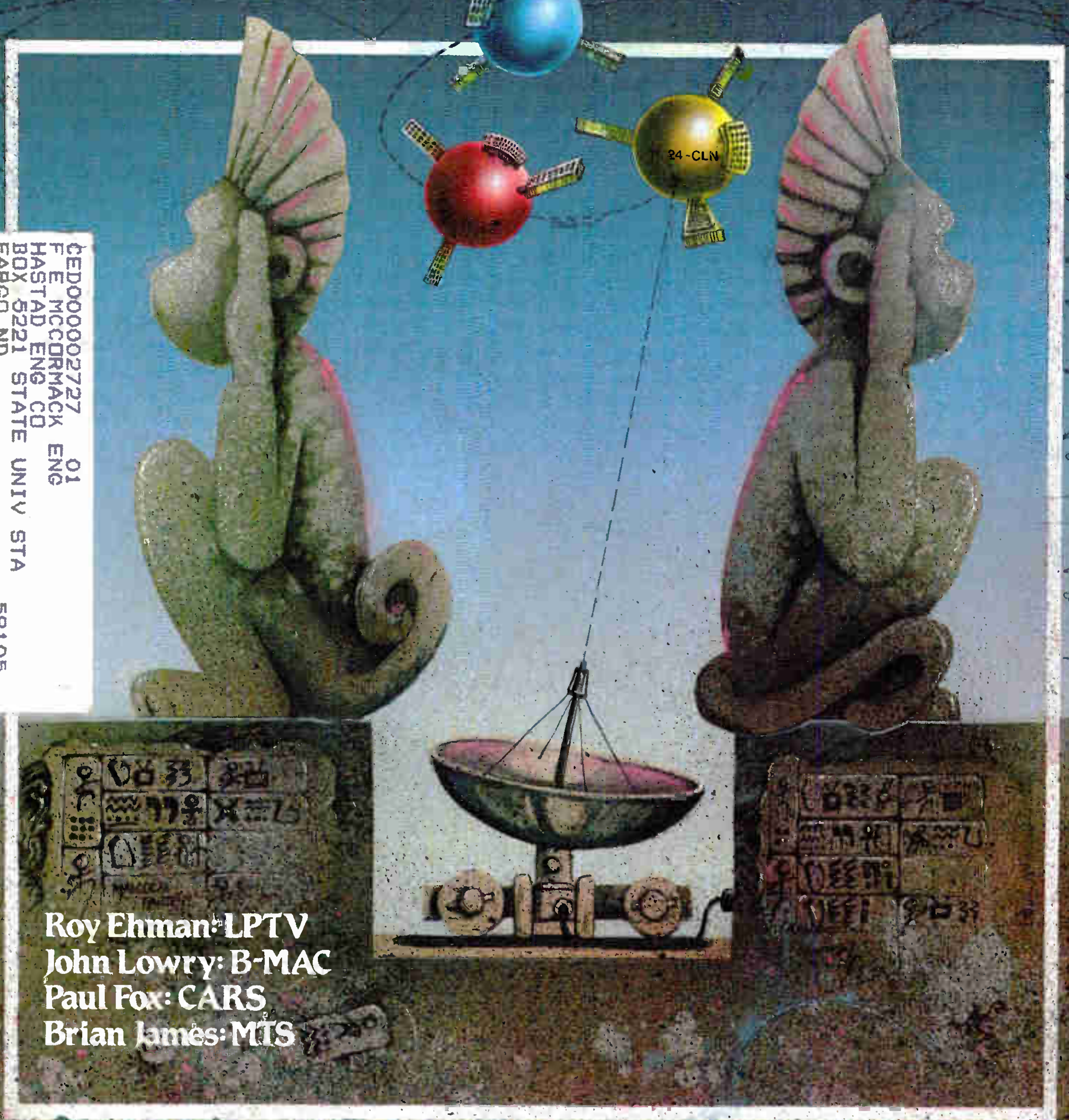
CED

Communications Engineering & Design/The Magazine of Broadband Technology

January 1985

Taps, traps



Roy Ehman: LPTV
John Lowry: B-MAC
Paul Fox: CARS
Brian James: MTS

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Reader Service Number 2

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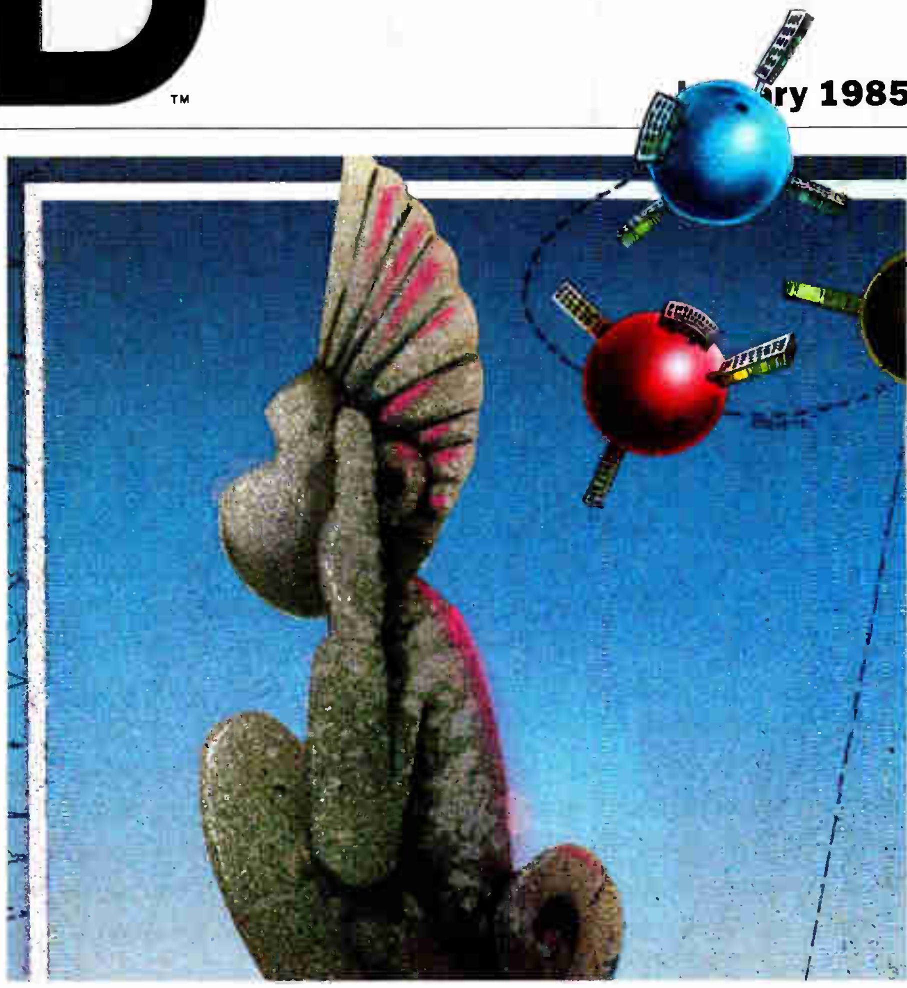

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Reader Service Number 3

Walt Ciciora

Achievement seems to come easily for Walt Ciciora, ATC vice president for research and development. But not everybody can translate vast quantities of knowledge into lay terms. Ciciora not only can, he does so with regularity. The skills? A Ph.D. in Electrical Engineering, pioneering work in videotex, a stint as manager of research and development at Zenith, an MBA from the University of Chicago, director of cable sales and marketing at Zenith and his current position at ATC.

In addition to playing an important role in the development of the Z-TAC converter, Ciciora has an impressive grasp of the consumer products industry.

But Ciciora's knowledge and diversity are not what others appreciate most about him. "What really characterizes Walt is his ability to translate highly complex technical issues into understandable terms. He really is a good teacher," says ATC Vice President of New Business Development Dean Erickson. NCTA Vice President of Science and Technology Wendell Bailey agrees: "Walt is remarkably articulate. Eight months before digital TV sets became available, he gave a presentation at the NCTA on digital circuitry. It was the most lucid discussion I've ever heard on the subject."

At ATC, Ciciora and his team of engineers are currently working on delivering premium audio to subscribers in digital form. Ciciora stresses that in developing new products and technologies there is always a significant probability of failure. "We must be able to accommodate this possibility emotionally," he says. "A sense of humility is also necessary—the ability to bring someone else's good ideas to fruition, not always your own."

Ciciora has obviously mastered these abilities in his role at ATC. In fact, according to Bob Rast, senior vice president for corporate development, "Walt has helped ATC's research and development division become a leading example for the rest of the industry." Although much of Ciciora's time at ATC is taken up with meetings and other administrative affairs, he must be there with advice and ideas when needed, in a manner that doesn't inhibit the creativity of the other engineers.

Upper management does have its drawbacks, however. "I don't get to spend much time on the bench anymore, and that is something I really miss," he says.

In addition to his responsibilities at ATC, Ciciora is chairman of the NCTA Cable Interface Working Group (a subgroup of the EIA/NCTA Joint Engineering Committee). The group is working on recommended standards for devices that connect to cable—to maximize the consumer's utility and minimize his frustration. "We must bridge the gap between consumer electronics and cable TV," Ciciora asserts. "This issue causes more consumer dissatisfaction than anything else."

Ciciora is acutely aware that technology must be geared for specific customer needs. "Technology alone is not the issue today. Focusing in on satisfying the customer's genuine needs is the issue. Technology can be a loose cannon on deck unless it is carefully guided to serve the consumer."

Ciciora's job at ATC is to understand the impact technology will have on current and future business. "Two-way technology, data transmission via cable and, of course, developing appropriate interfaces between consumer electronics and cable TV are some of the long-term issues we are working on," he says.

During his rare free time, Ciciora enjoys tinkering in his basement shop and home remodeling. Also an avid reader when time permits, one of his favorite books is *The Soul of a New Machine* by Tracy Kidder, the true story of a computer developed at Data General. "It's the kind of book an engineer like me just can't put down."

The cable TV industry has come a long way thanks to men like Walt Ciciora. "Every industry goes through cycles," Ciciora says. "We need time to pause and digest what has happened and consolidate for the next growth time. Those companies which are preparing for growth now will do well. The others, well, they may be in for trouble."

ATC has an advantage. It has Walt.

—Lesley Dyson Camino

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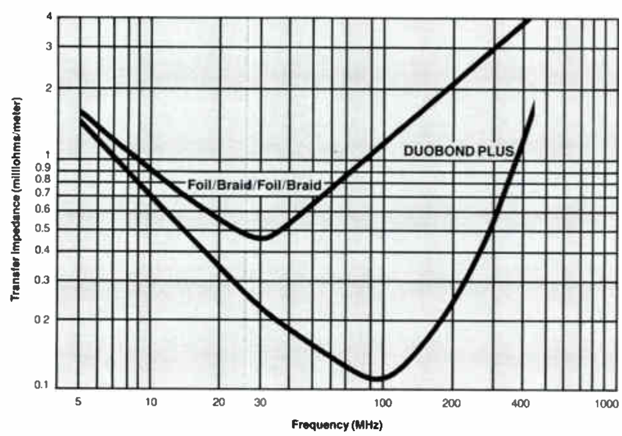
Belden's drop cable with DUOBOND PLUS™ shield helps you prevent costly call-backs. It's also the most shield-effective drop cable in the CATV industry.

Easier termination for maximum shielding integrity.

The DUOBOND PLUS shield features a foil/braid/foil construction with a shorting fold in the outermost foil which provides superior shielding effectiveness to typical 4-layer shield constructions. The transfer impedance graph demonstrates this effectiveness.

The added benefit is easier termination. This means less chance for error, resulting in greater shielding integrity and reliability. It also means fewer call-backs, lower operating expenses and more satisfied subscribers.

Cables with the DUOBOND PLUS shield require only half the steps for termination than 4-shield cables. Because it's less bulky, more flexible and its outer foil is bonded to the jacket, stripping and connectorizing are much simpler tasks. You can minimize your connector inventory to one size connector and one crimp tool.



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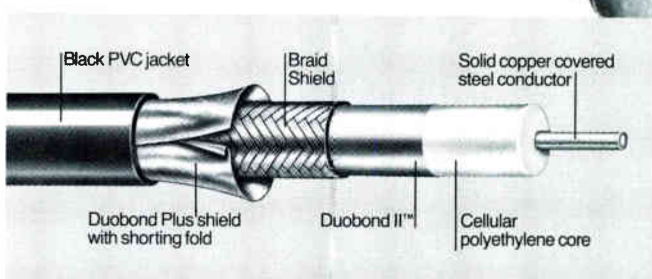

The inner foil of the DUOBOND PLUS shield is bonded *directly* to the core. Foil pushback and signal leakage problems are eliminated. Protection from shielding degradation is eliminated during installation–where most shielding problems occur.

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Reader Service Number 4

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Volume 11, No. 1

CED

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Audacity, audacity, audacity

Markets, whether for stocks and bonds, lettuce or tractors, are ultimately rational and efficient in the long run—occasional manias for tulip bulb futures notwithstanding. Cases in point: the cable industry, its suppliers and trade press. And no, this is not a commentary on the Western Cable Show. It is, however, a statement of my conviction that a variety of markets are going to make their judgements known in 1985. It won't be comfortable, necessarily pretty or, perhaps, just. Nevertheless, each of us, in all of our markets, is going to have to face up to the inexorable pressure of a certain invisible hand.

And while the ultimate economic result may be desirable—better products and services at a lower cost—the individual casualties will be painful. It's an iron, and sometimes cruel, discipline, but market pressures are going to drive us toward greater efficiencies of many sorts.

All of us—operators, equipment vendors, program suppliers and trade journals—will face and hopefully meet the new challenges. "Better fewer but better" might be one way of characterizing the changes. Fewer players in some cases, but hopefully stronger, more creative survivors and healthier businesses as a result.

The point, my friends, is that all of us at *CED* have had to respond sharply and decisively to the not-so-gentle nudges of our friend the invisible hand. We've had to learn to read our markets more attentively and really take a hard look at our business. It isn't always fun. But we've taken the market's advice—sometimes subtle and occasionally blunt—deeply to heart.

As the first tremors of a coming shake-out began to rumble through our offices, we took a cold, hard look at everything we had—and hadn't—been doing. The product you hold in your hands, it's cousins before and those to follow, are the result of our labors. We can offer you several assurances.

We're going to do our level best to raise the level of technical coverage of this industry. It's a fine-tuning process that has only begun, but is being pursued in earnest. We're staying very close to the market and expect to be the best. Not one of the best, just the best.

There's a shake-out of cable trades in progress. A few have fallen and more will follow. So we're trying to look at it as a chance to do more than simply survive. We're actively pressing to gain significant ground. Yes, it's ambitious, but then, we're ambitious. We love this industry and hope you can see that in our work.

In 1985, our watchword will mirror the tactical and strategic advice once given by a French general. The key? Audacity, audacity, audacity.

We're sure the market will respond.

On a more personal note, this new year has brought a few changes to our staff. This is the first issue I've ever worked on that didn't have Constance Warren's attentive eye glued to it in Denver. She's moved to New York in anticipation of an upcoming June wedding. She'll still be contributing as a writer, of course, but her production duties will be assumed by Lesley Dyson Camino, who has gradually assumed more of Constance's work. We're excited and happy for Constance, and think you'll enjoy Lesley's handling of *CED*'s production process. It's where all the many elements come together—for better or worse and it's people like Connie and Lesley that make it happen. We'll miss Connie here in Denver, that's for sure.

And we hope you liked our December issue cover. We intend to run similar covers twice a year, once at the NCTA and again at the Western Show. It's a nice cable tradition and we're pleased that *CED* will carry it forward. It's about time that the technical community got a bit of recognition, don't you think?

Gary Y Kim

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Interface problems spotlighted at Western Cable Show

ANAHEIM, Calif.—The cable/consumer electronics interface figured prominently at Western Show technical seminars held here Dec. 5-7. Cable-compatible and digital TVs, VCRs and stereo sound were some of the hot issues.

It's time to get over the "fingerpointing" stage and work with consumer electronics manufacturers, NCTA Vice President of Science and Technology Wendell Bailey advised attendees.

Groups such as the EIA/NCTA committee are actively searching for solutions and they need your ideas and support, Bailey said. Subscribers also need to hear the problems and solutions. "Include a consumer electronics/cable TV fact sheet in the bill," he added.

Aside from problems raised by scrambling and converter remotes, speakers also tackled digital TVs and stereo sound. And while a modified digital TV can decode sync-suppressed signals, no domestic off-the-shelf model can. Which doesn't mean no sets ever will. Bailey expressed concern that an off-shore manufacturer might develop such a set.

But as matters stand now, no reputable domestic firm is putting sets on the market that pose problems off-the-shelf. Jerrold's Vice President of Marketing Pete Morse said the company ran ten months of tests and is convinced its sync suppression schemes cannot be defeated by the ITT chip set.

And depending on the outcome, of the FCC's decision on multichannel sound, which has been postponed to sometime next year, operators may have to replace varying amounts of headend and subscriber equipment to accommodate the wider deviation BTSC signal, SCTE's Executive Vice President Bill Riker warned.

If operators are required to carry the BTSC signal in its original form, filters in many heterodyne processors will have to be adjusted or replaced.

Most likely, baseband headends will have to be replaced because the demodulators are only designed to handle the 25 kHz monaurual signal, and they completely strip off stereo information and the second audio program. However, it's possible that at 4.5 MHz the signal could be looped out of the domodulator and looped back in later, Riker added.

When the stereo signal is delivered over systems using sync suppression, two things can happen. Herringbone interference appears in the video as a result of the descrambler picking up audio information along with the sync reconstitution key. With pulse insertion systems, false triggering of the stereo may occur because the MCS decoder misinterprets F_h-generated artifacts as the F_h stereo pilot carrier.

Baseband converters usually strip off the stereo and SAP, passing only monaural. However, in some cases, enough of the pilot carrier is passed to trigger the stereo TV, but the L-R doesn't get through. The result is a stereo signal that is monaural in quality and very noisy, Riker said.

"New stereo-compatible equipment is coming to market, and there are at least three vendors who can sell you hardware that duplicates digital disc quality at 90 S/N," Gill Cable's Vice President of Engineering David Large told attendees.

Another vendor offers a "very good quality" advanced analog system that uses 400 kHz for the stereo pair, and another uses a digital transmission scheme that achieves a 70 dB S/N and carries less information within the TV signal, he added.

All three methods offer a good 10 dB or more improvement over the 50 dB S/N cable systems would achieve while transmitting the BTSC signal in its original form, Large continued.

But, he warned, these alternatives have their drawbacks: they require more bandwidth; the stereo decoder box costs $100; a separate processor usually is required for each stereo channel and costs about $1,000; and the decoder aggravates the consumer electronics tracking problem.

Still, there's a market to be served, some speakers said. A study involving Westinghouse/Sanyo, Warner Amex and Group W showed a "high degree of interest" in stereo among cable subscribers in the 15-20 percent penetration range. And 50 percent of this group will own VCRs by the end of next year, Group W's Director of Strategic Planning Anne Kirschner reported. Most also would prefer not to buy stereo TVs and would rather own the stereo decoder, she added.

Judging from this year's Western Show, cable manufacturers are ready to help operators carry stereo. New transmission schemes were unveiled along with several MCS decoders and adapters. (See p. 56.)

But cable stereo will aggravate existing consumer electronic interface problems. Another box and tuner will be added to the home, so it's possible consumers could end up with four separate tuners.

This duplication is unnecessary and costly, Large argues. But, he admits, there is no easy solution.

However, "doing nothing is not an option at this time," he said. Operators should support and participate in groups such as the joint EIA/NCTA committee, he added.

Already the group has put together a fact sheet explaining the consumer electronics/cable TV incompatibilities and has enlisted the support of city officials to distribute the material.

Also, an EIA/NCTA interface committee plans to test a 20-21 pin interface plug in Mile Hi Cablevision's Denver system this January. If all goes well, the device could become an interface standard, reports the group's chairman and ATC Vice President of Research and Development, Walter Ciciora.

Meanwhile, an EIA home bus committee is busy working on a remote control standard that will integrate all consumer electronic controls in one device. —*Constance Warren*

FCC gives 21006 details

WASHINGTON—Details on the new technical rules governing cable use of the aeronautical frequencies have been released by the FCC. Among the new specifications are annual cumulative signal leakage indices. Compliance with the CLI is mandatory if frequency bands 118-136 or 225-400 MHz are used.

Two separate measurement techniques may be used. The first requires sampling of at least 75 percent of cable strand at least once a year. All portions of the system known or expected to have less leakage integrity than average must be included in the sampling.

Compliance with the CLI can be demonstrated if 10 log I_{3000} is equal to or less than -7 or 10 log I_{∞} is equal to or less than 64, using one of two formulae:

$$I_{3000} = \frac{1}{-\phi} \sum_{i=1}^{n} \frac{E_i^2}{R_i^2} \quad \text{or}$$

$$I_{\infty} = \frac{1}{-\phi} \sum_{i=1}^{n} E_i^2 \quad \text{where}$$

$$R_i^2 = r_i^2 + (3000)^2 \quad \text{and}$$

r is the distance in meters between the leakage source and the center of the cable system;
ϕ is the fraction of the system cable length actually examined for leakage sources and is equal to strand miles tested divided by total strand miles;
R is the slant height distance in meters from leakage source i to a point 3,000 meters above the center of the cable system;
E_i is the electric field strength in microvolts per meter measured three meters from leak i; and
n is the number of leaks found of field strength equal to or greater than 50 uV/m.

The measurement system, including receiving antenna, must be calibrated against a known field of 10 uV/m RMS produced by a well-characterized antenna composed of orthogonal resonant dipoles, both parallel to and one-quarter wavelength above ground plane of a diameter of two meters or more at ground level. The center collocated dipoles must be excited 90 degrees apart and detector half-power bandwidth must be 25 kHz.

If an aeronautical receiver is used, it must meet specifications set by the Radio Technical Commission for Aeronautics. The aircraft antenna has to be horizontally polarized. If data is recorded digitally, the 90th percentile level of recorded points can't exceed 10 uV/m RMS. If data is taken in analog fashion, the smoothed peak values of the curves can't exceed 10 uV/m RMS.

Airspace measurements must be made when the system cannot sample 75 percent of strand according to specifications. All new sections of plant must meet these tests before turn-on or demonstrate that there are no individual leaks exceeding 20 uV/m at three meters in the new section.

In addition to the new annual leakage tests, systems must meet new monitoring standards. Monitoring of all portions of the system is required at least once every three months. Equipment used must be able to detect leakage with a field strength of 20 uV/m or greater at a distance of three meters. Leaks found during these checks must be fixed within a "reasonable amount of time."

All aeronautical frequencies used must be offset. Standard and IRC systems must operate with carriers shifted 12.5 kHz ± 5 kHz in the 118-136, 225-328.6 and 335.4-400 MHz bands. HRC systems must use a comb generator with a master frequency of 6.0003 MHz ± 1 Hz.

In the 108-118 and 328.6-335.4 MHz bands, carriers must be offset 25 kHz ± 5 kHz.

Peak power levels are set at 10^{-4} watts.

Cable systems in operation and using the aeronautical bands before Jan. 1, 1985, can operate under the old rules until Jan. 1, 1990, as long as carrier signals or components carried at peak power levels equal to or greater than 10^{-4} watts are offset.

The NCTA is expected to challenge the new ruling, at least in part.

Sat-delivered training

WEST CHESTER, Pa.—SCTE satellite-delivered technical training seminars will be transmitted on a once-per-month basis, beginning February 1985. The sessions will feature technical papers delivered at SCTE state and regional conventions and manufacturers' training tapes. Test equipment operation, preventative maintenance and new technology implementation will be covered.

B-Mac format for satellite transmission

By John D. Lowry, Scientific-Atlanta Inc.

As presented at the 18th Annual SMPTE Television Conference, Montreal, Feb. 11, 1984.

Market requirements for distribution of satellite television programming services into the home have been examined in this paper. The Direct Broadcast Satellite format selected must be capable of distribution through cable, satellite master antenna television and UHF terrestrial broadcast systems. Other commercial considerations require "hard" audio and data encryption and hard video scrambling, combined with broad addressing and tiering capabilities, such as impulse pay-per-view, personal message transmission and teletext. The format also should be able to accommodate extended definition television.

During the past two years, a transmission format meeting these market needs has been developed. The decoding hardware for both professional and consumer use currently is being reduced to a set of integrated circuits scheduled for completion in late 1984.

The driving force

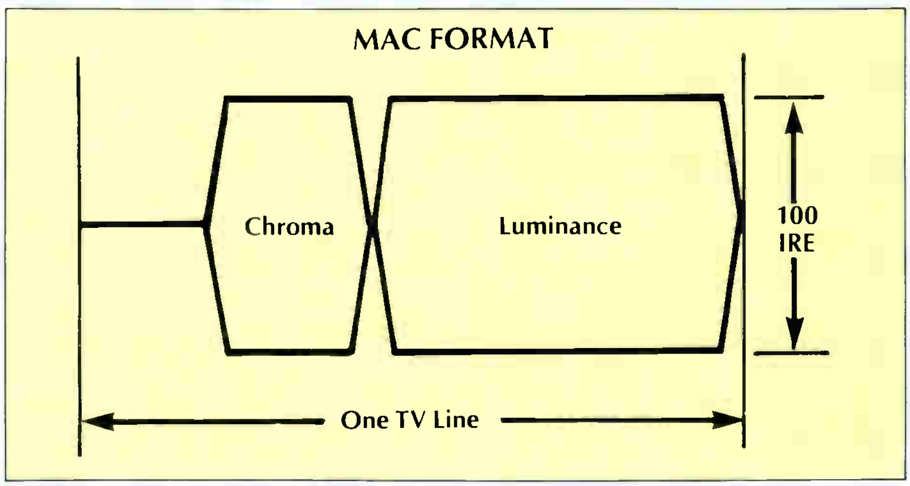
The initial impetus for the development of the system came from two sources: investigations into improved formats for DBS transmission and a parallel effort investigating means to secure signals for pay television. The requirement for scrambled signals (which are by definition non-standard) and the introduction of a completely new direct broadcast satellite service presented the rare opportunity for the commercial success of a new signal format.

Both NTSC and PAL were designed for Amplitude Modulation (AM) transmission with the NTSC specification finalized in 1953, four years before the first Sputnik satellite was launched. FM transmission via satellite was not seriously contemplated at that time.

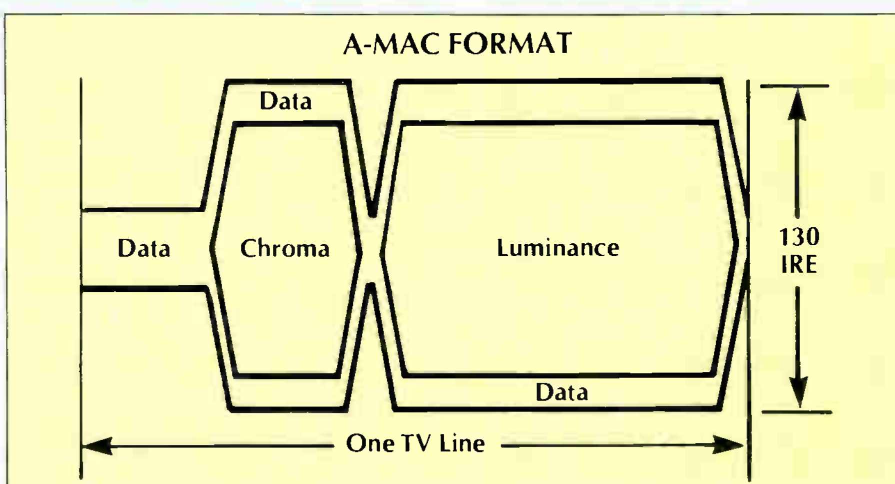
In a marketplace driven in part by the need to reduce dish size, signal noise is of great importance. With AM transmission, noise is relatively flat in relation to frequency. FM noise is triangular and increases with frequency. The human eye perceives a noise characteristic that is basically the opposite and complementary to the triangular FM noise with visibility of noise maximized at lower frequencies. This relationship between FM and human perception is not the case with the NTSC or PAL television systems, which frequency multiplex the color information on a subcarrier at the relatively high frequencies of 3.58 and 4.43 MHz. When the color is demodulated down to baseband for display, the high amplitude noise present on the high frequency subcarrier is converted to low frequency noise and becomes much more visible.

A number of methods have been explored to improve satellite transmission, including all-digital transmission systems. These yield excellent quality at the receiving point, which in some cases, is equal to that transmitted. Due to the extremely high data rates required for video transmission, complex and expensive equipment is required at the receiver. Even with state-of-the-art large-scale integration, it is doubtful that all-digital transmission will be cost effective for use in the home in the 1980s or, possibly, well into the 1990s.

Multiplexed Analog Components is a hybrid system that uses digital transmission techniques for the audio and data, combined with analog component video. MAC originally was devel-



Chrominance and luminance are time compressed and transmitted in a sequential format on each TV line.



A-MAC provides a baseband frequency multiplex of the audio and data on a subcarrier.

oped for satellite transmission by the Independent Broadcasting Authority (IBA) in the U.K. The chrominance and luminance are transmitted in a line-by-line, time multiplexed, rather than frequency multiplexed, mode.

For the past 1½ years, there has been a great deal of discussion on the C-MAC format, but there are three other basic options open for combining data with video. These are described by the matrix of frequency multiplex or time multiplex at either baseband or RF.

A-MAC provides a baseband frequency multiplex of the audio and data on a subcarrier at approximately 7 MHz. This provides the advantage of an extremely rugged data channel. However, its potential for threshold extension is limited and the video bandwidth is too restricted for extended definition.

D-MAC employs frequency multiplexed data at RF. With video centered at 70 MHz, for example, the data might be on a separate carrier at 85 MHz. Audio and video can be uplinked from separate locations and exceptionally high data rates are possible, but two receivers are required and interference problems can occur.

C-MAC time multiplexes the data at RF, providing an excess of 20 megabits per second during the 9 microseconds that would otherwise be devoted to the horizontal blanking period. One advantage is the efficiency of direct demodulation from RF to digital data, which results in high data rates for up to 8 audio channels. Separate demodulation of this data is costly, and a transmission channel greater than 10 MHz is necessary for applications such as cable or SMATV.

B-MAC

B-MAC time multiplexes the audio and data at baseband using a multilevel code during the 9 microsecond "horizontal blanking" period. The video is essentially identical to C-MAC, but the bandwidth of the system is held to just over 6 MHz because the wide dynamic range of the transmitted "video" signal is used for multilevel data. This provides a satellite signal that can be used for cable, SMATV, terrestrial microwave or UHF broadcast without requiring decoding at intermediate distribution points.

In SMATV applications, the B-MAC signal can be received from the satellite and passed directly through the building's cable system for subscriber access control at each individual television set. This also provides the potential for high quality red, green and blue signals for the television display combined with digital stereo audio directly to each viewer.

Compared with C-MAC, B-MAC has a lower data rate of 1.8 megabits per second, but it is compatible with conventional video tape recorders and can be demodulated with one conventional low cost satellite receiver. It also is compatible with future extended definition systems with wider bandwidths.

Sync is extremely rugged, yet it requires 0.2 percent of the total time as opposed to over 20 percent required for NTSC or PAL. Sync is carried on one line in the vertical interval as a highly redundant digital word and provides for receiver lockup at 0 dB carrier-to-noise. This will assist the amateur in dish set-up and satellite signal acquisition and provide picture continuity under the most adverse reception conditions.

Through elimination of the traditional sync pulses and both the color and audio subcarriers, FM deviation in the channel, IF filters, and the pre-emphasis/de-emphasis networks can be

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#7010-S/1 GHz	$310.	$25.	$75.	N/A
#8007-S	$350.	$60.	$75.	$125.
#8010-S	$435.	$60.	$75.	$125.
#8013-S	$499.	$60.	$75.	$125.

MODEL	RANGE (FROM 10 Hz)	TIME BASE FREQ	TIME BASE STAB-DESIGN	AVERAGE SENSITIVITY BELOW 500 MHz	AVERAGE SENSITIVITY ABOVE 500 MHz	GATE TIMES	MAX RESOLUTION 12 MHz	17 MHz	60 MHz	175 MHz	MAX FREQ	SENSITIVITY CONTROL	EXT CLOCK INPUT/OUTPUT	METAL CASE	PROBE POWER JACK
K-7000-AC	550 MHz	5.24288	±1 PPM-RTXO	15 mV −24 DBM	N/A	(2) .1, 1 SEC	10 Hz			100 Hz		No	No	Yes	No
7010-S	1 GHz 600 MHz	10.0 MHz	±1 PPM-TCXO *±0.1 PPM-TCXO	10 mV −27 DBM	20 mV −21 DBM	(3) .1, 1, 10 SEC	.1 Hz	1 Hz		10 Hz		Yes	No	Yes	No
8007-S	700 MHz	10.0 MHz	±1 PPM-TCXO *±0.1 PPM-TCXO *±0.05 PPM-OCXO	10 mV −27 DBM	20 mV −21 DBM	(4) .01, .1, 1, 10 SEC	.1 Hz		1 Hz		10 Hz	Yes	Yes	Yes	Yes
8010-S	1 GHz														
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optimized to yield excellent results. Smaller satellite receiving dishes can be used or improved performance achieved. B-MAC is also unaffected by most non-linearities in the transmission channel. Further reductions in dish size can be achieved by reducing the video bandwidths and data rates for applications where "video cassette quality" pictures and 2-channel stereo sound are considered viable.

Standard NTSC or PAL satellite receiving equipment including dishes, low noise converters, receivers, and television sets can be used with the B-MAC system. Certain portions of this chain will be less costly and have better performance when the design is optimized for B-MAC. Of the systems studied, B-MAC yields the lowest cost satellite distribution system.

In summary, the principle advantages of the B-MAC system are:

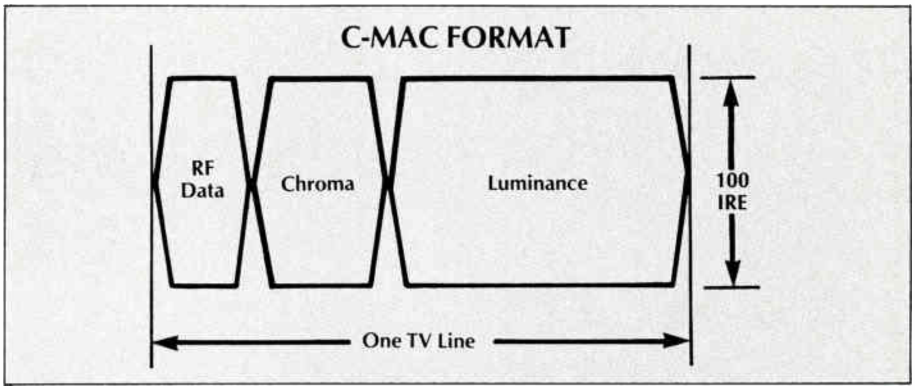
- component system eliminates cross luminance and cross color effects
- color noise is reduced
- color bandwidth is increased
- red, green and blue signals are available for improved television display
- rugged, truly digital sync
- improved threshold extension techniques can be applied when all subcarriers are eliminated
- dish size is reduced

Video scrambling

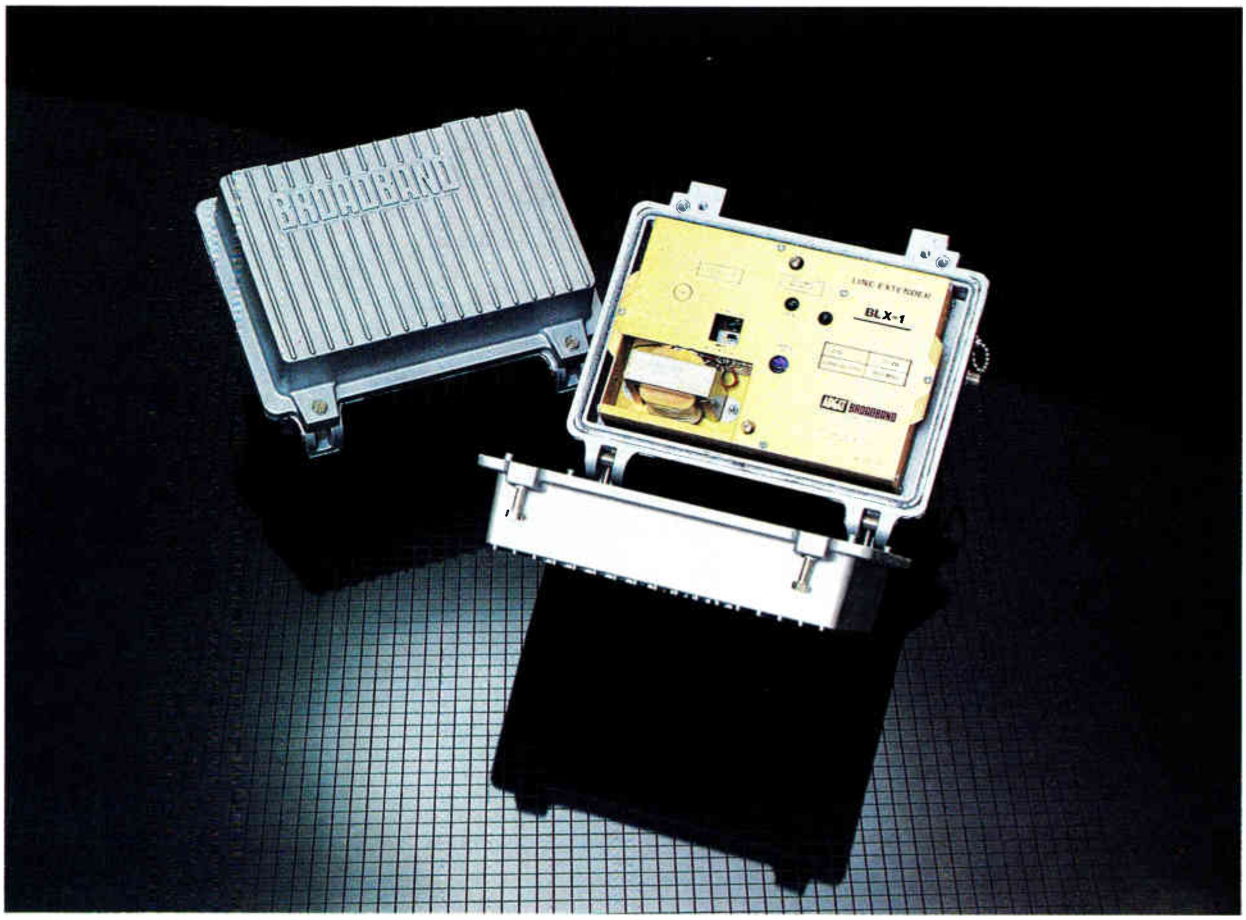
Analog video signal scrambling can be done in two ways: The amplitude of the signal can be varied or the video can be rearranged in relation to time.

The most elementary scrambling system is sync suppression (or sync denial), which has been used for many years in the cable TV industry in North America. Even in a controlled distribution cable environment, signal piracy with sync suppression systems runs high. With minor modifications, some of the more sophisticated new television sets are capable of providing a locked picture in the absence of traditional sync pulses. As a result, sync suppression and sync denial are considered to be inadequate for satellite distribution if any level of controlled access is to be maintained. More sophisticated scrambling methods include video inversion, line reversal, line segmentation or line rotation, line shuffling using a field store and line translation.

Video inversion is an amplitude system that provides a relatively low level of security. It is particularly subject to non-linearities in the channel. Should there be black stretch and white compression in the channel when the transmitted video is inverted, this becomes



C-MAC time multiplexes the data as RF with the baseband chroma and luminance on each TV line.



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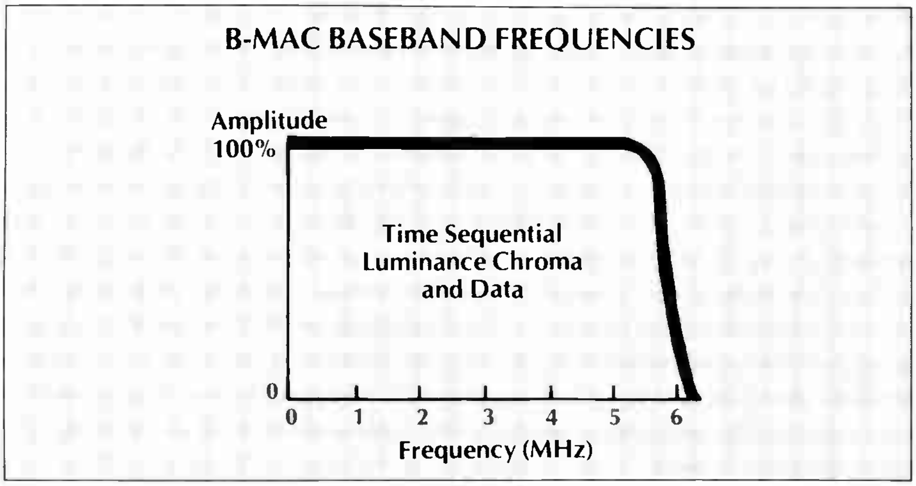

The baseband bandwidth of B-MAC is held to just over 6 MHz for data, chrominance and luminance yet provides 1.8 Mbits/sec.

black compression and white stretch and yields an amplitude flicker at the rate of the change from inverted to non-inverted video. In general, all systems varying amplitude have provided relatively low security and, in some cases, poor picture quality.

Use of a field store at both the transmit and receive points to reorganize the line sequence during transmission obscures pictures. Perfect reconstruction of the picture can be achieved in the descrambler through knowledge of the correct line sequence. This is potentially a high-quality scrambling system, but its cost will remain relatively high, particularly in light of the requirement for a random access memory in the decoder. Integrated circuits for field store use being developed today generally provide sequential access only.

Line segmentation or "line rotation" scrambling is essentially a technique where each line is divided into two segments that are interchanged in position for transmission. Portions of the line are repeated to mask the effects of the "splice." Using digital sampling, the lines are reconstructed in the descrambler with the repeated portion of the line around the splice discarded. This system, and variations of it, place excessive demands on specifications such as linearity, line tilt, and frequency response in the various equipment in the transmission chain.

Line tilt in the order of 3 to 5 percent is usually not visible to the human eye because of the gradual change across the picture. When even 1 percent tilt is added to a segmented line signal during transmission, the reconstructed pictures are unacceptable. When descrambled, the tilt becomes a dc level shift in the picture that changes from line to line as the scrambling patterns change and manifests itself as highly visible low frequency noise. A total system line tilt specification of 0.3 percent is required to provide acceptable video. This defines a very basic rule about video: The clamp-to-video timing relationship must be held constant.

Should a segmented line picture be distributed via a vestigial sideband (VSB) cable system, other problems occur. Any mistuning at the receiver causes a boost or attenuation of the low frequency component of the signal, which affects the step response of the channel. A low frequency transition that is artificially created by line segmentation scrambling yields a long overshoot or undershoot recovery period that is visible in the descrambled video and has no relation to actual picture transitions.

Line translation scrambling uses a horizontal time-shift technique. The blanking time is varied on a line-to-line basis from a minimum of zero to a maximum of two times the normal blanking. The clamp period is tied to the video with that relationship held constant. This line translation, or "time base" scrambling system, redistributes the picture information in time, yielding a scrambled picture that is totally obscure but that can be reconstructed by the descrambler into a high-quality picture with no visible or measurable degradation or scrambling artifacts.

The scrambling is dynamic, with the patterns changed every frame. Another benefit is the decorrelation of transmission channel interference patterns when the pictures are descrambled. The only requirement is the transmission channel must be relatively time invariant for approximately 100 microseconds, a specification easily met by every normal channel today.

B-MAC format decoding, line translation descrambling or both together require a maximum of three TV lines of storage. High security and good picture quality are provided; the cost is low, and it is compatible with CCD technology. The video descramble key is encrypted using the data encryption standard (DES) algorithm and is interleaved with other information in the digital data channel.

The digital data channel includes audio, addresses, the data decryption key, video descramble key, personal message data and optional full field data. The system supplies hi-fidelity digital stereo sound that can be connected to the viewer's standard hi-fi sound system.

Six-channel digital audio

B-MAC has been designed with a six-channel digital audio system with 31.4 or 31.2 kHz (two times the TV line frequency) digital sampling. A new enhanced delta modulation technique yields a dynamic range at the descrambler greater than 84 dB and very gentle failure under low carrier-to-noise ratio reception conditions. The audio is encrypted to the data encryption standard. This encryption algorithm is applied on a bit-by-bit basis, with the decryption keys and codes changing at irregular intervals. This provides dy-

MAC format options

	A-MAC	B-MAC	C-MAC	D-MAC
Data capacity (approx.)	2 Mb/s	1.8 Mb/2	2.5 Mb/s	3 Mb/s +
Cable compatible	no	yes	no	no
STV/MDS compatible	no	yes	no	no
Conventional satellite receiver compatible	yes	yes	no	no
VTR compatible	no	yes	no	no
Compatible with EDTV bandwidths	no	yes	yes	yes
Cost	medium	low	medium	high

Sync is replaced by a digital code on one line in the vertical interval (defining the top left-hand corner of the picture), combined with a burst on each line for phase and frequency to generate all timing requirements.

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namic DES encryption for the highest security commercially available. A data channel with 94 Kbits per second is standard. Any audio channel can be assigned to data transmission and reception, each channel providing 320 Kbits per second. Full field data is also available by replacing the picture with digital information. This yields an additional 10.8 million bits per second.

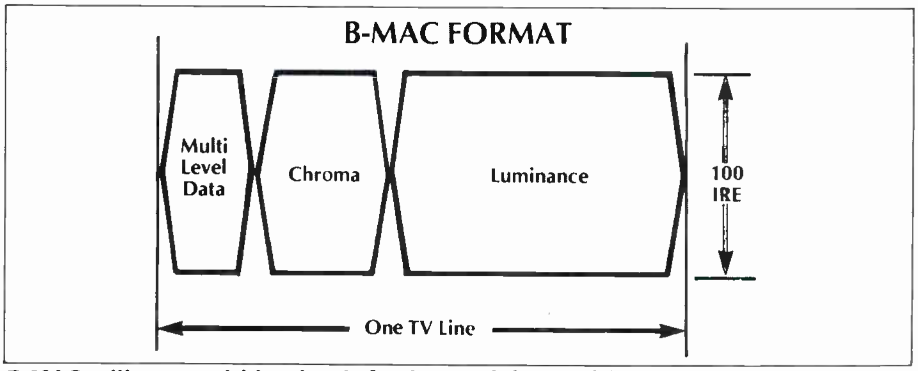
The addressing technique provides for as much as 4 billion addresses with redundancy for reliable reception. This high number of addresses provides for effectively infinite tiering. Addressing is at the rate of 1 million per hour. Instant (1/4 second) access is provided to all authorized programs when the subscriber switches channels. The decoders are generic and capable of being addressed by any one or all program distributors using the system.

Teletext is an integral part of the B-MAC system with 200 pages of encrypted or clear text available to all or any specific user with 20 second access. Uses include film subtitles as a user option, subtitles for the deaf, general and personal messages, program guides, current tiering and parental lock information, and individual account status for monthly and pay-per-view billing including presentation of the bill itself.

Summary

The B-MAC transmission, scrambling and encryption system employs a satellite optimized format; highly secure yet low-cost scrambling, high data channel capacity; "virtually" unlimited addressing; facilities for pay-per-view programming and infinite tiering; multichannel digital audio and hard encryption. Personal messages can be sent to any individual, group or to all receiving points. Red, green and blue video are available along with baseband NTSC or PAL and RF channel outputs. B-MAC provides excellent potential for use of two channels on one transponder and leaves the door open for extended definition techniques in the future.

The current implementation of the system is designed for professional use at cable headends, teleconferencing and other professional applications of the 525-line TV standard. The technology is being implemented as a set of custom integrated circuits for both 525- and 625-line standards. These custom ICs and other components will be carried on a printed circuit board approximately 6 by 9 inches and can be inserted or built into satellite receivers. Sample quantities of this decoding equipment will be available late this year, with production quantities to be available in the first half of 1985. ■



B-MAC utilizes a multi-level code for data and time multiplexes this baseband signal with chroma and luminance.

Multichannel sound

By Brian James,
Cablesystems Engineering

While the prospect of stereo television is not new (the Japanese have been transmitting stereo TV for several years), it is just now being introduced in the United States.

In 1978 the Electronics Industries Association (EIA) charged its Broadcast Television Systems Committee (BTSC) with evaluating available multichannel television systems (MCS) to determine the one most compatible with the television system in use. The EIA hoped the FCC would accept their recommendation as the standard. This would allow for a fast, orderly introduction of MCS stereo TV sets, with all of the sets able to receive the signal. Incompatibility always has been a significant concern, as shown by the slow introduction of AM stereo due to the 'marketplace decision' made by the FCC.

Three systems were selected by the BTSC for evaluation: Zenith, Telesonics and EIA-J (Electronics Industries Association of Japan). Laboratory facilities were made available in Matsushita's Chicago plant where the tests were performed. The EIA tests considered all parameters and problems of propagating the signal over the air to the TV set. The 860 page report devoted very few pages to the effects of cable TV on the MCS signal and made no comments on the effects of the MCS signal on cable equipment.

As the BTSC was preparing to vote for the standard, changes to improve one proponent's system results were suggested. However, other proponents did not want the changes considered in the voting. It was decided to perform the tests again, using upgraded equipment from the three proponents in order to recommend the best possible system. The manufacturers had the opportunity to review test results and make the necessary improvements to their equipment. In addition, a standard demodulator was used to supply the composite audio baseband signal to each stereo decoder rather than each proponent providing his own demodulator.

About this time, the cable industry became fully aware of, and alarmed at, the possible consequences of the introduction of stereo. The industry wanted more details on the effects of MCS. The National Cable TV Engineering Committee established an ad hoc subcommittee under the chairmanship of Alex Best of Scientific-Atlanta. Funding was obtained to retain a consultant to test the effects of the MCS signal on cable equipment and vice versa. The tests were performed with EIA's permission in the same Chicago labs as the EIA tests.

The cable tests were broken down into a number of areas including headend equipment, scrambling equipment, descrambling equipment, converters and TV sets. In each area, tests were performed to determine if the cable equipment reduced the quality of the MCS signal and, also, if the MCS signal had any effect on the cable equipment or its function.

The NCTA tests indicated that all the proponents' equipment could cause problems for cable operators, and there was no 'best choice'. The NCTA recommended that one system be chosen so that the effect of the one system could be determined and the solutions found to one rather than three systems.

The EIA voted to recommend the Zenith/dbx system as the standard to the FCC. The FCC, in its ruling, made the Zenith/dbx system (referred to as the BTSC system) the defacto standard but will allow other systems providing they do not interfere with the BTSC system.

Headend processors

The first piece of cable equipment with significant potential for causing problems is the headend processor. The antenna will receive and the downlead transmit the BTSC signal as well as a monaural signal. There are currently two major types of headend processing equipment, a heterodyne processor and a demod-remod pair. Both of these have significant potential for degrading the quality of the BTSC signal.

Heterodyne processors can be divided into two principle types: split visual/aural processing and notch level control units. The split type of processor has bandpass and bandstop filters to direct the visual and aural portions of the signal to the appropriate sections of the processor for amplification, limiting and filtering as required. These filters have specified bandwidths and skirt shapes to minimize the effect on the color subcarrier located very close to the aural subcarrier. The BTSC signal can be degraded by the bandwidth of the aural filters.

The monaural signal has a baseband of 15 kHz and a deviation of 25 kHz that yields an occupied bandwidth of 80 kHz. Processors are designed with a bandpass to adequately accommodate the signal. They are not normally designed to pass a significantly wider signal due to the need to attenuate the color information only a few kHz away from the aural subcarrier. The BTSC signal can have a baseband of 120 kHz with a total deviation of 73 kHz, resulting in an occupied bandwidth of 386 kHz. The filters of current processors will attenuate some portion of the signal; the amount is dependent on the bandwidth designed into the filter.

Notch type processors do not split the aural and visual portions of the signal but use a narrow trap of variable depth to reduce the level of the aural carrier to that desired for the cable system. This notch can have the opposite effect of the bandpass filters on the split type of processor. It may attenuate the center portion of the aural signal but not the information at the extremities of the pass band.

The Chicago tests confirmed that a slight increase in distortion occurred and that there was some reduction in the stereo separation when the signal was passed through the processor. The tests did not include the professional (voice or data) channel at the upper end of the baseband, as it was not available at the time of the tests. The noise floor also increased when the signal passed through the processor.

The cable operator must ensure that degradation of the signal is minimized when passed through processing equipment. Depending on the make and vintage of the unit, it may provide adequate quality of the processed signal. If the station is transmitting a stereo signal without the second language program, there will probably be minimal degradation, while the professional channel may not get through the unit.

Current demod-remod units will not pass the BTSC signal if the aural carrier is demodulated and then remodulated. The aural demodulator has a de-emphasis network and low pass filter to provide a flat 15 kHz baseband signal to the operator. The modulator has a pre-emphasis network and modulator capable of handling the 15 kHz baseband signal. A BTSC signal passing through the demodulator will have everything but the sum channel (monaural) stripped before it reaches the output terminal strip. The modulator, if pre-

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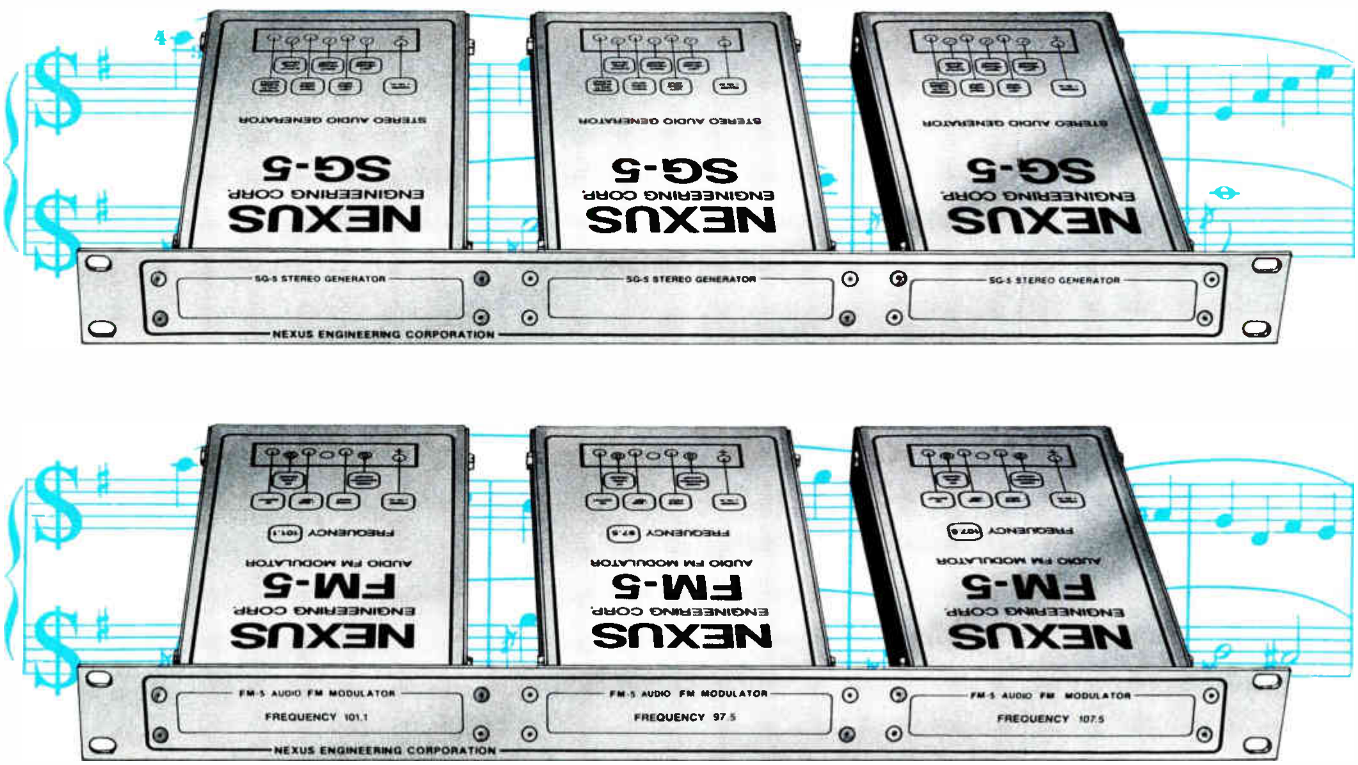

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sented with a stereo channel, will attempt to pre-emphasize the signal and then modulate it. The modulator is not designed to be linear over the wide deviation required for the BTSC signal, which will result in a distorted signal.

To accommodate the BTSC signal, the de-emphasis and pre-emphasis networks must be removed and the linearity improved to adequately handle the signal. This may be possible by a field upgrade or may require replacement modules from the manufacturer.

Some demod-remod applications may not demodulate the aural carrier. The 4.5 MHz subcarrier is passed from the demodulator to the modulator without additional processing. The bandwidth of the filters in the aural section will determine the signal degradation similar to the situation in a heterodyne processor. The make and vintage of the unit, and the BTSC signal received, will determine the extent of any signal degradation.

The next portion of the system to degrade the BTSC signal is the trunk and distribution system. The major concern in this area is noise. During the first set of EIA tests, it was determined that it would be necessary to have the signal companded if quality audio were to be delivered to the sets located in the Grade B contour area. Cable companies typically reduce the signal level of the aural carrier to 15 dB below the level of the visual carrier. This is a marked reduction for stereo signals, as it moves the signal closer to the system noise floor; and the BTSC subcarriers are significantly more susceptible to system noise than the monaural signal. With the reduced aural carrier and higher noise floor of the system, it was expected that stereo reception on a cable system would not be satisfactory. With this input the EIA decided to further investigate companding systems to determine if the noise performance of the BTSC signal could be improved. The final BTSC system incorporates a companding system devised by dbx.

The effects of system noise were not investigated in Chicago, as the companding equipment was not available at the time of the tests. Subsequent tests were performed in Toronto for the Canadian Cable TV Association to determine the effects of the BTSC system on cable systems. Part of the test program included measuring the noise floor of the stereo and SAP channels as the visual carrier to noise ratio was reduced. It was found that the stereo noise floor did not increase significantly until the visual carrier to noise was reduced below 30 dB. The audio remained quite good when the picture was not watchable. The SAP channel is more susceptible to the system noise, as its noise floor increased with the reduction in visual carrier to noise.

Amplitude Modulated Links (AML) do not cause significant degradation of the BTSC signal. There is a slight increase in distortion and noise floor while reducing the separation.

Terminal devices

The final component in the cable system is the converter. Units that heterodyne the cable signal to one output channel were found not to cause significant quality degradation. These units introduce some phase modulation on the converted channel, but it is normally removed during the intercarrier detection process. One concern is the possibility of set manufacturers returning to the split sound detection method. This approach can produce better audio quality, but any phase modulation caused by the converter will reduce the quality of the stereo signal.

Converters that take the signal to baseband and remodulate it will not pass the stereo signal at this time. The units may provide the cable customer with a means of remote volume control without requiring a hand control unit for

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You can now offer up to 52 channels of stereo television and 17 premium audio channels on your system. All this, with sound quality unaffected by cable noise and transmitted 25db below video carrier so they will not overload your system.

With the revolutionary set-top converter from Studioline, combined with the advanced Leaming head-end equipment, you provide the cleanest, brightest sound ever offered – quality superior to any other transmission system. While, at the same time, you offer EVERY TV channel in stereo. All EIA signals are transmitted in true stereo, and monaural signals are automatically converted to synthesized stereo so your subscribers will perceive all television audio in stereo.

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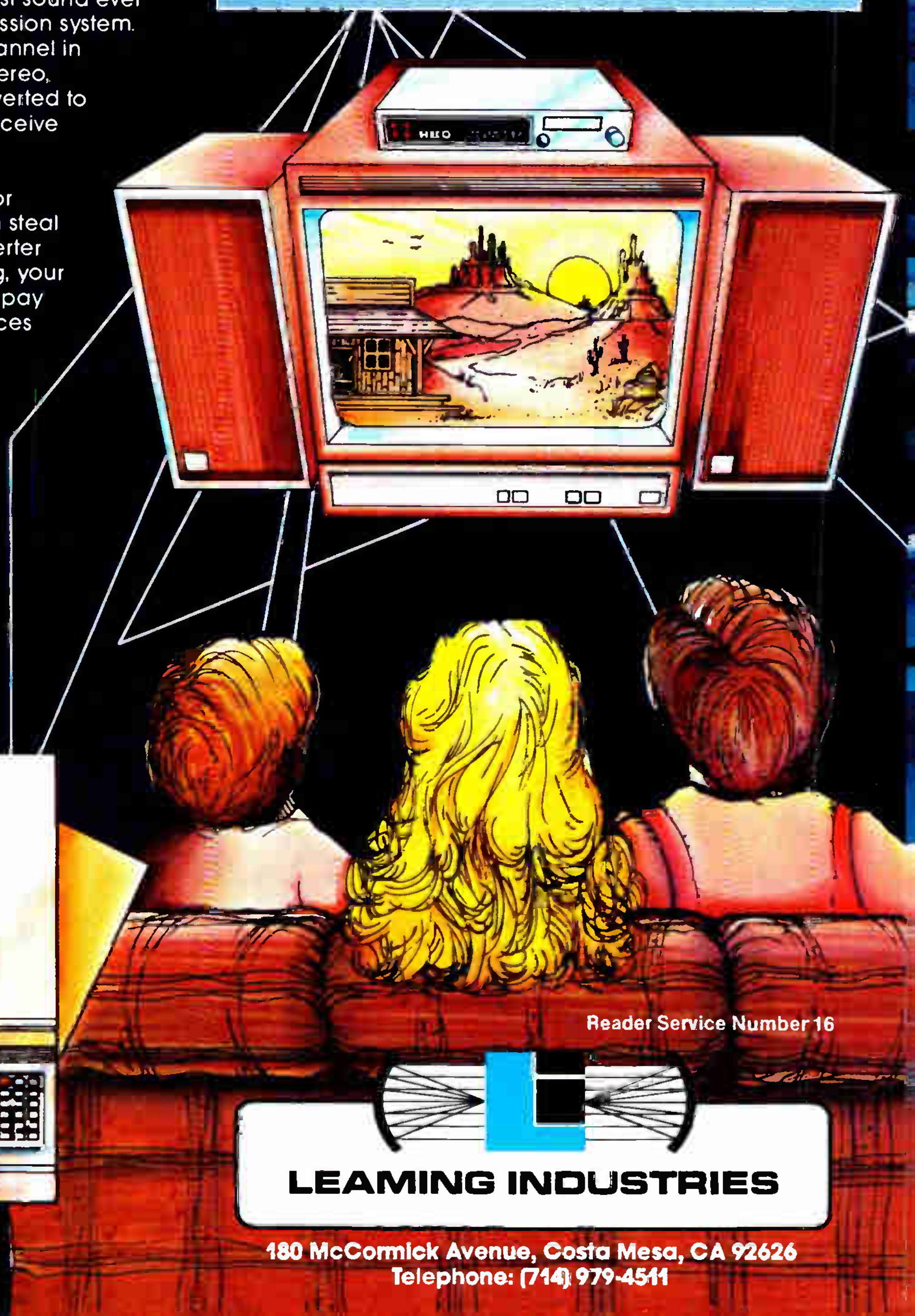

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the TV set. Present converters have a low pass filter to limit the audio baseband to a maximum of 15 kHz and to minimize distortion. When a BTSC signal is passed through the converter, the pilot, stereo difference channel, SAP and any other subcarriers are stripped by the low pass filter. The subscriber only should receive the monaural signal. Due to manufacturing tolerances, it is possible that if the volume levels are set high enough, sufficient pilot carrier may pass through the converter to trigger the stereo decoder in the TV set. This can result in noisy, possibly distorted audio quality. The subscriber will have to be educated to the fact that the converter will not pass the BTSC signal.

Manufacturers of baseband converters presently are redesigning their units to pass the complete BTSC baseband and remodulate it with minimal distortion. These units will probably not be on the market until spring 1985. In the meantime, cable opertors will have to purchase units with built-in obsolescence.

The overall quality of the BTSC signal as it passes through the cable equipment and system will be continually degraded. The final quality delivered to the customer will depend on the quality of the received signal and the total system degradation. Alignment of the equipment or replacement of components should minimize degradation and ensure that customers receive a quality signal.

Scrambling systems

The off-air signals can be received and transported to the customer's home without significant degradation, providing equipment is obtained that will pass the signal and the system is well maintained. A different situation exists, however, with signals received from the satellite. A number of different methods of supplying stereo signals are available to the satellite user, and the one chosen by the supplier is based on his belief that it will supply the best quality for the price. At the present time, no suppliers are considering the use of the BTSC standard for satellite transmission. Whether it will be used in the future remains to be seen. It will depend on the quality of the signal available at the TVRO and uplink audio scrambling factors.

If the cable operator wants to supply customers with a satellite service in stereo, a BTSC encoder must be purchased and installed at the headend. These units now cost between $12,000 and $20,000 for broadcast quality equipment. There are no cable quality units available at this time, and the broadcast units have a very long delivery time.

The stereo signals generated by the cable operator will generally be on a tiered service and will require scrambling. The scrambling technique used will determine if there is any interaction between the BTSC signal and the scrambling/descrambling process.

The Chicago tests and subsequent Toronto tests confirmed that some scrambling techniques are susceptible to interference from the BTSC signal. One type of scrambling system converts the signal to baseband prior to descrambling and then remodulates the signal for the TV set. This type of unit typically converts the audio to baseband at the same time to supply the customer with a volume control option. The BTSC signal will not pass through the baseband audio portion of current baseband descramblers because of the low pass filters. The subscriber will receive the monaural portion of the BTSC signal. The cable operator will have to replace the converter/descrambler with a unit that will pass the composite baseband before the subscriber will be able to receive a stereo signal.

A preproduction descrambler with an optional aural subcarrier output was tested. The subcarrier was decoded in a BTSC decoder that accepted the 4.5 MHz input. The signal was switched from scrambled to unscrambled with minimal degradation change in the scrambled mode. Baseband converters, when adapted to pass the composite baseband, should not cause significant signal degradation, provided the manufacturers use quality components in the new units.

Other types of scrambling systems suppress the sync signal and then reinsert the sync by changing the RF gain in the decoder. The decode information is provided by a number of different techniques, with the key placed on the aural carrier, in the vertical interval or on a separate carrier. The decoding process can degrade the audio quality, and the presence of the BTSC signal can degrade the visual picture quality.

Decoding the scrambled signal requires the regeneration of the horizontal sync information. The sync occurs at 15.734 kHz, which is the same frequency as the stereo signal pilot carrier. During the decoding process there is normally some sync information either transferred to, or not totally removed from, the aural carrier. This sync information can change the phase and level of the stereo pilot carrier, resulting in a reduction or separation of the stereo signal. The placement and timing of the reinsertion signal determines the amount of signal degradation that occurs. For most systems there is not sufficient degradation to cause customer complaints.

In addition to degrading the audio quality during the descrambling process, the visual quality of the channel can be degraded by the presence of the BTSC signal. A number of systems carry the reinsertion timing information on the aural carrier. The presence of the wide deviation information on the aural carrier can result in timing instability or low frequency noise in the decoded picture.

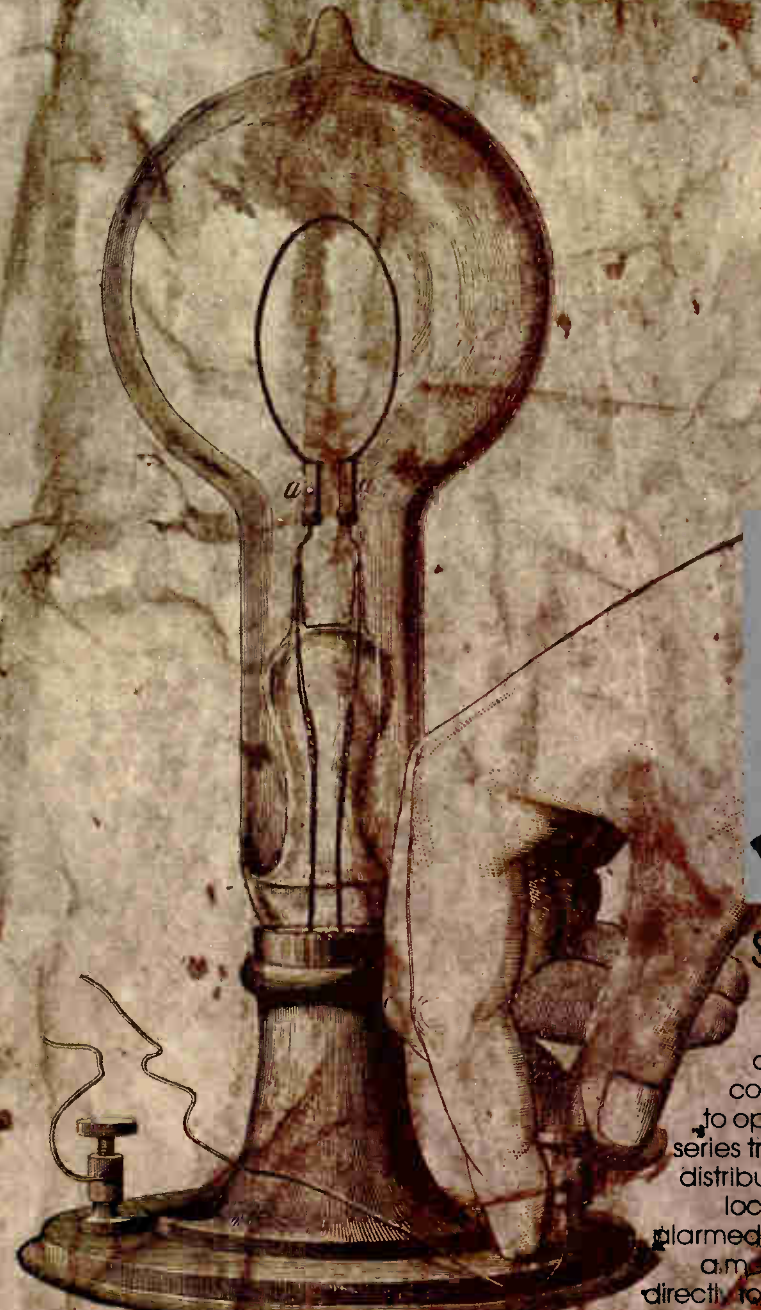
Systems using a sine wave sync suppression system with decoding information on the aural carrier are susceptible to low frequency streaking in the picture. The decode information is passed through a narrow bandpass filter to obtain the AM information necessary to regenerate the sync signal. The wide deviation BTSC signal, when passed through the filter, suffers some FM to AM conversion. The AM information contaminates the decoding information causing level changes and streaking or low frequency noise.

The pulse-type sync suppression systems with decode information on the aural carrier are less susceptible to the FM to AM conversion process. The reinsertion pulse just sets the timing of the sync reinsertion and does not control the gain over the complete video line. The video levels do not change with the additional AM information on the aural carrier. The sync timing information can be affected by the additional AM information especially during periods of high deviation, such as loud music passages. This can show up in the picture as a loss of video line similar to the effect that high level sweep can have on a picture. The amount of picture degradation will depend on the level of modulation of the aural carrier.

Scrambling systems that transport the decode information in another portion of the band are less susceptible to picture or audio degradation. The picture is not normally affected because the decode information is not carried on the aural carrier. The BTSC quality will not be affected if no changes are made to the aural carrier.

Conclusion

The delivery of BTSC signals on a scrambled service may be more difficult. The signal must first be encoded in BTSC format, then delivered to the subscriber in the scrambled format. The scrambling system used will determine the quality of service provided and whether equipment in the field needs to be retrofitted. The operator must determine, from a cost and marketing standpoint, the best method of delivering stereo service.■



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Reader Service Number 21

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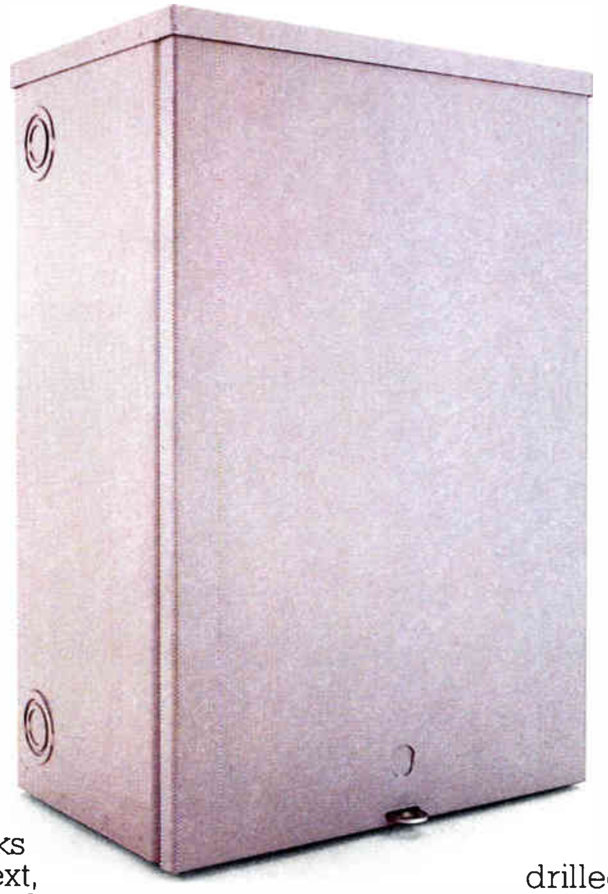

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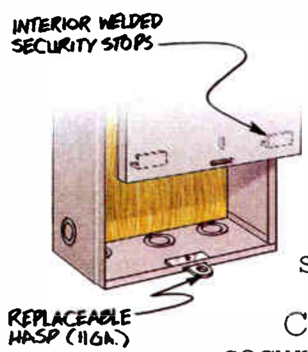

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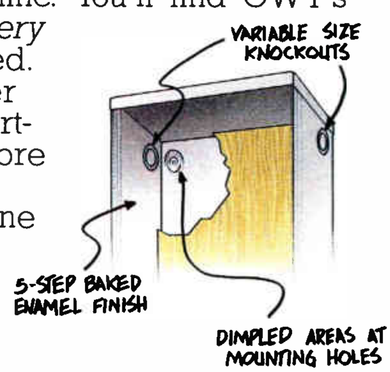

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Reader Service Number 22

CARS expands to 18 GHz

By Paul J. Fox, P.E., Fox Associates

As a result of recent FCC action, the cable industry now has access to more than three times the microwave spectrum it previously had. Historically, CARS (Cable Television Relay Service) has referred to the band 12.7-13.2 GHz. This existing band ("12 GHz CARS") has become increasingly crowded as cable television use of microwave has expanded. Now, there is an additional band at 18 GHz available to the cable industry. While it cannot do everything the 12 GHz band can do (propagation conditions make it poorly suited to long distance carriage such as importing distance signals), the large number of channels and lack of frequency congestion suggest that it will be a valuable tool for the cable industry.

Regulatory action

On Sept. 9, 1983, the FCC adopted the 18 GHz (17,700-19,700 MHz) channel plan. This channel plan significantly expanded the amount of spectrum available to cable operators. But it had one significant disadvantage. While 440 MHz was allocated for use by 6 MHz channels, the spectrum was in two separate sub-blocks separated by 1,120 MHz of spectrum allocated for different uses. This non-contiguous channel plan would have increased the cost and complexity of CARS systems serving the high capacity systems the cable industry is building today.

Fortunately, the cable industry was able to mount a concerted effort led by the NCTA and Hughes Microwave Communications Products—that resulted in a revision to the September 1983 channel plan. As a result of this effort, on Aug. 8, 1984, the FCC revised the 18 GHz channel plan so cable could enjoy access to a contiguous band of 440 MHz.

In examining the FCC channel plans, two concepts are central. The first is service sharing—the idea that several services (industries) share access to the same channels. And the second is overlapping channels in which the same spectrum is channelized for several different channel bandwidths.

Service sharing

In the 18 GHz band, the FCC implemented a proposal that it had considered for some time—service sharing. Under service sharing, the technical nature of the proposed use is more important than the identity of the operator. "Service" is the term used by the FCC to distinguish between different kinds of radio system users. The microwave services are common carrier, broadcasting, cable TV and private (i.e. everyone else).

At 18 GHz, the FCC decided that, rather than divide the spectrum up between the services, it would divide up the spectrum by the technical nature of the use (wideband point-to-point channels, 6 MHz channels, etc.). All microwave users who need 6 MHz channels, regardless of their service, use the same frequencies. Hence, the same 6 MHz channels used by the cable industry for local distribution service (delivery to distribution hubs) will also be used by private companies wanting to set up video teleconferencing links between two plants or a broadcaster wanting to transmit vestigial sideband video. These same 6 MHz channels also will be used by common carriers or private companies wanting to transmit 6.312 megabits per second T-2 channels (96 digital voice channels) in 6 MHz.

The price for this increased technical flexibility is a more complicated coordination procedure. In the 12 GHz CARS band, cable operators only had to worry about coordinating with other cable operators and an occasional broadcast installation. At 18 GHz, a cable operator must also coordinate with common carriers and private users, using the procedures specified for common carriers in the FCC rules.

Overlapping channels exist when an operator can use the same spectrum for more than one channel bandwidth. This is nothing new for cable since the 12 GHz CARS band already is channelized for overlapping 25, 12 and 6 MHz channels. At 18 GHz, the FCC expanded the use of this procedure.

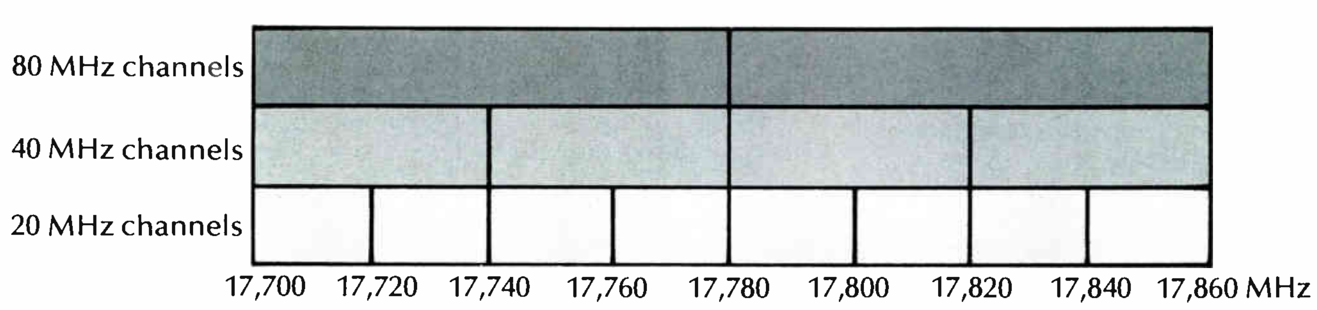
Figure 1 shows how the concept was applied to the "wideband" channels. At any given location along a particular azimuth, the frequencies from 17,700-17,780 MHz can be used for one 80 MHz channel, two 40 MHz channels, or four 20 MHz channels (or one 40 MHz channel and two 20 MHz channels). The channels shown in Figure 1 were unaffected by the changes between the originally adopted plan and the revised plan.

In addition to the wideband channels of 80, 40, and 20 MHz bandwidths, the 18 GHz channel plan also provided for "narrowband" channels of 20, 10, and 5 MHz. These narrowband channels are overlapped in the same way as the wideband channels. Again, the cost of this greater technical flexibility is a small increase in the complexity of the coordination process.

Types of channels

Both the originally adopted channel plan and the revised channel plan involve the same "building blocks"; the

Figure 1



difference is the order of these building blocks, not their internal composition or bandwidth. The four building blocks are:

- Wideband Channels (880 MHz) - The 80, 40, and 20 MHz point - to - point overlapping channels discussed above, including directional ("spoke") point-to-point channels. All four services (cable, broadcasters, common carriers, and private) are eligible.
- 6 MHz Channels (440 MHz or 73 6 MHz channels) - Again, all four services are eligible for these point-to-point channels.
- Narrowband (480 MHz) - 20, 10, and 5 MHz point-to-point overlapping channels. Common carriers, private and broadcasters (5 MHz channels only for radio studio-to-transmitter links and intercity relays are eligible.)
- DTS [Digital Termination Service] (200 MHz) - An omnidirectional digital service that common carriers and private users can apply for.

In addition, there was a fifth type of channel provided for in the FCC's decision. These were 220 MHz wide channels intended for carrying 274.176 Mbps T-4 channels (4,032 digital voice channels). These 220 MHz channels overlap the wideband and 6 MHz "building blocks" in both channel plans. The rearrangement of the "building blocks" simply moved the location of the individual 220 MHz channels. Since the FCC did not anticipate that anyone other than common carriers would require 220 MHz channels, it is the only service eligible for these channels.

In both the originally adopted and revised channel plans, the FCC separated each "building block" into a transmit and receive portion. This distinction is more a matter of nomenclature than technical significance because the channels do not have to be paired in each direction. Users are free to use both "transmit" and "receive" channels in the same direction.

Figure 2 shows the originally adopted channel plan and the revised channel plan. While the "building blocks" are rearranged in the revised channel plan, the major difference is that the transmit (T) and receive (R) 6 MHz channels are now contiguous. As noted above, the transmit and receive nomenclature in no way prevents a cable operator from using all the channels "downstream" in one direction.

Remaining regulatory activity

It is possible that the revised channel plan may not be permanent. AT&T has petitioned the FCC to reconsider the August 1984 decision, proposing yet another channel plan. Fortunately for the cable industry, the AT&T proposal does not affect the two channel blocks for which cable is eligible (wideband and 6 MHz channels). As a result, further FCC action on the 18 GHz channel plan would probably not directly affect the cable industry.

What could affect the cable industry is if the FCC reopened Docket 82-334 with a Further Notice of Proposed Rulemaking and reintroduced some of the proposals that were not adopted this time around. Several of the proposals, such as the minimum path length proposal, failed to take into account the particular circumstances of cable usage of microwave and would have had a serious impact on cable systems. Fortunately, the cable industry was able to persuade the FCC to abandon these proposals. A concerted effort on our part may again be needed if the FCC reintroduces these earlier proposals.

Docket 82-334 was necessitated by the earlier FCC decision to authorize DBS (Direct Broadcasting Satellites) on an exclusive basis in the band: 12.2-12.7 GHz (just below the 12 GHz CARS band: 12.7-13.2 GHz). Unfortunately, the 12.2-12.7 GHz band already was occupied by private microwave users, so the FCC needed to find a home for these "displacees." The bad news? The FCC decided the 12 GHz CARS band was a good place. The good news? Only existing licensees in the 12.2-12.7 GHz band can use the 12 GHz CARS band. New private users, who previously would have filed applications in the 12.2-12.7 GHz band, are not eligible to use the 12 GHz CARS band. This means that between now and September 1988, it is possible that some existing private users will be eligible to use the 12 GHz CARS band. However, it is unlikely that this will have a significant impact on the cable industry as the rules now stand.

Likely 18 GHz uses

While 18 GHz obviously suffers from propagation problems due to rain attenuation and greater multipath fading, it also has some significant advantages, especially in crowded metropolitan areas. The two major advantages are that it is essentially unused at the present time, and a second wideband cable can be fed from the same location. With the large number of channels allocated and the short distances between co-channel reuse, frequency congestion should not be a problem for some time, even in large metropolitan areas with severe frequency congestion in the lower frequency bands.

In the past, to provide microwave feeds to two high bandwidth cables it was necessary to establish two "headends," feeding the A cable with microwave from one headend and the B cable with signals from a second headend. While this worked on several occasions, it is a complicated procedure that cannot be applied in every circumstance because of the unavailability of two separate transmitter locations with adequate separation between them. With the adoption of 18 GHz, it is now possible to feed one cable with 12 GHz and one with 18 GHz. The other advantages are the large number of channels (up to seventy-three 6 MHz channels) and the large channel bandwidths available (up to 80 MHz).

Eighteen GHz microwave can be useful in providing upstream communications because it avoids frequency conflicts (either current or future) with the existing downstream system. The complex multiplex systems that are sometimes necessary when 12 GHz CARS is used for both up- and down-stream can be avoided with 18 GHz.

Institutional network uses

While feeding dual cable systems will probably be the most important contribution the 18 GHz CARS band will make (simply because of the lack of alternatives available), given present cable design trends, it is unlikely to be the majority use. In the short term, the more frequent use of 18 GHz will probably be in supplementing institutional links. Eighteen GHz will be ideal for the short links connecting an institutional user to a cable system when a cable link does not exist because of natural barriers, high underground construction costs, an earlier decision not to build into industrial/commercial areas, or a location outside the franchise area.

One use that should prove valuable is helping interconnect local area networks (LANs), the multipurpose communications networks many companies are installing to interconnect their data processing and office automation equipment. Since many of these systems already use the same RF technology as CATV systems, using a cable system to interconnect corporate LANs at various locations is a perfect application for the institutional networks many cable systems have built. As discussed above, 18 GHz CARS microwave may be valuable in quickly and economically filling in the "missing links."*

Another application for which 18 GHz microwave will find frequent application is as a link between a long distance user and a long distance communications company. These links, sometimes labeled "by-pass," usually provide better service than the local exchange carrier and avoid the effects of artificially raised prices for long distance access.

The lack of frequency congestion in the 18 GHz band and the short distances involved in the above applications make 18 GHz microwave the perfect solution when cable connections are unavailable.

Equipment availability

Several microwave equipment manufacturers already have digital 18 GHz systems available today. Many cable applications, however, will require analog systems. Even the digital LANs discussed above may want an analog microwave system that is "transparent" to the LAN, eliminating the need to demodulate the VHF cable waveform to a baseband digital signal that can be input into existing 18 GHz digital microwave systems.

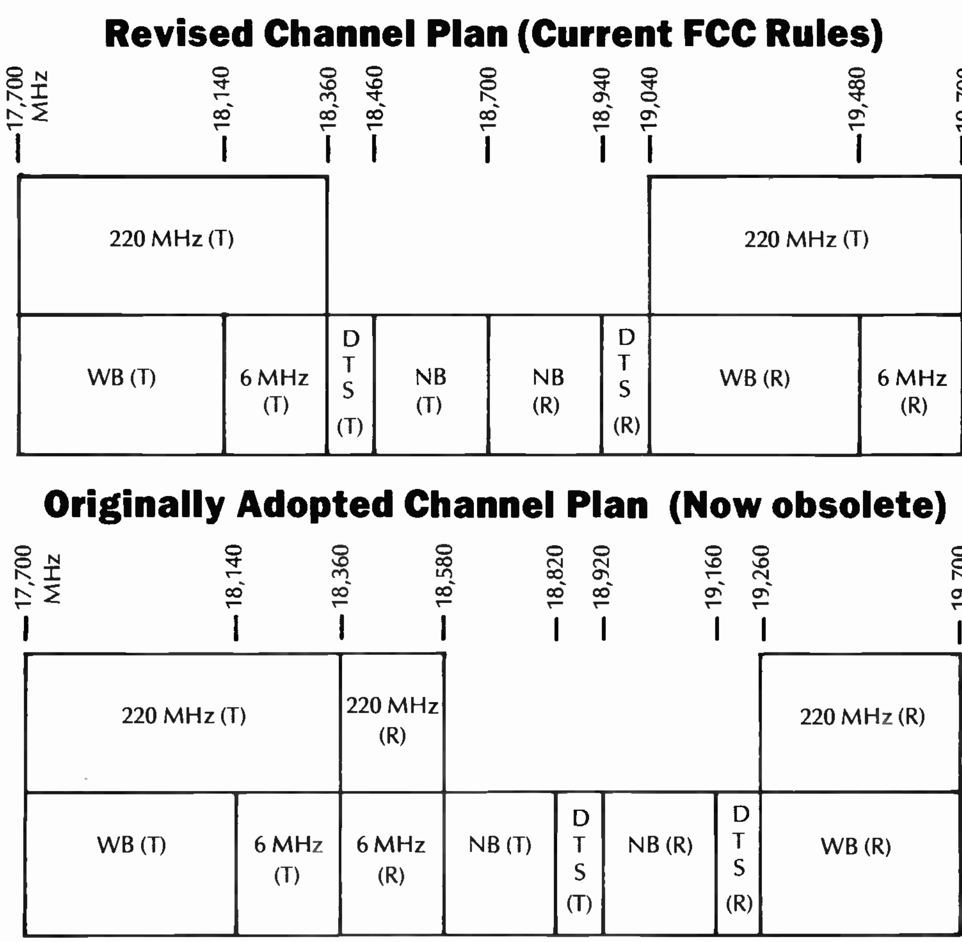
Several of the major manufacturers expect to have announcements in the near future, but Hughes Microwave Communications Products already has received FCC type acceptance and will start shipping in February. The Hughes radios will be capable of handling 6 MHz vestigial sideband video, FM broadcast radio signals, FM video, and transparently passing LAN signals. Equipment performance is similar to that achieved by Hughes at 12 GHz. (System performance, however, is not similar because of the higher rain attenuation and multipath fading encountered at 18 GHz.)

The recent FCC decisions significantly expanded the microwave spectrum available to the cable industry. While the new band is not a panacea for all of the industry's microwave needs, it does provide significant benefits. The large number of channels, the lack of spectrum congestion for several years to come, and the technical flexibility available to users, all combine to make 18 GHz microwave a valuable addition to the cable industry. ■

Footnote

**In situations where there may be regulatory problems in using a CARS license, it may be expedient to have the license formally held by the customer (as a private licensee) and for the cable operator to provide and operate the equipment. There are ample precedents for such procedures in the private land mobile area.*

Figure 2
18 GHz Channel Plans



Key:
DTS = Digital Termination Systems
220 MHz = 220 MHz channels
WB = 10, 20, 40 & 80 MHz channels
NB = 5, 10 & 20 MHz channels
6 MHz = 6 MHz channels
(T) = Transmit frequencies
(R) = Receive frequencies

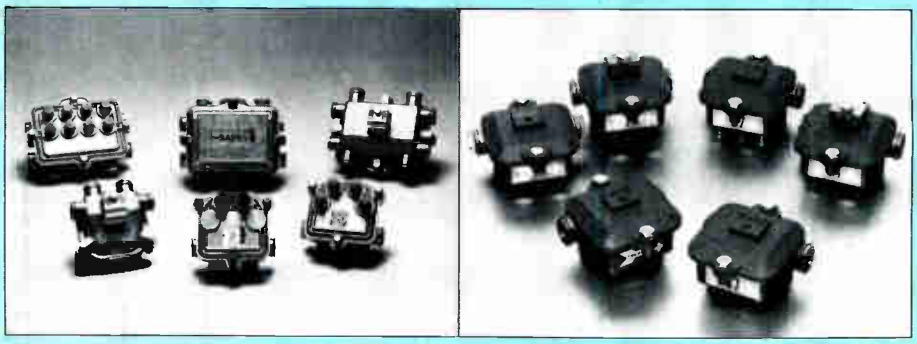
Communications Engineering & Design

TECH II

CED's feature supplement and Product Profile

January 1985

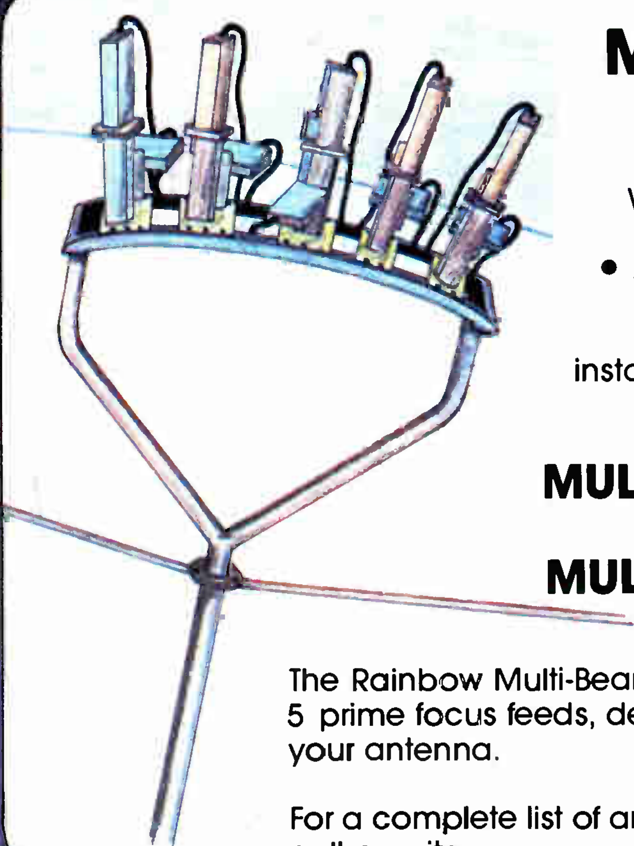
- **Keeping an eye on LPTV**
- **Product Profiles: directional taps, traps**



Directional taps from Scientific- Atlanta and American Technology

Reader Service Number 25

5 Star General



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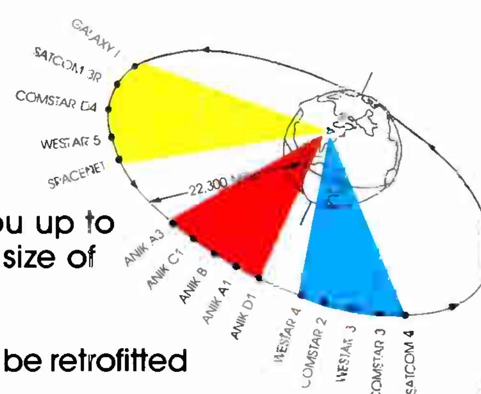

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Reader Service Number 26

Keeping an eye on LPTV

By Roy Ehman,
Director, Technical Services, Storer Cable Communications

Now that we have convinced ourselves of the importance of "LPTV watching" and have gained a working knowledge of the licensing and denial procedures and their "windows" from last month's article by Katherine Rutkowski, let's look at how you can track LPTVs on your own computer with the assurance that no single development will escape your attention. We also will see some examples of what is "out there" and develop some interesting, possibly surprising statistics.

To begin tracking, we must have the FCC database (obtainable from the NTIS* on standard half-inch IBM tape). The format is pure ASCII @ 1600 BPI, and there are no stumbling blocks such as binary codes or embedded control characters. Recently, the NTIS has been offering its data on other media, such as floppies. Recent tapes have had about 39,000 records of 360 characters each, making them a little over 14 megabytes. This length would necessitate several floppies.

This database not only holds all LPTV records, but also all translator and TV records, which makes it useful for determining must-carry distances with precision and antenna orientation with relative field strength prediction for off-air reception. Each individual record contains all you could want to know about a station. This information is well documented in the paper work accompanying the first copy, and it gives a full description of what each field contains and exactly where it is located. In fact, there is such a wealth of information that most of it can be dropped in the transfer process, making it possible to get the record size down to as little as 51 characters.

Here are two raw records using 51 character fields containing everything you need for doing your own LPTV watching:

```
NEW-T 04-.588MELBOURNE  FL282555080403481021 7RHTXAP
NEW-T 07 31.4ORLANDO    FL283231081220284030 6R3TXAP
```

This is how they might look after formatting and printing:

```
CALL   CHAN  POWR  CITY       STATE  LAT ------LONG   APP REF#  STATUS
NEW-T  04-   .588  MELBOURNE  FL     282555 0804034   810217RH  TX  AP
NEW-T  07    31.4  ORLANDO    FL     283231 0812202   840306R3  TX  AP
  6     3     4    11          2     6      7         8         2   2 = 51
```

Use whatever formatting techniques your computer provides. If "print using," mask, or mapping statements are not available, you can fall back on string manipulation such as:

```
110  CITY$=MID$(RECORD$,14,25)  or  CITY$=RECORD$[14,11]
```

A length of 51 characters is convenient because it gives 10 records for each 512 character disc block. At this density your 16 bit microcomputer will gather the statistics shown in Figures 3 and 4. Distances also can be checked using the coordinates at about 100 per second. An excellent alternative size would be 64 characters, giving 8 records per block and allowing you to hold the first 13 characters of the owner's name if you desire. On the tape a field of 36 characters is allowed for the name.

The power used in the compressed record is the EIRP. Since the problems you will encounter with LPTV are strictly line-of-sight phenomena, the HAAT and AMSL can safely be dropped. The additional complications of using beyond-the-horizon calculations over anything but "plain earth" and using antenna height corrections are unnecessary and increase run-time. The minus sign after the 04 is, of course, the offset.

The APP REF# is needed to identify any application and typically comprises the date (computer style with no delimeters: YYMMDD followed by two letters). The TX abbreviation indicates that the record is an LPTV or a translator; the AP, that it is an application. Other codes encountered are LI for license and CP for construction permit.

The main problem in doing this yourself is getting the database off the tape and down to a manageable size. If you do not have access to one of the larger micros with a tape drive, shop around for a data processing house.

During this transfer, it is desirable to drop areas such as Alaska, Hawaii, Puerto Rico, Guam, etc. This takes only one line of code and speeds things up. For example:

```
115  IF INSTR(1,"AK,HI,PR,TT",STATE$) > 0 RETURN
```

This line means that if the STATE$ of the record is IN-STRing "AK, HI, PR, TT" (position greater than 0), then stop processing and go back and read the next record. The size of the database after this compression technique is only about 34,000 records and only 1.79 Meg.

Our new compact file now needs to be sorted by ascending latitude. Simply use your computer's sort utility to do this, but be patient. A file of this size may take ten minutes to sort.

Next, our data file must be a random access type so that we can read it backwards as well as forwards and do binary searches. If it is not already random access, convert it by writing it into the new format:

```
200  OPEN #1,"TV.SEQ",INPUT
210  OPEN #2,"TV.RND",RANDOM,51,RECNUM   'RECNUM =  record # Variable
220                                      'This is the READ Loop entry
230  INPUT LINE #1,RECORD$               'Read a line
240  (IF END-OF-FILE, CLOSE FILES AND QUIT)  'translate as read
250  WRITE #2, RECORD$                   'write line to Random file
260  RECNUM=RECNUM+1                     'Increment record number
270  GOTO 220                            'Return to read loop
```

Low power TV primer

LPTV interference is caused in the following ways:

- By transmitting on the output frequency of the converter box, which is usually channel two or three. Any ingress of sufficient level would cause co-channel interference which would appear to the subscriber as being on all channels.
- By transmitting on, or adjacent to, a channel which is being used for reception of distant signals. This could happen on VHF or UHF. It then is necessary to calculate the strength of the interfering signal at the receive site. In order to consistently avoid visible co-channel, this level would have to be 60 to 70 dB down on the distant signal level under worst case conditions such as fading.
- By transmitting relatively high power on VHF and being located among the system subscribers, causing ingress into the distribution system and co-channel interference on that particular channel.
- LPTV stations also may win away a few cable subscribers.

There can be no doubt that LPTVs pose a real threat to cable operators. But if we are willing to learn the steps involved in tracking LPTVs from application to operation, our systems can avoid the problems listed above. The choice is yours: a little work now, or a lot of work later?

If your BASIC can use labels, simply replace the vacant line with meaningful labels and scrap the line numbers.

We now have two ways we can go with our data. First, we can write a program that will give us a printout of any combination of TV, TX, license, application and CP or everything within "X" miles of a set of coordinates, such as your headend(s). (See Figure 1.) Or we can search out LPTVs by application reference number (before or after the lottery); commit the coordinates to memory; and have the computer run them against a file containing all our system coordinates and have it print warnings of conflicts to file and/or print. An example of how this could look is shown in Figure 2. (Many lines were deleted in Figures 1 and 2 because of space limitations.)

First, we do not read or calculate on the entire file, but only scan the relevant portion from a suitable latitude south of us to a similar offset to the north. Here is a simple example: Suppose we want to know everything within 60 statutary miles. We could start at the beginning of the file and do the distance calculation on every one of the 34,000 entries. This would take six to ten minutes rather than the usual one minute. Knowing that one degree of latitude is very close to 60 miles depending on the latitude itself (the world is a little flattened at top and bottom), we only need scan our sorted-by-latitude file from minus one degree of the given coordinate latitude to one degree north of it. Other radii are accommodated in a similar manner using one degree of latitude for every 60 miles of search radius. It is a good idea to scan 2 or 3 percent extra, since there is over a mile difference in a degree latitude between Miami and "up-north."

Binary search

How do we get that starting point latitude? One way is to start at the beginning, reading the latitudes until we get there.

TV-SEARCH for TV TX (LI AP CP)

CALL	CH	LOCATION	STATE	POWER	MILES	BRNG	dBmV	APP/LIC#	STATUS	
WESHT	02-	DAYTONA BEA	FL	100.00	25.2	36	31	4158	TV	AP
NEW	15+	NEW SMYRNA	FL	2014.00	31.8	38	24	830919KE	TV	AP
NEW	65	ORLANDO	FL	5000.00	18.9	83	28	820907KK	TV	AP
WRES	18-	COCOA	FL	5012.00	39.2	112	25	820416KH	TV	CP
NEW	32	LAKELAND	FL	1175.00	48.9	220	16	800521KH	TV	CP
WESHT	02-	DAYTONA BEA	FL	100.00	27.3	8	31	800723KE	TV	LI
WCPXT	06-	ORLANDO	FL	100.00	17.6	77	31	2476	TV	LI
WFTV	09	ORLANDO	FL	316.00	17.6	77	29	810910KF	TV	LI
WMFET	24-	ORLANDO	FL	1260.00	17.6	77	26	396	TV	LI
NEW-T	04+	MELBOURNE	FL	0.13	30.6	115	-4	840301NH	TX	AP
NEW-T	04+	MELBOURNE	FL	0.13	30.6	115	-4	840302RE	TX	AP
NEW-T	04-	MELBOURNE	FL	0.13	30.6	115	-4	810304IV	TX	AP
NEW-T	07	ORLANDO	FL	0.03	-14.7	138	19	810331OF	TX	AP
NEW-T	07	ORLANDO	FL	0.03	-11.6	274	19	840229NS	TX	AP
NEW-T	07+	ORLANDO	FL	0.16	-14.5	213	26	HA0308RS	TX	AP
NEW-T	07+	ORLANDO	FL	0.04	-14.5	211	20	GH0308XM	TX	AP
NEW-T	07-	MELBOURNE	FL	0.03	30.6	115	-19	8403076L	TX	AP
NEW-T	07-	ORLANDO	FL	0.10	-11.9	323	24	EO0307FS	TX	AP
NEW-T	11	ORLANDO	FL	0.03	-3.8	298	17	HK0308PV	TX	AP
NEW-T	11	ORLANDO	FL	0.03	-14.6	210	17	810312JR	TX	AP
NEW-T	11	ORLANDO	FL	0.03	-14.6	210	17	HH0308SE	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.7	266	22	810311IU	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.5	211	22	GP0308PQ	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.5	211	22	GP0308QG	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.5	211	22	GP0308PR	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.5	211	22	GP0308PV	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.5	211	22	GP0308OA	TX	AP
NEW-T	11	ORLANDO	FL	0.16	-14.5	213	25	HA0308RT	TX	AP
NEW-T	11	ORLANDO	FL	0.08	-14.5	211	22	GP0308PP	TX	AP
NEW-T	11	ORLANDO	FL	0.03	-14.4	349	17	GP0308RH	TX	AP
NEW-T	11	ORLANDO	FL	0.03	-14.4	349	17	840307QJ	TX	AP
NEW-T	11	WINTER PARK	FL	0.03	-14.7	189	17	GQ0308LU	TX	AP
NEW-T	11	WINTER PARK	FL	0.03	-14.7	189	17	GU0308NE	TX	AP
NEW-T	11	WINTER PARK	FL	0.03	-14.7	189	17	GS0308NE	TX	AP
NEW-T	11	WINTER PARK	FL	0.03	-14.7	189	17	GX0308SS	TX	AP
NEW-T	11	WINTER PARK	FL	0.03	-14.7	189	17	HI0308UV	TX	AP
NEW-T	11	WINTER PARK	FL	0.03	-14.7	189	17	GN0308QU	TX	AP
NEW-T	11+	ORLANDO	FL	0.79	-14.7	266	32	840302RJ	TX	AP
NEW-T	11+	ORLANDO	FL	0.03	-14.6	210	17	840302MB	TX	AP
NEW-T	11+	ORLANDO	FL	0.79	-14.7	266	32	840302LT	TX	AP
NEW-T	11+	ORLANDO	FL	0.79	-14.7	266	32	840302LS	TX	AP
NEW-T	11+	ORLANDO	FL	0.79	-14.7	266	32	840302LR	TX	AP
NEW-T	11+	ORLANDO	FL	0.73	-14.7	266	32	840302LQ	TX	AP
NEW-T	11+	ORLANDO	FL	0.03	-14.6	210	17	840302RI	TX	AP
NEW-T	11+	ORLANDO	FL	0.03	-14.6	210	17	840302PO	TX	AP
NEW-T	11+	ORLANDO	FL	0.03	-14.6	210	17	840302SM	TX	AP
NEW-T	11+	ORLANDO	FL	0.79	-14.7	266	32	840302RL	TX	AP
NEW-T	11-	DAYTONA BEA	FL	0.22	30.3	17	-12	HN0308WT	TX	AP
NEW-T	11-	DAYTONA BEA	FL	0.22	30.3	17	-12	GJ0308LG	TX	AP
NEW-T	11-	EDGEWOOD	FL	1.66	-11.7	204	35	810327IA	TX	AP
NEW-T	11-	ORLANDO	FL	0.10	-11.9	323	22	HJ0308QP	TX	AP
NEW-T	11-	ORLANDO	FL	0.10	-11.9	323	22	HJ0308PJ	TX	AP
NEW-T	11-	ORLANDO	FL	0.10	-11.9	323	22	GO0308NJ	TX	AP
NEW-T	11-	ORLANDO	FL	0.10	-11.9	323	22	GE0308OS	TX	AP
NEW-T	11-	ORLANDO	FL	0.08	-14.7	244	21	HG0308UJ	TX	AP
NEW-T	11-	ORLANDO	FL	0.08	-6.2	105	22	GI0308SU	TX	AP
NEW-T	11-	ORLANDO	FL	0.05	-14.7	229	19	GH0308XN	TX	AP
NEW-T	11-	ORLANDO	FL	0.10	-11.9	323	22	GW0308LW	TX	AP
NEW-T	11-	WINTER PARK	FL	0.14	-8.6	48	24	GB0308QT	TX	AP
NEW-T	11-	WINTER PARK	FL	0.16	-12.0	1	25	810304IY	TX	AP
NEW-T	11-	WINTER PARK	FL	0.14	-8.6	48	24	GO0308TW	TX	AP
NEW-T	14	LAKELAND	FL	23.80	34.9	226	0	630216VY	TX	AP
NEW-T	14	LAKELAND	FL	4.54	29.1	212	-6	810304II	TX	AP
NEW-T	14	ORLANDO, ET	FL	15.60	-14.5	213	37	830217UH	TX	AP
NEW-T	14	OCOEE	FL	6.55	-1.6	274	33	830218YU	TX	AP
NEW-T	14	ORLANDO	FL	1.07	-14.6	210	25	810324IR	TX	AP
NEW-T	14	WINTER HAVE	FL	4.54	29.1	212	-6	84030706	TX	AP
NEW-T	15	ORLANDO	FL	0.50	-14.7	189	22	GX0308SY	TX	AP

End Run #115. OPR: Roy.
For TVs, Dipole Levels & distances are in MILES & dBmV at coordinates.
For TXs, MILES are from FRANCHISE PERIMETER & NEGATIVE if INSIDE, in which case the dBmV is at .6 Miles from LP/TX otherwise at perimeter.
Verification of Coordinates is your responsibility.

Figure 1

This is preferable to doing all the distance calculations, but there is an even better way.

On a file of this size, a binary search really shines. It does exactly what we should do when looking for a system fault: divides the job (number of records) in half, goes there and reads the latitude and asks, "Is what I am looking for in the top half or the bottom half?" If it is in the bottom half, it divides that in half and repeats the process. Logic tells us that there will come a time when the piece is so small that it cannot be divided anymore. This will be your file record.

So how do we find a latitude that we just calculated which may not necessarily be in the file? We add a little tailpiece onto the binary search telling it to back down one record at a time until it has a latitude which is the first one *below* what we asked for.

This is what the code looks like. You can use it to do a binary search on any sorted key in any of your future programs.

```
300                                       'OPENER:
310 INPUT"ENTER H/E LAT";D1,M1,S1         'your head-end or whatever
320 LET HLAT=D1+M1/60+S1/3600             'converted to floating point degrees
330 LET START=(HLAT - 1)                  'this is what we will search for
340 OPEN #1,"TV.RND",RANDOM,51,RECNUM     'or whatever your computer needs
350 LET RECNUM=0                          'or wherever you store the file info
360 READ #1,NUMRECS                       'get number of recs in the file
370 LET NUMRECS = HIGH                    'for clarity & to leave NUMRECS intact
380 LET SEEKS=INT(LOG(NUMRECS)/.693147)+1'number of reads to find record

400                                       'BINARY:
410 LET RECNUM = INT((HIGH+LOW)/2)        'Low usually=zero. INT means integer
420 READ #1,TVLAT                         'reads at recnum from previous line
430 LET TVLAT=DD+MM/60+SS/3600            'convert TVLAT to numeric degrees
440 IF TVLAT = START  THEN GOTO MATCH     'a lucky match. take short path home
450 IF TVLAT ) START  THEN HIGH = RECNUM 'Is the Lat higher than start?
460 IF TVLAT ( START  THEN LOW  = RECNUM 'Did I land up too low. Go to top half
470 LET SRCH=SRCH+1                       'Count number of reads
480 IF SRCH(SEEKS THEN GOTO BINARY        'Not done yet. do another read

500                                       'MATCH:
510 READ #1,TVLAT
520 IF TVLAT =) START THEN RECNUM=RECNUM-1 :GOTO 510 'back up if equal or high
```

You are now positioned to process only the needed records. Sequentially read each record and calculate the distance. Here is a popular and simple formula that's based on circular trigonometry and is accurate enough for this work: (L1 and L2 are your headend coordinates. L3 and L4 are the latitude and longitude read from the record and converted to a floating point number of degrees.)

```
600                                       'DISTANCE:
620 IF L3 ) FIN THEN GOTO END'OFF         'Fin is end of scan = HLAT+1
630 LET A=(L2-L4) * .0174532925           'Converting to RADIANS
640 LET B=(90-L1) * .0174532925           'B is constant. Better done once only
650 LET C=(90-L3) * .0174532925
660 LET E=COS(B)*COS(C)+SIN(B)*SIN(C)*COS(A)
670 LET F=ATN(SQR(ABS(1-E^2))/E)
680 LET DIST= F*3956.268                  'MILES
690 IF DIST ) RADIUS THEN GOTO SCAN       'In our example it was 60 miles

700                                       !BEARING:
710 LET G=(COS(C)-COS(F)*COS(B))/(SIN(F)*SIN(B))
720 LET AZ=ATN(SQR(ABS(1-G^2))/G)*57.295779578 'DEGREES. Az is azimuth.
730 IF H ( 0 THEN H=H+180
740 LET J=SIN(A)*57.2957795785523         'DEGREES
750 IF J (= 0 THEN H = 360-H

800                                       'LEVEL:
810 LET LOSS=36.6+20*LOG10(DD)+20*LOG10(FREQ) 'Calculate path loss in dB FREQ=MHz.
820 LET EIRP=(10*LOG10(POWER))+108.75     !Express EIRP in dBmV. Log = base 10
830 LET LEVEL=(EIRP-LOSS)+2               'Line of sight DIPOLE reading in dBMv

    REM  Thats it' Send the record and results to spooler file.
    PRINT USING MASK,CALL,CHANNEL,POWR,LOCATION,DIST,BEARING,LEVEL,STATUS
    (GD BACK AND READ THE NEXT RECORD ETC UNTIL DONE.)
```

Since our main data file is sorted by latitude, we cannot use it to do a binary search by application reference number (ARN), so we create an index instead and sort the index in ascending order of ARN. If you use dBASE II or something similar, that is just one command: "INDEX ON APPREF TO APPREF." But it is more fun and very little trouble to build your own, which seems to work better than dBASE anyway. Just read the main file and transfer the ARN (for example, 840321RE) and the record number to a new file with a name like TV.IDX. If you store the record number in binary form, it only takes two bytes, giving a total record size of a mere ten bytes. Now, sort this by ARN, and when the FCC announces a lottery date or the results of one, you can enter the apprefs

```
LPTV MONTHLY PROTECTION RUN

     The following LPTV/Translator Applicants have been drawn in
this months lottery, identified in our data-base by Application
Reference and listed in expanded form below.

APP/LIC# CALL   CH   LOCATION-STATE POWER LAT---LONG---  STATUS
810217MG NEW-T  60   ST. LOUIS   MO  9.06 383851 902013  TX   AP
830218ZN NEW-T  49   RICHLAND,  EWA   2.9 4614011191904  TX   AP
840116NS NEW-T  25   DESTIN      FL  11.0 302419 862956  TX   AP
831214VL NEW-T  42   COLUMBIA    MO  15.5 385647 921918  TX   AP
840116LH NEW-T  47   BELLINGHAM WA   13.0 4845401222913  TX   AP
810116RE NEW-T  52   MEMPHIS     TN  3.34 350917 894920  TX   AP
810108IL NEW-T  69   LITTLE ROCKAR   1.67 344750 922926  TX   AP
810217MY NEW-T  62   COLUMBUS    OH  .941 400933 825521  TX   AP
840116R2 NEW-T  25   COOS BAY    OR  12.8 4323281240748  TX   AP
800909II NEW-T  57+  FORT MYERS FL   1.62 264256 815036  TX   AP
831214MS NEW-T  05   OIL CITY    PA  0.06 412505 794252  TX   AP
820617M8 NEW-T  28   FOND DU LACWI   11.7 434340 883330  TX   AP
820330TZ NEW-T  03+  OSCODA      MI  .241 442018 833716  TX   AP
820430RY NEW-T  39   BRIDGEHAMPTNY   10.7 405628 721832  TX   AP
840116SY NEW-T  27-  JONESBORO   AR  1.30 355118 904420  TX   AP
840116RD NEW-T  17   CARIBOU     ME  2.64 464552 675923  TX   AP
8401167M NEW-T  19-  JEFFERSON CMO   19.1 384044 920431  TX   AP
820419SV K70DO  34   MANTI, ETC.UT   .741 3912061114339  TX   AP
820615PV NEW-T  51   WABASH      IN  .744 404711 854919  TX   AP
820617G7 NEW-T  45   FORT LEONARMO   16.8 374530 920630  TX   AP

ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC


We have less than 15 days in which to file for a denial of
licence where any of the above may intrude into one of the
protected systems as indicated below

SYSTEM ST  RAD  STATUS
BAYMIN AL 10.0  OKAY
CLANTO AL 11.0  OKAY
DAPHNE AL  8.0  OKAY
ELBAXX AL  5.0  OKAY

FLORAL AL   5.0 POSSIBLE CONFLICT
CALL   CH  LOCATION STATE    POWER  MILES BRNG dBmV  APP/LIC# STATUS
NEW-T  25  DESTIN      FL    11.00   37.7  194   -3  840116NS TX  AP

GENEVA AL   5.0 POSSIBLE CONFLICT
CALL   CH  LOCATION STATE    POWER  MILES BRNG dBmV  APP/LIC# STATUS
NEW-T  25  DESTIN      FL    11.00   50.9  221   -5  840116NS TX  AP

    MONTGO AL 10.0 OKAY
    PRATTV AL 10.0 OKAY

SAMSON AL   5.0 POSSIBLE CONFLICT
CALL   CH  LOCATION STATE    POWER  MILES BRNG dBmV  APP/LIC# STATUS
NEW-T  25  DESTIN      FL    11.00   50.3  210   -5  840116NS TX  AP

    SLOCOM AL  5.0 OKAY
    SYLACA AL  5.0 OKAY
    TROYXX AL 10.0 OKAY

LITTLE AR 15.0 POSSIBLE CONFLICT
CALL   CH  LOCATION STATE    POWER  MILES BRNG dBmV  APP/LIC# STATUS
NEW-T  69  LITTLE ROCKAR      1.67   -7.8  311   23  810108IL TX  AP
```

Figure 2

(since the FCC presently does not give the coordinates) and do a binary search for the APP REF. It will be found if it is in the file and will give you the Recnum of the LPTV so that you can go straight to it with one read. The record along with the coordinates can be stored in an array. When finished batching in the LPTVs by ARN, you can use the same basic distance, bearing and loss calculations to run against any or all of your system coordinates and have it print out the ones that fall within "X" miles of your headend(s).

A small portion of a six-page printout of all the activity within 50 miles of the Orlando City Hall, generated using these techniques, is shown in Figure 1. The radius of this imaginary system is 15 miles. In order to show a representative selection of VHF entries on one page, 30 channel 07 applications and several from other channels and catagories (except channel 11) were edited out.

Actually, this is probably all you will ever need, since it tells you both the nature and magnitude of any upcoming problems. You then can watch the FCC publications to see whether anything potentially serious comes up.

A few words of explanation might be in order here regarding some features that have been built into this version. Let's look at the real case marked by asterisks in Figure 1. The applicant is asking for channel 11+ and a horizontal EIRP of 795 watts. The level off of a dipole antenna at 0.6 miles is +32 dBmV. The 0.6-mile figure was chosen because it covers a distance of a little more than one square mile. Assuming a drop level of 0 dBmV and a drop cable isolation of 100 dB, you can see that the level calculated will place customers on the threshold of co-channel.

In the likely event of minor deterioration in drop or connector integrity, co-channel will become disturbingly visible on channel 11. (Note that this is at 0.6 miles from the LPTV station

```
                ANALYSIS of TV DATABASE

                         VHF        UHF      TOTAL
TV LICENCES              606   +    521  =    1127
TV CP'S                   76   +    326  =     402
TV APPLIC.                84   +    518  =     602

TV SUB TOTALS            766   +   1365  =    2131

TX LICENCES             2472   +   1823  =    4295
TX CP's                  273   +    486  =     759
TX APPLIC.              3790   +  23833  =   27623*

LP SUB TOTALS           6535   +  26142  =   32677

GRAND TOTALS            7301   +  27507  =   34808

RECS SCANNED                                 34808
Time taken                                00:06:04

LPTV POWER LEVELS APPLIED FOR:

NUMBER OF APPLICANTS     - - >  VHF          UHF
POWER SHOWN AS ZERO:              0            0
UP    TO     100 WATTS:       2,364          299
101   TO    1000 WATTS:       1,196        3,465
1001  TO   10000 WATTS:          69        7,549
TEN TO 100 KILOWATT:            142       12,374
OVER 100 KILOWATTS :             19          146

              LPTV POWER REQUESTED:
HIGHEST     LOWEST     AVERAGE (KILOWATTS)
425.000     0.001      12.764
```

Figure 3

transmitter.) Subscribers closer in will receive more. This case is based on a real application at 795 watts, and an analysis of the data shows that 37.6 percent of the VHF applicants are asking for similar or higher levels.

Figure 2 shows the kind of printout we could generate by going in via the application references. This could be run just before a lottery (a lot of work) or on the lottery results. In the latter case, you would have to work fast with only a 15 day window.

Finally, the same database and methodology produced the rather interesting statistics shown in Figure 3. Here we are working with over 100 variables, but the 82 channels of the graphic are taken care of with an array and one line of code:

```
900 CHANNEL(CHAN'NUM)=CHANNEL(CHAN'NUM) + 1
```

Where CHANNEL is the channel we are counting to, and (CHAN'NUM) is the subscript of the array we are storing the results in and is, of course, the same number as the channel number.

If all this do-it-yourself programming seems rather arduous, don't worry. These services are available from specialists at a range of prices. But whether you "do-it-yourself" or buy the printouts, make sure you stay abreast of what's happening around your systems.■

* *NTIS is the National Technical Information Service, 8258 Port Royal Rd., Springfield, Va. 22161. Singles-$240. Subscription-$180/month.*

Traps

Co. name, model	Minimum channel rejection depth	Lower adjacent video	Lower adjacent sound	Upper adjacent video	Insertion loss	Temperature range
Eagle Comtronics						
NF super						
2-6	-75 dB	.5 dB	-4 dB	-.5 dB	see above	see above
A-F	-75 dB	1 dB	-6 dB	-1 dB		
G-I	-75 dB	1.5 dB	-7 dB	-1 dB		
7-13	-75 dB	2 dB	-10 dB	-2 dB		
J-O	-70 dB	3 dB	-15 dB	-3 dB		
P-W	-70 dB	3 dB	-25 dB	-3 dB		
Gamco						
617 4-pole						
2-6	-75 dB	-.75 dB	-4 dB	-.75 dB	1 dB	
A-H	for all	-1 dB	-5 dB	-7 dB	5-400 MHz	
G-I	channels	-1.5 dB	-7 dB	-1 dB		
7-13		-2 dB	-10 dB	-2 dB		
J-W		-2.5 dB	-20 dB	-3 dB		
Intercept						
TT-super						
2-6	-65 dB	-.5 dB	-4 dB	-.5 dB	see above	see above
A-E	-65 dB	-.5 dB	-6 dB	-1 dB		
F-I	-65 dB	-1 dB	-8 dB	-1 dB		
7-13	-60 dB	-2 dB	-10 dB	-2 dB		
J-W	-60 dB	-3 dB	-15 dB	-3 dB		
Microwave Filter						
5KV standard		(@ + 12 MHz)		(@ + 12 MHz)		
2, 3	-70 dB	-1 dB	-4 dB	-1 dB		-40-- + 140°F
4	for all	-1 dB	-5 dB	-1 dB		
5-D	channels	-1 dB	-6 dB	-1 dB		
E, F		-1 dB	-7 dB	-1 dB		
G-I		-1 dB	-8 dB	-1 dB		
7		-1 dB	-9 dB	-1 dB		
8		-1.5 dB	-10 dB	-1.5 dB		
9		-1.5 dB	-11 dB	-1.5 dB		
10		-1.5 dB	-12 dB	-1.5 dB		
11		-1.5 dB	-14 dB	-1.5 dB		
12, 13		-2 dB	-15 dB	-2 dB		
J-L		-2 dB	-16 dB	-2 dB		
M-O		-2.5 dB	-17 dB	-2.5 dB		
P-S		-2.5 dB	-18 dB	-2.5 dB		
T-V		-3 dB	-19 dB	-3 dB		
W		-3 dB	-20 dB	-3 dB		
Pico						
SNF 4-pole supernotch						
2-6	-60 dB	-1 dB	-3 dB	-1 dB	N/A	-40-- + 140°F
A-C	for all	-1 dB	-4 dB	-1 dB		
D-F	channels	-1 dB	-5 dB	-1 dB		
G-I		-1 dB	-6 dB	-2 dB		
7-13		-1 dB	-8 dB	-3 dB		
Vitek						
single channel						
2, 5	-50 dB	-2 dB	-2 dB	-2 dB		0—100°F
3, 4, 6	-50 dB	-2 dB	-8 dB	-2 dB		
A-2—I	-50 dB	-3 dB	-40 dB	-3 dB		
7-13	-50 dB	-3 dB	-40 dB	-3 dB		
A-I (narrownotch)	-65 dB	-3 dB	-40 dB	-3 dB		
A-I (special notch)	-65 dB	-3 dB	-40 dB	-3 dB		
J-W	-50 dB	-5 dB	-40 dB	-4 dB		
AA-QQ	-50 dB	-7 dB	-40 dB	-6 dB		
Electroline TV Equipment						
EMSR						
0-100 MHz					-.5 dB	-30-- + 150°F
108 MHz					-1 dB	
120-160 MHz					-40 dB	
175-216 MHz					-2 dB	
223 MHz					-25 dB	
300 MHz					-45 dB	

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CATV & LAN TECHNICAL FIELD SUPPORT

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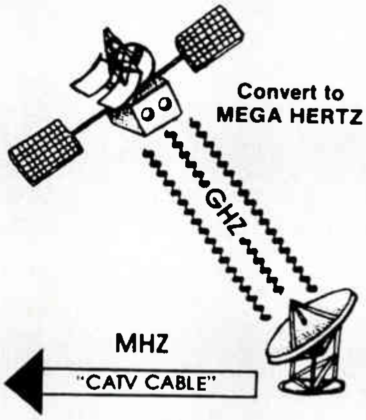

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AM Cable SDT series	5-450 MHz	2-, 4- & 8-way	18 dB (450 MHz)	7 amps	0.5 (2,4); 0.6 (8)	21-45, 24-45, 27-45	aerial or pedestal
American Technology 300 series	5-450 MHz	4-way	20 dB	6 amps	0.7	—, 28-44, —	strand or pedestal (convertible)
Blonder-Tongue DMT series	5-450 MHz	2-, 4-way	18 dB (300-400 MHz)	6 amps	0.2 @ 54 MHz	24-44, 29-50, —	strand or pedestal
Cabletenna TD series	5-500 MHz	2-, 4-way	18 dB (450 MHz)	7 amps	0.6	23-44, 25-47, —	aerial or pedestal
Eagle Comtronics EC series	5-600 MHz	2-, 4-	20 dB & 8-way	7 amps	0.5 (5-400 MHz)	23-43, 25-47, 26-50	aerial or pedestal
Gamco 608	5-450 MHz	4-way	18 dB	6 amps	n/a	—, 30-45 (TV: 14-30)	n/a
Intercept IMT series	5-500 MHz	2-, 4-	20 dB & 8-way	6 amps	0.5 (400 MHz)	23-44, 25-47, 28-50	aerial or pedestal
Jerrold SPT series	5-600 MHz	2-, 4-way	18 dB	7 amps	0.7 @ 450 MHz	23-50, 23-50, n/a	pedestal or strand
FFT series	5-600 MHz	2-, 4-	18 dB 8-way	7 amps	0.5	n/a	strand
Macom Tru-Spec	5-900 MHz	4-way	18 dB	n/a	n/a	n/a	indoor or outdoor
Magnavox 8000 series	5-600 MHz	8-way	18 dB (to 400 MHz)	6 amps	0.6	—, —, 30-46	aerial or pedestal
RMS Electronics Unitap series	5-550 MHz	2-, 4-,	18 dB 6- & 8-way	6 amps	0.3 @ 54 MHz (300-400 MHz)	21-42, 24-42, 26-42	aerial or pedestal
Scientific-Atlanta SAT series	5-500 MHz	2-, 4-	18 dB & 8-way	6 amps	0.7 (300-400 MHz)	22-41, 25-43, 27-44	aerial or pedestal
Texscan T4DTM	5-450 MHz	2-, 4-way	18 dB (300-450 MHz)	7 amps	0.65	22-44, 22-47, —	strand or pedestal
Trans USA OT series	5-500 MHz	2-, 4-way	20 dB	6 amps	0.5	27-44, 27-47, —	aerial or pedestal

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Reader Service Number 35

Subscriber

Jerrold intros products

Jerrold announced four new products at the Western Show. The Starfone impulse-pay-per-view system operates with any Jerrold one-way addressable converter and uses a telephone return path for upstream communications. The subscriber portion is configured as a sidecar add-on and hooks up to standard telephone equipment via a plug-in extension line.

Jerrold's and Tocom's new stereo adapters upgrade existing Jerrold RF addressable and plain converters and the Tocom 5503 baseband set-top terminal to pass the BTSC stereo signal.

The Jerrold add-on stereo adapter intercepts the audio signal before it is passed to the descrambler, thereby circumventing any sync reconstitution problems.

The Tocom stereo decoder works by taking the 50 Hz-100 kHz composite audio signal from the baseband converter's audio demodulator. Since the stereo signal isn't sent to either the baseband converter's descrambler or modulator, the stereo and second audio program information are not stripped from the signal.

Jerrold's new Starcom addition—the Model VI RF addressable converter—also is stereo upgradeable. Its downloadable capability eliminates the need for PROM-burning and permits all service authorizations and terminal parameters to be transmitted from the addressable computer-controller. Elimination of the trap door and reduced components improve reliability and converter security.

For more information, contact Jerrold, 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

Zenith decoders

Zenith Electronics debuted a stereo compatible Z-TAC baseband decoder, a TV stereo adapter, a 450 MHz "A-TAC" decoder and the "TAC-Timer" remote control transmitter.

When used with the Z-TAC decoder, the stereo adapter lets any color TV set receive stereo and second audio programming.

The A-TAC decoder is a low-cost version of the Z-TAC that is stereo transparent because it doesn't place sync information in the audio subcarrier.

For more information, contact Zenith Electronics, 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181.

Westinghouse/Sanyo converter, module

Westinghouse and Sanyo released their VM 2000 500 MHz RF addressable converter and SM 2001 stereo module that enables subscribers to receive stereo sound without a stereo TV.

For more information, contact Westinghouse Buildng, 11 Stanwix St., Pittsburgh, Pa. 15222, (412) 642-3494.

OTAS multidwelling unit

A security rack for OTAS off-premises multiple dwelling applications has been introduced by Pico Products. The rack is preassembled with as many as 40 subscriber modules, with one module required per subscriber. Each module contains an addressable switch for basic service and seven active traps.

For more information, contact Pico Products Inc., 103 Commerce Blvd., Liverpool, N.Y. 13088, (315) 451-7700.

S-A releases converter

A 450 MHz addressable converter was introduced by Scientific-Atlanta.

The model 8550 converter features dynamic switched sync suppression and self-diagnostics, which indicates subscriber tampering as well as the unit's operating status.

By eliminating the PROM, the unit is able to store authorizations and frequency allocations downloaded from the headend.

For more information, contact Scientific-Atlanta, One Technology Parkway, Atlanta, Ga. 30348, (404) 441-4000.

Oak unveils products

A baseband converter/decoder that passes the wider deviation BTSC stereo sound signal was unveiled by Oak Communications.

Through the use of a multichannel sound decoding feature, the Sigma Three supplies stereo and second audio programming to properly equipped stereo TVs. For subscribers with monaural TVs, the unit acts as an adapter, feeding left and right baseband outputs to the subscriber's stereo system. The SAP can be selected through the subscriber's set-top keypad or remote control.

Like the rest of Oak's SIGMA line, the SIGMA Three uses "sound-in-sync" digitized encrypted audio security.

Oak also has developed a 64-channel basic RF converter with volume control. "In the past, adding the volume control feature to basic RF converters tended to degrade both audio and video signals," Oak's Marketing Director Doug Howe said. The signal had to be demodulated to baseband and then remodulated back to RF.

The SIGMA 450-V converter uses a different signal-processing technique requiring less circuitry.

For more information, contact Oak Communications, 16935 W. Bernardo Drive, San Diego, Calif. 92127, (714) 485-9300.

ATC/Toshiba's D-CAT

ATC/Toshiba has unveiled a digital cable audio terminal, the D-CAT, which uses a pulse code modulation technique to convert analog signals into a series of digital impulses. Digital signals can be enciphered and the keys changed to protect against theft. Each subscriber terminal can be individually addressed. A frequency range of 88-120 MHz supports 26 digital channels. Ultra and super versions are available.

For more information, contact John Rigsby, 94 Inverness Terrace East, Englewood, Colo. 80112, (303) 799-5607.

Pioneer prototype stereo system

A prototype stereo sound system that will be available sometime next year was displayed by Pioneer. The system can work with any converter system because it simulcasts the stereo and SAP information in a different bandwidth than the video. A data inserter for each channel inserts a key into the video signal, telling the subscriber's stereo adapter where the stereo information is being carried. If there is no stereo, the adapter passes the monaural signal. Audio quality is similar to standard FM broadcast, Pioneer Product Development Manager Rich Annibaldi said.

For more information, contact Pioneer Communications of America, 2200 Dividend Drive, Columbus, Ohio 43228, (614) 876-0771.

WVL upgrades TM-1

World Video Library has added parental control, remote control, "clear" and on/off keys and favorite channel programming features to its TM-1 addressable converter. The unit is available in RF and baseband models.

For more information, contact World Video Library, 2747 Airport Freeway, Fort Worth, Texas 76111, (817) 831-3811.

Distribution

Magnavox goes 600 MHz

Maganavox CATV Systems demonstrated 600 MHz gear at the Western Show.

The gear will be available in conventional, power doubling, parallel power doubling and feedforward versions, with production scheduled to begin with conventional the second quarter of 1985.

Preliminary specifications cite 80 dB and 85 dB composite triple beats for conventional and power doubling trunks amps, respectively. Cross mod is rated at 82 dB for the conventional and 87 dB for the power doubling.

Six hundred MHz bridgers, line extenders and passives are also available, with subscriber taps boasting 100 dB RFI isolation.

Besides 600 MHz, Magnavox debuted its second generation status monitoring systems and a fiberoptic supertrunk.

The status monitoring system monitors feedforward as well as conventional and power doubling amplifiers. It also measures amplifier temperature and power supply, AGC and AGS voltages. An ingress locating program is also available.

The fiberoptic baseband input/output supertrunk can run 25 miles without a repeater. Its overall cost—including installation and maintenance—competes with metallic FM supertrunking.

For more information, contact Magnavox CATV, 100 Fairgrounds Drive, Manlius, N.Y. 13104, (315) 682-9105.

Broadband amplifier

A new 450 MHz underground amlifier—the BUA—which is available in line extender, manual trunk and terminating bridger versions has been released by Broadband Engineering. It can be installed within tap pedestals without any 90 degree connectors. The base can be installed alone and housing and electronics plugged into it once the system is activated.

One version uses two lockable clamps to secure the cover without requiring tools to enter the amplifier. A sub-split plug-in return amplifier is also available.

For more information, contact Broadband Engineering, 1311 Commerce Lane, Jupiter, Fla. 33458-5636, (305) 747-5000.

Headend

Pico modulators

Pico Products Inc. has released two multiple dwelling modulators and one cable modulator. The two PCM audio-video modulators are crystal-controlled for adjacent channel operation and are available in 35 and 55 dBmV output series and on a single VHF or midband channels. The cable M45 rack-mount modulator features features frequency agility, plug-in filters and crystals. The saw-filtered, monolothic passband filter requires no maintenance or calibration. Units in 2-W channels are available.

For more information, contact Pico Products, 103 Commerce Blvd., Liverpool, N.Y. 13088, (315) 451-7700.

Clarification

In last month's Product Profile on coaxial cable, Capscan was listed as testing their cable for structural return loss to 450 MHz. In fact, this testing is done to 550 MHz.

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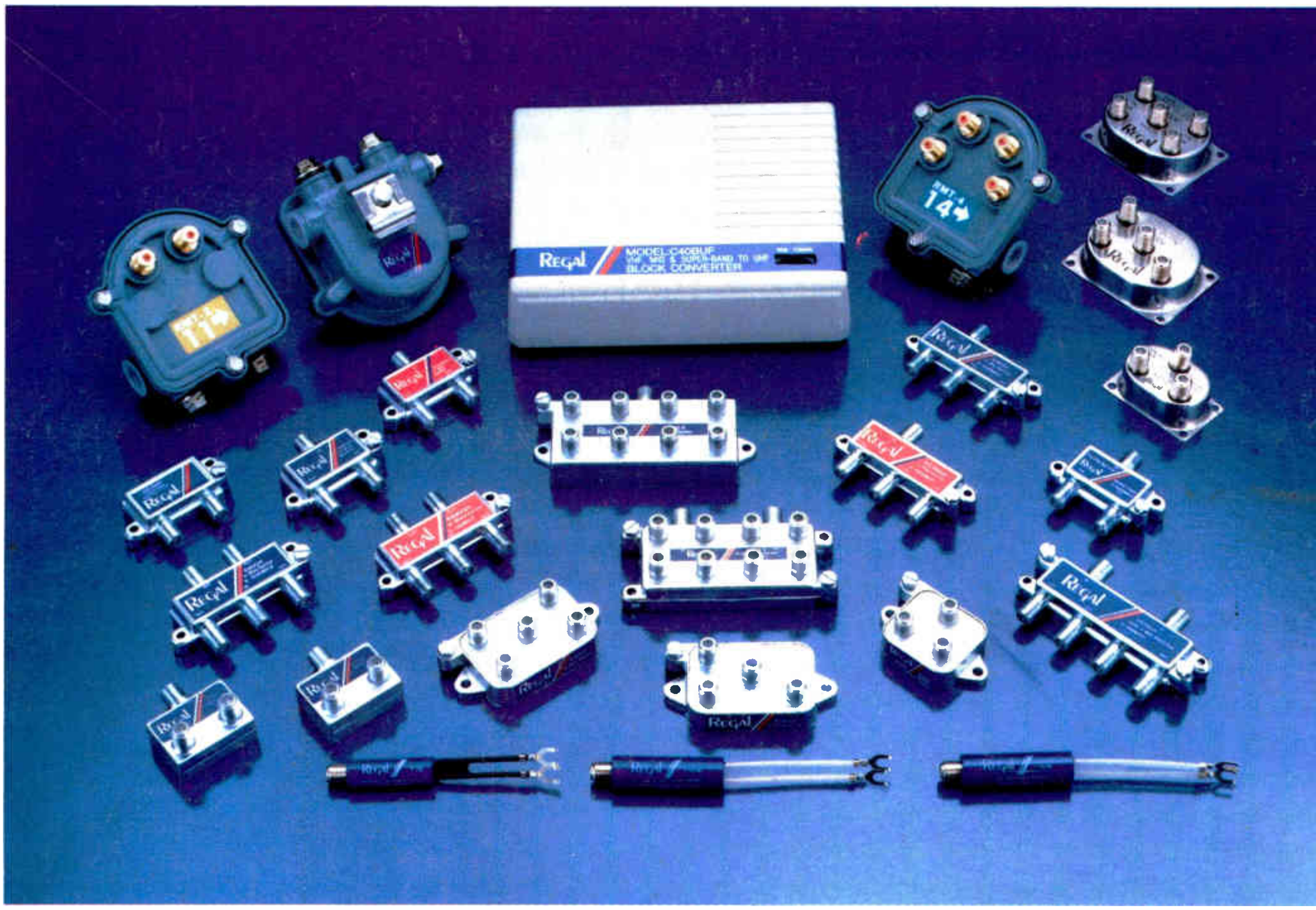

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