Network World

February 2, 1987

SECTION: FEATURE FOCUS; Special Section: Bypass; Pg. 1

LENGTH: 1711 words

HEADLINE: Conjuring up data over CATV

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HIGHLIGHT:
The wizardry of bypass works wonders over broadband.

BODY:

Can the same cable system that brings that costly brew of Home Box Office, Music Television and other entertainment to your television set also bring data to your office workstation? The answer is yes, and it is probably easier than you think.

Broadband cable communications technology has been around since 1949. Its most popular application is in community antenna television. But CATV is not widely used as a data communications bypass medium, mainly because most users are unaware that use of CATV systems rather than conventional bypass methods can save them a considerable amount of money.

Despite continually increasing user demand for data communications alternatives, most CATV franchises have been too engrossed in broadcasting television signals to become interested in the networking market. Thus, it is up to communications managers to investigate broadband and determine whether it is appropriate for their applications.

Not just a one-way street

Perhaps the most common misconception about CATV is that it can't be used for data communications because it is most commonly used for one-way transmission. In fact, cable systems are capable of two lanes of traffic, and the second lane already exists.

This misconception stems from the way most CATV systems were originally installed (see Figure 1). Video signals originated at the head-end transmitter and traveled down through the cable network to the subscribers' sets below.

These signals are termed "outbound" signals, whose sets are referred to as being "downstream." Amplifiers are required periodically to boost signal strength over long distances. However, amplifiers perform other functions, and that is what causes the misconception.

Just as ripples in a pond can be reflected back to their source, so can the CATV signal. If allowed to pass back through the system, the amplified signals will interfere with picture quality. To prevent this, line amplifiers also act as filters and block reflected signals to keep them from traveling back upstream. Therefore, any signal sent from one terminal to another would be an inbound, or upstream, signal and would be blocked by the amplifiers. Another lane is needed to carry signals that are independent of the existing downstream traffic.

A basic cable system provides 55 channels, each six MHz wide, but for various reasons, many channels are not used. One reason is that the Federal Communications Commission prohibits the use of any frequency that corresponds to aircraft navigation frequencies. Other channels are not used because the FCC set them aside for upstream traffic flow in an attempt to standardize channel pairs for modem makers. And it is here that the other lane is found.

Using subband

Occupying the low end of the frequency spectrum is the subband. Within it are eight channels that have been reserved for upstream traffic. Known as T-7 through T-14, they are available for data traffic. To use the subband channels, two things must be done.

The first is to modify the amplifiers to allow the subband frequencies to pass upstream. Because this is a common procedure, most amplifiers are designed to accept a plug-in module that can split the CATV band into the upstream and downstream lanes.

The second is to install a device known as a frequency translator at the head end. The sole purpose of this piece of equipment is to convert inbound frequencies.

The resulting change involves transmitting on channel T-7 and receiving on an unused outbound, or downstream, channel (see Figure 2). When the terminal operator hits the enter key, the terminal transmits on channel T-7.

The amplifiers have been conditioned to allow the subband frequencies to pass upstream to the head-end transmitter. The inbound T-7 signal is then converted by the translator to an outbound signal to be received by the computer downstream. The return message from the computer would follow the same procedure: The transmitted T-7 signal would travel upstream to the translator, be converted to an outbound signal and be received by the terminal. Because a frequency translator is needed to convert the inbound frequency to an outbound frequency, this system of broadband communications is known as a "translated" system.

The cost involved to make this lane available is about $1,500 for the frequency translator and $200 per amplifier for the plug-in modules. The total cost would depend on how many terminals or nodes are in the network and how close they are to each other. Only those amplifiers leading to communications devices need to be converted. The remainder of the cable system is unchanged.

To increase the number of data lines, a user doesn't necessarily have to go to the cable company to obtain more channel pairs. At the lowest transmission rate of 19.2K bit/sec, a single pair of CATV channels can accommodate up to 120 duplex data lines. This number is usually more than enough for most users' needs.

CATV reliability

The second most common misunderstanding concerning CATV communications is its reliability. Most people tend to equate reliability with the quality of the picture on their television sets, but data signals are quite different from TV signals.

The device responsible for sending and receiving data signals is a radio frequency (RF) modem that is programmed to look for a specific signal pattern and ignore the rest. Picture anomalies like snow, ghosts and herringbone patterns, which annoy the average television viewer, are ignored by the RF modem. In fact, the RF modem is capable of functioning in an environment many times more hostile than a TV viewer would tolerate.

Another characteristic that distinguishes data signals from TV signals is the origin of the signal itself. The sole source of a television signal is the head end transmitter. Data signals, however, are not only received by the RF modem but are transmitted by it as well. The head end is only needed to house the frequency translator, which operates independently. Thus, the TV tube can be blank, and the terminal tube will be unaffected.

Broadband data reliability, while not as good as the local telephone company can provide, is still somewhat better than a CATV viewer might expect. Balanced against an increase in performance and a decrease in operating costs, occasional interruptions in service might be tolerated. And that is what CATV communications excels at: providing high performance at low cost.

The advantages of cable channels

Data communications traffic is like automobile traffic in that the wider the lane, the more efficiently it can operate. The speed and accuracy of data communications are proportional to the size of the lane as well. Because a CATV channel is 2,000 times wider than a telephone channel, it has several benefits.

The first benefit is accuracy. If someone were to drive his car at high speeds along narrow streets, his error rate would increase. In communications, this quantity is the bit-error rate, or the number of erroneous bits of information per million transmitted. Because of the wider lanes in CATV, the bit-error rate is 1,000 times better than with a telephone line.

Another benefit involves the transmission speed and the number of data lines users can get from a transmit/receive pair of CATV channels. Higher transmission rates require wider subchannels and reduce the number of available data lines; lower rates have the opposite effect. In a single transmit/receive channel pair, there can be several different speed subbands, depending on the data. The benefit for the manager is that he has some flexibility in determining how to arrange various speeds on the same channel pair.

Channel size also affects the cost of modems. Telephone modems must use sophisticated techniques such as quadrature phase shift keying, bit compression/decompression and constant line-quality sampling to achieve their high data rate transfer. Because of the larger channel size in broadband communications, it is must easier for the RF modem to do its work. The simpler design is reflected in lower modem costs -- normally a third to a half as much as their telephone counterparts.

Some companies manufacturing RF modems today are Fairchild Data Corp. in Scottsdale, Ariz., General Instrument Corp. in New York, Kee, Inc. in Beltsville, Md., and Zeta Laboratories, Inc. in Santa Clara, Calif. Most divide the CATV channel into smaller subchannels. The modems are transparent to computer protocols and support either point-to-point or multipoint communications.

However, some products like Kee's Bus Interface treat the entire CATV channel as one big pipeline. Using an X.25 protocol, they allow all nodes access to one another in a high-speed, packet-switching network.

Legalities of data over CATV

Can a local franchise offer a bypass service to the public or private sector? Yes, says Syd Bradfield, supervisor of electronic engineers in the cable television branch of the FCC, as long as the cable operator observes restrictions involving aeronavigation frequencies.

On a larger scale, the FCC recently ruled that Cox Communications Co., a CATV franchise in Omaha, Neb., will be permitted to operate a microwave link between two of its cable systems. This opens the door to interstate transmission of broadband data.

The key to broadband data transmission is procuring transmit/receive channel pairs from the CATV franchise, and local governments and public school systems have an advantage in this regard. Most franchise agreements that local governments have with CATV companies require the cable company to provide a community service by reserving certain channels, usually the T channels, for institutional use.

Whatever means are used, the communications manager must be the insigator and stir up the notion of data over cable. Cable franchises are not eager to get into this mysterious caldron of data communications. Before meeting with CATV officials, a manager should assemble as much supporting information as possible. The reward can be a communications system that will pay for itself in a few years, accommodating network growth at the same time.

GRAPHIC: Illustration, no caption, TOM BARRETT; Figure 1, Typical CATV installation, SOURCE: RODNEY MITCHELL JR., ANNAPOLIS, MD.; Figure 2, Data over CATV, SOURCE: RODNEY MITCHELL JR., ANNAPOLIS, MD.