

TWO-WAY IS ALIVE AND WELL

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ABSTRACT

This paper deals with certain technical, operational, and economic considerations and features relating to interactive, bi-directional CATV systems developed and installed by TOCOM, Inc. at several locations. Extensive operational field experience has provided TOCOM with a fully-operational two-way system design and production home terminal units that are generating additional, paid services in these systems. Inherent features of the TOCOM system provide faster, more accurate system maintenance techniques and an array of interactive functions, including effective "per-program" pay-TV mechanisms. The services described represent a new market for CATV systems with the TOCOM capability.

Contrary to the impression one might gain from the lack of publicity, discussion, and articles in the CATV industry trade journals, "Two-Way" is alive and well across the country. The term "Two-Way", as used herein, does not denote bidirectional "capability" only, which is theoretically present in many operating systems today, but refers to fully-operational, bidirectional systems utilizing interactive response terminals in the customer's home.

These systems are not "experimental" systems, utilizing limited numbers of esoteric hand-crafted terminal units. These are fully operational, bidirectional, 31-channel CATV systems utilizing production terminal units in the subscriber's home to provide additional, paid services. These systems are not subsidized by the manufacturer, but are systems that were purchased for cash by seasoned businessmen during a period when the CATV industry was in one of the worst recessions in its history.

The reader will probably be surprised to learn that the developer and supplier of these operating two-way systems is not one of the industry giants or a major MSO,

but is TOCOM, Inc., a small, Dallas-based firm formerly known as CAS Manufacturing Company.

TOCOM has sold and installed the headend, central data system, and initial section of cable plant at five locations, to date. Each system is also a fully-compliant, licensed CATV system. Follow-on installation contracts with TOCOM provide for continuing plant construction; system owners may also contract with TOCOM to provide system management, operation, and maintenance personnel and services under a management contract. Home terminal units are also supplied on a continuing basis, as the systems require them.

The author of this paper is the manager of one such operational two-way system, located in The Woodlands, Texas. The Woodlands is a new town development located about 30 miles north of Houston, and will comprise about 50,000 homes when completed.

Woodlands CATV, Inc. is actually the third of five such systems to come on line in the past two years. Two new systems are currently scheduled to become operational during 1976. This paper will deal principally with the Woodlands system, but is representative of the other systems, as well. The intent of this paper is to provide the reader with an insight into some of the daily operation aspects of two-way systems, rather than merely reiterate all the "pie in the sky" features that may some day be available to the users of future two-way systems.

The past difficulties associated with the creation of a demand for cable TV service in the urban and suburban marketplaces should be a familiar subject for those readers responsible for sales and marketing in those marketplaces. Pay-TV represents an additional piggy-back service that is currently responsible for increasing average revenue-per-subscriber and basic penetration percentages in many systems. Pay-TV is only the first step in the right direction, however. The end objective

of those system operators desirous of maximizing return on investment is the addition of as many more piggy-back services as possible, providing revenues increase faster than costs.

Two-way services represent an additional incremental increase in potential revenue per drop that does not detract from existing services, but adds another attraction to the existing package offered by the cable system. A two-way command and control capability is also obviously not unrelated to the problem of hard security for pay-TV.

The current major commodity in the TOCOM II systems is security, an area of opportunity not currently addressed by any other CATV system. Conventional commercial security systems offering central-station monitoring 24 hours a day are generally too expensive for typical residential application. The "residential" security systems are typically too expensive (if they work reliably), or unreliable (if they are affordable). Despite this problem, there is an increasing demand among urban and suburban residents for household security systems; a demand that closely parallels the increasing crime rate. It is this demand that has provided TOCOM the opening wedge in supplying two-way service that the subscriber is ready and willing to pay a monthly premium to obtain.

Household emergencies requiring outside assistance generally fall into three categories: fire, police, and medical. In each case, the speed of response is extremely critical in determining the effectiveness of the response. The typical time lag, from the moment the need for assistance is recognized by the individual to the time the appropriate response agency has sufficient information to react effectively, is three to five minutes...or more. If automatic detection and reporting systems are not utilized, the delay frequently means total loss, with little or no chance for recovery.

To demonstrate to the reader's satisfaction that the 3-5 minutes is not an excessive estimate, visualize the specific, time-consuming steps that would follow discovery of a fire in the reader's home: the first indication would generally be detection of smoke, by sight or smell; assuming the reader was not asleep at the beginning of this exercise, detection might be after the fire is well-started. Second, the reader would try to locate the source and make an on-the-spot determination as to whether it can be handled without assistance. If the decision is negative, the next step is to find the phone, locate the number of the fire department, dial the number,

wait for someone to answer, identify the problem to the answerer, provide name, address, and telephone number, and then wait while the information is relayed to the fire department dispatcher, who selects and dispatches the nearest available unit.

Alternatively, visualize a fire detection system that detects the fire immediately, whether the reader is home and awake or not. The alarm is sounded locally and, at the same time, is printed out at the fire department dispatcher location, together with the reader's name, address, telephone number, and other data which might be pertinent to the responding unit....all within 30 seconds from the time the alarm first sounded.

Without further belaboring the point, it should be obvious that elimination of the requirement for personal action and possible communication delays associated with the telephone system drastically reduces the total time required for an agency to arrive on the scene of an emergency. Operating experience in the various TOCOM systems has demonstrated both demand and acceptance by the subscriber, and a willingness to pay an additional premium for these services.

The balance of this paper will deal principally with a functional description of the TOCOM II system and how various operational aspects of the system impact on daily operations.

The TOCOM II system essentially consists of a Central Data System, bidirectional cable plant, and home terminal units. Each of these major elements are described in more detail below:

a) Central Data System: The CDS comprises a Hardwire Control and Display Console, a minicomputer with bulk memory, a data transmitter, one or more data receivers, several modems, teleprinters, and other peripheral devices.

b) Cable Plant: The cable plant utilizes dual trunk cable with unidirectional amplifiers providing a 5-300 MHz response, and bidirectional distribution cable and line extenders which exhibit a 5-30 MHz response.

c) Home Terminal Unit: The home terminal unit is a flush-mounted device, with all control functions located in a remote-control "palm unit", which is connected by a 25-ft cord to the terminal unit. The home terminal incorporates a preamplifier, a 31-channel converter with AFC, a digital transceiver, and a control logic board.

Each home terminal incorporates unique identification logic which allows the unit to respond to only one "address" in a block

of 1024. The transmitter portion of the integral digital transceiver utilizes one of 60 possible frequencies, thereby providing a potential of 60,000 unique addresses for the system. The limitation is arbitrary, rather than inherent.

The home terminal is modular in construction, which greatly facilitates field maintenance. Functional problems are readily associated with specific modules, which can be easily replaced in a matter of minutes by the field technician or installer. Experienced MTR (mean time to repair) in the Woodlands System, for service calls resulting from malfunction of the home terminal unit, is approximately 15 minutes.

The hardware controller generates sequential interrogations for all terminal units during a six-second cycle, which is transmitted to all units on a common interrogation frequency. Responses are received by one or more receivers in the CDS as time-division multiplexed signals within each frequency "group". The detected signals are fed to the hardware control console logic for decoding and display of the returned data. The hardware controller normally operates under computer control in the "ON-LINE" mode, but is also capable of operating in a free-standing (OFF-LINE) mode without computer assistance.

When operating in the ON-LINE mode, the computer recognizes only those addresses which have been entered by the operator into memory. If an "active" address fails to respond to interrogation, the computer pauses and reinterrogates that address up to 50 times. Each response, if any, is parity checked for valid data; less than 47 out of 50 valid data responses initiates a MONITOR alarm, as does a totally missing response, or a response that appears in an "inactive" address time slot.

Return data words containing MONITOR, FIRE, POLICE, or MEDICAL alarms cause the computer to initiate an output alarm message to a teleprinter in the appropriate location (i.e.: fire station, police station, etc.) which identifies the unit address code, the type of alarm, time of day and date, followed by a block of demographic subscriber data which includes name, street address, telephone number, geographic location, and other selected data pertinent to the specific nature of the alarm.

Each home terminal unit may be addressed with any one of 16 different commands during interrogation, and can select its response from any one of 16 different local inputs. This command/control/response capability affords ample reserve functions for future services. Currently, the basic

system utilizes only two command words and one response word in normal operations. The normal response word contains status of the three alarm circuits, on/off status of the TV set, channel selected, subscriber response data, pay-TV authorization, and data validation information.

The full data block from a single terminal unit may be selected manually for display on the operator console, or the computer can summarize specific data blocks for all units in the system, without individual identification.

Two separate techniques may be alternatively employed for pay-TV operations:

a) Positive Control: In this system, all terminal units will display only a "pre-view" channel when any premium channel is initially selected. Actuation of the pay-TV key on the home terminal palm unit initiates a "request" for that channel to the CDS. If previously authorized, the computer will return a tuning command to the home terminal which causes the converter to tune the appropriate channel for display. Subscriber identification and viewing time is logged by the computer for each requested block of premium viewing time.

b) Passive Control: In this system, actuation of the subscriber's pay-TV key enables the tuning of a premium channel. The combination of pay-TV authorization, TV power "ON", and the selection of a premium channel during premium viewing time is required to initiate the identification and logging process for that subscriber.

With the basic functional description provided above, let us now move on to the method of implementation of these various services in the Woodlands CATV system:

Construction of new cable plant in the Woodlands CATV system is accomplished at a pace dictated by the development of new real estate, currently about two miles of plant per month. All utilities in the Woodlands are underground, and are installed concurrently in advance of release of each parcel to the builders. TOCOM Construction Company, a division of TOCOM, Inc., provides turnkey construction of the CATV, gas, and electrical plant, plus physical installation of the telephone plant at the Woodlands. Major blocks of CATV plant construction at other sites are also supported by TOCOM Construction Company.

Housing construction typically begins within 30 days after completion of plant installation, with total buildout of each parcel currently averaging about 15 months from activation of the plant.

Each residential dwelling unit in The Woodlands is required, by covenant, to be prewired for a minimum service capability. The "minimum package" required for each unit consists of a smoke detector, two tv outlets, two manual medical alarm stations, and two manual police alarm stations. The cost of this prewire package is borne by the builder, and is included in the price of the house. The builder and/or buyer have a further option of adding additional outlets, smoke detectors, heat detectors, alarm stations, and sophisticated intrusion detection systems which are interfaced to the police alarm circuit.

It is interesting to note that over 65% of the homebuyers are currently specifying optional intrusion detection systems.

House drops are installed by the prewire crew on a turnkey basis. Responsibility for repair and maintenance of the prewired system and the house drop is assumed by system operations and maintenance personnel after functional acceptance tests of the installation.

As each new home is occupied, the resident has the option of not subscribing, subscribing to TV service only, or subscribing to the full-service package. All service charges are flat-rate monthly charges that are independent of the number of outlets, or number or type of alarm devices in the home. If the subscriber desires the full-service package, he is required to "purchase" a home terminal unit. Some builders purchase the home terminal units in advance and supply them with the house.

This mechanism, of course, eliminates the major capitalization requirement that has historically been the downfall of proposed two-way systems, and represents a major key to economic viability in this type system.

The basic statistics of the Woodlands CATV system penetration, in the environment described above, may be somewhat surprising:

- a) 97.4% of all occupied homes behind the plant are subscribers to some level of service.
- b) 93.5% of the system subscribers subscribe to the full-service package.

Higher penetration percentages have the net effect of reducing plant maintenance costs, when computed on a "per-subscriber" basis. With the exception of the additional staffing required to cover operation and maintenance of the Central Data System complex and the home terminal units,

plant maintenance requirements, in the aggregate, are no greater than that required in any properly-maintained, fully compliant system.

Downstream electronics, which consist of TOCOM "Blue Chip" series amplifiers, are completely conventional in operation and maintenance. Upstream electronics require periodic adjustment of squelch thresholds until the home terminal population on each feeder leg stabilize; thereafter, the maintenance interval required is the same as for the downstream electronics.

Maintenance of the home terminal units requires principally digital logic skills. Competent RF maintenance technicians can be cross-trained readily to handle repairs of the RF circuitry and components of the home terminal unit, as well as field replacement and calibration of functional modules within the unit. Although the theoretical MTBF (mean time between failures) has not been officially calculated for current production terminal units, the actual, experienced MTBF of the units installed in the Woodlands CATV system is currently (at this writing) in excess of 10,000 hours...and improving.

The two-way nature of the operating system provides a maintenance bonus: performance of any portion of the system can be observed by analysis of the data returns from that section of plant. The console operator can select a single terminal unit for examination, in the OFF-LINE MANUAL mode of operation, which results in continuous interrogation of that unit. The RF signal, when examined with a spectrum analyzer, provides an indication of the performance of the section of cable plant through which that signal passes. Level measurements from several adjacent locations quickly provide an indication of any degradation that may have occurred since the last examination of that section, well before problems become evident in the subscriber's pictures.

In the event of failure of an amplifier or power supply, or physical damage to the cable plant, an immediate alarm message generation for units downstream of the affected point permit immediate pinpointing of trouble spots. No more 5:15 PM service calls to correct a 10 AM problem!

In normal operation, the home terminals, central data system, and cable plant have sufficient dynamic range to accommodate cumulative perturbations of interrogation and return signal levels. It is immediately apparent to an experienced operator at the CDS when a section of the system displays a trend away from

normal operational levels.

On a personal level, the system personnel are more closely involved with the quality of their workmanship than the author has ever observed in conventional systems. Although the complexity of the system, in overall terms, is at least an order of magnitude greater than a conventional one-way system, the incidence of service calls does not appear to be significantly higher than in a one-way system of equivalent size.

At the initial briefing of fire, police, and medical personnel last year on the operational capabilities of the system, there was some quiet skepticism evident about the effectiveness of the system. These agencies have all completely accepted the system, to the point where standard operating procedures for all three services are specifically written around the operation and capability of the system.

Subscriber response to the services offered can only be described as overwhelmingly affirmative. In the words of one subscriber, "...the system is worth its weight in gold!". The subscriber, Mrs. Terry Merritt, made this statement to the Fire Chief after having a fire extinguished in an attic-mounted gas furnace....less than five minutes after the alarm sounded in the Merritt residence. The family was unable to even locate the fire until less than a minute before the Fire Department arrived on the scene, and the fire was extinguished without any damage to the roof, attic, or ceiling of the house.

Although a year of operation at the Woodlands is perhaps not statistically valid, there has not yet been a burglary loss involving a home with an intrusion detection system, or a major loss due to smoke or fire damage. Numerous incidents have been recorded at the Woodlands and in other systems of major losses that have been averted and lives saved that would not have been possible without the TOCOM II system.

The effectiveness of the protection afforded by the Woodlands CATV system has been recognized by some insurance companies, who are now offering substantial discounts on homeowner insurance premiums to full-service subscribers of the system. The total amount of the discount on an average policy reduces the mortgage payments by more than the monthly service charge for the additional service.

In summary, it is evident that a system service that requires a substantial outlay of cash for a home terminal unit, plus an additional monthly service charge for the service must have something to offer to achieve a net penetration of 91% of all homes behind the plant.

Readers interested in learning more about TOCOM II systems or in seeing a two-way system in actual operation are invited to contact the author at The Woodlands system or just drop in anytime they are in the Houston area. For those readers in other parts of the country, contact TOCOM, Inc. in Dallas, Texas for the location of the system nearest you.