

Industrial Two-Way CATV Systems

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ABSTRACT

The technology of two-way CATV transmission has provided a unique solution to the internal communications problems within large scale industrial complexes. At one time the requirements for audio, video, and digital information within a plant were treated on an individual basis. Cable technology combined with minicomputers and inexpensive terminals is beginning to integrate these needs in a single cost effective system in the automotive and chemical industry.

INTRODUCTION

The progress of two-way CATV growth has been slowed due to many inter-related factors. These can best be summarized in terms of the lack of a defined market for the range of potential services which were available. Not only has it been difficult for the cable industry to successfully demonstrate the services, but it also has been equally difficult for subscribers to define the nature of the service that they would purchase. This stalemate may yet be broken under the proper conditions. However, the effort which has been expended in the development of the hardware associated with two-way cable systems has not been misspent. Many industrial or institutional complexes represent a market in which the "subscriber" has clearly drawn communication requirements which can be uniquely fulfilled through cable technology.

Industries which are spread over a significant area have been faced with an ever growing internal communication need. As plants have expanded, the need for acquiring and delivering data on a real-time basis to many locations has outgrown the conventional means of distribution. Similarly, the

audio and video applications have grown in similar proportion. The central problem in all three areas is not the devices used for digital, audio, and video needs, but rather the more mundane issue of the wiring required to interconnect literally hundreds of possible communication points either with each other or to computers. The wiring problem for data usually involved the installation of twisted pairs within conduit. The audio intercom employed a separate twisted pair facility, and the distribution of video is commonly carried on individual base band video cables also in conduit. It is this maze of wiring which prevents the coherent growth of industrial communications.

However, the wide-band coaxial cable represent a consistent and unified approach to the problem, and by its very nature permits an orderly expansion of the communication network without having to rewire a plant each time. In many ways, the industrial plant looks like a small community in which there are hundreds of points effectively tied together through a coaxial cable. Therefore, it may be useful to the CATV industry to briefly review the progress to date in industrial CATV and perhaps conjecture about the role that the cable operator might play in this growing field.

INDUSTRIAL APPLICATIONS

The typical scope of two-way applications can be divided into three broad categories. The first involves the transmission of digital data from the production floor and between computers. Production information is generated by a variety of methods. The most typical is the entry of keyboard data directly by machine operators, inspectors, and foremen. This provides a real-time data base for the types of defects which are encountered and the status of production machinery. Another class of digital data arises from the acquisition of sensor outputs, such as piece count, analog process variables, alarms, badge and card readers, etc. In addition to the retrieval and processing of this information, there is a need to provide operators and management with real-time reports of the significant data. The latter is usually accomplished through CRT displays to minimize the generation of hard-copy reports.

The second category of transmission requirements concerns the distribution of video or conven-

tional TV. This includes not only the ordinary security surveillance, but also the expansion of two-way television for in-plant training, management conferences, random access to micro-fiche material, remote inspection of production line problems, etc. Furthermore, the audio/video conferences are now being considered between distantly located plants as well as within the plant environment itself. There is also a control aspect associated with these TV applications, particularly in the form of remotely controlling the motion of the camera.

The third category of information transmission is the standard audio distribution. The first level of requirement is for the establishment of party-line conversations among production and supervisory personnel outside of the usual telephone circuitry. The audio associated with the TV program is, of course, another application. However, a more encompassing problem is the in-plant telephone network itself. As will be seen, this situation can also be accommodated on the coaxial cable.

Again, the common factor in all of these applications is the extensive wiring requirements, the large number of terminal points, and the extreme bandwidths involved from simple switch contact closures to television. However, this is precisely the transmission problem envisioned in the use of two-way services for community CATV using a broadband coaxial cable. When viewed in this light, it becomes very practical to utilize the low cost modems that were developed for interactive TV services.

INSTALLATIONS

Utilizing the above concepts, Interactive Systems, Inc. (ISI) has installed coaxial cable and the associated modems and computer hardware at the following sites.

A. Oldsmobile - Lansing, Michigan

Approximately 15,000 feet of coax was installed for the operation of a defect monitoring system. Inspectors would key in observed defects in real-time and the computer would provide CRT displays of the most frequently occurring defects. Plans are underway to interconnect another plant by cable which is two miles away and to extend the applications to other data displays and television programming.

B. Chevrolet - Detroit, Michigan

A security surveillance system was installed with 8,000 feet of coaxial cable. In addition to carrying the TV signal, the cable was also utilized to transmit all of the signals for remotely controlling the cameras. The cable was run parallel to the axle production lines, so that future data acquisition systems can be easily added, merely by tapping into the cable and avoiding the need for new wiring.

C. American Motors - Kenosha, Wisconsin

Over 15,000 feet of cable has been installed with 80 terminals again for a real-time

defect monitoring application as well as television for employee programs. Consideration is also being given to extending the cable to neighboring plants to integrate the data acquisition and retrieval and to include machine status monitoring.

D. Dow Chemical - Midland, Michigan

This is probably the largest facility encompassing 40,000 feet of trunk cable over a two square mile area and interconnecting 75 buildings. The initial application involves television programming for in-plant surveillance, training, and then expanding to two-way audio/video conferences. An experimental data acquisition program is currently in progress to transmit in a digital mode, analog process information from scattered buildings to a central computer.

Plans are now being completed to install another cable facility at Corporate headquarters about two miles from the production facility. Although it will have its own head-end facility, there will be one interconnect to the initial installation. Part of the same program includes an experimental microwave facility to interconnect a distant Dow facility with the Midland complex for two-way audio/video conferences.

Several other corporations are also planning to install the ISI Videodata network for even more sophisticated applications involving computer to computer transmission.

GENERAL TECHNOLOGY

A. Cable Configuration

In almost all cases, the solid aluminum sheath cable was used for trunking and feeder lines, with double shielded RG-6 used for the short drops to terminals. Considerable cost reductions were achieved through the elimination of conduit.

Where extensive applications were envisioned within a complex, it was decided to use a single cable (multiple leg) mid-split spectrum in order to provide symmetric transmission potential from any point in the system. Unlike conventional practice, the trunk system is tapped for branches rather than using bridge amplifiers.

B. Data Transmission

The digital network is similar to those previously described in the literature on broadband cable. ISI utilizes a two computer system; one for the general polling of terminals, and the second for the actual application data processing. A generalized modem has been developed which permits a very simple interfacing to a variety of peripheral devices such as:

- a. keyboards
- b. printers
- c. CRT displays
- d. alarm monitors
- e. production controllers
- f. analog-to-digital and digital-to-analog transmission
- g. production sensors

The data rate for these channels has been adjusted for particular customer preferences and varies from 12,000 bits/second to one megabit.

C. Audio/Video Transmission

For straight video transmission, conventional CATV modulators and demodulators are utilized with security achieved through the use of mid-band and super-band channels, computer controlled converters, and scrambling. Separate modems have been developed for party-line audio networks or for control systems which could not effectively utilize digital modems.

The use of the cable network for telephone communication within a plant has recently been developed by Collins Radio. The basic system can accommodate up to zero phones on the equivalent of one TV channel. Further, study is currently underway to integrate this process with the previous audio, video, and digital transmission network. Thus, within the not too distant future, new industrial plants may be completely cabled for their entire communication needs.

ROLE OF CABLE OPERATOR

Although the industrial and institutional area may seem foreign to the cable operator, this may actually afford new opportunities to provide services on a selective basis. There are many advantages to the operator, particularly MSO's, in entering some portion of the market.

- 1) The cable installation and maintenance is similar to his present activity.
- 2) It offers a means of learning the two-way technology in a more controlled environment.
- 3) In some cases, the transmission between plants could involve his own cable network, or the overlaying of a new link which is leased or owned by the customer.
- 4) The market is profitable.

The industrial field will undoubtedly grow more rapidly than CATV under present conditions, and this may be the time for re-evaluation.