FIBER OPTICS MEDIATED TELECONFERENCING

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Fiber optics transmission system can play a key role in the development and implementation of multi-capability local networks. Integrated teleconferencing has been proven to be an effective interactive medium for making day-to-day work decisions and a viable substitute for certain types of business travel. A prototype, intracorporate, fiber optics supported integrated teleconferencing system layout and details are discussed in this paper.

Introduction

Broadband transmission and distribution facilities are finally coming into commercial use as the privacy and security aspects as well as the cost effectiveness of in-house local networks are beginning to be appreciated. The local networks encompass a wide variety of service offerings that include various types of data transmission systems, monitoring and control systems, and video systems. It is expected that the much talked about integrated video teleconferencing capabilities will become a commercial success with the help of the enhanced transmission medium--namely fiber optics. This medium provides a commercial system provider with a flexible, reliable and a high growth capacity facility that not only accommodates traditional operations but adds value by providing new revenue sources. Fiber optics development, which is significantly supported by defense related R & D funds, is viewed from the CATV perspective by organizations such as Times Fiber Communications who bridge the special marketplace of intra business teleconferencing and the new technology. It is the intention of Times Fiber to develop components, methods and practices that are in conformance with the current CATV industry practices so that an orderly transition to the use of a new transmission technology could be effected in a painless way. This presentation is an attempt to look at the development of one commercially attractive service offering that a present CATV operation could offer over a fiber optics trunk. While the plans are for a dedicated teleconferencing link, it is conceivable in the near future for it to be an 'overlaid' service function that adds value to traditional video transmission links.

Integrated Video Teleconferencing

Many studies in the last decade have outlined the advantages of an integrated video teleconferencing service to aid business discussions while reducing the time and travel costs. Integrated teleconferencing refers to the accessibility of data, voice, video, and graphic modes of interaction for the participants of a conference. For large corporations with centralized operations regular use of teleconferencing has been found to be an effective decision making tool. At the middle management working level the integration of various interactive media capabilities such as graphics and data displays would be required to supplement the visual capabilities. The advantages of such systems have been recognized by large carriers such as AT&T and SBS who have definite intentions of offering commercial integrated teleconferencing systems by the early 80's. While the revenue forecasts of such a service linking major cities have been estimated to be in multiples of millions, similar opportunities in an intra-city or community setting have not been widely recognized.

Recognizing the fact CATV systems might be interested in a full capability local network system for servicing the business community, Times Fiber decided to experiment with Integrated Teleconferencing concepts. Obviously ultimate forms teleconferencing service would involve direct business access on a contractual basis, at various points in a CATV network facility connected, if necessary, to long-haul facilities. These facilities would, in addition, carry most of the intra organizational special types of information streams that are generated and are increasingly demanding expensive transmission links.

Teleconferencing Facility Design

Parts of existing building complexes were chosen as the areas to be converted into two teleconferencing rooms. These areas will be aesthetically treated--both in terms of special wall treatments and partition structures--to be non fatiguing environments for meetings. The number of participants will vary depending on the size of the room--but the rooms were designed to accommodate four to six conferees.

The aim of the facility was for it to be totally automatic--namely obviate the need for special assistants to conduct, control or operate the equipment. Once the equipment was turned 'on', only the chairman would have overriding control over an automated voice-cued video system. Broadcast quality color video and high quality spatial-imagery audio system add to the sense of real live participation. Both an overview video scene and select speaker video images are to be transmitted and displayed on monitors. Graphics display capabilities are built-in to be at hand for the participants. A high speed digital facsimile will be located in an adjoining room. Given this combination all hard copy, slide and transparency material can be presented for viewing and comments by the conferees. The objective is to provide quick access within a few seconds, to any type of prepared visual material with sufficient resolution.

The following diagram (Fig. 1) illustrates the system lay out end-to-end. Only one of the two fiber interactive links is shown for the sake of simplicity. Cameras chosen are broadcast quality color cameras that are cued to react in less than 10 ms. to display the image of the speaker. Similarly high quality electret microphones are used for each speaker. While these are the 'lavalier' type, coded FM microphones will also be tried out for ease and convenience of use. The video information as well as the mixed audio information are modulated by an FM carrier through the use of special 8 MHz deviation FM Modulators. These were chosen to provide a 25 dB S/N enhancement that will yield an acceptable level of end-to-end video performance. All these channels of information are multiplexed with the FSK stream from the digital facsimile--essentially added--as they are already appropriately positioned in frequency. The optical transmitter TFC OTL-1101 driven by this multiplexed information stream will be connected to the 11 km length of fiber separating the two facilities. At the other end the optical signal is reconverted by the receiver TFC OR-2111A and after it is demultiplexed is fed through the demodulators. The demodulated signal streams are connected to color video monitors and the high speed facsimile machine. Audio signal recovered is amplified and fed to low-distortion wide dispersion speakers.

A simple sketch of the transmission link (Fig. 2) indicates that the link will be run with two duplex repeaters TFR/A 3000D spaced approximately 3.7 km apart. While only two fibers are required for an interactive conferencing link a six-fiber cable will be installed for experimentation purposes. The cable will be installed in a combination of aerial, direct, buried, and conduit settings. As can be seen in the figure the link loss for each 3.7 km segment is estimated to be about 28 dB. The decision is to use 600 MHz 6 dB/km fiber that is expected to yield an effective bandwidth of about 180 MHz. Considering the different installation methods required to set up the link a fairly rugged cable design that can withstand better than 250 lbs. of installation stress was selected. Special design factors that would prevent thermally induced optical characteristic changes of the fiber were incorporated for longer life span of the cable. Various splices that will have to be made at different points in the cable run will all be done with a fusion splicer. (TFC Model 2030). This fusion splicer can be operated in a portable mode with built-in rechargeable batteries. The splice arc is interlocked and enclosed for field operator safety and typical splice losses have been in the 0.1-0.2 dB range. Special ramping of the fusion arc at the beginning and the end of the heating cycle provides for considerable reduction of thermal stress on the fiber.

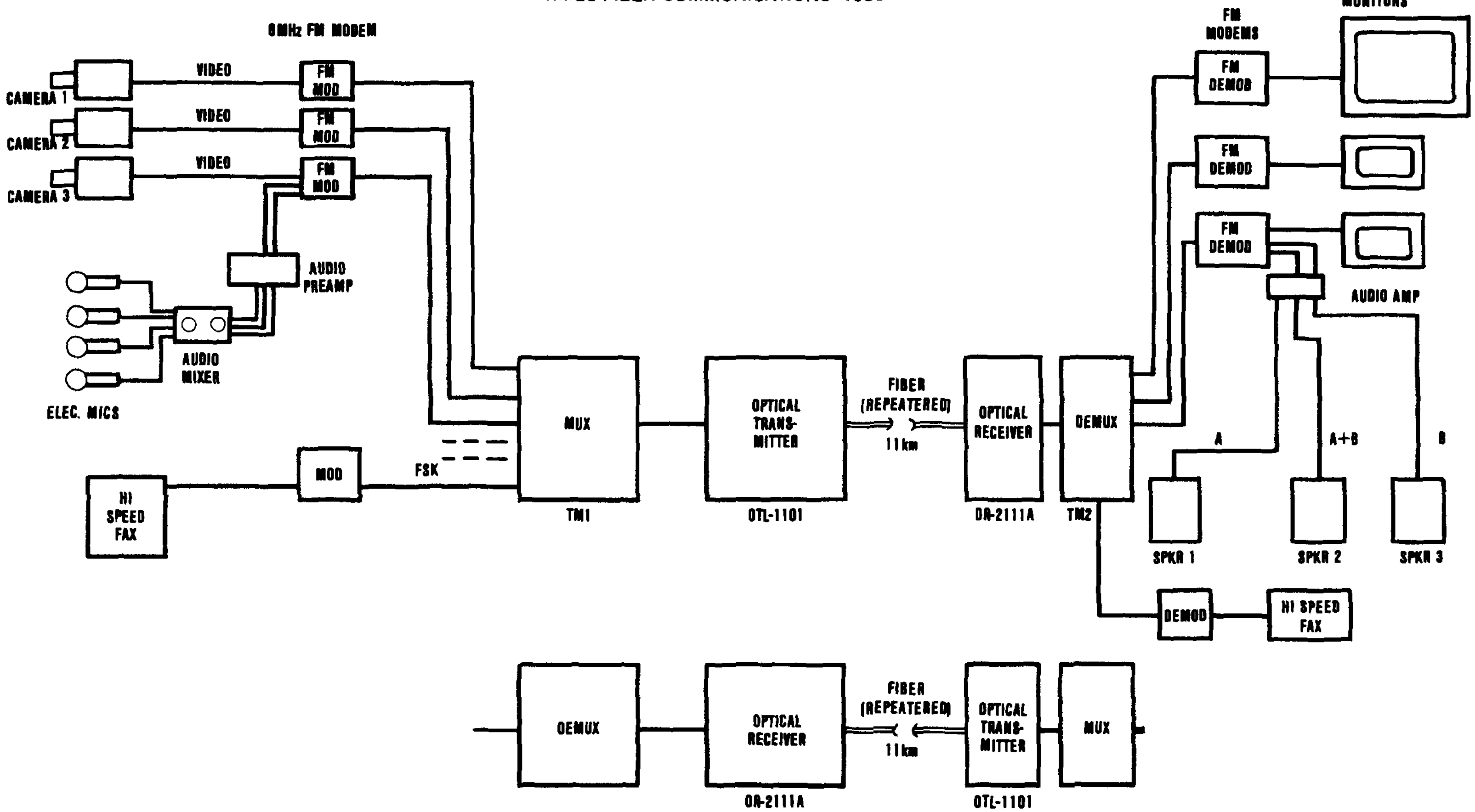
Design performance levels for the teleconferencing system end-to-end are indicated in the table attached (Fig. 3). We expect to achieve better than 50 dB S/N for the video transmission with the use of large deviation low noise FM Modems and reliable fusion splices. Realistic teleconferencing environment can only be achieved by a large dynamic range, low noise audio environment. Availability of program quality channels in the fiber optic transmission medium will help us realize better than 55 dB S/N for the audio link. A transmission medium that is of very high capacity, linearity and reliability still is not enough to make a business teleconference successful if the terminal ends are not designed properly. Some of the key considerations given to the terminal design parameters are listed in the figure. These values represent an environment that is ideally suited for non-face-to-face deliberations that can be carried out over long periods of time. Considerable attempts have been made not to design a broadcast studio environment as this would both intimidate and fatigue the conferees.

Conclusion

We have made an attempt to marry two significant trends in the telecommunications arena, namely teleconferencing and fiber optics. This seems to be a logical evolution as the fiber optics medium provides for a number of significant advantages. Chief among them are the following: 1) Flexibility 2) High capacity 3) Reliability 4) Security and 5) Economic Viability. As long as our energy costs are in an upward spiral, the concept of teleconferencing facilities that can be added on or considered as part of a local private network makes great economic sense. It is not just enough to look at the substitutable savings in such a system, but also necessary to consider the stimulative new application areas that will open up in an organization that decides to install an integrated teleconferencing system.

TELECONFERENCING SYSTEM LAYOUT

TIMES FIBER COMMUNICATIONS 1980



TELECONFERENCING CABLE DETAILS

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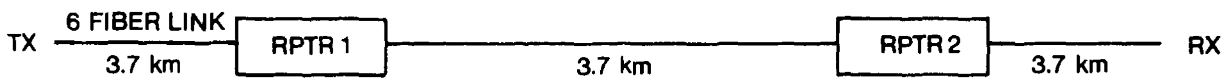
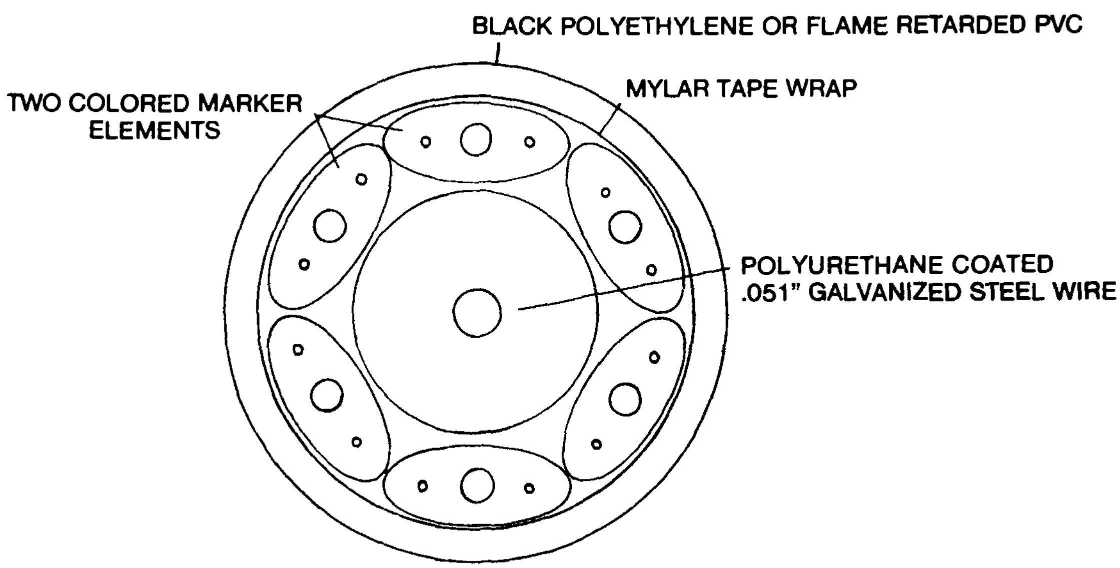


POWER LOSS PER SEGMENT - (CONNECTORS + SPLICES + CABLE) ≅ 28dB
(600MHz/km, 6dB/km FIBER)



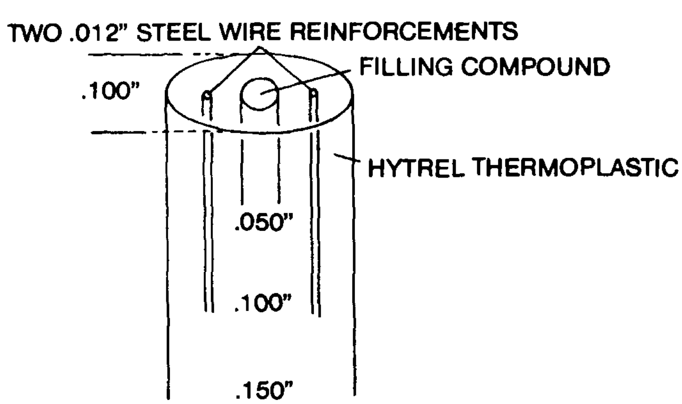


FIG. 3
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EXPECTED PERFORMANCE LEVELS

TRANSMISSION

S/N (WEIGHTED)	≥50dB
DIFF. PHASE (10% to 90% APL)	2°
DIFF. GAIN (10% to 90% APL)	5%
LOW FREQUENCY NOISE	≥55dB
REST CONFORM TO NTC-7 STANDARDS	

CONFERENCING FACILITY

DIMENSION	MINM.: 12' x 20'
ACOUSTICS	≤40dB SPL (A WEIGHTED) ≤0.4 SECONDS REVERBERATION TIME
LIGHTING	≥400 FOOT LAMBERTS ≥40 FOOT CANDLES (MEASURED FROM THE CAMERA ANGLE) BACKLIGHTING TO SEPARATE CONFEREES
GENERAL	TEMP. RANGE (70°F - 75°F) AIR MOVING CAPACITY 7 - 10 TIMES/HR.