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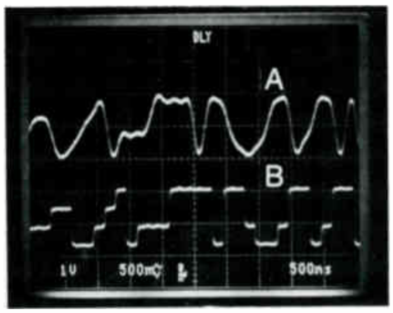

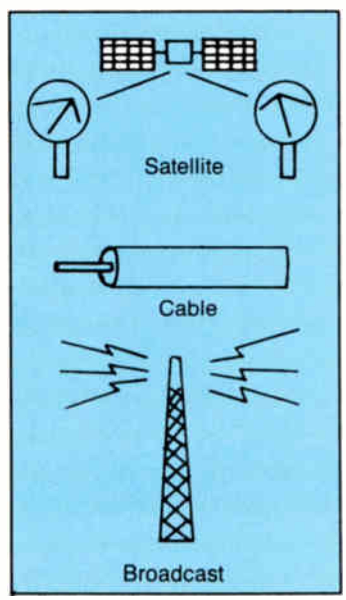

Features

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EDITOR'S LETTER

Historic crossings

World events have often been shaped by leaders crossing bodies of water. Along with Julius Caesar's crossing of the Rubicon and George Washington's crossing of the Delaware River, there could be another one—much more recent—for the textbooks: Ron Hranac, senior staff engineer for Jones Intercable and president of the Society of Cable Television Engineers in the United States, crossing the Atlantic Ocean.

During a business trip to England last October, Hranac set up a casual but soon-to-be historic meeting with Tom Hall, secretary of the United Kingdom's SCTE and editor of its official trade journal *Cable Television Engineering*. No, this get-together over tea didn't mend the rifts caused by Messrs. Washington, Jefferson, Franklin, etc. However, it did signal the beginning of an era—an era of future opportunities for cooperation between the two Societies. As a result of the meeting, Hall joined the U.S. Society. Hranac joined the U.K. Society and was appointed the first Honorary Fellow of the U.K. SCTE from the United States (see "News," page 11).

Then, Hall crossed the "pond" (British slang for the Atlantic Ocean) in December for the 1988 Western Show in Anaheim, Calif.; his trip was arranged by Gilbert Engineering's Scotty Flink. Hall planned "to assess the extent of U.S. interest in the developing cable TV scene and to meet principals of the American SCTE with a view to cementing the close relationship that was rapidly developing between our two Societies."

Immediately following the show, I had the distinct pleasure of engaging Hranac, Hall and other SCTE notables from both countries in a short (yet lively) discussion on international issues. The chemistry and camaraderie among the participants were amazing. Let's face it: You had to be there. But since you weren't, you can read the interview just as it took place in this issue on page 68.

And if that wasn't enough, we've engaged in yet another transatlantic journey: This issue of *CT* (the official trade journal of the SCTE on this side of the pond) will be the first to be mailed to all the U.K. SCTE members. Those who think our people are rather different from their people and those who think we're not so different are both in for a surprise. It seems each country has a lot to learn from the other, and not only in terms of technology. So, in future issues we'll be reporting on events in the U.K., the rest of Europe and other emerging CATV markets.

Greetings to our new readers in the U.K. and welcome to *CT*. I extend an invitation to all of you to join us in continuing this new age of international understanding and cooperation. We'd like to hear from our U.K. subscribers (just as we always want to hear from our current loyal readers).

New and noteworthy

I'd also like to welcome aboard three new writers who recently joined our ranks. Archer Taylor, senior vice president of engineering at Malarkey-Taylor, began his "Taylor's Vantage" column last month. Gary Kim, former editor/publisher of *CED*, now provides behind-the-scenes news stories straight from his "Reporter's Notebook." Finally, Steven Biro, president of Biro Engineering, starts a series of co-channel locator maps, beginning with Ch. 2.

This month's issue is the first anniversary of the NCTA Engineering Committee reports in *CT*, which appear bimonthly in our "News" page. If you haven't already discovered by reading these meeting minutes the invaluable work of this committee, you are hereby ordered to stop perusing this letter and turn to page 11. Many thanks to Wendell Bailey, Brian James (who usually writes the reports), Katherine Rutkowski (who wrote this month's report), Sabine Lavaud and the committee and subcommittee members for a job always well done.

Next month marks *CT*'s fifth anniversary and we'll celebrate it with a look back to March 1984. We'll ask the question, "In your opinion, how has the CATV industry changed in the past five years?" and get some rather interesting answers. And we'll take a cautious look into what the next five years might bring. By the way, if you want to know what else we have on the drawing board, see our "CT Publications Focus" on page 87.

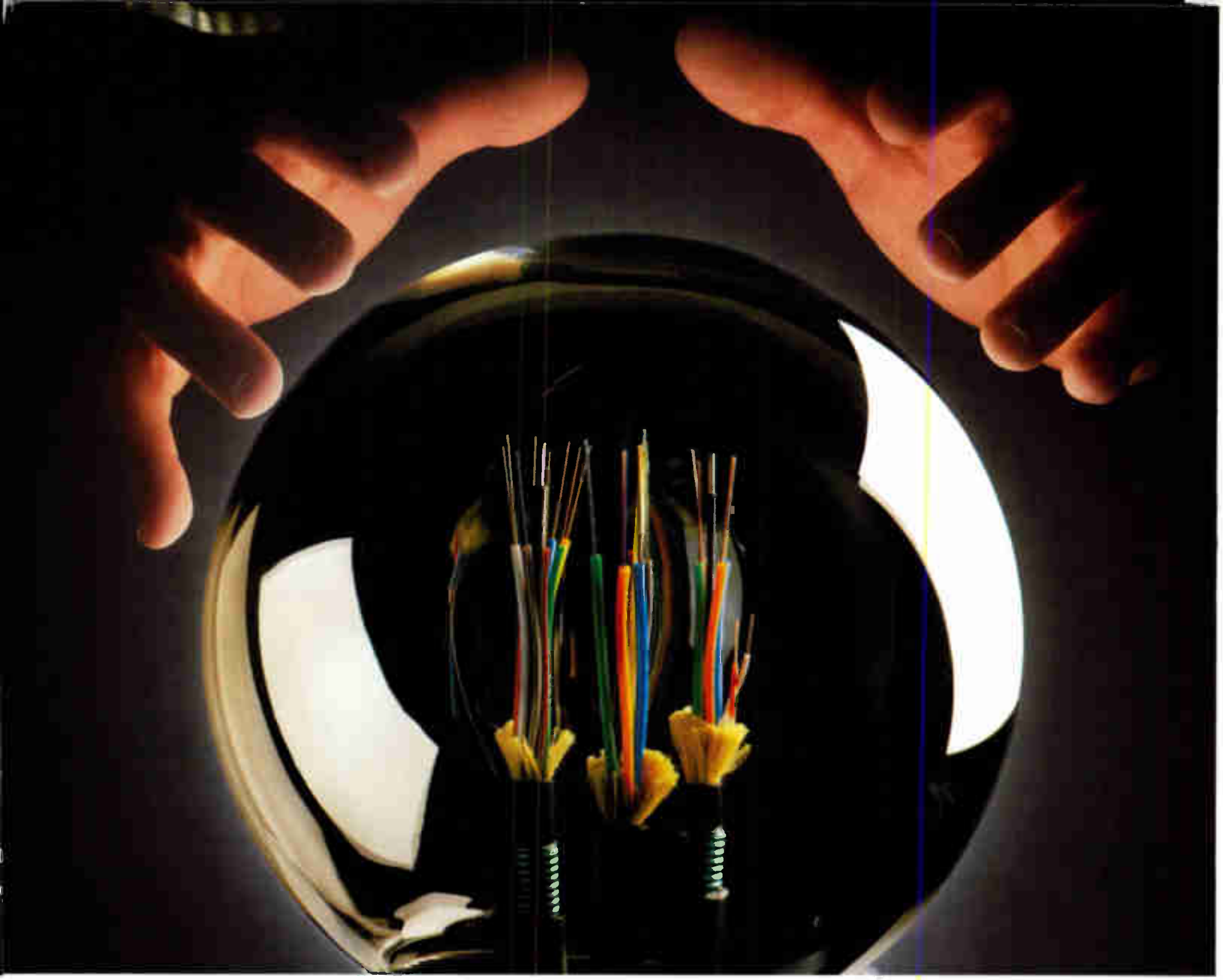
Howdy, pard'ner

It's February, famous for Groundhog Day, Valentine's Day, President's Day and the Texas Cable Television Association's annual convention in San Antonio Feb. 22-24. As usual, it's packed with food, fun—and technical seminars, coordinated by the SCTE. This year's agenda includes, among other things, two don't-miss sessions on CLI testing. (Haven't we heard enough of this CLI stuff? You bet your sweet channel capacity you haven't!)

Also, the SCTE Interface Recommended Practices Committee will hold a meeting Feb. 22 from 8 a.m.-1 p.m. in Room 106 of the Convention Center. And the FCC's Mobile Testing Laboratory will be on the exhibit floor, staffed by compliance engineers from FCC field offices in Houston and Kingsville, Texas. And finally, don't forget to sign up for the BCT/E testing that takes place Feb. 23 from 3:15-5 p.m.

And y'all come back now, hear?

Rikki T. Lee



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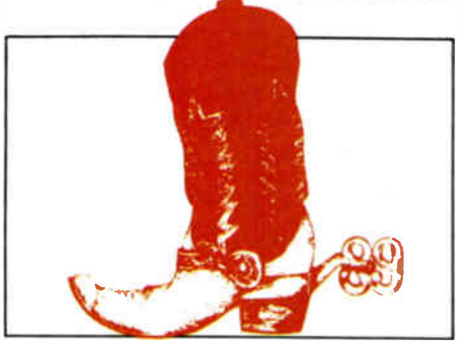

Texas Show to host technical sessions

SAN ANTONIO, Texas—The Society of Cable Television Engineers will sponsor technical sessions for the 29th annual Texas Cable Television Association Convention and Trade Show, to be held at the San Antonio Convention Center Feb. 22-24. The agenda for the technical sessions is as follows:

Thursday, Feb. 23

9-10:15 a.m.—"CLI: It's not just for engineers anymore," with Ted Hartson (Post-Newsweek Cable) and John Wong (FCC).

10:30-11:45 a.m.—"CLI: Protecting your channel capacity," with Robert Dickinson (Dovetail Systems), Les Read (Sammons Communications) and Raleigh Stelle (Austin Cablevision).

1:45-3 p.m.—"New technologies: A look at the future," with Wendell Bailey (National Cable Television Association) and John Holobinko (American Lightwave Systems).

3:15-5 p.m.—BCT/E examinations administered.

Rikki Lee

U.S. SCTE President Ron Hranac (center) receives his Honorary Fellow certificate from Ray Seacombe, U.K. SCTE president, and Tom Hall, U.K. SCTE secretary.

SCTE president named U.K. Honorary Fellow

ANAHEIM, Calif.—Ron Hranac, national president and Region 2 director of the Society of Cable Television Engineers in the United States, was recently appointed an Honorary Fellow of the United Kingdom's SCTE, it was announced here during the 1988 Western Show. This honor is the U.K. SCTE's highest membership distinction and has been awarded to only 11 people since the Society's formation in 1945.

Hranac, senior staff engineer at Jones Intercable corporate headquarters in Englewood, Colo., becomes the first representative of the U.S. SCTE—as well as the first American—to receive this honor.

NCTA Engineering Committee report

ENGLEWOOD, Colo.—The bimonthly meeting of the NCTA Engineering Committee was held here Dec. 15. Wayne Luplow and Vito Brugliera of Zenith gave a premeeting slide lecture on Zenith's spectrum compatible high-definition TV system.

Wendell Bailey gave a "Washington update" that covered:

1) Terminal devices (RM 85-301)—The Federal Communications Commission released its Final Report and Order on RM 85-301 (Part 15 terminal devices oversight). The rules now call for equal output from all converters and lower standards for signal leakage (Part 15 instead of Part 76) with the only option for non-compliance of cable subscribers being the right of the cable system to disconnect the home with faulty equipment. The NCTA will file a third petition for reconsideration.

2) Technical deregulation (RM 85-38)—A Further Notice of Proposed Rulemaking on technical deregulation has been issued by the FCC. It proposes to extend Class 1 rules to Classes 2, 3 and 4 video and then pre-empt the rules. The FCC is asking for comments on this position. The National League of Cities suggests that the NCTA's Recommended Practices be adopted as a standard. Some discussion ensued on whether that adoption would be advisable and also whether or not the Class 4 signals needed to be regulated by a group other than the cable industry.

3) Syndex—The NCTA has filed a Petition for Reconsideration on Syndicated Exclusivity (Syndex), trying to minimize the compliance burden on the cable industry. The major problem is the notification date of August 1989. Operators will not know what must be protected until a point when it will probably be too late to order and have installed the necessary substitution equipment.

4) Cable/telco cross-ownership—The FCC is reviewing the restriction cross-ownership and is considering modifying the waiver process in an attempt to circumvent the Cable Act.

5) Cable system depreciation schedules—The Internal Revenue Service is reviewing lives of all assets. Cable was included in the first group of 10 industries, which was basically looking at production equipment. NCTA and cable operators have been helpful to the IRS and worked to have cable reviewed as a separate group in order to avoid having the cable plant considered with telephone plant. NCTA is mailing surveys and/or compiling case studies on various aspects of depreciable equipment and materials.

6) Advanced television and the Advisory Committee—Meetings continue. The need for cable industry participation was stressed as being crucial to the industry's competitive welfare.

7) Congress—The new Congress shows signs of great interest in telco TV issues. It is also looking to fix the must-carry problem and to follow up on Senator Albert Gore's scrambling legislation.

Subcommittee reports

SCTE: Ron Hranac reported that the next Cable-Tec Expo will be held in Orlando, Fla., June 15-18. Recent press releases announced availability of insurance for members, the signing on of the 5,000th member and the fact that the SCTE is talking to the United Kingdom's SCTE about joint activities. The new member directory is due in January.

Ad hoc 75 ohm standard: Hranac also asked that the responsibility for this subcommittee's work be transferred to an SCTE interface committee headed by Tom Elliot.

Advanced signalling and switching and information systems: Ned Mountain summarized the second meeting of an industry subcommittee set up to develop a new process for control and information services for local avails adding that syndex needs were being taken into account. Mountain wants protocols to be submitted to the Engineering Committee by July. The next meeting is set for February at the Texas Show.

CLI seminars/signal leakage: Ted Hartson reported that the first of five seminars on cumulative leakage index took place in Kansas City, Mo., and was quite successful. Attendance was over 150 and participants seemed pleased. Hartson thanked Brian James, Sabine Lavaud, and other organizers and speakers for their excellent work. Other possible sites—Memphis, Tenn.; Hartford, Conn.; and Philadelphia—were mentioned for late February or early March. The difficulty of accurate measurement and compliance was reiterated.

Multichannel TV sound: Alex Best presented a 58-page draft document "BTSC Stereo and Cable Systems: Measurement Techniques and Operating Practices" for the group's review and asked for input on content and distribution. The chairman suggested that the work could be a series of papers for the Institute of Electrical and Electronic Engineers' Consumer Electronics Show in June as well as part of the next *NCTA Recommended Practices* text.

HDTV: Don Monteith (reporting for Nick Hamilton-Piercy) noted that recent activities include contributing to the NCTA's FCC comments, as well as meeting with the Canadian government's equivalent to the FCC Advisory Committee on Advanced TV Systems and also with the Cable Labs, Advanced TV Test Center and the FCC Advisory Committee. This was done to divide overlapping tasks of system testing and cable characteristics testing equitably and efficiently. Hartson suggested that Cable Labs fund a repeat of the Mertz curve measurement—noting that the microreflections in cable make this crucial to the success of HDTV over cable.

A test of the MUSE-E system through a couple of typical cable systems and a demonstration to various audiences has been planned for January/February. This would include satellite transmission from the HBO uplink with reception at a cable system and then vestigial sideband transmission over the system.

Standards: Katherine Rutkowski (speaking for Mike Jeffers) announced that the *NCTA/SCTE Glossary of Cable Technical Terms* has been printed. The 8½- by 11-inch softcover includes 66 pages of definitions, three pages of acronyms and a two-page bibliography. It sells for $5 a copy.

Pending delivery of one or two more measurement procedures and NCTA approval, the second edition of the *NCTA Recommended Practices* text will be ready for reprint. It will include nine or more new procedures.

IS-15: Joe Van Loan stated that there was good traffic at the joint EIA/NCTA booth at the Western Show—though input for improving the booth and attracting more people would be welcomed. More manufacturers have the plug; RCA has it in a 20-inch set. A two-day training seminar for visiting Japanese consumer electronics engineers is planned for the June Consumer Electronics Show in order to acquaint them with cable systems.

EIA/NCTA Joint Engineering Committee: Walt Ciciora added that the final standardization of IS-15 hinges on minor options and additional features. Its status has been stable for months and the committee is anxious to complete its work soon. A new interest—ID codes imbedded in signals for consumer products—has arisen. Ciciora asked whether a new NCTA/EIA subcommittee should be formed with Bill Thomas of Nielsen Media Research as chairman; the consensus was "yes."

Cable '89: Bailey gave an update on publicity and other plans for the next National Show in Dallas May 21-24. Deadlines for submitting registration forms and technical paper synopses were repeated and the 1989 Paper Selection Subcommittee named: Matt Miller, Ted Hartson, Ed Milner, Mike Aloisi and Dave Large.

American Radio Relay League: Bob Dickinson mentioned that one ham operator complained directly to the FCC (circumventing the usual ARRL-NCTA route). Generally there have been few complaints lately.

National Electrical Code: Jim Stilwell reported that the committee reviewed the 1990 code draft at the December meeting. In April 1989 the 1990 draft will be available to the public.

ATSC: Bernie Lechner (for Jud Hofman) said that the ATSC met Dec. 12 to update its own organization/structure. Members want ATSC to keep them up-to-date on advanced TV issues. Bob Hopkins has started a newsletter toward that end. Dec. 22 is the CCIR deadline for comments on HDTV production standards papers.

CEBus: Bob Burroughs (also for Hofman) reported that work on the CEBus demonstration booth for the January Consumer Electronics Show was on schedule. He made the points that there are lots of electronics in the home now that either degrade cable signal or radiate signal and that consumer confusion will result when both Smart House and CEBus come on the market since both schemes lock out current cable system architecture.

Smart House: Lively discussion followed the CEBus report. The chairman raised two questions regarding problems for cable inherent in CEBus and Smart House: "What should we do about it and who should do it?" Some suggestions for action were that NCTA attempt to make both groups more sensitive to cable's concerns by inviting them to the National Show or by having Jim Mooney write them. Instigating an FCC Notice of Inquiry also was suggested as was the formation of another subcommittee (with Tom Jokerst as chairman). It was decided that Wendell Bailey would secure an invitation for the Engineering Committee to tour the Smart House facilities in Annapolis, Md., as a premeeting event for the February meeting.

Fiber to the home: CATV, telcos battle

CEDAR KNOLLS, N.J.—Probe Research Inc. recently released a 400-page study entitled *Fiber Optics and Video: Telcos vs. Cable Operators in the Battle To Fiber the Home.* The report predicts a major battle in the 1990s between cable operators and telephone companies over fiber access to American homes. According to the study, the future of video delivery (including high-definition TV) and the

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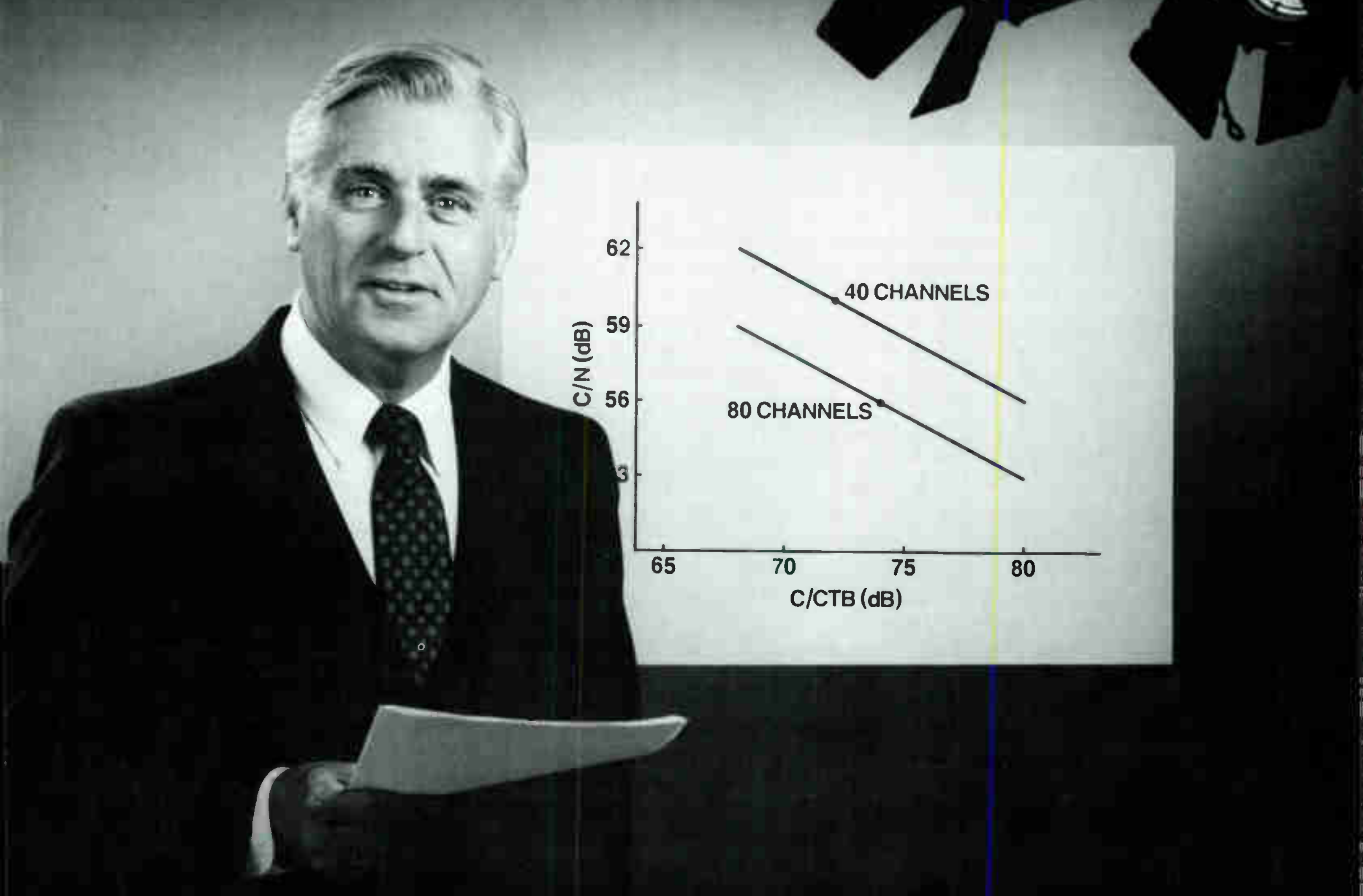

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growth of telephony are crucially at stake.

Also mentioned is the finding that strategy choices in the next few years will vitally impact the conflict between the two industries, expected to emerge full-blown by the mid-'90s. In addition, the report contains detailed forecasts of market growth from 1988 to 2000.

● Anixter Bros. reached its first billion-dollar sales year in the company's 31-year history in 1988, surpassing $1 billion on Dec. 28. Also, Cable TV Industries shareholders recently voted overwhelmingly to approve its merger with Anixter; the cable TV division of Anixter was renamed Anixter Cable TV to reflect the consolidation.

● C-COR Electronics announced that the company's fiscal year 1989 estimated revenue projections of $45 million were increased to $53 million, with operating margins expected to remain stable with those reported in fiscal year 1988.

● Copperweld Corp. in Pittsburgh, Pa., will raise base prices 7 cents per pound on all copper-clad aluminum wire, used primarily as center conductor wire for CATV coaxial cable. The increase is scheduled to go into effect April 1 with all shipments. According to the company, this will cover higher costs that include raw material fabrication, wage and utility increases.

● Times Fiber announced the expansion of its Chatham, Va., facility to meet increasing demand for the company's products. The addition of 23,000 square feet is expected to be completed this month, with a portion of the expansion to house fine-wire production equipment being purchased from Florida Wire.

● W. Smith & Co. of Huntington Beach, Calif., will represent the Tailgater truck bed systems throughout California, Nevada, Arizona and Hawaii.

● National Satellite Equity Associates in Rosenberg, Texas, is offering its National Satellite Equipment Auction service to connect those with used or surplus equipment for sale with those interested in buying this equipment. Bimonthly mailings of lot descriptions, which began last month, are being sent to cable operators for their bids; each lot goes to the highest bidder.

● United Artists Cablesystems signed an agreement with Scientific-Atlanta to purchase 100,000 S-A Model 8590 set-top terminals to upgrade the MSO's franchises in Grand Rapids, Mich., and other Midwestern locations.

● East London Telecommunications Ltd., a recent acquisition of Jones Intercable and Pacific Telesis International, was awarded by the Cable Authority of Great Britain a second franchise that covers about 230,000 homes in the London boroughs of Barking and Dagenham, Bexley and Redbridge. Construction on the system is expected to begin before year's end. The joint venture now operates the cable system that will serve approximately 150,000 homes in the East London boroughs of Newham and Tower Hamlets, including the London Docklands area. It has also applied for a third franchise that will provide service to 175,000 homes in the Greenwich and Lewisham boroughs of London.

● Microwave Filter named AB Finvik of Stockholm as exclusive distributor for its positive scrambling systems in Sweden, Denmark and Norway. An initial contract of $191,000 for encoding units and decoding traps was signed.

● Wegener Communications announced that the West German Post and Telecommunications Agency (*Deutsche Bundespost*) will use Wegener products to implement a satellite broadcast digital audio network to provide programming to radio stations throughout Germany.

● The New York State Cable Television Association changed its name to Cable Television Association of New York Inc. Its new address is 126 State St., Third Floor, Albany, N.Y. 12207, (518) 463-6676.

● International Cablecasting Technologies (ICT) and Marantz Co. signed an agreement to plan integration of ICT's Digital Modulation (DM) capability into the Marantz product line of audio components. The companies also plan to develop a licensing program for manufacturing, retail distribution and marketing of cable-ready DM tuners.

● Comcast Cable recently signed an agreement with the Jerrold Division of General Instrument Corp. to provide fiber-optic and conventional CATV electronics for the MSO's West Palm Beach, Fla., system rebuild; Jerrold will supply about $10 million worth of equipment. Also, distribution equipment from Jerrold will be installed in the Bat Yam and Kiryat Shmone regions of Israel, two new-builds of Cable Systems Media Ltd.


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Fiber to the home?

By Gary Kim
Special Correspondent

There has been much talk—much of it wild, much of it wrong—about delivering video services to U.S. consumers by fiber-optic drops instead of coaxial cable drops. It's time to get a bit more realistic. While it is clear why telephone companies, in particular the regional Bell Operating Companies (RBOCs), are interested in "fiber to the home," it is much less obvious why CATV ought to look at it. Furthermore, despite telco arguments to the contrary, fiber to the home could not be installed as quickly as it often argues, even if all current regulatory barriers were demolished.

Fiber to the home is not a technical issue; it's an economic and political issue. Take cost: Coaxial cable tree-and-branch systems currently can deliver 82 video channels to the home for about $800 or less capital investment per subscriber. Assuming current telco fiber to the home trials require about $10,000 per sub capital investment, and in volume production might require only $3,000 per sub, it's still hard to make a case for fiber drops if one assumes the network primarily will deliver multichannel video. The issue is not whether fiber drops can be installed; it's whether a company can make money providing services over those drops.

Consider the cost of drops alone, isolating connector and optoelectronics costs. Bell Communications Research (Bellcore), the RBOC equivalent of AT&T Bell Labs, estimates fiber costs at 18 cents a meter. At that price, the typical telco subscriber drop of 4,300 feet costs $236—just for the cable—at current prices. At hoped-for 1993 prices of 4 cents per meter, a telco-style drop still costs $52. Compare that to cable costs for a 150-foot RG-6 drop, which might run $9.75 today. How many consumers now getting telephone service want to pay for those kinds of capital costs to get services they already get for less? How many public utility commissions will let RBOCs add fiber installation, digital switching and other costs to the existing rate base when they see the numbers?

That's just drops. Bellcore has estimated there are between 200 million and 500 million miles of copper local loop in the United States. Converting that plant to fiber-optic cable at 18 cents a meter works out to between $57.6 billion and $144 billion, if my math is correct.

Not that drop cable costs are the big barrier. A fiber drop necessarily requires a laser/receiver pair, optical-to-RF signal conversion and possibly digital-to-analog conversion as well at each house. Even in volume, that's costly. So why do we keep hearing about fiber to the home?

We keep hearing it because B-ISDN, in reality, is a telco plant modernization program. Telcos in Japan, Western Europe, Canada and the United States have agreed on international ISDN standards that would create all digital wideband transport facilities as the new communications infrastructure of advanced economies early in the 21st century. And video is "one of the prime motivators for wideband services," Bellcore says.

Wideband, remember, means fiber optics because the telco twisted-pair local loop cannot handle conventional video bandwidths. How to pay for installation of all that bandwidth when the current copper drops work just fine for voice service is the issue. BellSouth, which has said it can pull glass to homes based on revenues from voice service alone, also has estimated it can get $59 a month in revenues per home from sources including:

• Basic local phone service	$24
• Videotex	$10
• CATV	$ 6
• Home security	$ 6
• Energy management	$ 4
• Meter reading	$ 1
• Other services (channel signaling)	$ 8

So RBOCs have to put fiber drops in place to get wideband transport facilities CATV already has in place. Of course, telcos say 450 MHz isn't enough. Fiber offers 1 GHz or more of bandwidth. But fiber isn't the only way.

By the NCTA convention this May, most U.S. and Canadian mainstation vendors to CATV will announce amplifier products offering between 750 MHz and 1 GHz of bandwidth. Volume production of these 1 GHz technology platforms won't begin until the last quarter of 1989, although few of the vendors actually expect to book significant orders initially. By June, units will be in beta site testing. Why 1 GHz and why now?

For starters, American Television and Communications Corp., Jones Intercable and other MSOs have been asking for 750 MHz to 1 GHz technology, and for good reason. Assuming high capacity fiber-optic backbones become more prominent, it won't make much sense to run high volume pipes into moderate volume feeder and distribution plant. Also, slicing amplifier cascades to five or so mainstations means a new set of tradeoffs can be made in the area of signal level, distortion and noise parameters. A few operators also are investigating further non-entertainment uses for existing plant. So 1 GHz isn't as crazy as it might at first seem. Running 750 MHz on a four-amplifier cascade isn't really that tough, amplifier vendors say.

For their part, many of the mainstation vendors had been looking at technology enhancements for other reasons, and bandwidth expansion seemed to make business sense. More flexible upgrade paths was one consideration. Vendors with heavy European sales already must supply UHF-compatible gear and 1 GHz technology could help some players gain market share. HDTV (high-definition TV) compatibility is another driver for higher bandwidths. And current 550 MHz-rated gear will run to 600 MHz already.

Some redesign work on housings obviously will be required. There are connector issues and boards to rework. A few vendors probably will use a high-low amplification technique to get units into production sooner (one hybrid for 50 to 550 MHz, a second hybrid for the 550 MHz to 1 GHz band). Others will wait for single-chip designs currently being worked on by semiconductor vendors.

Cable, connector and tap vendors say it won't be much work to retool their product lines for 1 GHz. There may be a slight cost premium for the additional quality control procedures, but current generations of coaxial cable already are swept out to about 1 GHz today, although 600 MHz is specified. That's largely because military customers demand 1 GHz. The only real issue is loss—is 1 GHz within the designed loss budget or can amplifiers run at higher gain?

Taps will have to be redesigned, their PC boards altered, housings made a bit larger perhaps, ports moved around and that sort of thing. But tap vendors say there's no real mystery to it. Again, current technology is specified to pass 550 MHz but capable of passing 600 MHz. Return loss probably ranks among the biggest design issues.

Connectors also are tested out to 1 GHz now. They just aren't guaranteed to that bandwidth.

ATC, for its part, already has tested drop cable and found that there's no problem passing 1 GHz bandwidth. So there appear to be no laws of physics, engineering roadblocks or manufacturing obstacles to 1 GHz RF gear for CATV, available in a very short timeframe.

The implications are far-reaching. Telcos have been arguing that fiber-optic technology is required to put high bandwidth into U.S. homes. That obviously is less compelling when CATV can use hybrid fiber/coax technology to quickly put lower cost bandwidth into homes. CATV's current willingness to integrate optical technology into its own plant also pricks a pin in the argument that fiber optics is a technology only telcos can understand and deploy.

Furthermore, 1 GHz capacity all the way to the home ensures that no matter what HDTV standard is chosen for CATV delivery (broadcasters are limited to 6 MHz compatible, even if that degrades picture quality—but CATV isn't), this industry will have the bandwidth to carry it.

Current and feverish efforts to slice amplifier cascades also will ensure that CATV has adequate signal quality—50 to 53 dB signal-to-noise (S/N)—to put those signals into subscriber homes cleanly. Microreflections? Serendipity again. The process of retooling passives and taps to pass 1 GHz also will require previously unheard of electrical matching. Better matching; fewer microreflections. Neat, isn't it?

In essence, the "fiber to the home" issue can be redefined. The real issues boil down to two. Who can put 1 GHz into homes most cost-effectively and quickly? And who can deliver HDTV-compatible signal quality of 50 to 53 dB S/N?

If the issue is "1 GHz/50-53 dB S/N into the home," CATV will be very tough to beat. We're a scrappy lot, aren't we?

The IEC TC 12 in Italy

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories Inc.

Grouped meetings of the International Electrotechnical Commission (IEC) Technical Committee No. 12 (Radio Communications) are held approximately every two years. Three of the subcommittees—12A (Receiving Equipment), 12C (Transmitting Equipment) and 12G (Cabled Distribution Systems)—conducted individual sessions to present their consensus on matured topics to the parent committee TC 12. I attended in my role as the U.S. technical advisor to the IEC SC 12G.

Apparently, a member nation will volunteer to sponsor the meeting (at considerable effort and expense). This session last November was hosted by the *Comitato Electrotecnico Italiano (CEI)* together with *Radiotelevisione Italiana (RAI)*. They proved to be the most gracious, generous and efficient patrons one could desire. Special praise has to be given to the secretary from *RAI*. She always had the right answer, secured copies of documents in a thrice, never slept and coped with a dozen nationalities with grace and beauty. *Vive la Italiana*!

The site of the meeting was the Hotel Villa Pamphili, a modern hotel and sports complex concealed in an extremely quiet residential area on the side of the big Doria Pamphili park about one hour from the center of Rome. *RAI* sponsored two social events whose quality and ambiance were superb. One evening we attended the opening concert of the *RAI* season—Berlioz's *Romeo and Juliette*, directed by Gabriel Ferro in the *RAI* auditorium. The arias, emotionally projected by three international artists and accompanied by a chorus of 70 singers and a 75-piece orchestra, seemed flawless and perfect in every way. The other event, an *RAI* dinner, was staged in the *Saloni di Palazzo Branceaccio*, a former palace and now the scene of formal affairs and upscale weddings. The main hall had ceilings 30 feet high with seamless mirrors from top to bottom. Elegant enough to go with the pheasant and veal dinner!

RAI also provided two field trips, one to its production center in Rome to view a demonstration of its Radio Data System (variants of teletex) and the other, a tour of the *stazione del Fucino—Piero Fanti*, the Italian ground station for telecommunications through satellites. Both facilities were impressive.

The total number of delegates was 75; by country, they were as follows: Belgium-1, Canada-3, Czechoslovakia-1, Denmark-2, Finland-1, France-11, West Germany-3, East Germany-1, Italy-11, Japan-5, Netherlands-3, Sweden-2, Switzerland-3, United Kingdom-8, United States-4, Soviet Union-2, Yugoslavia-7, IEC office-1.

Suggested standards

The principal task facing the members of 12G during the technical meetings was to examine the suggested standards and the associated submitted comments to determine whether a standard could be issued, or if the subject required further study. For example: The H Factor method seems too complex; a new course of action is needed to assess system performance for television data signals.

The open stripline method for the measurement of radiation leakage was approved. Performance recommendations for data services other than those carried within the structure of a television signal were approved for circulation under the six months rule. Revision to the performance requirement for frequency stability was approved, etc.

Fiber-optic systems installations were reported by various countries: France—trunk links only; Denmark—20,000 meters on fiber; Finland—experimenting with digital and analog FM transmission; West Germany—short trunk FM, digital soon; East Germany—only experimental; Italy—experimental Rome network; Japan—several systems, no data available; Sweden—digital 70 megabit trunk; Switzerland—digital and FM, Geneva has digital trunk; U.K.—under wraps; Canada—CCTA report; Finland—short haul of

"The spirit of cooperation among such diverse countries... leaves one optimistic about the future of world politics."

satellite receiver IF 950-1,750 MHz.

Review of TV standards for satellite broadcasting: Long discussions on considerable changes are needed for this document to reflect the views of all parties; it needs to be redrafted.

Under "new business," many topics were briefly introduced—high-definition TV, for one. I asked whether there was a standard for the 75 ohm cable connector and the answer was vague; there was no accepted standard and not much chance of one soon. Why did I raise the subject, particularly when the United States is also without a standard for the F connector? In my hotel room, the European-style (Belling & Lee?) coaxial plug into the TV set unfortunately had the shield retracted about an inch away from the ground terminal of the plug.

The European cable plug grips the center conductor of the cable securely with a set screw, but the shield is held by two little ears from the outer rim of the plug crimped onto the cable shield. In the case of our F connector, a metal sleeve is placed under the shield and an outer sleeve is crimped tightly on the shield and the inner sleeve making a very secure connection between the shield and the connector. As I found on my hotel set, the Europlug is distinctly inferior in this respect. Also, the connection lacks the security of the F thread. The Europlugs I purchased at a hardware store were identical to those in the hotel. My research went no further, so it is possible this problem is being studied and solutions are under way. Good luck to our European cousins!

To summarize, the trip was instructive and the technology impressive. The spirit of cooperation among such diverse countries and the sight of Soviet, East German and Yugoslavian scientists generously participating in setting international TV standards leaves one optimistic about the future of world politics. Now, just a little cooperation from the United States, if you please!

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Digital fiber-optic transmission of video

"In the future, digital transmission of CATV will become the preferred transmission format." Practically everyone in the CATV industry has read this statement before. The key question that must be asked is "When in the future?" This article is intended to address the question of when through a discussion of digital video transmission basics and a review of the current state of this technology.

By John Holobinko
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The greatest benefit by far of digital transmission is the ability to transport signals for very long distances with virtually no degradation of signal quality. Therefore, for all practical purposes, signal quality is independent of distance. Theoretically, one could build a single CATV system with only one headend to serve the entire United States; the customers in Los Angeles, New York and Omaha, Neb., would all have the same high quality picture. This is due to the ability of a digital transmission system to restore the original signal free of most errors even after signals are sent over repeaters many times.

There already exists a complete digital transmission network in this country with predefined levels of transmission hierarchy based on standard data rates. A digitized telephone conversation can be sent at a 64 kbps transmission rate. Twenty-four such conversations can be sent simultaneously at a rate of 1.544 Mbps. A channel in this format is called a *DS1 channel*. Twenty-eight DS1s equal a DS3 channel (44.736 Mbps) and so forth. The current telephone network has the capability of routing channels up to and including the DS3 rate. Therefore, a backbone architecture including hardware components is already established to transmit digital signals, arguably independent of their information content.

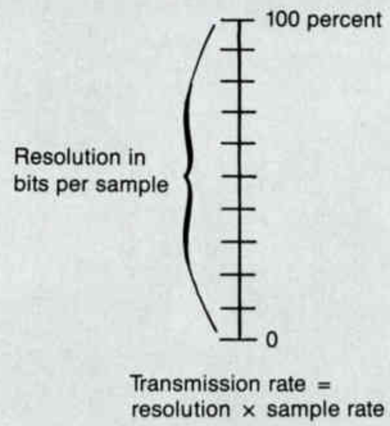
Unfortunately, as we will see, transmission of current CATV system video channel capacities would bring the long distance telephone system to its knees.

How video is converted to digital

The device that converts an analog video signal to a digital video signal (and back) is called a *codec*. To digitize a video signal requires sampling the signal and defining the amplitude of the signal as a digital value. The greater the information rate of any analog signal, the more often samples must be taken (Figure 1). The digital transmission rate is a function of how finely the various possible levels of amplitude are divided and the number of samples per second required to accurately record changes in signal level. Theoretically, the sampling rate must be two times the highest frequency of the signal being sampled (Nyquist rate). However, due to practical system limits, typically the sampling rate must be higher than two times the highest frequency (Figures 2 and 3).

If the amplitude of the signal is not divided finely enough, stepwise discontinuities will be observed when the signal is converted back to the analog format. For example, a fixed video scene that gradually changes in shade will be observed to have abrupt shade change boundaries instead of a smooth transition. Correspondingly, if the digital sampling rate is not adequate, then changes in picture content will not be accurately reproduced; i.e., motions will appear to be jumpy.

Figure 1



For NTSC video channels the sampling resolution requires between eight to 12 bits, while the sampling rate must be up to three times the highest video frequency of 4.2 MHz. In practice, this translates to a data rate of over 90 Mbps in order to achieve studio quality (RS250B short haul, 67 dB signal-to-noise ratio) picture transmission.

There are two methods employed to reduce this effective transmission rate while still retaining a very high quality (RS250B medium haul, 60 dB SNR) picture quality. The first is to eliminate redundant information from the video signal itself, such as the sync pulses; this results in some savings. The second technique that provides much greater savings is to use the fact that, from frame to frame, only some of the pixels in the picture change value and not all of them. The key then is to transmit only the pixels that have changed value and to be able to predict these changes. If an algorithm is used to examine the previous value of the pixel in the last frame and the values of pixels in close proximity to the pixel being digitized, then a significant reduction in transmission rate can be achieved. One technique commonly employed utilizes differential phase code modulation (DPCM)[1].

Current digital codecs employing compression techniques are available that transmit at the DS3 rate (45 Mbps) and slightly slower, providing RS250B medium-haul transmission quality. Note that the DS3 rate can be transmitted throughout the United States on the existing telephone network. Codecs also have been developed down to the DS1 rate (1.544 Mbps). However, these do not provide acceptable picture quality for entertainment transmission and are more ideal for video teleconferencing, where movement is minimal. Another disadvantage of these modems is that the lower the transmission rate, the more expensive the codec. Current DS3 rate codecs cost approximately $10,000 per channel. DS1 rate codecs are approximately $50,000 to $100,000 per channel. A DS1 rate codec therefore only makes sense in light of the reduced cost of a switched DS1 circuit vs. the cost of a DS3 circuit on a "dialup" vs. dedicated-line basis.

Practical limitations

Digital video transmission systems are not being used in CATV networks today. There are two major reasons for this. First, current analog CATV systems are not distance-limited based on analog fiber technology. Although this may sound surprising, consider the following: Current FM (frequency modulation) over fiber systems that deliver equal or better than DS3 codec quality (RS250B medium-haul specifications) are capable of transmission distances of up to 40 km at 1,300 nm (repeaterless). The distance between CATV master headends and hubs is never beyond this distance in metropolitan areas. One can make an argument that a 57 dB contribution of the fiber backbone between hubs is perfectly adequate to still be able to deliver 49 dB SNR signals to the home in a hub/node AM (amplitude modulated) fiber backbone system. In this case, current FM/FDM (frequency modulated/frequency division multiplexed) fiber systems with one repeater are capable of maximum transmission distances of over 80 km (48 miles). Therefore, end to end, system spread can be 100 miles across.

A comparison of FM/FDM fiber systems to DS3 codecs finds that, when multiplexing equipment is added, the cost of DS3 codecs is approximately three to four times the cost of FM analog fiber systems. At a 1.2 Gbps rate, a digital transmission system can transmit 24 channels per fiber per wavelength. In comparison, our FM fiber systems, for example, routinely transmit 18 channels per wavelength; we have experimented with up to 40 channels per wavelength. These 40-channel systems are completely technically possible. The reason they are not available today is simply the additional cost of this capacity per fiber is not warranted in an FM system. The point is that a 40-channel FM fiber system would still cost one-third of the price of a digital system and provide the same performance advantages to current CATV systems.

But this whole comparison becomes moot if one examines current trends in CATV architecture: The foremost disadvantage of digital transmission in CATV networks today is format conversion. This is the identical problem experienced by FM fiber systems for CATV. Given that the cost of a DS3 codec were to go down to $500, the cost of VSB/AM (vestigial sideband/amplitude modulated) modulators at each hub means that the total cost of using hubs is still much higher than with currently available or soon to be available AM fiber systems. In reality, the only way a digital fiber system can make sense for CATV is

"The foremost disadvantage of digital transmission...is format conversion."

if the system is digital all the way to the home, to eliminate the costs of format conversion and allow longer distanced systems to be built.

There are many proposed schemes of transmitting digital video to the home. The two most commonly proposed methods are broadband and switched-star transmission.

If an all-fiber system were to be designed in a broadband digital format (i.e., tree-and-branch or ring structure), an 80-channel digital fiber-optic system would require a staggering 3.6 Gbps receiver in every home. This is equivalent to 53,760 voice conversations of equivalent capacity per home. Today, no digital links are even available to handle this rate on long distance systems, let alone to every home. The cost would be staggering, like the cost of providing an AM over fiber system all the way to the home in broadband format.

In a switched-star format, the cost of the in-home equipment goes down substantially. In fact, one can argue that the cost of a DS3 codec could easily come down to the $100 range if they were produced by the millions similar to today's CATV converters. However, when looking at the digital video switch that also must be provided, this same volume does not apply. The current cost of digital broadband switching technology is prohibitive. Current digital telephone switches operate at data rates of 64 kbps per subscriber (144 kbps for integrated services digital network or ISDN). For video we are talking about 45 Mbps data rates. Today the cost of 320 crosspoints per home (80 channels × four TV sets per home) is easily $16,000 per home for these switching rates[2]. This cost needs to come down by two orders of magnitude in order to be competitive with alternate delivery systems.

HDTV and codec compatibility

Recall that the digital video transmission rate is proportional to the highest frequency of the sampled signal. If it is necessary for HDTV signals to be transmitted through the network, entirely new codecs will be required. This is because 45 Mbps NTSC codecs are not compatible with HDTV signals, due to the fact that DPCM video compression relies on the signal format as well as the frequency in order to reduce system transmission rates, as stated previously. Therefore, even 6 MHz HDTV auxiliary channels will not be compatible with existing codecs, since their format would be different from NTSC signals. Identically, the digital star video switch would be useless for HDTV signals of higher frequency and/or different format. Compare this to current FM/FDM fiber systems and AM over fiber systems, which do not rely on the content of the signal in order to provide acceptable video transmission.

Forgetting about HDTV for a moment, if one looks at current 45 Mbps codecs, there is the additional problem of compatibility. If a phone conversation is digitized by one brand of equipment, it can be transmitted and then converted back to analog by equipment from another manufacturer. This compatibility standard is one of the key benefits of digital voice transmission. Yet in digital video transmission today no DS3 codec is compatible with any other manufacturer's DS3 codec. This is because each manufacturer uses slightly different compression algorithms. An ANSI (American National Standards Institute) standards committee has been established (the T1. Y1 Committee) to establish a single standard compression algorithm for each digital transmission speed. But, paradoxically, if a standard is established, this means that further advances in DPCM algorithms for reducing transmission rates will not be compatible with the network, which virtually halts algorithm improvements.

Telcos that have tried fiber to the home trials with completely digital systems for voice, data and video have discovered these digital video transmission limitations. There is a growing trend to look at hybrid systems; i.e., fiber to the home systems that take advantage of digital transmission and switching benefits for data and voice channels and analog transmission and switching techniques for video channels. These systems can transmit telephone, data and video simultaneously using only a single light source and fiber. These hybrid systems promise the lowest cost in the intermediate term of all fiber systems with the ability to migrate to the all-digital fiber network of the future if and when it becomes

Figure 2: Video signal to be sampled (one line)

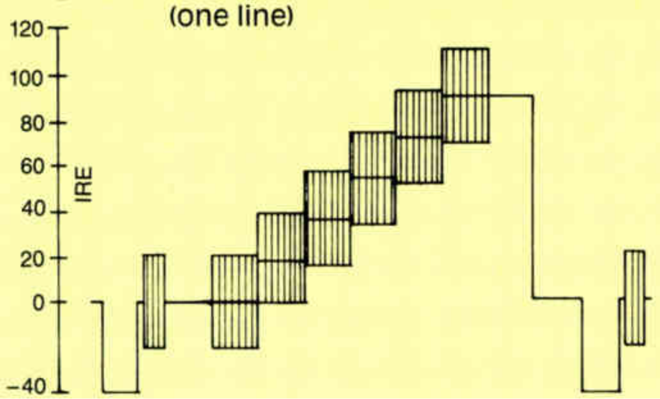
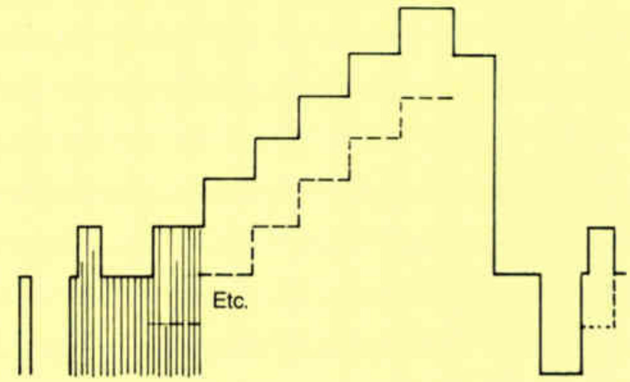


Figure 3: Digital sampling of video signal



technically and economically viable, without the need to modify any of the fiber backbone plant that is initially installed.

Economic obstacles

Digital transmission of video over fiber is possible for headend to hub applications in CATV but suffers from the disadvantages of cost and format conversion and inability to handle HDTV signals as easily as FM/FDM fiber systems. Although it offers the advantage of longer distance transmission than FM/FDM fiber systems, for virtually all current U.S. CATV system installations this increased distance is not a significant advantage. As AM over fiber systems increase in performance, the economic obstacles to digital video trunking systems will become greater in comparison, not less in the intermediate term.

For hub-to-node applications, digital trunks suffer the same format conversion disadvantages as FM/FDM fiber systems. For the distant future, this will be the realm of AM over fiber and AM microwave systems.

In fiber to the home applications, the cost of digital systems and their current technical limitations create cost disadvantages that are orders of magnitude above current alternative hybrid fiber to the home systems. These disadvantages will be gradually overcome based on the overwhelming belief in the advantages of digital transmission and the extensive long-term research emphasis that is being universally focused in this area.

But the differential between the cost of analog and digital video transmission has not decreased as rapidly as many expected. Therefore, widespread use of digital video transmission equipment for CATV applications appears highly unlikely in the near term.

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Digital techniques in scrambling

By Joseph D. Keyes
Associate Staff Engineer, Scientific-Atlanta Inc.

Scrambling technology is in a process of change, a process that ensures continued revenue now and in the future. The simple scramblers of a few years ago are now powerful integrated RF and computer packages. Here is a description of the significant changes and the reasons for those changes.

In the beginning

Scrambling by removing (or hiding) a part of the TV signal that the subscribers' sets require for operation was one way to achieve premium channel security. A converter reinserted the required part of the signal. Attenuating sync pulses by suppressing the RF carrier during that time was a very popular technique for scrambling.

Initially, scrambler designs were very simple. The RF circuitry was straightforward and the controls were not much more complicated. Some used inexpensive one-shots or simple oscillators to control all required timings. Those one-shots controlled the suppression as well as the timing pulses sent to the converter to synchronize its sync restoration. Such simple scramblers performed adequately for their required purposes. The amount of circuitry required, however, may have been unwieldy. One manufacturer's scrambler featured no less than 18 one-shot circuits.

Although they did the job they had to do, one-shots have traditionally suffered from problems with touchy adjustments and drift. In one product, a one-shot set to about 63 μs controlled the beginning of sync pulse suppression. A second circuit set to about 6 μs controlled how long suppression lasted. A few percent drift in the first circuit could have caused the timing of the second circuit to miss sync entirely.

As theft-of-service became a more visible issue in the industry, changes were made to increase the degree of security. One method was by transmitting information (along with the scrambled signal) that would identify the channel tuned. The converter used that data to make sure that it was tuned to a channel it was authorized to tune.

Some manufacturers made their scramblers send data by adding a modification that injected some more one-shot controlled pulses to the timing pulses. Others redesigned their whole product. Either way, this new requirement to send some rudimentary data began the changes to the humble scrambler—changes that are still going on today.

The present-day scrambler

Today's scramblers include a variety of technologies and features. They include precise digital control of timings related to sync suppression scrambling, new scrambling modes, circuits for immunity to terrestrial and satellite link-induced noise and data communications capabilities, along with a user interface designed to ease the burden for overworked headend personnel. All of this circuitry works in harmony with the high performance RF circuitry needed to provide the clean signals that cable system standards require.

Long-term accuracy and signal quality: Analog control of traditional sync suppression scrambling using one-shots could typically be adjusted to work adequately. However, digital control of timing gives an improvement in long-term stability. Replacing the older technology of one-shots for timing control virtually eliminates the need for difficult periodic tweaking of sync suppression timings at the headend. The accuracy of the digitally controlled sync suppression timings are as good as that of the digital circuit's reference standard. When that standard is a crystal oscillator, its long- and short-term accuracy is a few parts per million. That accuracy is better than the few percent of analog one-shots.

Further, a series of timings can be generated digitally without one affecting the other. In the one-shot based product previously mentioned, inaccuracy in one circuit causes inaccuracy in a second circuit. Large numbers of precise timings can be generated in digital circuitry without the need for cascading circuits. Each one has the same accuracy as the crystal reference. Even if one is in error, all others are still accurate.

Increased security: As cable operators strive to increase their system penetration, the issue of theft-of-service becomes more and more important[1]. In the continuing struggle against pirates, new and innovative scrambling techniques and modes become increasingly important. Toward that end, scramblers are now called on to provide more depth of security by providing additional scrambling modes.

A scrambler that is capable of producing only one mode of scrambling provides an opportunity for a technically adept pirate. When the method of scrambling never changes, the pirate has large amounts of time to study the signal and look for a trigger for the defeat circuit. Dynamic modes of scrambling make sure that the pirate no longer has ample opportunity for study. The cable operator can choose to change scrambling modes weekly, daily or on whatever schedule desired. Before the pirate can analyze and decipher one mode, the scrambler changes to a different mode. The pirate then has to start over from scratch.

Security can be enhanced while using one mode of scrambling. The scrambler can make dynamic changes in timing on a random basis, so the pirate will not have a stable timing source to trigger defeat circuits. Further, sync suppression can be momentarily dropped on a random basis, while maintaining timing signals. The pirate's circuit then tries to restore sync to a signal that does not have sync pulses suppressed.

An effective security scheme is to let the scrambler continuously control the converter through random changes in scrambling type and timing. This way, potential pirates never find a repeatable pattern on which they can "hang their hats."

Increased precision: Crystal-controlled digital timing circuitry is very precise. That precision allows the scrambler to perform novel scrambling of the video signal. Less precise analog one-shots are sufficiently repeatable to resolve details like the location of the horizontal interval. With a precise crystal-controlled time base, individual elements within each line can be resolved. The scrambler can then operate on those elements to achieve strong scrambling effects.

One such strong scrambling effect is video inversion. The inversion of black for white in various combinations with sync suppression and inversion yields good security. Some previous attempts at video inversion were troubled by hum and other artifacts. Being able to rely on accurate, fine resolution timing within the horizontal interval makes a high quality video inversion TV picture possible.

Foretelling the future: Sync suppression scramblers must foretell the future. The video RF is attenuated before the leading edge of the horizontal sync pulse. The scrambler cannot wait for the sync pulse to occur and then begin suppression. By the time the scrambler can respond, part of the sync pulse is already on its way to the subscribers' sets. Some sets can lock up on that small signal. Instead, the video RF is attenuated just before the sync pulse and remains suppressed until after the end of the horizontal interval. Therefore, the scrambler must be able to predict with high accuracy just when the sync pulse will occur.

Although knowing when a horizontal sync pulse will occur may seem easy in theory, in practice it is not. The very slight changes in the signals introduced via satellite links and terrestrial noise can cause some sync time base jitter. Most of all, the greatest challenge to sync stability comes from the variations introduced by some consumer-grade (or higher) VCRs.

To guard against all these sources of time base corruption, some modern scramblers feature phase-locked loops (PLLs), which can track and adapt to the horizontal line rate of the video source. Such PLLs can be designed in a traditional analog way or they can be made using purely digital adaptive techniques. Either way, the result is greater precision in timing for a more accurate restoration in the customer's converter and a better picture on the TV set.

In-band and out-of-band addressability

Addressability creates the need for a reliable, inexpensive data path from the operator's headend to the subscriber's converter. Addressable systems are broadly classified as in-band or out-of-band, depending on whether data transmission takes place within the cable channel. The decreased costs and increased security associated with in-band transmission has made it a popular means for that data path. With in-band data transmission, the scrambler becomes a logical place to apply the data to the TV signal.

As has been described[2], in-band data can be sent in many ways. Data can be placed on lines in the vertical blanking interval of the baseband video, in phase modulation of the video carrier or in pulses that are amplitude modulated onto the audio carrier. Any of these schemes could be accomplished in the scrambler.

The need for in-band addressability data changes the scrambler. No longer is the scrambler an analog device dealing only with the analog TV signal; it is now a vital part of the data communications link. In a way, the scrambler serves as a modem for communication between the billing computer and the subscribers' converters. The scrambler has to be as much computer and data communicator as video equipment. The modern scrambler includes as much computer circuitry as analog circuitry.

When scramblers were basically analog devices needing only analog adjustments, operators required a very steady hand with a screwdriver applied to the adjustment ports to setup and maintain a scrambler. Now the scrambler must do more types of functions. There are more options and modes available to the operator, and easier ways to select them.

In the future

There are many different causes for the evolution of digital circuitry into scramblers. Signal quality, security, addressability and ease of operation are important issues for cable operators. These issues led to the rise of digital techniques in scramblers. In the future, the importance of these issues will increase, rather than diminish.

There will be opportunities for increased revenues and decreased costs through addressable technologies (including pay-per-view). Scramblers' increases in computing power and data capability will help to make those opportunities into reality. The increasing use of digital technology in scramblers will continue to ensure our industry's success in these areas. Wrap up that success in an easy-to-use package and the combination is hard to beat.

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ISDN, B-ISDN, SONET—A triple threat?

By H. Mark Bowers
Director of Technical Planning, Centel Cable Television Co.

ISDN, B-ISDN and SONET. Are these acronyms that should strike fear in a cable operator's heart or merely new complements to existing telco architecture? Some in our industry have heard the term "ISDN" used; others may not have or are confused as to the capabilities and intent of this new technology. Other terms such as B-ISDN and SONET are probably new for most of us.

We all understand and appreciate that existing cable TV architecture and technology are evolving at a startling rate. We also should recognize that existing telco architecture and services are evolving as well. The intent of this article is to take a capsulized look at the world of ISDN, B-ISDN and SONET. Let's begin with some basic definitions.

Demand for digital

ISDN is an acronym for "integrated services digital network." ISDN is being developed to satisfy the telephone/network customer's increasing demand for digital transport of voice, data and narrowband video services. It offers simple, economical access to an unrestricted range of services without the cost and complexity of multiple access loops.

ISDN by definition is completely digital in construction and distribution and carries voice and non-voice (data and telemetry) services. It evolved from existing phone system switching and distribution architectures, has an intelligent control overlay and has a defined set of both user-to-network and network-to-network interfaces. It should be viewed as (eventually) being universally available. A customer should be able to access enhanced services, interLATA (local area telephone access) carriers or other ISDN terminals by plugging any ISDN terminal into any ISDN receptacle and entering a correct directory number.

Elements that differ ISDN from non-ISDN architecture are end-to-end digital connectivity and integrated access for the customer (access to a wide variety of services over a single access link). Also, ISDN uses a small family of standardized customer network interfaces to provide a wide range of services. It will permit unrestricted portability of customer premise equipment. It provides out-of-band digital signaling, which offers speed and versatility while greatly increasing information transmission capability, and offers customers control in allowing dynamic allocation of their use of bandwidth and services.

B-ISDN is an acronym for "broadband integrated services digital network." It is an ongoing natural evolution of the ISDN plan, which is basically a narrowband service offering transmission rates of 144 kilobits per second (kbps) and 1.544 megabits per second (Mbps). This evolution of technology in the telephone network toward ISDN and B-ISDN really began in the 1960s with the introduction of the T carrier interoffice digital transmission system. Broadband rates for B-ISDN are still under consideration by the CCITT (Consultative Committee on International Telephony and Telegraphy) but rate offerings are expected to be approximately 150 and 600 Mbps and to be compatible with SONET.

B-ISDN by definition will be a layered extension of the ISDN service and broadband in nature. It therefore has all of the features and advantages of ISDN listed previously. Given its greater bandwidth, B-ISDN would in theory be able to provide such services as full-motion video, HDTV (high-definition TV) and transmission of high-fidelity stereo sound, to name only a few.

Finally, *SONET* is an acronym for "synchronous optical network," a system under development to define an optical interface standard that would be used to connect equipment from different suppliers. SONET is expected to have major impact on the next generation of telecommunications optical equipment.

Current SONET interface specifications are covered in two major documents. The first covers multiplexing specifications, while the second contains specifications related to optical parameters at the interface level. SONET offers the promise of national and perhaps worldwide uniformity at data rates of up to 1,327 gigabits per second (Gbps). Although formal adoption by ANSI (American National Standards Institute) and CCITT may take some time, the basics have been sufficiently settled for aggressive vendors to begin equipment development.

SONET by definition is a single-mode fiber transportation network constructed as a progressive hierarchy of synchronously multiplexed tributary signals. It is optical, digital and synchronous in nature and has the capability of surveillance-based maintenance. Information is carried by signal overhead bytes so that facility and equipment maintenance activities can originate from the network elements. The basic electrical signal of SONET is called the synchronous transport signal level 1 (STS-1). It has a rate of 51.84 Mbps. The optical equivalent of STS-1 is called optical carrier level 1 (OC-1). Only an electrical-to-optical conversion is needed to go between STS-1 and OC-1. Higher level (data rate) signals are easily obtained by synchronously multiplexing lower level signals. For example, STS-N is the nth synchronous signal level and has a rate of n × 51.84 Mbps.

Basic building blocks

Much additional time could be spent on definitions and basics, but let's get on to some practical application. What does all this mean in terms of telecommunications network construction and utilization? Let's assemble some basic building blocks of an elemental future system.

Two basic types of ISDN interfaces were standardized by the CCITT in 1984: the *basic access* and the *primary rate* interfaces. The basic access interface contains two 64 kbps bearer (B) channels and one 16 kbps data (D) channel. The B channels carry voice or data, while the D channel carries necessary signaling, telemetry and packet data. The overall rate for the merged 2B+D basic access interface is therefore 144 kbps. The primary rate interface is based on the existing T1 standard. The standard data rate for T1 is 1.544 Mbps. Of this rate, 1.536 Mbps carries the actual information while the other 8 kbps is used for framing and maintenance. The primary rate 23B+D structure is therefore composed of twenty-three 64 kbps B channels and one 64 kbps D channel plus 8 kbps for framing and control. Configuration of a 24B structure is also available.

It is important to note that all of these configurations are realized without the use of fiber-optic cable. ISDN, as originally envisioned and developed, does not require fiber cable and is basically a narrowband copper-based network implementation. Bell Communications Research (Bellcore), the research arm of the regional Bell Operating Companies, estimates that approximately 70 percent of all existing telephone service drops in the United States are capable of passing the full primary T1 1.544 Mbps rate. ISDN implementation at the T1 rate is therefore not a difficulty for the majority of existing telco plant architecture, with the bulk of the capital outlays required in the switching system(s).

As telco technology evolved over the past decade, it also became obvious that a narrowband network with a high-end capability at the T1 rate would not satisfy the future data requirements of phone/network customers into the next century. While all this was occurring, fiber optics also was enjoying early widespread application within the telephone industry. It offered the advantages of an immense leap in bandwidth plus dramatically reduced maintenance costs compared to existing copper plant technology. Early telco fiber-optics applications were central office to central office. Then fiber's use spread from the central office to remote switching sites (remote terminals), with final evolution from the remote terminal to the business and private residence.

It is obvious that the new higher bandwidth advantages of fiber are not fully realized until the entire distribution plant is fiber. But we also must note that the many advantages of fiber over copper-based plant will cause eventual full deployment with or without the added impetus of video signal delivery. The high bandwidth of the single-mode fiber-based B-ISDN evolution will allow dramatically increased data transmission rates and services.

A primary remaining handicap for the typical telephone switched star or switched multistar distribution system is the high cost involved due to individual line requirements from the central office or remote switching center (remote terminal) to the customer premise. This places a high cost factor on the system since bus or tree-and-branch distribution system economics are currently not possible.

Recognize, however, that the current evolution toward B-ISDN and SONET will slowly resolve those remaining obstacles. The dynamic, configurable approach to these two architectures allows for a slow expansion of a layered system toward the business and home residence. Economies of scale will evolve, albeit slowly. The cable industry should not make the mistake of giving a cursory examination of these technologies and then dismiss them because they "appear" to be cost-prohibitive. Given a long-term view, the systematic evolution of their architecture makes economic sense as well.

It is reasonable to project that this broadband switched technology will evolve toward the business and residential consumers. The rate of evolution and expansion now becomes the unknown in our equation. B-ISDN and SONET are just at the beginning of their life cycles; most recent projections are that widespread application and use will not commence until the mid-1990s or beyond. The past lack of standards as well as disagreements between the United States, European and Japanese industries have slowed the rate of development thus far. The preponderance of those problems now appears to be resolved and development will accelerate. The various parties are now working toward a common worldwide standard, and deployment by the mid-1990s is not unrealistic.

Why should we worry?

Where do these new capabilities lead the telecommunications industry? What new services might be added and do they represent an immediate or long-term threat to the established cable industry? Let's begin to answer the question by stating new services projected by Bellcore itself. Bellcore has outlined four classes of new services expected to arise from the technical evolution toward ISDN, B-ISDN and SONET. These are:

- broadband interconnection between local

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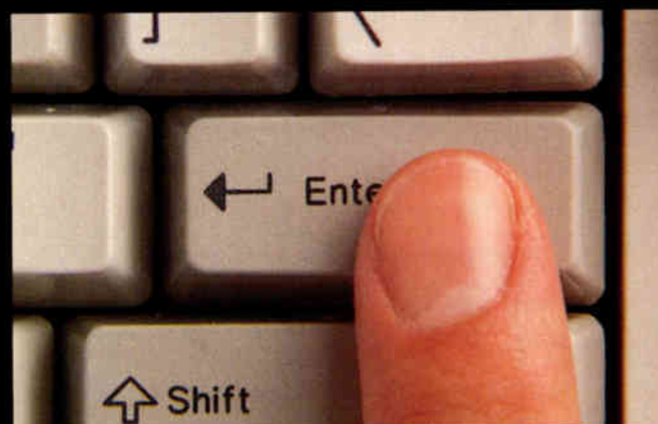

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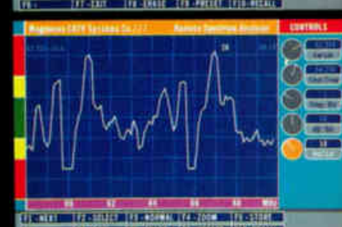
MLM display showing sweep response. White is actual response; yellow is stored response.



MLM display showing the video, color and sound carriers of Channel 3 with upper adjacent channel picture carrier and lower adjacent sound and color carrier also shown.

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- packeted voice services.

Do these offerings represent an immediate threat? Probably not. As discussed, the most immediate effect of this evolution will be the introduction of ISDN-type services and ISDN is fundamentally a narrowband service offering. ISDN will most certainly enhance data and telemetry service offerings to both the business and private residence.

The classic example of an ISDN-type service would be the ability to determine who is calling when a call is received. The consumer can then accept the call or opt to signal an unwillingness to receive the call at that time. Many other services are possible in this enhanced, digital, separate signaling channel environment. The ISDN marketplace does not represent any immediate or implied threat, since cable operators currently do not offer these types of services.

What about the B-ISDN and SONET evolution? The eventual realization of this technology will allow delivery of our current classic video services with a potential increase in signal quality and the conceivable offering of services beyond our present capabilities. To be sure, we still have the advantage of the economics of the tree-and-branch distribution architecture, and by the mid-1990s fiber optics will likely be in widespread use in our own distribution plants. But we should not underestimate the potential capabilities inherent in the B-ISDN and SONET evolution and approach.

Although cable TV has survived and flourished over the past several decades, we have had a tendency (at least at times) of being rather shortsighted in our approach to system capabilities and service offerings. Billions of dollars are currently being spent in research toward the networks discussed briefly in this article and volumes of text are written each year.

Our short-term advantages could quickly become long-term liabilities. The cable industry certainly has the ability to compete long term in an evolving telecommunications revolution. Advantages for our industry are its demonstrated ability to react and to react quickly to new innovative technologies, its established presence in the video delivery marketplace, its more economic design in distribution plant architecture and its short-term capital depreciation cash flow-based financial structure.

We also must demonstrate our desire to compete as long-term players. Any industry going through deregulation has experienced a period of trauma and difficult times, both for those in the industry and for the affected consumer. The cable industry is no exception. We must demonstrate that we have the desire and ability to focus long term if we wish to step to the table and compete head-on with the players assembling there in the B-ISDN and SONET arena.

Even assuming that we only wish to continue to provide entertainment video signal delivery, much greater emphasis must be placed on long-term research, planning and system engineering in general. There is currently a disturbing trend toward maximizing cash flow and return on investment while ignoring the gathering "competitive clouds" on the horizon. At the very least, we as an industry must begin to better examine the evolving capabilities of the potential competitive forces assembling around us. Cable Television Laboratories is a very good beginning but still doesn't entirely address the type of industry consortium and consensus that is needed.

So, are the discussed evolving architectures and systems a short-term threat? Definitely not. But are they a long-term threat? Certainly! Can the cable industry compete long term? Yes, assuming we demonstrate a clear will to compete in the long term. This must involve the converging of our collective talents and resources; establishing long-term research, system standards, common practices and goals; and demonstrating the financial conviction and confidence to reinvest for the long term—in engineering talent, in equipment development and evolution and in system architecture evolution based on future plans and needs as well as short-term commitments.

The tone of this conclusion should not be construed as the playing of taps for the cable industry but rather as a call to arms and battle. The future competitive marketplace is sufficiently well-defined for the work to begin. We should begin defining battle plans—and soon!

Digital audio services

By Clyde Robbins
Senior Staff Scientist, Jerrold Division, General Instrument Corp.

Cable TV developed because it could provide broadcast reception to areas where signals were not available or were of poor quality. Further growth came from providing programming not available from broadcast sources. In addition to carrying video, many systems also carried FM audio by processing and retransmitting FM signals from over-the-air sources. At the present time many systems are considering expanding their audio service to include programming not available via FM broadcasters, delivered to the headend via satellite. At this point, two questions beg answers: What quality will the received audio have? How will access to audio programs be controlled?

Consumer awareness and standards for audio quality are rapidly evolving. According to Electronic Industries Association estimates, approximately 15 percent of all U.S. homes have CD (compact disc) players. CD sales in the United States have passed album sales. In Japan, where CDs have been available for a longer period of time, CD sales exceed album sales by a nine-to-one margin. In addition to CDs, hi-fi VCRs have brought theater quality sound with video into many homes via rented tapes. Every proponent of HDTV (high-definition TV) technology includes some form of digital audio delivery in the system.

A convenient method for delivering additional audio services over cable is to transmit stereo FM multiplex signals with 400 kHz channel spacing in the 88 to 108 MHz frequency range. This allows up to 50 channels if all frequencies are usable. But what quality will those channels actually have and what revenue can be derived from this level of quality?

Mono FM is an extremely robust signal due to the wide deviation constant: β

$$\beta = \frac{\text{peak deviation}}{\text{frequency of modulation}} \quad (1)$$

For example, a 1 kHz tone deviated 25 kHz has a β of 25. An expression for the signal-to-noise (S/N) improvement of the detected FM signal relative to the carrier-to-noise (C/N) ratio (above threshold) in decibels is:

$$\begin{aligned} S/N &= C/N + 10\log(3\beta^2) \quad (2) \\ &= C/N + 33\text{ dB} \end{aligned}$$

for this case. A mono FM signal also is quite immune to spurious interfering signals and multipath.

The stereo FM multiplex (FM MPX) system is an outgrowth of the need for backward compatibility in the broadcast environment. FM MPX does not retain the robustness of the mono FM system. If we take a 1 kHz tone and apply it to the left channel only of an FM MPX modulator, and again have 25 kHz L+R deviation and thus 50 kHz L−R subcarrier deviation, the mono portion of the signal is improved by 33 dB but the stereo portion is improved by:

$$\beta = \frac{50\text{ kHz}}{38\text{ kHz subcarrier}} = 1.3$$

thus:

$$S/N\text{ stereo} = C/N + 7\text{ dB}$$

In many broadcast situations, C/N is not a limiting factor; in CATV, it is a different story. If we assume a system is delivering 45 dB C/N pictures, the FM C/N would be 41 dB. This assumes FM carriers 15 dB below picture carriers and an 11 dB improvement due to the 300 kHz FM receiver bandwidth. Adding 7 dB stereo FM improvement, the resultant stereo S/N is only 48 dB. This is equivalent to a cassette deck without noise reduction and about 7 dB worse than typical mono TVs. In fact, the only con-

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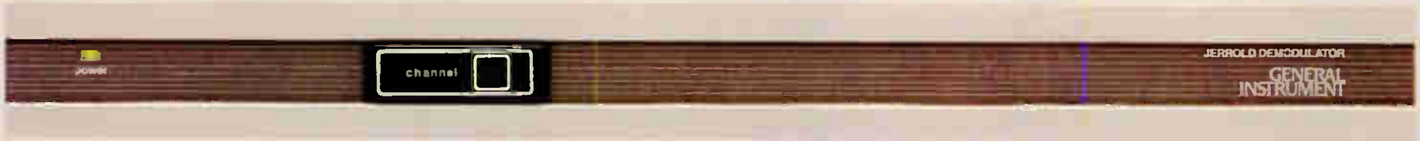

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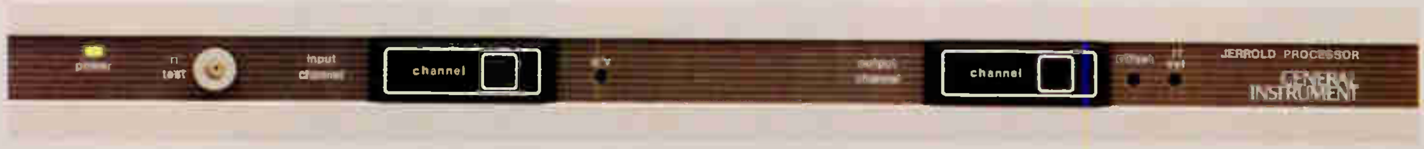

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GENERAL INSTRUMENT

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sumer audio source with which cable FM MPX compares favorably is AM radio.

It is an incorrect assumption that cable subs are not interested in or willing to pay for audio services. Audio software and hardware are growing industries. CATV needs a technology that can deliver secure high quality audio. The capital expenses involved in establishing an audio service also should pay back in a relatively short period of time.

Today's digital technology can provide both signal security and state-of-the-art audio quality. We have a unique opportunity to provide a level of quality that broadcasters cannot equal. In order for broadcasters to transmit digital audio signals, both industry standards and regulations will need to be established. This will undoubtedly be a lengthy process. Digital audio over cable provides a means of delivering quality, uninterrupted and non-repetitive music, which is also not available to the consumer via any other means. Digital audio transmission will eliminate reductions in audio quality due to noise and interference through the transmission process. The transmitted and received audio are identical.

A common misconception

There is a common misconception that digital audio signals require enormous amounts of bandwidth for transmission. There are many digital audio sampling and companding systems, as well as many digital modulation schemes. A criterion that is logical for selection of a sampling/companding system is that the sound quality through the system should be indistinguishable by audio professionals from that of the best source available (currently the compact disc). Another criterion is that the system should use as low a data rate as possible and still meet the first criterion. Another desirable digital system feature is the ability to withstand data errors without catastrophic results; Dolby adaptive delta modulation has been shown to meet these requirements.

Transmission of digital audio signals can be handled in various ways. One method is to combine the data streams of numerous digital audio signals and transmit them on one carrier. The downside of this choice is that the receiver must be wideband, and a sensitivity to noise, interference, group delay and reflection results. This approach generally requires a chunk of bandwidth of suitable quality for a video service. This puts the audio service in direct competition with video services for channel space.

An appealing alternative is to modulate each digital audio signal (stereo pair) on an individual carrier. These digital carriers could be spaced as little as 400 kHz apart, depending on the sampling and modulation scheme used. This spacing is no different than required for an analog FM MPX. Individually placed carriers also avoid interference-prone portions of the spectrum without losing 6 MHz channels at a time. If the discrete carriers are placed in the 88 to 108 MHz range, the digital audio does not compete with video services for channel space.

Transmission can be via amplitude, phase or frequency modulation. As more data levels are added, the transmission bandwidth decreases, but the receiver complexity and signal susceptibility to noise and interference increase. A popular choice in data communications is QPSK (quadrature phase shift keying), which is two data levels in each of two carrier phases. QPSK achieves the optimum bit error rate curves and two bits/Hz bandwidth efficiency. In order to operate a digital audio carrier on or near a frequency of a local FM broadcaster, a robust modulation method such as QPSK is desirable. For example, a 15 dB carrier-to-interference ratio is usable with QPSK but is not with four-level amplitude shift keying.

For digital audio over cable to become a significant revenue producer, the programming variety and price must be accepted, the hardware must be functional and cost-effective, and the service must be aggressively marketed. Once a digital cable audio system is available and in widespread use, many categories of programming will evolve. Possible examples that have video service equivalents are pay, pay-per-play, superstations, distant signals, local broadcast, video simulcast, local origination, jukebox, comedy, news and sports. There are many opportunities for new revenue sources. A key requirement is digital audio delivery technology with room for programming growth; a system with eight to 10 channels is far too limiting. A 50- to 80-channel capacity is desirable to provide for long-term growth potential.


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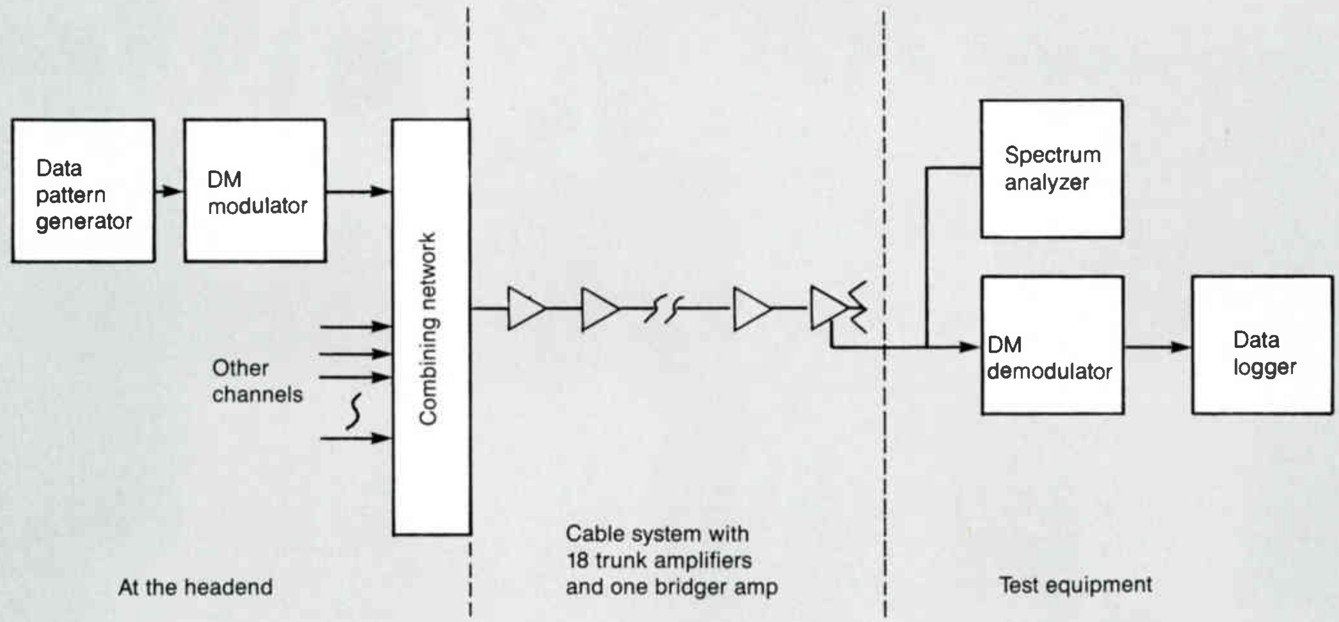
Figure 1: Cable system test



Multichannel compact disc digital audio for CATV

By Joseph L. Stern
President, Stern Telecommunications Corp.

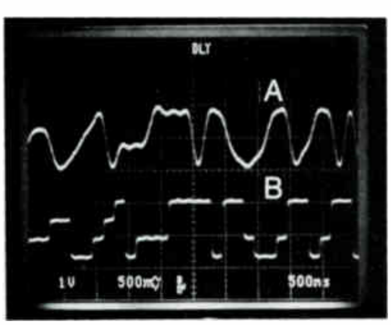
Compact discs (CDs) are rapidly becoming a dominant music source in the home. CDs not only overcome the traditional problems caused by physical wear, dust and handling but also provide a quality reproduction that brings the listener closer to the original music as it was first recorded.

Currently, the highest quality audio transmission system that consumers enjoy is FM broadcasting. While FM provides relatively noise-free transmission on 50 to 15,000 Hz signals, its modulation technique cannot match the CD's dynamic range of 96 dB or extended frequency range of 2 to 20,000 Hz. Therefore, a new method of transmission is required to deliver true CD quality to the home.

A new digital music system (called "DM" for "digital modulation") achieves this standard. DM carries nine stereo channels of music with full CD performance specifications on a single 6 MHz

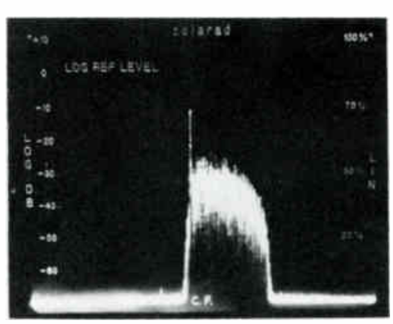
"The DM system can operate without degradation on a cable channel at full carrier amplitude or at 15 to 16 dB below visual carrier level."

Figure 2



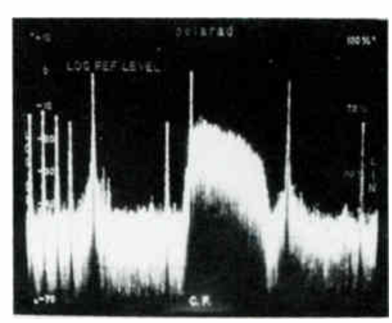
DM baseband signal
A—Filtered output
B—Four-level dibits

Figure 3



DM modulator output
Ch. A-1

Figure 4



DM signal
(Ch. A-1) after 18 amplifiers

Figure 5: DM dibit data representation

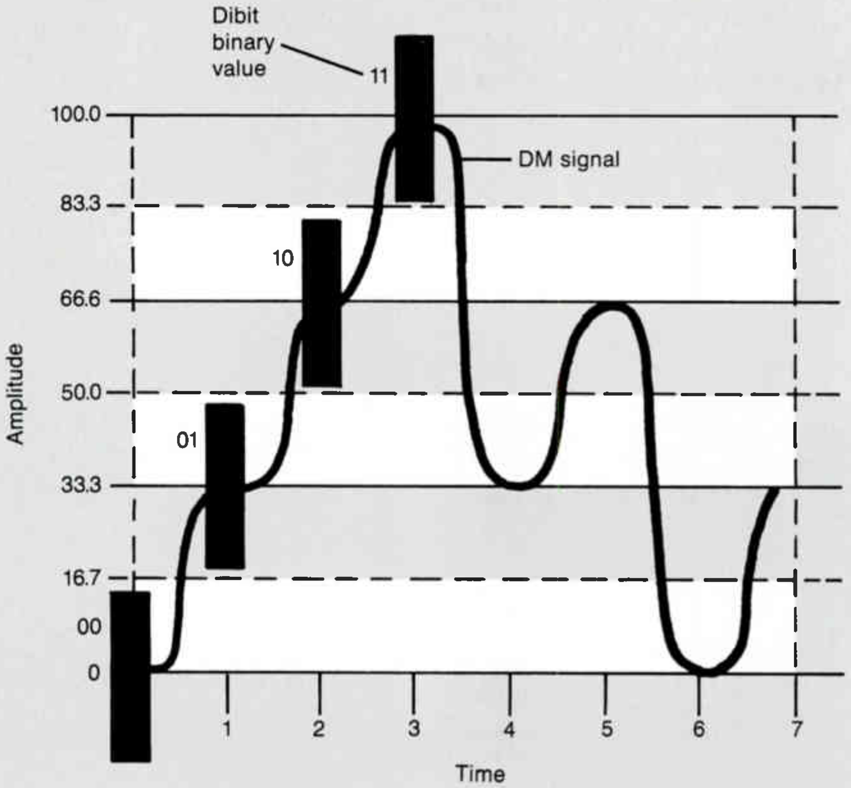
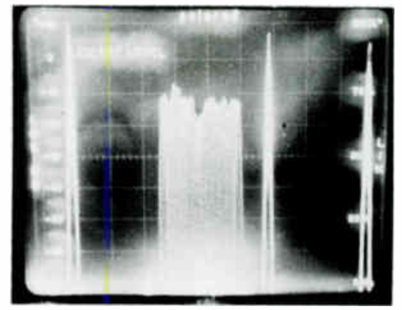


Figure 6



Ch. A-1
Amplitude response after 18 amplifiers (2 dB/division)

cable channel. Moreover, the same digital technology that made CDs a commercial reality has been used to develop this transmission system.

Testing the DM system

We were asked to undertake tests to determine how the DM system (which was introduced by International Cablecasting Technologies and developed in cooperation with Frederiksen and Shu Laboratories) performed under real-life microwave, satellite and cable TV operation. The tests were conducted to determine if the existing systems could carry this multiplexed digital signal without degradation. Cable system carriage of the signal also was analyzed to see if a fully loaded cable system would interfere with the DM channel and/or if the DM signal would interfere with other signals.

The quality of transmission at various system carrier-to-noise (C/N) levels was studied to determine the range of operating input levels within which the system would perform to specifications. The performance of the DM tuner, which receives the signal in the subscriber's home, also was assessed at various input levels.

Tests were conducted using a custom-built DM data pattern generator and data error logger package. The generator created a random pattern of data corresponding to nine stereo audio channels, plus 40 9.6 kbps and 24 19.2 kbps data signals; this is the package of information carried in one 6 MHz channel by the DM system.

All compression, multiplexing, encryption and forward error correction signals were included. The output of the generator was identical to the output of the DM broadcast center, except that all digital signals representing music were randomized. The generator output was fed to the DM vestigial sideband modulator, then fed to the cable system combining network and transmitted on the system to the DM tuner demodulator. The output of the demodulator was fed to the data error logger package (Figure 1).

The error logger was equipped with counters to register the number of Hamming errors transmitted but fully corrected and the number of cyclic redundancy code (CRC) errors that were not corrected. Sync errors and frame errors also were counted. Errors were logged over fixed time periods under all test conditions. Operating conditions were changed to determine the points at which signal quality was acceptable and the points where degradation was found.

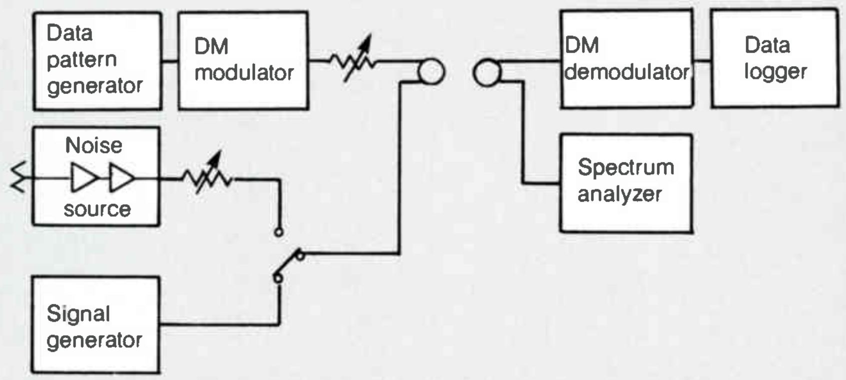
The transmission of these digital signals is carried through a compression and encryption scheme using a four-level pulse amplitude modulated signal. The scheme provides a 12 megabit data rate—a 6 megabaud symbol rate—in a bandwidth of 3 MHz (Figure 2). The transmission is via a vestigial sideband modulator scheme. A 6 MHz channel is used to allow for the proper group delay shaping.

The signal applied to the cable system looks very much like a video signal without an audio carrier. It puts negligible extra load on the cable system and can be handled as just one more channel (Figure 3). When introduced into a multichannel system with channels in use on both sides, there is no interference caused to either adjacent channel since the energy tapers off rapidly at band edges to at least −60 dB (Figure 4). Measurements also substantiated the amount of signal interference caused by adjacent channels. The results showed that the audio signal

Transmission tests of the DM system

Date		Environment	Corrected errors per min. (Hamming)	Uncorrectable errors per min. (CRC)
10/87	Satellite/ microwave	Four-hop microwave	1	0
12/87	Microwave	Four-hop half-video channel plus four-hop full channel, with pre-emption	125	0
		Four-hop half-video channel plus four-hop full channel, without pre-emption	16	0
4/88	RF bench test	C/N = 40 dB	2	0
		C/N = 30 dB	4	0
		C/N = 25 dB	470	0
		C/N = 21 dB	16,000	23
4/88	Cable system	18 amplifiers C/N 40 dB Ch. response 2.1 dB	447	0

Figure 7: RF bench test



could pass through a cable system without problems.

Components of the DM system

The DM system consists of several components. First, there is a broadcast center where the music from CDs is played, processed, compressed, encrypted, multiplexed and put into packets or frames that include error correcting codes. A major advantage of digital transmission, regardless of the modulation scheme used, is that forward error correction is available and is very effective.

Nine banks of industrial-grade CD changers feed their digital outputs to a digital-to-digital converter. All audio adheres to the Audio Engineering Society (AES) digital format, which specifies 16 bits of information for each sample period. The sampling rate of the incoming signal is 44.1 kHz, with the samples multiplexing both 16 bit left and 16 bit right channel information.

The compression algorithm operates on the left and right channels with two identical circuits. The DM system provides sound block encoding with a compression technique that maintains full CD quality.

The data is reduced, converting 16 bit samples to 10 bit samples. The information is then put into 25 bit packets. This goes through the Hamming encoder circuit where the 5 bit overhead of error correction is added; the output is a 30 bit packet. These packets are assembled into a frame of packets, containing 400 music and data packets along with eight control packets. This interleaving of packets provides the multiplexing function that places all information on one signal. The frames are transmitted at a 900 kHz rate, with 40 packets per frame for each stereo music channel and 30 bits per packet. The transmission rate per music channel becomes 1.2 Mbps.

For the nine music channels, plus the addressable and data channels, plus overhead, the overall data rate is 12 Mbps. Using a four-level "dibit" pulse amplitude modulation (PAM) system to develop the video format, we divide the approximate 12 Mbps signal by four; the result is a 3 MHz bandwidth video signal. This four-level system also provides a robust transmission even along noisy transmission paths (Figure 5).

The four-level PAM signal is sent to a satellite uplink, either by direct connection or through microwave transmission. Tests show that half of a broadband microwave channel can be used without errors. In addition, either half or full satellite transponder can be used, again without errors.

Tests were run on three satellites using eye patterns and an error-checking test package. The tests of microwave and satellite transmission showed that the forward error correction system operated perfectly and there were no uncorrected errors under all test conditions.

When the signal is received on a normal satellite receiver at the headend of the cable plant, the output is four-level PAM. This is fed into a DM modulator that provides the unique vestigial sideband transmission characteristics on the channel chosen for operation. The signal then is mixed with all other signals in the combining network at the headend and is transmitted to the subscriber locations. →

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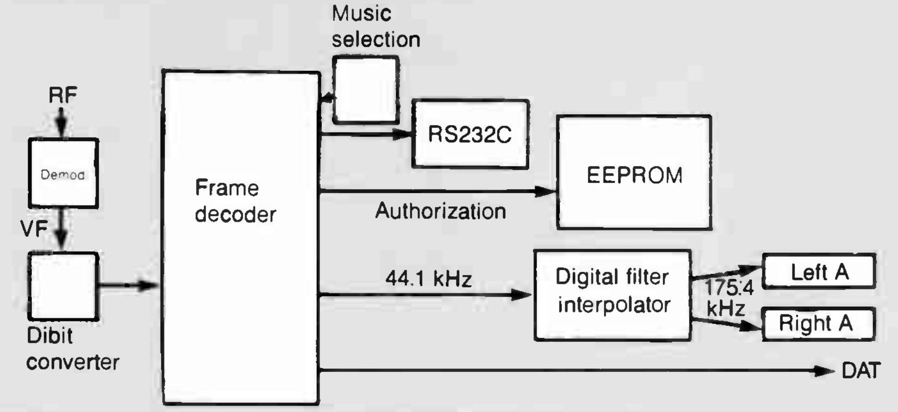
Figure 8: Components of the DM tuner



The tests were conducted on different cable systems while observing changes in signal eye patterns in order to determine data integrity. Additional tests were conducted on another cable system using the error checking test package. The CATV system tests were conducted at 400 MHz with the receiver located 18 amplifiers from the headend. In running the tests (Figure 6), Ch. A-1 was chosen for four-hour blocks of time. The frequency response of the channel was tested and found to conform with results shown.

The performance of the DM system also was tested at varying C/N levels, so it could be determined how the system would operate under reduced level conditions (Figure 7). There were no uncorrected errors present in the signal until a C/N of 23 dB. This indicates that the DM system can operate without degradation on a cable channel at full carrier amplitude or at 15 to 16 dB below visual carrier level.

These tests confirmed that theoretical calculations of the DM transmission system can operate those in the aeronautical bands where a reduction in signal level is required (see accompanying table).

Tuner operation

Once the signal has been carried through the microwave, satellite and cable system, it goes to the DM tuner, which connects to the cable in the subscriber location via a splitter (Figure 8). If the subscriber already has a splitter to feed an FM tuner, that connection can go directly to the DM tuner, which has a loop-through input. This can then feed the RF input of the FM tuner. If no splitter is available, a normal two-way splitter is applied to the line and fed to the DM tuner.

The tuner input contains a signal-seeking front end that scans the full cable spectrum, looking for the distinctive 980 Hz frame sync signal. This recognition takes less than one second. Then AFC (automatic frequency control) goes into action and locks the tuner on channel.

The tuner outputs are left and right audio connections, which go directly to the system's stereo amplifier. A front panel switch or infrared remote control are used to select any one of the nine stereo music channels. Selecting a music format is as simple as operating any hi-fi component. With the tuner, once power is activated, any music channel can be selected and the volume is controlled at the stereo amplifier.

Tests have shown that using the DM signal processing techniques, nine channels of full CD quality audio can be transmitted on microwave systems, via satellite and on a cable system with no adverse effects on adjacent TV signals. ■

Acknowledgments: Facilities used for the tests described in this article were Group W Satellite, Wold Communications and GE/Americom. The measurement work was conducted by David Carlson, senior engineer, Stern Telecommunications, with assistance from Michael Steckman, engineering associate, under the direction of the author.

This article was presented as a paper at the 1988 National Show; it is published with permission of the National Cable Television Association.

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Reader Service Number 37.

Small systems—The last frontier

This is the second in a series of articles designed to help the small system operator or entrepreneur avoid some basic (and perhaps fatal) mistakes. Editor's note: Opinions expressed belong to the authors, based on their experiences.

By Bill Grant
President, GWG Associates

And Lee Haefele
President, Haefele TV

The design philosophy that is applied in developing a small system will have a significant impact on both initial cost and long-term maintenance expense. It is also critical to the economic viability of such a venture. Here is where some in-depth understanding of the transmission technology is essential. Many people working in the cable industry today have only been exposed to larger urban installations. So it is understandable that they may never have questioned or considered the design philosophy itself at all, simply accepting and applying it as presented.

Urban systems employ a trunk/feeder design configuration; it's easy to simply accept this approach as being the ultimate refinement of coaxial cable transmission design. Such designs actually are the logical evolution of many years of applications. But this design philosophy was developed in direct response to the demographics of the urban areas in which it is applied; namely, rather extended service areas with evenly distributed and dense service tapping requirements. If the demographics are changed—and surely the small installations we are discussing here are quite different—then there may be a more efficient, more cost-effective way to apply the technology in such instances.

We have extended experience with and confidence in the construction of systems using a single-cable approach, sometimes referred to as a "tapped trunk" design. Systems constructed in this manner are substantially less costly and much simpler to maintain. If self-regulation is applied intelligently, the quality of the transmitted signals will be equal to or better than the quality of transmission through many more extensive urban installations.

Later in this series we will discuss this in greater depth. However, anyone considering a small system venture would be well-advised to review the basics of the conventional trunk/feeder design. Is it simply a second cable provided for all tapping? How many different transmission levels does it introduce into a system? How many different types of hardware? Why did it evolve as the urban standard design? Is it automatically the best design for all applications? Is is technically superior to other designs? Does it present economic advantages or disadvantages?

Just one consideration is operating power consumption. A conventional trunk/feeder design might consume around $10 of commercial power per mile of cable plant per month, where a single-cable design would consume maybe $6 or $7. Not a very large difference, perhaps, but not insignificant either from a long-term point of view.

Small system headends

Since by definition a smaller system will involve a limited size cable plant and present a very limited supporting subscriber base, the headend in itself constitutes a much more significant economic factor than it would in a larger subscriber base. Headend costs must be supported by subscriber revenues, of course. If there are fewer subs fed from a headend then the cost supported by each sub is higher than if there were many subs fed from that same location.

Although the problems of signal acquisition—and it is not unreasonable to think of it as "product" acquisition—has become simplified with the availability of satellite programs, the question becomes one of program selection. How many satellite dishes are essential? Direct off-air broadcast reception is probably best handled by simply ignoring any signals that cannot be cleanly received on top of a 40- or 50-foot pole or tower. Certainly the old days of going 300-400 feet up to fight for signal with stacked arrays of antennas are long gone (and good riddance) but the decisions required now are still not all that simple.

Then there is the perplexing question of tiering services. If a multiplicity of programs is to be offered—and remember that market penetration is vital—then how the operator chooses to handle the various grades of service and how many grades are established is very important. If a more sophisticated, more expensive subscriber converter is required or if signal encoding or decoding is casually introduced, then additional costs could be incurred at every single subscriber station.

Although the decision is technical in nature, its impact on the economic viability of the venture is very profound. It requires sound business judgment and a realistic examination of both the costs and the impact on the subscriptions for service. An error in judgment here could mean disaster and even in the best case it could mean a less profitable operation. It takes courage to undertake a small system venture but it takes knowledge and experience to make such a venture a success.

Later in this series we will discuss problems of headends and tiering. But you should be aware that it is in this general area that the most critical make-or-break judgments will probably be made. We particularly caution you against promising to deliver a very wide range of services before having researched the program costs of each of these. Some of the available programs impose a minimum license fee and, if the subscriber base is small, the minimum program use fee may be economically insupportable in some cases.

Art or science?

It may sound a bit vain to use the term "art" in connection with small system operations but it is entirely appropriate. If such opportunities are to be successfully pursued, technical skills alone cannot ensure success. One needs sufficient familiarity with the technology to understand all the alternatives and to finalize on the system design with confidence. However, the ultimate success or failure of a venture depends upon much more than this alone. To evaluate a specific application, to develop a business operations plan and to construct and operate systems of this scale successfully requires a blending of many skills. Not the least of these is a "grassroots feel" for what levels of service, which programs and at what level of service charges the community will accept and enthusiastically support. Thus, the term "art" seems very appropriate indeed.

Small systems can present opportunities for many people who are actively involved in CATV today. The scale of such operations may not be inhibitive for even those with limited financial resources. But what represents an opportunity?

A system with two miles of cable plant carrying 12 channels and serving only 50 subs could be constructed for a total cost of perhaps $25,000. Such a system could generate gross monthly revenue on the order of $1,300; certainly to some people this might represent an opportunity. On a larger scale, a six-mile system carrying 18 channels and serving 200 subscribers could be constructed for around $60,000. Such a system could produce gross monthly revenue on the scale of $5,200. This could certainly qualify as an opportunity.

It's all well and good to have an objective of working for yourself in your own business, but that business must be healthy enough to support you decently and produce some return on the capital you must invest. If you are already employed in the CATV industry, the new venture must replace the income that salary from the present job presents. If it does not provide as much income initially, the venture must be handled as a part-time activity. Return on investment is another question entirely.

If you are capable of financing either with capital in hand or borrowed or both, it seems logical to ask what that same amount of capital could produce if invested in other more conventional ways, such as real estate or stocks, etc. The venture under consideration does present some risk. You may underestimate costs or overestimate revenues. If this investment will not produce a return on the capital required that is at least equivalent to that of more conventional lower risk investments, you had better take another very hard look at the whole idea.

If the investment does not realistically project to produce a return on capital on the order of 15 percent or so, then perhaps you ought to abandon it entirely or at least re-examine the project thoroughly. Maybe you should carry fewer channels, charge higher rates, etc. There's no room here for wishful thinking. Whatever the analysis produces, it might be prudent to have it checked by someone with previous business experience (not necessarily in CATV) and who is not directly involved.

High-definition television: Evolution or revolution?

By H. Allen Ecker
Senior Vice President and Chief Technical Officer, Scientific-Atlanta Inc.

High-definition TV (HDTV), extended definition TV (EDTV), advanced TV (ATV) and enhanced NTSC are often used as if there were clear standards and specifications defining these terms. We speak of sharper pictures, better color without artifacts, larger and wider viewing screens and higher quality stereo audio as EDTV or HDTV. But what is our reference and how high is high? Within the TV industry HDTV definitions are often referenced to 35 mm slides or motion pictures. However, the real definition of the next generation TV format will ultimately be determined by the subjective judgment of the consumer where votes are cast from the consumer's pocketbook.

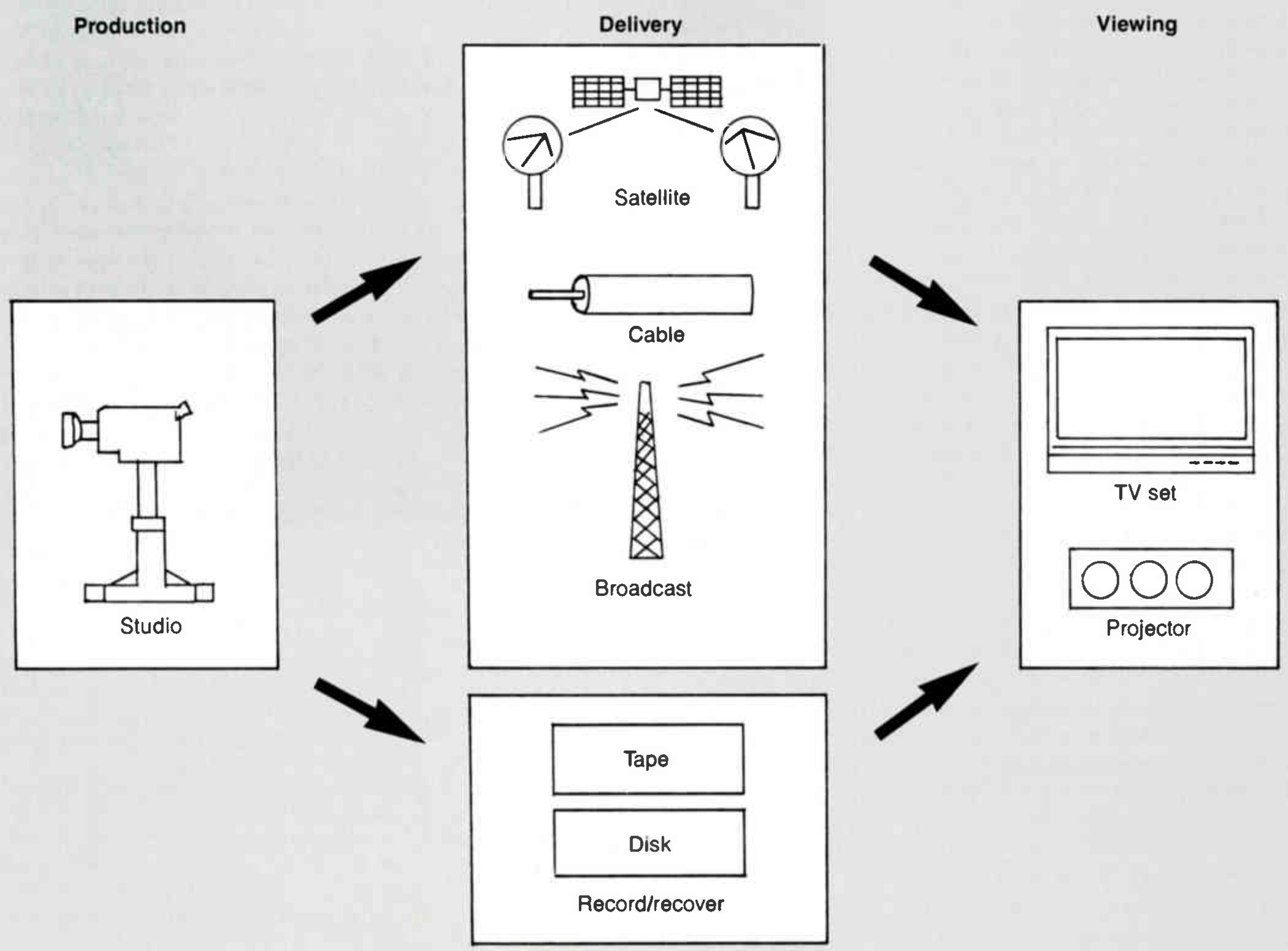
HDTV is a proven technical possibility. Pictures and audio can be electronically generated, delivered and viewed with resolution, scan rates, color and sound quality that can be considered "high definition" by any definition. However, significant controversy exists over possible implementation approaches, economic considerations, regulatory issues and consumer demand. Attempts have been made to achieve world acceptance of a production standard based on an 1,125 line/60 field approach with wide screen (16:9 aspect ratio) that is incompatible with the current NTSC format. Broadcasters and U.S. TV set manufacturers appear to be favoring an NTSC-compatible HDTV format that can be received on the installed base of NTSC sets as well as on HDTV sets. Major differences in business objectives in the various parts of the TV entertainment business are causing the controversy on formats.

It is important to distinguish among the three major parts of the industry that provide TV entertainment to the home. Figure 1 shows the relationships among production, delivery and viewing. These three business areas have different requirements and constraints that affect their business decisions on HDTV. Note that delivery is not limited to just the transmission media such as satellite, cable and broadcast but also includes videotape and discs as major players. Even within the delivery part of the business, the different media have conflicting objectives because of differences in technical and regulatory constraints related to HDTV.

Another major unknown leading to controversy is determining how the consumer will react to various levels of picture and sound quality and what the consumer will pay for each level. Most preliminary testing on consumer reaction to HDTV suggests that programming has more impact than picture format and quality. Also, there has been no indication that consumers will be willing to pay the differential in price that may be required for most HDTV sets. These preliminary reactions are contrary to consumer response to the introduction of compact audio discs. CDs have attained wide acceptance and have become the audio quality standard for consumers. The incompatibility with existing audio systems and the inability to record

(Continued on page 63)

Figure 1: Major parts of the TV entertainment industry



(Continued from page 46)

or duplicate discs in the manner that is common with magnetic tape cartridges has had little impact on CD popularity. From our experience with CDs, we must conclude that it is too soon to judge consumer reaction to HDTV on the very limited demonstration testing to date.

The major issues facing the adoption and implementation of HDTV in this country can be categorized generally as the following:

1) a value/cost tradeoff among the various alternative approaches for production, delivery and viewing and
2) how to manage the start-up risks among set manufacturers, production and delivery parts of the industry.

The value/cost tradeoff involves technical issues, market issues and manufacturing and operating costs. The start-up risk issue is sometimes called the "chicken and egg dilemma" because it means simply, "Which comes first, programming or TV sets?" The studios, programmers and delivery parts of the industry are reluctant to make major investments in HDTV equipment and programming until there are enough consumers with HDTV receiving equipment to generate a reasonable source of revenue. Set manufacturers don't want to invest in the designs, manufacturing start-up and inventory for HDTV sets until there is programming to fuel consumer buying.

HDTV value/cost tradeoff issue

We know that there are almost 90 million TV households, but it has yet to be determined how many of these households will buy HDTV sets. Determining market size is extremely difficult when a new market is being established. Not only have the parameters and features of the product not been defined but also the value of each to the consumer is not known. HDTV (however designed and implemented) must have value to the consumer in which there is clear distinction and advantage over existing television.

The HDTV value drivers can be separated into two categories. First, there are those unreal things in today's TV pictures that don't exist in the real world. For example, even with poor eyesight you don't see rows of black scan lines when you view a real world scene. The second category includes those factors that can be perceived to improve the quality and impact of the TV image. Noise that produces graininess in the picture, scan lines in the TV raster and the NTSC artifacts that result from spectrum sharing between luminance and chrominance are the unreal artifacts that must be removed to realize the value of HDTV. Increased horizontal and vertical resolution to produce sharper pictures, large screens with potentially wide-screen aspect ratios and high quality digital stereo audio are the quality and impact value features that the consumer will judge.

The technical characteristics in an HDTV format that will produce perceived value to the consumer also increase the cost of production, delivery and viewing systems. These cost drivers are increased bandwidth, increased carrier-to-noise (C/N) ratio, scan formats with more lines on larger screens and signal processing to enhance resolution and improve color quality. The accompanying table shows a matrix of tradeoffs between value and cost indicating which of the cost drivers will affect the value drivers. To make the correct tradeoffs between cost and value for each factor, we must consider both cost and price of the HDTV set to the consumer and cost and price of programming to a subscribing consumer. Also, we must consider that the technical and regulatory constraints affecting the value/cost tradeoffs differ significantly by delivery method.

If we examine the near-term constraints on these four cost drivers, we find that they are significantly different for cable, tape, broadcast and direct broadcast satellite (DBS). Broadcast has serious constraints both from technical and regulatory viewpoints. Spectrum limitations, individual channel bandwidth and requirements for NTSC compatibility are all imposed on a broadcast format. There are essentially no external constraints on the drivers that produce potential value with associated cost for tape or DBS delivery. If the consumer and the program deliverer want to pay the cost, both tape and DBS can support signal formats with bandwidths, C/N, scans and signal processing to produce HDTV pictures. Current cable architecture and system implementation will in many cases require significant upgrades to achieve noise and distortion headroom necessary for HDTV. Also, in the majority of systems total distribution bandwidth must be increased to maintain channel capacity if HDTV channels require more than 6 MHz. Subscriber products also must be changed out for those

EDTV/HDTV value/cost tradeoffs

Value driver	Cost driver			
	Band-width	C/N	Scan	Signal processing
Remove unreal artifacts				
1) No graininess				
2) No scan lines				
3) No dot crawl or cross-color				
Quality and impact				
4) Sharp picture image				
5) Wide screen (size)				
6) Quality audio				

consumers desiring HDTV.

A major hurdle in the development of HDTV in the United States is that of the start-up costs and risks to those parts of the industry responsible for getting television to the home and for the set manufacturers. Production and transmission companies must make substantial capital investments to create and deliver high-definition programming in sufficient quantity to interest the consumer. Prices of HDTV sets must be attractive to the consumer to build a subscriber base. Who makes the first move and how are the risks and costs contained?

Both the U.S. government and the TV industry are struggling with standards setting because of the different technical constraints and business interests that drive each part of the industry. The set manufacturers would like to see an NTSC-compatible standard regardless of the production or delivery medium. The production part of the industry would like to see one global standard (not necessarily NTSC-compatible) because of the major export business in programming. As mentioned previously, the value/cost tradeoffs are significantly different among the delivery media (cable, tape, broadcast and DBS) and none of the media wants to be unnecessarily limited in quality and features because of constraints in another delivery medium.

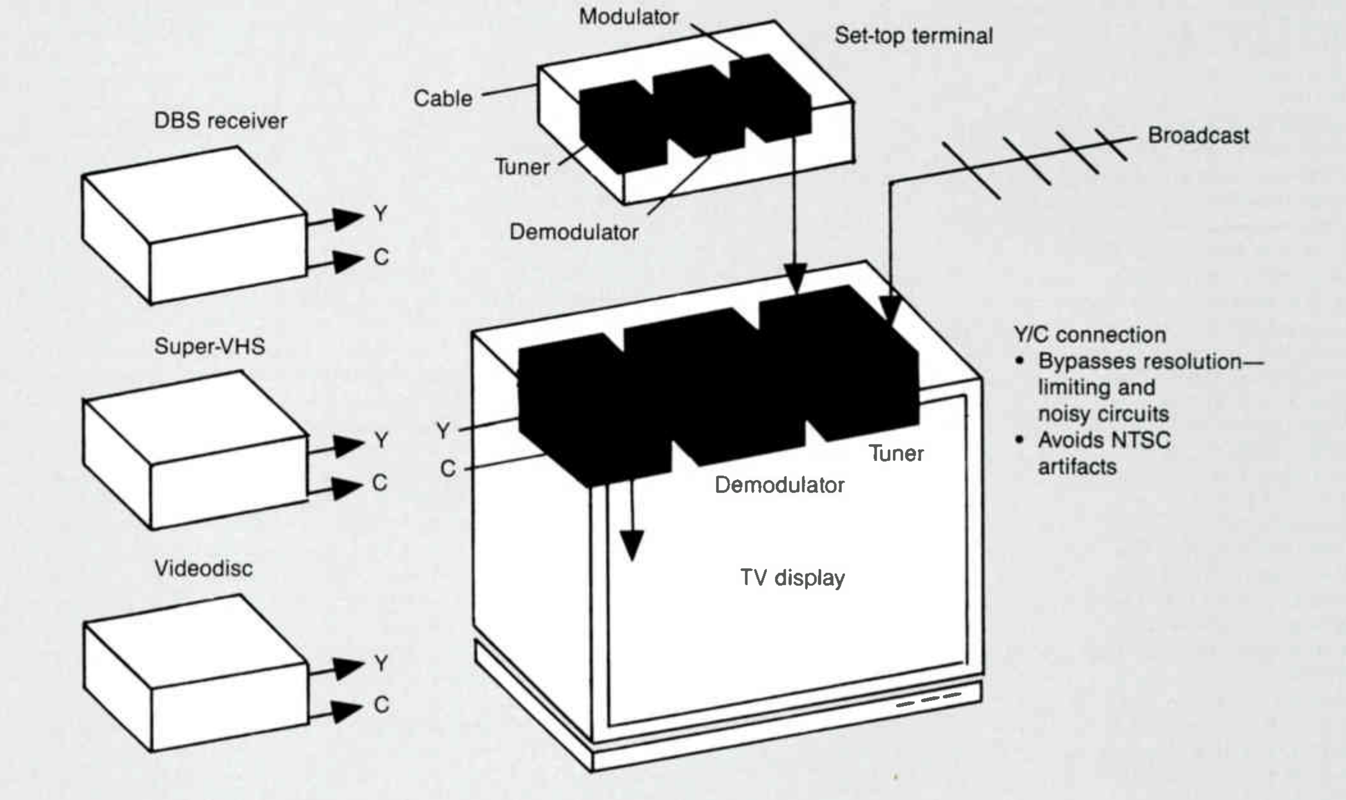
The revolutionary and evolutionary scenarios

If the government and industry could agree on one HDTV system, and if the consumer perceived the resulting pictures and sounds to have value corresponding to the required price, a complete changeout of television delivery to the home to achieve HDTV could occur. In the same way CDs captured the quality audio market, HDTV could capture the high-end TV market. The HDTV sets could be wide aspect ratio (e.g., 16:9) like wide-screen movies. NTSC compatibility would speed up the change but would not be a necessary requirement. HDTV inputs could be at both RF and baseband but HDTV processing would probably be included in sets for the chosen system.

In this revolutionary scenario, the production, delivery and TV set parts of the industry would have risks controlled by the existence of a single, possibly regulated, HDTV standard. The development of the industry would depend on marketing/sales effectiveness and the ability to achieve TV set costs and programming costs that would result in prices that consumers would pay. However, because tapes and discs are essentially a closed system with the TV set and because DBS and cable do not have the constraints of broadcasters, variations in HDTV formats within the HDTV system standard would probably be promoted.

The evolutionary scenario follows a course from existing NTSC to increasing levels of quality with EDTV and eventually to pictures and sound considered to be HDTV. This scenario minimizes the start-up costs and risks in any part of the industry. Technology has driven production equipment and TV displays to extended definition today. Studio cameras are capable of up to 700 lines of resolution with component outputs; Matsushita MII and Sony BetaCam SP tape formats provide component recording and with higher resolution than that currently delivered to the home. New TV sets on the market in Japan (soon to be available in the United States) allow baseband, component inputs with higher resolution and line doubling to significantly improve picture quality. Baseband stereo inputs have been

Figure 2: RF and Y/C (S-video) inputs to TV sets



available for some time. Satellite delivery of EDTV in component format is also available today with ED-MAC operational hardware.

The evolutionary scenario is driven primarily from the availability of EDTV pictures from new tape formats such as Super-VHS and Super-Beta and from baseband, component access to the TV set with the Y/C connector (in the consumer world, the S-video connector). The Y/C connector bypasses the tuner and demodulator; sources of noise and bandwidth limitation in the TV set. Note in Figure 2 that tapes, discs and DBS can access the set with lower noise and higher resolution because of the Y/C connectors. Currently, both broadcast and cable must use the conventional RF input. If Y/C connectors were put on set-top terminals, then cable could avoid the modulator in the set-top terminal and the tuner and demodulator in the TV set to improve noise and resolution performance.

Some of the new line doubling techniques that are being included in the most recent sets double the scan rate to remove perception of scan lines and to increase the perceived vertical resolution. With line doubling, component input and up to 50 percent improvement in resolution through the Y/C connector, the consumer realizes significant improvement in pictures in new EDTV sets.

The only parameter not addressed in this EDTV-to-HDTV evolutionary scenario is picture aspect ratio. The evolutionary scenario assumes strict NTSC compatibility (i.e., each set will accept existing NTSC and EDTV and display either format on the full screen). Even pictures from standard NTSC signals will be improved because of line doubling and signal processing with frame stores. However, change of aspect ratio from 4:3 to 16:9 can only be accomplished through some form of the revolutionary scenario. For a change in aspect ratio, all parts of the TV industry must share the risk of consumer acceptance of the new HDTV format. With the evolutionary scenario, no part of the industry is required to take significant risks.

The importance of wide aspect ratio pictures to the consumer is not known. If the screen of the display or projection system is large enough, the advantages of improved resolution and increased scan rate are evident without wide aspect ratio. However, as one advocate of the wide screen has stated, the difference between HDTV and standard TV is apparent even without the TV set on if the aspect ratio is increased from 4:3 to 16:9.

Down the evolutionary road

We have already started down the road on the evolutionary scenario for HDTV. Commercially available videotape systems with EDTV and TV displays (both direct view and projection) with line doubling, frame store processing and Y/C inputs offer the consumer EDTV today. Studio cameras and tape recorders that deliver component EDTV are also in use widely. Standard products that can deliver EDTV via satellite are available economically. However, the evolutionary EDTV scenario cannot deliver wide aspect ratio pictures. The key question to answer is how important is wide aspect ratio to the consumer? We may find that if the screen is large enough that the consumer really doesn't care about a wide screen.

For a number of years, the production part of the TV industry led by NHK (Nippon Broadcasting Co.) and CBS has advocated the revolutionary scenario with their 1,125/60 system and 16:9 ratio. The technical society representing this community, the Society of Motion Picture and Television Engineers (SMPTE), has adopted a production standard around these parameters. Although still quite expensive, production equipment is available from Japanese suppliers to meet the SMPTE HDTV standard. Also, Japanese suppliers such as Sony are showing transcoders from the 1,125/60 format to the NTSC and NTSC-compatible formats.

Major efforts are under way within the TV industry to reach consensus on an HDTV approach. Agreement among all parts of the industry would help bound the start-up risks for all concerned. The FCC Advisory Committee and its working groups plan to evaluate all proposed HDTV systems for the United States. They plan to use the new Advanced Television Testing Center (ATTC) for actual system testing. Industry organizations (such as the EIA, NCTA, SMPTE and AEA) all have established "blue ribbon" committees to address HDTV. Even Congress is getting into the act with the Markey subcommittee hearings.

Television in the United States is not a luxury or just a recreational/leisure medium; it is an ingrained part of our culture. HDTV could provide a boost to an unprofitable TV set industry and could be a means of growth to the source and delivery parts of the industry. We must face the value/cost trade-off and chicken-and-egg dilemma and decide which is the winning scenario—revolution or evolution.

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Headend rewire/ redesign considerations

By James Kuhns
District Technical Instructor, Continental Cablevision

A few years ago it was scrambling. Then came VideoCiphers. Now it's BTSC stereo. Tomorrow, it's anybody's guess. No matter how well you plan, sooner or later you will find yourself redesigning or rewiring your headend. There are several approaches to headend layout, all having certain advantages and disadvantages. Regardless of the method used, careful thought and planning before starting will save you a lot of headaches during and after rack-up. You would not dare build or rebuild outside plant without designing it first. And, since the headend affects your entire subscriber base, shouldn't you design and plan it just as carefully?

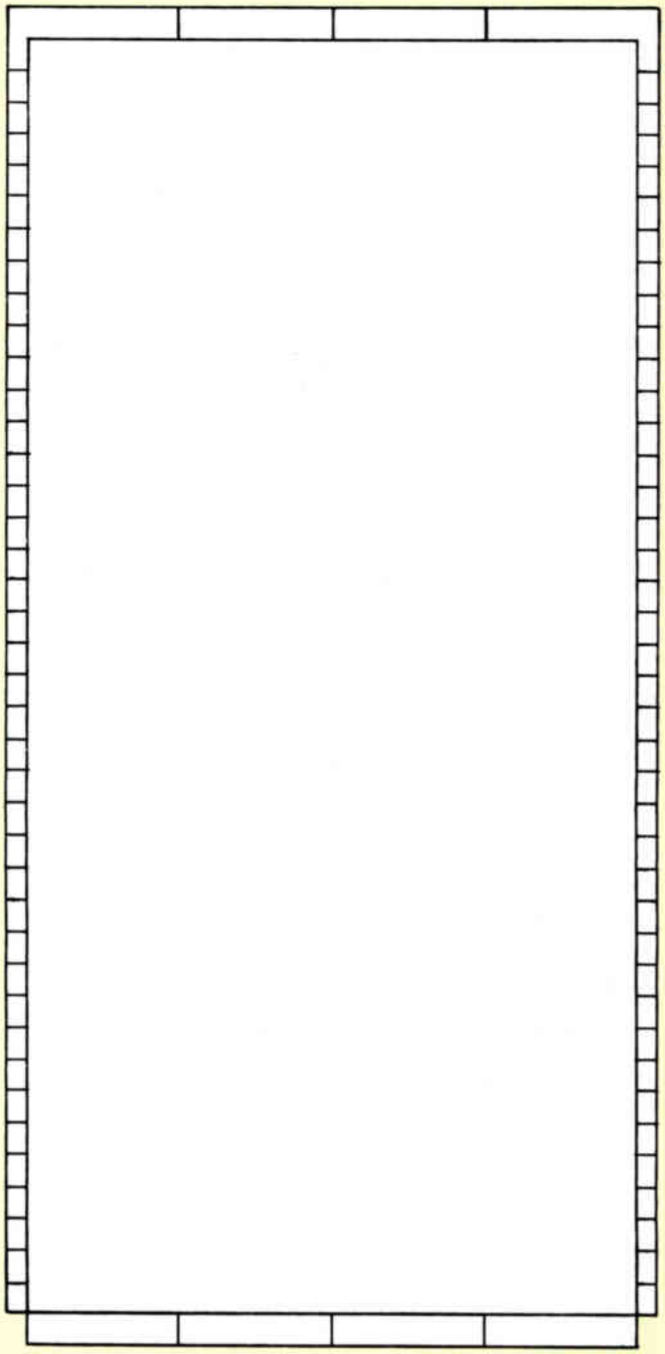
The accompanying figure is a standard EIA 19-inch equipment rack where each horizontal increment represents the width of a single P1 panel. Using a diagram such as this allows you to layout (to scale) each rack in the headend prior to moving any equipment. Another advantage is that an accurate bill of materials can be developed from these diagrams. Additional racks, blank panels and other items that may be needed can be ordered before starting the actual rack-up process.

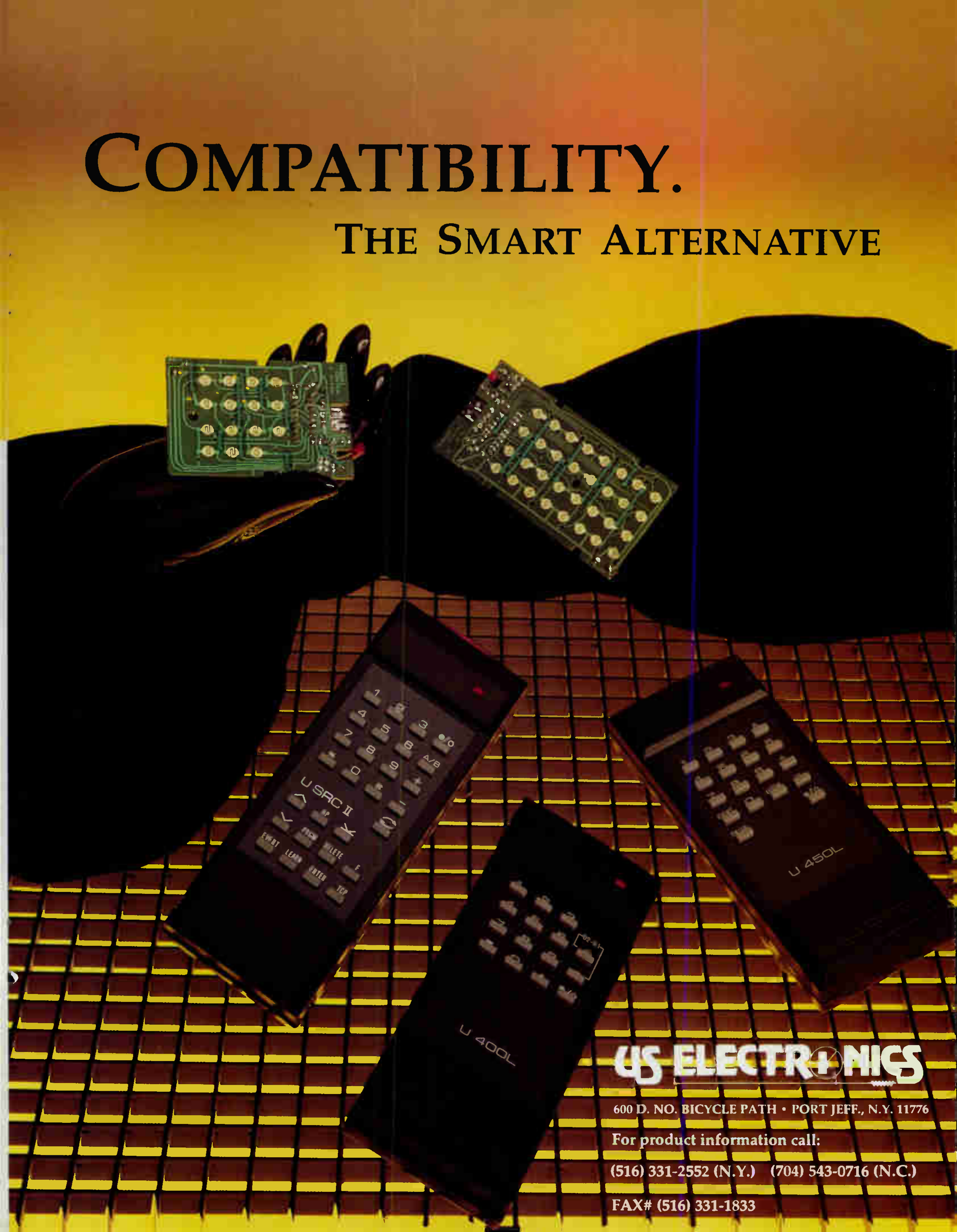
When you begin the rack-up, tape copies of the diagrams to the corresponding racks. Doing this makes equipment placement relatively simple and keeps rack-up errors to a minimum. Any changes made during rack-up can be noted on these copies.

Upon completion of the rack-up do a final set of diagrams. These final diagrams along with an accurate set of wiring diagrams will serve as the as-built "maps" for your headend. Proper documentation, revised and updated as necessary, will serve you (and anyone else who steps into your headend) well. Until the next time.

"Proper documentation, revised and updated as necessary, will serve you...well."

Headend rack redesign chart

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Rikki Lee

Participants in the interview conducted at the 1988 Western Show were: Ron Hranac, Tom Hall, Ray Seacombe, Paul Levine, Bob Luff and Bill Riker.

Hands across the pond

During the 1988 Western Show, Managing Editor Rikki Lee interviewed six people currently involved in the Society of Cable Television Engineers in the United States and the United Kingdom to elicit their comments on transatlantic cooperation. Participants in the interview were: Tom Hall, owner of the CATV consulting firm Yorkhall, U.K. SCTE secretary and editor of its journal "Cable Television Engineering"; Ron Hranac, senior staff engineer for Jones Intercable and U.S. SCTE president; Paul Levine, publisher/president of "CT," the U.S. SCTE's official trade journal; Bob Luff, group vice president of technology for Jones Intercable and U.S. SCTE past president; Bill Riker, the U.S. SCTE's executive vice president; and Ray Seacombe, chief engineer of City Centre Cable in London and president of the U.K. SCTE.

CT: Tom, could you describe the work the U.K. SCTE is doing?

Hall: The SCTE was set up to improve the standards of engineering, for engineers to meet very high entrance requirements—academic, principally. But we don't exclude those without, and the alternative is length of service in the industry in a senior position.

We get many people applying who are not eligible for membership. To those people we suggest methods of improving their knowledge, but we do give them the ability to subscribe to our journal. In addition to our 600-700 members, we have many hundreds of subscribers to the journal only.

We hold two or three lecture meetings a year—we limit it because of travel problems. We used to have regional meetings, principally in the north of England, but the attendance was not sufficient in any one area to continue these meetings.

Now that cable looks like it's taking off in the U.K., hopefully our membership will increase and it will be possible to resume regional meetings.

CT: How does this compare or contrast with the work the SCTE is doing in the United States?

Hranac: Well, the SCTE in the United States has a bit of a different approach on what it's been doing. It concentrates primarily on providing technical education to the cable industry. Whereas our membership has been open to installers, technicians and anyone in general with an interest in the cable industry, the focus of the two groups differs in their main thrust. But there are a number of similarities.

It's interesting that the direction we're going has enabled us to mature our very efforts. In fact, in our Executive Committee meeting a few days ago we were able to chart the big picture of the future of the SCTE. The big picture includes continuing the technical training efforts we have worked upon in the past. It also includes emphasis on technical certification. And another one that we've identified and we're looking forward to seeing in the long term is the SCTE's recommended practices.

I foresee the day when there's a stamp on a roll of cable or connector that says, "Meets SCTE Recommended Practice Number Such-and-Such"—in other words, the UL listing of the cable industry. And that, I think, is the direction that we're going.

But the two Societies have some things in common that really suggest we work together and share resources. There are certainly a few things that we do differently, but that's fine. I think it should remain that way. We each have our own identities, we each have our own goals as organizations, but we also have our respective cable industries to serve. The core area of increasing the technical skills of our people, of enhancing the technical knowledge of the cable industry and certainly our own professional image is extremely important.

CT: Bob, is this cooperation between the two SCTEs something that actually started years ago and we're just hearing about it now?

Luff: The manufacturers have been the link up to this point. The European manufacturers breaking into the U.S. market had to learn about our practices and our cable dimensions. The U.S. manufacturers are now entering the European market, particularly the U.K.—one of the hottest cable markets right now—with their expertise and their products and learning that there are some differences we need to chat about.

I think we all see the advantage of getting together so we have a more universal availability of cables, connectors and interface. But I think Ron Hranac's recent visit to the U.K. and Tom Hall's receptiveness has been the start or the resurgence of the official getting together of the SCTEs in a very proactive way.

CT: Why now? Why hasn't it started before?

Luff: It's an invasion.

Seacombe: But which side of the Atlantic is being invaded? I don't know, I suspect it's something that's grown slowly. We've come to know people personally on the other side of the pond and that tends to gel a relationship in a more solid kind of way. I don't think there's really anything specific happening to be the prime mover. We've gradually gotten to know each other and now seems to be the time when it's coming together.

CT: Bill, do you see this interest in the U.K. SCTE by the U.S. Society growing in the future?

Riker: I think the interest was really started with our current SCTE president when he went over there. We've finally built up a strong reputation in this country and we're ready to take that reputation to other parts of the world.

CT: Ron, why did you go to England in the first place?

Hranac: I was in the U.K. on business for some activities that Jones Intercable is involved with. It struck me that setting up a meeting with Tom Hall would be a good way to open the door between the two Societies. So, I set up a meeting with him. We sat down over tea and discussed what our two Societies have been up to over the last few years, the history of the groups and where we can go together in the future.

With the things that we do have in common, building that relationship and establishing the dialogue will enhance the professional image of both of our Societies. It will also enhance the participation that various companies have in each other's countries by providing a forum on neutral ground for sharing resources, technology, training materials and such.

CT: What exactly can we in the U.S. learn from a non-NTSC based system?

Hall: Quite a lot, I think. What our transmission systems are is not an important difference. I welcomed the idea of Ron coming to see me. We got along marvelously and had a wonderful opportunity to establish a relationship between our two organizations. I'm sure there can be a very useful interchange. After all, it looks as though cable is unlikely to get off the ground in the U.K. without American finance.

CT: How do you feel about that?

Hall: Well, I wish our bankers and financial houses were more enthusiastic. It's just too much of a long-term investment for them. With American and Canadian financing, things will start to move and attitudes may change.

CT: Ray, with this invasion of foreign investors, how do you think this will affect the U.K. SCTE?

Seacombe: It will certainly increase our membership. We will probably see a number of North American nationals becoming resident in the U.K. and that will be to the benefit of everyone in the sense that they will bring their long history of operating systems to us.

I think we will probably be able to bring a benefit in this opposite direction in that—if you pardon me for saying this—the technical quality of our television pictures is considerably higher than that which you generally find in North America. The way in which our Society has helped to keep those standards up will be of benefit to those traveling North Americans who come to our side of the pond to help us get the networks going. I'm sure a lot of that will brush off on this side of the Atlantic.

You ask the question about PAL and NTSC. I remember a very famous quotation—I can't remember who said it—but NTSC meant "never twice the same color." SECAM was "something essentially contrary to the American method" and PAL was "peace at last" or "pictures at last." I think that the way in which the European broadcasters (not just the cable industry) in general and the U.K. in particular have maintained very high technical standards will be a lesson to North American technicians who will no doubt come to the U.K. to help us get off the ground.

CT: Bob, is he justified in his comments about our standards? Don't we have something to teach them about running a cable system?

Luff: I don't know if it's anybody teaching someone else. We all have experiences and there's something to be said for 20 years in major urban construction techniques. One of the things we've learned in the last several years in the United States is the people issues, not so much the technology issues—we've gotten a pretty good handle on *those*. The quality of installations has not been where they should be on either side of the pond. In the concepts of preventive maintenance and quality assurance, we have good intentions. But somewhere between those intentions and our budgets and execution there's a big difference.

We're beginning to learn techniques. The SCTE has been very much involved in the BCT/E Certification Program and Installer Certification Program. These are not just SCTE programs but industrywide programs over here that CEOs in boardrooms are embracing as long overdue and needed. An experience and a relationship we have with one system in the U.K. suggests that they're grappling with the very same issues that we've grappled with for nearly a decade. I see no reason for a hands-off approach and allow another fine organization to have to reinvent the wheel and take a decade, when we can share things that we've learned that were successful and that we tried that weren't.

But we also have to be quite careful that although we share the same language (more or less) that there are profound differences between the two technologies, PAL and NTSC, and in the social structure between the two countries. I certainly want to be very cautious in the relationship we have so we don't go over there as if we know all the answers. We don't know all the answers here. We have to be very respectful of the different ways of doing business that have to be and will continue to remain different because of the two different countries involved.

CT: Bill, what do you see as the SCTE national headquarters role in increasing cooperation and sharing technical knowledge?

Riker: The first thing I'd do is ask Ron if I can go to the U.K. for a while. I've never been over there, but I've spent some time talking with Tom Hall. It was very enlightening to see how different we really are in the way that we do things. This interview is the beginning of our cooperation, working together and understanding each other. We would like to support the U.K. SCTE in every way we can and I think this is the beginning of a very good relationship.

CT: Paul, as publisher of the official trade journal of the SCTE in the United States, how do you feel about sharing our knowledge and working with the SCTE in the U.K., especially with their trade journal?

Levine: Their trade journal as compared with ours as far as the technical value is very high. Their technologies are very well represented. For all the reasons mentioned throughout this conversation, we have to respect not only that high level of technology but also how they are informing their audience—their technology for their area of the world and how it is presented for their consumer. Where we hope to help each other is by the exchange of information on how the technologies are put to use in the U.S., the U.K. and Europe, the training we have done here and the problems we have gone through both on this side and the other.

We're going to support each other and exchange information that will help both countries. That means having Tom also explaining to me at times very patiently certain aspects of what they're doing as opposed to my understanding of it and how we can put it to use. I think we've made very good strides toward that area. Tom is going to help us out in our publication; through those efforts that will help create some of the bridges besides the personal touches on a consistent basis coming from the U.S. back to the U.K.

Riker: We've also just invited Tom to join us at the Cable-Tec Expo, our Society's convention, this summer. And he's graciously accepted it.

CT: One last question. If you were to hold a convention between the U.K. SCTE and the U.S. SCTE, where would you hold it?

Hranac: I suspect if our relationship evolves to the point where we could hold joint conventions like that, it would make sense to alternate locations. One year, London. Next year, San Francisco or New York. Something like that would provide a lot of folks the opportunity to travel somewhere they may not have visited, but at the same time it affords those folks coming in to be able to get out into the real world and see how cable TV is done across the pond. I think sharing meeting locations would be a way to do that.

Hall: I'd like to think all of our members would be able to come over to the states, especially to Orange County, Fla., but I don't think it would be very practical. Our members are individual and not with companies. We're a very poor Society; we keep our subscriptions as low as we can so that no one's excluded for financial reasons. Although I'd very much like to see a joint convention, I don't think many of our members could afford to come over here. Possibly when the industry gets off the ground things might change.

CT: What about a satellite uplink shared between the two countries?

Hall: That's a nice thought, but it'll cost.

Seacombe: The best way to start a cooperation like that would be not to try to hold a joint convention but to invite each other's experts, shall we say, to address the other's convention. We have meetings in London twice a year; it would be very nice to say, well, we've got Mr. XYZ from Orange County who's done this-that-and-the-other and will tell us how he's done it. And to discuss with us whether or not what is practical reality in North America could be applied to the U.K. and vice versa. I think that's probably the best way to get the thing off the ground.

Levine: What Ray has said is valid. I think it's a start—it's a good start. Then we build upon that. It's going to take some time. It's taken quite some time for us to get to this point, with everyone having this conversation about international exchange and what we're doing to support each other.

Hall: An exchange of speakers—that's practical. I'd be delighted. It would be so much progress in such a short while.

Luff: We have enough problems in the United States convincing managers to send a tech or construction manager to the Cable-Tec Expo, which is almost a local trip, compared to an international trip. It's just the psychology and the image of it all. The vendors would have something to say because there's an order of magnitude of increased difficulty to ship exhibits back and forth, the cameras, VCRs and everything they use to show their wares that don't work on foreign voltages, different AC standards and such. A joint conference would take a tremendous amount of planning.

Ray's suggestion was what I was going to say. For whatever topic—signal leakage, preventive maintenance, fiber optics—where it's appropriate with your schedule, someone from the U.K. and vice versa could come over and share experiences. Maybe we could have a particular session on what's happening internationally because it means so much to all of us. There are other countries that are expanding in cable as well. There may be a need for those of us involved in the international rollout of cable TV to get together more often than once or twice a year. Some of these issues we have before us demand some resolution more than once a year. From the establishment of some international recommended procedures or standards bodies to executive committees between the two SCTEs over a conference call.

Riker: If I recall my geography, I believe Reykjavik, Iceland, is the midpoint between our two countries and would be a perfect location...

Hranac: ...Lots of off-air signals.

Riker: On the idea of an uplink or teleconference, I was just approached by a company in Pennsylvania where our national headquarters is that can do transfers from PAL and SECAM to NTSC and vice versa. We did do extensive videotaping of Cable-Tec Expo '88 and if Tom is interested, we can look into converting some of those tapes right now and sending them over to start that training right away.

CT: Thank you all for taking the time and sharing your comments with our readers. ■

Part III: Light measurement

This is the final installment of a series on the terminology of light. It will cover radiometric quantities and units as well as conversion between lumens and watts.

For years the necessity for a complete understanding of light for the production of good TV scenes has been a "given." As the importance of fiber optics in communications increases, the corollary importance of light and its measurement in that field follows. Over the many years of the study of light, a jungle of often bewildering technology developed. The lack of uniqueness, in addition to everyday connotations of much visual terminology, often confuses the reader not familiar with the subject.

It is further confusing because light measurement has two different generic approaches. From a physicist's viewpoint light is radiant energy and thus can be measured in watts—radiometry. Over the course of time, the measurement of light as we see it and photograph with it, for use by human observers, has produced light measurement units (lumens) in photometry. The formulas for various radiometric quantities are analogous to the ones for the corresponding photometric quantities. If watts are substituted for lumens, the units (in the international MKS unit system) in the radiometric quantities are the same as those of the corresponding photometric quantities.

Customarily, photometric measurements are used in general illumination and photography (film and TV), whereas radiometric measurements are widely used in scientific applications, e.g., microwave/satellite RF, fiber optics, etc.

By Lawrence W. Lockwood
Principal Scientist, Video Technologies, Contel
East Coast Correspondent

The symbols, names, definitions and units of radiometric quantities are summarized in Table 1, while Table 2 shows the radiometric quantities and units with the corresponding photometric quantities and units.

Conversion from lumens to watts and watts to lumens

Photometry refers to the measurement of light as perceived by the human eye. Radiometric quantities and units are those that actually exist in nature. Analogous units exist for photometric quantities, all evaluated re the human eye response. Radiant flux is power (watts); the unit of photometric flux is the lumen. Since the response of the human eye varies with wavelength, the conversion from watts to lumens (or lumens to watts) is wavelength dependent. The conversion factor, K (λ), between watts and lumens is shown in Figure 1. The K (λ) curve labeled photopic refers to high light-level human vision and the curve labeled scotopic refers to low light-level vision. The "photopic curve" has been suggested by the CIE (*Commission Internationale de L'Eclairage.*) The range of definition of K (λ) extends from 390 to 760 nanometers. The maximum value of K (λ) for photopic vision occurs at 555 nm and has a value of 683 lumen/watt. The reciprocal of K $(\lambda)_{max}$ has been called the "mechanical light equivalent M":

$$M = 1/K\,(\lambda)_{max} = 1.464 \times 10^{-3} \text{ watts/lumen}$$

Summary of terminology

In concept, both radiometry and photometry are quite straightforward; however, both have been cursed with a jungle of often bewildering terminology. Radiometry deals with radiant energy (i.e., electromagnetic radiation) of any wavelength. Photometry is restricted to radiation in the visible region of the spectrum. The basic unit of power (i.e., rate of transfer of energy) in radiometry is the watt; in photometry the corresponding unit is the lumen, which is simply radiant power as modified by the relative spectral sensitivity of the eye. Note that watts and lumens have the same dimensions, namely energy per time.

The principles of radiometry and photometry are readily understood when one thinks in terms of the basic units involved, rather than the special terminology which is conventionally used.

Photometry deals with luminous radiation; that is, radiation that the human eye can detect. The basic photometric unit of radiant power is the lumen, which is defined as the luminous flux emitted into a solid angle of one steradian by a point source whose intensity is 1/60 of that of one square centimeter of a black body at the solidification temperature of platinum (2042°K).

The unit of luminous intensity is called the *can-*

Figure 1: Absolute photometric radiation equivalents, K (λ) and K′ (λ), as a function of wavelength λ, K_m (λ) = 683 lumens/watt at 555 nm

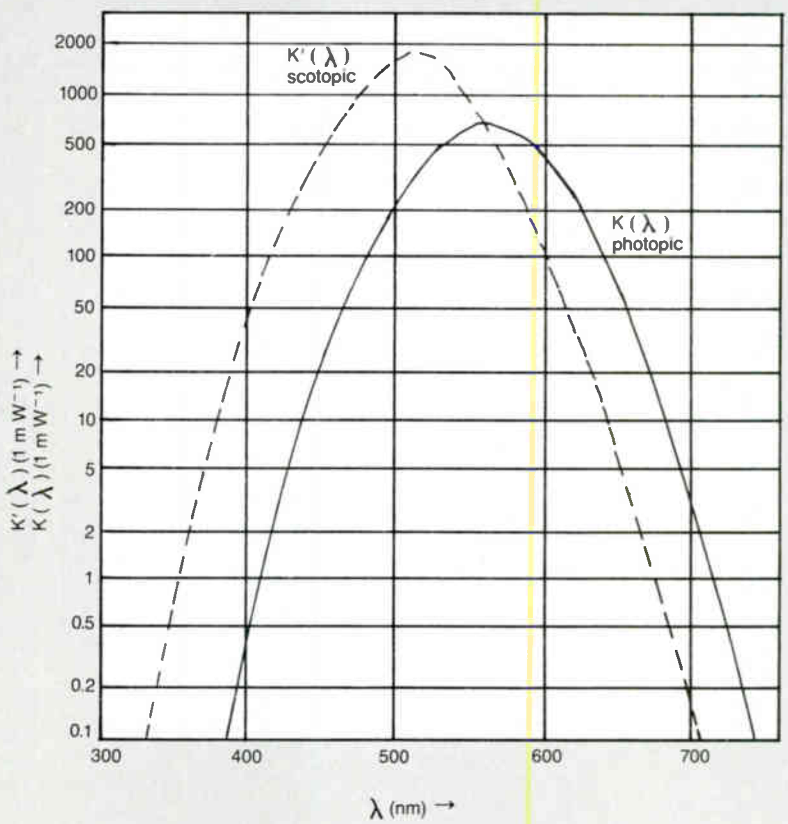


Table 1: Radiometric quantities and units

Symbol	Name	Description		Units
S, S_p	Area	Area, projected area		m^2
Ω	Solid angle	—		sr
ν	Frequency	—		Hz
λ	Wavelength	—		μm
U	Radiant energy	—		J
P	Radiant power	Rate of transfer of radiant energy	$\frac{\partial U}{\partial t}$	W
W	Radiant emittance	Radiant power per unit area emitted from a surface	$\frac{\partial P}{\partial S}$	Wm^{-2}
H	Irradiance	Radiant power per unit area incident upon a surface	$\frac{\partial P}{\partial S}$	Wm^{-2}
J	Radiant intensity	Radiant power per unit solid angle from a point source	$\frac{\partial P}{\partial \Omega}$	Wsr^{-1}
N	Radiance*	Radiant power per unit solid angle per unit projected area	$\frac{\partial^2 P}{\partial \Omega\, \partial S_p}$	$Wm^{-2}sr^{-1}$
P_λ	Spectral radiant power	Radiant power per unit wavelength interval	$\frac{\partial P}{\partial \lambda}$	$W\mu m^{-1}$
P_ν	Spectral radiant power	Radiant power per unit frequency interval	$\frac{\partial P}{\partial \nu}$	Ws or WHz^{-1}
W_λ	Spectral radiant emittance	Radiant emittance per unit wavelength interval	$\frac{\partial W}{\partial \lambda}$	$Wm^{-2}\mu m^{-1}$
H_λ	Spectral irradiance	Irradiance per unit wavelength interval	$\frac{\partial H}{\partial \lambda}$	$Wm^{-2}\mu m^{-1}$
J_λ	Spectral radiant intensity	Radiant intensity per unit wavelength interval	$\frac{\partial J}{\partial \lambda}$	$Wsr^{-1}\mu m^{-1}$
N_λ	Spectral radiance	Radiance per unit wavelength interval	$\frac{\partial N}{\partial \lambda}$	$Wm^{-2}sr^{-1}\mu m^{-1}$

* Some authors define radiance in terms of actual surface area rather than projected area; hence, they include a factor cos θ in their formulas, θ being the angle from normal incidence.

Table 2: Radiometric and photometric quantities and units

	Radiometric				Photometric			
Definition	Quantity	Symbol	Unit (MKS)	Defining equation	Quantity	Symbol	Unit (MKS)	Defining equation
Power	radiant flux	P	W	—	luminous flux	F	1 m	—
Power output per unit area	radiant emittance	W	Wm^{-2}	$W = \frac{\partial P}{\partial S}$	luminous emittance	L	$1m\ m^{-2}$	$L = \frac{\partial F}{\partial S}$
Power output per solid angle	radiant intensity	J	Wsr^{-1}	$J = \frac{\partial P}{\partial \Omega}$	luminous intensity	I	$1m\ sr^{-1}$	$I = \frac{\partial F}{\partial \Omega}$
Power per unit solid angle per unit projected area	radiance	N	$Wm^{-2}sr^{-1}$	$N = \frac{\partial J}{\partial S_p}$	luminance	B	$1mm^{-2}sr^{-1}$	$B = \frac{\partial I}{\partial S_p}$
Power input per unit area	irradiance	H	Wm^{-2}	$H = \frac{\partial P}{\partial S}$	illuminance	E	$1m\ m^{-2}$	$E = \frac{\partial F}{\partial S}$

dle (or "candela") and is so named because the original standard of intensity was an actual candle. A point of source of one candle power is one that emits one lumen into a solid angle of one steradian. A source of one candle intensity that radiates uniformly in all directions emits 4π lumens. From the definition of the lumen, it is apparent that a one square centimeter black body at 2,042°K has an intensity of 60 candles.

Illumination or illuminance is the luminous flux per unit area incident on a surface. The most widely used unit of illumination is the foot-candle. One foot-candle is one lumen incident per square foot. The misleading name foot-candle resulted from the fact that it is the illumination produced on a surface one foot away from a source of one candle intensity. The photometric term illuminance corresponds to irradiance in radiometry.

The term *brightness* or *luminance* corresponds to the term *radiance*. Brightness is the luminous flux emitted from a surface per unit solid angle per unit of area (projected on a plane normal to the line of sight). There are several commonly used units of brightness. The candle per square centimeter is equal to one lumen emitted per steradian per square centimeter. The lambert is equal to $1/\pi$ candles per square centimeter. The foot-lambert is equal to $1/\pi$ candles per square foot. The foot-lambert is a convenient unit for illuminating engineering work, since it is the brightness that results from one foot-candle of illumination falling on a "perfect" diffusing surface.

Since one lumen is incident on the one square foot area under an illumination of one foot-candle, the total flux radiated into a hemisphere of 2π steradian from a perfectly diffuse (Lambertian) surface is just one lumen. The brightness of a number of sources is shown in Figure 2.

The terminology of photometry has grown through engineering usage and is thus far from orderly. Special terms have derived from special usages and many such terms have survived. A tabulation of photometric units is given in Table 3.

If lumens are substituted for watts in all the expressions, the computations are straightforward. When the starting and final data must be expressed in the special terminology of photometry (as opposed to what one might term the rational units of lumens, steradians and square centimeters), then conversion factors may be necessary for each relationship. A very simple way of avoiding this difficulty is to convert the starting data to lumens, steradians and cm^2, complete the calculation and then convert the results into the desired units.

For convenience, the basic relationships are presented here:

a) *Intensity*

$$I = \frac{F}{\Omega}$$

where:
I = luminous intensity
F = the luminous flux emitted into solid angle Ω

b) *Illumination* (illuminance)

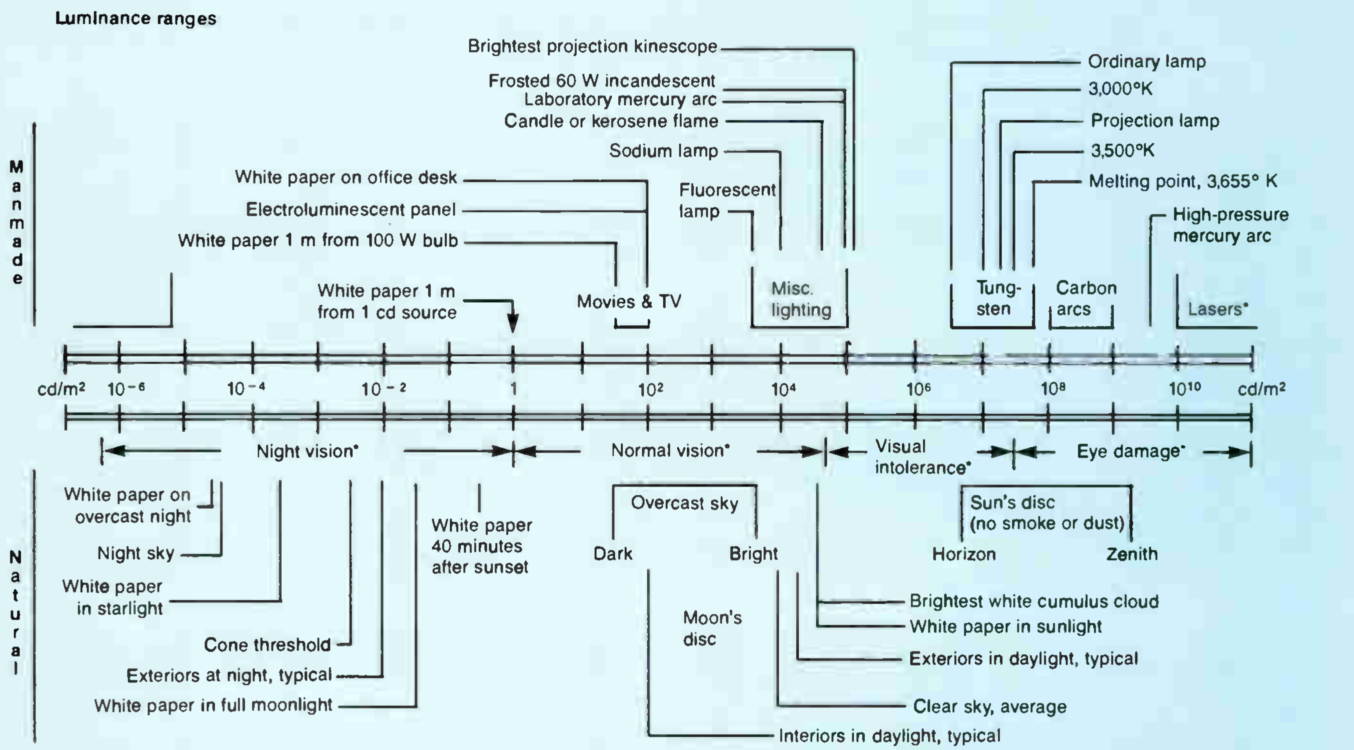
$$E = \frac{I}{S^2} = I\Omega$$

where:
E is the illumination incident on a surface a distance S from a point source of intensity I. Ω is the solid angle subtended by a unit area of the surface from the source.

$$E = \pi B \sin^2\theta$$

where:
E is the illumination produced by a diffuse cir-

Figure 2: Light-level brightness values of common objects



*Actual ranges depend on spectral makeup of radiation

Table 3: Photometric quantities

Flux (Symbol: F)	
lumen	defined in text
Intensity (Symbol: I)	
candle (candela)	one lumen per steradian emitted from a point source. 1/60 of the intensity of one sq. cm. of a black body at 2,042° K
carcel	9.6 candles
hefner	0.9 candles
"old candle"	1.02 candles (candela)
Illumination (Symbol: E) (Also called *illuminance*)	
foot-candle	one lumen per square foot incident on a surface
phot	one lumen per square centimeter
lux	one lumen per square meter
meter-candle	one lumen per square meter
Brightness (Symbol: B) (Also called *luminance*)	
candle per sq. cm.	one lumen emitted per steradian per sq. cm. area projected normal to direction
stilb	one candle per square centimeter
lambert	$1/\pi$ candles per square centimeter
foot-lambert	$1/\pi$ candles per square foot

cular source of brightness (luminance) B at a point from which the source diameters subtends 2θ.

$$E = B\omega$$

where:
E is the illumination produced by a diffuse source of brightness B at a point from which the area of the source subtends the solid angle ω.

$$E = T\pi B \sin^2\theta$$
$$(E = TB\omega)$$

where:
E is the illumination at an image formed by an optical system of transmission T whose exit pupil diameter (area) subtends an angle 2θ (solid angle ω) from the image point when the objective brightness is B.

c) *Brightness* (luminance)

$$B = \frac{F}{\pi A}$$

where:
B is the brightness of a diffuse source of area A that emits luminous flux F into a hemisphere of 2π steradians.

The two generic approaches to the definition and measurement of light (photometry and radiometry) have been described and units defined. The relation of photometric units and radiometric units and the method of conversion of one to the other have been presented. Customarily, photometric measurements are used in general illumination and photography (film and TV), whereas radiometric measurements are widely used in scientific applications and, most importantly, extensively in fiber systems.

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The opinions expressed in this article are those of the author and do not necessarily reflect the opinions of Contel.

Oscilloscope

The B&K-Precision Model 2160 oscilloscope offers 60 MHz bandwidth, 1 mV per division vertical sensitivity, V mode for viewing two signals unrelated in frequency, dual time base and a curve trace-style component tester for out-of-circuit tests on a variety of components. Other features include front panel x-y operation, z-axis input (TTL compatible), Ch. 1 output on the rear panel for driving a frequency counter or other instruments, signal delay line, beam finder, single sweep operation and a regular CRT with illuminated internal graticule.

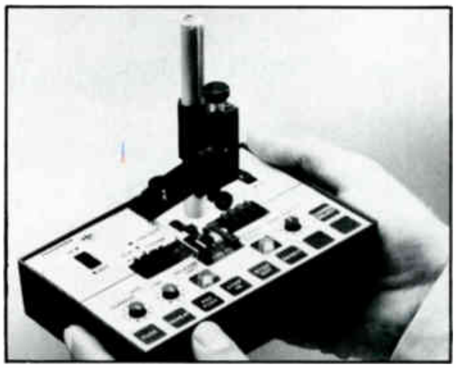
The user can select from 22 calibrated sweep time ranges on the main time base and 19 calibrated ranges on the delayed sweep time base. Each sweep time range is fully adjustable between calibrated ranges. A X10 magnifier is also provided to allow closer examination of waveforms, while maintaining display calibration.

For additional information, contact B&K-Precision, Maxtec International Corp., 6470 W. Cortland St., Chicago, Ill. 60635, (312) 889-1448; or circle #115 on the reader service card.

Cable protection

Pirelli Cable is producing the Poly Duct system, which incorporates a conduit loosely extruded over the conductor to provide a flexible pipe that is impact resistant. It also provides protection against acids and other corrosive chemicals commonly found in soil. According to the company, the system makes it possible to remove and replace the cable without excavation and impedes or eliminates water migration, if installed properly.

For further details, contact Pirelli Cable Corp., 800 Rahway Ave., Union, N.J. 07083, (201) 687-0250; or circle #135 on the reader service card.



FO splicer

The Fiberlign Micro Fusion splicer from Preformed Line Products is a small, self-contained and fully portable instrument designed to provide precision fiber-optic field splices in confined areas. Used for emergency repair and restoration of single-mode fibers, the system also can be used as a primary splicing unit on multimode fiber.

An internal NiCad battery pack provides up to 100 splices on a full charge; a warning indicator signals when recharge is required. Two charging options are available: a 10-hour overnight cycle and a four-hour accelerated cycle. The unit can also be powered from a 110 volt (with adapter) external source or from any 12 volt battery.

The product also incorporates a 50X microscope that provides for visual inspection for dirt or other contaminates in the V grooves as well as post-fusion visual inspection of splice cross section. To simplify positioning and subsequent fiber fusion, precision control is provided in the z-axis with a piezo drive.

For further information, contact Preformed Line Products, P.O. Box 91129, Cleveland, Ohio 44101, (216) 461-5200; or circle #122 on the reader service card.

Spectrum analyzer

Advantest America is introducing its Q8382 optical spectrum analyzer with a dynamic range of 60 dB at 1 nm and 50 dB at 0.5 from the peak wavelength. The measurement range covers 0.6 to 1.75 μm with a resolution of 0.1 nm and measurement of 0.5 nm at 25°C.

Features include auto function, a wide range of marker functions, cursor functions and automatic half-value width measurement functions. The unit also provides a three-dimensional waterfall display and is equipped with a built-in high speed printer.

For more details, contact Advantest America, 300 Knightsbridge Pkwy., Lincolnshire, Ill. 60069, (312) 634-2552; or circle #134 on the reader service card.

Math software

K-Talk Communications recently announced a graphics version of its MathEdit software that will support more word processors, desktop publishing packages and printers. MathEdit is mathematical editing software that allows users to construct math expressions for technical documents. MathEdit 1.1 now outputs math equations in a .PCX graphics file, which can be inserted into WordPerfect 5.0, PageMaker, Ven-

SCTE Sustaining Members

are cable industry organizations that show their support for the Society through financial contributions and personal involvement. Proceeds from Sustaining Membership dues are used to fund the Society's Satellite Tele-Seminar Program, now in its fifth year, which uplinks technical training videotapes for cable television systems across the country to downlink, view and record free of charge.

SCTE thanks the following sustaining member companies for their continued support.

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BradPTS *
Broadband Engineering/Augat *
Budco Inc. *
C-Cor Electronics Inc. *
Cable Converter Service *
Cable Link Inc. *
Cable Resources Inc.
Cable Security Systems *
Cable Services Co. Inc. *
Cable TV Supply Co.
Cablecom Specialists *
Cabletek Center Products *
Calan Inc. *
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Caribbean Communications Corp.
Catel Telecommunications *
CED
Centel Cable TV
Channel Commercial *
Channel Master *
Channelmatic Inc. *
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Di-Tech Inc.
Drop Shop Ltd. *
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Eagle Comtronics Inc. *
Eastern Microwave Inc.
FM Systems *
Foresight Products Inc. *
Galaxy Communications Systems
General Instrument/Jerrold *
Gilbert Engineering *
Goldak/UDSEC *
Hall's Safety Equipment *
Hewlett-Packard Co. *
Home Box Office Inc.
Hughes Microwave Products *
Intercept Sales *
Interstate Cable Enterprises *
Intrastellar Electronics
ISS Engineering Inc. *
ITW Linx
Jerry Conn Associates *
John Weeks Enterprises *
Jones Intercable
Kalun Communications *
Kennedy Cable Construction *
Layton Utility Eq. Co. *
Lectro Products *
Lenfest Cable Group
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Northeast Filter Co. Inc. *
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Oak Communications *
Panasonic Industrial *
PCC Inc. *
Pico Macom Inc. *
Pioneer Communications *
Power and Telephone Supply
Power Technologies Inc. *
Production Products Co. *
Pyramid Industries *
Qintar Inc. *
Quality RF Services *
R.L. Drake *
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Times Fiber Communications *
Toner Cable Equipment Co. *
Triangle Communications Systems
Trilogy Communications Inc. *
Triple Crown Electronics *
Tulsa Cable Television
TVC Supply Co. Inc. *
United Artists Cablesystems Corp.
United Video Inc.
US Cable Inc. *
U.S. Electronics *
Viacom Cablevision
Viewsonics Inc. *
Wavetek RF Products Inc. *
Wegener Communication *
Western Communications Inc.
Wometco Cable Television Inc.
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THE CABLE-TEC EXPO '89 EXHIBIT FLOOR IS ALREADY SOLD OUT

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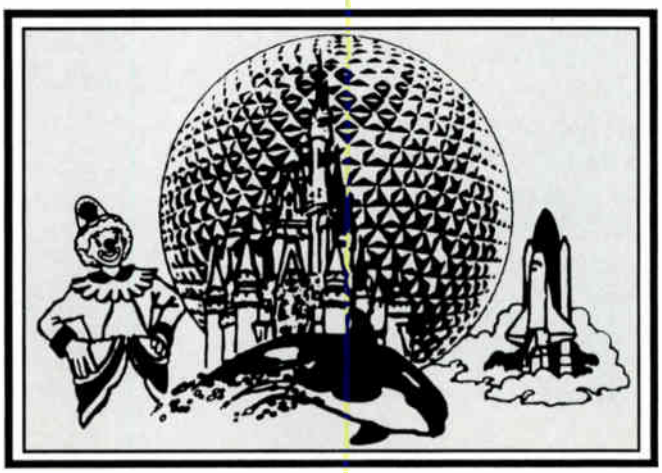


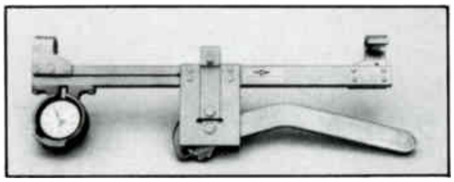
SHOULDN'T YOUR COMPANY BE AN SCTE SUSTAINING MEMBER TOO?

Reader Service Number 1.

tura and many others. Any printer supported by these packages will print the equations.

A "preview mode" has been added to MathEdit, giving the user a WYSIWYG view of the equations with a simple keystroke. According to the company, MathEdit features an easy-to-use interface; menus guide the user through math functions without requiring any special codes to be learned. It also adjusts sizing and formatting within all math equations. For example, values for exponents are reduced, and brackets adjust themselves to fit equations of any size.

For more information, contact K-Talk Communications, 50 McMillen Ave., Suite 100, Columbus, Ohio 43201, (614) 294-3535; or circle #113 on the reader service card.

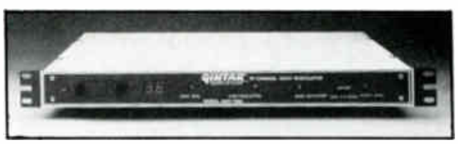


Tensionmeter

A deflection tensionmeter is now available from General Machine Products Co. According to GMP, the product will make it possible for CATV utility line workers to get reliable tension measurements in just seconds on almost any 3/16- to 5/8-inch suspension strand (under less than 10,000 pounds tension) without interrupting, disconnecting or dead ending the wire or cable.

The user hangs the instrument by its end hooks at any free point along the strand then moves the cam handle until the line on the handle head matches up with the line for the size of strand being measured. As the handle is moved, a cam forces the strand out of line, causing the upper bar to bend slightly. The amount of bending or deflection appears on a dial on the left end of the tool. This reading translates into a specific tension mesurement in pounds using the chart that comes with each instrument.

For more details, contact GMP, 3111 Old Lincoln Hwy., Trevose, Pa. 19047-4996, (215) 357-5500; or circle #119 on the reader service card.



A/V modulator

Qintar introduced its Model AVM-7060 frequency agile audio/video modulator with adjacent channel compatibility. The unit offers output channel selection of VHF 2 through 13, mid-band A through I, super-band J through W, A-1 through A-6 and hyper-band AA through WW. In addition it offers a front panel switch for standard, HRC and IRC offsets and delivers a full +60 dBmV output.

For more information, contact Qintar, P.O. Box 8060, Moorpark, Calif. 93020-8060, (805) 523-1400; or circle #126 on the reader service card.

Fusion splicer

The Controls Division of Ametek recently introduced the Orionics FW-310 automatic fiber-optic fusion splicer. The product provides automatic alignment and fusion of single- and multimode fibers and gives an immediate indication of splice loss on the built-in liquid crystal display. It utilizes a pre-defined program for automatic splicing and can be operated semiautomatically by aligning fibers with the piezo positioners while observing the built-in viewscreen. In addition, this splicer allows up to 15 different fiber profiles to be programmed for custom applications, including variations on arc duration, arc intensity and auto feed functions.

For more information, contact Ametek, Controls Division, 820 Pennsylvania Blvd., Feasterville, Pa. 19047, (215) 355-6900; or circle #118 on the reader service card.

Expander amplifier

Viewsonics' drop expander amplifier utilizes the 30 or 60 V power available at one of the two unused line ports at the tap and the signal from F tap port. Eight models are available with 10 and 20 dB gains and some with self-contained four way splitters. A power adapter, amplifier and strand mounting clamp are provided.

For additional information, contact Viewsonics,

QRF UPGRADE MODULES*

JERROLD COMPATIBLE

FINALLY, ADD CHANNELS AND BANDWIDTH to any CATV system, while improving specifications to new design STANDARDS.

CONVENTIONAL "P²" (SINGLE OUTPUT HYBRID), HIGH GAIN ALC/ASC MODULE OR POWER DOUBLER

- High gain, **complete modules** or "kits"
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- Reduces Input equalizer by 6dB to 7dB
- 46dB or better carrier to noise on all designs
- Stops low end roll off
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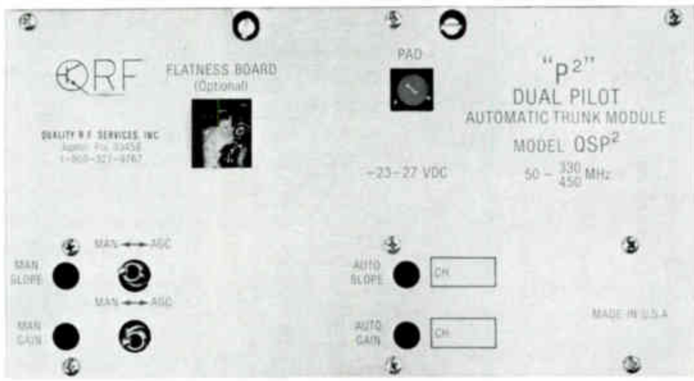
- Compatible with SCD-2W's, ST-20 housings, SPP or QRF power packs

CONVENTIONAL . . . Readily upgradable to power doubling/paralleling—(insurance for the future, and can be installed in the field)

QSP CONVENTIONAL $245.00



QSP² POWER DOUBLER $295.00

(ALSO AVAILABLE . . . MANUAL $150.00 or $200.00)

	300 MHz		330 MHz		400 MHz		450 MHz	
MODULE DESCRIPTION	QSP² 300		QSP² 330		QSP² 400		QSP² 450	
	PARALLEL	CONVENTIONAL	PARALLEL	CONVENTIONAL	PARALLEL	CONVENTIONAL	PARALLEL	CONVENTIONAL
Passband MHz	50-300	50-300	50-330	50-330	50-400	50-400	50-450	50-450
Flatness ± dB	0.2	0.2	0.2	0.2	0.25	0.25	0.25	0.25
Min. Full Gain dB	29 or 30	29 or 30	29 or 30	29 or 30	30	30	30	30
Gain Control Range dB	8	8	6	6	8	6	8	6
Slope Control Range dB	-1 to -7	-1 to -7	-1 to -7	-1 to -7	-2 to -8	-2 to -6	-2 to -6	-2 to -8
Control Pilots ASC: Turned to Ch.	"Q"	"Q"	"W"	"W"	"W"	"W"	"W"	"W"
Oper. Range dB	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
AGC: Turned to Ch.	4	4	4	4	—	—	—	—
Oper. Range dB	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
Return Loss dB	16	16	16	16	16	16	16	16
Noise Figure dB	6	6	6	6	6	6	6.5	6.5
Typical Oper. Level dBmV	34/30	34/30	34/30	34/30	35/30	35/30	35/30	35/30
Distortion at C/CTB	-93dB	-88dB	-92dB	-87dB	-91dB	-86dB	-89dB	-84dB
Typical Oper. XMod	-94dB	-89dB	-93dB	-88dB	-91dB	-86dB	-89dB	-84dB
levels 2nd order	-85dB	-82dB	-85dB	-82dB	-85dB	-82dB	-85dB	-82dB
DC Requirement mA at -23 VDC Note 1	630-730	420-500	630-730	420-500	650-750	430-500	650-750	430-500

Note 1: DC requirements are stated as typical to maximum.

Note 2: Specifications should be referenced to the modules, not the connector chassis.

QRF POWER DOUBLING AMPLIFIER MODULES are designed with parallel output integrated circuit gain blocks or single power doubler hybrid, which provides 5dB to 10dB improvement in distortion performance, in addition to increased reliability.

The 450 MHz amplifier modules provide performance characteristics comparable to 330 MHz products.

All power doubling amplifier modules offer superior heat sinking in the newly designed one piece extruded aluminum modules available only from Quality RF Services, Inc.

Reader Service Number 47.

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170 Eileen Way, Syosset, N.Y. 11791, (516) 921-7080; or circle #131 on the reader service card.

Digital adapter

Global Specialties' Model DSA-250 storage adapter allows the user to turn an analog oscilloscope into a digital storage oscilloscope. The product provides the user with the ability to acquire and display very slow phenomena and to view a stored waveform for extended periods of time. It is also capable of capturing information that cannot be obtained and viewed easily with a conventional scope.

Features include eight-bit resolution; 1 megasample per second digitizing rate; selectable 0, 50 and 100 percent pre-triggering; and a 1,024 word display capacity.

For more details, contact Global Specialties, P.O. Box 1405, New Haven, Conn. 06505, (800) 345-6251; or circle #114 on the reader service card.

Filters

Brickwall filters from Matthey are designed for use in microwave and satellite circuits to decrease incidence of interference. They have flat passbands and linear phase equalizers and move from passband to stop band in minimal time, according to the company. For example, transition from 0 to 45 dB occurs between 4.2 and 4.49 MHz or between 6.4 and 6.85 MHz. The filters are available in 13 cutoff frequencies and others can be made to order.

For more details, contact Matthey Electronics, Box 393, Boway Rd., South Salem, N.Y. 10590-0393; or circle #137 on the reader service card.

BTSC encoder

A BTSC stereo encoder system, designed to provide multichannel TV sound stereo within existing CATV systems, was announced by Standard Communications. The CSG60 stereo generator allows operators to upgrade their existing premium channels for stereo. It is approximately half the size of current BTSC generators and permits the installation of the two CSG60 stereo modules in one 1.75-inch high rack space.

True dbx companding is utilized along with video sync lock, high quality filtering and 4.5 MHz modulated RF output, thus assuring correct right/left stereo separation and maximum signal-to-noise ratio.

The CSG60 can accept stereo audio signals from VideoCiphers, stereo demodulators or any other local audio source. The mono input can accent commercial insertion equipment, creating left and right channel outputs, satellite subcarrier demodulated bypass audio or local civil defense type audio.

For more details, contact Standard Communications, P.O. Box 92151, Los Angeles, Calif. 90009-2151, (800) 243-1357; or circle #117 on the reader service card.

Oscilloscope

Tektronix introduced its 300 MHz 2432A digital oscilloscope with 250 megasamples per second sampling. This unit offers push button scope setup, push button measurements and readouts, building and running of measurement sequences and pass/fail waveform testing using a limits envelope.

For more information, contact Tektronix, P.O. Box 1700, Beaverton, Ore. 97075, (800) 426-2200; or circle #132 on the reader service card.

Encryption system

Leitch Video's addressable digital signal encryption technology, consisting of the VGE-2000N ViewGuard encoder and VGD-2100N ViewGuard decoder, permits scrambling of TV program signals, embedding of security keys and provides a medium for computer control in a two rack unit size. It offers hard encryption of both audio and video except for lines 10-21 to allow passage of VITS, VIRS or station ID. Sync, burst, audio data and decoding information are inserted into the data stream to the authorized users' equipment in such a way that the encoded output is transmitted in the NTSC North American broadcast standard and can operate within a 4.2 MHz bandwidth.

With a single subcarrier, up to three audio channels are provided, allowing stereo applications and data transmission. The data from the control terminal received by each scrambler is used to update and enable or disable the individual descramblers associated with its transmission link.

For further details, contact Leitch Video of America, 825K Greenbrier Circle, Chesapeake, Va. 23320, (804) 424-7920; or circle #129 on the reader service card.

FO splice

Now available from 3M's Telecomm Products Division, the Fibrlok splice for single- or multimode fibers can be completed in 45 seconds

or less after normal optical fiber preparation. Performance characteristics include insertion loss less than 0.2 dB, fiber retention greater than 0.75 lb., thermal stability from −40 to 77°C and return loss greater than −35 dB.

For additional details, contact 3M, Dept. 88-39035, P.O. Box 2963, Austin, Texas 78769-2963, (512) 834-3897; or circle #133 on the reader service card.

Tool kit

The JTK-85R tool kit from Jensen Tools is designed to assist the CATV installer. The kit contains more than 80 tools specifically selected to make installation work fast and efficient. Included are screwdrivers, nutdrivers, wire strippers, magnetic stud finder, hacksaw, drill set, calipers, drywall saw, fuse puller, grounded outlet tester, solder and soldering iron and more.

The tools are housed in a two-pallet, 17¾- × 14½- × 9¼-inch case with a tongue and groove closure, chrome plated latches and extra room in the case bottom for additional parts and equipment. Optional accessories include a Fluke 21 DMM, hole saw, 12 volt 3/8-inch cordless drill with two battery packs, staple gun, special bits and drill bit extension.

For more information, contact Jensen Tools, 7815 S. 46th St., Phoenix, Ariz. 85044, (602) 968-6231; or circle #120 on the reader service card.

Security wrench

Available from Budco, its universal security wrench is designed for work on the secured coaxial cable connectors used in the CATV industry. It fits most security cups and can be used on F-series and CF-type coaxial connectors or F-series terminators. Made of case-hardened, drop-forged high-alloy steel, the wrench is guaranteed not to split or spread and comes with a one-year replacement warranty, according to the company.

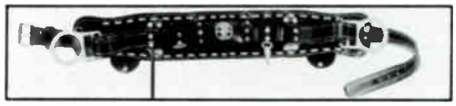
For further details, contact Budco, P.O. Box 3065, Tulsa, Okla. 74101-3065, (918) 252-3420; or circle #123 on the reader service card.

Battery tester

Performance Cable TV Products' universal battery tester enables users to determine the condition of deep cycle, high capacity storage batteries used in uninterruptible computer power supplies, inverters and CATV standby power supplies.

The hand-held tester contains LED indicators that show the condition of a battery while subjected to a 96 ampere electronic load for 10 seconds. Other LED indicators show when the tester is connected to an excessive voltage or leads are reversed.

For more details, contact Performance Cable TV Products, 1770 Macland Rd., Dallas, Ga. 30132, (404) 443-2788; or circle #125 on the reader service card.



Body belts

Two new full-floating protective body belts are being offered from Klein Tools. The belts are constructed of leather and are available in either black or burgundy. They feature a full 5½-inch rolled-edge elk-tanned leather cushion for extra support, are padded with sponge rubber for maximum comfort and are shaped at the sides for a proper body fit. The belts have full-floating 30° double-bar circle D rings that are connected by a 1¾-inch nylon-web strap allowing for a 4-inch lateral movement. Pocket tabs are reinforced with neoprene-impregnated nylon.

Each belt has a glove bag ring, two-way knife snap, two pocket tabs, four belt suspender rings,

and a tape thong. Six sizes of each belt are available.

For more information, contact Klein Tools, 7200 McCormick Blvd., Chicago, Ill. 60645, (312) 677-9500; or circle #121 on the reader service card.

Ohmmeter

A compact, direct-reading digital low resistance ohmmeter for making four-terminal low resistance measurements from 0.1 micro-ohm to 60 ohms with accuracies of 0.25 percent of reading is being offered from Biddle Instruments. Features include all controls, plus rechargeable batteries and charger in one heavy duty case.

After leads are attached, range is selected and the set is turned on, the product is able to measure bar-to-bar resistance on motor rotors, locate rotor cracks on squirrel-cage motors and measure resistance of switch and circuit breaker contacts, welded, bonded and bolted joints, motor and transformer windings, fuses, motor starter contacts, graphite electrodes, equipment ground bonding and battery connections for uninterruptible power supplies.

For more details, contact Biddle Instruments, 510 Township Line Rd., Blue Bell, Pa. 19422, (215) 646-9200; or circle #116 on the reader service card.

Receiver/descrambler

Nexus Engineering added its IRD-1 integrated receiver/descrambler to its line of headend products. The unit features a feedforward frequency control loop to compensate for system drift at any fine-tuned setting, power consumption of less than 4 watts per satellite receiver and a C-/Ku-band switch. It is housed in a standard 19-inch rack mount chassis and is $2^5/_8$ inches high.

For more information, contact Nexus Engineering, 7000 Lougheed Hwy., Burnaby, British Columbia, Canada V5A 4K4, (604) 420-5322; or circle #128 on the reader service card.

Earth anchors

Foresight Products is offering three new Manta Ray utility pole earth anchors in addition to its original MR-1 anchor. The MR-2 is designed to hold 10,000 to 12,000 pounds in normal soils and more than 20,000 pounds in harder soils. Its narrower wings allow it to be driven into harder soils faster. It also can be used in extremely hard soil where a 4-inch predrilled hole is necessary.

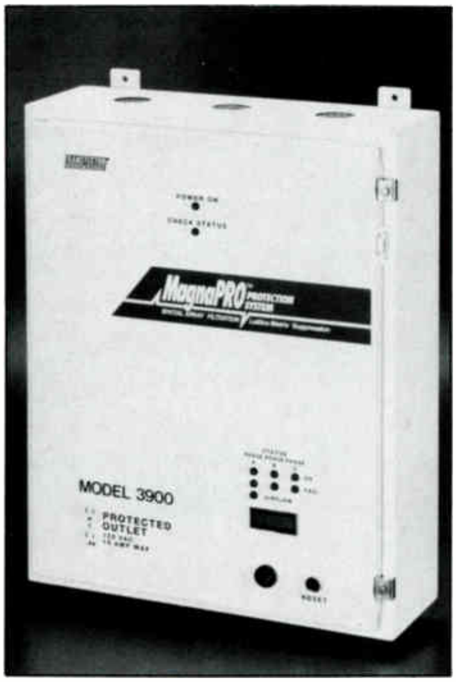
The MR-3 is rated between 6,000 and 8,000 pounds holding capacity and is said to be ideal for applications where aerial lines are strung and new guy lines and anchors must be installed. The MR-4 is rated at 3,000 to 4,000 pounds in normal soils. All Manta Rays are made of galvanized ductile iron, can be driven with the standard SG-C gad set and proof loaded with the Foresight load locker.

For additional details, contact Foresight Products, 6430 E. 49th Dr., Commerce City, Colo. 80022, (303) 286-8955; or circle #139 on the reader service card.

Cable locator

Metrotech's Model 650 is a lightweight transmitter/receiver for locating, tracing and determining the depth of underground cable and transmission pipelines. The 5-pound receiver may be operated with one hand while the user walks at normal speed and all controls and displays are within easy reach and line-of-sight of a normal standing position. The device operates in three selectable frequency ranges: active (9.8 kHz audio frequency), power (50/60 Hz) and radio (14-22 kHz).

For further information, contact Metrotech, 670 National Ave., Mountain View, Calif. 94043, (415) 940-4900; or circle #138 on the reader service card.



Power protector

Transtector Systems introduced its MagnaPro series of suppressor/filter power line protectors designed to protect computers and computerized electronics from disruption and damage by transient overvoltages and severe noise problems. These units use a proprietary Spatial Array filtration system combined with state-of-the-art filtering techniques to enhance noise attenuation across a broad frequency spectrum.

The units also have lattice matrix solid-state technology that delivers maximum bipolar suppression without degradation, according to the company. Models are available in six service voltages ranging from 208Y/120 to 480 VAC, 50/60 Hz.

For more information, contact Transtector Systems, P.O. Box 300, 10701 Airport Dr., Hayden Lake, Idaho 83835, (208) 772-8515; or circle #140 on the reader service card.

SAP generator

Leaming Industries' SAP-1 is a stand-alone second audio program (SAP) generator that encodes a monaural audio signal into the SAP format for TV transmission. It may be used with or without a BTSC stereo signal present and with any BTSC encoder that has an input for a SAP carrier. The unit is powered by +24 V. Typical uses include transmission of second language programming, local radio programs, weather reports, pay TV promotions and FSK data.

For additional information, contact Leaming Industries, 180 McCormick Ave., Costa Mesa,

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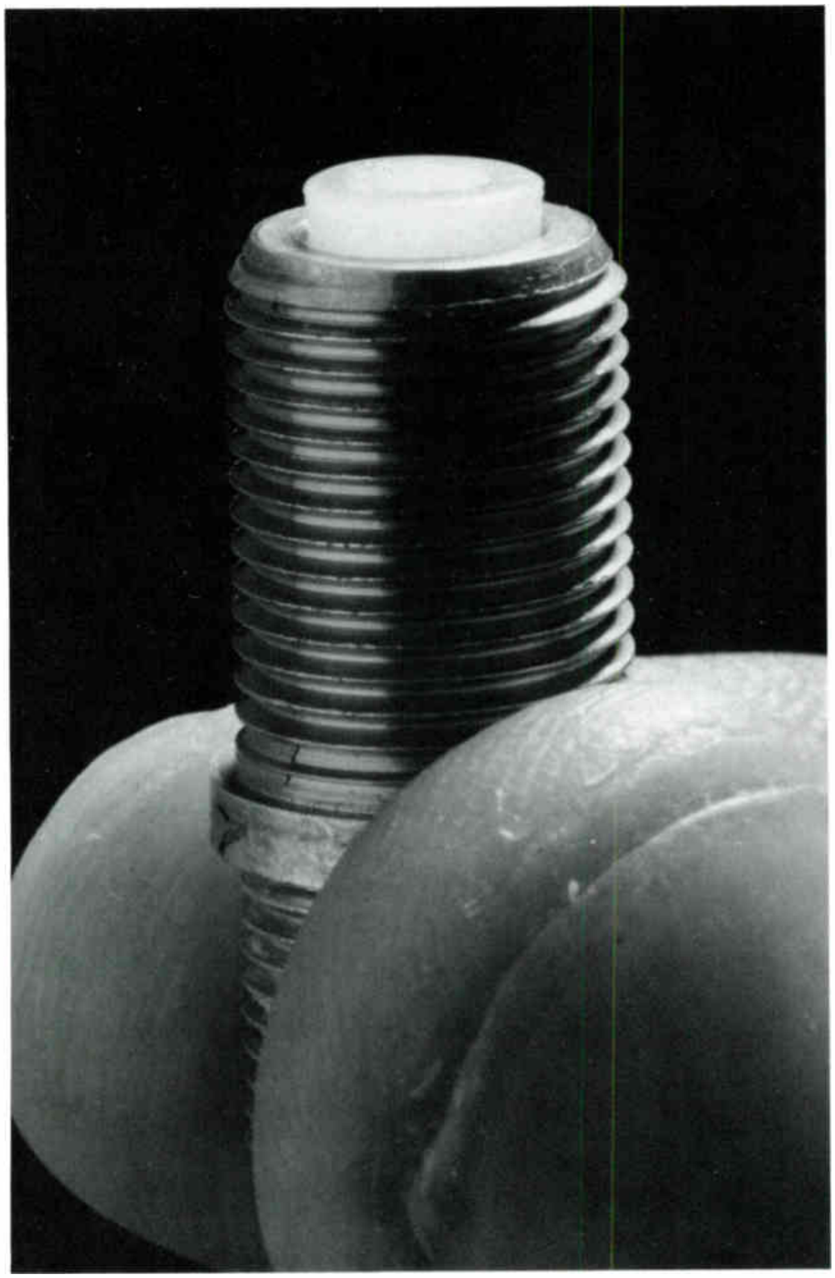
The "Connector Activated Mechanism" (CAM)



Introducing a revolution in cable port design: the Antronix® CAM-Port®

The new CAM-Port delivers the most reliable, intermittent-free connections since the dawn of the cable era.

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The new CAM mechanism will automatically grip any size center conductor with the exact contact pressure to insure a reliable, intermittent-free connection.

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The key to a proper mechanical and electrical connection is the contact area. Present design, by its own nature has to have a marginal contact area. In the CAM-Port, the whole contact is the contact area.

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This normally open contact design allows perfect plating over the entire contact area.

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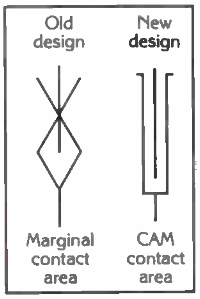

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Calif. 92626, (714) 979-4511; or circle #130 on the reader service card.

AML system

Hughes Microwave introduced its new amplitude modulated transmitter/receiver combination. It provides 60 dB carrier-to-noise signals at distances up to 32 km with 40 TV channels and 56 dB C/N at 32 km with 80 channels. The system includes the Hughes SSTX-145 solid-state high-power transmitter and the COR series of outdoor mountable, cable-powered receivers.

For more information, contact Hughes Aircraft Co., Microwave Products, P.O. Box 2940, Torrance, Calif. 90509-2940, (213) 517-6233; or circle #112 on the reader service card.

Satellite receiver

ISS Engineering announced its Model GL5020, a C- and Ku-band IRD satellite receiver scheduled for release in the first quarter of 1989. The product features a VideoCipher module that can be removed from the front panel via release latches. It meets RS250B video quality and includes ventilation for cool running operation.

Tuning of the GL5020 is accomplished by either channel or frequency, and audio outputs are balanced. The product also allows for remote control by way of a built-in RS232 control.

For further details, contact ISS Engineering, 1047 Elwell Ct., Palo Alto, Calif. 94303, (415) 967-0833; or circle #110 on the reader service card.

Cable identifier

PDW Industries is featuring its Audit Wizard, a cable pair identifier that consists of an eight-channel transmitter and a receiver. The product is designed to minimize labor costs and time spent in verifying cable identifications and allows an operator to verify up to eight cables at one time from a common distribution point to the cable's far end without additional assistance. A fiber-optic unit is also available.

To operate, the user connects from one up to eight cables to the transmitter at the cable distribution panel. By turning on the transmitter, a different channel frequency is transmitted into each connected cable, indicated by a blinking power lamp on the transmitter. The user seeks out the far end of the cables to be identified and connects a cable to the receiver. Upon pressing the receiver's read button, an LED dot bar display indicates channel number, which matches the channel frequency on the transmitter end, thus identifying the cable source to the cable end.

For more details, contact PDW Industries, P.O. Box 213, Northbrook, Ill. 60062, (312) 564-5251; or circle #109 on the reader service card.

Bulletin

Cablewave Systems released a new technical bulletin on the HCF 12-50J Cellflex coaxial cable. The cable is designed for areas that require tight bending or the need to withstand continuous bending. Because the cable has weatherproof connectors, field assembly is possible, according to the company.

The bulletin, No. 138A, outlines the electrical specifications for the coaxial cable such as maximum operating frequency, impedance, velocity of propagation, attenuation and DC resistance. Also, mechanical specifications are covered including nominal size, outer and center conductor, jacket material, maximum pulling force and minimum bending radius (both multiple bending and mobile application). There is also an attenuation and average power chart and a diagram of the HCF 12-50J connector type N male.

For more information, contact Cablewave Systems, 60 Dodge Ave., North Haven, Conn. 06473, (203) 239-3311; or circle #108 on the reader service card.

Brochure

Marconi issued a color brochure on its 6900A line of power meters. The 10-page brochure describes the features, specifications and accessories for the 6950 and 6960A power meters, as well as the 6910, 6920 and 6930 series of power sensors.

For additional details, contact Marconi Instruments, 3 Pearl Ct., Allendale, N.J. 07401, (201) 934-9050; or circle #127 on the reader service card.

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CT Publications, in its brief five-year history, has developed close bonds with all of the cable industry. Our keen sense of what type of information is needed by every level has spurred our growth. We plan to continue to provide the publications that deliver that all-important and necessary information. Our readers include CEOs, general managers, marketing personnel, technical experts, customer service specialists and many more. Disseminating the right information to key people is our job.

TO KNOW CABLE . . . YOU NEED THESE MAGAZINES

With our new Editor Deborah Arney, a cable industry veteran, on board, **CS** will expand its content to be even more responsive to our readers' needs. Some of our plans include the introduction of a financial column, a monthly section devoted to customer service, as well as expanded news coverage.

Copies of **CS** will reach you much sooner as we upgrade to second class postage.

We are adding a new classified advertising section for products and services as well as exciting business and career opportunities.

We have expanded **CT's** editorial coverage with "Reporter's Notebook," a monthly column by Gary Kim, special correspondent; "Taylor's Vantage," by Archer Taylor, senior vice president of engineering, Malarkey-Taylor Associates; and "Biro Co-Channel Locator Map," by Steven Biro, engineering consultant.

An upcoming readership survey will help us continue to provide the best in current technical information you have come to expect from the official journal of the Society of Cable Television Engineers (SCTE).

We are also expanding our circulation to include the names of international SCTE members.

Since **IT** was launched last May, 98 percent of our readers have directly requested their own copy—increasing the circulation to 11,000. **IT** addresses one of the largest and most important segments of the CATV industry—the rank and file—the technicians and installers. There is no other industry publication that addresses this group with monthly instructional "how-to" applications of products and environmental circumstances. **IT** consistently provides its readers with information on how to cope with practical day-to-day operations.

See you at the Texas Show in San Antonio!

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Merk

Chuck Merk joined the **Jerrold Subscriber Systems Division** of General Instrument as vice president of engineering. He was most recently vice president of engineering for the Farinon Division of Harris Corp.

Dave Wachob was promoted to Jerrold's director of advanced technologies. Previously, he was manager of product support. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

Scientific-Atlanta appointed **Dr. H. Allen Ecker** as senior vice president of technical operations and chief technical officer. He was previously vice president of corporate development and technology. Contact: 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

Cunningham

Robert Cunningham was named vice president of sales for **Zenith Cable Products**. He was previously national accounts manager. Contact: 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181.

Midwest CATV named **James Kazda** to a sales position serving Georgia, Alabama, South Carolina and Tennessee. Prior to this, he was an account executive for Magnavox CATV Systems.

Michael Cooke was appointed telemarketing sales representative in Ocala, Fla. Before joining the company, he was a sales representative/account executive with Cable TV Supply/Merit Communications Supply. Contact: P.O. Box 271, Charleston, W. Va. 25321, (304) 343-8874.

Pfundt

William Pfundt was appointed vice president of operations by **General Machine Products Co.** Prior to this, he was director of marketing and marketing manager at the firm. Contact: 3111 Old Lincoln Hwy., Trevose, Pa. 19047-4996, (215) 357-5500.

Ned Mountain was promoted to vice president of marketing for **Wegener Communications**. He was formerly director of marketing for the company.

Doug Kennedy was appointed marketing manager, data communications. Prior to this, he was sales engineer of Varian's Electron Device Group. Contact: Technology Park/John's Creek, 11350 Technology Circle, Duluth, Ga. 30136, (404) 623-0096.

Irwin/Superior Communications Construction announced several new appointments. **Sandy Sanders** was named vice president of operations of the construction division (cable TV and telephone). **Dennis O'Brien** was appointed vice president of operations of the installation division. **Pete Cavaretta** was named installation manager.

Ernie Bench was promoted to Northwest regional manager. **Cindy Owens** was appointed controller and **Kathy Crabtree** as executive assistant/office manager. Contact: 1639 E. Edinger, Santa Ana, Calif. 92705, (714) 542-1055.

Dowling

Lindsay Specialty Products named **Michael Dowling** sales manager of Eastern United States. Before joining the company, he was a commercial officer at the Canadian Consulate General in Atlanta. Contact: 1248 Clairmont Rd., Suite 3D-231, Atlanta, Ga. 30030, (404) 633-2867.

ISS Engineering appointed **Karl Witbeck** as an applications engineer. Before this, he was a field engineer with RFI Inc.

Bruce Randall Murray and **Kevin Lamb** were assigned to the new products design group. Murray was previously a design engineer with Modulation Associates; Lamb was an RF engineer for Radionics. Contact: 104 Constitution Dr., #4, Menlo Park, Calif. 94025, (415) 853-0833.

Bruce Dittman was named vice president of contractor sales for **Anixter Bros.** Before this, he was with Morrison-Knudsen in international purchasing and operations. Contact: 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600.

NaCom Corp. announced the addition of **Doug Coverdale** and **Jeff Metheney** as computer-aided design and drafting (CADD) specialists. Contact: 1900 E. Dublin-Granville Rd., Columbus, Ohio 43229, (614) 895-1313.

Andrea Sheys was named assistant director of the **National Cable Television Association**'s Office of Cable Signal Theft. She was formerly administrative assistant in the association's Government Relations Department. Contact: 1724 Massachusetts Ave., N.W., Washington, D.C. 20036, (202) 775-3629.

Woolard

ADC Telecommunications named **Patricia Woolard** account manager in its Ameritech District. She joined the company from Rockwell International where she was product manager. Contact: 4900 W. 78th St., Minneapolis, Minn. 55435, (612) 893-3136.

Robert Moel was promoted to director of technical operations for **Warner Cable**'s corporate engineering department. Prior to this, he was manager of technical operations.

William Prestridge was appointed director of technical operations for Division I. He was formerly director of design. Contact: 400 Metro Pl. North, Dublin, Ohio 43017, (614) 792-7408.

Continental Cablevision named **William Riley** engineering director for its Southern Massachusetts District. Prior to this, he was engineering director for the South Shore/Cape Cod region. Contact: 1266 Furnace Brook Pkwy., Quincy, Mass. 02169, (617) 472-1231.

Philips Telecom Equipment Co. named **Gerald Maloney** customer support engineer in the company's Test Equipment Division. Maloney was previously telecommunications project manager at Management Access Control Systems Inc. Contact: 250 Federal Rd., Brookfield, Conn. 06804, (203) 775-4401.

G-Line troubleshooting procedure

By Ron Hranac
Jones Intercable Inc.

The data herein appears courtesy M/A-COM MAC Inc. This is the first of a two-part series.

This procedure assumes that the antennas are aligned correctly and that polarization has been set and line-of-sight exists between the end sites. Also, that the meter readings have been logged prior to failure. If not, typical values are indicated. *Apparatus:* digital multimeter, frequency counter (12 GHz or 200 MHz), scope (10 MHz), spectrum analyzer (70 MHz or 12 GHz), field strength meter, microwatt power meter, video generator, video monitor, audio test set, RMS voltmeter, 60 to 120 dB attenuator set (at frequency range of unit), waveguide-to-N adapter, TNC-to-N adapter, SMA-to-N adapter, OSM-to-N adapter, BNC-to-N adapter and two BNC-to-BNC jumpers (2′).

Procedure:
Step 1) Look up the indicated alarm or failure mode (A).
Step 2) When alarm or failure is located, move to B for possible fault cause.
Step 3) Select a cause and move to C and locate evaluation parameter.
Step 4) If evaluation parameter is incorrect, move to D for corrective action.
Step 5) If evaluation parameter is correct, move to E for next step or cause.

A: Failure mode/alarm—No meter voltages.

B	C	D	E
POSSIBLE CAUSE	**EVALUATION**	**CORRECTIVE ACTION**	**NEXT STEP**
a Defective Power Supply	a Check rack Power Supply circuit breaker and fuse	a Reset or replace fuse	a See defective interconnect harness or connector
b Defective interconnect harness or connector	b Check harness and connector	b Repair, replace or secure	b See Power Supply manual troubleshooting procedure

A: Failure mode/alarm—No +28V (6G, 6GW, 12G and 15G).

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective AFC module
c Defective AFC module (802396-1) analog	c Disconnect AFC interconnect P5 J5 If +28V returns, check E5 feedthru CR3, C25, and C41	c Replace defective item	c See defective RF Amp
d Defective AFC module (802396-2) digital	d Disconnect AFC interconnect P5 J5 If +28V returns, check E5 feedthru C32, U1, CR8, C34, CR9, C11, U2, and Q7	d Replace defective item	d See defective RF Amp
e Defective AFC module (842756-1) digital	e Disconnect AFC interconnect P5 J5 If +28V returns, check C38, U8, U10, and CR16	e Replace defective item	e See defective RF Amp
f Defective RF Amp (805173)	f Disconnect orange lead from TB-1 Pin 2 If +28V returns, check C2 and L1 on the RF Box and CR1, Q1 on the RF Amp	f Replace defective item	f Check interconnect wiring and harness
g Defective RF Amp (805157)	g Disconnect orange lead from TB-1 Pin 2 If +28V returns, check C2 and L1 on the RF Box and CR1 Q1 on the RF Amp	g Replace defective item	g Check interconnect wiring and harness. If good, see defective Video Presence Detector
h Defective RF Amp (805078)	h Disconnect orange lead from TB-1 Pin 2 If +28V returns, check CR1, Q1 and Q2 on RF Amp	h Replace defective item	h Check interconnect wiring and harness
i Defective Video Presence Detector (CARS Band only)	i Disconnect orange lead from TB-1 Pin 2 and confirm video input at J2	i If video is present at J2, check U1 Q1, Q4 and CR7	i Check interconnect wiring harness

A: Failure mode/alarm—No TX +24V (2G, 2.5G and 7G).

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective AFC module
c Defective AFC module (802396-1) analog	c Disconnect AFC interconnect P5/J5 If +24V returns, check E5 feedthru, CR3, C25, and C41	c Replace defective item	c See defective RF Amp
d Defective AFC module (802396-2) digital	d Disconnect AFC interconnect P5/J5 If +24V returns, check E5 feedthru, C32, U1, CR8, C34, CR9, C11, U2, and Q7	d Replace defective item	d See defective RF Amp
e Defective AFC module (842756-1) digital	e Disconnect AFC interconnect P5/J5 If +24V returns, check C38, U8, U10, and CR16	e Replace defective item	e. See defective RF Amp
f Defective RF Amp (805195)	f Disconnect orange lead from TB-1 Pin 2 If +24V returns, check CR1, Q1, and Q2 on RF Amp	f Replace defective item	f Check interconnect wiring and harness

A: Failure mode/alarm—No TX +12V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective BB Amp
c Defective BB Amp (802382)	c Remove BB Amp from mounting location. If +12V returns, check C12, C10, C24, C16, CR1, CR2 and C11	c Replace defective item	c See defective TX Logic Card
d Defective BB Amp (1841920)	d Remove BB Amp from mounting location If +12V returns, check C10, C20, C2, Q6, Q7, Q8 and Q9	d Replace defective item	d See defective TX Logic Card
e Defective TX Logic Card (803068)	e Remove TX Logic Card from mounting location If +12V returns, check CR20, CR21, C10, CR10 U1, U2, U3, U4, and CR17	e Replace defective item	e See defective 2 GHz Oscillator (2G only)
f Defective 2 GHz Oscillator Regulator 804427 (2G only)	f Disconnect red lead from TB-1 Pin 3 If +12V returns, check C2, CR2, and C4	f Replace defective item	f Check connections and harness

A: Failure mode/alarm—No TX −12V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit.	b If problem disappears, isolate unit and continue procedure	b See defective BB Amp
c Defective BB Amp (802382)	c Remove BB Amp from mounting location If 12V returns, check C33, C3, C12, CR2 and CR1	c Replace defective item	c See defective TX Logic Card
d Defective BB Amp (1841920)	d Remove BB Amp from mounting location If 12V returns, check C11, C5, C12, Q6, Q7, Q8, and Q9	d Replace defective item	d See defective TX Logic Card.
e Defective TX Logic Card (803068)	e Remove TX Logic Card from mounting location If 12V returns, check CR11, CR5, C5, CR4, U5, U6, and U2	e Replace defective item	e Reconfirm fault procedure

A: Failure mode/alarm—No TX −24V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a Check C8, CR2, and CR3 on Elco connector J1 If good, see short circuit in other TX/RX unit
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective Reference Oscillator
c Defective Reference Oscillator (801204 or 800946)	c Remove yellow lead from TB-1 Pin 5 If voltage returns, check C4, C2, C16, C1, and C1 feedthru	c Replace defective item	c Check for shorts and wiring

A: Failure mode/alarm—No TX −30V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a Check wiring and harness
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective AFC module
c Defective AFC module (802396-1) analog	c Disconnect AFC interconnect P5/J5 If 30V returns, check CR18, Q14, Q12, C33, and C32	c Replace defective item	c Check wiring and harness
d Defective AFC module (802396-2) digital	d Disconnect AFC interconnect P5/J5 If 30V returns, check C3, CR2, CR1, C1, C2, C5, and CR5	d Replace defective item	d Check wiring and harness
e Defective AFC module (842756-1) digital	e Disconnect AFC interconnect P5/J5 If 30V returns, check C23, CR10, Q4, C21, CR8, C15, U9, and CR4	e Replace defective item	e Check wiring and harness

A: Failure mode/alarm—No RX −12V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX/RX.	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective RFI Filter
c Defective RFI Filter	c Disconnect lead from TB1 Pin 3 If 12V returns, check C5 and C8 coupling between TB1 Pins 3 and 8	c Replace defective item	c See defective IF Network
d Defective IF Network (802461-1 through -11)	d Disconnect IF Molex connector from harness If 12V returns, check IF Amp C40, C34, C30, C22, C18, C10, C7, C3, Q1, Q2, Q3, Q4, Q5, Q8, and Q7	d Replace defective item	d See defective RX BB Amp
e Defective IF Network (802461-12 through -15)	e Disconnect IF Molex connector from harness If − 12V returns, check Video Demodulator C36, C17, C18, C13, C16, C12, C10, and U3.	e Replace defective item	e See defective RX BB Amp
f Defective RX BB Amp	f Remove RX BB Amp from mounting location If 12V returns, check C24 and C25	f Replace defective item	f See defective RX squelch
g Defective RX squelch	g Remove squelch card from mounting location If 12V returns, check C5, CR10, CR11, U1, and U2	g Replace defective item	g See defective de-emphasis *
h Defective De-Emphasis	h Remove De-Emphasis from mounting location If − 12V returns, check for short across connector	c Replace defective item	h See defective Mixer-Preamplifier
i Defective Mixer-Preamplifier (12G and 15G)	i Remove harness from Mixer-Preamplifier	i Replace Mixer	i Check interconnect harness and wiring

A: Failure mode/alarm—No RX +12V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX RX.	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective RFI Filter
c Defective RFI Filter	c Disconnect lead from TB1 Pin 2 If + 12V returns, check C6 and C7 coupling between TB1 Pins 2 and 7	c Replace defective item	c See defective IF Network
d Defective IF Network (802461-1 through -11)	d Disconnect IF Molex connector from harness If + 12V returns, check IF Amp CR8, Q9, C46, C47, C45, C44, C43, C42, C41, Q1, Q2, Q3, Q4, Q5, Q6, and Q7	d Replace defective item	d See defective RX BB Amp
e Defective IF Network (802461-12 through -15)	e Disconnect IF Molex connector from harness If + 12V returns, check Video Demodulator C9, C35, C34, C27, and U3	e Replace defective item	e See defective RX BB Amp
f Defective RX BB Amp	f Remove RX BB Amp from mounting location If + 12V returns, check C8, CR2, C14, C17, CR4, C19, and C27	f Replace defective item	f See defective RX squelch
g Defective RX squelch	g Remove squelch card from mounting location If + 12V returns, check C4, CR18, CR19, U1, and U2	g Replace defective item	g See defective de-emphasis
h Defective De-Emphasis	h Remove De-Emphasis from mounting location If + 12V returns, check Q2	h Replace defective item	h See defective Mixer-Preamplifier
i Defective Mixer-Preamplifier (12G and 15G)	i Remove harness from Mixer and check for shorts across connector	i Replace defective item	i Check interconnect harness and wiring

A: Failure mode/alarm—No RX −24V.

a Defective Power Supply	a Check harness and connectors	a See Power Supply manual troubleshooting procedure	a See short circuit
b Short circuit in other TX RX	b Remove interconnect power harness from other TX or RX unit	b If problem disappears, isolate unit and continue procedure	b See defective RFI Filter
c Defective RFI Filter	c Disconnect lead from TB1 Pin 4 If − 24V returns, check C3 and C4 coupling between TB1 Pins 4 and 9	c Replace defective item	c See defective diode bridge
d Defective diode bridge	d Measure CR1, CR2, and C9 located between TB1 Pin 4 and squelch lamp	d Replace defective item	d See defective IF Network
e Defective IF Network	e Disconnect IF Molex connector from harness If 24V returns, check IF Amp s CR8, Q9, C46, C47, C45, C44, C43, C42, C41, Q1, Q2, Q3, Q4, Q5, Q6, and Q7	e Replace defective item	d See defective IF Limiter
f Defective IF Limiter	f Check C30, C26, C23, C14, C10, and C3	f Replace defective item	f See defective IF Discriminator
g Defective IF Discriminator	g Check C28, C26, C32 and C22	g Replace defective item	g See defective Mixer-Preamplifier
h Defective Mixer-Preamplifier (2G, 2 5G 6G, and 7G only)	h Check C15 C12 C9 and feedthru caps to Mixer	h Replace defective item	h Check interconnect harness

A: Failure mode/alarm—Incorrect meter OSC volts.

See TX alarm lamp on #1 *			

A: Failure mode/alarm—Incorrect meter ERROR volts.

See TX alarm lamp on #1 *			

A: Failure mode/alarm—Incorrect meter PA CURRENT.

See TX alarm lamp on #2 *			

A: Failure mode/alarm—Incorrect meter RF volts.

See TX alarm lamp on #2 *			

A: Failure mode/alarm—Incorrect meter PILOT volts.

See TX alarm lamp on #3 *			

A: Failure mode/alarm—TX fault lamp ON.

Note This alarm lamp is a summary alarm A number prior to the possible cause will indicate start of that particular fault procedure (1) TX off frequency, (2) defective RF system and (3) no pilot deviation

a Confirm presence of dc voltages on front panel meter *		a See dc volt faults	
b Confirm presence of video at J1 or J2 TX video input		b Apply video	
(1) a TX off frequency (not within 0 005% of channel frequency	1) Check voltage level on E1 of AFC module (25 to 27V)	1) See defective AFC loop	1) See defective Logic Card
	2) If AFC voltage is correct and AFC error is off by 1 to 3 units		
	a) 802396-1	a) Check Reference Oscillator	a) See defective Logic Card
	b) 802396-2	b) See Section 5 of manual (AFC Alignment)	b) See defective Logic Card
	c) 842756-1	c) See Section 5 of manual (AFC Alignment)	c) See defective Logic Card
	3) If AFC voltage is correct and channel frequency is incorrect (AFC switch ON)		
	a) 802396-1	a) Adjust C17 for correct frequency	a) See defective Logic Card
	b) 802396-2	b) No adjustment, see AFC Loop	b) See defective Logic Card.
	c) 842756-1	c) Adjust C29 for correct frequency	c) See defective Logic Card

(Continued in Part II)

*Indicates see noted procedure first

Cable Exchange

Item Number	Description	Item Number	Description
PCTB-6	TRUNK TERMINATING BRIDGER	FFT4-17D	TAP 4W 17DB
PH	HOUSING—P SERIES TRUNKS	FFT4-17F	TAP 4W 17DB
T3LE	LINE EXTENDER NH	FFT4-20	TAP 4W 20DB
T4CM	CONTINUITY MOD. NH	FFT4-20D	TAP 4W 20DB
TFAV	TRUNK AMP AGC	FFT4-20F	TAP 4W 20DB
TFM	TRUNK AMP MGC	FFT4-23	TAP 4W 23DB
TFPS	POWER SUPPLY	FFT4-23D	TAP 4W 23DB
TH	HOUSING FOR T SERIES L.E.	FFT4-23F	TAP 4W 23DB
XH	HOUSING FOR X SERIES L.E.	FFT4-23H	TAP 4W 23DB
XR2A	FORWARD AGC MOD.	FFT4-26	TAP 4W 26DB
XR2B	BRIDGER INTERMEDIATE	FFT4-26D	TAP 4W 26DB
XR2B-2	BRIDGER 2 OUTPUT	FFT4-29	TAP 4W 29DB
XR2B-4	BRIDGER 4 OUTPUT	FFT4-29D	TAP 4W 29DB
XR2DA	DIST AMP HYBRID AGC	FFT4-32D	TAP 4W 32DB
XR2DM	DIST AMP HYBRID MGC	FFT4-7T	TAP 4W 7DB
XR2F-1	INPUT MOD.	FFT4-7TD	TAP 4W 7DB
XR2F-13	INPUT MOD.	FFT8-4D	TAP 8W 4DB
XR2F-14	OUTPUT MOD.	SHS-2	HYBRID SPLITTER
XR2F-19	OUTPUT MOD.	SO-2	FEEDER MAKER
XR2F-3/110	INPUT MOD.	SO-4	FEEDER MAKER 4DB
XR2F-4	INPUT MOD.	SPJ-2	POWER COMBINER
XR2F-5	OUTPUT MOD.	SPJ-3C	DIRECTIONAL COUPLER 3DB
XR2F-7/110	OUTPUT MOD.	SPX-0.5	PAD 0.5 DB
XR2F-8	OUTPUT MOD.	SPX-00	PAD 00 DB
XR2HA	LINE AMP HYBRID HRC	SPX-01	PAD 01 DB
XR2HM	LINE AMP HYBRID HRC	SPX-02	PAD 02 DB
XR2LA-PS	POWER SUPPLY	SPX-03	PAD 03 DB
XR2LAF-1	POWER INPUT MOD.	SPX-06	PAD 06 DB
XR2LAF-2	POWER INPUT MOD.	SPX-09	PAD 09 DB
XR2LAF-3	POWER OUTPUT MOD.	SPX-1.5	PAD 1.5 DB
XR2LAF-4	POWER OUTPUT MOD.	SPX-12	PAD 12 DB
XR2LARA	REVERSE AMP MOD.	SSP-12	POWER INSERTER
XR2LS-3	LINE EXT.	STC-12	DIRECTIONAL COUPLER
XR2M	FORWARD MGC MOD.	STC-12C	DIRECTIONAL COUPLER 12DB
XR2PS	POWER SUPPLY	STC-16	DIRECTIONAL COUPLER
XR2RHA110	REVERSE AGC MOD.	STC-3	DIRECTIONAL COUPLER
XR2SPH	HOUSING FOR XR2SP	STC-3B	DATA LINE
XRBI	INTERMEDIATE BRIDGER	STC-3C	DATA LINE
XRCE-3	LINE EXT.	STC-3D	DIRECTIONAL COUPLER 3DB
XRCE-6	LINE EXT.	STC-8	DIRECTIONAL COUPLER
XRDC-16	LINE EXT.	STC-8B	DIRECTIONAL COUPLER 8DB
XRDC-8	LINE EXT.	STC-8C	DIRECTIONAL COUPLER 8DB
XRLA	LINE EXT.	STC-8D	DIRECTIONAL COUPLER 8DB
XRLS-2	LINE EXT.	DCW-06DB	MINITAP 06 DB
XRLS-3	LINE EXT.	DCW-09DB	MINITAP 09 DB
XRPR	POWER SUPPLY	DCW-12DB	MINITAP 12 DB
XRRP	LINE EXT.	DCW-16DB	MINITAP 16 DB
XRSP	LINE EXT.	DCW-20DB	MINITAP 20 DB
N4-S5	TRAP CH. 5	2-14BW	TAP
BPF-B	BAND PASS FILTER CH. 8	2-17BW	TAP
BADC	B.A. DIRECTIONAL COUPLER	2-20BW	TAP
BAEQ-12-1	B.A. EQUALIZER	2-23BW	TAP
BAEQ-3-3	B.A. EQUALIZER	2-26BW	TAP
BAEQ-8-1	B.A. EQUALIZER	4-08BW	TAP
BASP	B.A. SPLITTER	4-14BW	TAP
CSA-300-3	EQUALIZER T4XX	4-26BW	TAP
DISP-3	DISTRIBUTION SPLITTER 3-3	4-32BW	TAP
EQ-450/13	EQUALIZER 450 MHZ 13DB	8-17BW	TAP
EQ-450/15	EQUALIZER 450 MHZ 15DB	8-20BW	TAP
EQ-450/8	EQUALIZER 450 MHZ 8DB	8-26BW	TAP
EQA-1A	EQUALIZER T4XX	8-29BW	TAP
EQA-220-2	EQUALIZER T4XX	8-32BW	TAP
EQA-220-4	EQUALIZER T4XX	EQ-04DB	EQUALIZER 450MHZ
EQA-220-6	EQUALIZER T4XX	EQ-08/250	EQUALIZER
EQS-0	EQUALIZER LAN 0DB	EQ-08/300	EQUALIZER
EQS-186-4	EQUALIZER LAN 4DB	EQ-08DB	EQUALIZER 450 MHZ
EQT-450/10	EQUALIZER 450 MHZ 10DB	EQ-12/300	EQUALIZER
PB-0	PAD 0DB	EQ-15DB	EQUALIZER 450MHZ
PB-1	PAD 1DB	EQ-16DB	EQUALIZER 450MHZ
PB-2	PAD 2DB	EQ-18DB	EQUALIZER 450MHZ
PB-5	PAD 5DB	PCSPL-1	SPLITTER
PB-6	PAD 6DB	PCSPL-2	SPLITTER
PPLUG	POWER PLUG T4XX	PCSPL-3	SPLITTER
DS-200	SPLITTER 2-WAY 3.5 DB	PD-0	PLUG-IN PAD 0DB
DS-300	SPLITTER 3-WAY 5.5 DB	PD-3	PLUG-IN PAD 3DB
DS-3EL	SPLITTER 3-WAY 5.5 DB	PD-6	PLUG-IN PAD 6DB
DS-400	SPLITTER 4-WAY 6.5 DB	PD-9	PLUG-IN PAD 9DB
DS-4GB	SPLITTER 4-WAY 6.5 DB	PPLUG	POWER PLUG
DS-800	SPLITTER 8-WAY 11DB	T4BDC-8	PLUG-IN PAD
FFT4-10D	TAP 4W 10DB	T4BDL-12	PLUG-IN PAD
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Who is the SCTE?

By Ron Hranac
President, Society of Cable Television Engineers

"The (SCTE) membership represents a cross section of the entire cable industry."

The SCTE is well-known in our business for *what* it is—a non-profit professional organization dedicated to the dissemination of operational and technical knowledge to the cable TV and broadband communications industries. The Society uses a number of tools to increase the technical knowledge and skills of its members. Among those tools are its BCT/E Professional Designation Certification Program, the Satellite Tele-Seminar series, the annual Cable-Tec Expo, local chapters and meeting groups, technical seminars, a scholarship and tuition assistance program, and a host of training materials, videotapes and publications available from the Society's headquarters.

But *who* is the SCTE? At first glance, one might assume from the organization's name that its membership consists only of engineers: vice presidents of engineering, corporate engineers, regional engineers and engineers involved in manufacturing/production research and development. In fact, many of these people are members of the Society. But the majority of the SCTE's members are not high-level engineers.

A sizeable portion

It is system-level people who make up a sizeable portion of the SCTE's 5,000+ members. System managers, chief techs, installers, technicians, construction personnel...even system owners are members. From the manufacturers and vendors come sales reps, service and repair technicians, designers and marketing personnel. Consultants and owners of companies are members as well.

What is the point of all this? To show that the SCTE caters to more than just engineers. The membership represents a cross section of the entire cable industry.

Who is the SCTE? It is people like Don Holland, maintenance technician; James Nolan, construction manager; Dave Farren, service tech; Jeff Spiegelman, system manager; Brad Conine, draftsman/designer; Ken Covey, chief tech; and Ben Archuleta, service manager. It is these people and some 5,000 others—the engineers, the technicians and all who comprise the membership of the Society.

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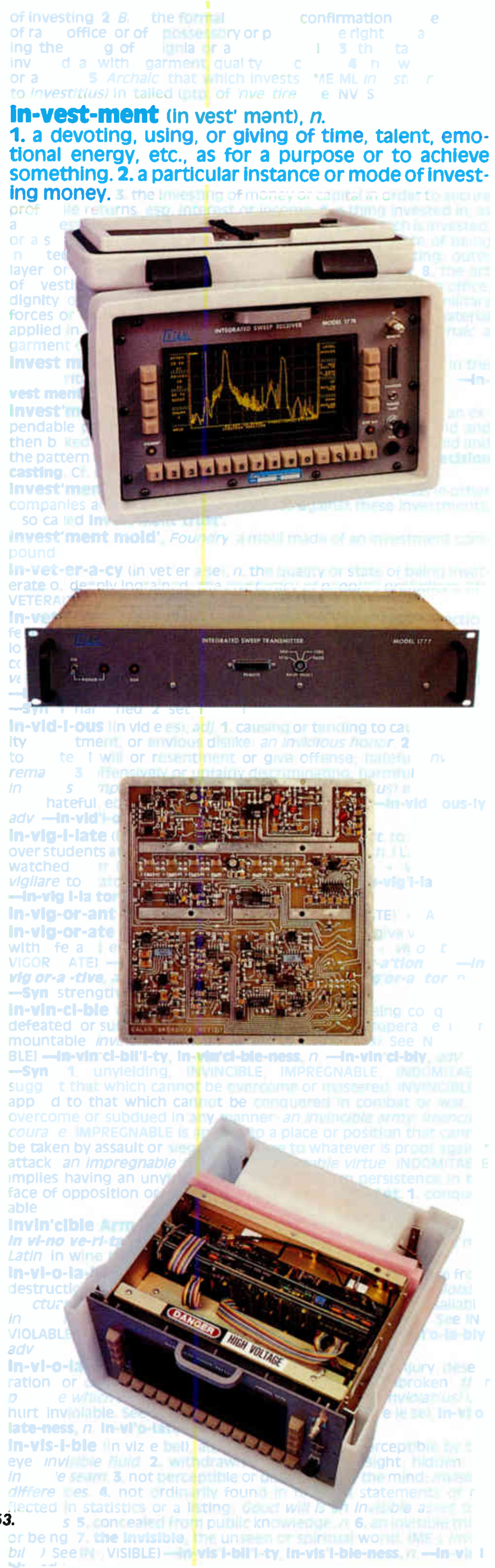


On being young and growing old

By Archer S. Taylor
Senior Vice President of Engineering, Malarkey-Taylor Associates

Several years ago, I called a service technician to restore the cable service that had failed at my house. We got to talking about cable TV—actually, CATV (community antenna TV). I told him how in 1953 we had built the first CATV system in Montana. His reaction suggested the theme for this essay: "That was before I was even born!"

I would suppose that a great majority of the cable technicians working today have had little, if any, experience with vacuum tube amplifiers. What in heaven's name is mutual conductance? What are A, B and C power supplies? What is a 704-B? Or 6AK5?

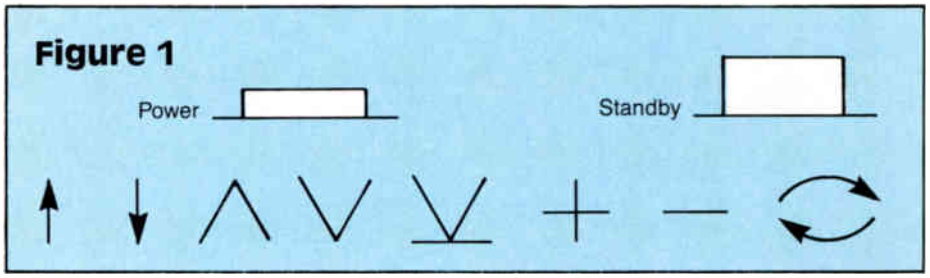
On the other hand, however, there are those of us over 50 who have to think of the transistor base as the grid, the emitter as the cathode and the collector as the plate (or anode). It doesn't quite work that way but the analogy helps. However, the idea of moving "holes" about the landscape leaves us quite bemused.

Fortunately, the need to understand vacuum tubes in this day and age is almost non-existent. And, I am happy to report, most of us grandfatherly types have adopted *solid state* as a second language that we can handle at least as well as Zbigniew Brzezinski handles his second language.

Analog or digital

But there is another problem confronting the generations today. Are you an analog- or a digital-type technician? Analog people think logically (some of us would say) in terms of continuous sound waves and video waveforms that can be observed on an oscilloscope as we think they are in the real world. Digital people on the other hand tend to think rather irrationally (we think) in terms of "bits of information" defining the sound of voices or music, or "pixels" defining a picture image. Analog people are "old"; digital people are "young." When you stop to think about it, though, hearing and vision are based on discrete nerve endings in the ear and discrete rods and cones in the retina of the eye. Maybe the digital concept is after all most logical, more relevant to the physiology of sound and sight.

The explosive pace of technology and the exponentially expanding pool of knowledge have created a serious "generation gap." The most experienced engineers, representing leadership in manufacturing and operations, often depend on younger people for the detail work because their own fluency in solid state and digital physics is weak. It is the younger engineers—who really do not understand analog technology—who are driving the new age with concepts and developments that simply boggle the analog mind.



But while the old vacuum tube- and analog-based engineering leadership has generally been wise enough to hire the skills it lacks in solid-state and digital technology, serious user problems remain. The writing of operator manuals cannot be called a "lost art"; it has never really been mastered. Perhaps this is partly because so much consumer electronic equipment is manufactured by foreigners. Operator manuals are often written in the author's second language. But more to the point, I think, is that operator manuals are probably written by young people who neither recognize nor comprehend the background and experience from which the older user comes. Not only are many people who were born before World War II technologically illiterate, but even those with considerable technical training and skill remain largely unfamiliar with the new digital world of microprocessors.

Consumer electronics products are coming out with new features with which users are often unable to cope. In simpler days, the goal was to make all user-operated controls as nearly self-explanatory as possible. You could turn the radio or television on and off by simply rotating the volume control knob. There was a certain logic to turning the volume (counterclockwise) all the way down to accomplish the off function, which was positively indicated by a physical detent and a click. Now you have a button marked "power/standby" with pictorial symbols as shown in Figure 1. How do you turn it off?

You used to select radio stations by turning a tuning knob. It was not too difficult to use digital push buttons, except that sometimes you have to use two digits (06, 09, etc.) while others will work on one. But now tuning may be indicated by hieroglyphics, such as those in Figure 1. Often, these symbols are not even labeled to distinguish "tuning" from "volume." Sometimes the tuning control is marked "scan." These things are hard for the over 50 crowd to manage.

Operating a VCR is a challenge that defeats many of the older generation and probably even some younger people. Moreover, the new, sophisticated telephones defeat almost everyone (except the system designer). A common factor here is the operator manual that is either incomprehensible or in error or both.

The creativity of young engineers is beautiful to behold. But if the new ideas are worth developing into consumer products, much more attention needs to be directed toward designing functionally logical control mechanisms and preparing comprehensive operator manuals written in language that is understandable to lay people, young and old.

The consumer electronics market today is driven by technology, limited only by the imagination. Not enough consideration is given to the need for gadgets that are technologically feasible, nor to identifying and dealing realistically with possibly dangerous consequences of new products. Seat belts, emission standards, collapsible steering columns and high speed (5 mph) crash bumpers represent belated corrective actions. What about the dangerous diversion of attention inherent in carrying on a cellular telephone conversation while driving in traffic? Is anyone studying the risk of accidents accompanying the handy CRT or LCD map display on the dashboard of a "smart car" advising drivers of alternate routes to bypass construction or traffic bottlenecks? Or how about the infantry rifle or the tanks or the aircraft that are so high tech they tend to fail in adverse conditions (e.g., combat) and, in any case, are too sophisticated for mere soldiers to operate?

Instrument panel

A few months ago, I wrote a column for another trade magazine (*CED*, September 1988) on "The Smart House." I quoted from a column in the *Washington Post* by Jeane Kirkpatrick, a Georgetown University professor and recently U.S. ambassador to the United Nations. "Nothing in philosophy, history, literature or life," she wrote, "prepared us for the array of switches, buttons, flashing lights and peremptory commands that surround us in our new house. Our bedroom wall resembles the instrument panel of a medium-sized commercial airliner." Complaining about incomprehensible instruction manuals and illogical control mechanisms, she continued: "Our bedside table and kitchen cabinets are strewn with instruction manuals offering unfathomable advice and cryptic warnings. 'Never operate the door opener if the safety system is not functioning properly,' a manual warns in red against doing what I think we were just informed was impossible in any case. 'This appliance is manufactured with a white neutral power supply wire and a frame-connected green ground wire,' another owner's manual tells us,

(Continued on page 106)

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February

Feb. 13-14: Georgia Cable Television Association annual convention, Omni International Hotel, Atlanta. Contact (404) 252-4371.
Feb. 14-15: National Cable Television Association seminar on FCC's signal leakage regulations, Airport Hilton, Atlanta. Contact (202) 775-3637.
Feb. 15: SCTE Florida Chapter's South Florida Group technical seminar on system design and powering. Contact Dick Kirn, (813) 924-8541.
Feb. 15: SCTE Greater Chicago Chapter technical seminar on antenna theory and multipath co-channel interference, Embassy Suites, Schaumburg, Ill. Contact Joe Thomas, (312) 362-6110.
Feb. 20-22: Financial Times' Conference on Cable Television and Satellite Broadcasting, Intercontinental Hotel, London. Contact 01-925-2323.
Feb. 21-22: InfoLAN seminar on broadband local area networks, Westin Buckhead Hotel, Atlanta. Contact (800) 526-7469.
Feb. 21-23: C-COR Electronics technical seminar, Charlottesville, Va. Contact Shelley Parker, (800) 233-2267.
Feb. 22: SCTE Great Lakes Chapter technical seminar on transportation systems. Contact Daniel Leith, (313) 549-8288.
Feb. 22-24: Texas Show, Convention Center, San Antonio, Texas. Contact (512) 474-2082.
Feb. 25: SCTE Rocky Mountain Chapter technical seminar on installation troubleshooting, ATC National Training Center, Denver. Contact Rikki Lee, (303) 792-0023.
Feb. 27-March 1: Center for Professional Development course on fiber-optic communications, Arizona State University, Tempe, Ariz. Contact (602) 965-1740.
Feb. 28: SCTE Satellite Tele-Seminar Program, a BCT/E review course on Category VI, 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

March

March 6-10: Military and Government Fiber-Optic and Communications Conference and Exhibition (MFOC '89), Hyatt Crystal City, Washington, D.C. Contact (617) 232-3111.
March 8-9: ComNet Engineering seminar on broadband LANs, Marriott Airport Hotel, Austin, Texas. Contact John Gutierrez, (512) 892-2085.
March 12: SCTE Razorback Chapter technical seminar and BCT/E testing, Convention Center, Hot Springs, Ark. Contact Jim Dickerson, (501) 777-4684.
March 12-14: Louisiana/Arkansas Cable Television Associations' L'Ark Show, Convention Center, Hot Springs, Ark. Contact (501) 724-6273 or (504) 387-5960.
March 14-15: InfoLAN seminar on broadband local area networks, Orrington Hotel, Chicago. Contact (800) 526-7469.
March 18: SCTE Florida Chapter's South Florida Group technical seminar. Contact Dick Kirn, (813) 924-8541.
March 21-23: Magnavox CATV technical seminar, Milwaukee. Contact Amy Haube, (315) 682-9105.
March 21-23: C-COR Electronics technical seminar, Orlando, Fla. Contact Shelley Parker, (800) 233-2267.
March 28-30: Magnavox CATV technical seminar, Minneapolis. Contact Amy Haube, (315) 682-9105.
March 29: SCTE Great Lakes Chapter technical seminar. Contact Daniel Leith, (313) 549-8288.

Planning ahead

May 21-24: NCTA Show, Convention Center, Dallas.
June 15-18: Cable-Tec Expo '89, Orange County Convention Center, Orlando, Fla.
Aug. 27-29: Eastern Show, Atlanta Merchandise Mart, Atlanta.
Sept. 20-22: Great Lakes Expo, Convention Center, Columbus, Ohio.
Oct. 3-5: Atlantic Show, Convention Center, Atlantic City, N.J.
Oct. 17-19: Mid-America Show, Kansas City, Mo.

AD INDEX

Off-air Ch. 2

By Steven I. Biro
President, Biro Engineering

This is the first in a series of maps with technical and program parameter listings for off-air Chs. 2-69, designed to be used when the cable system experiences co-channel interference. With this information, the headend technician can pinpoint the closest (i.e., the most probable) offenders, determine their directions and start the verification process with the rotor-mounted search antenna. Based on the tabulated technical information, the search can be concentrated on the most powerful stations or those that have the highest transmitting antenna towers.

The computer program for the maps was developed and data for the listings was collected by the staff of Biro Engineering, Princeton, N.J. The information is accurate as of Sept. 1, 1988.

Key to listing

Call letters: Ch. 2 station identification

City: Station location or the area served by the station

Network affiliation:

A/C	ABC and CBS programming
C/N	CBS and NBC programming
A/N	ABC and NBC programming
ACN	ABC, CBS and NBC programming
ED	Educational station (PBS)
IND	Independent station
CBC	Canadian Broadcasting Corp.
CTV	Canadian Television Network
TVA	Canadian Independent Programming
SRC	Societe Radio-Canada
SP	Spanish language programming

Power: The effective visual radiated output power (in kilowatts)

Offset: The offset frequency of the station

0	No offset
–	–10 kHz offset
+	+10 kHz offset

HAAT: Transmitting antenna height above average terrain (in feet)

Call letters	City	Network affiliation	Power	Offset	HAAT
WDIQ	Dozier, Ala.	ED	100	–	695
KTUU	Anchorage, Alaska	NBC	100	–	721
KATN	Fairbanks, Alaska	A/N	28	+	45
KNAZ	Flagstaff, Ariz.	NBC	100	0	1540
KETS	Little Rock, Ark.	ED	100	–	1780
KCBS	Los Angeles	CBS	36	0	3650
KTVU	Oakland, Calif.	IND	100	+	1571
KWGN	Denver	IND	100	0	1050
WESH	Daytona Beach, Fla.	NBC	100	–	1650
WPBT	Miami	ED	100	0	930
WSB	Atlanta	ABC	100	0	1036
KHBC	Hilo, Hawaii	IND	2	0	1
KHON	Honolulu	NBC	100	+	60
KBCI	Boise, Idaho	CBS	65	0	2640
WBBM	Chicago	CBS	35	–	1368
WTWO	Terre Haute, Ind.	NBC	100	+	950
KGAN	Cedar Rapids, Iowa	CBS	100	0	1430
KSNC	Great Bend, Kan.	NBC	100	0	970
WBRZ	Baton Rouge, La.	ABC	100	0	1680
WLBZ	Bangor, Maine	NBC	51	–	640
WMAR	Baltimore	NBC	100	+	1000
WGBH	Boston	ED	87	+	1040

Call letters	City	Network affiliation	Power	Offset	HAAT
WJBK	Detroit	CBS	100	+	1000
KTCA	St. Paul, Minn.	ED	100	–	1310
WMAB	Mississippi State, Miss.	ED	100	+	1254
KQTV	St. Joseph, Mo.	ABC	100	–	810
KTVI	St. Louis	ABC	100	0	1085
KTVQ	Billings, Mont.	CBS	100	0	670
KNOP	North Platte, Neb.	NBC	100	–	630
KTVN	Reno, Nev.	CBS	35	0	490
KNMZ	Santa Fe, N.M.	IND	100	+	1970
WGRZ	Buffalo, N.Y.	NBC	100	0	995
WCBS	New York	CBS	21	0	1577
WKTV	Utica, N.Y.	NBC	35	–	1380
WUND	Columbia, N.C.	ED	100	0	992
WFMY	Greensboro, N.C.	CBS	100	–	1842
KXMA	Dickinson, N.D.	CBS	100	+	840
KGFE	Grand Forks, N.D.	ED	100	0	1337
WDTN	Dayton, Ohio	ABC	100	0	1000
KJRH	Tulsa, Okla.	NBC	100	+	1828
KOTI	Klamath Falls, Ore.	NBC	36	–	1050
KATU	Portland, Ore.	ABC	100	0	1560
KDKA	Pittsburgh	CBS	100	–	990
WCBD	Charleston, S.C.	ABC	100	+	1960
KUSD	Vermillion, S.D.	ED	100	+	760
WKRN	Nashville, Tenn.	ABC	100	–	1353
WSJK	Sneedville, Tenn.	ED	100	+	1763
KACV	Amarillo, Texas	ED	100	–	1405
KPRC	Houston	NBC	100	–	1930
KMID	Midland, Texas	ABC	100	–	1052
KUTV	Salt Lake City	NBC	46	–	3060
KREM	Spokane, Wash.	CBS	85	–	2203
WBAY	Green Bay, Wis.	CBS	100	+	1205
KTWO	Casper, Wyo.	NBC	100	+	2000
CFAC	Calgary, Alberta	IND	100	+	989
CKSA	Lloydminster, Alberta	CBC	116	–	780
CBCH	Houston, British Columbia	CBC	1	+	1335
CHCB	Kelowna, British Columbia	CBC	4	0	3000
CKPG	Prince George, British Columbia	CBC	5	0	1082
CBUT	Vancouver, British Columbia	CBC	100	+	1980
CKND	Minnedosa, Manitoba	CTV	100	–	1330
CHBT	Caledonia, Maritime Provinces	CBC	1	+	225
CBIT	Cheticamp, Maritime Provinces	CBC	2		611
CKCW	Moncton, Maritime Provinces	CTV	100	0	1013
CJCH	Sheet Harbor, Maritime Provinces	CTV	2	+	225
CBYT	Bonne Bay, Newfoundland	CBC	2		110
CIII	Bancroft, Ontario	IND	100	+	949
CFCL	Kapuskasing, Ontario	CBC	1	+	363
CFCL	Kearns, Ontario	CBC	27	0	737
CBWF	Kenora, Ontario	CBC	7	+	391
CHBX	Sault Ste. Marie, Ontario	CTV	100	–	600
CKPR	Thunder Bay, Ontario	CBC	56	0	1257
CKCO	Wiarton, Ontario	CTV	100	–	985
CBGA	Carleton, Quebec	CBC	100	–	1540
CHRS	Chicoutimi, Quebec	TVA	1	+	60
CBFT	Montreal	SRC	100	0	900
CHAU	Perce, Quebec	CBC	18	+	1215
CJBR	Rimouski, Quebec	SRC	100	–	986
CBGA	Riviere Au Renard, Quebec	CBC	4	+	720
CBCP	Cypress Hills, Saskatchewan	CBC	7	+	900
CKCK	Regina, Saskatchewan	CTV	100	0	670
CKBQ	Star City, Saskatchewan	CTV	12		490
XHCH	Chihuahua, Mexico	SP	6	–	165
XEPM	Ciudad Juarez, Mexico	SP	10	0	95
XEPM	Juarez, Mexico	SP	6		1150
XHCR	Matamoros, Mexico	SP	4	+	330
XEFB	Monterrey, Mexico	SP	100	+	1000
XEFA	Nogales, Mexico	SP	1	+	5
XEFE	Nuevo Laredo, Mexico	SP	21	0	200
XHIA	Torreon, Mexico	SP	14	+	575
WKAQ	San Juan, Puerto Rico	SP	55	+	2830

Transmitter locations for Ch. 2

Winter Consumer Electronics Show

By Walter S. Ciciora, Ph.D.
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The Electronic Industries Association (EIA) Winter Consumer Electronics Show (WCES) was held in Las Vegas, Nev., Jan. 7-10. This is one of the largest trade shows in the United States, with attendance exceeding 100,000. To the jaded looking for revolutions and breakthroughs and to the simply unobservant, there was once again "nothing new." But to one sensitive to important trends, the dramatic consumer electronics evolution continues with no end in sight.

The sister show takes place this year in Chicago June 3-6. If you've never attended either, you should seriously consider going to the June show. You'll get a sense of what our subscribers will be using.

Home automation

Home automation made its debut at WCES. The EIA has been working on a project to develop a standard for communications between consumer electronics products since 1984. The name of the standard is the Consumer Electronics Bus or CEBus. Five communications media are involved: twisted copper pairs, low-power radio, power line signaling, infrared light links and coaxial cable. These last two are of primary interest to the cable TV industry.

The infrared link standard has the potential of alleviating the remote control problems with consumer electronics. A universal protocol is defined that facilitates the use of any CEBus remote with any CEBus product. When the generation of CEBus products replaces the current stock of customers' units, remote control confusion will be significantly reduced. We should be involved with this work to ensure that pay-per-view, home shopping and other services are accommodated in the infrared link command set.

The coaxial part of CEBus has both advantages and disadvantages for cable TV. From the positive perspective, a properly implemented CEBus coaxial standard could faciliitate subscriber responsibility for in-home wiring. This would save the operator both money and headaches. New subs would be easier to install; cable would be available on nearly every video product in the home. This contributes to making cable TV an indispensable part of the sub's life.

The negative side of this has three aspects. First, if the coax is improperly installed, the danger exists of a contribution to cumulative leakage index (CLI). The hazard also exists of ingress and spurious signals being back-fed into the cable system. While the contribution from each home is small, the total may not be negligible, especially in a high-definition TV (HDTV) environment. Second, revenues from multiple outlets are essentially eliminated except where descrambling is required. Finally, there is a negative consequence to CEBus providing the routing of in-home generated video to other areas of the residence. CEBus accomplishes this by trapping out several channels of the CATV spectrum and replacing them with the subscriber-generated signals. Again, we must be involved to protect our interests.

In addition to CEBus, another organization, Smart House (a project of the National Association of Home Builders) is creating a rival standard.

The Engineering Committee of the National Cable Television Association has been monitoring these developments and is in the process of establishing a special subcommittee to carefully pursue details. Any volunteers? A visit to the Smart House group is planned prior to one of the upcoming meetings.

Improved definition TV

Improved definition TV (IDTV) appeared in several locations at the show. You'll recall that IDTV is a product design technique utilizing extensive digital signal processing in the receiver to minimize the deficiencies of our present television standard, NTSC. The signal being received is ordinary, unmodified NTSC. Most notable of these receivers were in the Philips private suite and the Panasonic booth. Philips is important because it has a product already on sale. Philips has several direct-view (picture tube) models available, the largest being 31 inches. Since demand has outstripped availability, the price has been adjusted upward to near $2,000. The receiver has a built-in demo system that presents a split-screen display. The IDTV mode is shown on the left side and good old NTSC on the right. This is a very effective way of demonstrating the advantages to a would-be buyer.

The Panasonic IDTV receiver was a 70-inch rear projection set not yet available for sale. The picture was truly spectacular and drew a constant crowd. It was bright and viewable from nearly any angle without the usual projection set darkening when viewed off axis. Rumor has it that a 50-inch model will be introduced this year for about $6,000. Buy yours early before it too is out of stock and experiences a price increase.

Both receivers displayed excellent still pictures. Most viewers would say they were watching HDTV except for the old four-by-five aspect ratio. Unfortunately, these sets showed definite motion artifacts. The old NTSC chroma dot crawl appeared on edges that were moving rapidly. A blocky structure also appeared on edges of moving objects. In one case, a forest scene was zoomed. During the zoom, the appearance was that of looking through frosted glass. When the zoom stopped, suddenly the whole picture snapped into a clear image. This was not a pleasing effect. It is possible that these problems will never be overcome since they result from information missing from the NTSC signal. It may not be practical to include sufficient computing power to estimate the information that was never transmitted.

The importance of these products for the CATV business is that they produce great pictures when fed with a quality signal. Superb signals come from videodisc players and high quality VCRs. For those living in strong off-air signal areas that are also free of multipath, broadcast TV can be a source of quality signals. Cable can, of course, provide the best signals. But when it fails to provide quality signals, these receivers will make it painfully obvious. They remove the masking effect older receivers provided for signal imperfections.

A second lesson comes from observing the 70-inch set. It was comfortably viewed from less than two times picture height. With that large of a screen, moving objects are tracked by the eye. The strategy of letting moving objects have lower resolution as a bandwidth-saving mechanism fails. This may have important consequences as cable competes with prerecorded media and digitally delivered video over fiber. This is particularly important when the era of truly large screens is upon us.

Next month we'll discuss a couple of other important subjects from the WCES. These will include HDTV, universal remote controls and the further digitization of consumer products.

Taylor's Vantage

(Continued from page 98)

as though we cared to know."

Doesn't anybody know (and respect) Murphy's famous law? Don't the high tech manufacturers ever ask: "How could the user have trouble making this product work properly?" Maybe they do but simply do not know how to make the operation easy and obvious under the conditions in which it is most likely to be used.

Recently, however, I have begun to wonder. Children learn so easily how to use a computer (as well as another language). They could adjust the controls on a color TV set (fine tuning, brightness, contrast, color, hue) much better than adults. They can figure out the VCRs without even reading the manual. Could it be that what seems illogical and irrational to the over 50 crowd may be just ordinary common sense to those who will not be over 50 for several decades? Will they, in turn, wonder what their children are doing with quarks and solitons? Are we doomed to comprehend less and less about more and more? Or can the under 50 set find ways to bridge the generation gap with user manuals and operational controls that communicate in the language and experience of the over 50 set?

Reader Service Number 55.

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