USE OF LOW-FREQUENCY BI-DIRECTIONAL, DIGITAL TRANSMISSION ON CABLE

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Six years ago a major representative of one of the leading manufacturing companies said these words, "Cable Television of the future will include two-way, answer-back, communications for subscribers who desire it. Shopping, banking, opinion polls--and many other services--will be made available. But these things are tomorrow." -- Gentlemen, welcome to tomorrow!

The cable television industry has long been faced with the dilemma of meeting the social demands placed upon it by it's purported technological capabilities and the real problems of generating adequate income to support these humanitarian goals. Through the use of the Bi-Di-Comm system, we will describe how ICC has analyzed the goals and placed them within the realistic achievements of the cable television industry. We will also demonstrate where and how the additional revenue can be generated to not only make the cable television industry once again the profitable gold mine at the end of the rainbow, but also a valuable asset to the community which it services.

Introduction

Bi-Di-Comm represents a novel application of an old and existing technology, interfaced to the state-of-the-art RF world. The result of this is to accomplish many of the tasks previously referred to as the blue-sky of cable television.

The Bi-Di-Comm system is a bi-directional, digital data communications network generated from an intelligent home terminal unit and transmitted to a central computer location. The method of the transmission of digital information is through the use of pulse-code modulation at the 3 to 300 KHZ range. The use of low-frequency transmission is neither new nor novel when applied to the general communications media. Until recently, however, it has not been considered an acceptable method of transmission by the cable television industry.

When faced with the challenge to supply all the blue-sky, state-of-the-art capabilities, the CATV industry turned its' engineers loose on the 5 to 35 MHZ frequency band. (Unfortunately, this frequency band is not devoid of other transmitters and static generators. Among these generators is included the world's worst -- the citizen's band radio.)

From an engineering standpoint, a typical two-way RF system can be made to function very nicely in a laboratory; however, once subjected to the real-world atmosphere, it becomes a monster waiting to devour the unwary operator's potential profits along with a large portion of his operational capital.

It was for this reason that ICC looked towards an alternate method of transmission. We identified, prior to design, some of the real-world applications which might be used to generate additional revenue for the cable operator.

An examination of the potential markets indicated that there were three areas in which a cable operator could make very effective use of this technology to generate a substantial rate-of-return. They are:

1. Pay television on a pay-per-view basis with remotely programmable control of hardware in the home.
2. Police, fire and medical security surveillance.
3. Energy conservation and load management.

Before delving into the financial impact and applications of these three areas, I would like to discuss briefly the operational and technical considerations that made the Bi-Di-Comm

system unique in its' application. The basic system consists of a central polling computer which may be divided into four parts:

1. Microprocessor for management of data processing.
2. Bulk information storage capacity of the central processor which normally uses a disc for rapid access to data files.
3. Dispatcher computer interface, whether it be video display screen, a hard-copy teleprinter, or both.
4. Computer I/O terminal board which is used to decode incoming data and also code the out-going data to be accepted by the subscriber home terminal unit.

Once the data leaves the central computer terminal, it is transmitted through the coaxial cable system; and, at special data reconstruction terminals located at key points along the CATV system, it is regenerated. Typically, such a data regenerator would be located at approximately every fourth CATV line amplifier.

Part I: Bi-Di-Comm Data Format -

Reference Figure 1

Upon entering the home, the signal is passed through an individual home terminal unit capable of data reconstruction prior to processing. The home terminal unit first identifies its' own unique address then receives the computer data word associated to that address. Upon completion of the receiver cycle, the transmitter portion of the home terminal unit responds back to the central computer with its' own set of data information.

Part II: Bi-Di-Comm Home Terminal Block Diagram -

Reference Figure 2

In order to more fully understand the various applications of a system of this nature, it is important first to understand the functional block diagram of the nome terminal unit.

The home terminal unit consists of a duplex filter with its' high output fed into the input decoder network. This has as its' nucleus a phase-lock-loop that tracks the central transmitter frequency. When a start bit is received, it is analyzed by the start bit detector. This in turn enables the control logic to begin check-out of the transmitted address. The incoming address is compared with the units internal wired address. If, during the address transmission sequence, the two addresses do not compare, the control logic will be reset. Should all address bits be identified, the following transmitted computer data word will be stored in the receiving data storage register where it is used in controlling peripheral equipment.

Upon completion of the receiver cycle, the control logic enables the transmit portion of the home terminal unit to be activated. The transmitter frequency F 2 is derived from the control logic which is in turn derived from the master input clock located in the input decoder. This output frequency is modulated at a data rate. Data consists of the line-sync and start bit information, the data mode identification, the address code of the particular unit, and the data which has been entered into the transmitter data storage register. If the data has been received from the alarm mode of operation, it will override any serial data which might have been received from the remote control unit. In the normal mode of operation, the remote control unit, which is hard-wired to the main modem box, consists of a keyboard interfaced to a microprocessor which drives a two-digit, seven-segment read-out. Data from this microprocessor is stored in a data storage register in the remote unit until such time as either the "C"-channel or the "R"-response key is depressed. This indicates that the user wishes to transmit one or the other back to the central computer.

The control logic from the main modem unit assures that the data are transmitted from the remote unit to the transmitter data storage module at the proper time sequence.

Significant features of this system are:

1. It is a self-reporting system, meaning that every time the computer interrogates an address, it must receive a valid response from that address whether the unit desires any action be taken.

2. It is a synchronous type system with both the line drivers and the home modem units tracking the frequency of the central transmitter at all times. This greatly reduces the complexity of the system and makes much more cost-effective use of all the internal logic.
3. Noise immunity is greatly enhanced by using a data rate which is less than one-fourth of the carrier frequency. This allows each data pulse to be sampled at the center rather than trying to compare an entire data pulse.
4. Through the use of the phase-lock-loop and the decoder network, the entire transmitted data stream is reconstructed prior to data processing.

Applications and Their Economic Impact

Now that we have had an opportunity to review the technological operations and flexibility of this system, I would like to discuss the applications as we see them in today's market place.

Part I: Energy Management

In our present day and age, it has become increasingly apparent to all concerned that the world is rapidly reaching its' functional limits in the area of available energy resources. As this energy commodity becomes less available, the basic economic system demands a higher cost. This increased scarcity and higher cost warrants the use of some means of improved energy management.

The average power used by the consumer in today's market is not of principal concern. What is of principal importance is controlling the peak energy demand. To this end, many agencies are seriously considering some method of time-of-day rate structure; and, there are several power companies presently reviewing methods of load control.

The bi-directional use of the Bi-Di-Comm system would readily facilitate the interface of a solid state meter. This could easily allow a utility company to do continous monitoring of a community and generate definite guidelines as to their rate structures.

In addition to this, along with rate structure information, the data can also give the power company the necessary information to make more efficient use of available energy.

Also aimed at the same goal of reducing the peak load required by any community, is the system's ability to implement a deferred-useage plan whereby such things as water heaters, air conditioners and space heaters could be interrupted for short periods of time with a minimum of inconvenience to the user and a maximum efficiency to the power company. The most logical means of accomplishing these functions would be over a coaxial wired system since it could be operated at a high frequency that is still well below video frequencies.

Further applications of energy load control using a bi-directional communications network would be in the commercial market, where monthly billing is based on peak load rather than average power consumption. In this case, a computer program would be utilized to direct the termianl controller units as to which items could be cycled on or off to stay within the energy guidelines of the industrial complex.

An example would be an organization with multiple machinery which might be cycled on at the same time. The computer could take over and insure that these units would be started on a sequencial cycle, thus reducing the peak load.

Power consumption information could be continuously fed to the central computer. As the power consumption increased, the computer would have in its' files a list of priority titles to indicate which service could be terminated for short durations to retain the most efficient level of energy consumption. The net result would be reduced energy bills to the commercial user and also reduced peak load capacity from the supplying power company.

An economic example of the applications of this system would be in the use of a commercial hotel complex, where, through a simple data entry at the front desk, the clerk could turn off the AC power to any room in the complex as the guests checked out. A short time prior to the new guests' arrival, the clerk could turn the power back on allowing the room to air out beforehand.

In one actual application, a hotel's monthly energy bill was $330,000. Through the application of this system it was determined that the user could save a minimum of $33,000 a month in energy bills. The approximate cost of installation for this system would be $125,000. Thus recouping the investment after only a few months.

Part II: Security and Public Safety

Through the use of this system, we have the ability to transmit priority data from a home terminal unit to a central dispatcher to help a subscriber in distress.

In a typical operating security system, these sources would be assigned to monitor such things as the power status of the home terminal unit. These could include: smoke detectors, heat sensors, exterior detectors, interior detectors and three separately identifiable panic situations.

Subscriber Information File -

Reference Figure 3A

The subscriber would fill out a data information sheet at the time of installation. This is fed into the computer and then assigned a computer entry code. This code would correspond to the computer address of the subscriber's home terminal unit at the residence.

Subscriber Data Sheet
Figure 3A

Computer Address
Address Phone
Name Age Blood Type Sex
Name Age Blood Type Sex
Name Age Blood Type Sex
Name Age Blood Type Sex
In Case of Emergency Notify:
Name Phone
Doctor Phone Hospital

Special Instructions:

Typical Alarm Read-Outs -

Reference Figure 3B

Should any alarm sensor be triggered it would automatically override any other data presently being passed through the home terminal unit and would indicate an alarm message to the central station dispatcher, via both video display and hard-copy print-out. Such a display would indicate the name, address, phone number and any pertinent information pertaining to that type of alarm. The implementation of this system can be extremely complex or as simple as the operator desires.

If a medical alert were to be generated from a home, for example, it could be patched automatically to the local hospital. The hospital computer then could display the complete file history and the hospital would be prepared to receive the patient upon arrival. The same could be true in patching both security and fire alerts to the proper agencies.

Typcial Alarm Read-Outs
Figure 3B

```
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
X                               X
X        Medical Alert          X
X                               X
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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Name
Address

Notification

Name
Phone

Physician/Hospital
Doctor Phone
Hospital Phone
Special Instructions:

```
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
X                               X
X          Fire Alert           X
X Notify Residence/Local Station X
X                               X
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Name
Address
Phone
Special Instructions:

```
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
X                               X
X         Security Alert        X
X Varify and Notify Local Station X
X                               X
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Name
Address
Phone
Special Instructions:

In the polling method utilized by the Bi-Di-Comm system, each home terminal unit is interrogated in sequence and must respond and indicate the status of that home terminal unit. In the event of an alarm, the central computer will automatically varify the alarm through consecutive interrogations - each interrogation taking approximately 2.4 milli-seconds. Through the use of the receiver data lines, any sensor, such as a smoke

detector, may be reset and retested through the central computer without human intervention. This further reduces the false alarm rate.

There are two alarm functions that could be generated because of interrogation. The first would be a "no-response" alarm which indicates that the home terminal unit has completely failed to respond. The second would be an "incorrect address response" which would indicate that the home terminal unit has attempted to respond but that it's address does not match the one transmitted by the central station. Both of these methods of detection are designed to prevent the possibility of an undetected electronic or mechanical failure in the system or to show up any attempt to subvert the system in its' normal operation.

From an economical standpoint, it has been projected that a typical two-bedroom condominium could be completely wired for security for less than $300. A monthly service rate for monitoring police, fire and medical alerts from such an installation might be in the $15 to $30 range.

There is also a growing market in the public health and safety fields with new legislation being passed daily for high-rise buildings and private residences requiring installation of fire and public safety monitoring systems.

I would like to point out that the cable operator has a unique opportunity to step into the lucrative security field. The justification of this security market lies in the fact that there are 2.6 million burglaries reported annually. This translates into one burglary every eleven seconds! The security market was a five billion dollar annual industry in 1974, and has grown to a seven billion dollar industry today. By 1980, it is projected to be an industry of thirty billion dollars.

Part III: Subscriber Response Capabilities

Through the implementation of a remote terminal device interfaced to the Bi-Di-Comm home terminal unit, a subscriber can generate a two-digit numerical response on a pseudo-random-basis and, through this method, respond to a situation presented on a television channel. The cable television industry can offer the possibilities for pre-school, high school and Educare programs for senior citizens.

The use of the Bi-Di-Comm system capability in the area of subscriber and instructor interaction lends itself to solving many of the educational concerns of home teaching. No longer would the subscriber be tied to the traditional 6 a.m. to 11 p.m. instructional television. Programs could be offered at the viewers' convenience. Students who have been assigned to double sessions at their regular school could utilize a system of this type to derive additional educational benefits and homework assistance.

At the present time, many shut-in students are denied educational opportunties that their healthy counterparts enjoy. Through this system, complete classes can be taught with examinations being taken by the home student. This would allow the instructor to immediately evaulate the level of comprehension of the students.

Through the use of indicator lights on the remote terminal keyboard, the student can immediately tell whether or not his response to the questions asked were correct. The applications of this system become readily apparent when one views the utter chaos in the school systems of the Eastern United States due to poor weather conditions. If a system like this would be implemented, the closing of classrooms would not have such damaging consequences as they presently have.

Other remote response capabilities of this system could be utilized in conjunction with our local political system. An example is a city council meeting where citizens are asked their opinions on matters of issue. Here, several options are presented and the residents are invited to respond with their desired opinion. This means true democracy for the people when they can be heard - here - at the grass roots level.

From an economical standpoint, the cable operator should be interested in educational applications of the cable television system because the typical school system looses seven hundred dollars for each student who drops out. They must then send an instructor out to give home lessons to the student if they wish to retain their federal and state subsidies. Through the use of this system and its' ability to do roll call, testing and complete educational functions, the school system can make much more economical use of their teaching resources. The cable operator would have a desirable and saleable product to school systems in addition to offering an invaluable service to the entire community.

Cable television relies heavily upon its' public relations appeal and its' application of ancillary services to generate new subscribers. In the

past, this has always been an area of negative cash flow. Through the use of the Bi-Di-Comm system, the cable industry is offered the ability to supply a multitude of services previously referred to as the blue-sky applications to its' subscribers and, above all, generate a reasonable profit.

Part IV: Premium Television

Traditionally, pay television has been handled through the use of either a specially allocated, although not normally available, channel or by installation of a specially prepared descrambler box placed in the home of the individual wishing to view the pay television program. Some of the disadvantages of a system of this type are that whenever the subscriber desires pay television service, a piece of physical hardware must be installed and when they wish to discontinue this service, that piece of hardware must be removed. Another disadvantage is the fact that the user must subscribe for a minimum period of time and must accept any and all programming that is available during that period of time whether they find it pleasing or not.

The Bi-Di-Comm system incorporates the remote terminal keyboard as a converter control. When a subscriber desires to change channels, the central computer is automatically notified and can implement individual pay television programs.

An example would be if a particular channel were allocated as a pay-television channel, and a resident selected that channel for viewing, the computer would receive notification when the channel was tuned in and could allow the resident to preview that channel for an arbitrary period of time. At the end of that time, the computer would reinsert the scrambling. The viewer would then have the option of recalling the channel or of turning on a non-pay channel. Should the viewer choose to recall the program, the computer would take care of any billing and allow the viewer to continue watching.

The principal advantage of the Bi-Di-Comm system is to allow for a true pay-per-view type system where total control of what the subscriber desires to see and pay for is in their hands. The entire system relies on software computerized control as opposed to hardware implementation. A multitude of such channels might be activated without changing the existing hardware in the user's home.

In addition to the pay television capabilities of controlled channel selection, the cable operator is immediately presented with a totally new capacity of supplying secure channels for special interest groups, such as doctors, teachers, lawyers, etc., whereby only certain home terminal units would be authorized the use of certain channels during specific times of the day. Once again, total control is by the software programming as opposed to any hardware installation.

Because of the data recording system, the cable operator can generate revenue from their ability to supply broadcast stations and advertising agencies with statistical data as to the number of people watching any program or commercial at any given time. This data can be derived from the computer since any individual using it to change channels is automatically recorded by the central computer. Through special programming, this data may be accessed by the cable operator.

Also inherent in the system capacity is the ability to do automated billing and credit reference checking by the computer on each subscriber who uses a premium program.

A typical example would be a client who indicated at the installation of the system that they did not wish to exceed a given amount of premium program or ancillary service charges during a thirty-day period. The computer would take care of billing each time service was required by the subscriber. If the subscriber approached his credit limit, the computer would notify the central dispatcher who in turn could notify the user and ask if he desired an extension on his credit limit.

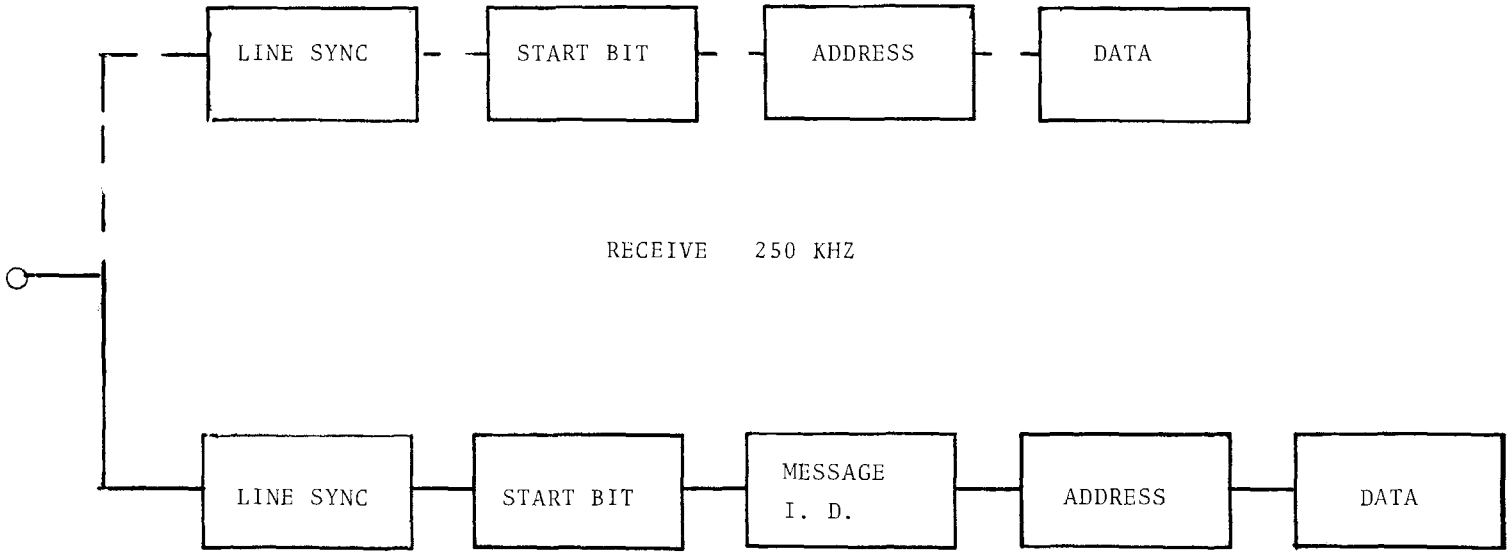
Summary

I would like to reemphasize that th Bi-Di-Comm system allows the cable operator the advantages of two-way data communications over an existing cable television plant with a minimal amount of changes or additions.

Now that you have had the opportunity to review the Bi-Di-Comm system with me and analyze both the technological and financial advantages it offers, I am sure that you will agree that the blue-sky promises of the cable television industry are here today.

BI-DI-COMM DATA FORMAT

Figure 1



BI-DI-COMM HOME TERMINAL BLOCK DIAGRAM

Figure 2