FIBRE OPTIC SYSTEMS IN UK AND EUROPE

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ABSTRACT

This paper highlights the major differences in approach taken by European administrations to the application of fibre optic systems. The emergence of a comprehensive European undersea system network based on optical fibres is identified and reviewed. Although optical fibre is becoming the preferred medium for long haul network growth, no consensus of opinion has yet emerged about the optimum local access topology.

INTRODUCTION

Europe comprises some 19 West and 8 East European nations. In 1988 Western Europe will spend approximately $1 Billion on fibre optics for the first time. The population and spend on fibre optics is shown in Figure 1 for the most significant users of fibre systems in Europe.

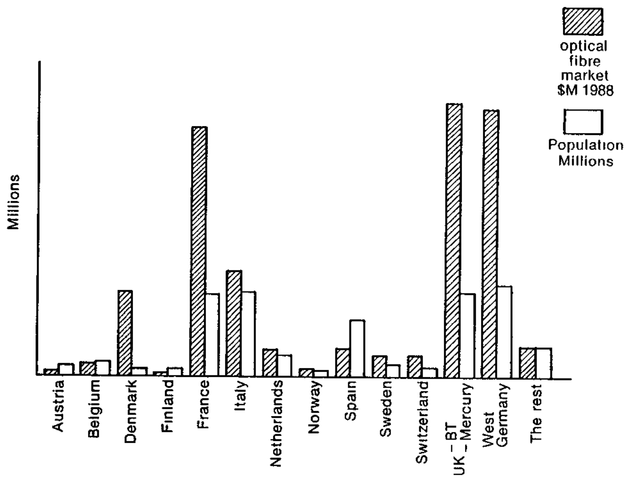
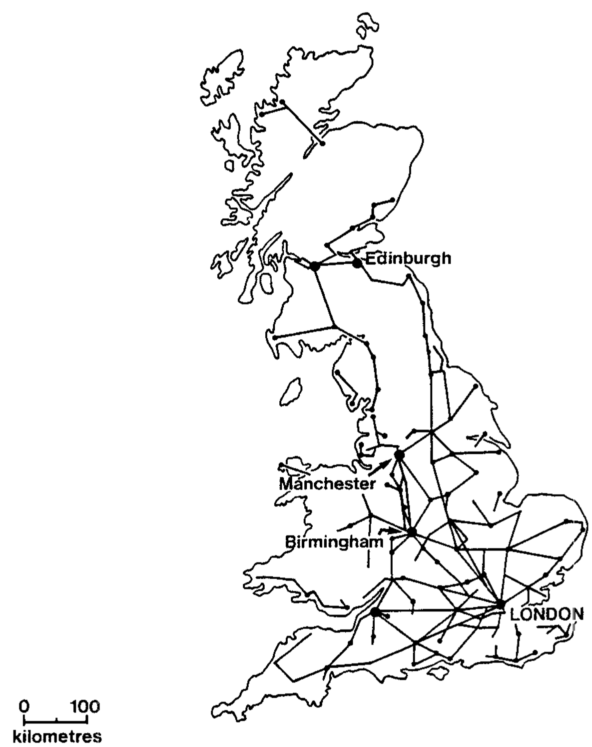


Figure 1 — European Fibre System Markets

Only 5 of these countries spend more than $50M per annum. It is on these 5 - Denmark, France, Italy, West Germany and United Kingdom - that this paper will concentrate.

Each of these countries differs from the others in culture, geography, language, regulatory regimes and mixes of transmission media. The UK for example has installed a comprehensive network of optical fibres in its long haul network before beginning the move to shorter links, see Figure 2. In this regard the UK and USA have approached the

Figure 2 —
UNITED KINGDOM



fibring of the network from the same starting point. France however, is an example of the opposite approach for, having recently renewed its long haul network with coaxial cables, it has concentrated on installing fibre in the local access part of the network. Figure 3 shows the French long haul network for comparison with the UK, Figure 2. On the other hand France began its ambitious local access fibre programme in 1985 to fibre over 20 cities, whereas in the UK only London has a significant amount of fibre. A further difference is that French fibre carries telephony and TV, whereas the UK network carries only telephony. Denmark is an example of a network

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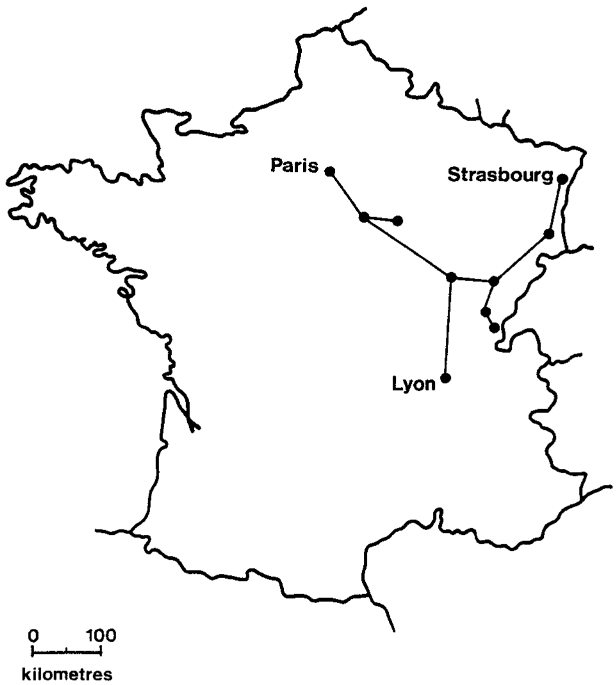
Figure 3 —

FRANCE



carrying TV and telephony that will have fibre for the trunk only but use coaxial cable for the subscriber loop. What makes Denmark remarkable is the scale on which this new network is being deployed. Originally scheduled for completion in 1991, this network will reach all homes in towns of over 250 houses. It is for this reason that Denmark has the highest fibre consumption in the world on a per capita basis.

All 5 of these major European nations are owners of undersea, long haul (trunk), inter-office (junction) and local loop (local access) systems using fibre. All use the digital hierarchy based on the 2 Mbit/s 30 channel module. The other rates in this hierarchy are 8, 34, 140, 280 and 565 Mbit/s. 280 Mbit/s is used only for undersea, while 565 Mbit/s is not an agreed hierarchical rate. Systems at 2.4 Gbit/s are being developed but none of them has yet been installed in Europe, although field trials have taken place.

UNDERSEA SYSTEMS

There are many European undersea optical fibre systems, excluding those connecting Europe and America. The first field trial of an undersea optical fibre system took place in Europe in Scotland in 1980. The first international system was laid in Europe between England and Belgium (UK-Belge 5) in 1986.

Fourteen undersea optical systems with both terminals in Europe will have been installed by the end of this year, while a further 10 will be installed by 1991 (see Table 1). Figure 4 shows the currently planned European undersea network for 1991. The most significant technical trend is the move to the lowest loss window of silica fibre (1550 nm). All unrepeatered systems moved to this wavelength in 1987, while repeatered systems ordered for 1991 will use this wavelength. It is also noticeable that there has been a significant growth in the number of Branching Units being planned; 5 of these will be in use in European waters excluding the 3 associated with TAT-8 and TAT-9.

TABLE 1

EUROPEAN SUBMARINE SYSTEMS

DATE	SYSTEM	DISTANCE (km)	NO OF REPEATERS	NO OF BRANCHING UNITS	WAVELENGTH (nm)
1985	Danish Great Belt	20	0		1300
1985	Optican 1	126	2		
1986	Italy-Sicily	17	0		1300
1986	UK-Belgium 5	113	3		1300
1987	France-Corsica	390	8		1300
1987	Italy-Sardinia	270	5		1300
1987	UK-Isle of Man	91	0		1550
1987	Zealand-Jutland	40	0		1300
1988	Sicily-Sardinia	530	10		1300
1988	UK-Eire	127	0		1550
1988	Scotland-N Ireland	41	0		1550
1988	UK-Channel Islands	132	0		1550
1988	UK-Denmark 4	673	13		1300
1988	UK-Isle of Wight	7	0		
1989	Italy-Sardinia	440	8		1300
1989	Italy-Sardinia	110	0		1550
1989	UK-France 3	143	0		1550
1989	UK-Netherlands 12	170	0		1550
1989	Spain-Majorca (Penbal 3)	∿200	*		
1989	Spain-Canaries (Pencan 4)	1400	20	1	1300
1990	Sicilly-Greece-Turkey-Israel (EMOS1)	2700	*	2	
1991	Majorca-Sicily (MAT-2)	3415	34		1550
1991	UK-France-Portugal (Tagide 2)	∿1200	*	1	
1991	UK-Germany-Denmark	690	6		

* Not yet finalised

It is the view in Europe that systems with a length of 200 km can be planned for commercial use with adequate margins at 140 Mbit/s. Above this length all systems will need undersea housings. Today these contain regenerators, but within a few years a new class of systems will be in use in Europe using travelling wave optical amplifiers at 1550 nm, eliminating the need for regenerators in European waters. These amplifiers have the advantage of being bit rate independent so that systems can be uprated in capacity as traffic grows, so reducing the need for extra undersea systems. The possibility of non-silica fibre (eg fluoride based) is also being explored. This may be a longer term option, and could eliminate all undersea housings in Europe on new routes.

LONG HAUL SYSTEMS

In Europe turn-key contracts were awarded in 1979 for a number of multimode 8 and 34 Mbit/s systems. In 1981 the first operational system in Europe was installed by British Telecom between Brownhills and Walsall. By 1983 single mode systems were being installed, and in UK a policy decision was taken to cease ordering coaxial systems and order only single mode for its trunk network. In 1985 the first 565 Mbit/s system was installed in Europe.

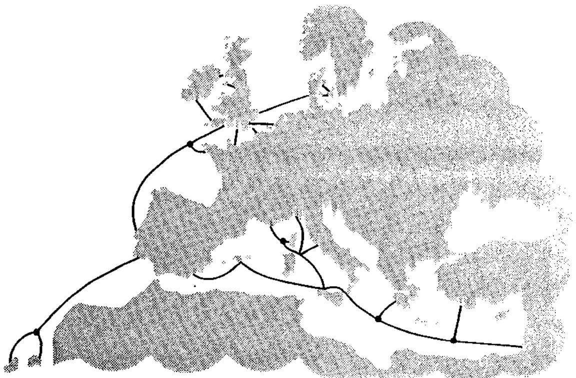


Figure 4 — European Submarine Systems

Most fibre specifications in Europe are designed to ensure both the 1300 nm and 1550 nm windows remain open. Last year 3/4 million km of fibre was bought by European telecomms carriers, about 50% of it single mode. In 1988 it is anticipated that this will increase to 1 million kilometres. Figure 5 shows the cost comparison of coaxial, multimode and monomode systems bought by BT in 1980, 1982 and 1984. The area of the circles is proportionate to cost. This year sees the full interconnection by fibre of all 53 Digital Main Switching Centres in Great Britain.

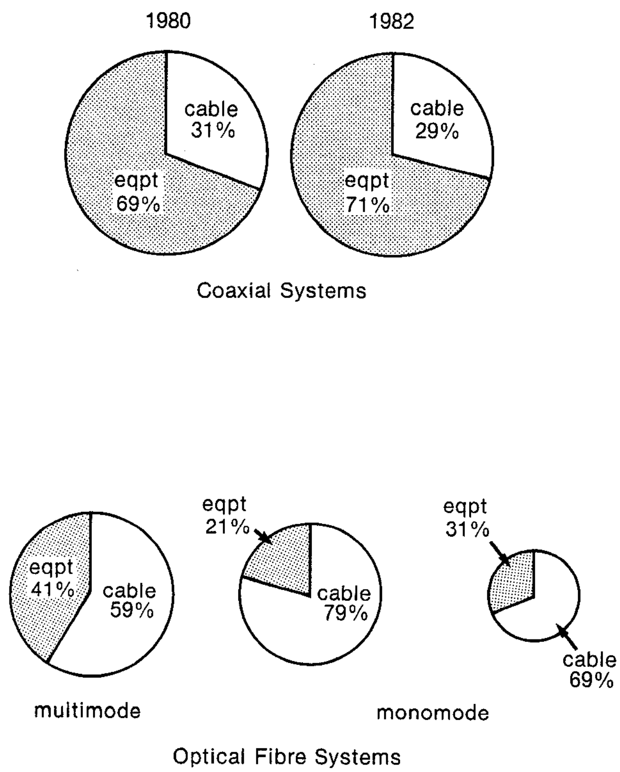


Figure 5 — Line Transmission Cost Trends For 140 Mbit/s Link

SHORT-HAUL SYSTEMS

France, Denmark and Germany are leading Europe in local access fibre systems. France's BIARRITZ experiment in 1984, was the first large-scale installation of fibre with 5000 homes passed. West Germany's BIGFON trial was an early landmark experiment based on 10 separate projects in 7 cities. It was brought into service at the end of 1983 and beginning of 1984. With 320 subscribers this was much smaller than the French experiment. These systems are based heavily on the multimedia transmission concept. This has also been the case in Denmark where the DOCAT system is aimed at providing a nationwide system for the relaying of TV and radio systems and is also used for telecommunications. All settlements with a total number of households of more than 200 will be served by the network.

The major drive in countries where the telephony and CATV networks are not under the control of the same operator is to reduce the costs of local loop optics. Although fibre prices in Europe have fallen dramatically (Figure 6) to today's figure of 15¢ per metre for single mode fibre, the average

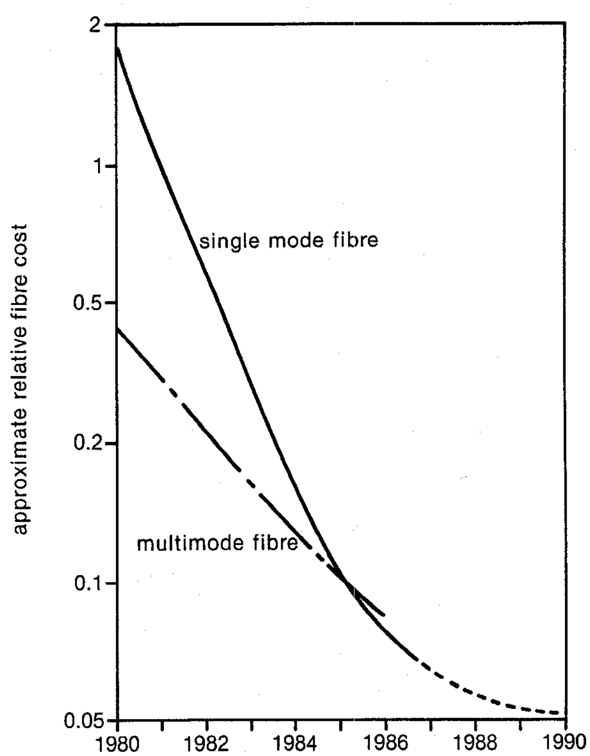


Figure 6 — Trend in Cost of Optical Fibre

local loop length in Europe of only 5 km means that further falls will not significantly impact the price of one fibre per residential customer. This is because the dominant cost is that of the optical transmitter and receiver at each end. Current research is aimed at finding means of sharing the fibre and transmitter costs between customers as far as possible. This will be helped by the development of optical couplers to separate channels in space, and optical wavelength multiplexers which separate channels in frequency. Given that optical architectures will resemble point to multipoint radio systems in some ways, one architecture being proposed uses broadcast out, TDMA back optical local loop systems. At present studies are being conducted to determine to what extent electronics needs to be deployed in the local loop. The advantage of electronics is that it allows remote reconfiguration of the network, and the option for dropping off services to selected customers. On the other hand, the advantages of a completely passive optical network includes reduced maintenance and installation costs, uninhibited expansion of capacity and the option of wavelength routing. This latter passive concept has one option referred to as the optical ether, in which each location has a fixed receive wavelength. Routing is achieved by tuning the wavelength of the sending station to the desired received wavelength.

CONCLUSION

Deployment of optical undersea systems is probably more advanced in Europe than anywhere else for obvious geographical reasons. The long haul network installation program is almost complete in some European countries, yet in other, equally large networks, it has barely begun. It is in the local loop that the most obvious differences between nations emerges - some are proceeding rapidly to hybrid (fibre "tree", coaxial "branch") networks, others aspire to an all fibre network, while yet others, mainly those dependant on telephony revenue only, are seeking optimum cost solutions and are proceeding most slowly and cautiously.

It can be seen that in many ways the development of optical systems throughout the 1990s will track the development of microwave systems in the 1960s: these paths of development will only diverge when optical devices which have no analogue in microwave terms are used in innovative ways in the future.

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