satellite Service Operators (SSSOs). Initially, the licences were intended to limit service to the UK, but in 1989 the service area was widened to cover Europe. In addition the SSSOs were authorised to receive messages and re-transmit them on behalf of customers.

Following the conclusion of the Duopoly Review in 1991, the Government issued a class licence for the provision of two-way satellite services not connected to the PSTN and in 1992 announced that it would issue individual licences allowing Operators to provide two-way satellite services, including passing messages over the PSTN (but excluding connection at both ends for international voice traffic). Six of these licences have now been granted.

3.13. The Pan-European Trend Towards Liberalisation

As we can see from the examples above, a major process of legislative change has been taking place in all countries in recent years. The trend is clearly towards liberalisation. Restrictions are being lifted as regulations are modified and additional authorisations or licences are provided.

In the United Kingdom, after 10 years of duopoly in infrastructure competition, OFTEL has allowed newly licensed long-distance and local Operators to provide both telephony and entertainment services. According to OFTEL, this further liberalisation is essential for the creation of a truly competitive marketplace, by challenging BT in its core operations. At the same time, BT is currently prevented from offering broadcasting services through its network, a condition OFTEL considers essential for promoting stable competition in the local loop.

Within an 18-month period, 62 licensed CATV Operators have already gained significant market shares in the residential areas they cover, whereas previous efforts by Mercury within the duopoly context failed to create much competition in the residential market. The new cable companies in the UK are expected to win about 20 per cent of the residential telephony market and 8 per cent of the business telephony market by the year 2003, representing ECU billion 3.8 in annual revenues. This development will be driven primarily by lower total local call tariffs.

In the Netherlands, the Government has announced a plan to launch a second Operator (TeleNed) in 1995 comprising NS (national railway), the national electricity distribution company and CATV Operators. This alternative Operator will be able to offer data (at first) and voice services on the basis of its own independent infrastructure.

In France, the Minister of Industry has begun to very *progressively* liberalise infrastructures. For example, the Ministry has allowed provision of data services over a CATV network (i.e. in Nice), thus effectively endorsing the conclusions of the *"Lasserre Report"*[12]

(published in March 1994, after widespread public consultation). This report favours a controlled and staged liberalisation of infrastructure, while stressing the need to liberalise both infrastructure and services at the same time in order to impart more autonomy to the service providers. In relation to overall infrastructure policy in France, the *"Théry Report,"* published in October 1994, has attracted much attention both in France and elsewhere in Europe. The report, commissioned by the French government from the former managing director of France Telecom, calls for a considerable investment in new infrastructure if the government's plans for an information superhighway are to be realised. A figure of up to FFr 200bn will be needed, according to the report, if the planned extensive fibre optic network is to be installed.

The Spanish Government has announced its selection process for CATV franchises throughout the country. These franchises will be permitted to provide telephony services in competition with Telefónica.

In countries like Belgium, where the roles of Regulator and Operator were still intertwined, they have now been separated.

Undoubtedly, the remaining European Union countries will introduce legislation allowing for the progressive development of alternative infrastructures. All EU Member States have now licensed or are in the process of licensing a second GSM Operator. In addition, PCN licences have been awarded in the UK, Germany and France.

Finally, the role of Regulators is changing. Their objectives are now more focused on creating benefits for users and enhancing the overall competitiveness of the industry, less on protecting the Operator. However, many questions remain on the constitution and future role of local Regulators. In particular, local Regulators have in their hands the power to steer the evolution of the telecommunications markets. Market distortions will be created by both the Regulator and the incumbent Operator (due, for example, to its size and ubiquity) that will have to be addressed in relation to the ultimate objectives of the regulatory process – to strengthen the European telecommunications industry and the quality of the services it provides to its citizens.

There are many tools at the Regulator's disposal for achieving its objectives. It is important to recognise that how the Regulator uses these tools can fundamentally affect the financial attractiveness of the different markets, either directly, through pricing, interconnection and access rules, or indirectly, through the level of competitive rivalry that it fosters (e.g. BT broadcasting restriction). In particular, whether European telephony Operators will continue to be allowed to own both telephony and CATV infrastructures in the same geographical area is a fundamental question that the regulatory authorities in Europe will now face.

Chapter 4: Technological Convergence and Potential of the Infrastructure

4.1. Definition and Classification of the Infrastructure

The definition of telecommunications infrastructure is, in itself, an important aspect of the infrastructure debate. To clarify this issue, we have considered a layered approach to the definition of infrastructure, as shown in Exhibits 4.1 and 4.2. Each layer corresponds to an added degree of functionality within the network.

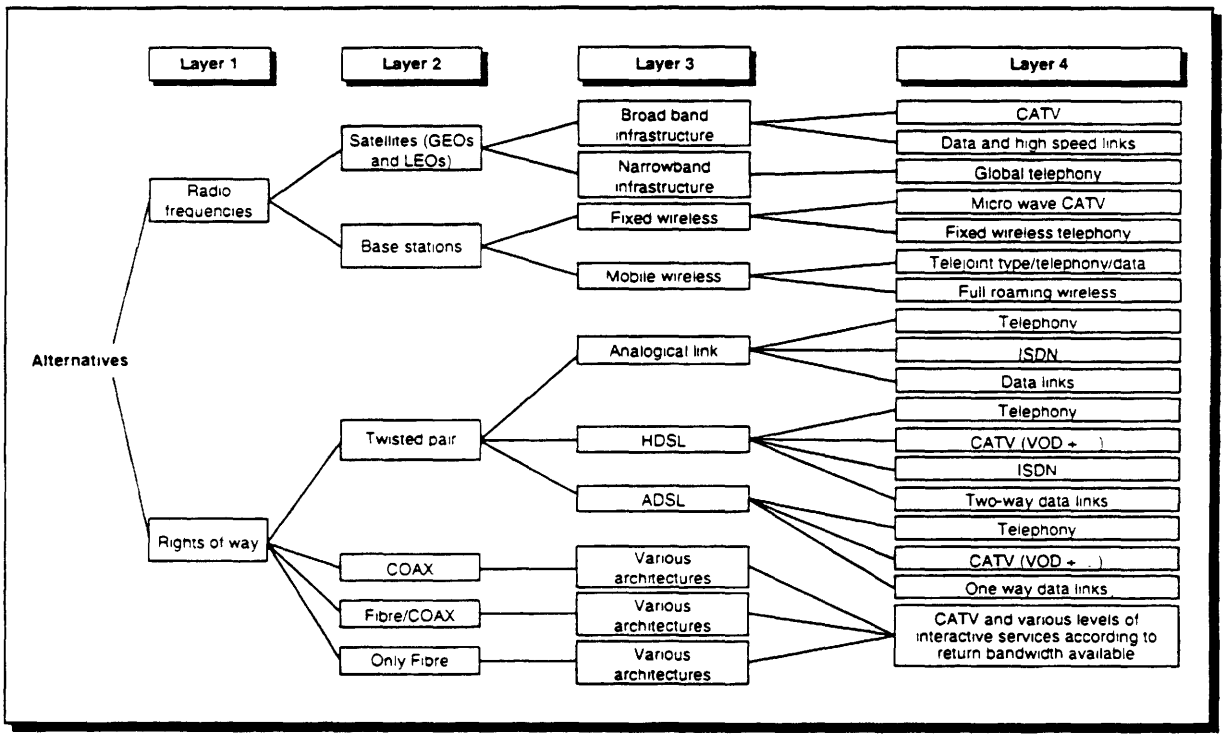
- Layer 1 corresponds to the prerequisites for establishing the subsequent layers. This layer encompasses rights-of-way, frequencies, space segments, etc. Without access to these resources, no telecommunications infrastructure could be built.
- Layer 2 corresponds to the physical elements required for the transmission of information. It covers mainly cables (copper or fibre-based) and radio emission base stations.
- Layer 3 covers the equipment used for coding and transmitting information. This layer encompasses transmission equipment, multiplexers, compression/ decompression modules, etc.
- Layer 4 covers all the equipment that allows point-to-point communication through the networks. It entails all the systems for the switching, signalling and configuration of a telecommunications network.
- Finally, Layer 5 is the user-application layer, which covers all the applications (interactive or broadcast) that can be based on the previous four layers.

Exhibit 4.1: Layered approach to infrastructure definition

	Layer of infrastructure	Functionalities	Examples
Layer n° 5	Advanced applications hardware and software	Provision of advanced or customised applications over layer 4	• Information services servers • Interactive Cable TV equipment ...
Layer n° 4	Switching, signalling and configuration equipment/software	Ensuring point-to-point basic services (PSTN, ISDN ...)	• STM and ATM switches • LAN routers • ATM • Corresponding software ...
Layer n° 3	Transmission equipment and terminal equipment/software	Information coding and transport	• PDH and SDH equipment • ADSL equipment • PABX • Set-top boxes • Broad band terminals
Layer n° 2	Cables Base stations	Transmission support	• Fibre cables • COAX cables • Twisted pair cables • Mobile systems base stations
Layer n° 1	Rights of way Frequencies	Prerequisite for upper levels (Access to scarce resources)	

Source: Mercer Management Consulting research

Exhibit 4.2: Infrastructure options in the distribution network



Source: Mercer Management Consulting research

This chapter first discusses the economics of the first three layers (i.e., the basic network architectures) and then the services offered (Layers 4 and 5). We look at how viable these infrastructures and services can be under various regulatory scenarios and in different economic environments.

4.2. Presentation of Main Technologies

This section provides an overview of existing and emerging technologies for telecommunications infrastructures. This does not represent comprehensive coverage of telecommunications technologies, but rather is a discussion of the technologies that we believe will have the greatest impact on the industry in the short and medium terms. We have focused on wireline technologies, as wireless technologies were considered in the recently published Green Paper on Mobile and Personal Communications.[13]

Clearly, most of the technologies we have reviewed focus on the potential of digitalisation and on the so-called "convergence" of telecommunications and broadcast technologies.

For the sake of convenience, we will discuss technologies affecting local loop and long-distance infrastructures separately, although this distinction is to a large extent artificial. Technologies primarily affecting local loop infrastructure are presented first; technologies affecting mostly long-distance networks follow. We then present main services and the key service-network requirements relationships. We end with possible scenarios for the emergence of new infrastructures in the Member States.

4.2.1. Local Loop

ADSL (Asymmetric Digital Subscriber Line)

ADSL is part of the DSL group of line-coding technologies developed by the Bell Laboratories to carry high bit-rate signals over copper pairs (see Exhibit 4.3). ADSL gained recognition over the last few years when some Operators presented it as a potential alternative to COAX-based networks for the provision of video services to residential customers (including video-on-demand, or VOD). Among those, Bell Atlantic and BT have been very active in promoting this technology and testing it on-site. Both have stressed the flexibility that ADSL allows by enabling progressive, on-demand provision of new services. Some Operators conducting major trials include Bell Atlantic (New Jersey), BT (Ipswich), Rochester TV, Singapore Telecom and Telia. However, some of the trials already initiated have not fully met earlier expectations, and broad market trials have been postponed by some Operators. In Europe, BT appears to be at the forefront in testing ADSL technology. It is planning to follow up its limited Ipswich trial

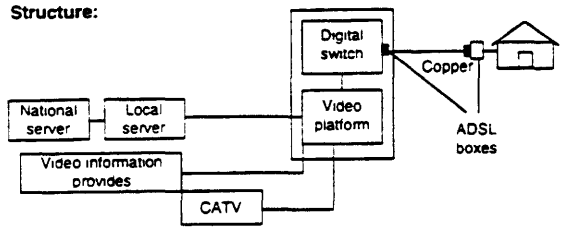
with a commercial trial of 2,500 users "some time in 1995." The commercial trial, in addition to further testing the technical feasibility of the project, will also indicate the willingness of users to actually pay for the VOD offering.

Exhibit 4.3: ADSL technology watchcard

Technology: ADSL
Version: BT

Service provided: – 2 Mbps + delivery over standard twisted pairs

Structure:



Capacity:
- 1.5 Mbps (Bell Atlantic's Virginia Trial)
- 2 Mbps (1994) downstream (using MPEG 1)
- 6 Mbps (1996?) downstream (using MPEG 2) + 16 Kbps bidirectional

Encoding systems: – CAP (Amplitude/Phase modulation) or DMT (discrete multitone)

Developments: – Greater capacity both upstream and downstream are envisioned (4 video channels + 384 Kbps two-way channels)

Usage:
- Delivery of video-on-demand service over twisted pair: "video-dialtone" at VHS-like quality
- Usage may evolve as bandwidth increases

Pros:
- Cost - positive cash flow
- Compatible with ISDN services over same line
- Good image quality (Europe)

Cons:
- Cannot provide live video, until real-time compression is available
- Limited upstream bandwidth
- May require the installation of a digital loop to shorten copper loop
- Risk of disturbance to regular telephony service
- Intensive line conditioning required

Cost: – Cost estimates vary widely across sources

Test:
- BT (Essex)
- Rochester telephone
- Bell Atlantic in Washington DC + New Jersey

In Rochester ADSL will be tested against Fibre/COAX architecture (separate home vs. apartment building)

Source: BT; Mercer Management Consulting research

In principle, ADSL allows multiplexing and downward provision of 2 to 6 Mbps over conventional copper-based infrastructures through the use of specific terminal equipment, with a return capacity of nx64 Kbps.[14] Actual capacity depends on the quality, length and gauge of the local loop where the equipment would be provisioned. Based on current technical developments and our infrastructure survey, we estimate that about 70 per cent of European subscribers could be provided with 2 Mbps video signal using this technology,[15] although this percentage varies substantially by country.

The actual penetration of ADSL equipment is likely to depend both on the current penetration of alternative systems (for instance, CATV networks) and on the actual cost of ADSL equipment. Estimates for ADSL investment per customer, if the technology becomes widely accepted, range from ECU 700 to ECU 2,500 (depending on the quality of the local network). In the UK, BT estimated a cost of ECU 520 per served customer in a "mature market,"[16] which may be considered somewhat ambitious, given current prices and level of interest for the technology. It is clear, however, that ADSL is still at an early stage of development and that price and performance estimates are likely to change over the coming years.

Current systems use either CAP (Carrierless Amplitude/Phase) or DMT (Discrete Multitone) coding technologies, with AT&T Teledyne (USA), Westell (USA), Newbridge Corp (Canada) and Northern Telecom[17] (Canada) as the main developers.

HDSL (High-Bandwidth Digital Subscriber Line)

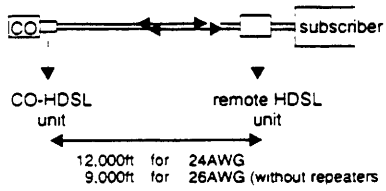
While ADSL can be regarded an alternative to cable-based networks for residential services, HDSL (Exhibit 4.4) is an alternative to optical fibre and traditional methods for the provision of E1 connection to business customers. This DSL technology, which has been standardised in Europe by ETSI using the 2B1Q coding technology, allows the provision of 2 Mbps circuits using two copper-based pairs, on up to 3 Km.

Exhibit 4.4: HDSL technology watchcard

Technology: **HDSL (High Bitrate Digital Subscriber Loop)**
Version:

Description: – Line -coding technology allowing the delivery of 2 Mbps + over normal twisted pair local loop

Structure: – Same upward/downward capacity



Capacity: – Capacity depends on gauge/length

Usage: – Provision of 2 Mps service (6 Mps in 1996 ?)
– Replaces optical fibre systems for distance ≤ 2 km

Pros: – Alternative to using repeaters on local loop
– Very adaptive: can carry signals over 0.4 mm pairs, automatically adjust for gauge changes, bridged taps, noise
– Low installation cost, ease of installation

Cons: – Limited span without repeater
– Limited bandwidth vs. hybrid/fibre systems :
1 Mps for 2440 m without repeater
2 Mps for 2440 m without repeater
6 Mps for 460 m without repeater

Test: – 700 Alcatel HDSL system already in operation in the U.S. The first European applications are being installed

Source: Mercer Management Consulting research

As it requires no cable reconditioning and allows for bridged taps and other circuit "difficulties," HDSL can be regarded as an inexpensive upgrade option both for private and public networks. Current equipment prices in Europe range from ECU 1,300 to ECU 2,500 per HDSL terminal and current total cost estimates (including public work) per circuit range from ECU 3,000 to ECU 8,000, depending on location. Recent decisions by several companies to market off-the-shelf HSDL chips are estimated to further reduce the cost of E1 circuits by a factor of 3-4 by 1997.[18]

As with ADSL, the actual development of HDSL for public networks is likely to depend on the presence of existing alternative infrastructures (mostly ISDN and fibre-to-the-business networks) and Operators.

Current HDSL equipment providers include PairGain Technologies (USA) and Telllabs (USA) and, to a lesser extent, Level One (USA). Alcatel-CIT (France) has been licensed by PairGain Technologies to market E1/HDSL equipment to the European market.

Integrated Fibre/COAX

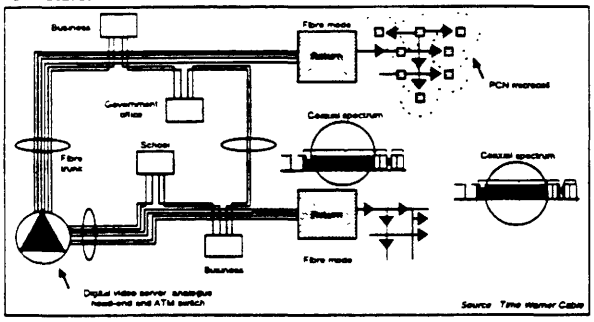
Integrated fibre/COAX systems (Exhibit 4.5), which are derived from existing COAX-based CATV networks, allow the provision of both telecommunications and entertainment services over the same medium, using digital technologies. They can be viewed as the medium of choice for the delivery of high-bandwidth services to both residential and business users and as a low-cost alternative to all-fibre systems (FTTH/FTTB). Current cost estimates range from ECU 600 to ECU 1,500 per subscriber, depending on home density and technology used, well below the ECU 2,000-ECU 2,500 per subscriber usually estimated for FTTH/FTTB. As such, integrated fibre/COAX is viewed by existing CATV networks as a way to compete with TOs for voice, data, broadcast and interactive entertainment services.

Exhibit 4.5: Full service network technology watchcard

Network: COAX/Fibre
Service: Full Service Network
Location: Orlando

Service provided: – Delivery of analogue video, digital video-on-demand (with full VCR capacity) interactive services and PCS over a Fibre/COAX network (10,000 homes)

Structure:



Companies involved:

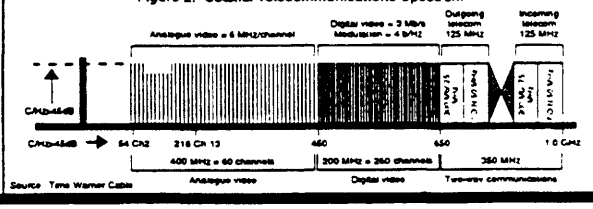
AT&T	– ATM switch
Scientific Atlanta	– Fibre/COAX distribution system
	– Set-top box
Silicon Graphics	– Digital video server
	– Set-top box o/s and applications (VOD, multiplay, interactive, navigational)
Toshiba	– Set-top box components
USWest	– Telephony
Qualcomm	– IPCS service equipment
Time Warner	– Interactive context

Estimated cost: Most of the cost = ATM switch + set-top box ($5000 today)

Impact:
- Test of most interactive components on a large scale (10,000 homes)
- Rest of customer response to interactivity – VOD
- Rest of ATM structure
- Estimated contention rate ≤ 40%

Characteristics:
- Fibre to 480 households + 4/5 amplifiers cascade
- 1 GHz capacity, using the bandwidth above 750 MHz for two-way communication (including PCS service, video combat and interactivity)
- Set-top box provides full video programming, analogue & digital receivers, digital transmitter, digital decompression, ATM reframing. Uses RISC processors operating at 100 MPS

Figure 2: Coaxial Telecommunications Spectrum



Source: Time Warner Cable; Mercer Management Consulting research

Some telecommunications Operators in the United States are also publicly considering replacing their existing copper-based PSTN with integrated fibre/COAX for the provision of telecommunications and video services, if allowed. Arguments in favour of such a move are derived from integrated fibre/COAX proved bandwidth and supposed savings: Pacific Bell, for instance, has been quoting operational savings of up to ECU 45 per subscriber-year over traditional copper-based networks, due to higher reliability and lower repair costs. Most of these savings are labour related.[19]

Integrated fibre/COAX cannot be described as a single technology, but as the combined use of various existing or emerging technologies on a single network. As such, the characteristics of fibre/COAX networks can vary greatly. Most systems under trial, however, include the following components:

- Optical fibre in the upper part of the network and high-bandwidth COAX cable in the lower part. Bandwidths used usually range from 750 MHz to 1 GHz, depending on network topology and upward bandwidth requirement. Actual number of customers served by a single optical fibre usually ranges from 400 to 2,000, depending on topology and return bandwidth requirements. The topology of choice for the access network is a star (or multiple star), although some other topologies may be used in the case of a network upgrade
- Digitalisation of all or part of the signals transmitted over the network, whether entertainment or telecommunications
- Use of ATM-based switching equipment, due to its capacity to provide bandwidth on demand and to switch both low-bandwidth/no-delay voice communications and high-bandwidth video or computer communications
- Use of compression technologies to provide multiple digital channels, allowing for such services as video-on-demand
- Provision of digital/analog terminal(s) on customer premises, usually defined as set-top boxes, to provide access to both entertainment and telecommunications services

Several companies are currently testing integrated fibre/COAX systems, mostly in the United States. Time Warner's Full-Service Orlando Trial is the most ambitious and most widely publicised trial. Other companies currently testing such systems include Jones Intercable, Rochester Telephone and SNET.

Vendors of integrated fibre/COAX management systems include Scientific-Atlanta (USA), General Instrument (USA) and AT&T (USA).

Overlay

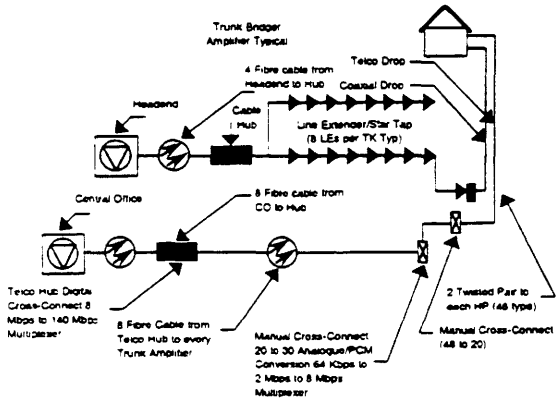
Overlay systems (Exhibit 4.6) can be described as a mundane, no-frills alternative to the integrated fibre/COAX systems described above. They consist of the joint provision of a COAX link and a twisted pair to the customer, usually bundled together in a "Siamese" cable. Like integrated fibre/COAX systems, overlay systems use optical fibre for the upper portion of their network. The actual size of the optical serving area may vary from 400 to 6,000 homes.

Exhibit 4.6: Fibre-COAX overlay network technology watchcard

Technology: COAX + Telephone overlay
Version: TeleWest (UK)

Description: – Provision of telephony service over existing CATV plant infrastructure + twisted pair overlay

Structure: (TeleWest)



Service provided: – Telephony and standard (or extended) video service

Pros:
– Low cost
– Equipment availability
– Easy to set up

Cons: – No real interactive service

Cost: (estimates) – ECU 400-700 per subscriber depending on local topography

Test: – In use at TeleWest (UK) and similar system used by other cable TV companies in the UK

Source: TeleWest; Mercer Management Consulting research

Overlay systems have been the medium of choice for CATV Operators in the UK for the provision of both CATV and telephony. Reasons for selecting this technology include the wide availability of equipment, ease of implementation, low materials cost and the important effective economies of scope. Estimated cost per subscriber ranges from ECU 400 to ECU 700, depending on local topology.

In favour of these systems is the growing opinion that little return bandwidth and on-time interactivity will actually be required for so-called "multimedia" residential services and that the copper pair is more than adequate to provide the required return bandwidth.

FITL (Fibre In The Loop)

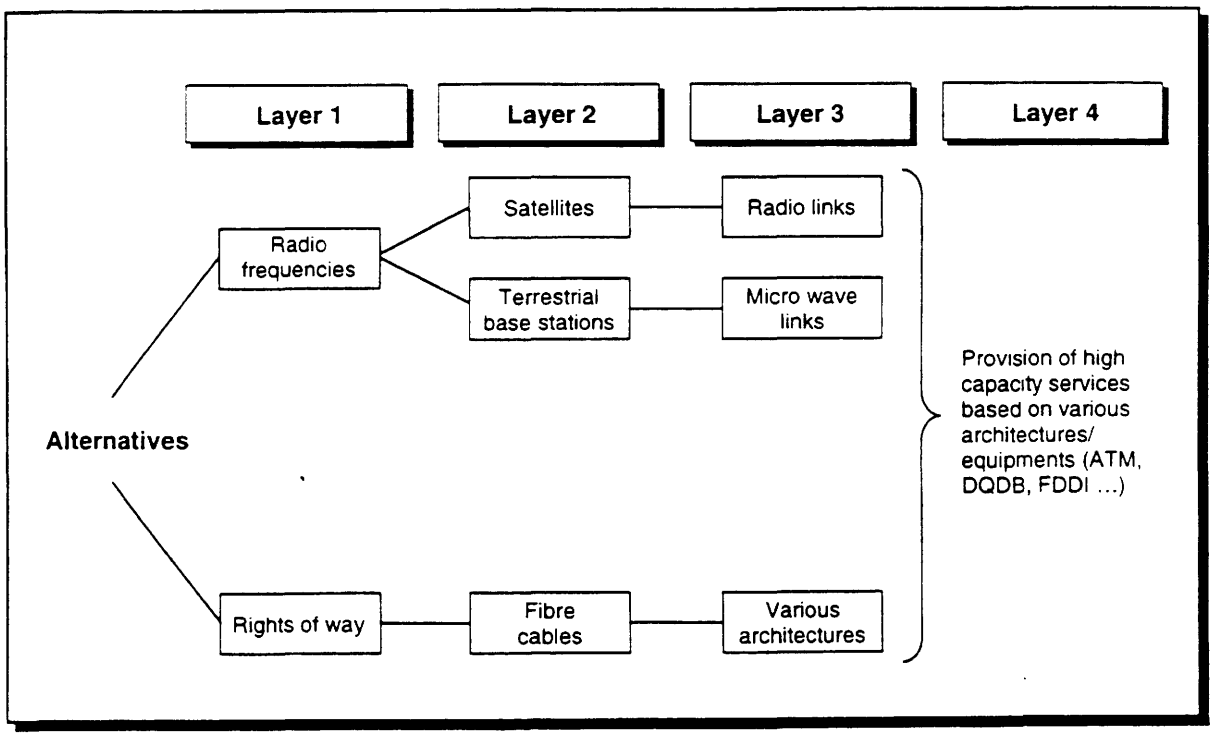
Unlike fibre/COAX systems, FITL systems rely on the copper pair for final delivery of signals to subscribers. As such, they are a natural upgrade for existing Operators' networks worldwide.

Several fibre-in-the-loop technologies are being implemented and tested by Operators for the upgrade of existing PSTN and the provision of bandwidth-hungry services to residential and business customers. Several topologies exist, based on the size of the optical serving area. The actual topology chosen by an Operator depends on the estimated bandwidth required, the cost of the optical fibre and its existing network. For greenfield situations, we have estimated that, in most cases, the cost of bringing fibre to the last cabinet is almost equal to the cost of using copper. In the UK and the United States, where they have been allowed to develop their own infrastructure, alternative access providers and CATV Operators have often found it economical to bring fibre to businesses. For existing Operators, our analysis shows that the cost of fibre still has not dropped to the point where it is economical to bring the fibre further than the feeder, using a remote concentrator.

In the United States, Ameritech is planning to provide 2.5 million subscribers in large cities and residential areas with FITL by 1995, under its "Looking Glass" project. Ameritech managers plan to use HDSL technologies to complement their FITL infrastructure and deliver large bandwidth to customers. In Europe, several Operators have started to implement FITL systems, due to the continuous drop of fibre cost and the increasing demand for high-bandwidth services. In agreement with most sources, we estimate that FITL is likely to be systematically deployed for new lines and line refurbishment very soon.

4.2.2. Long-Distance

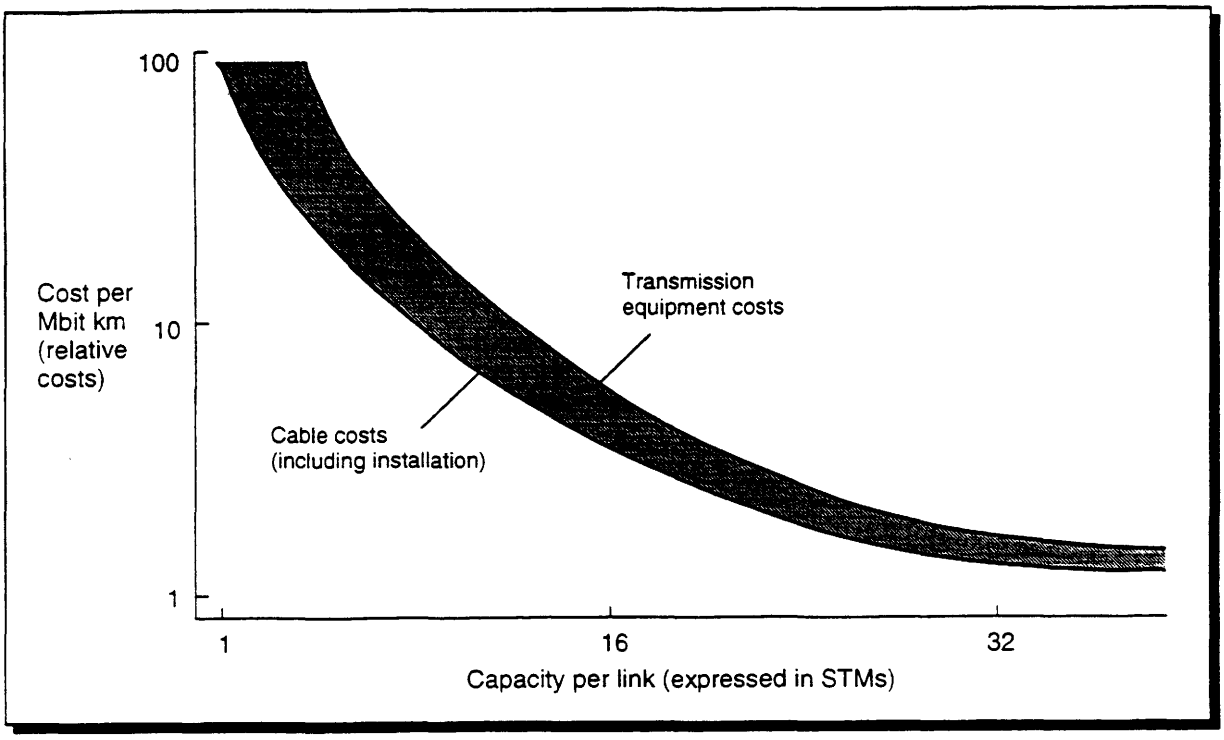
Exhibit 4.7: Options for long-distance infrastructure



Source: Mercer Management Consulting research

Long-distance services can be offered with a few architectural options at the layer 3 as shown on Exhibit 4.7. Costs of typical long-distance PDH transmission systems are very sensitive to the capacity required, as shown in Exhibit 4.8. In this section, we describe the two technologies that have emerged in recent years which are likely to change the range of services offered and the traditional economics of long-distance infrastructure: ATM and SDH.

Exhibit 4.8: Relative costs of long-distance infrastructure



Source: Mercer Management Consulting research

ATM

ATM (Asynchronous Transfer Mode, Exhibit 4.9) has emerged in recent years as the technology of choice for the provision of large bandwidth services, including voice, data and video. Three key factors may explain this trend: ATM is supposed to be universal, from long-distance, high-capacity networks to local-area networks, it handles various signal types simultaneously and it provides bandwidth-on-demand.

ATM is a cell-switching technology, carrying information in fixed-length cells using statistical multiplexing techniques. Since the cell size is fixed, ATM can operate at a wide range of speeds, currently from 45 Mbps to 2.5 Gbps in long-distance. Lower speed (down to 2 Mbps) can also be provided for use in local networks.

ATM currently runs only on optical fibres: provision of this technology is therefore dependent on the development of long-distance fully optical fibre infrastructures. In the United

States, for instance, Sprint and WilTel beta-tested nation-wide ATM services at 155 Mbps as early as 1993, while Pacific Bell started testing 45 Mbps services in the San Francisco area.

In Europe, 16 Operators have joined for a pan-European trial of ATM starting in 1994-95, including those of Belgium, Denmark, France, Germany, Italy, the Netherlands, Portugal, Spain and the UK (BT).

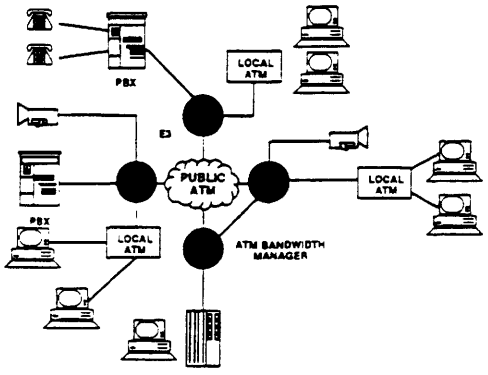
Exhibit 4.9: ATM technology watchcard

Technology: **ATM Asynchronous Transfer Mode**
Version:

Definition: – Cell-switching technology, enabling the integration of voice, data and video over the same channel based on a standard 53 - octet cell encapsulating information, virtual circuit and virtual path identifications

Capacity: – Flexible capacity, from 2 Mbps to 2.5 Gbps and more. Speed is adaptable to each kind of information transmitted. Connection is traded off against increased network delays (latency) → allows "dynamic" traffic management, with prioritisation

Example: – Integrated ATM Network



Usage:
– Desktop-to-WAN network switching telephony
– Integration of data/voice/video

Pros:
– Adaptive, flexible, universal:
  • ATM can be deployed in LAN and WAN as a "total area" network → potential cost reduction
  • ATM is potentially easier to implement than other LAN technologies
  • ATM allows a full integration of data, voice and video over the same terminal and different speeds
  • "Dynamic" Traffic management

Cons:
– Expensive and skill in development
– Lack of standards for equipments
– Lack of interface to existing networks (but some ATM switches provide those)
– Runs only on fibre

Tests: – Multiple tests are being conducted in Europe, on both long distance and local ATM Networks

Source: Mercer Management Consulting research

Provision of commercial national services is still some time away, however, given ATM's current cost. France Telecom has recently launched a limited ATM service (Transrel ATM), offering the wide area interconnection of ATM LAN's. This provides speeds of up to 25 Mbps and is available initially in Paris, Nice and Grenoble. DBP Telekom is also providing some ATM-based services. Prices are expected to drop quickly as a European standard emerges and as equipment becomes more widely available. This may ultimately lead to Operators providing very-high-speed multi-media connections at today's 2 Mbps rate, thereby fostering the development of advanced services in Europe.[20]

All major telecommunications vendors have presented or are developing ATM systems. In the long-distance area, Siemens, Alcatel and Ericsson all provide large switches to European Operators.

SDH (Synchronous Digital Hierarchy)

It may seem irrelevant to review SDH among the emerging technologies, as it is already being deployed by most incumbent and emerging Operators. It is, however, a key component of the emerging bandwidth-on-demand infrastructures.

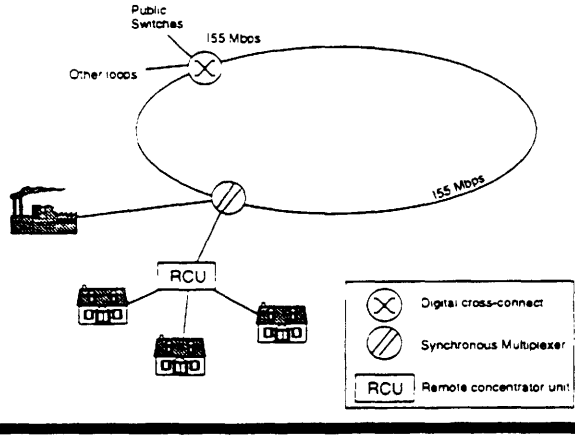
SDH (Exhibit 4.10) is a synchronous transmission system, allowing multiplexing of signals at different speeds over the same medium, on an "add-drop" basis. Under SDH, user information is grouped within "virtual containers" (VCs), which in turn are encapsulated into "frames" containing monitoring information for transmission at higher speed. In addition, SDH monitoring systems allow for flexible routing of a signal along different "virtual paths" within the same network. The transmission speeds defined range from STM1 (155 Mbps) to STM16 (2.4 Gbps). Although SDH is mainly designed for optical-fibre networks, it can work with other wireless technologies such as millimetric radio and, possibly, satellite systems. In these cases, available bit rates will be limited to STM1 or STM2. SDH systems have an added advantage in that they can be introduced directly into existing networks.

Exhibit 4.10: SDH technology watchcard

Technology: SDH Synchronous Digital Hierarchy
Version:

Definition: – Digital transport and cross-connection technology, based on synchronous multiplexing, allowing the provision of services/direct access

Capacity: – SDH uses a loop-based architecture to connect public switches with customers



Pros:
- Immediate provision of 2 Mbps line, through reprogramming of digital cross-connects → flexible access
- Reduction in network cost (equipment expenditure, installation, operation and maintenance) due to the flexibility of the provision process, the ring topology and the better use of network capacity (≈ 20% savings according to AT&T in the Netherlands)

Cons: – Lack of standard

Risk: – Loss of TO's control over network access (SDH allows cross-connects to be reprogrammed any time using remote control)

Tests:

Source: Mercer Management Consulting research

For customers, SDH is likely to provide higher service quality, faster transmission and cheaper bandwidth. It also offers the unique opportunity to offer variable-bandwidth virtual private circuits. For incumbent Operators, SDH offers several advantages over traditional PDH techniques, including flexible channel management, easier network redesign and lower maintenance costs. For new long-distance Operators, it is a unique opportunity to develop an

"opportunistic" network, with bandwidth provided on-demand and new SDH-based services brought selectively to customers. Most of the new infrastructure Operators we interviewed are building or planning to build SDH-based networks.

Finally, SDH offers CATV Operators and other alternative access providers an opportunity to provide new switched bandwidth-hungry services (including video) at a competitive price.

The inherent flexibility of SDH poses some risks to the incumbent (and other large) Operators, as customers and independent service providers may gain more control over their signal channelling. A popular opinion among the people we interviewed is that SDH may eventually limit the role of Operators to the provision of infrastructure, with customers and service providers taking over more of the value-added chain.

SDH initially developed in the US as SONET (Synchronous Optical Network). It was standardised by CCITT in 1988. Like ATMs, SDH equipment is being sold by most telecommunications vendors. Siemens, Alcatel, Ericsson and Nokia are the main European contenders, while AT&T and Northern Telecom are among the primary players in the North American market. The Danish Operator, Tele-Danmark and Telecom Italia are already deploying SDH technology in their long-distance networks, while Deutsche Telekom is deploying SDH rings in its access network.

4.3. Presentation of Main Services

The infrastructure technologies described above have to a large extent been developed for a single purpose: to allow the provision of services with multiple bandwidth or bit rate requirements over the same channel (or group of channels in the case of overlay infrastructures). The idea of "digital superhighways" relies on the concept that new bandwidth-hungry communications are likely to grow and complement (if not supersede) current low-speed communications. Whether such capability is actually required will depend on the growth of customer demand, for both business and residential customers.

4.3.1. Residential Services

We present below the main categories of residential services. We briefly describe the main technical requirements for each service in terms of transmission requirements, billing functionality and individual network components. This is summarised in Exhibit 4.11.

- Telephony Service: It requires little bandwidth (64 Kbps or less); it is also one of the few residential services in which the traffic is symmetric.

Exhibit 4.11: Key service-network requirements relationships

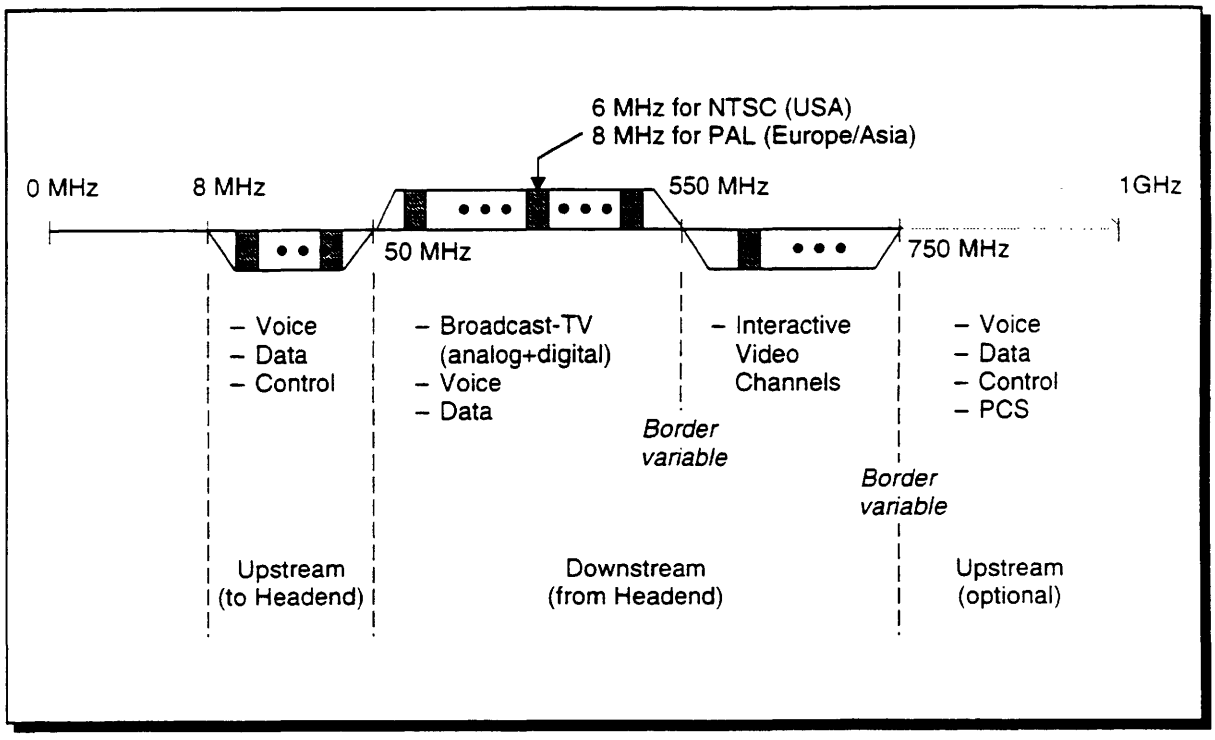
			Broadcast TV	Premium Broadcast TV	APPV	VOD	Games (download)	Home Shopping	Voice	Home working
Transmission Requirements	Bandwidth	downstream	N/A	2...8Mb/s	4...6Mb/s	4...6Mb/s	4Mb/s	4Mb/s	64 Kb/s	<10Mb/s
		upstream	N/A	–	–	64Kb/s	–	64Kb/s	64 Kb/s	<10Mb/s
		Control	–	–	√	√	√	√	√	√
	Characteristic		uni	uni	uni/asym	asym	asym	asym	sym	sym
	Traffic Behaviour		–	Isochron	Isochron	Isochron	bursty	Isochron	Isochron	bursty
	Connection Type		mp-t-p	mp-t-p	mp-t-p	p-t-p	p-t-p	p-t-p	p-t-p	p-t-p
Billing	Monthly		√	√	–	–	–	–	–	–
	Debit Card		–	√	√	√	–	–	–	–
	Transaction		–	–	√	√	√	√	√	√
Components	STB - digital		–	√	√	–	–	–	–	–
	STB - interactive		–	–	–	√	√	√	–	–
	Headend		√	√	√	–	–	–	–	–
	Video Distribution Unit		–	–	–	√	√	√	–	–
	Server		–	–	√	√	√	√	–	–
	AIN (B-SCP/B-IP)		–	–	–	√	√	√	–	√
	ATM Node		–	–	–	√	√	√	–	√
	Content Conversion		–	–	–	√	–	√	–	–

Source: Siemens Public Networks

- Analog Broadcast TV: The most common service offered by CATV Operators. It is unidirectional and isochronous (constant traffic volume). The bandwidth required for such a service is 8 MHz for a PAL TV signal (in Europe) or 6 MHz for an NTSC TV signal (in the US and Japan).
- Premium TV Broadcast: This category encompasses services such as pay-per-view or per-consumption (PPV). The characteristics of this service are similar to those of analog broadcast services. The main differences are the need for some interactivity for billing purposes and the use of scrambling/descrambling techniques.
- Advanced Pay-per-View (APPV): Similar to traditional PPV. The main differences come from a higher level of interactivity and the use of digital signals/compression techniques.
- Video-On-Demand (VOD): Delivery of video programmes on demand. This service requires a dedicated return channel for billing and control information. Typically, the signal will be sent in digital form, although conceptually this service could be supported by analog transmission systems.
- Games or Software Programmes Downloading: Consists of the distribution of software – for example, video games – over the network. The major characteristic of this type of application is that traffic occurs in bursts: bandwidth required during service usage is high but the duration of usage is short.

- Home Shopping: Consists of ordering goods (or services) from home while viewing programmes presenting those goods and services. This service requires some interactivity functionality at the set-top box level as well as sophisticated billing functionality.
- Home Working: Consists in providing data and/or basic video-conferencing services to the home. This service is characterised by the traffic volume in bursts and by a medium to large bandwidth requirement (up to 5 to 10 Mbps).

Exhibit 4.12: Frequency scheme on a fibre/COAX system



Source: Siemens Public Networks

Exhibit 4.12 shows the bandwidth of a typical COAX cable where 750 to 1000 MHz are available for signal transmission. This bandwidth is typically sufficient to offer all the services mentioned above, assuming that the number of homes passed by a single cable is reasonable and that traffic patterns are normal.

Demand associated with each of these services is crucial to understanding the viability of network investments and the emergence of competition in network infrastructure. Very few significant tests have been carried out so far regarding the most advanced services. Exhibit 4.13 shows consumption levels which have been observed or are expected in a few large-scale trials of pay-per-view and video-on-demand.

Exhibit 4.13: Summary of a few advanced services trials

Trials/Company	Price per viewing targeted	Number of viewing per month	Monthly charge	Revenue/ subs/ annum	Estimated annual gross margin (net of rights payments)
Saint-Germain/ Lyonnaise Communication	ECU 5	1.4	0	ECU 84	ECU 25
BT (expectation from ADSL)	ECU 3.2	3.5	ECU 11	ECU 270	ECU 172
Littleton/US West	ECU 0.9-3.5	2.5	–	ECU 30-105	ECU 12-45

Source: Mercer Management Consulting research

4.3.2. Business Services

Business services typically require more bandwidth than residential services. Furthermore, they have a symmetric nature as opposed to the broadcast nature of most residential services. The main business services with their characteristics are:

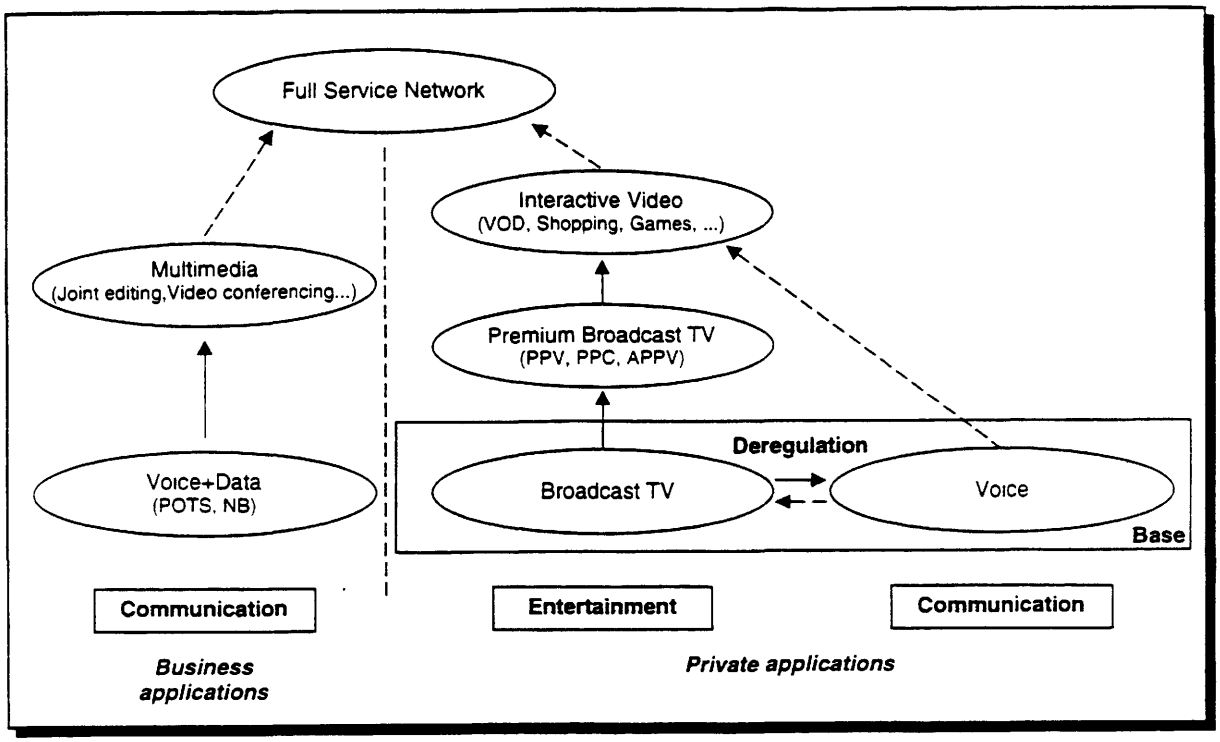
- Telephony and Video-Telephony: Symmetric in nature. This service can be offered with as little bandwidth as 64 Kbps (or less) for telephony and 128 Kbps for video-telephony.
- Video-Conferencing: Offers the possibility for multi-site conferencing with high-quality video images and simultaneous data or fixed-image transmission. The characteristics are similar to telephony services except for the bandwidth requirements, which are typically on the order of 500 Kbps or higher. Applications derived from video-conferencing such as distance learning have the same network requirements, but the transmission could be asymmetric in nature.
- Information Retrieval, Database Access and Other Transaction-Oriented Services: This category of services is characterised by average band-width requirements and asymmetric traffic in bursts.

4.4. Observations: Emergence of New Infrastructure

This brief review of the various technologies being adopted and tested by the most advanced Operators around the world illustrates the efforts that support service convergence. The future telecommunications industry will offer a mixture of voice, data, image and sound in

support of both integrated and discrete applications. Ultimately, the user will not care about what medium will deliver these capabilities. Instead, the user will care about access to the widest choice of services at the lowest possible cost – in this regard we should not expect customers for telecommunications services to be any different from customers for other industries.

Exhibit 4.14: Network architecture logical evolution



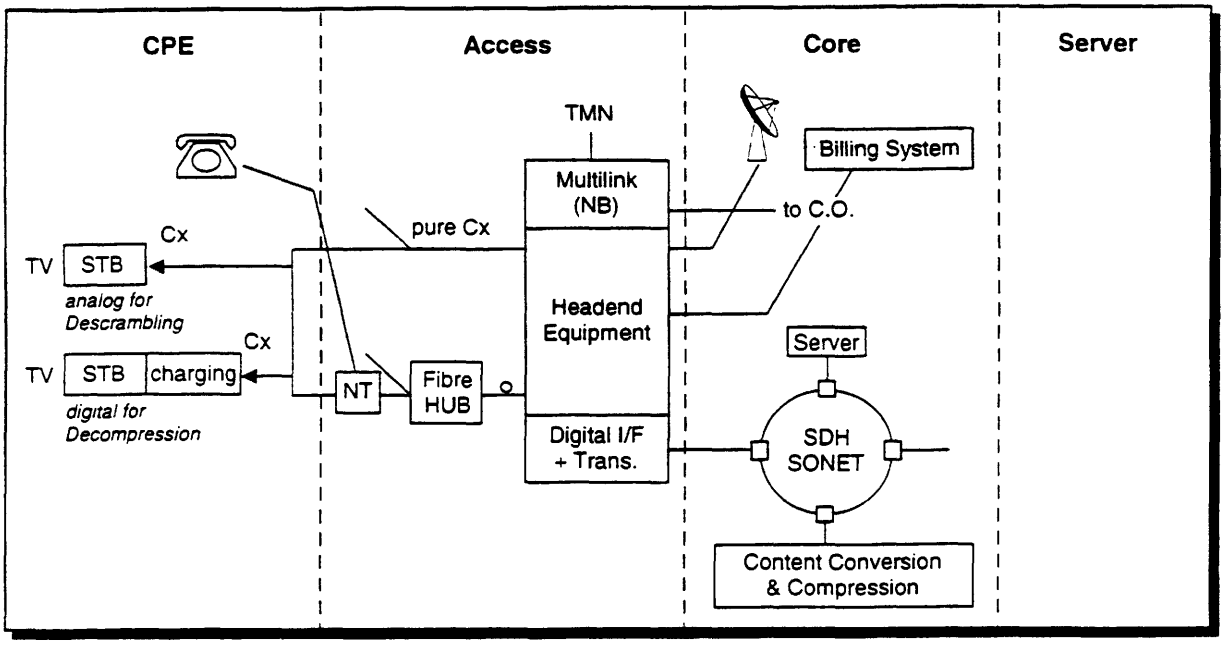
Source: Siemens Public Networks

Exhibit 4.14 shows the logical evolution of service offerings for a cable Operator and a telephony Operator. Each of these services is associated with a different network architecture and with different network components. Exhibit 4.15 and Exhibit 4.16 show the schematic network architectures associated with each of the product offerings. Exhibit 4.15 displays the first step of the upgrade of a Cable TV network (or, assuming a more comprehensive upgrade, a traditional telephony network). The additional equipment will allow the simultaneous broadcast of analog and digital signals. The example shown assumes that analog signals are used for broadcast, with scrambled signals used for customised channel packages, while digital signals are used for pay-per-view or video-on-demand. Unlike a traditional Cable TV network, this architecture will require set-top boxes with digital signal decompression/descrambling capabilities, charging devices on customer premises and head-end equipment that can support digital signal handling. In the core network, the digital head-end facilities can be interlinked with other remotely located servers via an SDH network.

Exhibit 4.16 shows the final stage in the logical evolution described in Exhibit 4.15. The full service network will ultimately support analog and digital broadcast, digital premium

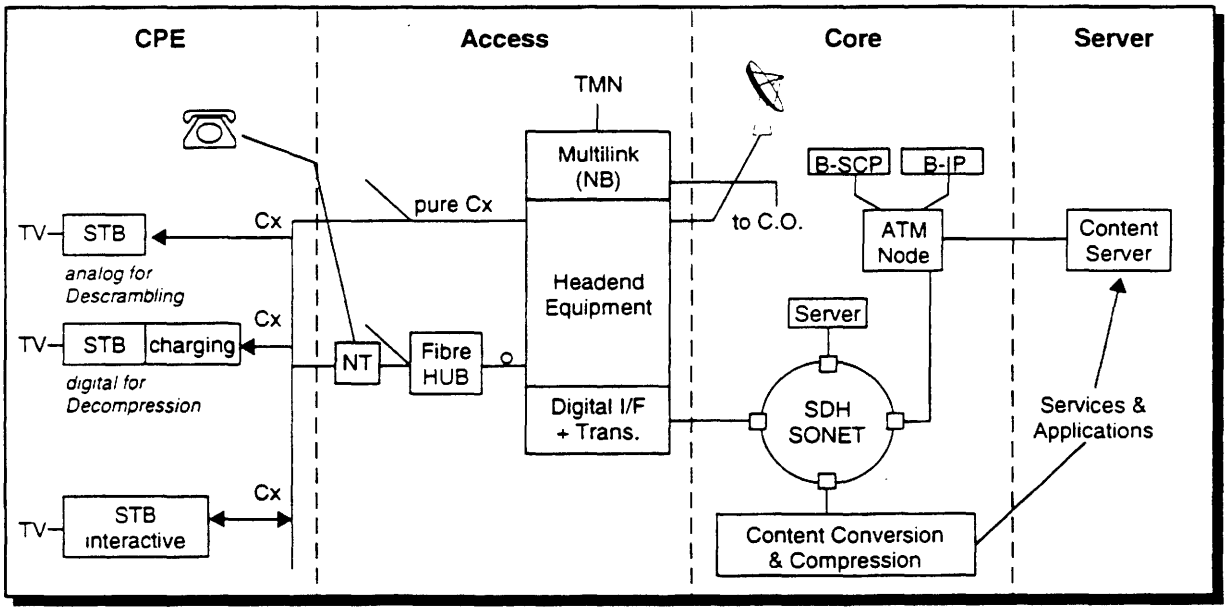
broadcast services and narrow-band (e.g. telephony) as well as broadband interactive services (e.g. interactive video). In addition to the architecture described above, the full service network will necessitate advanced set-top devices for interactive video services and interlink facilities with the telephony network. Ultimately, the core network will use ATM transmission techniques.

Exhibit 4.15: Network architecture for digital broadcast and premium broadcast with telephony services



Source: Siemens Public Networks

Exhibit 4.16: Network architecture for digital broadcast, digital premium broadcast, cable telephony and interactive video services



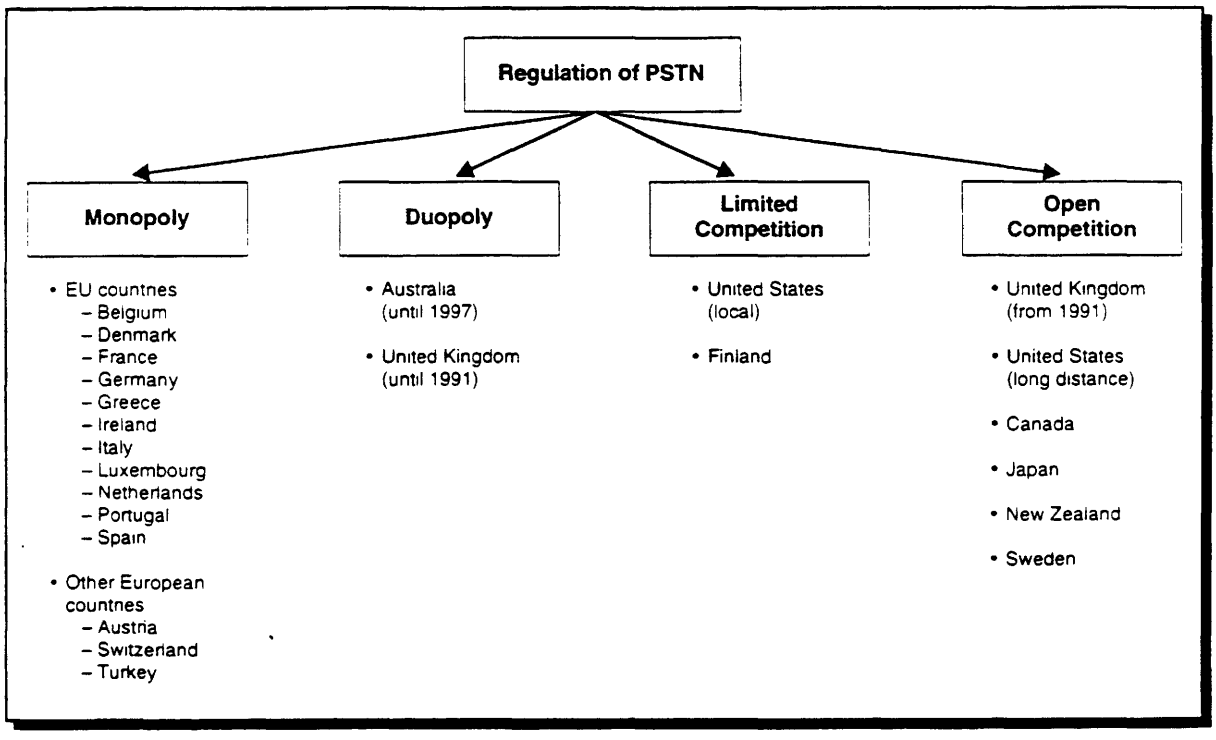
Source: Siemens Public Networks

Operators and equipment suppliers are hard at work to develop the combinations of technologies that will win in the marketplace of the future. The precise set of technologies that will dominate the future telecommunications infrastructure is not yet known; however, it is unlikely to be based on the existing twisted-pair and old coaxial technologies. In that case, the owners of the current infrastructure will find themselves with an infrastructure of little value. Buying into a telecommunications or CATV Operator (through privatisation or public offer) will be expensive, offering little advantage over building a greenfield network. This will be especially true in the local loop unless duct space is widely available. Furthermore, if demand for broadband services becomes widespread, the investment required to build new access networks will dwarf the investment required to bring technological parity among Member States to existing networks. As a result, owners of existing infrastructures are likely to find themselves at the starting line along with everyone else as technologies develop, new services are brought to market and infrastructure becomes liberalised.

Chapter 5: Experience in the US, Japan and Sweden

As shown in Exhibit 5.1, most EU countries, including newcomer Austria, operate their voice telephony (PSTN) under a monopoly regime. Australia today operates under a duopoly regime (as did the UK until 1991), while Finland and the US (for local calls) operate under a regime of limited competition. Open competition now prevails in the UK (since 1991), in the US (for long-distance services), in Canada, in Japan, in New Zealand and in Sweden.

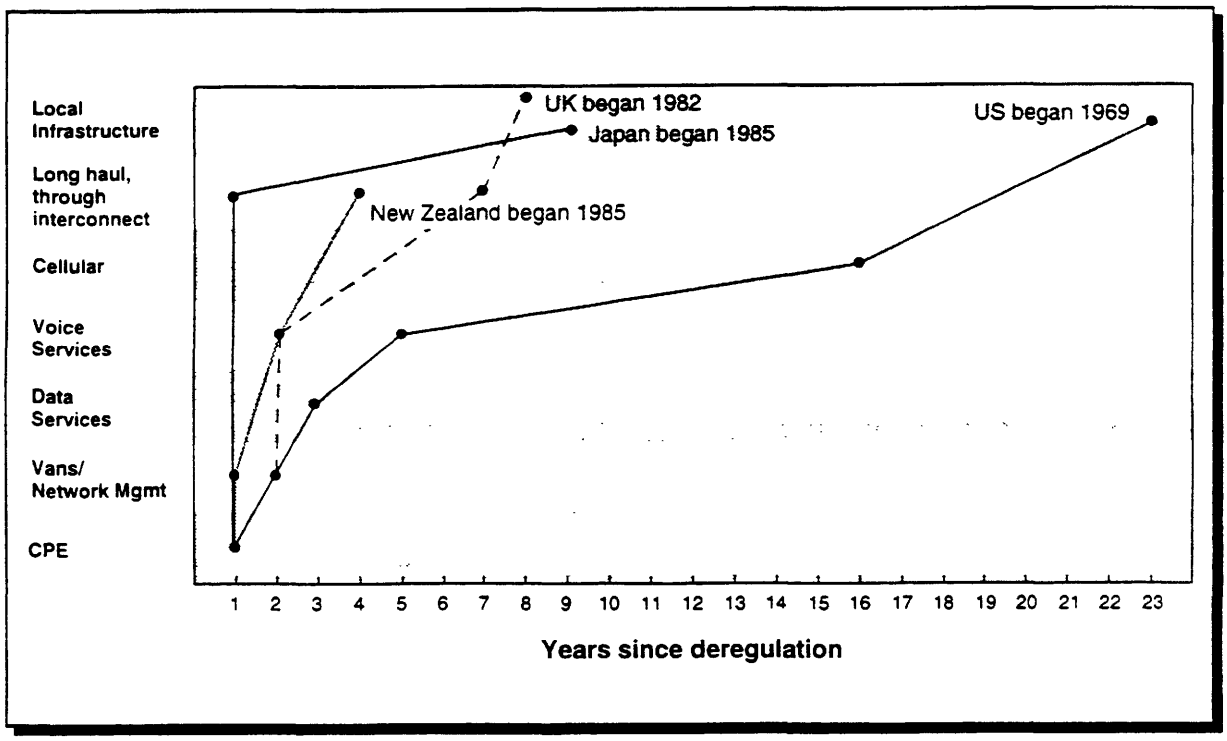
Exhibit 5.1: Regulation of PSTN in a few major countries



Source: Mercer Management Consulting research

With the exception of Sweden – where the telephony market has always been open to competition – deregulation in other countries has been progressive; however, the time frame for liberalisation has accelerated recently (as shown in Exhibit 5.2).

Exhibit 5.2: Timescale for liberalisation of the telecommunication market in various geographies



Source: Mercer Management Consulting research

5.1. Experience in the US

In the US, regulation of interstate communications is reserved exclusively to the Federal Communications Commission (FCC), while intrastate regulation is under the authority of the individual utility commissions in each of the 50 states. After a period of competition at the turn of the 20th century, the industry was controlled by a virtual AT&T monopoly until 1983. AT&T still dominates today, but the "*Modified Final Judgement*" (MFJ) issued by Judge Green in 1983 loosened AT&T's grip on the telecommunications market. Some of the most important rules defined in the MFJ are the following:

- The Regional Bell Operating Companies (RBOCs) can provide basic services only (i.e., those services providing *only* for the movement of information, by whatever means) and are prohibited from manufacturing telecommunications products or providing long-distance services. RBOCs' services are confined to specified Local Access and Transport Areas (LATAs). RBOCs are, however, permitted to provide interexchange intra-LATA services, if they can show evidence that their entry into the market would not stifle competition.
- All RBOCs with adequate technical capabilities (in practice, electronic switching systems) that serve a market of at least 10,000 access lines must offer *equal access* to all common carriers. This is to allow customers to choose a primary long-distance

carrier by dialling 1. As of today, 91 per cent of all access lines have been converted to equal access. Most of the remaining unconverted lines are in small telecommunications territories, which claim they should not support the financial burden of this conversion. Changeover fees are paid by customers, although these are frequently waived for marketing reasons.

- The RBOCs are not permitted to discriminate in favour of AT&T (their former parent company) for procurement of products or services, dissemination of technical information, facilities planning or other services.

The *Cable Communication Policy Act (1984)* prohibited telephone companies from providing programming within their respective regions. According to the FCC, this decision was made at the time to protect the fledgling CATV industry.

The monopolistic restrictions imposed on the local loop soon came to be viewed by Operators and Regulators as too restrictive and constraining of the potential development of new services and of alternative Operators. Hence, consistent with its aim of "maintaining balanced regulatory policies to ensure that the consumer has competitive choice for program and telecommunication services," the FCC engaged in a second round of liberalisation in the early 1990s, which accelerated the deregulation process.

- Judge Green's *Second MFJ Triennial Review (1991)* lifted the ban prohibiting RBOCs from offering information services, including long-haul services, electronic publishing and CATV in their own local serving areas.
- The *Special Access Ruling (September 1992)* opened the *special access market* to competition at the interstate level and mandated collocation. It requires RBOCs and other independent Operators to allow Competitive Access Providers (CAPs) to interconnect their switching and trunking equipment at reasonable rates. The collocation mandate also states that a CAP will be permitted access to the local exchange centres (switch centres) to maintain and monitor its terminating network lines. The order is aimed at helping CAPs move out of their niche markets and leverage their network infrastructures by interconnecting with RBOCs' networks. In exchange, RBOCs were given more price flexibility by being allowed to create rate zones based on the density of their customer base and the presence of competition.
- The *FCC Video-Dialtone Order (1992)* authorised Operators to provide video dialtone service, enabling them to act as common carriers for transmitting cable television programmes with open access and without discrimination. This decision was motivated by the opinion that the Operators' entry into the video marketplace would increase investment in the development of "full-service, broadband multi-media infrastructures"; provide additional competition in the video and communication

markets "so that free market forces, rather than Government regulation, determine the success or failure of new services"; and provide a diversity of video services in order to create "additional opportunities for consumer choice."

To avoid creating monopolistic environments in the video services markets, the FCC required accounting separation and cost-allocation measures to ensure that the RBOCs do not cross-subsidise their video dialtone services with revenues from regulated telephone services. Nevertheless (and as expected) cable companies predict that, under competition from Operators, some of them may be forced to postpone new services and other technological improvements and that small CATV Operators may be forced out of the market altogether or fall behind in capital investments as a consequence of lower revenues.

Under the Clinton Administration, much emphasis has been given to the development of the so-called "information superhighway" and to the potential impact of the technical and service convergence in telecommunications. In an attempt to "realise the full potential of a competitive broadband multi-media future," the Administration favours open access to multi-media services and deregulation of both the CATV and the telecommunications industries. According to a White House statement, "Cable companies, long-distance companies and electric utilities must be free to offer two-way communications and local telephone service."

These statements and the general expectations created around technological convergence have led, in recent months, to several decisions in favour of a new round of liberalisation, which would end the regulatory separations between Operators. In particular, the Markey/Fields and Brooks/Dingell Bills were approved by the House of Representatives. A bill addressing similar issues, known as the Hollings Bill, was not adopted by the Senate because of time pressure. It is expected that the legislative process will be re-started and that these provisions will ultimately be adopted.

The *Markey/Fields Bill (House of Representatives, June 1994)* would have allowed CATV Operators to provide switched local services, while RBOCs would be allowed to provide entertainment services. This bill, however, would not have allowed Operators to buy CATV Operators within their own service area, to prevent a single company from owning *all* local access networks within a single area. It proposed the creation of a Federal State Joint Board to ensure *universal service provision* through fair contributions from all providers.

The *Brooks/Dingell Bill (House of Representatives, June 1994)* would have allowed RBOCs to enter the long-distance telecommunications market from their existing operating regions within five years of bill approval, provided stringent conditions on cross-subsidisation and free competition were met. In particular, a local exchange carrier would be requested to demonstrate that its local market is open to competition when seeking the right to offer interstate

and international services. The bill would also have allowed RBOCs to manufacture CPE and other telecommunications equipment.

In support of the Brooks/Dingell Bill, NYNEX, Bell Atlantic, BellSouth and Southwestern Bell started legal action in the Washington courts to be allowed to enter the long-distance market. The White House stated, as early as January 1993, that "this Administration endorses the basic principle of the Brooks/Dingell Bill, which proposes a framework for allowing long-distance and local companies to compete against each other." In its statement, the Administration indicated that "We will make sure that the Regional Bells will not be able to use their present monopoly positions as unfair leverage into new lines of business. This is why the Administration supports the approach of the Brooks/Dingell Bill requiring the approval of the Department of Justice and the FCC before the Regional Bells may provide inter-exchange services, most notably long-distance."

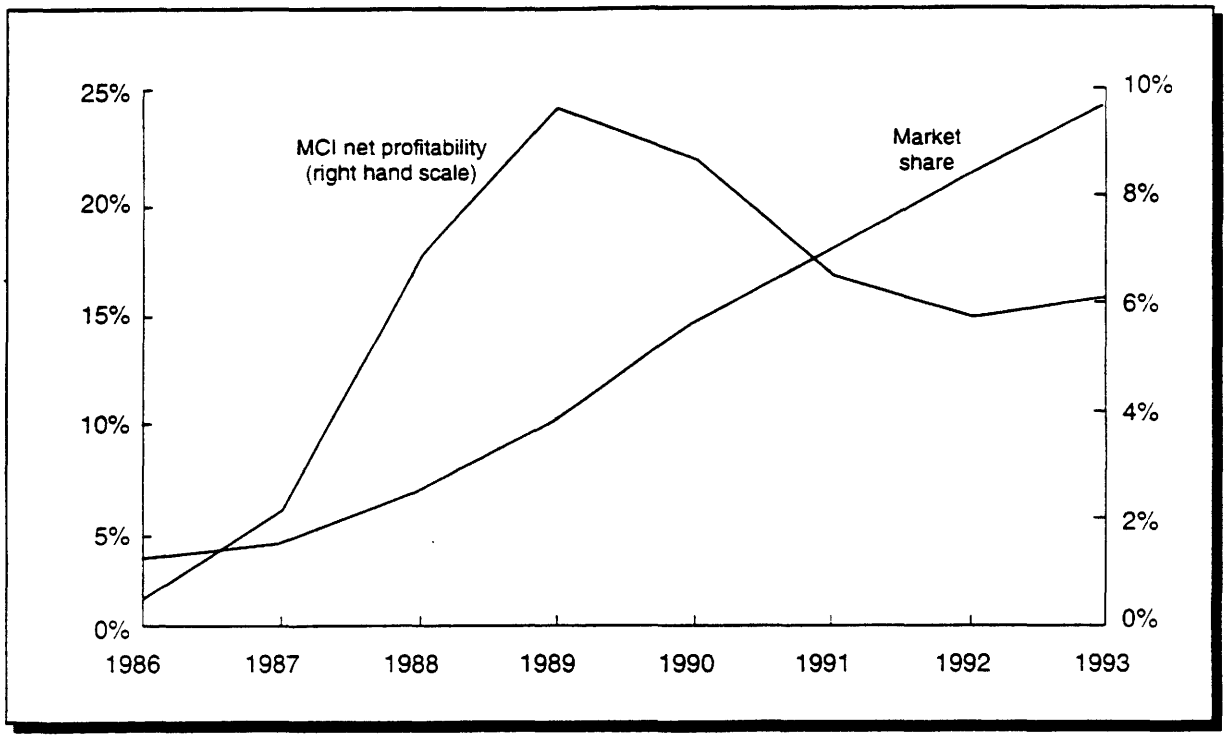
In July 1994, the FCC granted Bell Atlantic the right to build a video-on-demand system serving 38,000 homes in New Jersey (i.e., outside its region). The system is due to start operating in 1995 and support 64 different programmes. This decision is another breach in the Cable Act, after the September 1993 court decision allowing a company to operate a CATV system outside its own operating area.

For the time being, the US local market is still dominated by RBOCs. Most RBOCs have diversified into unregulated markets such as computer retail, software development and LAN design and installation. Up to now, the only competitors to the RBOCs have been the CAPs, which started as niche bypass marketers with their own fibre-optic networks in metropolitan areas. CAPs today have a significant share (approximately 5 per cent) of the total local market.

Not surprisingly, convergence has been the key element of the recent changes in US regulation, as these mostly reflected a willingness to break the barriers set up in the early 1980s between the components of the "old" AT&T and to reunite the different elements of the telecommunications jigsaw puzzle.

The US long-distance sector has flourished under full competition during the last 10 years. Three competitors dominate this market – AT&T, MCI and Sprint. The market shares of these Operators are approximately 68 per cent, 12 per cent and 9 per cent, respectively, for a total of 89 per cent (see Exhibit 5.3 for the evolution of MCI's market share). Other long-distance carriers include LDDS/WilTel, Advanced Telecommunications of Atlanta, Telecom USA, AllNet and Cable & Wireless.

Exhibit 5.3: MCI market share (long-distance market) and profitability



Source: Federal Communications Commission; Disclosure Worldscope; Mercer Management Consulting analysis

On average, MCI's prices are 5 per cent below AT&T's, and Sprint's prices are about 10 to 15 per cent below MCI's. Quality differences between these companies have diminished over time as the new entrants approach perceived quality parity with AT&T. Today, current statistics show that there is little difference in the quality of service among the three companies. Sprint uses a 100 per cent fibre network as a point of differentiation; both MCI and Sprint have significantly better billing software than AT&T, which they use to provide customised billing as a differentiating factor. Pricing and advertising are major competitive tools, as are the strong telemarketing programmes used by MCI and Sprint to encourage customers to switch.

5.2. Experience in Japan

The Japanese broadcasting and telecommunications market is regulated by the Ministry of Post and Telecommunications (MPT), while the electronics industry is regulated by the Ministry of International Trade and Industry (MITI).

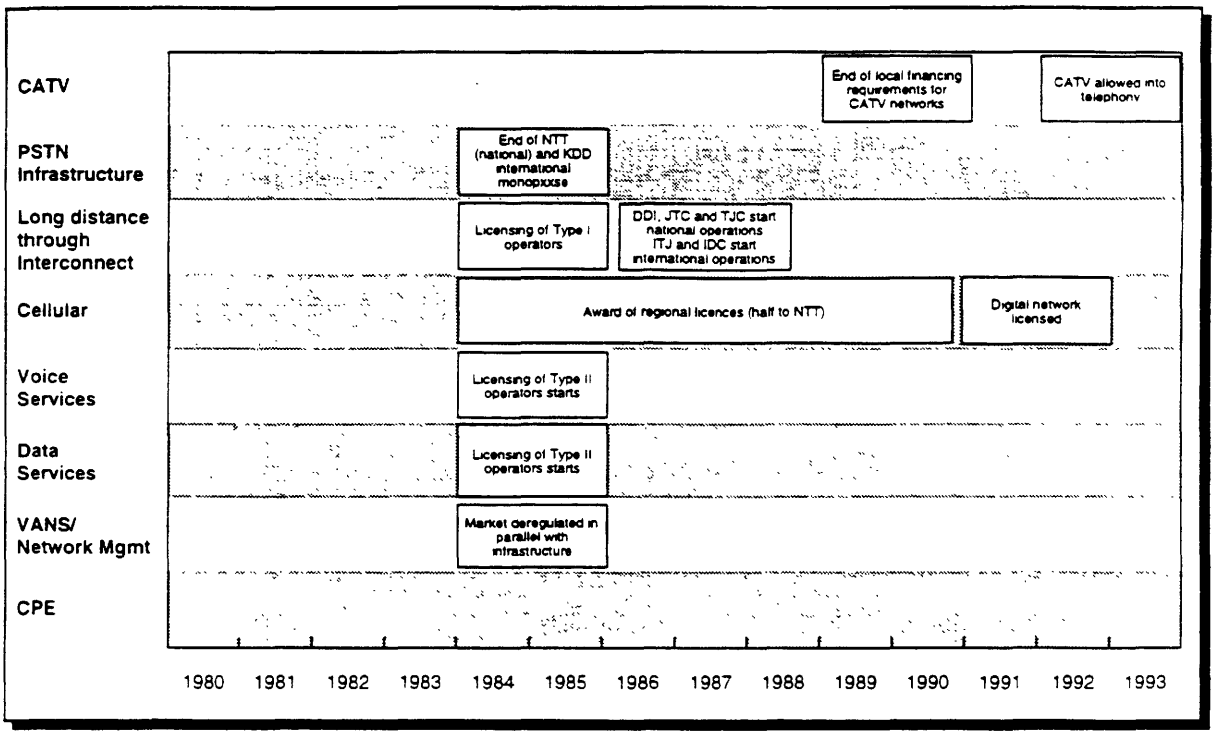
The Emergence of New Carriers

The liberalisation of the Japanese telecommunications market began in 1985 (Exhibit 5.4). Until that date, Nippon Telegraph and Telephone (NTT) and Kokusai Denshin Denwa (KDD) each had a monopoly on national (NTT) and international (KDD)

telecommunication services and infrastructures. The Japanese State still owns 65.6 per cent of NTT. Several types of Operators have emerged:

- "Type I" carriers can own infrastructure. They need to be licensed by the MPT. There were 86 Type I carriers on 1 April 1994, in addition to NTT and KDD.[21]
- "General Type II" carriers can offer telecommunications services in Japan using leased lines. There were 1,550 General Type II carriers on 1 April 1994.
- "Special Type II" carriers can offer telecommunications services in Japan and abroad using leased lines. There were 39 Special Type II carriers on 1 April 1994.

Exhibit 5.4: Japan telecommunication deregulation



Source: Mercer Management Consulting research

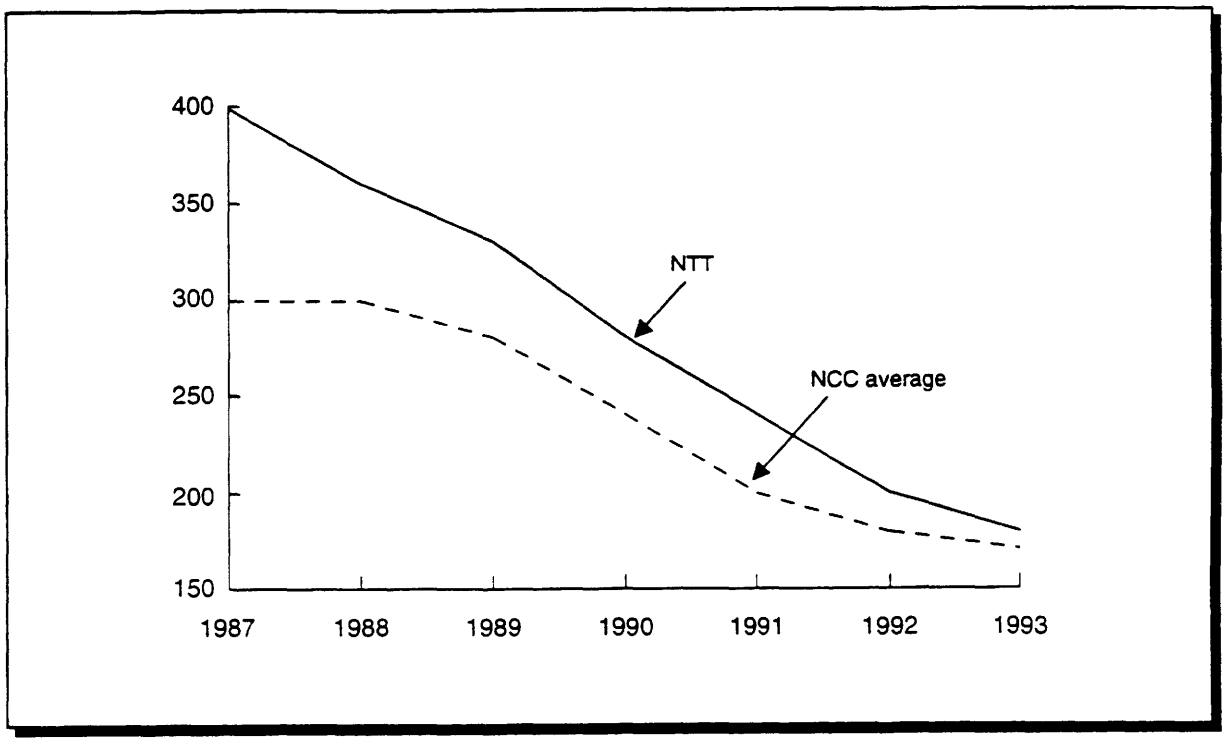
Type II Operators do not need a licence and are only required to be registered with the MPT. The only service for which NTT and KDD still have a monopoly is the delivery of telegrams.

Among Type I Operators, two international carriers (ITJ and IDC) and three national carriers (DDI, JTC and TJC) have been licensed, and there are 58 mobile communications licences (17 for mobile phones, 31 for radio paging and 10 for other services). The other 23 licences are for regional/local services, often for the provision of business services using alternative infrastructures.

Foreign participation is limited to 20 per cent in the capital of NTT or KDD, whereas the limit for the other Type I carriers is 33.3 per cent. There is no foreign ownership restriction for Type II carriers.

As can be seen in Exhibits 5.5 and 5.6, the prices of long-distance communications (telephony and leased lines) in Japan have fallen sharply since 1985. The discount offered by the New Common Carriers (NCCs) has also been reduced, NTT having reduced its tariff dramatically in 1991. This readjustment has slowed down NTT's loss of market share, which is now down to 73 per cent of the long-distance telephony market (percentage of inter-prefecture traffic).

Exhibit 5.5: Evolution of the price of a 3 minute peak line Tokyo Osaka telephone call (yen)

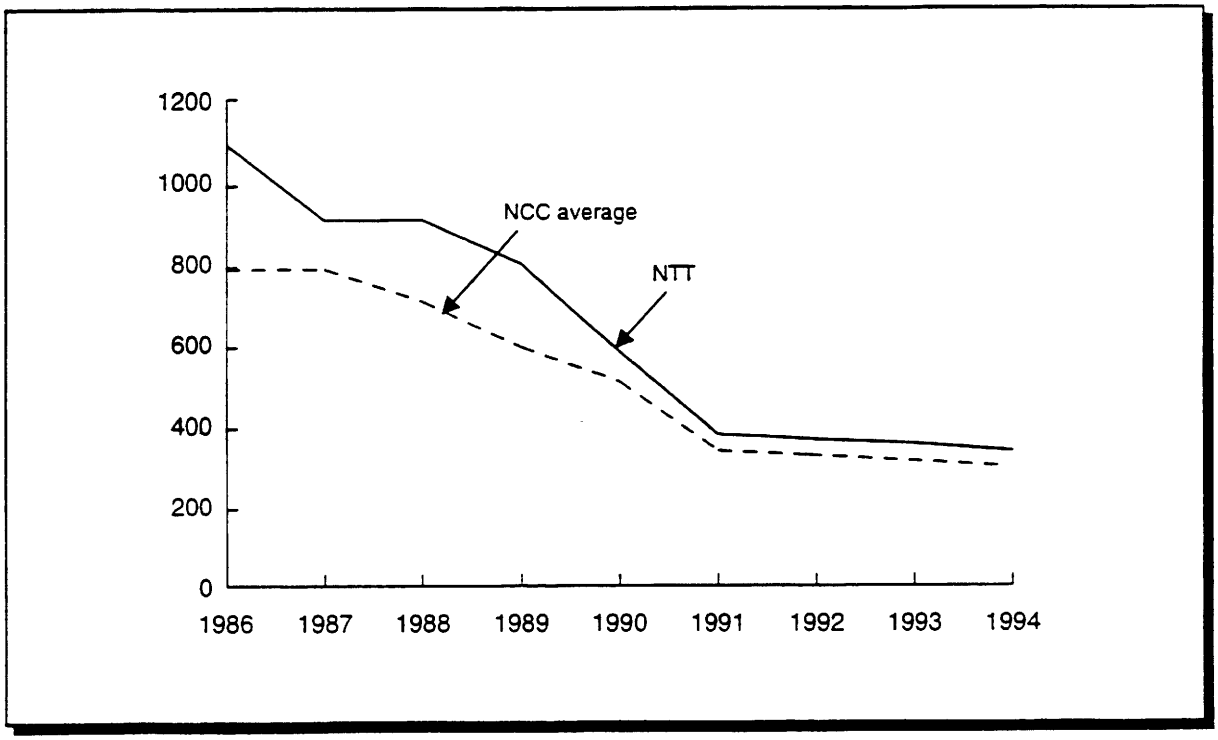


Source: Ministry of Post & Telecommunications – Japan; Mercer Management Consulting analysis

While NTT faces strong competition in the long-distance market, the MPT has consistently refused to allow it to raise its local rates, arguing that NTT must reduce its costs first. In 1993, NTT announced a plan to reduce staff numbers by 32,000, using voluntary retirements. It plans to have a staff of 200,000 by 1996, compared with 314,000 in 1985 and 242,000 today. This would make NTT one of the most productive Operators in the world.

To a great extent, the long-distance and international markets in Japan are truly competitive. The pressure on NTT and KDD from their NCC rivals has led to substantial price decreases and to rapid erosion of NTT and KDD's market shares. On the other hand, local access and traffic have stayed firmly in the grip of NTT, largely because of unattractive local tariffs but also because of the over-regulation put on its potential competitors (CATV and mobile Operators).

Exhibit 5.6: Evolution of leased circuit rental prices Tokyo Osaka ('000 yen)



Source: Ministry of Post & Telecommunications – Japan; Mercer Management Consulting analysis

The future of the telecommunications infrastructure in Japan will depend on the readiness of the MPT to relax its control over the industry, especially over tariffs. A truly competitive market in the local loop will appear only if clear rules on interconnection with NTT are imposed and if NTT is allowed to raise its local tariffs.

Mobile Communications

The market for mobile communications is still relatively small in Japan. Mobile telephony penetration is about 1 per cent, compared with 4 per cent in the US and 10 per cent in Scandinavia. This low penetration can be attributed to several factors:

- The high cost of the service
- The need, until April 1994, to rent the handset at high prices (roughly ECU 20 per month) – the market for handsets has been liberalised since
- Lack of available frequencies in urban areas
- The need to ask for authorisation from the MPT for tariff changes

The MPT has a general policy of granting two licences in most areas, both based on analog systems (AMPS or NTT). One of the two licences is generally granted to NTT, which operates nine regional mobile subsidiaries.

Cable TV Networks

About 20 per cent of Japanese households (8.4 million) are connected to a CATV network. The market is very fragmented; most licences have been awarded for only a few *ku* (districts). There are roughly 56,000 cable systems operating, and only 41 per cent of the subscribers are connected to systems of more than 500 subscribers (as of April 1993). NTT is prohibited from operating CATV networks.

This fragmentation of the industry can be attributed to the MPT's initial requirement that CATV networks be funded locally. The first cable networks should have been built by non-profit organisations with the support of the local authorities using rights-of-way of railways or electricity distribution companies.

Cable networks evolved in the mid-1980s, when new profit-oriented companies were licensed. This led to a two-tiered system:

- Small, locally-funded networks, where the technology used is largely obsolete and which cannot support more than 10 to 15 channels
- Larger systems (average 14,000 subscribers), which started to emerge after 1985 and which have a capacity of 50 to 60 channels (usually 25 to 30 are used)

A second evolution took place in December 1993 as the MPT largely deregulated the industry. CATV companies can now set up networks outside their original franchise areas and offer telecommunications services. The limit on foreign ownership has been raised from 20 per cent to 33 per cent. Furthermore, the Operators now only need to notify the MPT of tariff changes; no authorisation is required. This has led to a flurry of joint ventures:

- Chofu Cable TV of Tokyo has teamed up with Toshiba, Time Warner and US West to build a network covering 10 per cent of the Japanese population.
- Sumitomo, which already controls 29 CATV networks, teamed up with Tele-Communication Inc.
- Tokyo Cable Television, which has about 85,000 subscribers and uses the rights-of-ways of Tokyu Corp., a railway company in the Tokyo area, has formed a joint venture with Tokyo Telecommunication Network, a company specialising in providing high-speed lines to business customers using the rights-of-way of its parent company, Tokyo Electric Power.

The ultimate objective of these joint ventures is to provide a mix of entertainment and telephony over large areas. However, NTT's low local tariffs make it unprofitable to provide basic local telephony services in Japan. Furthermore, interconnection rules with NTT have not

yet been clarified; the two Operators offering telephony services – Iida and Lake City Vision – have not been able to provide full interconnection with the NTT network.

Therefore it appears that the introduction of competition in the local network will proceed slowly until NTT is allowed to raise its tariffs and until issues such as interconnection are satisfactorily settled.

Direct Broadcast Satellites

Several direct broadcast satellites are licensed in Japan:

- A satellite owned by NHK, the state-owned broadcaster, broadcasts the two NHK channels, the JSB programme, the PCM music channel and Hi-Vision (the Japanese analog HDTV standard) programmes.
- Satellites owned by JSAT and SCC have been allowed since 1989 to broadcast programmes over Japan; their programmes include MTV, CNN, etc.

These three satellite systems have a combined subscription base of about 6 million households. Looking forward, the trading companies Itochu, Mitsui, Nissho-Iwai and Sumitomo have announced plans to launch a service of digital TV direct broadcast.

The MPT and MITI Reports

Two recent, much-publicised reports from MPT and MITI can be seen as resulting from an escalation of a turf war between the two ministries for control of the telecommunications industry. They also clearly indicate the willingness of the State to foster the development of new telecommunications infrastructures and services while relying on private industry for the bulk of the financing.

Heavily criticised for having over-regulated the telecommunications and CATV industries and spurred by the announcements of the US National Information Super-Highway, the MPT's Telecommunications Council published a report on its vision of the "Info-communications infrastructure for the 21st century"[22] in April 1994. The report stresses the benefits of a high-performance infrastructure (improving lifestyle, dealing with ageing population, addressing environmental problems, etc.). Two technical scenarios are envisioned:

- All business customers connected with optical fibre and residential customers connected with fibre/COAX architecture. The average cost is ECU 230/subscriber (at 2010 prices).
- All customers connected with their own optical fibre. The average cost is ECU 370/ subscriber (at 2010 prices).

These costs do not include installation of new ducts for feeder lines, on the assumption that existing ducts would be used.

The plan calls for coverage of the densest areas first. With work starting in 1995, all cities with populations of 100,000 or more should be covered by 2005 and the entire population should be covered by 2010.

The report estimates that construction of its proposed infrastructure will create 2.4 million jobs, but fails to state over what period. It insists that the construction of the network should be left to the private sector, in particular to telecommunications carriers and CATV Operators. The need to ease interconnection between networks is recognised, as well as the need to lift tariff authorisations on some unspecified services. Provision should be made for some undefined universal service. Interest-free loans, tax incentives and the easing of restrictions on the use of existing rights-of-way should reduce the programme's cost.

The report remains vague on the issue of the development of appropriate applications. It simply states that the Government should play a "leading role in triggering future developments, particularly with regard to the development and introduction of public applications."

In parallel, the MITI published a "Program for Advanced Information Infrastructure."[23] This report describes new technologies in detail, with a focus on the possibilities offered by digital compression techniques. It is far less specific than the MPT report as far as the new infrastructure is concerned, stressing the uncertainty of demand from the residential customers. As a result, it recommends leaving decisions on the technology and timing "which are most suitable for each assumed area of demand" to the private sector.

MITI's report then goes on to describe the measures the Government should take to promote new applications in the public sector: promotion of standardisation, provision of on-line services, remote teaching, introduction of computers in schools, introduction of ultra-high-speed computers in research facilities and of high-speed networks between facilities, introduction of remote diagnostic systems in medical centres, etc.

5.3. Experience in Sweden

Sweden's telecommunications market has always been open to competition. The dominant Operator, Telia (formerly Swedish Telecom), with a 75 per cent share, is not protected by a monopoly.

Sweden's price level, service offering and productivity are all very competitive. It is also interesting to note that the Swedish Parliament ruled against access deficit charges (to

compensate for the largest Operator's Universal Service Provision obligations) as part of interconnection payments.

Fair trade practices, consumer protection, etc., in telecommunications is overseen by the Ombudsman, the common authority in charge of competition. Other regulatory functions, which were formerly part of Swedish Telecom, are now covered by the National Telecommunication Council.

Until July 1993, Sweden had no specific regulation for telecommunications. At the beginning of the century, Parliament decided to let Swedish Telecom provide nationwide telecommunications service, without creating a statutory monopoly. This was described as a *de facto* monopoly/*de facto* competition system.[24] The only historical restriction to open competition regarded the resale of leased circuit capacity for voice and data services.

Telia's main competitor, Tele2, had 7,000 residential and business customers[25] as of June 1993. Tele 2 provides international service, national trunk service and local telephony in major cities such as Stockholm.

In 1980, Parliament set the framework within which Swedish Telecom was allowed to operate. According to this text, Swedish Telecom (now Telia) is responsible for providing nationwide access to what is defined as "public services," implicitly maintaining a "public service" penetration rate of 100 per cent, with nationwide tariffs and open interconnection. "Public services" include telephony, telex, fax and teletex. The market was also opened to competition.

Cable TV development is open, on a free-for-all basis; no franchise is required for the installation of a CATV network, and several networks may coexist in the same geographic area. Small user groups (less than 100 households) can also freely build their own CATV system around satellite dishes. Cable Operators are considered telecommunications carriers and are not involved in programming. Currently, CATV networks serve nearly 1 million households, or about 50 per cent of the total urban market. The largest network is owned by Telia.

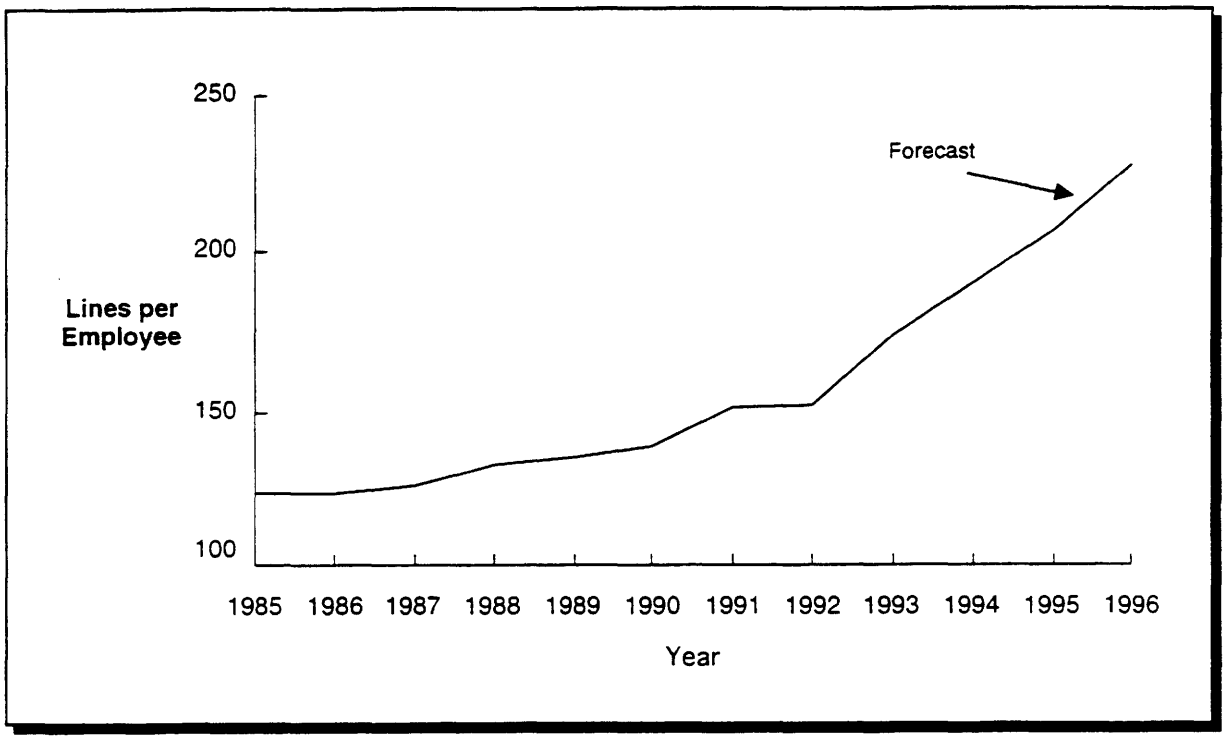
The wireless market is also totally deregulated, with both analog and digital (GSM) networks. Mobile telephony has reached a penetration of 10 per cent of the population (20 per cent in Stockholm City), with more than 850,000 subscribers.

Given open competition and Telia's public (universal) service obligation, interconnection charges became an issue. After failing to reach a deal on national interconnection charges with Telia, Tele2, which is 40 per cent owned by Cable & Wireless, asked the Government to arbitrate. In June 1993, the Swedish Parliament ruled against access deficit payments, stating that Telia's price for interconnection may not include any contribution toward the cost of running its loss-making local telephony services. The Government stated that an access deficit payment would deter competition from entering the market.

In return for denying access deficit payments, the Government allowed faster rebalancing of tariffs for Telia by setting an overall price cap for a full basket of services (instead of a price cap per category of service). At the same time, Parliament agreed to convert Telia from a state-owned public service company to a public limited company.

The new law also set up requirements for specific licences for telecommunications operations, in opposition to Sweden's "no-law" policy. Operators of PSTNs, mobile networks and value-added services all require licences, although the Government is granting these liberally. Current licence holders include Tele2, Fonetel, Transpac (a France Telecom subsidiary) and BT.

Exhibit 5.7: Evolution of Telia productivity



Source: Annual reports; Mercer Management Consulting analysis

Faced with these competitive pressures, Telia expects its market share to decline to 60 per cent of international and 80 per cent of national traffic by the end of 1995. In response, Telia is:

- Reducing its manpower; the work force has been reduced by 12,000 (one-fourth) in 1992 and 1993; another 25 per cent reduction is planned over the next three years (Exhibit 5.7 shows the evolution of Telia's productivity over 10 years)
- Disposing of non-core assets such as manufacturing facilities
- Modernising its network; it is introducing large digital switches to replace small analog ones and accelerating the deployment of optical fibre in the local loop
- Developing in growing market niches such as mobile telephony and CATV

- Improving its offerings to large multinational companies through the Unisource[26] alliance

5.4. Summary of Developments in Liberalised Countries

The consensus in liberalised countries is overwhelmingly in favour of competition. Users benefit from wider choice and lower prices, Operators benefit from new growth opportunities and shareholders benefit from higher returns (e.g. AT&T just had the most profitable quarter since its break-up, despite intense competitive rivalry in the US long-distance market). In the US, the liberalisation of infrastructure, initiated in the long-distance market, will ultimately extend into the local loop, despite the delays faced by the legislative process.

The Markey-Fields Bill was proposed to *"promote a national communication infrastructure to encourage deployment of advanced communication services through competition and for other purposes."* This bill is symptomatic of a general willingness to break the barriers to competition that had been set up as "safeguards" in the early 1980s, as these now appear increasingly artificial. Advances in technology and the realisation that all three sectors of the US telecommunications marketplace – local, long-distance and CATV Operators – are now strong enough to compete against each other have rendered the current US regulatory framework obsolete.

In Japan, the long-distance and international markets are effectively open. Significant alternative infrastructures do exist. It is interesting to note that the leading new carrier, DDI, built a "greenfield" network rather than rely on the alternative railway or highway-owned infrastructures that existed at the time of liberalisation. Locally, new regulations introduced in December 1993 have allowed CATV networks to provide telephony services, although low local tariffs (not yet adjusted) and difficulty of interconnection with NTT have, for the moment, hampered the emergence of a truly competitive local loop. The December 1993 initiative was justified by the recognition that allowing an independent CATV industry to offer telephony services fosters a higher level of investment in CATV infrastructure and the emergence of a broader service offering.

The Swedish market has always been open to competition. The leading Operator has a 75 per cent share and, with the exception of one year, has been consistently profitable since 1980. The country's price level, service offering and productivity are all very competitive.

Overall, the experience of countries that have introduced full infrastructure competition constitutes an invaluable source for assessing the impact of liberalisation on consumers, businesses, Operators and shareholders. This experience also constitutes a set of benchmarks for developing liberalisation scenarios for the European Union. In particular, it suggests that

liberalisation leads to rapid market share gains by newcomers, especially in segments where tariff imbalances create excess profit opportunities. However, the incumbent Operator is not powerless in the face of the new competition – quite the opposite. If it decides to focus its full energy on responding to competition, it can take advantage of favourable economics of scale and scope to contain share loss. Furthermore, it can do this at the same time that it improves its financial performance and the quality and range of services it offers to its customers. Competition can indeed be a trigger for a powerful renewal of the telecommunications infrastructure.

Chapter 6: The Infrastructure Discussion

6.1. The Competition Mandate

As we have just shown, the number of telecommunications markets being liberalised is growing. From the US and UK to Japan, from New Zealand to Finland, and from Australia to Sweden, telecommunications markets are following a more or less rapid path towards full competition. In those markets, multiple competitors are allowed to offer telecommunications services and to fully control all the activities supporting those services. This has led to the emergence of multiple Operators with distinct customer focuses; to a reorganisation of the incumbent Operators; and to a flurry of alliances.

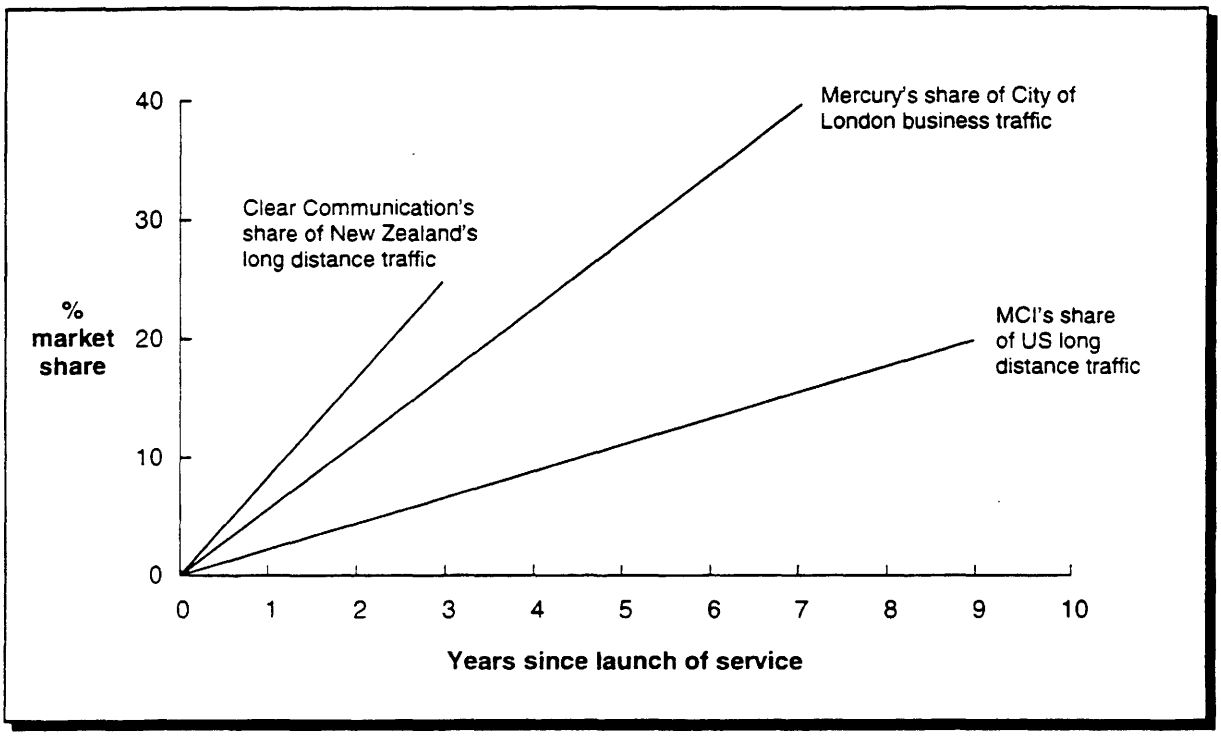
Besides direct competition, the threat of future competition and pressure from Regulators have greatly influenced Operators' drive to restructure. As a consequence, telephony's penetration has increased, new services have been introduced, quality and responsiveness have improved and prices have decreased in most Member States; these advances have, in turn, driven new growth in demand. Operators in all Member States recognise that, because of the integration of services and infrastructure, and because of deregulation in some countries, the continuance of infrastructure monopolies is no longer a viable option.

The accelerating deregulation of the telecommunications markets around the world has altered the competitive landscape in fundamental ways. The new landscape supports a multiplicity of competitors with distinct product and customer focus: alternative long-distance carriers and local bypassers; equipment suppliers, facilities managers and global outsourcing providers; CATV Operators offering telephony; mobile Operators offering various complementary technologies; and satellite-based services. The recent offensive and defensive alliances, acquisitions, cross-border investments and restructuring programmes have been fuelled by the need for Operators to enhance their competitiveness along these segments. Leaders are quickly positioning

themselves to dominate particular markets (such as *mobile services*) or particular customer segments (such as *large multinational businesses*) at the cost of several billion ECU.

The experience of countries no longer operating under infrastructure monopoly suggests a common pattern for the impact of competition. Most alternative Operators have rapidly taken a 20 to 30 per cent share of the markets they have focused on (see Exhibit 6.1). The ensuing competitive rivalry has led to more services being available, better quality and customer responsiveness, and lower prices. (It must be noted, however, that in many cases much of the initial price decline results from regulatory imposition and the threat of future competition rather than from direct competition.)

Exhibit 6.1: Competitor market shares in specific markets



Source: Federal Communications Commission; Mercer Management Consulting analysis

One way or another, to succeed in liberalised markets Operators are forced to adopt market-driven behaviour, with a high degree of accountability to shareholders and customers. As a result, Operators strive to dominate markets and achieve adequate financial returns by investing prudently, increasing productivity, innovating and improving service levels. In other words, they strive to meet financial and market goals by excelling at managing resources and meeting customer demands.

For example, between 1990 and 1993, following the liberalisation of the New Zealand telecommunications market, the ex-monopoly Operator, Telecom Corporation of New Zealand, reduced manpower by 40 per cent, improved quality by 30 per cent, reduced prices by 30 per cent, and yielded to its shareholders a 25 per cent annual return on investment. Similarly, between

1990 and 1993, BT reduced its manpower from 250,000 to 156,000 and it expects to reduce its staff to 125,000 before the end of 1995. During that time, BT has improved its customer satisfaction rate from 90 per cent to 95 per cent, reduced its tariffs by 20 per cent, and, despite the severe recession in the UK, reaped returns on equity averaging 17 per cent. Similarly, regional US Operators – which, despite still earning most of their revenues as monopolies, are facing imminent competition – are now implementing labour productivity targets of 350 lines per employee for telephony services (versus current levels of 250-300 and European levels of 150-250) in order to finance future tariff reductions and new services.

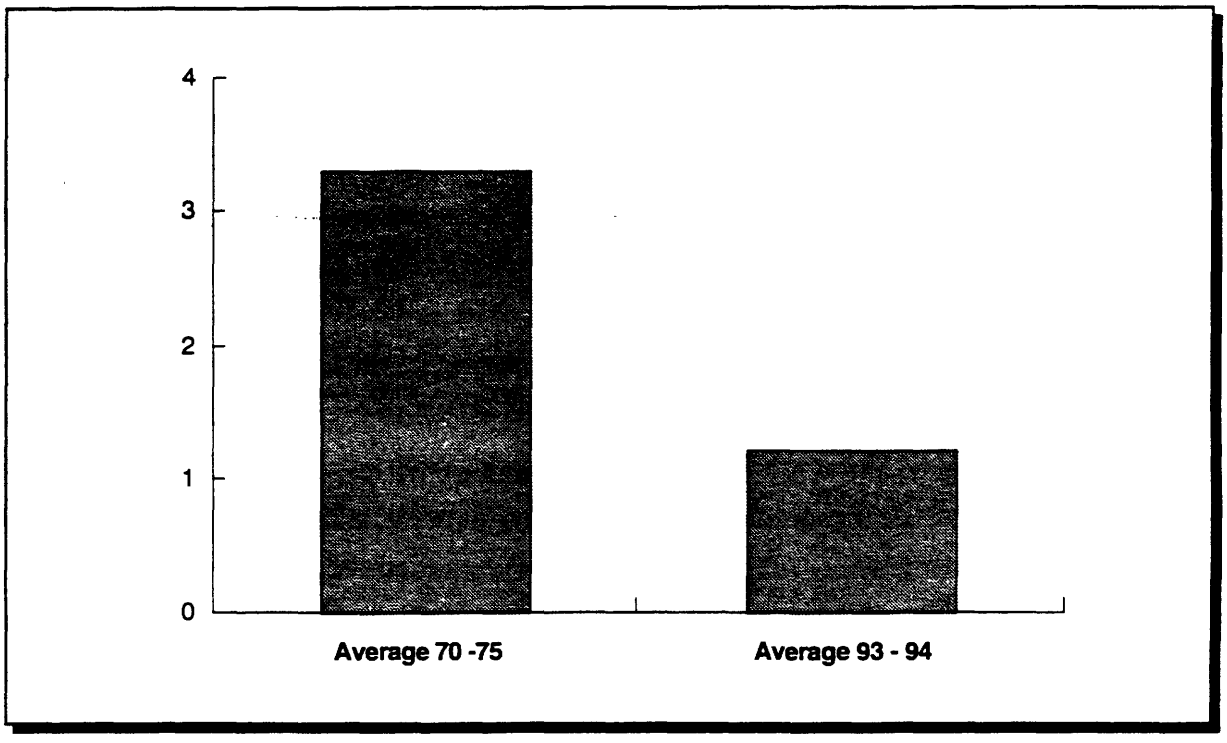
Despite an increasing recognition of the favourable incentives created by market forces in telecommunications and other industries, the road towards liberalisation and competition has been a long one. AT&T first raised the arguments defending its monopoly in telecommunications in the late 1970s, and many of these arguments are being heard in Europe today. The most common one is that telecommunications is a special industry characterised by low asset turnover, high sunk costs in the form of past investments, asset specificity (i.e., the difficulty in using the assets for anything but telecommunications services) and the fixed nature of the assets (i.e., a large portion of the investment costs go to the equipment installation). However, not only are these arguments no longer effective, but the economic factors associated with the telecommunications business argue even more strongly in favour of full liberalisation.

In the 1970s, the average penetration of lines per 100 population in Europe barely reached 20; the average penetration for southern Europe was barely 10 lines per 100 population and provision time exceeded one year in many areas. At the same time, high equipment costs, low network density and low GDP per capita combined to burden Operators with investment levels of ECU 2,500 per new customer, equivalent to 300 per cent of average revenue per line. As a result, the ratios of assets over revenues for the European networks during that decade averaged 300 per cent (see Exhibit 6.2). Consequently, the investment required to build such an expensive infrastructure was seen as sufficient justification to grant monopoly concessions guaranteeing the highest possible utilisation of assets.

The current situation is very different. The average penetration of lines per 100 population in Europe has attained 45, and the ratio of assets over revenues for the most modern European networks currently averages 150 per cent. Today, the ratios between investment and revenue, assets and revenue, or depreciation and cash costs are not much different from those found in a number of other industries such as forestry and paper, oil or bulk chemicals (see Exhibit 6.3). In these industries, utilisation of all resources, not just infrastructure, is a fundamental component of competitiveness, and higher utilisation of assets could certainly be guaranteed by local monopolies. However, anti-monopoly commissions and other Government bodies were created to prevent such local monopolies from developing. Indeed, it is generally recognised that for these industries, the benefits of market discipline far exceed the disadvantages of lower overall

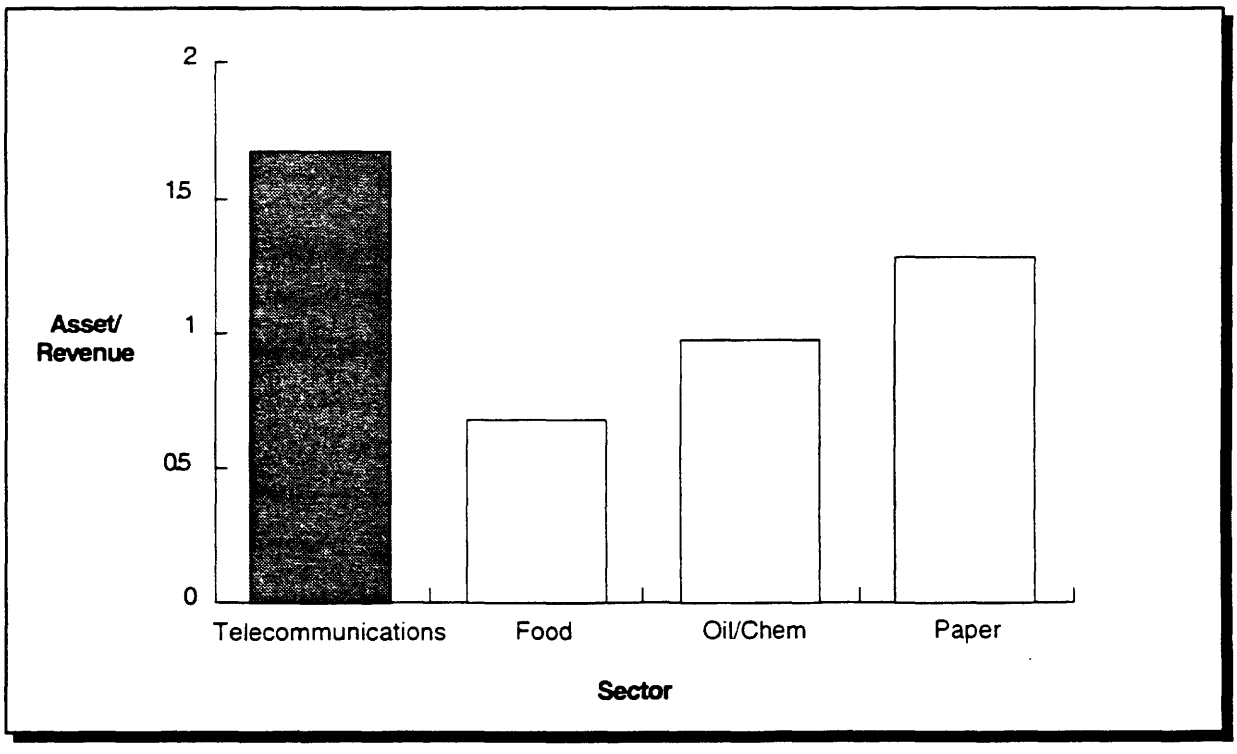
asset utilisation. In other words, the benefits of achieving maximum *overall economic value* exceed by far the benefits of achieving *maximum asset utilisation* along with *higher operating costs, restricted customer choice, or both.*

Exhibit 6.2: Evolution of asset turn from the 70's to the 90's



Note: *Figures refer to the GPO-Telecom (70-75) and BT (93-94)*
Source: *Annual reports; Mercer Management Consulting research*

Exhibit 6.3: Asset turn in telecommunication and a few other industries



Source: *Disclosure Worldscope; Mercer Management Consulting research*

6.2. Summary of Stakeholder Interviews

In the course of our work for the Commission, we interviewed each incumbent Operator, most alternative carriers, some customers and a large number of aspiring Operators. While it is impossible within the limits of this report to reflect all the remarks that were expressed during the interviews, the comments summarised here are representative of views of the different groups. (Interviews are documented in a confidential appendix to this report.)

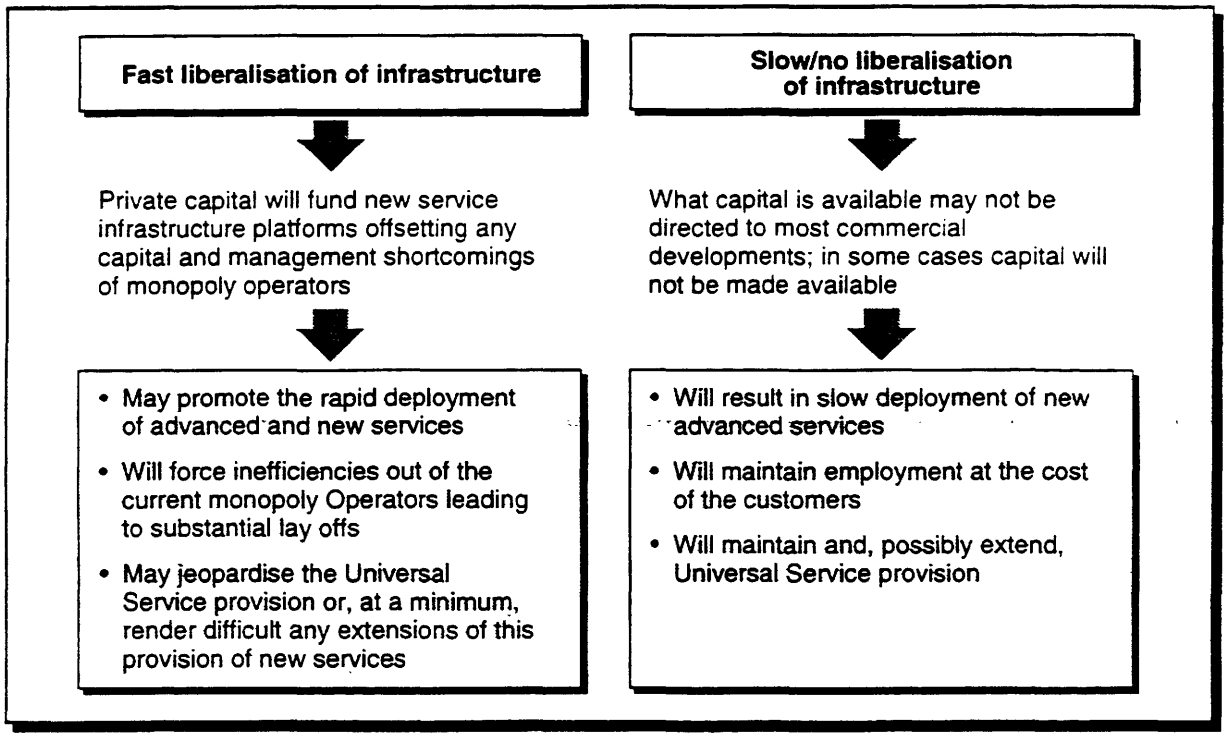
Our interviews strongly suggest that the benefits of competition in the European telecommunications industry have now been largely recognised by the majority of stakeholders, including many incumbent Operators. No interviewee openly suggested that there should be no infrastructure liberalisation. These Operators find that the benefits of expanded demand and access to new markets associated with worldwide liberalisation outweigh the short-term effects of market share loss in their home markets. For many incumbent Operators, expansion abroad offers the possibility to renew their *growth mandate*. The bullish level of cross-border investments and alliances among Operators bears witness to this aspiration.

Rather, differences of opinion arose over how and when infrastructures will be liberalised, and what the economic and competitive consequences will be. The process initiated by the European Commission requires completion. To fully liberalise the telecommunications industry in Europe, the regulatory authorities must grant to the emerging alternative providers genuine control of their cost structures and value-added. Some Operators object to this next step, and in our interviews they expressed concerns about duplication of assets, cost of labour dislocation and statutory transfer of wealth.

In general, the various opinions expressed fall within predictable ranges, with most users strongly favouring full infrastructure liberalisation at an accelerated pace, most incumbent Operators favouring a more gradual approach, and equipment manufacturers divided between a conservative approach and full liberalisation depending on whether or not they currently enjoy privileged access to the monopoly Operators (see Exhibits 6.4 and 6.5).

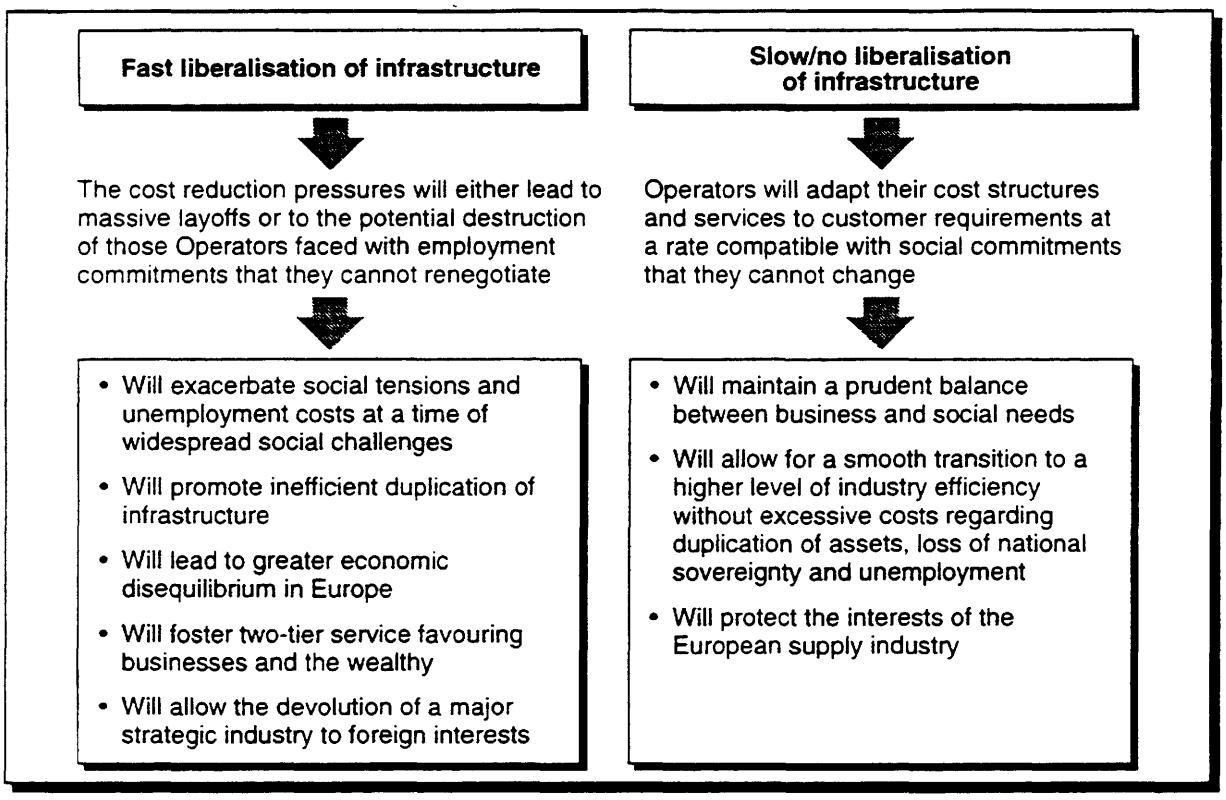
Some residential users, however, expressed concern about the implications of tariff rebalancing for their telephone expenditure and about the potential neglect of remote regions. No doubt these issues must be carefully considered by the Regulators, although the general reductions in operating costs and the continuing development of low-cost access technologies (e.g. radio-based) will alleviate these issues.

Exhibit 6.4: Arguments in favour of a fast liberalisation of infrastructure



Source: Mercer Management Consulting interviews

Exhibit 6.5: Arguments in favour of a slow liberalisation of infrastructure



Source: Mercer Management Consulting interviews

The Shape of Liberalisation

First, several interviewees – incumbent Operators, alternative Operators and non-Operators alike – raised the issue of how infrastructure is defined. They were uncertain whether liberalisation was intended to include switching equipment or even more intelligent components, or was restricted to bit transportation without switching.

In whatever way infrastructure is defined, however, many incumbent Operators are calling for liberalising infrastructure in parallel with services, or possible even earlier. (However, one Operator favours a *two-step* liberalisation process, in which the process for infrastructure liberalisation gains from the experience of service liberalisation.) One incumbent Operator said that infrastructure must be liberalised to promote efficient and fair competition on services, as it is difficult to offer services without controlling the infrastructure which to a large extent determines the quality of those services.

Perspectives differ on the proper pace for liberalisation. Businesses and most European Operators favour quick infrastructure liberalisation under fair rules. As one incumbent Operator commented, the issue is not what the EU wants in 1998 – it's what the customers want even before that. For these stakeholders, the emergence of alternative infrastructure Operators will lead to a wider choice of services and higher productivity. This, in turn, will translate into lower prices and higher quality for the customers, renewed growth opportunities for the leading Operators, and the emergence of a more competitive European telecommunications industry and, consequently, a more competitive Europe.

These opinions are in line with the conclusions published by a Regulator from a large northern European country. In this Regulator's view, abolishing monopolies and introducing competition would stimulate private investment on a massive scale and would improve the efficiency of the economy, promote social benefits and enhance the lives of Europe's citizens. It would also stimulate the economy directly and create jobs in building the infrastructure without using taxpayers' money. The issue of loss of scale must be weighed against the gains in efficiency and the innovation induced by infrastructure competition.

Comments on timing and impacts often differed according to how liberalised the Operator's own market was. In general, the incumbent Operators in Scandinavia, the UK and Benelux favoured infrastructure liberalisation as long as adequate measures were taken to ensure fair competition. Some measures cited were: making deregulation rules uniform across Member States; allowing tariff restructuring; modifying public service obligations to compensate for the loss of privileges (the 12/7/93 regulation for Universal Service Provision is perceived to be inadequate); granting access to non-European markets for European incumbent Operators. Among the larger incumbents, DBP Telekom and France Telecom have the greatest concerns about the potential liberalisation of infrastructure.

Other European incumbent Operators (primarily from southern Europe) and some equipment manufacturers are concerned about the short-term implications of infrastructure liberalisation and are asking for a longer transition period; some are even suggesting a continued monopoly on certain infrastructures. These stakeholders believe that the existence of alternative infrastructure Operators will lead to layoffs and to the inefficient duplications of assets, undermine the incumbent Operators' financial viability, threaten Universal Service Provision, and transfer a major strategic industry to foreign interests.

Also, incumbent Operators from medium-sized and small countries expressed fears that deregulation would leave them at a competitive disadvantage against larger Operators, in particular against US Operators. Fast deregulation is seen as allowing a massive entry of US Operators to the European market, with no reciprocity. This effect can already be observed in the mobile telephony market, where many manufacturers and service providers are at least partially American.

One incumbent Operator criticised both the UK and the US models of deregulation, perceiving the UK model as shifting value from the operator to competitors solely on the basis of ideology and viewing the US model as irrelevant for many of the small countries in Europe. This Operator pointed out that any deregulation law must take into account the difference in size of the countries and therefore should allow the possibility of different options for smaller countries. A new Operator commented that fast liberalisation could potentially create a situation like the one observed in the aviation industry, where market oligopolies quickly emerged in lieu of Regulatory monopolies.

As noted above, incumbent Operators in southern Europe generally favour a gradual process of infrastructure liberalisation or a transition period beyond 1998 that would allow for the development of collaborative structures (e.g. alliances) to minimise the risk of being overpowered by US Operators. The southern European Operators feel, however, that they do not have the necessary lobbying clout to hold back the deregulation process, and they perceive that public opinion is in favour of liberalisation. They have, therefore, been implementing programmes for some time to prepare themselves for fuller competition.

As for equipment manufacturers, some are concerned that infrastructure will be liberalised without taking into account the effect on them. They expressed the fear that a fully liberalised market will put additional pressure on equipment prices and will also introduce non-European standards in Europe's networks.

Number of Competitors

A significant group of alternative providers and potential Operators from the US favour *controlled* liberalisation to create financially attractive conditions for deployment of a few

alternative infrastructures (e.g. duopoly environments) whose Operators would behave *responsibly*. For example, long-distance infrastructure could be provided by utilities and rail companies, while the local loop could be provided by CATV companies and PTTs' local access networks.

One incumbent Operator agreed with US Vice President Gore's view that there will be two wires going into every home: one copper pair using ADSL based on today's telephony network, and one cable television multi-media link of some form. Homes will also have a DBS and wireless facility. This Operator anticipates that these networks will extend to 75 to 80 per cent of the population, while in the rural fringes there will be one provider of fixed network plus other providers using radio technologies.

Mobile Telephony

The growth of mobile telephony is generally perceived both as being an opportunity for alternative networks and as providing a new form of competition. An alternative Operator believes the development of PCN over CATV networks is an excellent option for the long term. It reduces total investment required for the development of alternative telephony infrastructure and increases the profitability of CATV networks.

Another mobile Operator is strongly in favour of deregulation in infrastructure provision since it will create opportunities for it to licence its technology to other Operators. It considers that, for many environments, the provision of an alternative wire-based infrastructure is wasteful.

Interconnection and Cross-subsidisation

Interconnection and cross-subsidisation were seen as crucial issues for liberalisation. A fair interconnection system is seen as a key element of successful deregulation.

One incumbent Operator stated that the Commission should lay down some common interconnection standards, and then leave it to competition to ensure that networks are built. However, any framework must take into account the interests of the remote communities to prevent "cherry picking" that would potentially jeopardise the incumbent Operators' ability to serve those remote locations. The market skimming by new entrants will exacerbate regional imbalances, with new entrants focusing on wealthier and denser cities and regions. A gradual deregulation accompanying the introduction of technologies appropriate for serving low density remote areas would minimise the cross-subsidisation to those areas and therefore minimise the risk of skimming.

Another incumbent Operator considers that the current high access prices set by monopoly Operators will cause a shake-out among service providers, to whom too little margin is left. Service providers offer more than incumbent telephony Operators for lower prices, but

because incumbent Operators cross-subsidise services through high infrastructure charges, most service providers operate below cost.

A Regulator stated that prices could vary between regions, according to cost based on population density, within a reasonable bandwidth. This Regulator would allow cross-subsidisation between networks up to a certain limit and advocates a "supervised" laissez-faire approach toward the functioning of markets – as long as services are good.

The Role of the Regulator

A Regulator said that the key tasks today are defining the time frame for liberalisation and determining whether the Open Network Provision framework is still valid. In general, interviewees felt that liberalisation must proceed at a predictable and fixed rate; knowing in advance the pace of liberalisation is critical for the management of any Operator.

Several incumbent Operators believe that, if the market is truly open, market forces will replace the need for more regulation. An incumbent Operator said the market should decide which networks should be built. It understands the Commission's proposals as including the possibility of the Commission issuing directives requiring companies to build networks. In its view, this is the wrong role for Government: it might be appropriate for the Commission to provide some seed corn and R&D support for new applications and experiments, but the Commission should not be involved in the commercial funding of the development of networks.

Stakeholders in general agreed that the Regulators' main responsibility should be to define a clear Regulatory framework that fosters the development of competitive behaviour on the part of all players and guarantees funding for Universal Service Provision. (An opposing view was taken by a new Operator, who suggested that incumbent Operators remain responsible for all public service obligations until such time as another competitor had gained a 10 to 15 per cent share of a country's telecommunications market.) The rules of the game must be clearly set and the transition pattern clearly defined.

According to a Regulator, any regulatory direction should focus on increasing the degree of confidence for value-added providers by guaranteeing that interconnection terms (not only price) will be fair and that the investments they make in new services will not be taken away by the next round of infrastructures.

Some sentiment was expressed for an European Regulatory body that would decide on pan-European commercial issues. Universal European regulation would eliminate "patchworking" by individual Member States. One incumbent Operator said the deployment of pan-European services is hampered by the variations in when and how EU resolutions are applied in the various Member States.

Restructuring and Financial Pressures

Several incumbent Operators pointed to their financial situations and agreed that a prudent approach was needed for any further deregulation in order to maintain their financial balance and their ability to meet their social obligations. The current deregulation is already threatening this balance, due to the cherry picking from international Operators.

To challenge the new entrants, incumbent Operators will need to reduce their work forces, which may prove particularly difficult when the company is state-owned. In some countries, Government policy has placed the monopoly Operator in the difficult position of having to enhance its competitiveness while maintaining high employment, even in the face of technology evolution. This cannot be maintained in a competitive environment. The current over-staffing of some of the European Operators is a direct consequence of the monopoly conditions in which they have historically operated, as well a result of Government constraints. Opening the market to competition will force Operators to restructure their operations and lay off personnel. Regulators may try to mitigate the hardship, but they cannot insulate Operators from the consequences of over-staffing.

One northern Operator explained that it has already engaged in restructuring in order to put its working practices in line with the best practices observed. A southern Operator said that whereas many of the Operators have benefited from extensive subsidies from governments in order to maintain a competitive balance sheet, it has had to fully finance its own balance sheet. In particular, it has just completed a heavy modernisation programme, achieving steady profits and good quality of service in the process.

However, the incumbent Operators feel that they must be allowed time to translate a healthy profit and loss into a healthy balance sheet. Some Operators have invested heavily in the modernisation of their network infrastructures in recent years and can only expect to make a return on these investments over a significant length of time. A major southern European Operator noted that it needs time to correct the sub-optimal investment policies of the past. Operators currently engaged in major network upgrades may slow down these upgrades because they could turn unprofitable if competition is allowed. (This is particularly a matter of concern in those countries currently making a substantial effort to catch up – Spain, Italy, Greece and Portugal.)

6.3. Conclusions from the Interviews

Ultimately, the liberalisation of the infrastructure can not be avoided. *Its necessity was conceived the moment the European Council adopted its 22 July 1993 resolution,*[27] *which states that all services will be open to competition in 1998.* In the debate that preceded this resolution,

the key question of whether customers of telecommunications companies have the right to a choice was raised.

In its resolution of 22 July 1993, the European Council answered this question positively, implying the necessity for infrastructure liberalisation. Regulatory checks and balances alone cannot guarantee that incumbent Operators possessing monopoly infrastructures will be impartial when making such infrastructures available to their competitors. In practice, the links between services and infrastructures are such that an alternative service provider will always be handicapped if it is not allowed to choose whether to build its own infrastructure. Recognising this fact, a growing number of countries have begun the process of deregulating infrastructure.

Chapter 7: The Path Towards Infrastructure Liberalisation

The "natural monopoly" status of telecommunications infrastructures is not as obvious as it once seemed. Comparing the situation and evolution in regulated and deregulated countries shows the advantages of liberalisation for users: prices go down, and the number and variety of services offered increase.

In this Chapter, we first discuss the possible evolution in the EU from an economic perspective. We then investigate whether the status quo can reasonably be maintained. After that, we review the many dimensions of liberalisation, including timing, geography, and the maintenance of public service provision. We then recommend a two-staged liberalisation process and discuss some of the issues it raises.

7.1. Possible Evolution in the EU

Across liberalised countries, there is a growing multiplicity of telecommunications providers, with overlapping product and customer focuses. These providers include, as mentioned in Chapter 6, alternative long-distance carriers and local bypassers; equipment suppliers, facilities managers and global outsourcing providers; CATV Operators offering telephony; mobile companies offering various alternative services; and satellite-based services.

Companies have been busy making alliances and acquisitions (Exhibit 7.1), as they believe that new forms of competition offer valuable advantages. For example, attempts at marrying telephony and CATV in the US resulted from the RBOCs' aspirations to lead the future multi-media market; BT is pursuing the large business customer market by developing global capabilities; and AT&T considers wireless to be important both as a source of continuing growth and as a defence against the uncertain evolution of local access technologies.

Exhibit 7.1: Recent alliances and acquisitions (not comprehensive)

Successful bids and bids in process

Date	Purchaser	Purchaser turnover $bn	Target/Partner	Activity of target	Value of deal $bn	Share of target %
Aug-94	LDDS	1	WilTel	IXC	2.5	100
Jul-94	US West	11	Wometco/Georgia Cable	CATV	1.2	100
Jul-94	Bell Atlantic Cellular	n/a	Nynex Cellular	Mobile	13.0	100
Jul-94	AirTouch	1	US West Cellular	Mobile	18.0	100
Jul-94	Nextel	0.1	One Comm	Mobile	0.7	100
Jun-94	AT&T	67	Unisource	Global sce provider	n/a	n/a
Jun-94	Eunetcom	n/a	Sprint Corporation	IXC	4.2	20
Dec-93	US West	11	Time Warner	Media/CATV	2.5	23
Nov-93	Nextel	0.1	Motorola mobile licences	Mobile licences	1.8	100
Oct-93	Bell Atlantic	13	Iusacell	Mobile	1.0	42
Aug-93	AT&T	67	McCaw Cellular	Mobile	12.3	100
Jun-93	BT	20	MCI	IXC	5.3	20
Jun-92	US Sprint	10	Centel	LEC	2.9	100
Oct-91	Bell Atlantic	13	Metro Mobile CTS	Mobile	2.5	100
Sep-91	AT&T	58	NCR	IT manufacture	7.4	100
Sep-90	Bell Atlantic & Ameritech	25	Telecom New Zealand	PTO	2.5	68
Aug-90	GTE	20	Contel	LEC	6.3	100
Apr-90	MCI	12	Telecom USA	IXC	1.3	100

Unsuccessful bids

Date	Purchaser	Purchaser turnover $bn	Target/Partner	Activity of target	Value of deal $bn	Share of target %
Aug-94	MCI	12	Nextel	Mobile	1.3	17
Jun-94	EDS	10	Sprint	IXC	20.0	100
Apr-94	SW Bell	11	Cox Enterprises	CATV	5.0	100
Mar-94	AT&T	67	Energis	Transporter	0.3	33
Feb-94	Bell Atlantic	13	Tele Communications	CATV	22.0	100

Source: Mercer Management Consulting research

Changes in the industry have been partly fuelled by rapid changes in technology. Over the last five years, the cost of optical fibre and wireless technologies has dropped by more than one-third, while the cost of copper networks has decreased by less than 10 per cent. Moreover, the utility of the alternative technologies – wireless's mobility and fibre's huge capacity – is much greater than that of the traditional twisted copper pair; modernised coaxial networks now can also support telephony. Compression techniques that increase the capacity of copper will offset these advantages somewhat, but it is unlikely that they will reverse the widening performance gap.

In Europe, our infrastructure inventory shows that few alternative telecommunications networks exist outside state control in Member States. Furthermore, most CATV networks in countries such as France, Germany and the Netherlands are to a greater or lesser extent controlled by the incumbent telephony Operator.

However, despite this background and even if greenfield networks need to be built, moderate competition in *long-distance and international* infrastructures will be profitable in most cases.

International and Long-Distance

The high margins associated with the international and national services have made these extremely attractive businesses. The technological options opened to players in the long-distance market are fairly limited. Based on current technologies, the highest capacities can be provided using optical fibres with an SDH transmission architecture. This is also the most cost-efficient architecture beyond a certain capacity requirement. To the benefit of incumbents, fibre-based SDH long-distance infrastructures offer significant economies of scale, particularly if one considers the installation costs of the cables. New entrants can compete, but they will be at a structural cost disadvantage to established players. They can overcome this disadvantage through higher efficiency and better marketing, both of which are beneficial to users and society. Even in tariff-balanced environments (e.g. some of the Scandinavian countries or the UK), alternative infrastructures with limited scope focusing on servicing particular customer segments are able to find economic returns.

Incumbent Operators still have an advantage over newcomers. Despite more than 10 years of competition in the US, AT&T still dominates the long-distance and international markets; Sprint, one of its leading competitors, has recently lowered its growth predictions. Similarly, BT still dominates the UK market; its main competitor, Mercury, has just announced a restructuring and refocusing plan. In both the US and the UK, competition has been a catalyst for strong increases in efficiency. A major disadvantage for incumbent Operators is the fact that Government authorities do not always allow tariff rebalancing to bring local call prices closer to operating costs. When rebalancing is allowed, an incumbent Operator can lower its tariffs in line with its scale advantage and restrict the challenger's ability to offer tariff discounts, which is the major differentiation criterion in the long-distance and international businesses. On the other hand, if the operational efficiency of the incumbent Operator is so low as to offset the scale advantage that it inherits, competition is likely to dominate these businesses.

New licences should not be limited to companies that already own or have access to an existing alternative infrastructure. New competitors that do not own such infrastructures or that will build greenfield networks are just as valuable and as likely to succeed if they are well-managed. The choice of using existing alternative infrastructures or of building new ones should be up to the market and not to the Regulator. We can expect that market players will become aware of existing alternative infrastructures' advantages and limitations and will make rational decisions to use them if and when advantageous. In addition, most existing alternative infrastructures are state-controlled or state-owned (as shown in Chapter 2), which may limit the ability or the willingness of these infrastructure owners to compete with a state-controlled telephone Operator.

Local Access

The economics of alternative *local* infrastructures are very different from those of long-distance and international infrastructures. For competition to spread effectively at the local level, several conditions must be met: Operators must be able to create a sufficient revenue stream, for example by providing both entertainment and telephony services; tariff structures must be rebalanced to make it worthwhile to offer local telephony; and investment must be encouraged by offering a low upgrade cost or a "first entrant" advantage.

Furthermore, demand for new multi-media services (or the extension of existing CATV services) is still very uncertain. Most new services, despite the tests initiated by the most developed Operators, are still speculative. Consequently, the financial attractiveness of an alternative local loop is largely associated with "Plain Old Telephony Services" (POTS) and the accessibility of a large choice of TV programmes.

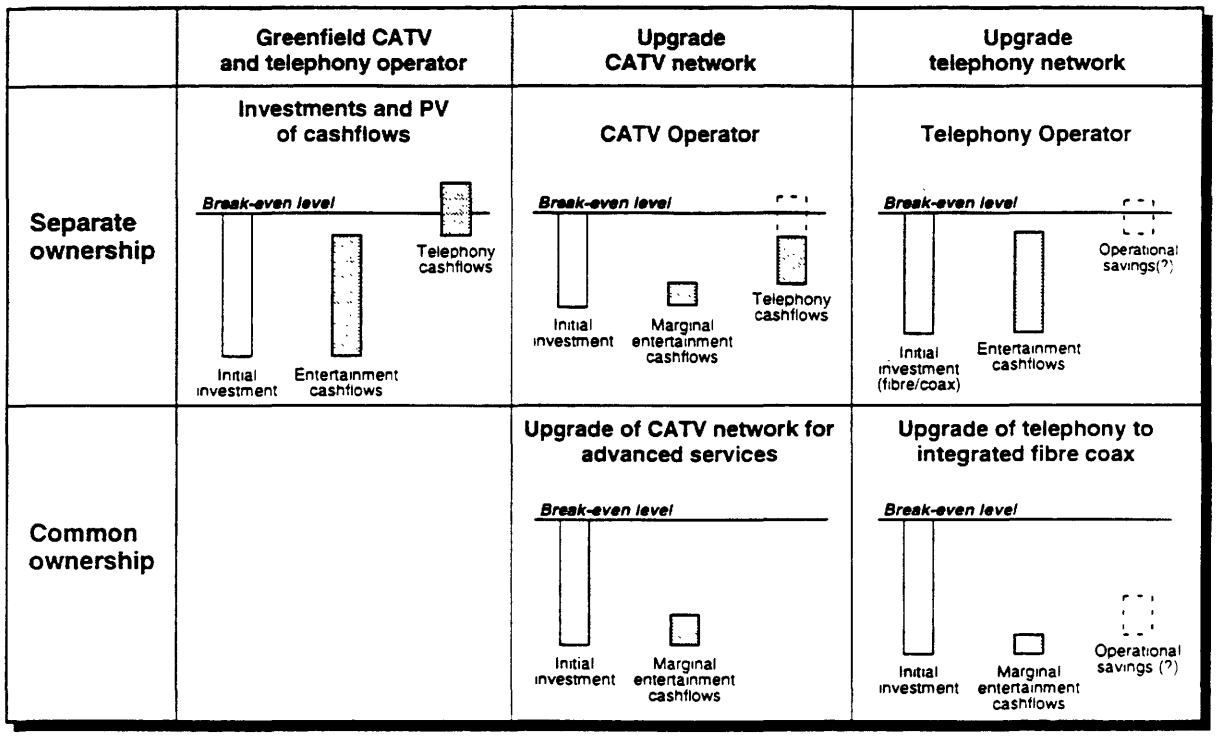
Through the use of wireless technologies, some Operators are attempting to change the economics of the local loop. Networks such as the ones being deployed, for example, by Ionica in the UK and by Telecom Finland may reduce the economies of scale and scope associated with the local loop – assuming radio spectrum can be made available on a wide scale. However, if a majority of customers demand broadband access, as is currently expected, the competitive attractiveness of current wireless technologies will be low.

Given the differences in infrastructure ownership in the various countries of the European Union, liberalisation will potentially lead to vastly different results. In some countries, the telephony Operators already control part of the revenues associated with current CATV services (e.g. Germany, the Netherlands and France). Hence, there is no financial case for the emergence of an alternative local loop. In other words, Operators who control both the local telephony and the CATV infrastructures effectively lock competition out of the local loop (with the possible exception of wireless services on a selective basis).

In other countries (e.g. Belgium, Denmark and Ireland), telephony and CATV revenues are controlled by separate Operators. In these countries, a dominant position in local access depends on the specific characteristics of the telephone and CATV networks (structure, length, cable gauge, technology, maintenance policies, etc.). In most cases, however, neither the telephony Operator nor the CATV Operator will be able to financially justify the investment required for upgrading. The status quo, therefore, is likely to be sustained for some time, and the upgrade of the local infrastructures will be delayed until technology costs decrease and genuine multi-media services emerge. It is important to realise that this situation is independent from the liberalisation of infrastructure. Furthermore, it implies that, in countries where both telephony and CATV infrastructures are well-developed, ownership separation alone is not sufficient to foster the upgrade of the local loop.

The most favourable environment for the development of an alternative local loop infrastructure is one in which no CATV network exists, ownership will be separate from that of the incumbent Operator, the alternative provider is at liberty to provide telephony and entertainment services, and tariffs are fully rebalanced. In these countries – such as the UK currently, but also potentially in Spain, Portugal, Greece and Italy (although the existence of many terrestrial TV channels in Italy may lower the attractiveness of broadband local loop in this country) – telephony Operators will find themselves in a vulnerable position. In fact, competitors in greenfield environments stand to gain higher financial returns from building a combined telephony/CATV local infrastructure than the incumbent does from upgrading its own telephony network (see Exhibit 7.2). In the UK, for example, US Operators have been steadily gaining market share against BT by offering combined telephony/CATV services.

Exhibit 7.2: Summary of CATV and telephony economics



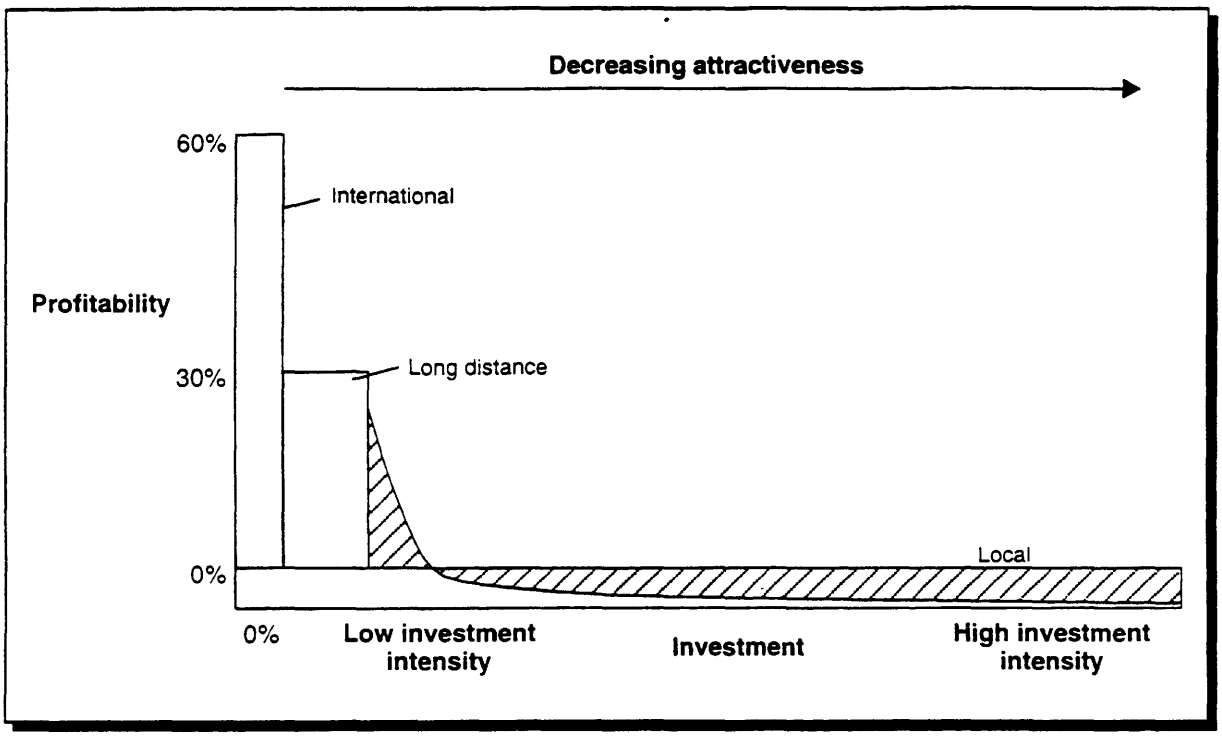
Source: Mercer Management Consulting analysis

Currently, no telephony Operator is able to contain market share loss against a greenfield Operator without taking severe losses from the substantial investment required to upgrade. Nevertheless, the rational behaviour for the telephony Operator would be to duplicate the newcomer's service offering even though this would destroy the profitability of the local services for both Operators. Thus, in countries with no CATV networks, the emergence of a challenger in the local infrastructure risks triggering a process of response and counter-response that may destroy for quite some time the financial attractiveness of the local infrastructure. Consequently, *while investments and competition in long-distance infrastructures will follow liberalisation, the development of alternative infrastructures in the local loop will be more variable.*

Impact on Telephony Operators

Typical relationships between investments to serve a market and returns on investments are shown on Exhibit 7.3. Liberalising the international and long-distance markets would be immediately attractive to newcomers under the current price structure. Some markets may show higher returns for national traffic than for international traffic. Exhibit 7.4 shows the possible margins of a competitor as a function of the market share it gains in the long-distance market. An incumbent Operator can be expected to react and readjust its tariffs to limit its market share losses.

Exhibit 7.3: Typical return in investment for telecomm infrastructure in a non-liberalised environment

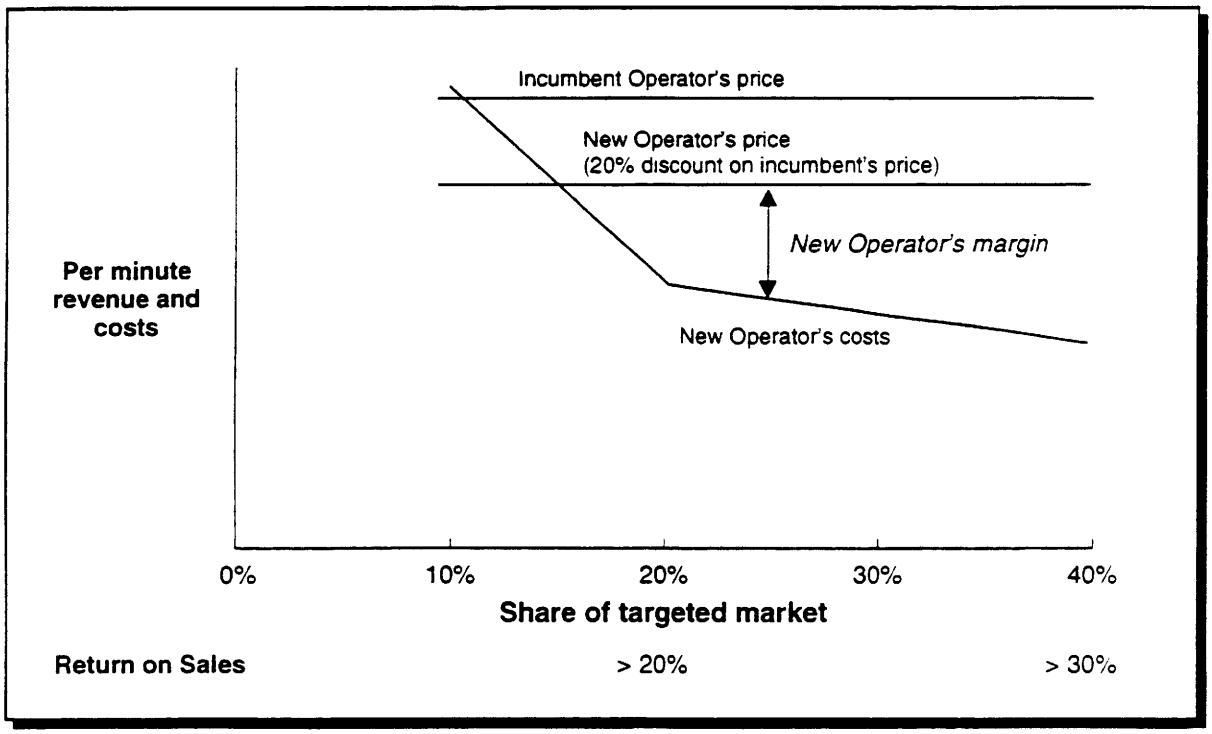


Source: Mercer Management Consulting analysis

Experience in other countries shows that the introduction of long-distance competition leads to a 20 per cent to 30 per cent market share loss for the incumbent. However, the extent and speed of this market share loss varies considerably according to the local conditions. Among the factors influencing the size and speed of market share losses are the discount level of the newcomers, their marketing aggressiveness (new services in particular) and their geographical coverage.

As we have seen, the incumbent Operator will have an incentive to upgrade its local network only under certain conditions. As mentioned in Chapter 4, two main options will be opened for the incumbent Operator to provide advanced services over its network: fit customer lines with ADSL equipment, or restructure its network with a fibre/COAX architecture.

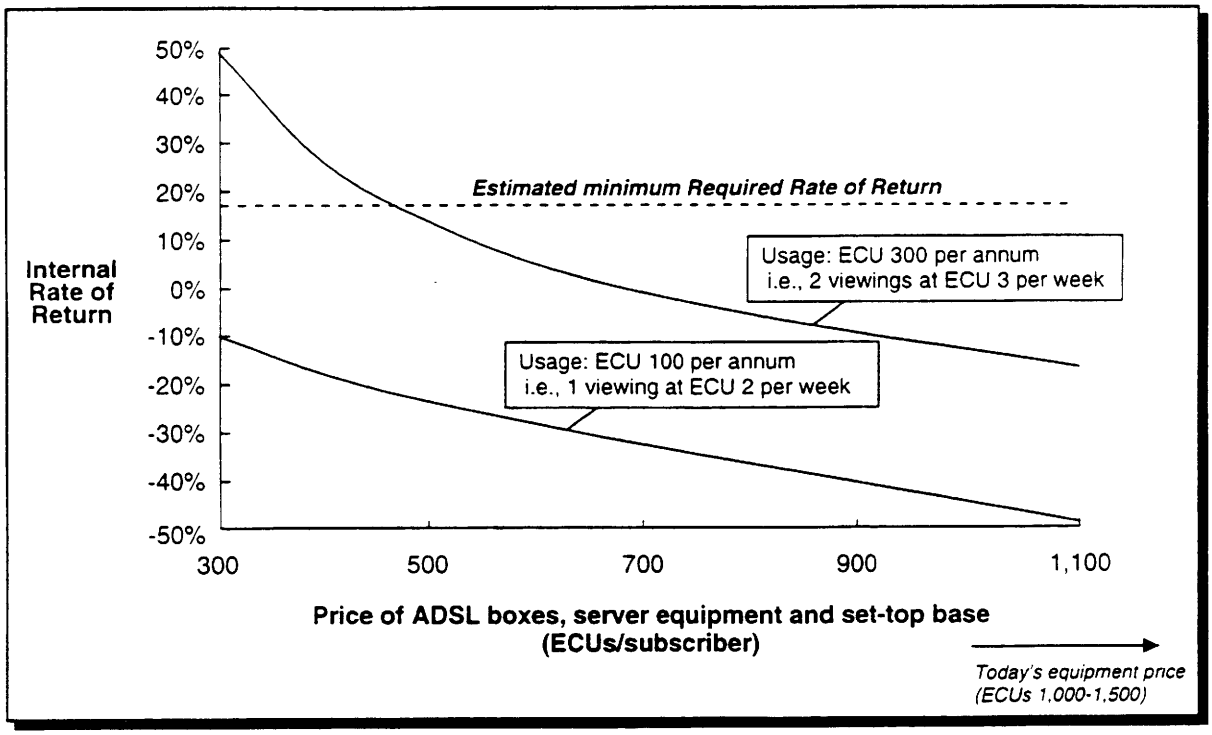
Exhibit 7.4: Revenues and costs for a new operator's long-distance infrastructure



Source: Mercer Management Consulting analysis

ADSL upgrades will be profitable only if one assumes a drastic decrease in equipment costs. Exhibit 7.5 shows the return on investment of ADSL equipment used to provide video-on-demand services. Even assuming video-on-demand consumption of ECU 300/year/household (far beyond what has been achieved in real-size experiments), the investments will not pay off unless total equipment prices fall below ECU 500.

Exhibit 7.5: Profitability (internal rate of return) for the provision of Video-On-Demand with ADSL

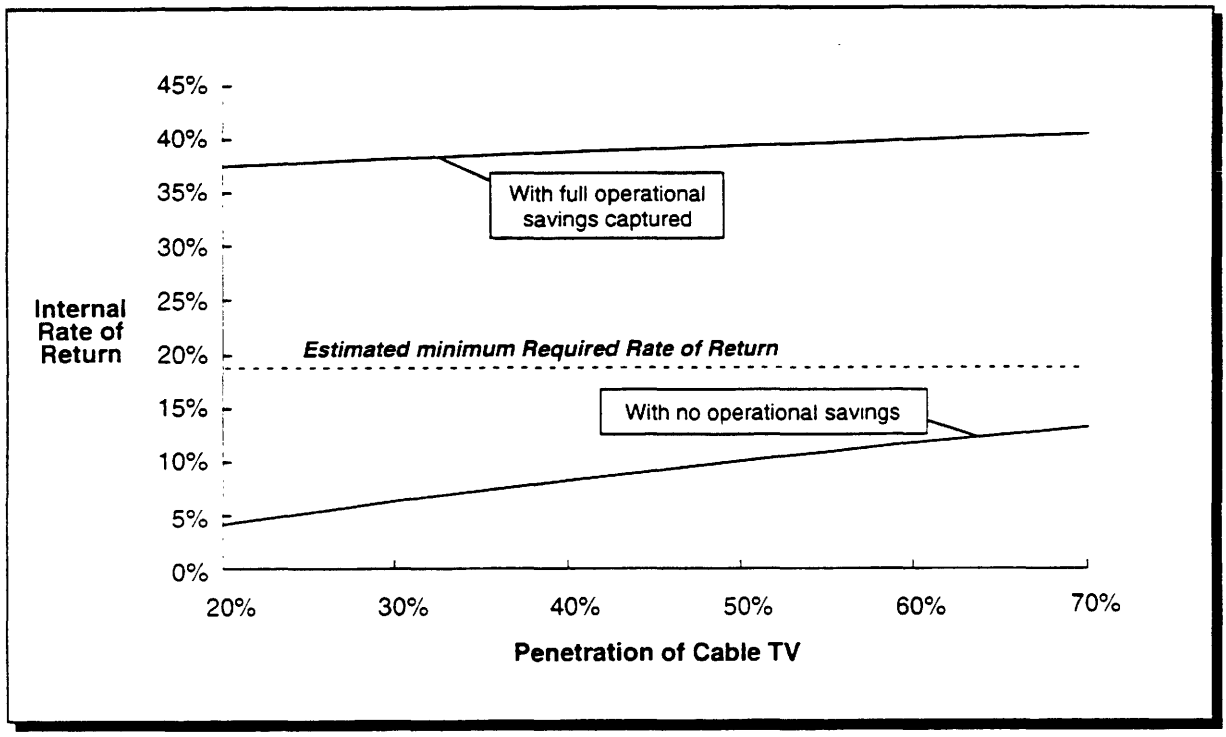


Source: Mercer Management Consulting analysis

This analysis of the ADSL upgrade, however, does not take into account the attractiveness of ADSL as a customer retention tool. It may be used to bundle a telephony cum video-on-demand offer and help the incumbent Operator retain its customers. In that case, one should consider not only the simple revenues from video-on-demand but also the telephony revenues that could otherwise be lost.

Fibre/COAX upgrades will make it possible to offer advanced services and generate large potential maintenance savings. Most of these savings are associated with manpower reduction, however, and many incumbent Operators may be restricted in their ability to reduce their work force. Exhibit 7.6 shows the return on investments with and without the maintenance savings. It is easy to see that the return on investment is attractive only if the telephony Operator is in a position to capture most of the work force reduction or redeployment savings associated with the investment.

Exhibit 7.6: Profitability of upgrading a traditional telephony network to a fibre/COAX architecture



Assumptions: – *UK economic inputs*
– *Indicated penetration reached after 5 years*
– *Telephony market at saturation at time of upgrade*

Source: *Mercer Management Consulting models and analysis*

Whether a CATV Operator generates new demand or simply captures incumbent Operator business will greatly influence the overall economic benefit of local telephony competition. Without growth in demand, the provision of local telephony by CATV Operators will reduce the incumbent telephony Operators' asset utilisation.

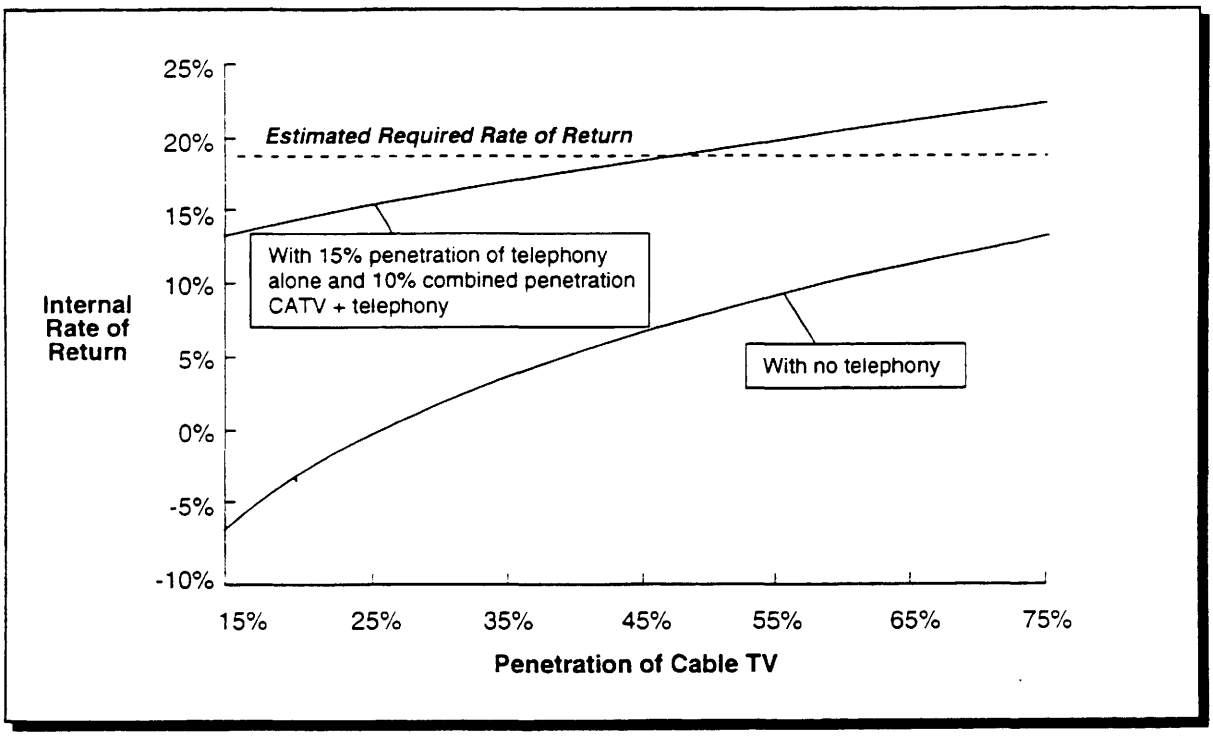
Impact on Cable TV and Interactive Services Providers

Existing CATV Operators would be allowed to provide telephony and other interactive services. To do so, as mentioned in Chapter 2, large upgrade investments are required.

Our analysis shows returns on such investments are sufficient only if the CATV Operators are able to gain significant market share in telephony. Depending on the cost of the upgrades and the CATV/telephony revenues in the area under consideration, a market share between 10 per cent (if upgrade costs are low and revenues are high) and 30 per cent (if upgrade costs are high and revenues are low) of residential and business telephony users would be needed. This analysis assumes that no other advanced services are offered. The provision of services other than CATV and telephony may increase the revenue stream and thus the attractiveness of the upgrade investment depending on the additional investments required (set-top boxes, video-servers, etc.), but development of new services will take some time.

Companies that own or operate both CATV and telephony infrastructures will have little or no incentive to invest in upgrades in the foreseeable future, given the costs of investment and revenue cannibalisation between services based on the two infrastructures. Separating the two infrastructures may introduce competition, which may lead a network being upgraded to provide advanced services and so gain an advantage. On the other hand, as we saw before, in areas in which both telephony and CATV networks are fully developed, structural separation will not be sufficient to make local loop upgrading attractive.

Exhibit 7.7: Profitability (internal rate of return) of cable TV networks with and without telephony



Source: Mercer Management Consulting analysis

In areas where no CATV infrastructure exists, a new CATV Operator would invest in order to generate the additional revenue from telephony activities. Exhibit 7.7 shows the return on such an investment with and without telephony.

7.2. Should the Status Quo Be Maintained?

Under the status quo, the timetable for service liberalisation would remain untouched, and the infrastructure monopolies of the incumbent telephony Operators and of the local CATV Operators would be retained. While maintaining the status quo in this way would minimise asset duplication, Operators would have little incentive to align their tariffs with their costs unless price-cap mechanisms were put in place. Indeed, the prospect of retaining the monopoly is enough to halt the tariff rebalancing that most Operators have begun recently. Similarly, little incentive would exist to reduce costs or to improve customer responsiveness.

Even under the status quo, infrastructure competition from mobile (excluding backbone), satellite and international infrastructures would constitute limited "breaches" in the monopoly:

- Mobile Operators are increasingly being seen as providing alternative access to customers. The European Commission has recently recommended that these Operators be given the freedom to operate their own long-distance infrastructures. In the medium term, this would give them substantial independence from the incumbent Operators. The available bandwidth over wireless access, however, is likely to restrict the service offerings of the mobile Operators.
- Telecommunications Satellite Access is also an alternative for data or even voice services. Such access would be well-suited for international traffic. Even though licensing procedures exist for the operation of earth stations, in practice they are hard to implement.
- Direct Broadcast Satellites (DBS) as a substitute for CATV will allow pay-per-view or even video-on-demand services as digital compression and encryption technologies become widely available. DBS Operators thus would compete head-on with the most advanced CATV Operators.
- The international infrastructure already allows for various kinds of telecommunications traffic capture, whether via call-back or via international resale services. This competition limits the tariffs of the monopoly Operators on the major international routes.

The DBS threat to CATV Operators is acute, and in practice their monopoly on broadcast would not likely be sustainable. For telephony Operators, however, these "breaches" of their

monopolies would only slowly erode market share, and for most Operators share losses would be limited given that their core activities would still be protected from competition. Furthermore, these Operators would benefit from leased lines and interconnection payments from mobile competitors and other service providers.

7.3. The Implications of Liberalisation

While maintaining the status quo will not provide the benefits of competition, full immediate liberalisation could create a significant threat to the stability of existing Operators and the public service functions they perform. Current inefficiencies and tariff imbalances (mainly between long-distance and local services and between business and residential services) would lead to significant market share loss in large segments of their business, without guaranteeing the benefits of liberalisation.

A *gradual* introduction of infrastructure competition would give incumbent Operators the time needed to restructure and to rebalance their tariffs at commercially (and politically) acceptable rates. The prospect of increased competition or increased pressures (price caps) in the near term would force Operators to improve their competitiveness without delay. Safeguards would be put in place to smooth the transition and to ensure the maintenance of their public service functions. Customer segments in need of special support could be identified by the Governments of the Member States and helped financially through explicit support programmes.

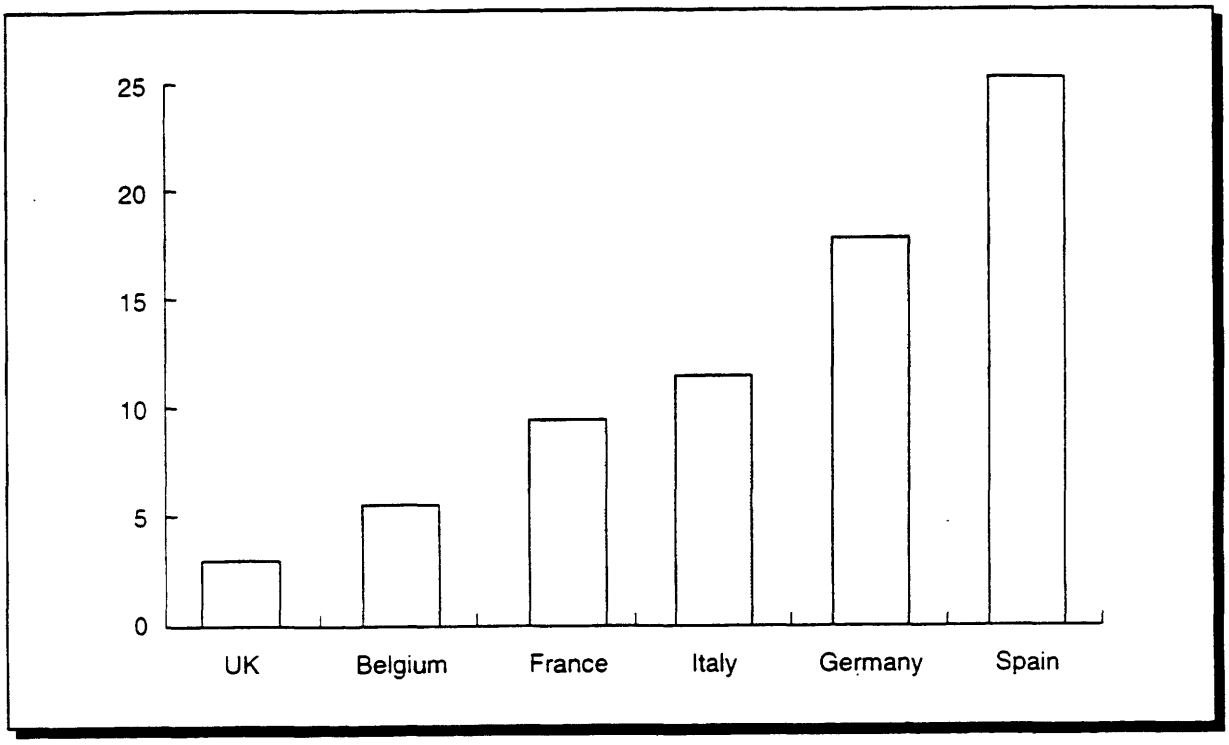
Safeguards required for a fair and efficient infrastructure liberalisation include providing for and financing some level of Universal Service, establishing inter-operability standards, setting access charges, avoiding cross-subsidisation, establishing a clear time frame, appointing a strong Regulator, developing a clear international reciprocity policy and creating access to scarce resources. Below, we examine these issues under the following headings:

- Market and tariff impact
- Number of competitors in each market
- Geographical coverage and exclusivity of the licences
- Timing of liberalisation
- Public service provision
- Interconnection rules and charges
- Avoidance of cross-subsidisation
- Role of the Regulator
- Third-country access

Market and Tariff Impact

Liberalisation will certainly affect tariffs. Past pricing policies have created a temporary distortion: international and long-distance prices have been kept artificially high and local prices have been kept artificially low. Exhibit 7.8 shows the relative costs of local and long-distance calls in the UK and non-liberalised countries.

Exhibit 7.8: Ratio of local and long-distance call basket



Source: Eurodata; Mercer Management Consulting analysis

These imbalances generally result from a political will to have business customers, who are heavy users of long-distance and international services, cross-subsidise residential customers who are heavy users of local services. From an economic standpoint, this cross-subsidisation is an attempt to reflect the marginal value of telephony services for both categories of customers and therefore facilitate the penetration of telephony services through all categories of population. This "hidden tax" on business is usually compounded by a rigid tariff structure with no volume discount.

To avoid users trading off PSTN for leased lines, the prices of leased lines have been kept artificially high in most Member States. One effect of these imbalances is that European industry has been put at a competitive disadvantage against other industrialised areas.

Another major imbalance today regards the "border effects" within the Community. International tariffs are much higher than domestic tariffs for the same distance, creating another obstacle to European integration and the emergence of the Single Market.

A progressive liberalisation that introduces competition gradually should give the incumbent Operators some freedom to restructure their tariffs. Otherwise, there still would be a risk that these Operators would be de-stabilised.

Price caps that mimic the effect of competition can be set to constrain the incumbent Operator to reduce its prices by a certain percentage in real terms. Similar measures can prevent the incumbent Operator from increasing some of its tariffs too rapidly (e.g. local tariffs) so as not to increase the costs of service for some categories of users.

Number of Competitors in Each Market

The number of competitors licensed in each market will affect the efficiency of competition. A large number of competitors reduces the risk of collusion but increases the risk of asset duplication. Furthermore, fragmented competition may not yield any Operator strong enough to compete effectively with the incumbent Operator.

Examples of infrastructure liberalisation policies pursued in several countries show different policies towards the number of competitors licensed:

- Until 1992, the UK had licensed only one national Operator, Mercury Telecommunications Ltd., to compete with BT. The stated objective of this duopoly policy was to give Mercury time to establish market presence. Once OFTEL determined that Mercury had in fact done so, additional national licences were awarded.
- In the US, no restrictions have been put on the number of long-distance Operators. Although AT&T, MCI and Sprint account for around 90 per cent of the long-distance market, many small Operators have emerged, concentrating on particular customer segments with specialised offerings. The most significant of these Operators are LDDS and WilTel.
- In Sweden, no restrictions have ever been placed on the operation of telecommunications networks, and consequently telephony prices in Sweden are among the lowest in the world. Telia had enjoyed a de facto monopoly until the end of the 1980s, when foreign Operators began to invest in the telecommunications infrastructure. As a result, Telia expects to have only 60 per cent of the long-distance domestic market in 1995 and has had to drastically restructure (see Chapter 5).

In most countries, CATV Operators hold exclusive local licences, as it is generally recognised that any CATV Operator would have difficulty operating profitably if it has to face competition. These local CATV monopolies are often counterbalanced by price regulations to bar monopoly profits. Sweden is one of the few industrialised countries where, for reasons of freedom of information, no restriction exists on the construction and operation of CATV networks.

Geographical Coverage and Exclusivity of the Licences

A further dimension to liberalisation is the geographical coverage of the licence given to the Operators:

- Local Licences: An Operator can only run its network in a metropolitan area. It is the typical form of CATV licence and Teleport type of operations.
- Regional Licences: These licences extend to several cities or large rural areas. This type of licence can be given for mobile Operators (e.g. Japan, US) or fixed telephony Operators (e.g. Finland, Hungary).
- National Licences: These licences cover entire countries and are the most typical form of licence for fixed and mobile operations in the European Union.
- Trans-European Licences

National and trans-European licences offer advantages over local or regional licences in that they represent a better offering for the markets and services where global coverage is important (although interconnection agreements largely overcome this issue). Operators are also able to benefit from economies of scale, and new Operators have greater bargaining power with the incumbent Operators in negotiating interconnection agreements.

On the other hand, local and regional licences have lower investment requirements that will ease the entry of new competitors, and local prices may more accurately reflect the costs of providing services in a given region without cross-subsidies between regions.

To obtain a licence, new entrants may often be obligated to cover a certain percentage of a country or of the population within a given time frame.

Timing of Liberalisation

Having a clear liberalisation timetable is important for all parties involved. Different timing policies can be implemented. For example:

- Incumbent Operators may be restricted from offering selected services until competitors have established strong operations. OFTEL in the UK, for example, has forbidden BT to market entertainment services until at least 1998. The aim of the measure is to allow CATV companies to maintain a local monopoly on the broadcast of TV programmes and thus achieve sufficient viability by the time the restriction is lifted.
- Introducing duopoly followed by unlimited licensing, which is a common timing policy, favours the development of a single strong competitor for a few years before introducing full competition.

- In the US and Japan, long-distance services were liberalised before local services, although no liberalisation of local services was initially planned by the Regulators in either case.

All timing policies are intended to favour the emergence of strong and sustainable competition as quickly as possible. A stepped liberalisation gives time to the incumbent Operator to adjust its tariffs, costs and service offerings, but also can allow increased competition or pressure (such as price caps) to be imposed on an incumbent Operator that does not show adequate improvement in a given time.

Public Service Provision

All incumbent Operators in the EU have Universal Service obligations imposed by Regulators. In a competitive environment, the definition, support and financing of the Universal Service Provision (USP) can be addressed in several ways:

- Option 1: The incumbent Operator retains the USP obligation and receives some financing directly from the State or from a levy on new entrants.
- Option 2: The Operators owning PSTN licences share the obligation. This approach could be combined with thresholds (e.g. market share) below which no USP obligation would be borne by the new entrant. In this case, the Regulators should be careful to avoid creating an incentive to the Operator to restrict its market presence simply to avoid the USP obligation.
- Option 3: Create an auction system where the Operator requiring the least financing is given an exclusive licence to operate in a specific area for a certain time with some tariff and quality constraints. If the best offer is given by a new entrant, then the operation of the local infrastructure built by the ex-monopoly could be transferred to the new Operator. The new Operator would compensate the ex-monopoly Operator by buying its local assets (at their residual accounting value or using a pre-established valuation method). The same principle can be applied to the operation of deficit services such as Operator assistance or networks linked to public security/defence.

Option 3 would give every player an incentive to operate the deficit-generating areas and services in the most efficient way. It would also provide the benefits of competition by giving incentives to newcomers to move into areas previously deemed unprofitable. It would allow the State to clearly identify the areas where access should be financed and what services to keep priced below-cost. However, it is politically difficult to accept as it may involve some form of regional pricing.

Interconnection Rules and Changes

An important prerequisite for the introduction of fair competition is the establishment of inter-operability standards between networks. Although this has not been a significant hurdle to competition in liberalised countries, Regulators must ensure that newcomers can easily interconnect with incumbent Operators as well as with each other.

Policing the calculation and implementation of interconnection charges is a key function of the Regulators in liberalised markets. Interconnection charges are typically the largest cost item for new entrants, and they should be calculated so as to reflect the true cost supported by the incumbent Operators (with a possible contribution for access/service deficits). Otherwise, strong competitors are unlikely to emerge. Recent experience with mobile Operators (e.g. in France) has shown the need for the Regulator to intervene in this area.

Avoidance of Cross-Subsidisation

Cross-subsidisation is the single largest danger to the establishment of fair competition. The Regulators must require some form of operational (or at least accounting) separation to ensure that the incumbent Operator does not cross-subsidise non-reserved services with profits obtained from reserved services.

In parallel, safeguards have to be required for alternative infrastructure Operators. Most of the alternative infrastructure owners have built their networks purely for internal usage and are using facilities originally intended for their core activities (rail tracks, pylons, etc.). Using free capacity on this infrastructure (or even benefiting from reduced costs via eased installation) entails a danger of cross-subsidisation between core activities and telecommunications activities. To ensure that no cross-subsidisation occurs, alternative infrastructure owners should be forced to establish separate subsidiaries for telecommunication activities operating at arm's length from the core company. Prices of the assets to be transferred between the telecommunications entities and core companies should be based on market prices where a competitive market exists or on average historical costs otherwise.

Role of the Regulator

EU legislation has not been uniformly implemented in Member States' national laws. National Regulators also have very different means and powers to enforce existing regulations on the incumbent Operators. This non-uniformity constitutes a disincentive for an Operator to operate on a pan-European basis: regulations are different and the Operator needs many different licences. Regions with the weakest Regulators run the risk of not benefiting from the advantages brought by new Operators.

One way to avoid this would be to introduce a policy whereby an Operator could apply to one "Euro-Regulator" for a licence and be allowed to operate in the whole EU. How far this Regulator would otherwise substitute for the national Regulators and how it would interact with them, is largely a political issue. The "Bangemann" report on Europe and the global information society has recommended the establishment of an authority at the European level.

Another option would be to leave regulation at the national level, recognising that key issues such as frequency availability, rights-of-way and environmental considerations are mostly national and likely to remain so for a while. The European Union would only set the framework within which national Regulators would act, with some co-ordination. This way of proceeding would be less ambitious, but perhaps more practical. It can also be a first step before the introduction of Euro-licences.

Incumbent Operators currently control scarce resources (frequencies, high points for antennae, rights-of-way, etc.) in most of the EU. Access to these scarce resources can be critical for the operation of a network and, in most cases, reduces the investment costs required. The Regulators should make sure that new Operators have fair access to these resources in the cases where sharing is possible. Where this is not the case, procedures can be established to ensure that the incumbent Operator does not benefit from its ex-monopoly status. This is especially true of rights-of-way, which in many instances have very high values because they reduce the cost of building alternative infrastructures. Access to these rights-of-way should also be controlled and possibly limited in order to limit the environmental damage associated with the construction of alternative infrastructures.

Third-Country Access

It is essential that the EU obtains access for European Operators to the US telecommunications market at the same time that European infrastructures are being liberalised. Liberalising infrastructure without a reciprocity agreement with the US could lead to a transfer of wealth to the US. An analysis of the alliance movement worldwide shows that US Operators are involved in virtually every acquisition, alliance or major cross-border investment. Together with a few European Operators, US Operators are powerful new entrants reshaping the European telecommunications industry.

Also, foreign Operators in large non-EU industrialised countries – the US in particular – face restrictions. These usually take the form of limits on foreign ownership of telecommunications Operators. It would seem appropriate to ensure that Operators from these countries face similar conditions in the EU. Otherwise, the EU Operators would be disadvantaged in reaching a global size.

Ideally, restrictions could be lifted on a reciprocal basis. World Trade Organisation talks on services could be a forum for the easing of these restrictions, as part of the current progressive liberalisation of services. Most industries use telecommunication services (and hence infrastructure) heavily. It therefore seems appropriate at a minimum to integrate the deregulation of telecommunication services and infrastructures.

7.4. Stages of Liberalisation

A potential framework for a *two-staged process* is described below. Some issues raised by this process are described thereafter.

Stage 1 – Liberalisation of infrastructures to provide non-reserved data services

Member states would give immediate rights to long-distance infrastructure owners or any other potential alternative Operators to provide non-reserved services with their own infrastructure. In cases where alternative infrastructures are already well developed, we would expect alliances to be formed between the owners of such infrastructures and international Operators. However, we do not suggest that this be made a condition for licensing an alternative Operator – Member States should also grant licences for greenfield operations. Caution should be taken to avoid cross-subsidisation between the core activities and the telecommunications activities of the infrastructure owners.

In principle, this would allow users to benefit from low-cost under-utilised capacities, from low marginal upgrade costs or from both. If Regulators were to limit the number of competitors, the risks of asset duplication, of financial instability and of environmental disruptions would be reduced.

Stage 2 – Liberalisation of infrastructure for voice services

By 1998, incumbent Operators can be expected to have adapted, to a large extent, their pricing, productivity and responsiveness to the demands of competition. In some Member States, infrastructure liberalisation could be delayed to match the delayed services liberalisation, as agreed to by the Council's resolution of November 1994.

Setting price caps for local tariffs at this time would ensure that incumbent telephony Operators do not abuse their position by raising their local tariffs unreasonably in areas where they keep a monopoly. The prospect of this price cap would also encourage them to complete their tariff rebalancing.

Allowing existing CATV Operators to provide telephony will be an incentive for them to upgrade their networks (under separate ownership). Allowing incumbent Operators to provide interactive services will create competition in services other than telephony. In some areas with no CATV infrastructure, the possibility to offer both telephony and CATV will constitute strong incentives for an Operator to build a new infrastructure. Granting a single local CATV/telephony licence in each area will give CATV Operators the opportunity to capture significant local telephony market share.

Issues

In Mercer's view, such a two-staged process does not deal completely with two issues: the imbalance in size between the non-reserved (data) services and the voice market, and the inefficiencies that unchecked competition can bring to this market.

Voice services account for more than 75 per cent of telephony revenues. Therefore, the first stage of deregulation, which does not include any voice services, is likely to have only a small impact. The second stage of liberalisation – infrastructure for voice services – affects a much bigger and more attractive market, as demonstrated in the UK.

Countries that have deregulated voice infrastructure have typically done so in steps. While it is true that the duration of deregulation processes has shortened, we still make the case that a *progressive* deregulation of *voice* services is desirable.

This leads us to the second issue, i.e., whether a limited or unlimited number of competitors should be allowed. While we agree that several markets can support a large number of competitors, our analyses also show that not all market segments can attract and profitably support multiple competitors. Another factor is that a temporary limitation on competition can help establish stable, powerful competitors. Therefore, we believe that Regulators should limit the number of competitors allowed; in certain situations, this restriction of competition would only be temporary; in all situations, it would have to be reviewed regularly.

Chapter 8: Conclusions

8.1. Summary

The European Commission retained Mercer Management Consulting to explore the implications of infrastructure liberalisation within the European telecommunications industry. This work was intended to support the European Commission's Green Paper on future policy for the telecommunications infrastructure and Cable TV (CATV) networks.

Few global trends are clearer than the rapid rise and diversification of telecommunications services. Many countries, including New Zealand, Finland, Australia, Sweden, the United States, the UK and Japan, have already responded to this trend by adopting policies to liberalise their business and consumer telecommunications markets. Regulators in general are willing to break the barriers to competition that had been set as safeguards of the public interest, but which now appear increasingly artificial. The European Union itself has set a timetable for the liberalisation of services and infrastructure.

The experience in countries where the long-distance and local loop markets have been in the process of deregulating for some time – such as the US, Sweden and Japan – shows that alternative Operators can gain share without endangering the provision of universal service or the stability of the incumbent Operator. In all these markets, prices have declined, service availability has grown and gains have been made in productivity. Sweden's parliament has even ruled that Telia's interconnection charges cannot include any contribution towards the cost of financing loss-making local telephony service ("access deficit payments"). Only Japan is experiencing some delay in achieving true competition in the local loop due to local tariffs and difficulty of interconnection. In essence, these experiences constitute a set of benchmarks for telecommunications market liberalisation.

There is no real debate on the fact that the telecommunications market in Europe will eventually open to competition. The points of contention are rather how, when and with what consequences the transition will be made. The European Union needs to define a regulatory framework that fosters fair competitive behaviour among all players and yet continues to guarantee some deficit services (i.e., Universal Service Provision).

In our study, we have surveyed existing telecommunications and Cable TV infrastructure in each Member State. We have also reviewed regulatory regimes for services, infrastructure and operations.

Not surprisingly, conditions vary greatly among the Member States. Luxembourg, Denmark and the Netherlands have the highest penetration rates for both telephony and CATV networks. Portugal and Ireland, by contrast, have below-average telephony penetration, whereas Italy, Greece, Portugal, Spain, France and the UK have little or no CATV penetration.

As we have seen, the potential side effects of deregulation differ by country and demand appropriate complementary measures. Some of the most important issues that such measures will have to address are:

- The financing of Universal Service, in particular in the "low-penetration" countries;
- The complexity of the ownership or operational structure of Cable TV which is a potential obstacle to its development as a credible alternative in local networks, for example, in Germany, France and Belgium.

In this report, we also described the technologies that allow the provision of services with multiple bandwidth or bit-rate requirements over the same channel or group of channels: ADSL, HDSL, integrated fibre/COAX, overlay, FITL, ATM, SDH, etc. The idea of "digital superhighways" relies on the assumption that new, capacity-hungry communications will grow and complement (if not supersede) current, low-speed communications. How much capacity is eventually required will, of course, be determined by market forces.

Experience from other countries tends to show that safeguards to ensure the fairness and efficiency of a liberalisation process are necessary. In particular, it will be necessary for the EU to have, at least initially, regulations on Universal Service Provision, inter-operability, access charges, cross-subsidisation, the time frame for deregulation, the choice of Regulator, reciprocity and access to scarce resources.

On the basis of the research and analyses carried out for this report, as well as on its experience in this sector, Mercer Management Consulting believes a *gradual liberalisation* to be the best course of action. This would ensure that the benefits of the information and telecommunications revolution accrue to European businesses and consumers, without undue pressure on incumbent Operators and their Universal Service responsibilities.

8.2. Recommendations

The first stage of liberalisation would be to open infrastructure supporting non-reserved services to competition. In some countries, an alternative Operator will be able to use existing infrastructure. In other countries, it will probably have to build a greenfield network.

The second stage of liberalisation should introduce competition in infrastructures supporting voice services, with a simultaneous rebalancing of prices. Price caps for local tariffs may be considered. It can be expected that, in an environment in which they will have been given the time to adjust, incumbent Operators will have made sufficient efficiency gains and pricing reductions so that their stability and the provision of Universal Service would not be in danger.

With regard to the actual emergence of competition, we believe that the economic characteristics of the long-distance and international market will attract many new entrants. The attractiveness of local infrastructure is more variable, depending on local conditions.

In all countries where deregulation has taken place, the soundness of the incumbent Operators has not been undermined by competition. Also, in each situation a number of "provisions" or "contingencies" have helped throughout the process. To smooth the introduction of further competition in the European Union, we recommend the following safeguards:

- Universal Service Provision: As a way to develop competition, new entrants could be exempted from any Universal Service obligation for a given period; beyond that, we recommend aiming for an auction system, in which the Operator requiring the least financing to operate in a specific remote access is given exclusive licence there.
- Regulation and time frame: Strong and effective Regulators will be required to manage the transition process. The ways in which Member States Regulators co-ordinate should be decided. The possibility of appointing a "Euro-Regulator" should be considered. Such a Regulator should have the power to "manage" the liberalisation process by allowing incumbent Operators to rebalance their pricing structure as competition is introduced, by speeding up deregulation, or by lowering price caps if an existing step of deregulation is not effective enough.
- Regulators will have to prevent cross-subsidisation, in particular in countries where telephony and CATV networks are under common ownership or operation.
- Regulators will also have to rule on inter-operability standards, access charges, access to scare resources and reciprocity for non-EU companies.

There is no doubt that these and other issues will be the subject of debate over the next few months. Together with the various stakeholders, the Commission and the local Regulators

must now answer the remaining questions to assure that all elements are put in place in advance of infrastructure liberalisation to guarantee a fair competitive environment to both incumbent and new Operators. The case for infrastructure liberalisation is, in our opinion, sound. However, it is only through its balanced implementation that the telecommunications industry and the telecommunications users in Europe will benefit. Upon a successful implementation lays the health of the future European telecommunications industry.

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We have also met other people who requested their name to be kept confidential.

Except where stated otherwise, the views expressed in this report are Mercer's. The inclusion or exclusion of any company in this report implies no judgement on such company.

Acronyms and Abbreviations

ADSL:	Asymmetric Digital Subscriber Line (or Loop)
ATM:	Asynchronous Transfer Mode
BRA:	Basic Rate Access
CATV:	Cable Television
COAX:	Coaxial (cable)
DCS:	Digital Cylinder System
DTH:	Direct To the Home
FITL:	Fibre In The Loop
FTTB:	Fibre To The Building
FTTH:	Fibre To The Home
GSM:	Global System for Mobile communication
HDSL:	High-bandwidth Digital Subscriber Line
ISDN:	Integrated Services Digital Network
LDC:	Local Distribution Centre
MAN:	Metropolitan Area Network
Mbps:	Megabits per second
ONP:	Open Network Provision
NMT:	Nordic Mobile Telephone (norm)
PCN:	Personal Communications Network
PCS:	Personal Communications Service
PDH:	Plesiochronous Digital Hierarchy
POTS:	"Plain Old Telephone Service"
PSTN:	Public Switched Telephone Network
RBOC:	Regional Bell Operating Company
RTMS:	Radio Trunked Mobile System
SDH:	Synchronous Digital Hierarchy
STM:	Synchronous Transport Module
TACS:	Total Access Communication System
TO:	Telephony Operator
TRAN:	Terrestrial Alternative Network
USO:	Universal Service Obligation
VAS:	Value-Added Services

Notes

1 Source: OECD Communications Outlook, 1993.
2 Source: Mercer Management Consulting Research.
3 Source: Mercer Management Consulting Research.
4 Source: Frost and Sullivan. World Multimedia Market Report, December 1992.
5 Information in this section is partly drawn from "Competition in the UK Telecommunications market," Oftel 4/8/94.
6 Based on information received from BIPT. 27/07/94.
7 Based on information received from the Bundesministerium für Post und Telekommunikation, 02/08/94.
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12 "Quelle réglementation pour les télécommunications françaises?" DGPT, March 1994.
13 "Green Paper on a Common Approach to Mobile and Personal Communications in the European Union," June 1994, Commission of the European Communities, Appendix A.
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15 Basic requirements include less than 3km long local loops, limited bridged taps and limited attenuations.
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23 Program for Advanced Information Infrastructure, MITI, May 1994.
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27 Council Resolution 93/C213/01 published in the OJ C213/1 06/08/93.

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