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SECOND WORKSHOP ON

OPTICAL FIBRE COMMUNICATION

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SECOND GENERATION OPTICAL FIBER COMMUNICATIONS SYSTEMS - IMPACT ON OPEN NETWORK ARCHITECTURE

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WORKSHOP AND PANEL

DISCUSSION

"SECOND GENERATION OPTICAL FIBER COMMUNICATIONS SYSTEMS - IMPACT ON OPEN NETWORK ARCHITECTURE"

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BROADBAND DISTRIBUTION NETWORKS

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1. Introduction

The first field trials for the use of optical fibre cables and systems in the public telecommunication network started in the second half of the '70s /1/, opening the way to the commercial use of optical fibres in the junction and trunk network in the early '80s. For these applications optical fibre systems offer, in comparison with coaxial cable systems, a better quality at a consistently lower cost; therefore it is not surprising that optical cables have about completely substituted copper cables in the new telecommunication connections, in a quite natural way and for the same kind of applications.

The use of optical fibres in the distribution network is at present in a much less mature stage. In this area the optical fibres have to compete with the simmetric pair, which is very cheap and easy to install and to maintain. The use of optical fibres can not normally be justified from the economic point of view for providing the telephonic-telematic services, but only for providing new broadband services, in particular video services. Therefore the introduction of optical fibres in the distribution network can not be a natural phenomenon, but it can only be the result of a clearly defined strategy.

In the following some considerations are made concerning the main aspects related to the broadband networks, with particular reference to the situation in Europe.

2. Field trials and first applications

Field trials on broadband distribution networks started in the first half of the '80s in several countries; in particular in Europe /2/ significant field trials were implemented in France (Biarritz), UK (Milton Keynes), Federal Republic of Germany (Bigfon), Switzerland (Marsens) and Italy (Milano Fair).

At present some countries, in particular France and UK, are implementing the first large commercial networks, while several others are planning a large scale introduction in the '90s. Moreover, the Commission of European Communities is starting a cooperative R & D programme, named

RACE (Research and development on Advanced Communication-technologies in Europe), aiming at stimulating the community-wide introduction of "Integrated Broadband Communication" (IBC) /3, 4/. In '85-'86 the definition phase has been completed, and in 1987 the main phase will be started, with a five year programme aiming at the implementation of precompetitive prototype systems.

3. Key issues for the introduction of broadband networks

In order to define the strategies for the introduction of broadband distribution networks, a few key issues must be considered:

- Services
- Technical aspects
- Economic aspects
- Financial aspects

Looking at the services, some bodies, like CCITT, have made a very detailed and precise classification in categories. Here it is enough to consider three big categories: telephonic-telematic services, like the ones offered by the ISDN; broadcast services, like TV channels; interactive services, with different possible degrees of interactivity, up to the bidirectional video communication (videotelephone, videoconference). Another important distinction concerns the type of customers: business customers and residential customers.

The service aspects are very important, as the success in this area is connected to the ability of offering services meeting the expressed or latent needs of the customers, at an acceptable price. However it is very difficult to make a general statement about what services can be successful, as this strongly depends from national situations. For instance, in Europe, where normally very few TV channels are available, it is generally considered that for residential customers it is very interesting to offer some more TV channels, that will constitute a basis to which it will be possible later on to add other services, at a marginal cost; however this situation is not valid in Italy, where most customers have the availability of some tens of TV channels. Moreover it is necessary to take into account legal and regulatory constraints, that can be substantially different in the various countries.

Looking at the technical aspects, it can be said that the development of broadband distribution networks does not present feasibility problems using state-of-the-art technologies, but it requires the coordination of studies in several fields (network architectures, transmission, switching, terminals, optical fibres and cables, optoelectronic components, integrated circuits, and optics), giving always the maximum importance to economic considerations. In particular, three areas can be considered in the distribution network: the service centre and the switching office; the subscriber loop; the customer terminals. In the first area the equipment is used by several customers and its cost is then shared among them; in the last one it is possible to rely on the economies of scale of the consumer

product industry; the maximum effort must then be done in order to reduce the costs in the subscriber loop, possibly also moving them towards the two other areas.

The technical solutions that are being considered in the different countries strongly depend on the time schedule for the introduction of the broadband networks.

Countries having large programs in the short term are generally oriented to the use of mature, easily available technologies (multimode fibres, analog trasmission etc.).

In the long term there is a common trend toward the use of technically-economically optimized solutions. In this perspective, several different organizations have expressed quite a good agreement about some fundamental choices. First, it is in general agreed that, in the long run, a broadband integrated services digital network (B-ISDN) is the rational and economical solution, compared with solutions based on specialized networks. Star or multiple-star topologies are considered the only solutions completely suitable for the whole range of services. A fully digital network is generally considered, based on single-mode fibres. Some other points remain more open, as the bit rates for TV transmission where bit rates between 17 Mbit/s and 140 Mbit/s (or possibly more for high definition TV, HDTV) are considered; use of time division multiplexing (TDM) and wavelength division multiplexing (WDM); role of coherent technologies.

A very important role concerning the technical aspects is played by the international standards; international bodies, like CCITT and, in Europe, CEPT are actively engaged in the discussion of standards for broadband distribution networks.

Looking at the economic aspects, the cost of a subscriber connection in the first field trials was very high; however, some evaluations /5,6,7/ show that the projected costs look affordable and able to ensure profitable opperations in a situation of deep penetration of the broadband network. Several forces work in the direction of the reduction of costs, like use of very large scale integrated circuits and of integrated optics, adoption of suitable system solutions, development of low cost devices, (e.g. sources, couplers), reduction in the installation costs (e.g. use of multiple splices and correctors).

The main factor is however certainly the volume of production, that has already strongly reduced the cost of the fibres and that will act in the same way also on the other system components; e.g. production costs of about 10$ per device are forecast for lasers /5/.

Finally, the financial aspects, that often are not considered in technical meetings, are a very important factor in the introduction of broadband distribution network. From this point of view, the situation is rather different for the two different categories of customers: business customers and residential customers.

In the case of business customers, the number of customers is rather limited and the cost sensitivity is not very high; therefore the

connections can often be implemented when needed, also because in many cases it is necessary to develop ad hoc projects. As a consequence, the amount of investments is normally easily affordable and the return on investments is normally rather quick.

The situation is quite different in the case of residential customers: in this case the number of customers and the cost sensitivity are very high. Therefore it is generally necessary to adopt a tariff policy oriented to "make the market", i.e. adopting low fees since the beginning of the implementation of the network, in order to push the demand and to achieve the volumes of production that will allow a strong cost reduction; moreover in this case it is absolutely necessary to deploy the network in advance, in order to achieve acceptable installation costs. Therefore in the case of residential customers the investments are very large and the returns are rather late; on the other hand, the total amount of the business is much larger than in the case of business customers and it can really open new persectives to operating companies and manufacturers.

4. Strategies for the introduction of broadband networks

Even with good agreement on the long-term goal, the strategies being developed are often substantially different in various countries /8/, depending on the existing situation concerning the telecommunication and broadcasting networks and on political and legal conditions. An important influence is also the time schedule for a widespread introduction of broadband distribution networks. Roughly, it is possible to group these different strategies in two different approaches:

- implementations of cable television networks, based on optical fibres and on a star topology, open to a future evolution towards other services; this kind of approach is followed, for instance, (even if with important differences) by France, UK and in part from Japan.

- B-ISDN evolutionary approach, based on the extension of the ISDN to form a B-ISDN. This approach is studied in CCITT and is adopted in several countries, e.g. Federal Republic of Germany and Italy; in particular in FRG precise time objectives have been planned, with several steps that should lead to the start of the B-ISDN around 1992.

In the short term about all the strategies plan the use of overlay networks, e.g. for videoconference, high speed data etc., in order to meet early market needs, in particular of business customers.

Moreover, in the case of residential customers, it is necessary, as said before, to deploy the network in advance; in order to reduce the finance problems, it is therefore very important to have some early returns, that will in part pay for this deployment. Different approaches are used in various countries in order to obtain these early returns. In some countries (e.g. France, UK), as said before, the cable TV service is considered the way to deploy these networks; in other countries adopting a B-ISDN evolutionary approach (e.g. FRG, Italy) it is considered that the

demand of broadband services already existing in the business segment of the market can help in the deployment of the network; finally in other countries, in particular in the United States, there are plans for an extensive deployment of optical fibres driven by existing services /9/.

5. Conclusions

In conclusion, there is quite a good agreement on the long term goal of establishing a B-ISDN and on several basic technical aspects. Economic evaluations made by several organizations say that, in case of deep penetration, the costs of the broadband network are acceptable and able to ensure profitable operations. It is therefore necessary to develop suitable introduction strategies, mainly concerning the service and finance aspects.

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