PRESENT STATUS OF FIBER OPTICS TECHNOLOGY AND ITS IMPACT ON THE CATV INDUSTRY

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ABSTPACT

This paper will review the present status of fiber optics technology and its impact on the CATV industry. Major broadband programs in Canada, France, Germany and Japan will be reviewed. Applications such as satellite earth station to headend, electronic news gathering, local area networks, teleconferencing, master antenna systems and local distribution will be reviewed. Major incentives or disincentives to fiber optics applications in each major country will be covered.

INTRODUCTION

Fiber Optics has reached the level of acceptance as a technology whose time has come and now the only questions are of refinement of components and applications. The telephone companies around the world have realized that the economics of fiber optics has been proven. Major parts of the telecommunications networks are now being wired with fiber as evidenced by the Bell System with the Northeast Corridor and Pacific Telephone, the Japanese Nippon Telephone and Telegraph, the British Post Office, the French and German administrations. In some countries, determinations have been made to use fiber optics instead of coaxial cable in future plans for long haul requirements.

Most of the major developments and attention are now in the local plant from the last switching center to the consumer. Although almost every country has either political or legislative problems of providing integrated voice, order, and data directly to the consumer, major experiments are underway to develop the technology, design architectures, and implement field trial to show the economics of providing integrated services directly to the home. This paper will review the experiments presently underway or planned around the world and then assess the important factors in the U.S. environment that will effect the provision of integrated services.

FIBER OPTICS EXPERIMENTS

At the present time, the major fiber optics programs providing fiber directly to home include:

a. Japan - Hi-OVIS and NTT
b. Canada - Eli Manitoba
c. France - Biarritz and Lille and Montpellier
d. U.K. - Milton Keyes
e. Germany - Bigfon, Berlin, Heinrich Hertz institute
f. Denmark
g. U.S.

The following is a short description of each of these systems:

Japan - Highly Interactive Optical Information System (Hi-OVIS)

The Hi-OVIS system is the first and oldest fiber optics experiment system designed to provide services directly to the home. Basic design and preparations were done from 1973 to 1977. Operation started in 1978 and has been in experimental operation since then.

Hi-OVIS was installed in the new town district in the neighborhood of NARA City, NARA prefecture 156 homes were wired with fiber optics and eight other terminals were located in schools, fire stations, and other public institutions.

The Hi-OVIS Program is being managed by the Visual Information System Development Association under the support of the Ministry of International Trade and Industry (MITI). Figure 1 shows the system outline. Table 1 lists the development schedule.

JAPAN - NTT Field Trials

In addition to the Hi-OVIS program, Nippon Telephone and Telegraph (NTT), has been conducting field trials of fiber optics subscriber loops since April of 1980 in Yokosuka near Tokyo. The purpose of the field trials is to examine the feasibility of existing fiber optics subscriber loop technology and to determine problem areas that need to be researched in future developments.

Tables 2 and 3 list the services for fiber optics subscriber loops and classification of fiber optic subscriber loop systems. Figure 2, shows in schematic form the layout of the system.

Canada - Elie Manitoba

Elie Manitoba field trial started in operation in late 1981 and will continue through March 1983. The trial is a rural fiber optics subscriber loop system, the joint venture of the Canadian Department of Communications in cooperation with the Manitoba Telephone System. It provides integrated services to 150 subscribers. The services provided include single party telephone with up to four extensions, and choice of seven stereophonic fm-band radio channel, access to 9 one-way television channels with expansion up to 12 channels, and one full duplex 50 kilobit data channel for additional digital services.

Approximately 110 subscribers will be fed by LED driven circuits using two fibers. Almost 40 subscribers will be fed by laser driven circuits.

The subscribers are served over fiber optic loop circuits which emanate in a star configuration from two distribution centers. The Field Trial Center in Elie and a remote distribution center near St. Eustache. These centers are connected by a nine kilometer unrepeated fiber trunk cable. The longest subscriber loop is 5 kilometers. Figure 3 is a block diagram of the system.

France - Biarritz

In September 1979, the French Government announced plans to wire the city of Biarritz, population 30,000 with fiber optics. In December 1979, four firms were awarded design contracts. In November of 1980, Societe Anonyne de Telecommunications (SAT) was selected as the main contractor for the Biarritz project.

The project has been designed to connect up to 5,000 subscribers. The first step will include 1,500 subscribers. Each subscriber will be provided the following services:

a. two-way videophone
b. two television programs, simultaneously selected out of 15 programs (30 programs later)
c. 12 stereophonic high quality radio channels
d. miscellaneous narrow band data/electronic directory, teletext, etc.

The system outline is shown in figure 4.

In order to provide two way interactive videophone connected to the standard telephone network, a separate broadband switching system is being developed, thus two switching systems are connected to the local network, voice switch and broadband switch. The two switching networks are situated in the central exchange controlled by their respective command units. A third contact unit is in charge of distributed services.

The system will be put into operation in early 1983. The experience gained during the following two years will be used for the development of future systems. In addition, this will be an important step in the development of optical component technologies and also should result in substantial reductions in component prices.

Lille and Montpellier

Experimental optical fiber cable T.V. networks are planned for the cities of Lille and Montpellier, as well as an experimental urban network for the distribution of video communications and computerized information services to 1,000 subscribers.

U.K. - Milton Keynes

British Telecom initiated a trial to 18 homes in the new town of Milton Keynes. After two years of study, the system has been installed to provide CATV services by the end of 1981. Its main purpose is to utilize fiber optics in the local networks. It will employ a new type star network other than the conventional tree structure, and a microprocessor controlled wideband switch to route the required program to the customers.

Each subscriber has two fibers into the home. The aims of the Milton Keynes trial can be summarized as:

--to demonstrate and stimulate interest in wideband services to the customer
--to assess the performance of existing optical communication technology for this application and to identify critical problem areas
--to gain technical and field experience
--to assess customer reaction to the system

Figure 5 is a schematic of the Milton Keynes Trial.

Germany - Bigfon

The Deutsche Bundespost envisages using fiber optics economically in the local exchange area beyond the 1985-86 period. The first step is a prototype system of a broadband integrated optical fiber local network call Bigfon. Seven different demonstrations are planned in the Federal Republic in the 1982-83 time period. These include:

City	Suppliers
Berlin	Krone, SEL, SIEMENS
Hamburg	TEKADE/FGF
Hanover	AEG-Telefunken
Dusselforf	AEG-Telefunken
Nurmberg	TEKADE/FGF
Munich	SIEMENS

The performance requirements have been specified as follows:

--Telephone (64 hbps)
—Data, Text, facsimile (8 or 64 kbps)
--24 VHF Stereo (digital or analogue)
--2-4 T.V. channels (digital or analogue, T.V. multiple access switching system)
--Picturephone (digital or analogue, 5 MHz/ color)

Figure 6 shows the various services being planned and network interconnection contemplated.

Berlin

In 1980, one of the first broadband optical communications systems to go into operation in Europe has been installed in 25 Berlin households. A single fiber delivers any 2 of seven 5 MHz T.V. channels, plus any 2 of 14 FM stereo channels to each subscriber, who can receive all four simultaneously. The network was built by AEG Telefunken for the German Bundespost at a cost of $3 million. The system is analog, and can be used for telephone, T.V. and viewdata and videotext services. System uses star configuration with loops up to 2.5 km without repeaters.

Heinrich Hertz Institute

Over the past several years, an experimental system of an integrated broadband fiber optics communications system has been developed using links of 8Mbps, 34 Mbps, 140 Mbps, 280 Mbps, and 560 Mbps. In addition, a 2.32 Gbps link has been developed. Thirty two T.V. channels have been multiplexed over a single made fiber link.

The experimental system consists of two broadband networks, a fully digital one with a decentralized exchange functions, and time division multiplex transmission. In the digital network, subscribers are connected by fiber optics loops, in the conventional network the subscribers are connected to the central public branch exchange by a star shaped fiber optic subscriber lines.

Denmark

In the spring of 1979, the Jutland Telephone Company decided to install and operate a main distribution system for CATV. The first phase of the system was installed and in operation by the spring of 1980. System distributes seven T.V. channels, six stereo channels, and twelve AM radio stations by digital PCM. The overall system is shown in figure 7.

U.S.

The introduction of fiber optics into CATV has been limited until recently to supertrunk applications and satellite to head end links. In mid 1981, Times fiber introduced the minihub system for distribution of T.V. signals to apartment buildings using fiber optics. These are no comparable experiments in existence or planned comparable to those described previously. (See figures 8, 9).

The telephone companies have seen the importance of this technology and have interested heavily in its application mainly for long haul and between central offices. They are a also developing the technology and experience with fiber optics. The Bell System has developed the SLC™ -96 system, that provides digital service to suburban and rural customers. This system is currently undergoing tests at Bell Laboratories in Chester, New York. This prototype long wavelength systems used light emitting diodes that operate at 1.3 micrometers.

Regulatory and legislative changes, will open up further the local distribution market. There is increased activity in the development of local area networks that will produce further impetus. It is not difficult to see that there will be a very competitive struggle for the local distribution market.

CONCLUSION

It appears that the following may occur:

a. Future local distribution using fiber optics will be provided either by the Telephone Companies or foreign manufacturers.
b. Fiber optics technology for local distribution will not be provided by U.S. Manufacturers.
c. Future CATV systems that can not accommodate the use of fiber optics will be technologically obsolete by the end of the decade.

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	1972	1973	1974	1975	1976	1977	1978	1979 ~ 1982
1. Hardware System Design Trial Production & Development Development & Production Delivery & Construction Adjustment & Test 2. Information Program Production Experiment & Evaluation 3. Selection of Experiment Town								

Table 1

Service Types		Content
End-to-End Service		Telephone Data Facsimile Video phone TV conference
Center-to-End Service	Broadcast	CATV Hi-Fi Stereo Still picture High-definition TV
	Interactive	Video Response System Captain
Leased Line		ITV High-speed data (1.5 ~ 6.3 Mb/s) High-definition ITV

Table 2

System	Service contents	Research items	Expected introduction period
Home-use subscriber system	· TV broadcast service · Telephone · Home facsimile · Video phone · VRS · Captain	· Cost reduction · Network construction · Video software and hardware technology · Market creation	10 ~ 15 years or more
Business-use subscriber system	· Telephone · PBX · High speed data · Still picture · ITV · TV conference · VRS	· Cost reduction · Strategic introduction	5 years or more
On-premises system	· Telephone · Data · PBX · TV conference · ITV	· Cost reduction · Network optimization	3 years or more
CATV distribution system	· TV broadcasting · Interactive TV · High-definition TV	· Cost reduction · Network construction which can lead to general subscriber loops · VHF-TV transmission · Video switching technology	3 ~ 5 years or more

Table 3

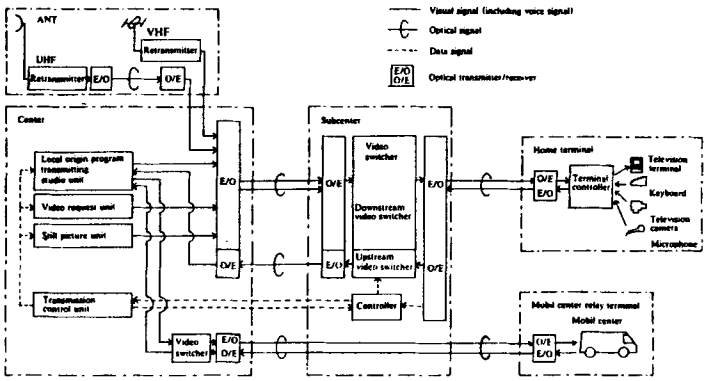

Figure 1

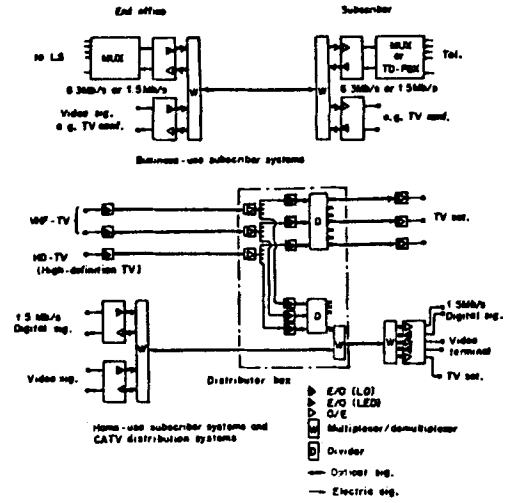

Figure 2

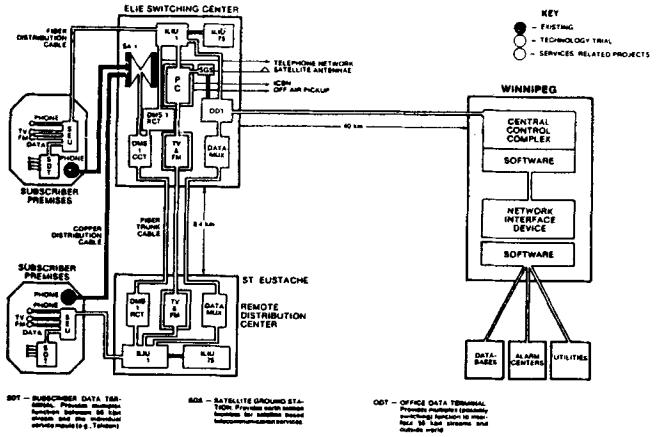

Figure 3

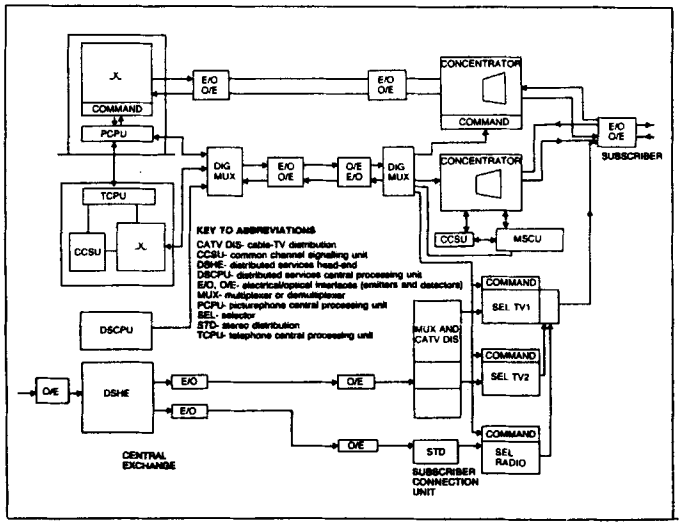

Figure 4

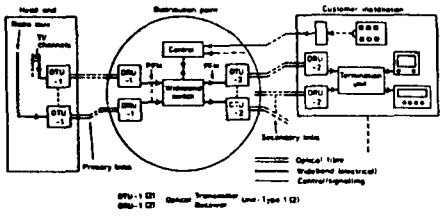

Figure 5

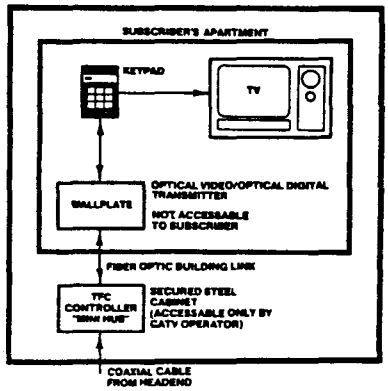

Figure 9

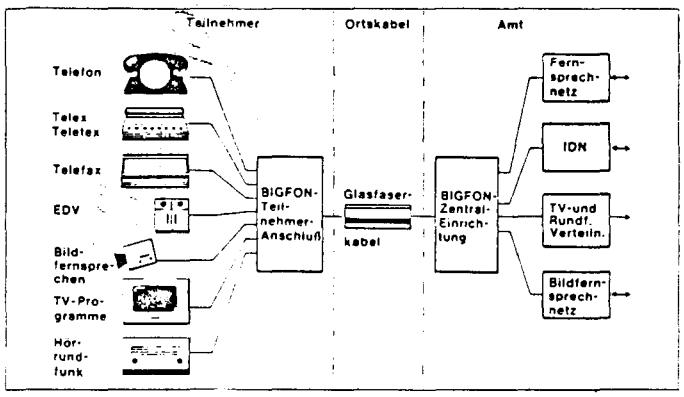

Figure 6

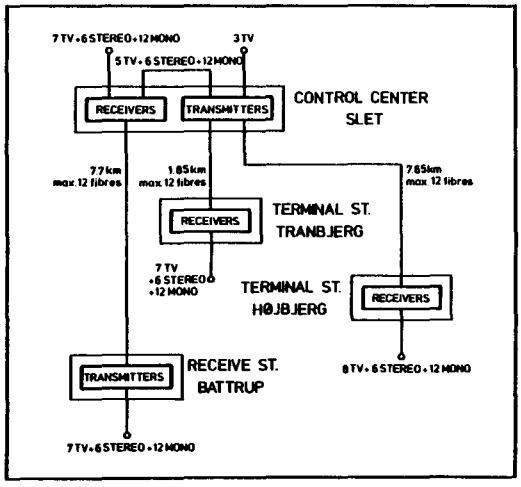

Figure 7

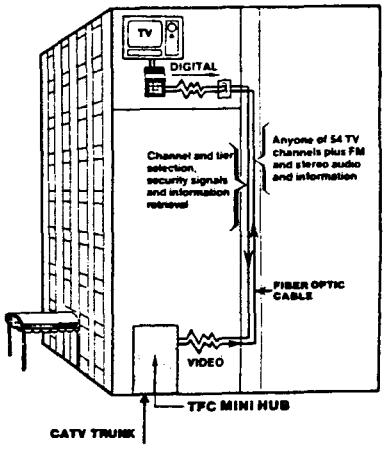

Figure 8