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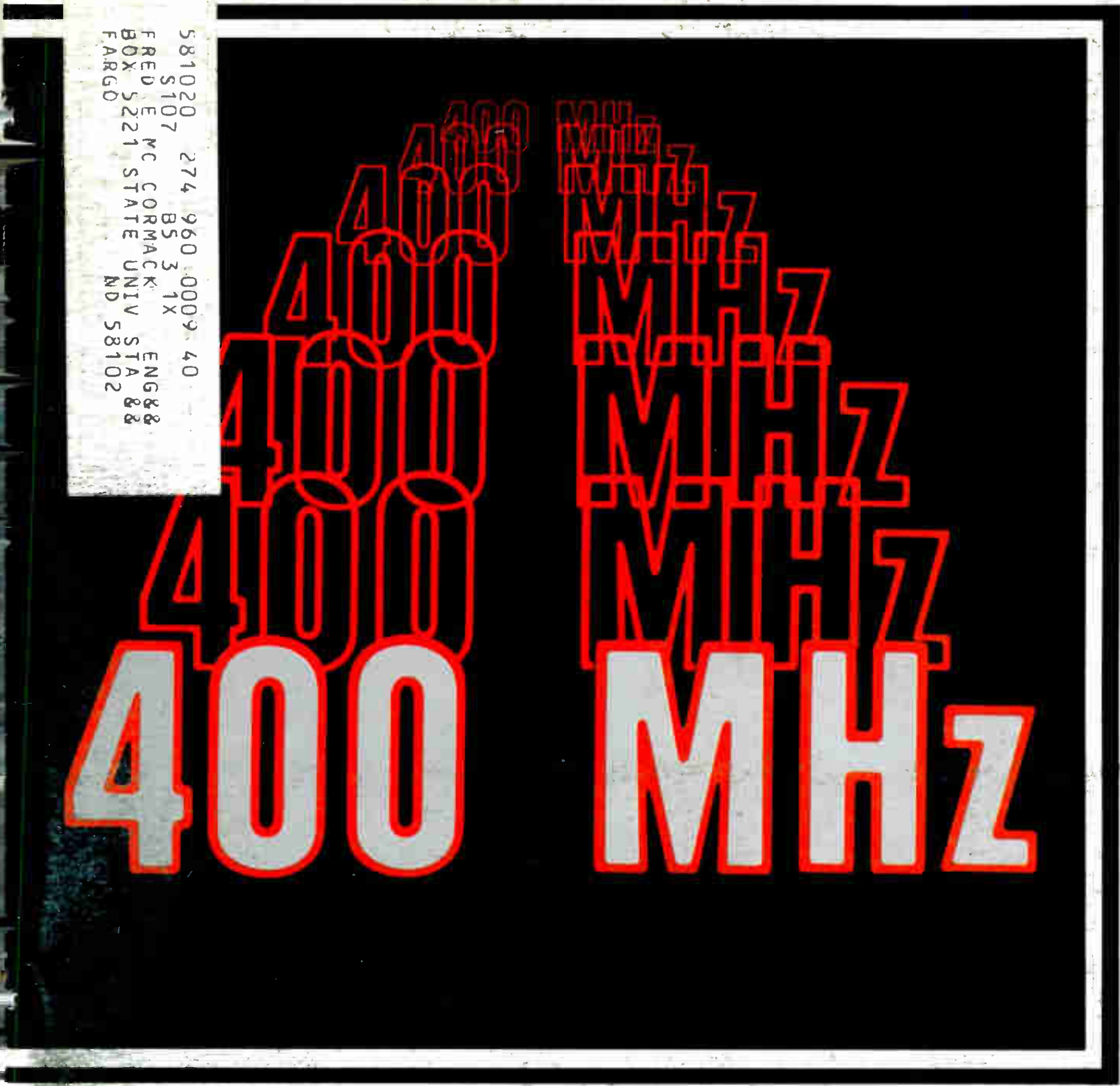
NCTA Convention Issue

400 MHz
CNN Profile
Fiber Optic Link

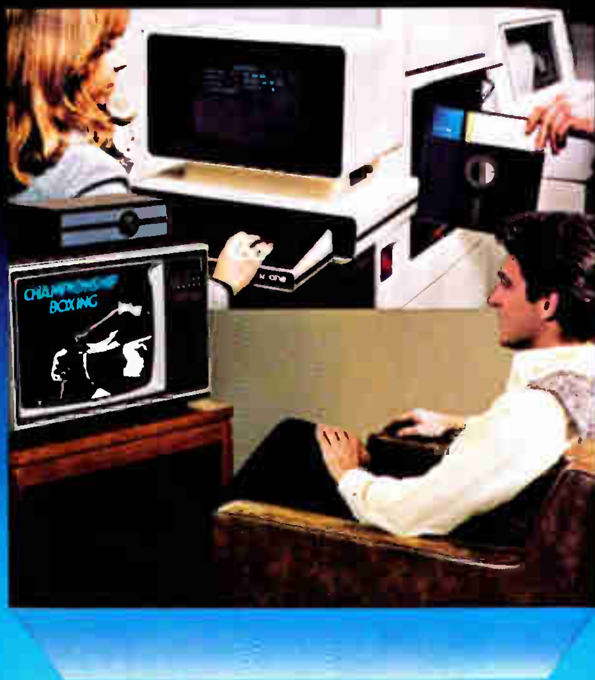


Communications-Engineering Digest
Reporting the Technologies of Broadband Engineering

June 1980
Volume 6, No. 6

TotalControl

TotalControl



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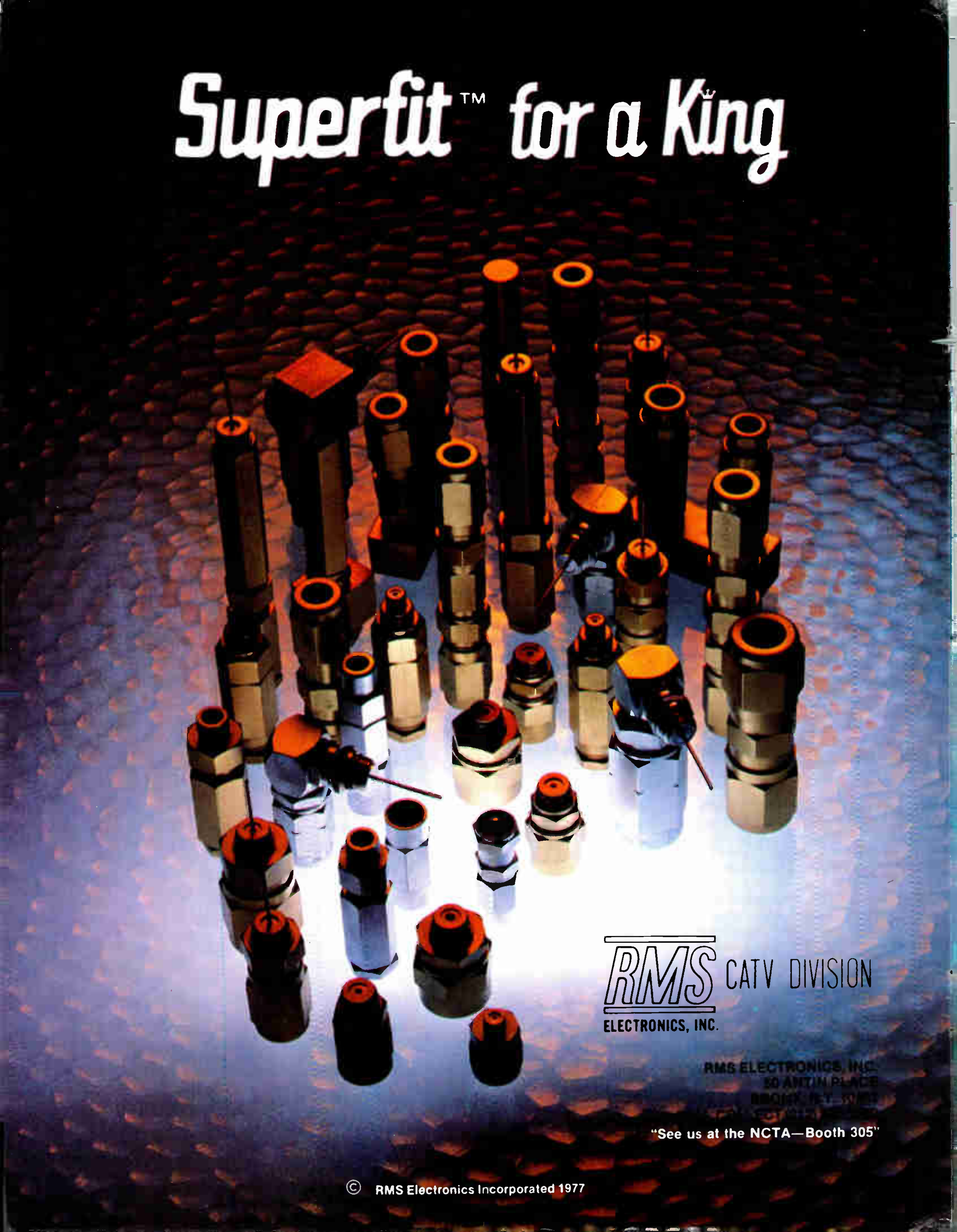
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C-ED News at a Glance

WASHINGTON, D.C.—**Valtec Corporation of West Boylston, Massachusetts, has installed a fiberoptic video and audio transmission system here to serve as part of a communications link between the U.S. Congress and cable television subscribers across the country.** The VS-100 fiberoptic system and 1.3 kilometers of fiberoptic cable used in the link were supplied by Valtec to the Cable Satellite Public Affairs Network. C-SPAN, with technical and installation support from local Arlington Telecommunications Corporation, provides more than 750 cable operators and their subscribers with public affairs programming from the nation's capitol. Valtec's three channel audio/video transmitter is set up at the House Radio and TV Gallery. Fiberoptic cable links the Gallery to the Capitol Power Plant Building through an underground steam tunnel connecting the buildings. At the power plant, a microwave transmitter picks up the signal from the fiberoptic receiver and transmits it to ARTEC's headend in Arlington, Virginia, and it is then microwaved another seven miles out to C-SPAN's satellite transmitter in Fairfax County, Virginia.

WASHINGTON, D.C.—In a further effort to stimulate competition in the provision of international telecommunications service, the **FCC has begun a rulemaking proposing to allow consumers** of international satellite communications services **to obtain service directly from the Communications Satellite Corporation (Comsat) without going through the American Telephone and Telegraph Company (AT&T) or the International Record Carriers (IRCs).**

The Commission said that it believed permitting Comsat to enter the retail market would actually further the express goals of the 1962 Communications Satellite Act in that it would be responsive to public needs, would maintain and strengthen competition, and more readily permit the realization of quality service at lower costs.

WASHINGTON, D.C.—**The FCC has determined that Satellite Business Systems (SBS) does not have to redesign its satellites to have the capability of providing direct service to the offshore points of Alaska, Puerto Rico and Hawaii.**

In 1977 the Commission authorized SBS to construct a new domestic satellite system to provide switched, private-line communications networks subject to a subsequent determination as to whether it should be required to redesign its satellites to provide direct service to those three areas.

In its application SBS proposed to provide direct service only to the 48 contiguous states, with service available to Alaska, Puerto Rico and Hawaii through interconnection with other carriers.

The Commission said it could not find that the public interest required that it order SBS to develop its proposed satellite system with the technical capability serve all 50 states and Puerto Rico. The Commission said one of its initial concerns in the early development of domestic satellite service was that the benefits of domestic satellite technology be made available to all 50 states. It said the Satcom, Westar and Comstar systems all have the capability of providing 50 states with a wide variety of domestic satellite service.

The Commission said it did not believe, however, that in the development of more specialized satellite services, the public interest was served by compelling carriers to design facilities to offer those services directly in markets where thery perceive insufficient demand for them.

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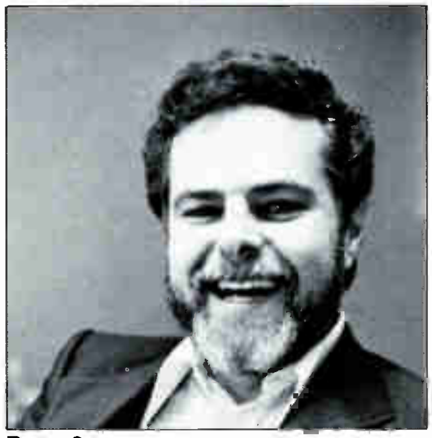

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FEATURES

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Editor's Letter

The Cable News Network—unquestionably one of the most ambitious news-gathering endeavors in history—is scheduled to begin service June 1, utilizing transponder 14 of Satcom I. This issue of C-ED carries two features directly related to this start-up: the CNN Profile on page 28, by Executive Editor Gary Witt, and a feature on page 63 by Washington Bureau Chief Pat Gushman on Satcom I, Comstar, and the hassle over transponders.

In addition, this special NCTA Convention issue contains an entire section devoted to system design. Bill Grant, Tom Polis, and Doug Adams each have provided articles on various design aspects, both practical and theoretical.

Also in this issue is an exceptional article by Bob Dickinson of E-Com Corporation on the role of data transmission vis-a-vis the cable industry. Bob has come through with a primer on data transmission theory, terminology, and application.

As a resource guide for information on a variety of technical fields, C-ED sets out the technical paper abstracts presented to the NCTA Engineering Committee for the National Show.

And, last but by no means least, our cover story on 400 MHz explores in-depth some vital considerations relevant to the shift to expanded bandwidth.

Paul A. FitzPatrick

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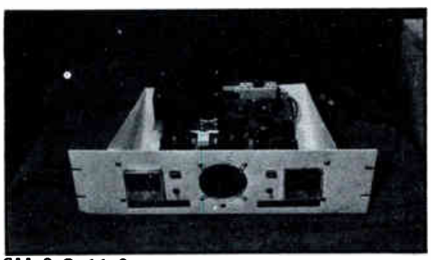

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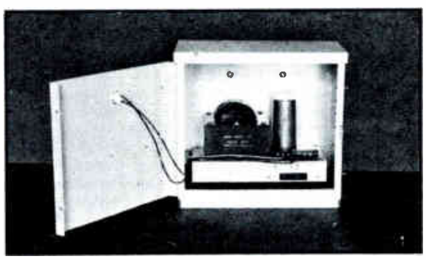

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SCTE: Present, Past, and Future

The SCTE is clearly one of the fastest-growing organizations within the cable industry. This month, *C-ED* presents an exclusive interview with SCTE President Larry Dolan and Executive Vice President Judy Baer.

C-ED: What is it about SCTE that makes it so unique?

Baer: What we are about, more than anything else, is trying to deliver information. We are trying to get it to the person who needs it, in such a manner that he can understand it and make use of it.

Dolan: In doing so, we are developing programs at many more different levels, from basic electricity to very complex, deep and heavy technical subjects, as well as everything in between. We have two meetings a year which are very technical and require a higher level of understanding. Other meetings are geared more toward the middle level of understanding. And I would say that we even need to get a little more into basics if we are to provide information for all of the members.

Baer: It is an amazing experience to see a vice president of engineering from a publicly held, very large, top-ten MSO organization come into one of our meetings and sit next to a kid in Levis who may have been in the industry barely a year. At our meetings and within our organization, everyone is equal. The kid is there to learn, and so is the vice president of engineering. For the vice president, it may be just a refresher. That happens all of the time. But we will also be developing an engineering institute program along the lines of a four or five day, closed, small group session with maybe 20 or 25 people attending. These vice presidents may be members of IEEE and SMPTE and they are all tops in their profession. But, no one has really provided them with a place to go and expand their horizons. They don't want to just stand around and talk to each other. We already do that all of the time. Meanwhile, our other programs and publications will assist those at the other end of the spectrum in growing and learning.

C-ED: What does management think of your efforts?

Dolan: You can get many different opinions on what SCTE is all about depending on who you ask, because it is an individual membership organization. The members belong as individuals, not as companies like in the trade associations. You have to be a company to join the other organizations. And that's not necessarily true with the SCTE. I'd be willing to wager that eighty percent of our members work for companies that belong to one of the other trade organizations.

Baer: Yes. And at this point, eighty percent of our members' dues are paid by the companies they are employed by. That is quite a change from three years ago when eighty percent of the dues were paid individually by the members.

Dolan: That would be a good indication that the top management must have identified benefit from participation.

Baer: What is heartening is that the management in this industry trusts us now. And when I use the word "trust" I mean that all of the suspicions about SCTE being a union or a guild or whatever have been dispelled. We don't hear discussions about that anymore. There is correspondence sitting on my desk right now from a couple of the major MSOs on doing cooperative trainiong programs with each other, including the production of video-taped programs with us. We have worked hard to gain that trust. And one of the most difficult and greatest responsibilities we have is that we don't blow that trust.

C-ED: Is training the main or only mission?

Baer: If you read the by-laws of SCTE, our mission is to promote this technology. And that remains very valid. In learning more about association management and no longer considering myself to be in the cable industry, I have learned that there are two different kinds of professional societies.

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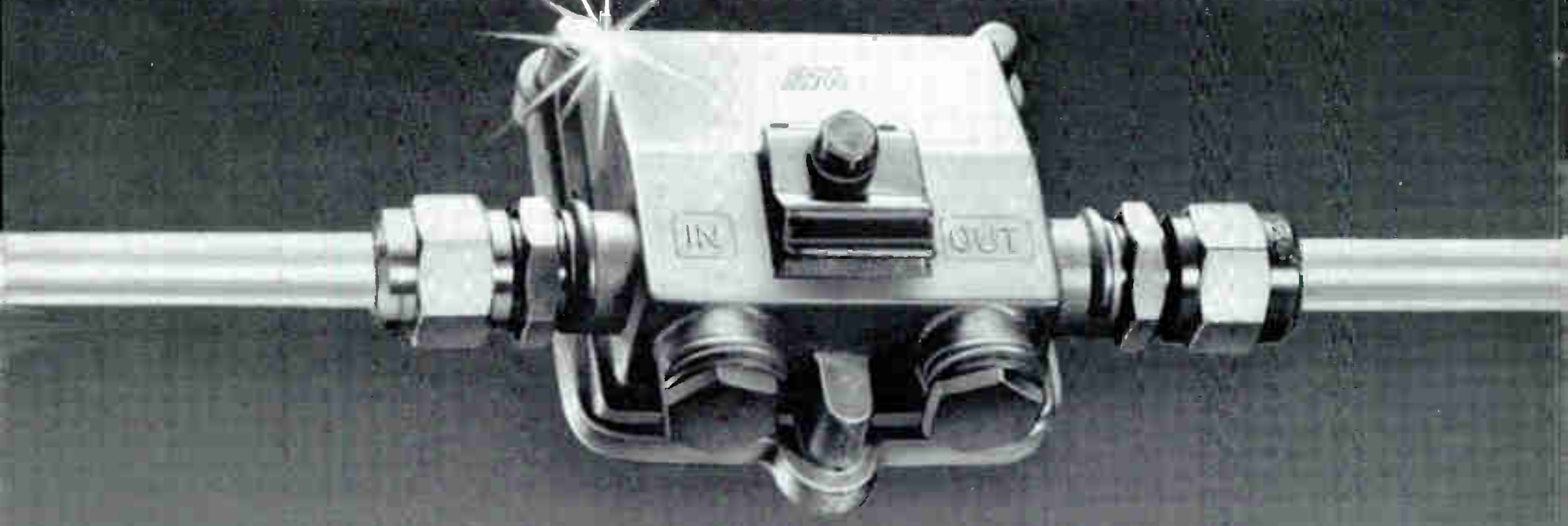

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There is a professional society of doctors or attorneys or CPAs in which everybody has reached a particular level in their profession and they are accredited and registered or validated as such. And the membership of that society is exclusive only to CPAs or attorneys, as opposed to a professional society which is a group of people promoting a profession, promoting an industry. And we are, I believe, promoting a profession, promoting an industry. And certainly, if you are doing that right then your membership is growing and benefiting. So basically, our mission is management development, it's training, it's education. Under the tax laws we are able to lobby; but we don't lobby. That is not our style right now. It may be that three years from now, we might respond to a rulemaking before the FCC. But our members are already vitally involved with committees of the other organizations that do lobby.

C-ED: So your meetings are not limited to playing with widgets.

Baer: We have hosted meetings which have been totally on manpower training and development. We have hosted meetings on communication, how to make slides, how to give a speech, how to communicate. You can be the most brilliant engineer in the world, but if you can't communicate that brilliance, you are stifled. You have no place to go if nobody can understand you.

Dolan: If you have a technical problem that requires money to resolve, if you need more equipment or if you need to rebuild something, you are going to have to be able to communicate that to whoever is paying the bills. And many of our members are just beginning to realize that.

Baer: This is an industry that is based on electronics for its delivery and distribution system. Without the technology, I don't care how much programming everybody gets into. You won't even have a delivery system if you don't pay attention to the management of that technology. And that most certainly includes engineering.

C-ED: What kind of revenues does it take to accomplish all of this?

Dolan: Revenues might not be the most important element here. Dues are a very small part of what makes SCTE work.

Baer: Dues are 22 percent of our revenues.

Dolan: If you really look at the budget, it doesn't give you the whole picture. The income doesn't really show the full extent of our activity, because it's a membership organization, a volunteer organization—people donate their time. Like the series of training tapes we just produced. All of those people donated their time and they brought in the equipment. We had more than a thousand dollars worth of equipment sitting in the studio being tested and demonstrated and all of the theory explained. Members donate their time and then they show their support by paying for the additional services they want. When people go to the regional meetings, they pay to attend. When they want a training tape, they pay for the training tape. That's why the dues are so low.

C-ED: What is the potential of SCTE?

Baer: There is no doubt about it. We are going to be around for a long time. Because of the growth and successes we have already had and because of the press we have received, the Board asked me what I thought the potential might be. We have thought about it, and researched it, and I think a valid answer is about 25,000 people.

C-ED: In what time frame?

Baer: By the end of this year I bet we have close to five thousand members. The members we have now are doing a marvelous job of promoting the organization and helping us gain that trust of management that I mentioned. But it could take five years, at a minimum, to reach that goal of 25,000.

C-ED: Larry, when did SCTE become more than Judy Baer who has been so closely associated with it over the years?

Dolan: The organization changed last year. And to do that, two things had to happen. The organization gained a little bit of financial strength and then Judy was able to start hiring professionals to manage some of the areas we wanted to move into. Several years ago, it was just Judy dragging everyone along kicking and screaming. All the while, she was building an organization, so it wasn't just a matter of revenues. And it is not just the professional staff here in Washington. It's the organization of members all over the country. It's a board of directors with responsibilities. It's appointing committee chairmen for different areas and saying this is your job; get it done. Bob Tenten in New York is putting together rules for our senior member classification. How do you become a senior member? What should be the requirements? Information on this will be coming in from all over the country and then the Board will say, "Yes, we'll go with that," or "Let's change this a little." Then they will vote and it will come back to the staff to implement the program. I hear from the staff, Susan Queeney and Jane Rudden, as much as I hear from Judy. And, we are sometimes asked why we don't have an engineer on the staff. But our staff is like a doctor who is a G.P. You can't take an engineer and expect him to know everything either. SCTE is like a group of specialists. It's like a computer bank. Give us a technical problem, and we can, very quickly, give you two or three names that are the very best and most knowledgeable people in the country on that particular subject. And that is exactly the role we wish to play. **C-ED**

Coax, Fiber Optics, to be Examined at SCTE Seminar

SCTE's upcoming seminar, Coaxial Cable or Fiber Optics? is an intensive, two-day session devoted to exploring every aspect of the issue. The seminar will be held July 14-15 in Wichita, Kansas.

The first day's general session, *Coaxial Cable Properties*, will be led by the University of Alabama's Dr. Bill Webb. After the general session, the manufacturers of coaxial will be on hand to lead individual breakout sessions.

Topics and speakers for the coax breakout sessions include: "Purchasing," Roger Dulude, Essex Group; "Handling," Larry Nelson, Comm/Scope; "Inventory," John Kaye, General Cable; "Storage," Dean Taylor, Systems Communication Cable; "Testing," Glen Grosser, Belden Corporation; "Construction/Sag & Stress," Rex Porter, Times Wire & Cable; and "Supply Capabilities," Duane Christ, CCS Hatfield.

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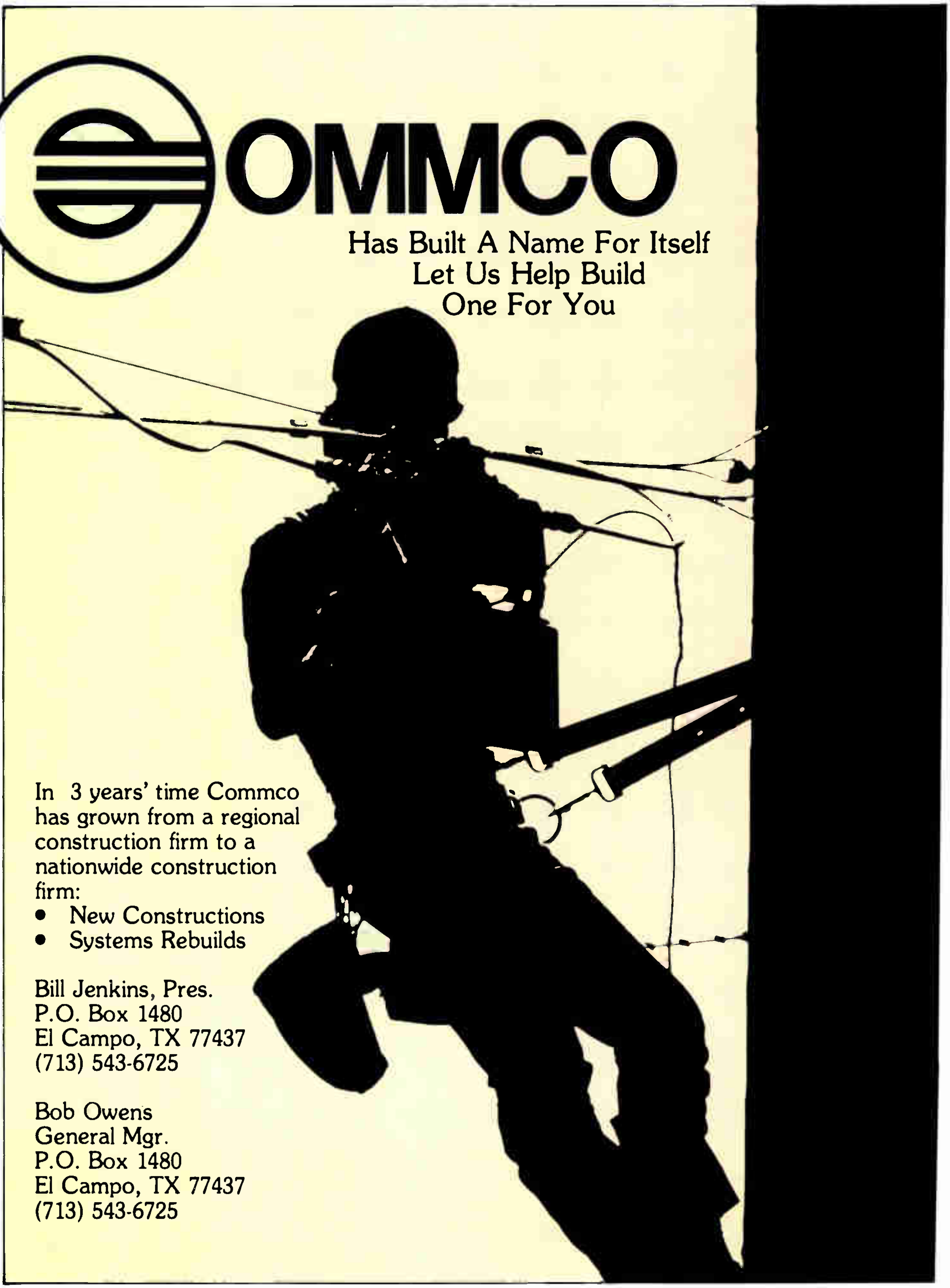
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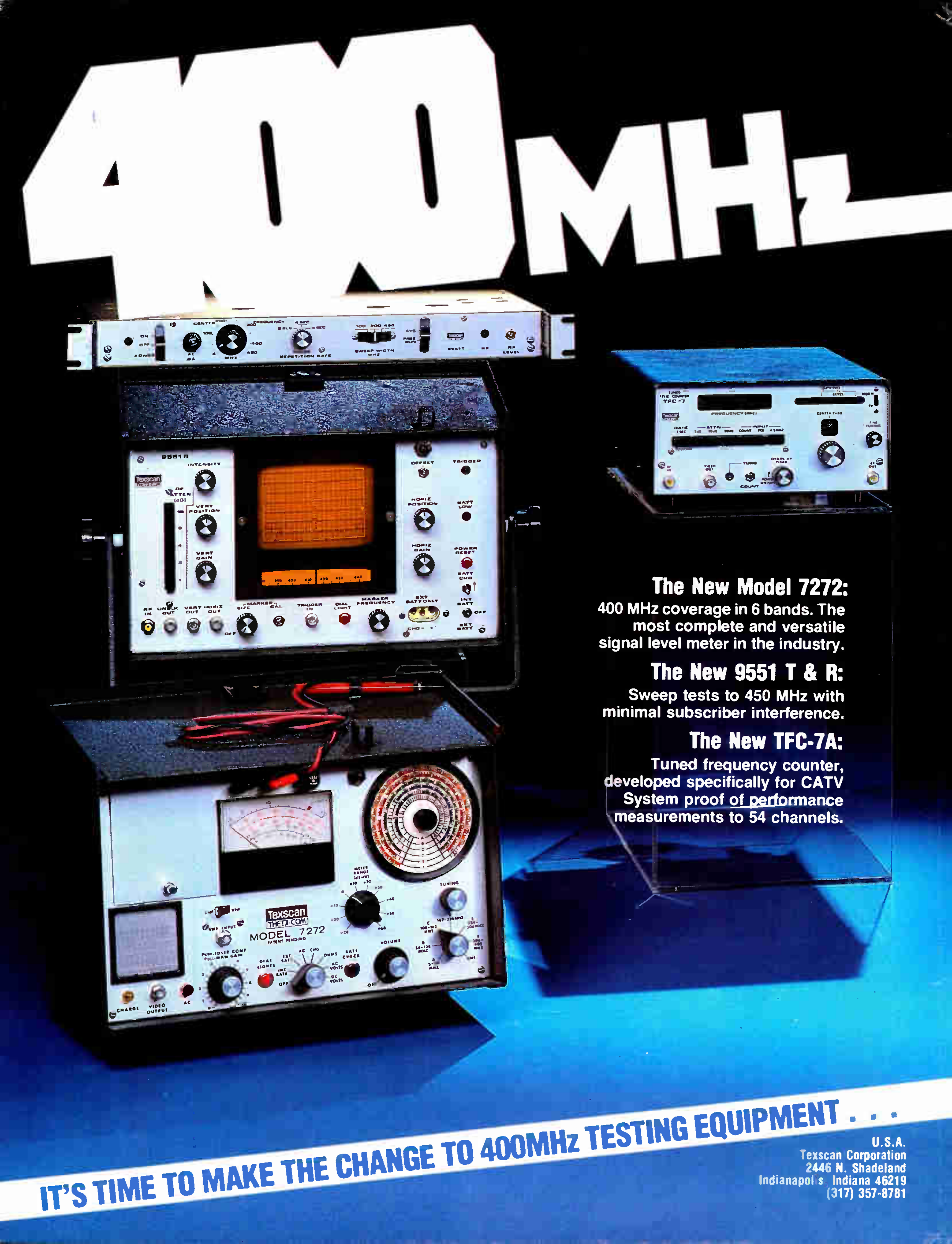
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George Fenwick, vice president, Katek, and technician Bob Prochaska.

Video production unit in use for SCTE's videotape materials.

SCTE Completes Video Production

WASHINGTON, D.C.—The Society of Cable Television Engineers has announced the completion of production on 12 new educational print, studio cassette and video tape projects.

The 1980 line of informational and training materials includes 10 color video tapes, one studio cassette and one printed release. The subjects range from teletext and viewdata to manpower and safe and proper pole climbing techniques.

"This represents a wide range of information with something here for everybody," according to SCTE president Larry Dolan. SCTE plans to release a minimum of twenty 30-minute tapes during the coming year to complement its schedule of eight regional meetings and two engineering conferences.

The concept, development and production of this current group of educational materials was coordinated by SCTE executive vice president, Judith Baer and Susan Queeney, SCTE director of publications and public relations. All the videotapes were produced under professional studio conditions and feature well-known experts from the society's membership.

"The staff set an ambitious goal for 1980," says Dolan. "In the first four months of the year, they have staged four successful meetings, coordinated speakers for all SCTE programs for the balance of the year and met their goals on publications and taped training materials. I am quite impressed with their accomplishments."

FCC Rejects Program Logging Requirements

WASHINGTON, D.C.—The FCC has denied the United Church of Christ (UCC) reconsideration of the August 1, 1979 action in which the FCC decided not to adopt program logging requirements for cable television system operators and terminated the proceeding. The FCC had based its August 1 decision on the fact that both mandatory origination and access requirements had been eliminated and the logging requirements would be burdensome to the industry without remunerative value to the FCC or the public.

In seeking reconsideration, UCC contended that the Commission's action predetermined the merits of UCC's rulemaking petition seeking local origination requirements for cable television systems. It also requested that the FCC stay termination of this docket since no oppositions had been filed to its rulemaking petition. UCC argued that the lack of opposition indicated that cable operators were not concerned about the pendancy of the proceeding in the absense of existing access or origination requirements.

The Commission said UCC had not presented any reason to alter the August 1 action. It said the rulemaking petition would be considered as a separate issue, adding that the fact remains that no origination requirement now exists which would necessitate the imposition of program log requirements. It stated that its decision did not preclude future actions necessary with respect to new rules or changes in policy.

It said it would be making some decisions with respect to a cable television program requirement in connection with UCC's rulemaking petition adding that local authorities also might be making decisions on this point. However, it said it did not believe that adoption of a program logging requirement was either necessary or appropriate for obtaining information to resolve that question.

Therefore, it denied UCC's petition and terminated the proceeding.

CableVision Magazine Moves to Weekly Frequency Beginning in July

DENVER, COLORADO—**CableVision** magazine, the leading industry trade journal for cable television and related businesses, will begin weekly publication in July. The magazine, published as a bi-weekly since its introduction in 1975, will now be published every Monday.

"The weekly frequency will allow our editors to provide readers with the most up-to-the-minute news possible on the ever-changing and increasingly complex cable television industry," said Robert Titsch, president of Titsch Publishing, Inc. (TPI), publisher of **CableVision**. "In addition," Titsch continued, "the weekly frequency qualifies **CableVision** for preferential treatment with the U.S. Postal Service, thus allowing **CableVision** subscribers to receive their magazines on a more timely basis."

Titsch also announced that the circulation of the magazine will be increased substantially, effective in July.

"The change to weekly publication of **CableVision** is a reflection of the dramatic impact that cable TV is having on communications in this country," Paul FitzPatrick, executive vice president and editor-in-chief, said. "Cable television is a growth industry that is completely altering the face of broadcasting and communications in general. And **CableVision** will grow with this dynamic business."

FCC Recommends Changes in Comsat Corporate Structure

WASHINGTON, D.C.—The FCC has adopted a Report to Congress on the structure and activities of the Communications Satellite Corporation (Comsat). The report examines the consequences of Comsat's increasing diversification into non-INTELSAT/INMARSAT businesses, and recommends certain changes in Comsat's corporate structure and accounting system and in current arrangements for governmental oversight of the corporation's activities.

The commission stated its intent to begin a rulemaking looking toward requiring Comsat to form separate corporate entities for its INTELSAT/INMARSAT related functions, on the one hand, and its other, more competitive businesses, on the other—i.e., domestic satellite service, product marketing and sales, technical and consulting services, etc.

Moreover, as a result of the analysis undertaken in preparing the Report, the Commission also indicated that it would modify its Comsat facilities application processing procedures, would modify its "unauthorized user" policy, and would modify the resale and sharing of international services. (The latter two proposals were adopted by the commission in separate decisions.)

Further, the commission said it would take steps to encourage joint action by the Department of State, the National Telecommunications and Information Administration and the FCC to revise the "instructional process" by which Comsat's position in INTELSAT/INMARSAT is determined.

Specifying matters which it concluded were amenable to legislative action, the commission recommended to Congress that the 1962 Communications Satellite Act be amended to authorize U.S. government representation on Comsat's delegations to INTELSAT and INMARSAT.

It also recommended that the Satellite Act be amended in several other areas, including clearly defining the scope of Comsat's authority to permit the corporation to engage in non-INTELSAT/INMARSAT business subject to controls imposed by the FCC; authorizing the President to issue instructions to Comsat necessary to ensure that its relationships and activities with foreign governments, international entities and INTELSAT are consistent with the national interest and U.S. foreign policy; authorizing the FCC to make recommendations to the President to assist him in giving instructions to Comsat; and authorizing the FCC to issue instructions to Comsat on regulatory matters within the commission's jurisdiction.

This report was to be transmitted to Congress on or before May 1, 1980.

In the final report the commission acknowledged that the global satellite system envisioned by the 1962 Satellite Act has been successfully established and that Comsat's role therein, although still significant, was diminishing. It also noted the changes that have occurred in the satellite telecommunications field since the time of Comsat's creation, and the fact that Comsat is embarking on an effort to diversify its activities significantly into non-INTELSAT/INMARSAT lines of business and to exploit its corporate technology and expertise by expanding its business horizons.

As a matter of policy, the commission said it did not believe that Comsat should be foreclosed from applying its corporate technology and expertise to the development of new lines of business as contributing to the overall development of satellite communications technology, and in the public interest.

Concerning Comsat's scope of authority, the FCC indicated that Comsat is permitted under the 1962 Satellite Act to engage in activities not inconsistent with its statutory mission. However, the FCC stated that Comsat's scope of authority would likely remain controversial and recommended that the 1962 Act be amended to clearly define the extent to which Comsat may engage in non-INTELSAT/INMARSAT activities.

The commission said Comsat's involvement in certain non-INTELSAT/INMARSAT lines of business posed certain problems with respect to its statutory duties and obligations. These problems will occur whenever the outcome of a matter before INTELSAT or INMARSAT will have a direct or indirect financial effect on a non-INTELSAT/INMARSAT activity or interest which Comsat or one of its subsidiaries has undertaken or in which it plans to become involved.

The commission said it also found that Comsat's unique INTELSAT/INMARSAT roles provided the corporation with the opportunity to gain advantages over U.S. competitors in the markets in which it seeks to participate. It also said that Comsat's involvement in non-INTELSAT/INMARSAT lines of business would increasingly provide the corporation with opportunities to evade rate regulation by shifting common costs incurred in the unregulated sector to the regulated

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sector.

Finally, the commission said current statutory, structural and government oversight safeguards were inadequate to protect the public interest from the problems which could result from Comsat's changing role.

In proposing that Comsat be separated into two distinct corporate elements, the commission said interlocking directors would be permitted between the two, but it would require separate officers, facilities, advertising and marketing, records and books of accounts, procurement, and operating personnel.

Integrated operations between the two corporations in the use of high technology facilities and professional resources would be permitted, subject to specific controls to minimize Comsat's opportunity to evade rate regulation through misallocation of costs and to discourage it from using its unique INTELSAT/INMARSAT roles to maintain exclusive access to and use of technology and information in order to improve its position in competitive markets. Dealings between the two corporations in connection with research and development and technology subject to competitive bidding.

Resale and Shared Use of International Communications Services Proposed

WASHINGTON, D.C.—In a further action to encourage development of the telecommunications market structure in a manner which increases efficiency in the utilization of services and facilities, gives rise to greater consumer choice and more diverse service offerings, and causes rates to become more closely aligned with the underlying cost of providing service, the FCC has proposed removing all restrictions on the resale and shared use of international telecommunications services.

Resale allows an entity to subscribe to communications services and facilities and resell them (with or without adding service innovations) to the public for profit. Shared use is a non-profit arrangement under which several entities collectively use communications services and facilities, with each user paying a pro rata share of the cost.

The commission noted that in 1976, it required domestic carriers to eliminate restrictions on resale and shared use from their private line tariffs, adding that earlier this year, it had begun a proceeding to consider the question of whether resale and shared use restrictions should be removed from domestic public switched network services tariffs.

In proposing to eliminate all resale and shared use restrictions on international services and allowing the production and pricing of services to be determined through market rather than regulatory activities to the greatest extent possible, the FCC noted that the primary impact on international services would be the reduction of price discrimination.

It said entry of resale and sharing would influence the international telecommunications market in two significant areas: increasing the number of firms and services from which telecommunications users may choose; and developing more innovative uses of basic services.

As a result, the FCC said firms supplying telecommunications services would be under increased pressure to accept a competitive rate of return on investment, adding that the marketplace method for achieving cost-based pricing of services was more effective and desirable than attempts by the commission to review cost studies generated by the carriers.

The commission said it recognized that the services which would become subject to resale and sharing were governed by operating agreements between the U.S. carriers and their foreign correspondents, and that these correspondents were in a position to either facilitate or impede the resale and sharing of service.

FCC Affirms Ruling That Cable Systems Are Not Required to Carry Pay TV Programming

WASHINGTON, D.C.—The commission has affirmed its 1978 decision declining adoption of rules to require cable television systems to carry the scrambled (pay) programming of local subscription television (STV) stations. It denied a petition by Blonder-Tongue Laboratories for rulemaking to make such carriage mandatory, and a petition by Suburban Broadcasting Corporation for a declatory ruling that such carriage is already required.

In a separate, but related action, the FCC editorially amended Part 76 of its rules to clarify that the cable TV signal carriage rules were not intended and do not require cable systems to carry pay programs broadcast by local subscription TV stations.

Blonder-Tongue and those supporting the petition contended that cable carriage of STV signals was critical to the effective integration of STV into the total television system; carriage would benefit TV viewers by contributing to the economic support of the STV stations; and carriage would benefit cable subscribers by providing additional program diversity and creating competition among cable distributed STV programming services.

While the argument that cable carriage would promote competition between broadcast and cable STV services clearly presented a desirable objective, the FCC noted that competition between the two delivery modes currently exists without any mandatory cable carriage requirement. The FCC noted that the carriage of STV programming, because it is a scrambled transmission, would impose burdens on the cable operator not associated with the carriage of conventional stations. Further, in contrast to conventional station carriage where service is available to all subscribers, STV would be purchased only by a fraction of the total although all subscribers would be required to bear the cost of carriage either in terms of higher regular subscription fees, lost opportunities for alternative service or both.

Concerning whether a mandatory carriage requirement would foster competition among STV services, the FCC noted that it did not appear that cable subscribership created any substantial technical barrier to off-the-air STV reception, adding that the public would benefit from competition of a type regardless of cable carriage.

Regarding the request for a ruling that the rules now require carriage of all local television broadcast stations without the scrambled STV programming being excluded, the commission noted it has publicly, clearly and consistently stated that cable carriage of the scrambled programming of STV stations is not required.

However, since the rules do not explicitly exclude such signals from those whose carriage is required, it said it would issue a separate order stating that carriage of local STV programming was not mandatory.

The effective date will be announced later.

From Washington

Commissioner Calls for Amendments to Communications Act

By Pat Gushman

While many officials here, including House Communications Subcommittee Chairman Lionel Van Deerlin (D-CA), believe the FCC's recent decision (which restructures the domestic telecommunications industry as a result of the FCC's Second Computer Inquiry) obfuscates the need for a rewrite of the Communications Act, Commissioner Tyrone Brown says the FCC has an immediate need for targeted amendments to that act in order to assist it in carrying out its mandate. And, he says, he can't emphasize this strongly enough.

"We at the Commission are not blinded by pride of authorship, at least on these matters," Brown said at the eighth annual Telecommunications Policy Research Conference at Annapolis, Maryland, late last month. "We would welcome, and as a practical matter we need, specific legislative responses to resolve uncertainty that otherwise will result in years of litigation over our recent decisions. To this end, I still hope that Congress, at a minimum, can take steps this year to clear up that uncertainty."

Brown points out that those who have felt the negative impact of the Commission's "innovative interpretations of the 1934 Act" are not hesitating to challenge the Commission in the courts, particularly in the international sphere where actions have also grown out of the same basic philosophy that to the extent possible competition should rule the day. In fact, competition is the first tenet Brown hopes the Congress could codify before time runs out this year.

Here are his four recommendations for a "minimum, much needed legislative package":

"First, I believe the Communications Act should be amended to include a broad policy statement which recognizes that competition is to be the preferred market structure and which calls for open entry into the various communications markets wherever feasible. This concern can be met by a statement that the FCC shall rely upon competition and the private sector to the maximum extent possible and shall exercise regulatory authority only when necessary to achieve the purposes of the Act.

"Second, I would strongly support legislative affirmation of the Commission's ability to forebear from regulation of areas concededly within our subject matter jurisdiction if we conclude that market forces alone are adequate. While I am confident that we do have such authority, it clearly is on the border of our powers, and legislative affirmation would cut off years of litigation and delay.

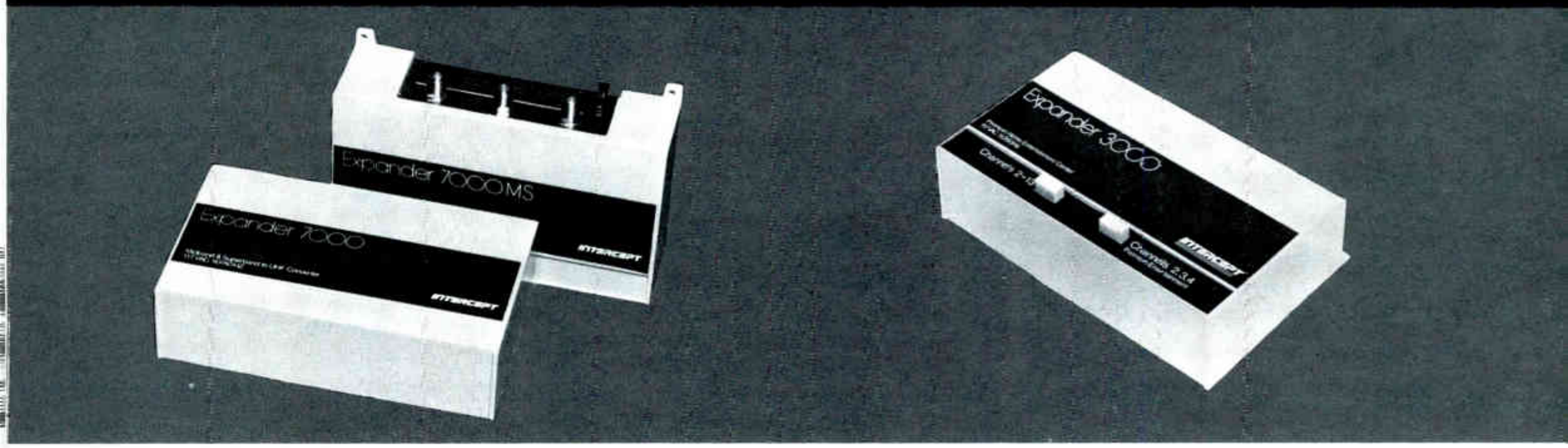
"Third, Congressional affirmation of our interpretation of the 1956 consent decree, set forth in our computer inquiry decision, also would be extremely beneficial. AT&T is entitled to know as soon as possible whether it will be free to provide enhanced services and sophisticated equipment through a fully separated subsidiary.

"Fourth, I would welcome an expression from Congress that the Commission need not always conduct comparative hearings in cases where it finds competing applicants for Commission licenses to be basically qualified. Such a provision would provide a further impetus for us to develop alternative methods to the lengthy comparative renewal process, which today threatens literally to overwhelm our limited resources. The Congress should declare that the FCC can use non-adjudicatory methods to allocate or assign spectrum and to transfer licenses for telecommunications services."

Brown says these amendments are needed now if the consumer is to receive the benefits of competition in the near future. "In my judgment," he adds, "they will add certainty to our decision making processes."

EXPANDER 7000, 7000 MS MID AND SUPER BAND TO UHF BLOCK CONVERTERS

EXPANDER 3000 MIDBAND TO VHF BLOCK CONVERTER



- Three Expander models to choose from for the most economical way of expanding any 12 channel system
- Low noise figure for clear, crisp pictures
- Multiple television sets may be fed from one Expander 7000 or 7000 MS
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The Expander series of block converters is an economical way of adding up to 18 additional channels to a 12 channel system. There are three expander models to choose from to suit the proper system application.

The Expander 7000 will convert incoming midband Channels A-3 thru H by mixing them with a crystal controlled local oscillator which up converts these signals to UHF Channels 14 thru 24.

The Expander 7000 MS will convert nine midband Channels A thru I to UHF Channels 47 thru 55 and nine superband Channels J thru R to UHF Channels 63 thru 71.

Both Expanders have extremely low noise figures and adequate gain to provide quality pictures even with older model UHF televisions.

The Expander 3000 in the premium entertainment mode will convert midband Channels G, H and I to VHF Channels 2, 3 and 4. When the front panel push button is pressed for basic service, the unit allows feed through of standard VHF channels.

Channel Conversion Chart

Input Channel	**Output Channel**		
Input Channel	Expander 7000	7000 MS	3000
A-3*	14		
A-2*	15		
A-1*	16		
A		47	
B	18	48	
C	19	49	
D	20	50	
E	21	51	
F	22	52	
G	23	53	2
H	24	54	3
I		55	4
J		63	
K		64	
L		65	
M		66	
N		67	
O		68	
P		69	
Q		70	
R		71	

*If channels A3 thru A1 are used, spurious signals may be created in some of the other midband channels.

Due to the frequency of the L.O., Channel A cannot be used.

Specifications

Expander 7000

	VHF	UHF
Gain	−1 db	+5 db**
Flatness	± .5 db	± 1 db
Frequency	50-300 MHz	470-536 MHz
Noise Figure		8 db
Return Loss	10 db	12 db
L.O. @ Input	−10 dbmv	
L.O. Frequency	368 MHz	
Cross Modulation	7 Channel @ −60 db @ 12 dbmv input	
Power Requirements	30 MA @ 117 VAC 60 Hz	
Connectors	75 OHM standard "F" female	

**Approximately −3 db less gain for Channel H conversion

Expander 7000 MS

	VHF	UHF
Gain	±0 db	± 1 db
Flatness	± .5 db	± 1 db
Frequency	50-300 MHz	668-818 MHz
Noise Figure		8 db
Return Loss	12 db	13 db
L.O. Frequency	548 MHz	
Input Channels	2-6, A-1, 7-13, J-M	
Output Channels	2-13, 47-71	
Cross Modulation	−60 db @ 12 dbmv Input	
Power Requirements	25 MA @ 117 VAC 60 Hz	
Connectors	75 OHM standard "F" female	

Expander 3000

Gain	4 db ± .5 db
Flatness	± .25 db
Frequency	50-300 MHz
Noise Figure	8 db
Return Loss	15 db
Mode Isolation	> 65 db
L.O. Frequency	102 MHz
Input Channels	2-6, G-I, 7-13
Output Channels	2-13 Cable Mode 2, 3, 4 Premium Mode
Cross Modulation	−60 db @ 12 dbmv Input
Power Requirements	25 MA @ 117 VAC 60 Hz
Connectors	75 OHM standard "F" female

INTERCEPT

Intercept Corporation, 215 Entin Road, Clifton, New Jersey 07014 Telephone 201-471-2212

Profile: Cable News Network

With the world's first 24-hour televised news operation slated to begin June 1, 1980, C-ED takes this opportunity to present an exclusive interview with CNN's Senior Vice President, Jim Kitchell.

C-ED: Is everything still set for a June 1 launch?
Kitchell: Absolutely.
C-ED: How many studios will CNN be using and where are they located?
Kitchell: Our main facility, of course, is here in Atlanta. In addition, we also have major facilities in Washington, New York, Chicago, Los Angeles, San Francisco, Dallas and Miami. Overseas, we have bureaus in London, Rome and, through some cooperative efforts, in the far east.
C-ED: Is there a distinction here between, say, a studio and a bureau?
Kitchell: Well, yes, the studios themselves will be in Atlanta, Washington, New York and Los Angeles. However, we will have the capability of originating from each of the individual bureaus elsewhere.
C-ED: Will you also have mobile units and additional ENG equipment?
Kitchell: Yes, basically in our operation we are going strictly with one-inch and three-quarter inch videotape; we have no two inch and no film. Everything is electronic.

One of the interesting things with our facility here—and in fact the real challenge—is trying to put together an operation which goes 24 hours a day 7 days a week. You have to build quite a bit of redundancy into it, and you have to analyze exactly how you're going to operate. In our plant here in Atlanta, for example, our total facility basically is open. The main, on-the-air control room is open in the middle of the studio. Now, of course, people have seen open newsrooms before, so that's nothing new. But our decision not to arrange a set with a backdrop and everything is an extension of our basic philosophy here at the Cable News Network: we want to present the ongoing *process* of news developing and being gathered as it occurs, on a live basis. So our main control room is open and is part of the whole facility.
C-ED: How many employees total are currently committed to this project?
Kitchell: I would guess on the order of 400.
C-ED: Can you give us an idea of roughly how many people will be in front of the camera? In other words, how many anchor-persons will you have?
Kitchell: The total number, with news, weather, sports, and the bureaus . . . about 35. Maybe 40. But that's not counting reporters in the field.
C-ED: You mentioned an arrangement that will allow you to cover the far east. Could you elaborate on that?
Kitchell: We have a cooperative arrangement with CTV, in Canada. They actually have a bureau in Peking. We will be putting some people into the far east, but we have not as yet determined where that will be. In addition, we will be using the services of UPI Television News.
C-ED: Are any of the other bureaus arranged in a similar fashion?
Kitchell: No, the other bureaus are all strictly CNN.
C-ED: What sort of technical arrangements have been made?
Kitchell: Well, for starters, we've assembled the largest single array of satellite receivers in the country. I'm sitting here looking out my window as they are pointing the first of the dishes. We have an antenna farm of five seven-meter satellite receivers and one eleven-meter dish, to bring material in from various points around the world. Then, for the uplink, we microwave out of here to Douglasville, where Southern Satellite will transmit us up to Satcom I.
C-ED: Approximately how much money has been invested, total, in the actual equipment?
Kitchell: Probably on the order of $8.5 million to $10 million.
C-ED: How much of that is in the uplink facility?
Kitchell: For the satellite links outbound, none of that. That's provided by Southern Satellite as a common carrier. In other words, we deliver them a signal, and they take it from the Channel 17 tower, which is about three thousand feet away from the studio, by microwave to Douglasville, which is about 15 miles away, and then up to the satellite.
C-ED: You'll be on transponder 14?
Kitchell: That's correct. The last assignment I heard was transponder 14.
C-ED: That won't shift or anything, will it? In other words, there won't be a split schedule.
Kitchell: No. The number has kind of bounced around, that's why I'm a little bit hesitant. But the last I heard was transponder 14.
C-ED: Aside from the acquisition of a transponder—and we understand there were some real gyrations that CNN and Ted Turner had to go through to get the transponder in the first place. . .
Kitchell: Yeah, a few.
C-ED: What was the other major technical obstacle which had to be overcome in order to get the service started?
Kitchell: The challenge of just doing the news 24 hours a day, seven days a week. It's never been done. Now, for example, I mentioned redundancy before; we've built duplicate control rooms, and we've included the technology necessary to move signals around the physical plant, so that we can utilize that redundancy. Just trying to define the needs of a 24 hour, seven

day a week, continuous service—that was the biggest challenge in planning it.

C-ED: Will there be a specific look to the service? In other words, will there be a particular emphasis as far as coverage is concerned?

Kitchell: We will cover the entire range of newsworthy events, of course. Now beyond that, there will be certain types of programming which will be heavily dealt with. Business news, for example. That's something that has never been covered adequately by commercial television, and it will be one of the major emphases out of our New York bureau. Basically, our service is one of providing coverage of events as they happen. You know, I would have loved to have been on the air as the aborted Iranian rescue attempt unfolded. That is the kind of story that is absolutely ideal for us, in the sense that people were constantly trying to find out what was going on. And the story merited continuous coverage; something only a continuous news service could provide. We will be providing a service which people can turn to any time of the day or night in order to find out what's going on.

C-ED: In addition to this—the attempt to obtain instantaneous news—will there also be features of various kinds?

Kitchell: Well, yes. There will be feature stories, and there will be certain kinds of emphasis during certain times of the day. Interestingly, one of the other challenges is the fact that we are live from the east coast all the way to Hawaii, all the time. So you have to plan your programming so that you meet the needs of your entire audience, in extremely divergent time zones. One of the things which we've done is to create something we affectionately call "NewsWatch Hawaii." That's a three-hour block of programming from two to five in the morning, eastern time, which is actually eight to eleven in Hawaii. So, not only are we providing live news to Hawaii for the first time, we're also presenting it there during their prime time.

So, at any rate, the point here is, as you go through the day, you will have certain feature segments, columns by our contributing columnists, and so forth. Just glancing at the schedule here, there's the A.M. News Watch, from five to seven, eastern time. That will consist of rotating single anchors hosting four fairly rapidly-paced half-hour summaries. Included in that will be segments like personal finance, staying fit, an overnight sports wrap-up, a money market piece, a farm orientation, an astrology piece—there are various short features that are included. But the one thing that is important above all is that we will be updating the news constantly. We of course have the capacity within our operation to deviate from what might be called normal programming, because it's all live.

C-ED: Have you received any reaction at all from the networks?

Kitchell: Well, yeah, they've expressed some interest in what we're doing. In fact, they've expressed considerable interest in what we're doing. They're *extremely* interested. They've played hard ball in some areas, as you may know, in terms of some of the talent we've been interested in. But on the other hand, as a newsman, I suspect that most of the newspeople at the networks love it, and in their hearts support what we're doing. A newsman always wants more time, wants more column space, or whatever. With commercial television, they don't have it. And I suspect that they feel that if we are as successful as we think we're going to be it may increase the amount of time that the networks devote to news.

C-ED: From a practical standpoint, how does your expected budget compare with the news budget of any of the networks, and will that difference present a problem to you?

Kitchell: I don't think so. You see, there are a number of factors here. The one thing that we have available to us is time. The networks produce a great deal of material that never sees the light of day. They don't have time to run it all. For example, they may take 45 seconds on a first lead on a story. There may be second or third leads that may be absolutely valid, but they never receive any follow-through. We will cover events in greater depth, and more extensively. In other words, more exposure. For example, let's take that recent unsuccessful rescue attempt in Iran. Our entire day effectively would have been devoted to that story, and everything that plays from that, from the various reactions in Washington to the financial and business ramifications. The networks did their morning programs, and they did specials, but it was something that we would have been covering in an on-going way.

C-ED: So, what you're saying is that, despite the fact that the networks may have higher budgets, no matter how much higher those budgets are, you're going to be able to cover the same ground that they do, in more depth, because they are not utilizing their resources as effectively as you will be utilizing yours.

Kitchell: That's right. Exactly. There is a great deal of wasted material, and wasted productivity, if you will, with the networks because they'll send an entire crew out to cover one single story, for a small segment on their evening newscast. We can get much higher productivity out of a crew, because they will be providing material throughout the entire day. The networks are locked into schedules. We are not.

C-ED: Obviously this is an extremely risky enterprise. . . .

Kitchell: We don't think so.

C-ED: Is there a point at which you will know for certain that you have been successful? In other words, do you have some sort of a time frame in mind?

Kitchell: Well, we have a general time frame, and we also have a target. We had originally anticipated that we would be somewhere around two million homes when we start up. Committed, that is. We are actually at about three and a half million right now. We also have some targets in terms of the number of homes and the amount of advertising. Obviously, if the number of homes increases, the amount of advertising revenue will also increase.

C-ED: How much time is going to be devoted to advertising?

Kitchell: We have structured it to be approximately 12 minutes per hour. Now, two of those minutes are reserved for the local cable system.

C-ED: One final question. What, at this point, is the most crucial thing to the success of CNN?

Kitchell: The most crucial thing right now is simply to get started. All we have to do is put it out there, and I think the audience is going to grow very rapidly. So far, we've been doing some preliminary rehearsals and so forth, and in fact, we will soon begin full-blown rehearsals. So, by the end of next week, we will actually be doing in-house, closed circuit 24 hour news. We will already have begun. Then, on June 1st, we will simply open the faucet.

And *that* is the most important thing right now. Opening the faucet. **C-ED**


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400 MHz: How Much Equipment Will Be Needed?

By Jay Staiger, Manager, Systems Design, Magnavox CATV Systems, Inc.

Introduction

The CATV system has evolved from a means to improve television reception to an increasingly sophisticated means of communication. With the advent of pay services, the need for more channel capacity was justified. Cable TV is now profitable in areas with good quality and quantity off-air programming. In order to maintain the profitable potential with a large number of off-air selections, STV, and other pay off-air services, the cable systems must offer a variety of services. The variety will require even more channel capacity.

In cable TV's beginning, operators had a hard time conceiving the need for channel capacity beyond 12 channels. However, some of the "blue sky" sages could conceive the expanded capacity requirement. Again this seems to be happening. Some say they can not conceive the need for loading past 35 channels, or the availability of programming or services to fill a 300 MHz band limit.

A lot of credit must be given to the proponents of the "blue sky" concepts. These are the people that inspire this industry's evolution. Just as the 12 channel system has seen obsolescence and must be upgraded in channel capacity, it is possible the 35 channel capacities will be made obsolete. This is already the case in some major build areas where there are 40 channels of service and programming already scheduled.

Expanded bandwidth to 400 MHz is a method to allow head room for new major builds. The head room will be filled with as yet unborn cable services.

The future cable system will give its subscriber the choice of all 52 channels (or more?) and permit him to choose one, all, or some of the available services. The greater the selection, the greater the chances of connecting and of maintaining the connection of a subscriber.

Table I
% Increase in Activities
(Reference is 300 MHz @ 35 Channels)

Column #	1	2	3	4
Design Frequency	300 MHz Reference Point	400 MHz	400 MHz	400 MHz
Trunk Amplifiers (Increase)	0% (.55/Mile)	20%	22%	25%
Line Extenders (Increase)	0% (1.5/Mile)	35%	70%	100%
Bridger Output Level	49 dBmV	49 dBmV	45 dBmV	42 dBmV
Line Extender Output Level	46 dBmV	46 dBmV	42 dBmV	39 dBmV
Trunk Maximum Cascade	25	8	8	25
Head End	Non-coherent	(HRC) Coherent	(HRC) Coherent	Non-coherent
System Carrier to Composite Beat	53 dB	Not Visible	Not Visible	53 dB
System Carrier to Cross Modulation	52.5 dB	50.5	58	52.5 dB
System Carrier to Noise	44 dB	47	46.6	44 dB

Since there seems to be the need for expanded bandwidth, there also is the need to know what considerations must be made in planning for the application of 400 MHz systems. There is the need to know what volume of electronic equipment will be needed to support the expansions. This paper addresses the question of equipment quantities and will illustrate how much more equipment will be required.

It is a known fact that a 400 MHz, 52 channel system will require more equipment than a 300 MHz, 35 channel system. A summary of the resulting increased quantities are given in the beginning of this text, and the reason for the increase is given later on.

Table I—Discussion

To obtain the information of Table I, three designs were completed:

1) 300 MHz, 35 channel reference design.

2) 400 MHz, 52 channels with the same feeder output levels as 300 MHz, 35 channel design.

3) 400 MHz, 52 channels, with lower feeder output levels to allow for a hub-type system. The lower feeder levels result in better distortion performance which permits a certain degree of degradation from a signal transportation system required to support the hub-system.

4) Column four of the table was estimated based on the results of the previous three designs.

Each design consisted of 27 cable-bearing miles. The same exact geograpical area and demographics were used for each. The area was of a semi-rural configuration and consisted of approximately 135 subscribers per mile and represented approximately 40 taps per mile.

Column #1 is the reference point for comparison. It represents a typical distribution system with up to 25 trunk amplifiers, one bridger and two line extenders in cascade. Columns 2, 3 and 4 also have feeder cascades consisting of one bridger and two line extenders.

Column #2 presents the increase in active equipment for the same feeder output levels as in column #1 (bridger and line extender levels). Take note as to the maximum trunk cascade and noise/distortion performance. In order to design the same coverage area as the 300 MHz system (25 amplifier cascade), there has to be a means of increasing the reach of the 8 amplifier cascade. This will have to be done via some form of transportation cable, super trunk or microwave link; all of which will degrade the performance from the levels shown. This system cannot tolerate any further distortion degradation as indicated by the 50.5 dB carrier to cross modulation ratio. This is already below the standards of most systems. This indicates that the feeder levels must be lowered to improve distortion performance.

Column #3 shows percentage increase in active equipment when feeder levels are reduced to permit an amount of degradation from a signal transportation system. With the same trunk cascade as in column #2, it can be seen that the noise/distortion performance can now tolerate a finite amount of degradation.

This permits a hub concept for designing larger systems and the reach of the cable can be extended to that of the 300 MHz system of column #1.

Column #4 shows percentage increase in active equipment when feeder levels are reduced to permit a cascade equal to the 300 MHz system. The great increase in feeder actives will significantly increase initial cost of system. More critically, the reliability, power costs, and maintenance of such a system would be factors for much consideration.

Also, in table I, there is a row indicating the type of head-end channel arrangement for each column. It is beyond the scope intended for this paper to go into the technology and techniques involved with harmonically related carrier (HRC) arrangements as compared to standard channel arrangements. It will suffice to say that the subjective effect of composite beats is significantly reduced with HRC, and cross-modulation becomes a consideration. This paper does not consider techniques such as video synchronization as a means of improving cross-modulation performance. This is an expensive proposition but may be feasible for larger systems.

The author has not seen sufficient documentation to substantiate the advantages of coherent carrier systems which are loaded to 52 channels. There are papers published (Ref. 1, 2) which demonstrate benefits at lower channel loadings but not for 52 channels. Therefore, the quantitative and subjective benefits are questioned. However, similar benefits with 52 channels are expected from coherent systems, and these benefits are assumed herein.

In column #3 it was necessary to consider HRC so as to minimize the increase in equipment quantity and extend the reach of the system cascade. This was due to the extremely significant effects of composite beats in non-coherent systems.

There is extensive testing presently in progress which will quantify the effects/benefits of coherent channels. The results will more than likely be available by the time this paper is published.

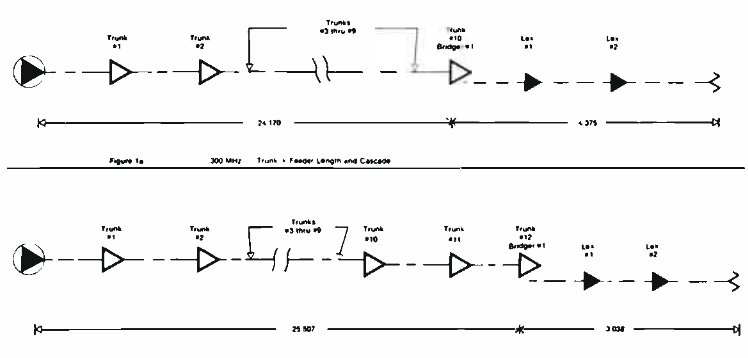

Figure 1.

11.43 trunk amplifiers (12) are needed at 400 MHz to cover the same length as 300 MHz. Figure 1b indicates the trunk must be extended further than the 300 MHz case because feeder as shortened at 400 MHz.

There are certain components of the distribution system which will not increase in quantity and are not dependent on the design frequency or channel loading. The amount of cable, and number taps, other passives, strand and strand hardware are determined by the linear street distance and the demographics of the area of build. These items will not be shown here.

The components affected are the actives—trunk amplifiers and line extenders. The quantities of these will significantly increase. The cable attenuation increases 15% from 300 MHz to 400 MHz. Some people believe this would yield a corresponding increase in active equipment of 15%. This is not the case as indicated by the numbers in Table I.

Actives on the trunk (trunk amplifiers & terminating bridgers) can be expected to increase a minimum of 15% to possibly greater than 25%. These increases cannot be reduced unless higher trunk amplifier gain is used. The feeder active equipment increase will be even greater.

To substantiate this, the following is offered. Consider a 300 MHz trunk spacing at 22 dB with .750 cable at .91 dB/100 loss. The total distance between trunk amplifiers can be 2,417 feet. As an example, the system requires 10 trunk amplifiers in its longest cascade of 24,170 feet of trunk cable from the head-end to the furthest trunk amplifier. After the last trunk amplifiers, there is a feeder cable and line extenders which extend to the system extremity. The length of the feeder may be 4,375 feet (two line extender cascade). Therefore, the head-end to extremity distance is expressed as follows:

Total (longest point)
28,545
= Trunk Cable
= 24,170 feet
+ Feeder Cable
+ 4,735 feet
Or 10 trunk amplifiers, 1 bridger, and 2 line extenders in cascade.

Now consider a 400 MHz distribution system in the same goegraphic area. To cover the same trunk distance as in the 300 MHz example there will be the need for 12 trunk amplifiers:

db of Cable
251.37 db

Number of Amplifiers
11.43 Amplifiers
= Trunk Cable x Attenuation
= 24,170 feet x 1.04 dB/100 feet
= db of Cable / dB Spacing
= 251.37 db/ 22 dB

Since you can't have a fraction of an amplifier, 11.43 is rounded to 12 amplifiers. This is a 20% increase in trunk actives.

Another factor which will increase the quantity from 15% is the need to extend the trunk beyond the 24,170 feet of the 300 MHz example. This is necessitated because the feeder will become shorter at the expanded frequency limit. See figure #1. (Subsequently, we will explore what happens in feeder.)

Therefore, the trunk cascade and trunk quantity increases because of two factors: 1) cable attenuation and 2) feeder length reduction.

This is averaged out over the entire feeder equipment at 400 MHz. The results are indicated in Table I.

There are three main factors which affect the distribution capability of feeders: 1) cable attenuation 2) output levels of bridgers and line extenders 3) strand efficiency of the area to be designed.

There are other factors such as minimum tap spigot output level and line extender gain, etc., but these were held constant for each of the sample designs and the increases in equipment are directly related to the three factors.

Cable Attenuation

The higher the cable attenuation, the more amplifiers it will take to overcome the higher loss. There will be more gain required to distribute signal over the same area of 300 MHz, 35 channel system. More gain means more amplifiers.

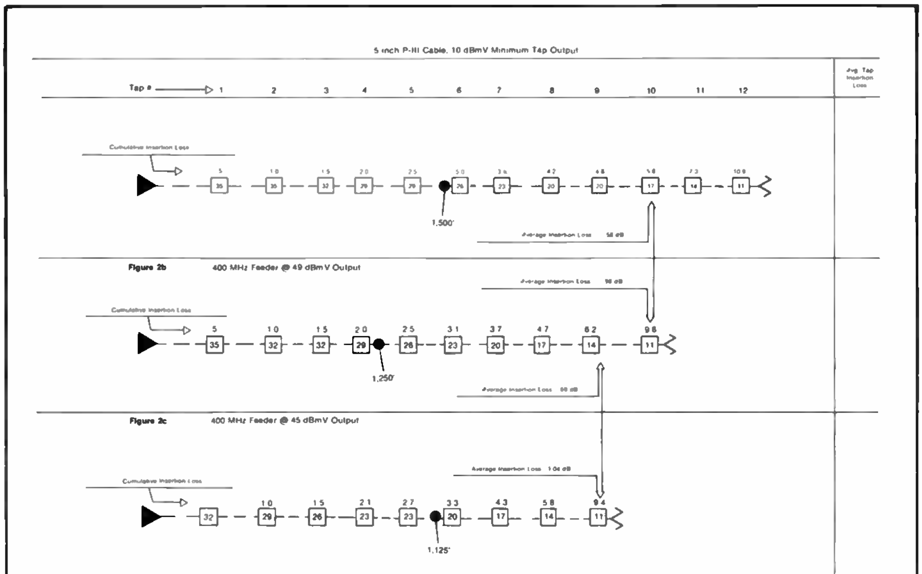

Figure 2

area of cable plant and considers that there is not only one cascade of trunk but several cascades.

There may be four separate main trunks emanating from a head-end/hub and several subtrunks emanating from each of the main trunks. This creates several trunk terminating points and multiplies the increase in trunk amplifier quantities (outlined previously) by the number of terminating trunk amplifiers. This results in an averaging effect, and the overall system effective average increase in trunk amplifier quantity should be within the ranges shown in Table I.

Sample designs were done for the purpose of quantifying the increase in

Higher cable attenuation has a secondary effect which shortens the feeder lengths by more than 15% expected from cable alone. This secondary effect causes the average through-loss per tap to increase.

This can be explained by theoretically considering two feeder lines both with an amplifier output level of 49 dBmV. The taps located directly at the amplifier output will be of the same value. As the feeder line extends away from the amplifier, the level of 400 MHz feeder attenuates at a faster rate. For example: the level after 500 feet of .500 inch, third generation cable will be (no taps installed):

After 500 feet @ 300 MHz 42.4 dBmV

After 500 feet @ 400 MHz 41.4 dBmV
Difference 1 dB

The difference is 1 dB in level. After 500 feet, a 400 MHz design will have a level at least 1 dB lower than a 300 MHz design. This may cause a lower value tap to be selected, which in turn would have a higher insertion loss and effectively increase the average tap insertion loss. This will result in an overall increase in actives beyond the expected 15%.

Comparing the two feeder lines in figures 2A and 2B, it can be seen that at the second and sixth tap, the level has been attenuated to cause the selection of a lower value tap and also at the sixth tap the cumulative insertion loss in the 400 MHz feeder line (figure 2B), starts to increase higher than that of the 300 MHz feeder line of figure 2A. After 10 taps the average tap insertion loss increases from .58 dB per tap to .98 dB per tap or an increase of 69%.

In the sample designs this was proven. The average increase in actives was higher than 15% for separate designs done with identical feeder amplifier operating levels at 300 MHz and 400 MHz.

Output Levels of Bridger and Line Extenders

A higher output level from the feeder amplifiers will result in fewer amplifiers being necessary to distribute signals to a given area. The inverse is also true. A lower output level will result in a higher number of amplifiers. At higher output levels, the tap through-loss is lower. The higher levels permit the use of more high-value, low through-loss taps and thus more taps can be inserted in the feeder line.

In figure 2B it can be seen that there is less average loss per tap as compared to figure 2C, due to more low through-loss taps in the feeder. These high value taps have the lowest through-loss (e.g., tap values of 35, 32, 29 and 26).

Another way to look at this situation is to consider that 30 dB is the maximum loss permitted between feeder amplifiers:

Max. Loss = Bridger Output - Line Extender Input

30 dB = 49 dBmV - 19 dBmV

If there were no taps inserted in the feeder, the length between amplifiers would be:

Length = dB of Cable / Attenuation @ 400 MHz.

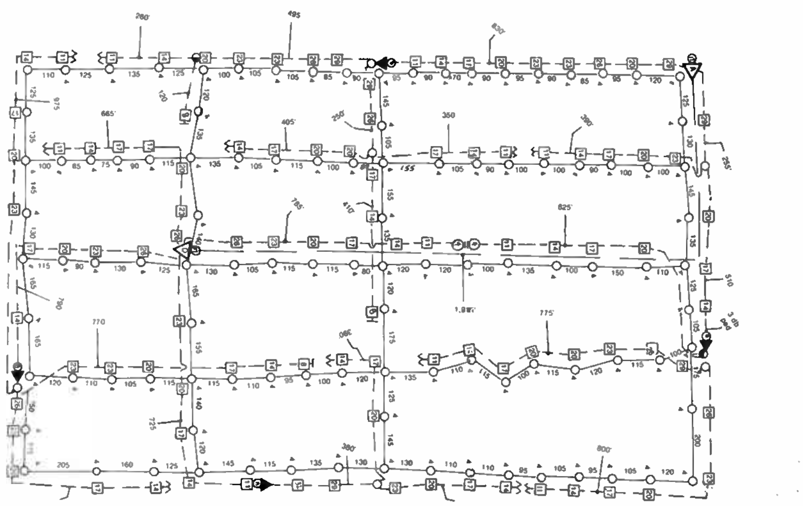

Figure 3a—High Strand Efficiency- 13,690 feet of strand, 104 taps, two trunk amplifiers. 4 line extenders.

1976 feet = 30 / 1.52 dB per 100 feet

Considering that taps are needed, a portion of the 30 dB loss must include the insertion loss of the taps. At lower feeder amplifier output levels the average insertion loss of taps might approach 1.2 dB per tap; with 10 taps in the feeder line the total tap insertion loss is 12 dB. This leaves 18 dB remaining for cable loss. Therefore, the feeder length could be:

Length =

1184 Feet = 18 dB / 1.52 dB per 100 feet

It becomes obvious that if the average tap insertion loss could be lowered, the feeder length could be extended.

At higher feeder output levels the average tap loss is approximately .9 dB. A feeder consisting of 10 taps would have 9 dB of tap insertion loss and therefore, 21 dB for cable loss. The feeder length could be:

Length =

1381 feet = 21 dB / 1.52 dB per 100 feet

This is an increase of 197 feet. To summarize, as feeder level decreases, the average loss per tap increases and the feeder becomes shorter.

Another output-related factor which reduces the feeder length is the maximum allowable loss between amplifier output and subscriber tap spigot output. This is directly related to output by: Allowable loss = amplifier output level - minimum tap output level

For example:

39 dB = 49 dBmV - 10 dBmV

Allowable Loss = 39 dB

If output level was lowered by 4 dB the allowable loss also lowers by 4 dB:

35 dB = 45 dBmV - 10 dBmV

Allowable loss = 35 dB as compared

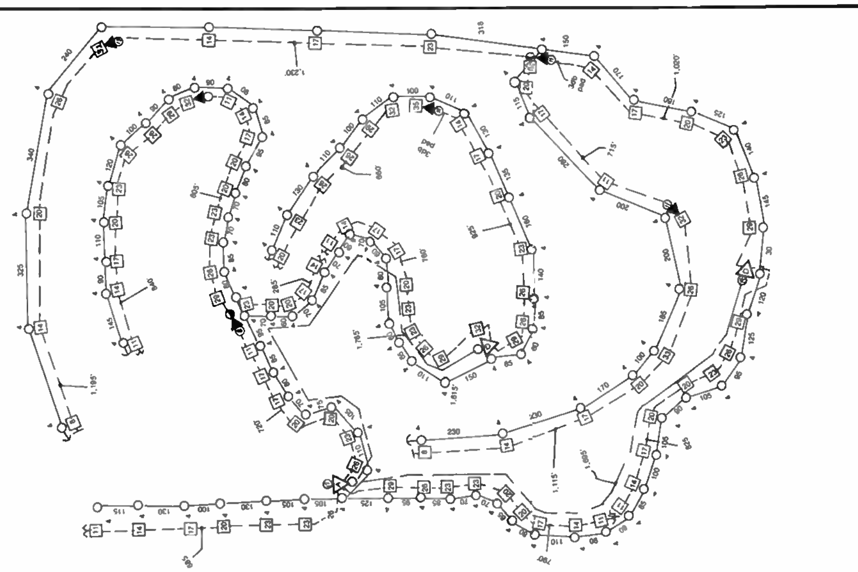

Figure 3b- Low Strand Efficiency- 12,710 feet of strand, 104 taps, three trunk amplifiers and five line extenders.

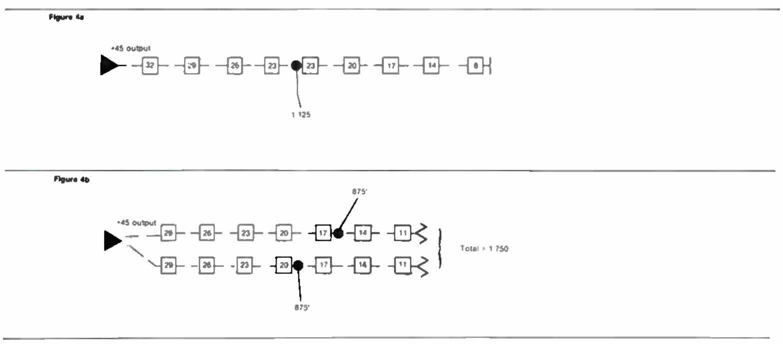

Figure 4

to 39 dB allowable loss at 49 dBmV output. This 4 dB in feeder length is 263 feet of .500 inch cable at 400 MHz.

When designing 400 MHz systems, a higher minimum tap spigot output level is required to service subscribers. This is made necessary because of the increased loss in the drop cable at 400 MHz. For example: the tap output level required for a 300 MHz design may be 10 dBmV minimum and at 400 MHz an 11 dBmV minimum may be required. Therefore, this will further reduce the allowable loss and increase active quantities.

Strand Efficiency

Strand efficiency is the most overlooked factor in the placement and usage of active systems components. It is defined as the ability of the strand to provide the best possible tie points so that the amplifiers can be positioned for optimum distribution. The more tie points or strand nodes, the higher the strand efficiency. Strand efficiency can be further defined as the ability of the strand to provide the shortest route between two points.

In a strand-efficient area there are more nodes. Nodes are decision points where it is possible to make splits. Splitting causes the coverage capability of an amplifier to increase. Figures 4A and 4B illustrate the results of splitting. Figure 4A is a feeder line calculated without a split. The total coverage for the amplifier is 1,125 feet. When a splitter is included, the coverage increases to 1,750 feet as shown in figure 4B. It can be seen that using one splitter increased the coverage of one line extender by 625 feet or approximately 56%.

Figures 3A and 3B show two strand (potential cable routes) configurations. Figure 3A has a higher strand efficiency than figure 3B. They both have approximately the same linear distance; however, figure 3B would require more amplifiers than figure 3A. Figure 3B is typical of a rural system where there are a lot of underground and easement routings. Figure 3A is more typical of metropolitan situations.

Less strand-efficient areas cause a less efficient feeder design. Where there are fewer tie points, the feeder more frequently ends with higher value taps. There is a high signal level dumped into a terminator.

An efficient design would be one in which the feeders ended with a high frequency of the lowest value tap. If all feeder line and taps were of the lowest value available (terminating taps), then this would be the most efficient design possible. A strand configuration with a large quantity of nodes is more conducive to an efficient design.

Design Efficiency Defined

$$\text{Design Efficiency} = \frac{\text{Number of lowest value taps} \times 100\%}{\text{Number of Feeder Ends}}$$

How does strand efficiency affect the equipment increase from 300 MHz to 400 MHz designs? In a less strand-efficient area there is more signal wasted in terminators. This wasted signal is consumed in the cable loss at 400 MHz and higher average tap loss; therefore, a more efficient design results at 400 MHz. The wasted signal is utilized rather than requiring the addition of amplifiers.

However, in a design with a high degree of design efficiency (which was effected by a high degree of strand efficiency) there are more amplifiers necessary to provide enough signal to overcome the added loss at 400 MHz.

The results indicated in Table 1 represented a strand efficient or metropolitan area and a less drastic increase in equipment could be expected in rural strand configurations.

The distribution system equipment is only one piece of the 400 MHz puzzle. There is a multitude of additional considerations for planning an expanded bandwidth system. Ongoing costs, (resulting from increased quantities) such as power consumption and system equipment maintenance are factors which cannot be overlooked. Other considerations are:

1) Will there be the need for 52 channels within the lifetime of the equipment and cable?
2) What type of Head-end will be required for a particular system? HRC?
3) Will HRC head-ends be available when they are needed (or other coherent head-end arrangements)?
4) Will standard head-ends be used because of HRC unavailability?
5) Will video synchronization be feasible and economically justified?
6) Converters will be required—will they be available to tune to HRC arrangements?
7) Should multi-hubs be used?
8) How many hubs are needed? Do I have a site? How extensive should the hub be?
9) How will signals be transported to the Hubs? Super trunk AML or something else? The Hubs and signal transportation equipment are additional expenses to the distribution system.

The results of these considerations will vary for every franchised area. Some will ascertain that it is practical to include all of the state-of-the-art technology and others will conclude it is not practical at this time. In any case, the homework must be completed and all aspects considered before the 400 MHz plan is finalized and executed. **C-ED**

Reference

1) *Improvement of CATV Transmission Using Optimum Coherent Carrier Systems by W. Krick Heinrich-Hertz-Institute-Berlin.*

2) *A Harmonically Related Carrier Systems for Cable Television by Israel Switzer, IEEE Transactions on Communications, Vol. Com-23, No. 1, January 1979.*

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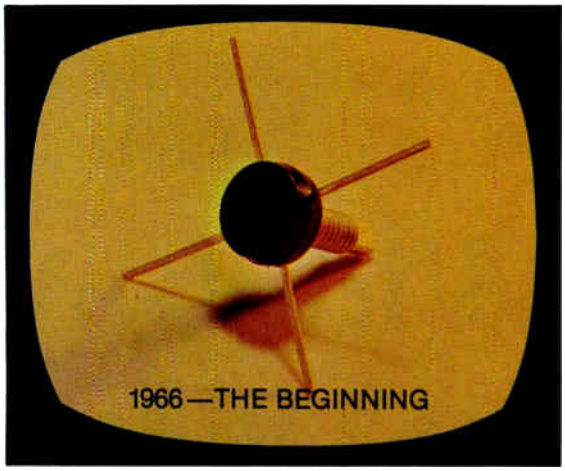

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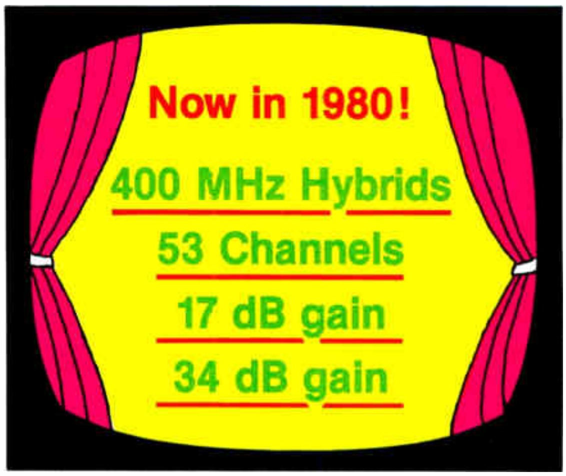

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Simplifying Wideband Transmission Design

By William Grant, Consultant to the Rural Electrification Administration.

Many aspects of our American way of life deal with or generate constants—events that recur, such that people come to expect, or to depend on them. In engineering, for example, constants are a familiar and welcome old friend. In many cases, they relieve the tedium of a series of repetitive calculations used in testing a premise, or they may be developed as an aid in simplifying otherwise complex comparative evaluations. New technolgies or applications frequently breed new constants.

The purpose of this paper is to develop certain constants for use in the design of rural wideband systems, in order to simplify procedures in that specific field.

The factors involved in producing an economically and technically satisfactory system design are numerous and varied.

1. Transmission performance: the noise and intermod distortion that the system will introduce to the desired intelligence.

2. Initial cost: unquestionably a factor, of which we are all constantly and intimately reminded in our personal lives.

3. Maintainability: the quantity of active, power-consuming devices employed will have a long term effect on operating and maintenance costs.

4. Overall system reliability: this must have a reasonable priority if we are to attract and hold revenue-producing customers.

What are the individual considerations or factors impacting most significantly on these factors?

1. Certainly the individual units of equipment selected, in this case, the amplifiers, are a most important item. The noise figure and output capability of the equipment will not only determine the transmission performance but will also impose operational signal levels which may dramatically affect amplifier spacing and initial costs.

2. The amplifier spacing possible for any given overall system length will surely affect the maintenance costs of the system due to the use of more or fewer active equipment locations.

3. Cost. Quite obviously, the less expensive an individual amplifer, the less expensive many such amplifers are.

4. Reliability—again directly related to the number of active stations required.

5. Cable size and cost. Larger cable, less loss, fewer stations—but higher costs.

The real significance of all this is that the system designer may directly affect many cost and quality factors simply in the design itself. Given identical equipment and less thorough or competent system engineering, any or all of the basic objectives can be missed by a very wide margin.

What we really need to do is reduce the complexity of the transmission engineering task and make it easier and faster as well so that various cost considerations such as cable size or amplifer gain can be run through the process for comparison and consideration.

Note we said transmission engineering. This is the intitial process which determines, for any given system, the operating input and output signal levels, the amplifier gain and spacing, and the transmission performance that the completed system will produce. Upon completion of the transmission engineering and subsequent physical or mechanical layout of the system, components may proceed accomodating and reflecting distances, subscriber taps, plant splitting and other routine considerations. But the basic operating parameters and ground rules must be established first.

How might this process itself be improved, simplified and expedited?

In essence, the name of the design

game is to optimize amplifier input and output levels such that maximum amplifier spacings are possible producing minimum cost. The transmission performance produced through the resultant system operating at these signal levels must, of course, meet specifications with respect to noise and intermodulation distortion.

For combinations of trunk and feeder plant where separate subsystems make individual contributions of noise and distortion, this is not a simple matter. There may often be a judgment required for feeder amplifiers of a different manufacturer entirely than the trunk equipment provided.

It becomes two transmission engineering problems with each subsystem (feeder and trunk) requiring individual consideration and an overview of combined peformance examined as a final step.

It should come as no surprise that many large CATV systems today may very well not be constructed, or be operated to produce maximum cost-effectiveness.

The author has been actively involved recently in the problems of design as they may apply directly to rural wideband systems. The objective here has been to develop, if possible, a simple, quick, repeatable and easily understood technique whereby potential applications might be evaluated for cost, for the impact of various size cables on that cost, and for the transmission quality that any structural changes might produce. It was also hoped that the technique could quickly establish the degradation of performance which would occur for incremental extentions of the system and the rapid consideration of mitigating this degradation by increased cable size or perhaps reduced amplifier spacings.

Since the application was distinctly limited to rural systems which involve no combination of feeder plus trunk designs, the problem was greatly simplified.

The initial approach was to evaluate amplifiers offering different gain specifications. A pilot system 100 Kft in length was designed with a variety of amplifiers; different cable sizes were also introduced. At every possible combination, an analysis of noise and distortion produced was performed, and the number of required active equipment locations was also graphed for review.

The calculations and formulas necessary are well-known industry standards but about the fifth or sixth time that the calculations were performed, the development of a few practical constants became apparent.

With some reflection it seemed that the problem might be resolved much more simply by separating the economic considerations from the technical.

We approached the question now as follows:

1. Given three different values of gain in three separate amplifiers, was any one particular gain device most cost efficient as the longer or longest system lengths?

2. Did the economic advantage shift to a different gain amplifier as system length was incrementally decreased?

3. What were the optimum input and output levels, the gain, the maximum physical spacing for the most cost-efficient unit?

4. How long could the system be for those optimums to meet a specified C/N ratio and X-mod?

5. How quickly, or at what additional system length, did these optimum levels become intolerable, performance-wise?

It turned out, not surprisingly, that there was a maximum gain that was available in "off-shelf" hardware, and in addition there was was optimum physical spacing. Furthermore, certain input and output levels, at maximum usable gain, would produce specified performance at and even beyond the pilot system's 100 Kft length.

We then examined system extensions to 125 and 150 Kft and established the performance, obviously somewhat poorer but still perhaps usable, that such extensions would produce.

At this point it became obvious we had optimized all the cost reductions of the application of this amplifier that were possible. We couldn't space the amplifiers farther apart without immediately producing out of spec system performance, and in any event there was no additional gain in reserve to accomodate longer spacings.

We could reduce the spacing, but this was simply less economical and only produced better than specified—and presumably better than necessary—transmission performance.

So, for systems 100 Kft long using that particular cable size, we no longer needed to establish input or output levels or gain and spacing.

But had we established a constant? Unfortunately no.

In our rural "trunk only" system, as in any cascade of trunk amplifiers, we were required to utilize two distinctly different units in combination to establish adequate automatic gain regulation for ambient temperature variations. And the ALC or AGC units had different output capability, different gain and different noise figures than the standard trunk amplifiers we were using. Incidentally we used a 1 in 3 combination, 1 AGC amplifier for every 2 intermediate trunk amplifiers.

For convenience and simplicity, we needed to develop a theoretical "equivalent" or "average" amplifier, reflecting identical noise and X-mod contribution of the combination, and to establish the optimum spacing in db loss for this equivalent amplifier. Then applications could be quickly reviewed with a minimum of calculations and a disregard of operating levels or gain since these had been established as inflexible and since no further cost reduction was possible anyway.

This was a simple development and we produced the following three parameters as constants for our equivalent amplifier.

1. S_k = Amplifier spacing in db—1 amp.

2. C/N_k = Carrier to noise constant—1 amp.

3. XM_k = X-mod distortion constant—1 amp.

The constants will hold true for any application, but of course, only for particular equipment and only if this equipment is operating at the input, gain, and output levels established as most cost-efficient. Should any of these considerations be changed, then recalculation of the constants would be necessary. Having recalculated new constants in such a case the design tool would be re-established for day-to-day usage.

Without referencing any specific manufacturer or units of equipment, and not presenting here all of the calculations performed, in the interest of brevity, we developed our equivalent constants as follows:

Optimum Usable Spacing

ALC units we were examining had a usable spacing of 29 db which allowed some gain reserve for two-way filters,

equalizers, and so forth.

The intermediate trunk amplifiers selected could be spaced 38 db apart.

Simple arithmetic established the equivalent spacing constant at 35 db from $\frac{38+38+29.}{3}$

Then, given any system leg length in feet or kilometers, and the cable loss for the highest transmission frequency required, the cascade of amplifiers is rapidly established for various cable sizes.

Example

Given a highest transmission frequency required of 216 MHz;

Given .77 db/100 ft cable loss in the 3/4 inch cable;

Given 1.09 db/100 ft cable loss in the 1/2 inch cable; and

Given a 95 Kft distance.

1. The cascade of amplifiers with 3/4 inch cable may be determined by: $.77 \times 10 \times 95 = \frac{\text{Total Cable Loss}}{\text{Amp Spacing Constant}} =$

$\frac{731.5}{35} = 20.9$

That's 21 amplifiers of which 7 will be ALC units.

2. The cascade of amplifiers with 1/2 inch cable may be determined by: $1.09 \times 10 \times 95 = \frac{\text{Total Cable Loss}}{\text{Amp. Spacing Constant}} =$

$\frac{1{,}035.5}{35} = 29.58$

That's 30 amplifiers of which 10 will be ALC units.

Given the number of amplifiers required and the size and length of cable, it is a simple matter to develop cost comparisons.

Note: In practice some number of amplifiers should be added to the cascade for noise or X-mod calculations since an additional amplifier or more may be required to compensate for trunk splitting losses in system layout. The addition of an amplifier or so for such purposes should not be considered when working with system overall length, however, since such added units do not reduce the optimum spacing at all.

A 38 db amplifier added to a system leg will accommodate 11 such trunk splits since splitting introduces 3.5 db loss each time.

Carrier to Noise Ratio Constant

Since we had pre-established operating input and output levels as a function of overall transmission performance, and optimized and reviewed these levels for maximum cost efficiency, these levels become inflexible. Given the input level and the noise figure it is a relatively simple calculation to produce the C/N ratio for an individual amplifier.

But we have two distinctly different units involved with different optimum input levels and different noise figures.

It is necessary, therefore, to determine the C/N Ratio for both types (ALC units and the manual gain amplifiers) and then develop a C/N constant derived from the combination of three (1 ALC plus 2 manual).

The C/N Ratio for our ALC amplifier which was cost optimized at an input level of +3 dbmv may be determined by:

$C/N_1 = S_{IN} + 59 - NF$

Where

C/N_1 = C/N ratio — one amplifier

S_{IN} = Input Signal Level

NF = Amplifier Noise Figure

Then

$C/N_1 = 3 + 59 - 8$

C/N_1 = 54 db C/N ratio (ALC Amp.)

The C/N ratio for our intermediate trunk amplifier which was cost optimized at +3.5 dbmv may be determined by:

$C/N_1 = S_{IN} + 59 - NF$

$= 3.5 + 59 - 6.5$

C/N_1 = 56 db C/N ratio (Manual Amp.)

The C/N ratio for two manual amplifiers in cascade would be 3 db poorer or 53 db.

Combining a 53 db and a 54 db C/N ratio will produce a C/N for the combination of 50.5 db.

The C/N ratio for an equivalent amplifier reflecting the combination of one ALC unit and two manual units may be determined by:

$C/N_K = C/N + 10 \text{ LogN}$

$= 50.5 + 10 \text{ Log } 3$

$= 50.5 + 4.77$

C/N_K = 55.27 db C/N ratio (1 Amp. Constant)

The application of this constant to various system configurations is simple and accurate. In our earlier use of the spacing constant we developed a cascade of 21 amplifiers on ¾ inch cable and 30 amplifiers on ½ inch cable.

Adding one amplifier to each cascade for trunk splitting losses as explained previously, these figures become 22 and 31 respectively.

We may determine the overall C/N ratio of both applications by:

$C/N_T = C/N_K - 10 \text{ LogN}$

For ¾ inch cable this is:

$C/N = 55.27 - 10 \text{ Log } 22$

$= 55.27 - 13.42$

C/N_T = 41.84 db C/N ratio

For ½ inch cable this is:

$C/N_T = 55.27 - 10 \text{ Log } 31$

$= 55.27 - 14.91$

C/N_T = 40.35 db C/N ratio

These figures may be used to determine compliance with system specifications or in making a judgment as to "extendability" of the system leg at some future time.

Given any cascade of these specifications units of equipment used in this same ratio (2 plus 1) and operated at the identical input and output levels, any particular system application is quickly checked for noise performance.

Cross Modulation Distortion Constant

As developed earlier, the operating output levels have been pre-established on a cost-optimum plus transmission performance basis.

The X-mod for a single ALC amplifier operating at our established +39 dbmv output may be determined by:

$XM_1 = XM_S + 2\,(OL_O - OL_S)$

Where

$XM_1 = XM_1$ = X-mod — one amplifier

XM_S = Mfg. Spec. X-mod — one amplifier

OL_O = Operating output level

OL_S = Mfg. Spec. output level — one amplifier

In our ALC units the X-mod is specified as -57 db for 21 channel loading at +50.5 dbmv output level.

Then

$XM_1 = -57 + 2\,(39 - 50.5)$

XM_1 = -80 db X-mod (one amplifier)

In our manual units, the X-mod is specified as -57 db for 21 channel loading at +52 dbmv output level.

The X-mod for a single manual gain amplifier operating at our established +40.5 dbmv output may be determined by:

$XM_1 = -57 + 2\,(40.5 - 52)$

XM_1 = -80 db X-mod (one amplifier)

Since both types of amplifiers produce identical X-mod distortion, this figure, -80 db, may be taken as the X-mod from an equivalent amplifier and becomes our X-mod constant.

The application of this constant to the various system configurations is simple and accurate. Again, our earlier example developed a cascade of 21 amplifiers on ¾ inch cable and 30 amplifiers on ½ inch cable.

Adding one amplifier to each cascade for trunk splitting losses as explained earlier these became 22 and 31 respectively.

We may determine the overall X-mod in both applications by:

$XM_T = XM_K + 20 \text{ Log } N$

For ¾ inch cable this is:

$XM_T = -80 + 20 \text{ Log } 22$
$= -80 + 26.84$
$XM_T = -53.15$ db X-mod

For ½ inch cable this is:

$XM_T = -80 + 20 \text{ Log } 31$
$= -80 + 29.82$
$XM_T = -50.17$ db X-mod

These figures may be used to determine compliance with system specifications or in making a judgment as to the "extendability" of the system leg at some future time.

Given any cascade of these specific units of equipment (2 plus 1), and operated at the identical input and output levels, any particular system application is quickly checked for X-mod performance.

General Discussion

Let's review what we have accomplished.

We have optimized the cost effectiveness of the amplifiers under examination and cannot produce any additional economy by respacing, manipulating operating levels, or reducing overall system transmission specifications. This optimum economic development will hold true for any system length using any size cable up to a total transmission loss of approximately 1,600 db or so. Beyond that point special consideration must be taken and three basic options are possible.

1. Decrease transmission losses by utilizing larger size, lower loss cable. Costs will be higher of course.
2. Decrease amplifier spacings to improve C/N ratio and/or X-mod distortion. Costs will be higher of course.
3. Consider relaxed transmission specifications for the extremities of the system. No cost penalty is incurred.

Using only three simple calculations and the three constants as developed here, costs and technical performance over a wide range of system lengths and various combinations of cable sizes may accurately and very rapidly be determined for comparison purposes.

To preclude possible confusion from the calculations previously shown, we will identify the three necessary calculations again.

Amplifier cascade may be determined for any given length and any specific cable loss by:

$$\text{Cascade} = \frac{\text{System Length in Kft} \times \text{cable loss per Kft}}{35}$$

Overall C/N Ratio for any given cascade may be determined by:

$C/N_T = 55.27 - 10 \text{ Log } N$

Overall X-mod distortion for any given cascade may be determined by:

$XM_T = -80 + 20 \text{ Log } N$

Once again, these constants are valid only for this specific equipment used in this specific ratio and operated at these specific signal levels.

Developing similar constants for other equipment is fairly straightforward, however, using the methodology shown earlier.

Perhaps several examples would more closely demonstrate the facility of this technique.

Example 1

How many amplifiers are required to transmit through 78 kft of ½ inch cable? What will the C/N ratio and the X-mod be? Cable loss is 10.9 db per kft.

$\frac{10.9 \times 78}{35} = 24.29$ or 25 Amps.

$-80 + 20 \text{ Log } 25 = -52.04$ db X-mod

$55.27 - 10 \text{ Log } 25 = 41.29$ db C/N ratio

Example 2

If we substitute ¾ inch cable in the above example, determine C/N ratio, X-mod and cascade of Amps. Use 7.7 db per kft cable loss.

$\frac{7.7 \times 78}{35} = 17.76$ or 18 Amps.

$-80 + 20 \text{ Log } 18 = -54.89$ db X-mod

$55.27 - 10 \text{ Log } 18 = 42.71$ db C/N ratio

Example 3

Extend the system to 95 kft using ¾ inch cable.

$\frac{7.7 \times 95}{35} = 20.9$ or 21 Amps.

$-80 + 20 \text{ Log } 21 = -53.55$ db X-mod

$55.27 - 10 \text{ Log } 21 = 42.04$ db C/N ratio

Example 4

Will we meet a specification of -50 db X-mod and 41 db C/N ratio across 95 kft if we use ½ inch cable? How many amplifiers would be required?

$\frac{10.9 \times 95}{35} = 29.58$ or 30 Amps.

$-80 + 20 \text{ Log } 30 = -50.45$ db X-mod

$55.27 - 10 \text{ Log } 30 = 40.49$ db C/N ratio

It should be noted that all applications and calculations in this paper were based upon a highest required transmission frequency of 216 MHz.

There is one aspect of the entire matter we may not have pointed out specifically, but which resulted from our development of this whole theme. The question is when, if at all, does a lower gain amplifier present cost economics in system design?

The units we examined offered gains of 36 db and 44 db but the cost differential between units was only $30 with almost equivalent performance characteristics. Even assuming the very shortest possible cascade, two 44 db higher priced units, the lower gain unit, which would require 2.62 amplifiers for an equivalent distance, proved higher in cost. Given different equipment and a different cost differential, this may not always be the case.

It was our intent to reduce the time and effort required to quickly produce cost data and transmission performance for a wide variety of applications. We believe the approach as developed herein does this if only for relatively unsophisticated tapped trunk rural systems. Subsequent development should produce some similar time saving techniques for trunk plus feeder systems but time and space do not permit this here.

Applications engineers, and systems designers should constantly be reviewing and examining new methods and techniques of course, as well as the use of constants demonstrated here. **C-ED**

William Grant is a twenty year veteran of the cable industry, having worked with Jerrold as Applications Engineer and Product Line Manager for twelve years, as well as having built systems in various parts of the country for another eight years. In addition, he worked for the New York Telephone Company for twelve years. He is currently a Communications Consultant in the Future Networks Development Branch, Telephone Division, REA.

CATV Design Systems

By Doug Adams, Paramount Designs, Inc., Phoenix, Arizona.

This article is not intended to be an engineering treatice, but rather a general discussion of system design. Just what makes a good design, and how can it be achieved?

Clearly, the ultimate goal in system design is to serve the maximum number of subscribers for the least amount of money. Money equals cable, strand, passives, actives, and construction costs. Beyond these costs, however, there is the additional consideration of the quality of signal which we supply to our subscribers. In short, we must provide a high quality signal to the maximum number of subscribers for the least amount of money.

Following are the areas believed to be of greatest importance to arrive at this end. Each of them will be discussed in turn.

1. Preliminary engineering
2. Strand mapping
3. Design

Preliminary Engineering

This could be the most important step in designing your system. Several facets will be covered under the category of preliminary engineering. Each one is extremely important.

First is the signal at the T.V. receiver. If this has not been previously set by your franchise, there are several factors you should consider. One of these is the strength of off-air signals. If you have strong off-air signals you may need to boost your own signal a little more than would otherwise be necessary. Another factor would be whether you are going to pre-plan for multiple outlets in the home. Multiple outlets are becoming extremely common right now. On the other hand, if you are using a converter you may be able to reduce the signal a bit, since most converters will accept a lower signal level than you may want to provide directly to the T.V. receiver. This may also help your strong off-air problems, so when establishing how much signal you want to the T.V. receiver, pay some attention to these variables.

The next link in the chain is the selection of drop cable. There are several good drop cables on the market; just remember that the higher the loss, the more signal you need out of the tap, and the less you have for the next subscriber.

This now brings us to the tap output. If you have performed the appropriate calculations and determined an average drop length, you should know what output you need. Your calculation should look something like this: if you wanted a minimum of +2 db at the set, you have an insertion loss of one db in the matching transformer, and a +1 db gain in your converter. You have 4 db of loss in the in-house splitter and 150 feet of cable, depending on which cable you are using. Let's say that in 150 feet you have 6 db cable loss; you should have a nominal tap output of 12 db. Again, let us state that the higher the tap output you come up with, the more actives you will have in your system.

Next let's look at the type of cable you are going to use in your system. You may pay more per thousand feet for a high-quality, low-loss cable, but if your system is going to have long distribution runs you may be able to save several actives by using the low-loss cable. Not only will this help offset the additional cost, but fewer actives result in lower maintenance costs.

Let us now look at the output levels of your actives. These are going to be directly controlled by the system specs you have to meet, such as signal to noise, cross-modulation and composite triple beat. Cross modulation and carrier to noise can be determined by the following formulas:

$C/X\text{-mod} = 57 + 2\,(oc - output) - 20 \log_{10}(N)$

$C/N = 59 + input - NF - 10 \log_{10}(N)$

OC = Output Capability

N = Number of amphlifiers in cascade

NF = Noise figure

Triple beat specs can be supplied by your manufacturer.

Needless to say, the higher the output levels, the farther the signal will go, thus supplying more customers.

The last consideration we will look at is AML and headend. The AML is a very valuable tool. In large systems it provides a means to get signal from your transmit site to points in your system that may otherwise have required dedicated trunks. It is also valuable because it helps to keep cascade shorter, thereby allowing, in some cases, higher output of actives. But, caution should be exercised, since an AML contributes to distortion approximately the equivalent of four trunk amps. Each individual case needs to be looked at carefully.

The headend is the breath of life to your system. A few refinements and considerations should be observed when determining what you will use. The signal in your system is going to be no better than what you have to begin with, so look at this very carefully.

Strand Mapping

Strand mapping: a part of your systems design? Yes, very much so, because it is the strand maps that your designer will be using in design. And that design is going to be no better than the strand map makes it.

When strand mapping, the first step is to generate a base map you can live with. What I mean by this is your base map is going to be just that: the base of your strand map. That map must be to a scale that is easily readable and of a quality that will facilitate the design of the system.

Routing and ties are very important considerations when strand mapping. The more options the designer has, the more efficient he can be. The shortest route may not be the best, so show on your strand map, all possible ties to serve an area. Also ensure the strand map is accurate. After you have completed strand mapping, make a reproducible copy of those strand maps. This will aid in pole permits, make-ready engineering, pole counts; or if rebuilts or as-builts are necessary, you have a clean map to work with.

Last but not least, the strand maps with design on them must be permanent. They should be of high quality, reproducible material; the design should be clear and concise. You, your technicians and construction people must be able to read them.

Design

It must seem that we've made a lot of decisions and looked at a lot of things to get to this point. But if you haven't, then you are going to be disappointed. You have made life miserable for yourself and your designer, or it is now very livable.

So now let's look at your decision. Trunks are the backbone of your system. When laying out your trunks, it is necessary to have a good overview of your system. There may be certain runs that need to go to the far reaches of your system. These runs will be your longest cascades and particular attention should be paid to keep passive loss as low as possible in these runs. Otherwise, in trunk design you have cable losses and passive losses that add up to the spacing of the trunk amplifiers. This correlates to output minus input equals trunk spacing.

If you have a 25db gain and your output is 32db, you must have a minimum of 8db into the amplification stage of the next amplifier. Subtracting 25 from 32 you arrive at 7. The difference between 7 db in-put and the actual 8 db in-put is to compensate for flat losses in the amplifier. If the amps you are using have greater flat losses, then the minimum in-put level must go up. Trunk is the easiest part of your system to lay out, but the hardest to change. Look very carefully at where you have gone and what you have done before going further.

Distribution design is a little more involved. Ideally, design should be easy to build and easy to maintain, but still adequately serve the most people with the least amount of equipment. This end can be achieved by any number of techniques; for example, by carefully routing your feeder legs so that the major portion of the signals can be channeled to the heaviest concentration of subscribers. This means that, if you can go down a main route and use directional couplers to service the smaller areas you have passed, the majority of the signal will still be available on the main route. Another technique that can be used is what I will call a foldover feedback. This is as you come down a distribution leg by passing taps that would have higher insertion losses, you are able to push the line extender farther down the line. You can then directional couple the output of that amp and bring the down leg back and pick up those locations previously passed up. The through-leg would then continue on. You may have allowed that leg to reach one, two, or more additional tap locations down the line. There are several other techniques that can be used to make your signal go farther, but as you look at all the particular things that can be done, just bear in mind that someday, someone is going to have to build and maintain that system. If you have created a nightmare in design, then most likely you have created a nightmare to build and maintain.

In closing, I would like to say that if you will spend the time to ensure all of the aspects of system design have been looked at closely, then the end product will be much more satisfactory. **C-ED**

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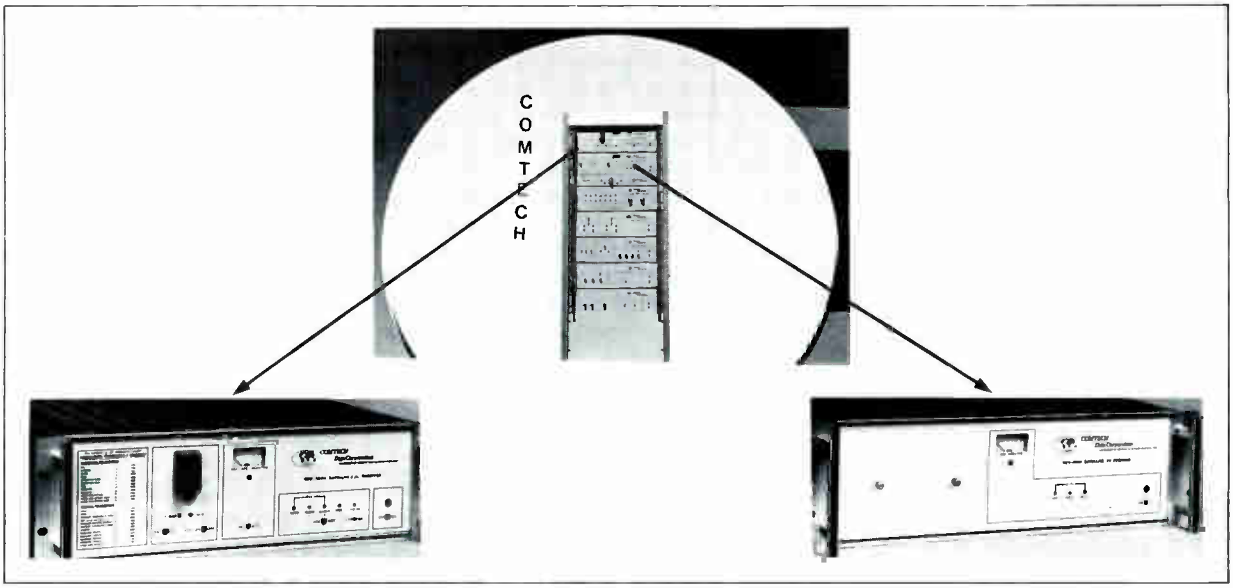

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The Use of Small-Base Computers for System Analysis and Design

By Thomas J. Polis

Our industry has been changing at an incredible rate. We are moving from the past, a home entertainment service industry, to the future, a broadband communications service industry, at a record pace. Every day we read more and more about such services as "Peak Power Management" via cable, alarm systems, interactive terminal usage (such as Qube). Data transmission is also in use in some systems interconnecting banks, doctors, and lawyers.

All of this has put great pressure on the industry to increase system reliability. The industry's manufacturer's laboratories have been working at a feverish pace to improve reliability of the components which are used to construct the state-of-the-art systems. One area which plays perhaps the most significant role in the reliability of the "total system" is the arrangement of the building block components, or as we know it "System Design." A poorly designed system can suffer from many ills, among which are low performance, poor reliability, costly maintenance, and high power consumption.

The basic problem with system design is that it is so "calculation intensive" that it becomes very prone to errors. This is not a new problem to industry in general. The solution has been the computer.

The computer has the ability to repeat calculation over and over without error and, in addition, is able to remember what the results of the calculation were.

In the past, computers were far too expensive to be considered for the design task. The typical starting price of a computer was around $10,000 and went up sharply from there. Even advanced programmable calculators with far less memory and calculation power started in price around $5,000.

The recent development of "microprocessors" has brought about a whole new age of computers. Extremely high power machines can now be purchased for less than $1,000 and are in fact being sold for "general home use."

This article will discuss what is available and how "Small Base Computers" can be used by even the smallest system operator to improve the reliability of design and subsequent system operators, at a cost effective level.

What is available?

There is an almost endless list of devices ranging from as little as $200 to as much as $5,000 which are usable for the system design function. As you can imagine, this leads to a great deal of confusion when trying to select one which will meet your needs.

To simplify things, let us consider that there are two classifications: 1) Programmable Calculators and 2) Computers.

Programmable Calculators

These units are generally limited to mathematical functions as the basis of their programming. They are specified in terms of the number of fixed program steps available to perform the mathematical functions. They may or may not have the ability to display alpha symbols. If they do not have this capacity, a great number of program steps are required to accomplish alpha characters. Hard copy is, generally, in the form of strip tapes of thermal paper. The printer may be built in or be an attachment item.

Examples of programmable calculators are: HP 9810; HP 9815; HP 97; TI 59/PC100A.

Programs for these units can be stored on magnetic cards. The HP 9815 has the ability of using audio cassette tape which greatly enhances its program capabilities.

Computers

These units are much broader in the range of functions which they can perform. They are specified in terms of their total memory capabilities, that is, the number of "bits" capability for RAM (Random Access Memory) and ROM (Read Only Memory). The heart of these devices is the CPU (Central Processing Unit). Communication with the CPU is done in the form of commands entered, generally on a typewriter style keyboard. Many "languages" exist to communicate with the CPU such as Fortran, Cobol, Pascal, APO—but the most common language for the small base computers is the "Basic" language as it most closely resembles common English.

Some examples of devices which are available are: Commodore Pet, Apple II, Ohio Scientific C2-4P, Compucolor II, Wang, Radio Shack TRS-80 System.

There is a whole array of peripheral devices which can interface with the CPU. These include: on the input side, tape drives, desk drives, telco communication interfaces, and speech recognition systems; on the output side, CRT, high speed printers, mass memory disc drives and x-y plotters.

Making a Selection

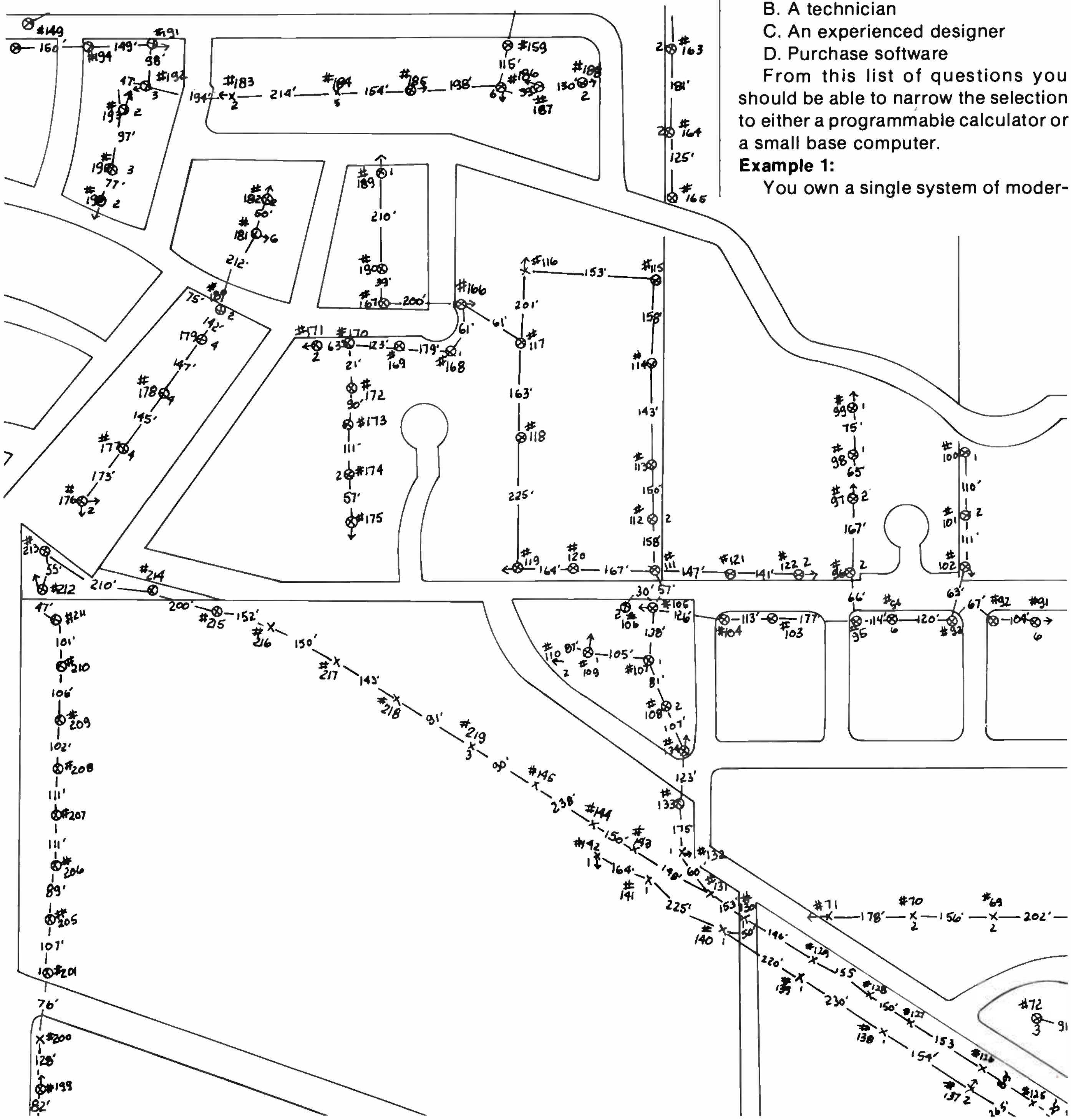
When selecting a system you must first ask yourself a series of questions. A great deal of thought should be given to your answers because even though the unit cost is very low, the total cost can still get quite high in terms of utility.

1. What is your current computer power?
   - A. In-house
   - B. Computer services
2. Where is the need?
   - A. In a central location
   - B. In a number of locations
3. Who will program?
   - A. An experienced computer operator
   - B. A technician
   - C. An experienced designer
   - D. Purchase software

From this list of questions you should be able to narrow the selection to either a programmable calculator or a small base computer.

Example 1:

You own a single system of moder-



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ate size. You are not currently using any time share computer base for billing or accounts management, nor do you have an in-house computer. You require extensions to be designed and possibly a small additional system in a "close-in" community. You would like to automate your accounts management, at least partially, and may be thinking of the use of addressable units for your apartment house complexes to cut down theft of service.

Your needs would indicate that the best investment might be a small base computer system.

Example 2:

You are currently using an accounts management time share service. You have a number of small systems which are located at far reaching areas and are not "clustered." You receive a summary record of all systems because they are all tied to the same share base. Your systems have good base subscribes and theft of service is not a problem.

Your design requirements are for small extensions and apartment complexes.

Your obvious choice is the programmable calculator. It would be far too expensive to initiate a complete new accounting system and you would lose your central control.

To demonstrate the possibilities of these devices, I have prepared a sample of each type of equipment. Representing the programmable calculator is the Texas Instrument (TI) TI-59/PC-100A. This unit was selected because of its ability to repartition memory to fit various program techniques and it's printout capability. Representing the computer is the TRS-80 System (Basic Level II). This unit was selected because of its flexibility of add-ons such as increased memory. This system can grown with your needs.

TI-59/PC-I00A

This system consists of a hand-held calculator and a detachable thermal paper strip printer (dot matrix).

It has the advantage of being very portable and easy to program. It has the ability to divide memory in most any format between program steps and RAM memory storage. Programs are stored on magnetic cards for fast entry.

While most programming is done on a custom basis by the operator for his needs, some software is now available.

Magnavox offers a complete set of five master programs and now an addendum. These programs include:

1. Levels Determinate Program:
   Used to select system operating levels for the system. The program will use any equipment as it is tied to unit output capabilities.
2. Normalization Program:
   Used to put unit performance to the operating levels for bench evaluation testing.
3. System Analysis Program:
   Used to evaluate system performance for any given cascade. This program displays noise ratio, cross-modulation ratio, second and third order beat ratios and composite beat performance.
4. Tap Selection Program:
   Used for proper tap selection in the design process. This program considers minimum tap output, tap window (i.e., low frequency over high frequency) cable losses and passive losses. It has the ability to remember splitter and coupler input levels for up to five splits per leg. For return systems (5—25 or 5—30 MHz), the calculator determines total loss between active devices to insure proper reverse sapcing.
5. Power Program:
   Used to determine, from IR voltage crops of cable and equipment current requirements, the best supply locations.
6. Addendum—Design Check
   Used for checking existing design and/or adding taps to existing system.

As you can see, the units have a great deal more power for the cost than most people think.

The average cost of the complete unit is $350.00 to $400.00. The programs sell for $75.00 with pre-programmed and labeled cards. (Note: Prices may vary depending on duty and country).

Radio Shack TRS-80

This is a micro-processor system using a Z-80 circuit as the CPU. It is a true computer system with memory capabilities in many ranges from 4K to 48K. It is expandable for use with a line printer, mini-disc drives (up to four), tap drives (up to two), RS-232C serializer and many other peripherals.

The basic unit consists of three components: Keyboard (contains CPU), Audio Cassette Tape drive, and a CR-7 Monitor.

Again, many programs are custom-made by the user but in this case, there are also many program packages available for accounts management, mailing lists, records management, and inventory control systems.

Magnavox has also developed software packages for CATV systems engineering using this device. These will be available soon in a similar format as for the TI-59/PC-I00A.

The programs include:

1. Systems Analysis Program:
   Combines the first three of the TI programs and adds error messages, temperature considerations and full print-out (when used with line printers).
2. System Design Program:
   The function is the same as for the TI-59 but the format is in a matrix to allow manipulation without re-entry.

These programs are for Level II machines only.

Again the cost of the machine is far out-weighed by its capabilities. A Level II machine sells for just under $900.00 with 16K memory.

A full system including disc drives, line printer and 16K interface can be purchased for under $5,000.00.

Summary

It should be realized that there is no such thing as "computer design," only "computer aided design." This is to say that the designer is still the key element in the system layout function.

The computer or programmable calculator is used to remove the cumbersome job of the mathematical calculations and allow the designer to spend his time on the critical areas such as efficiency and reliability of the system. If a designer is able to save two to three amplifiers in the system as a result of the tools with which he is working, those tools will be paid for in very short order.

This paper was prepared to lay out some of the tools which are available on the market today. These units mentioned are by no means the only available units nor are they the only ones recommended for this purpose. Many other devices could serve the purpose equally as well. Shop to insure the purchase you make will fit your long term goals. **C-ED**

Editor's note: This article was prepared while Mr. Polis was with Magnavox CATV systems, Inc., Manlius, New York. Currently, he is the Director of Engineering and Operations for Comcast Corporation.

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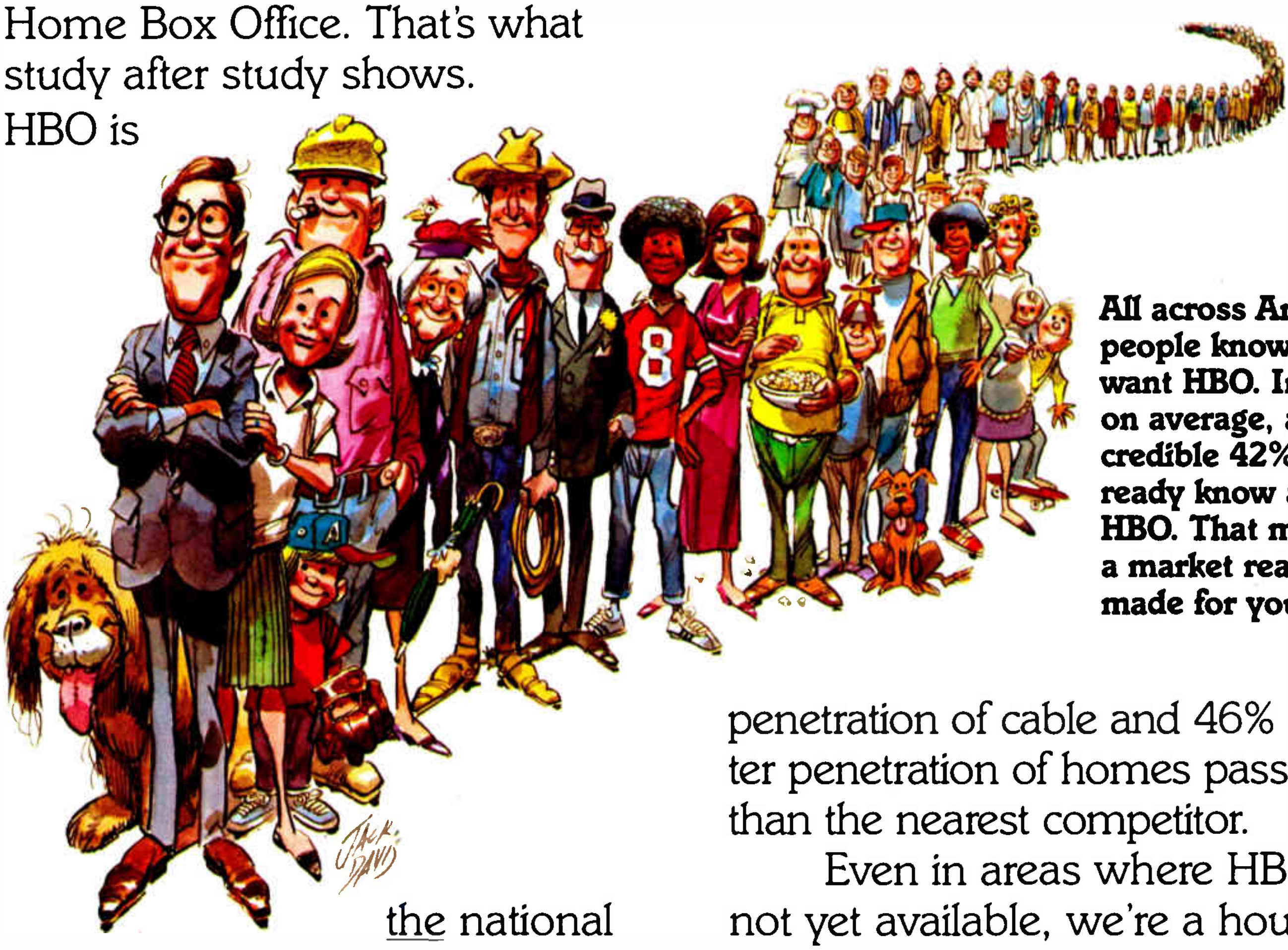

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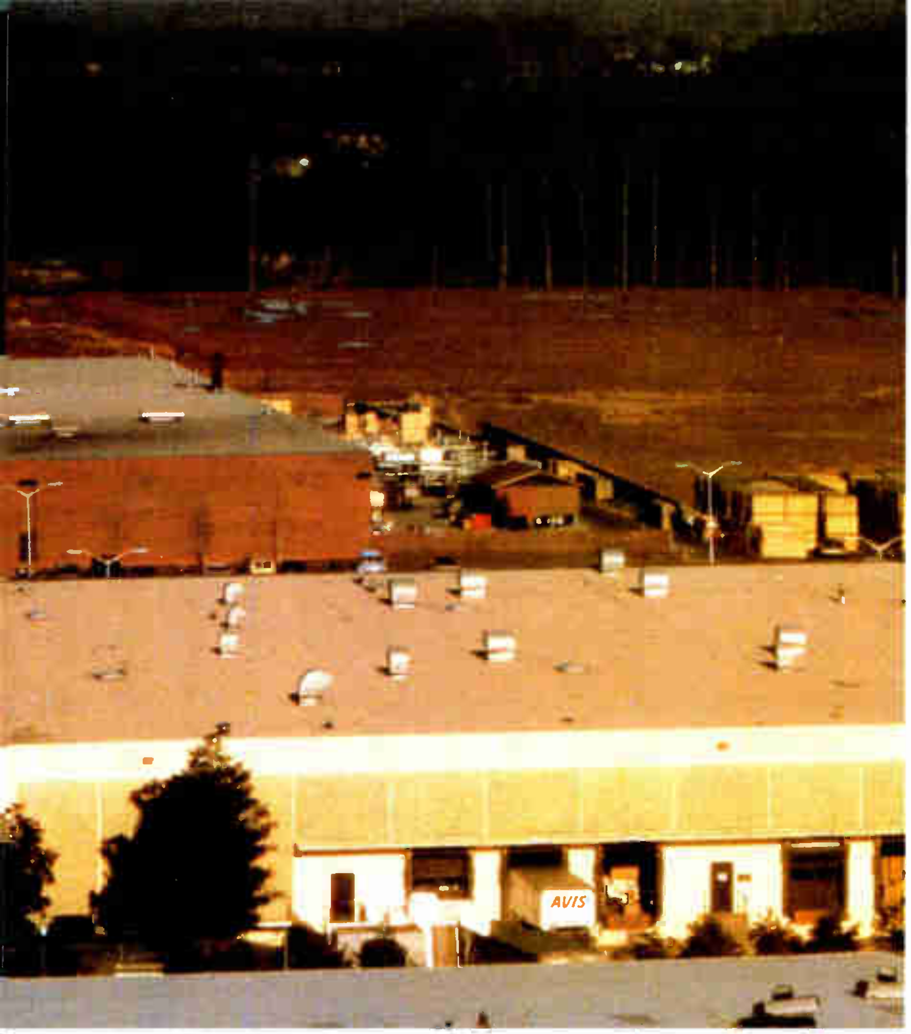

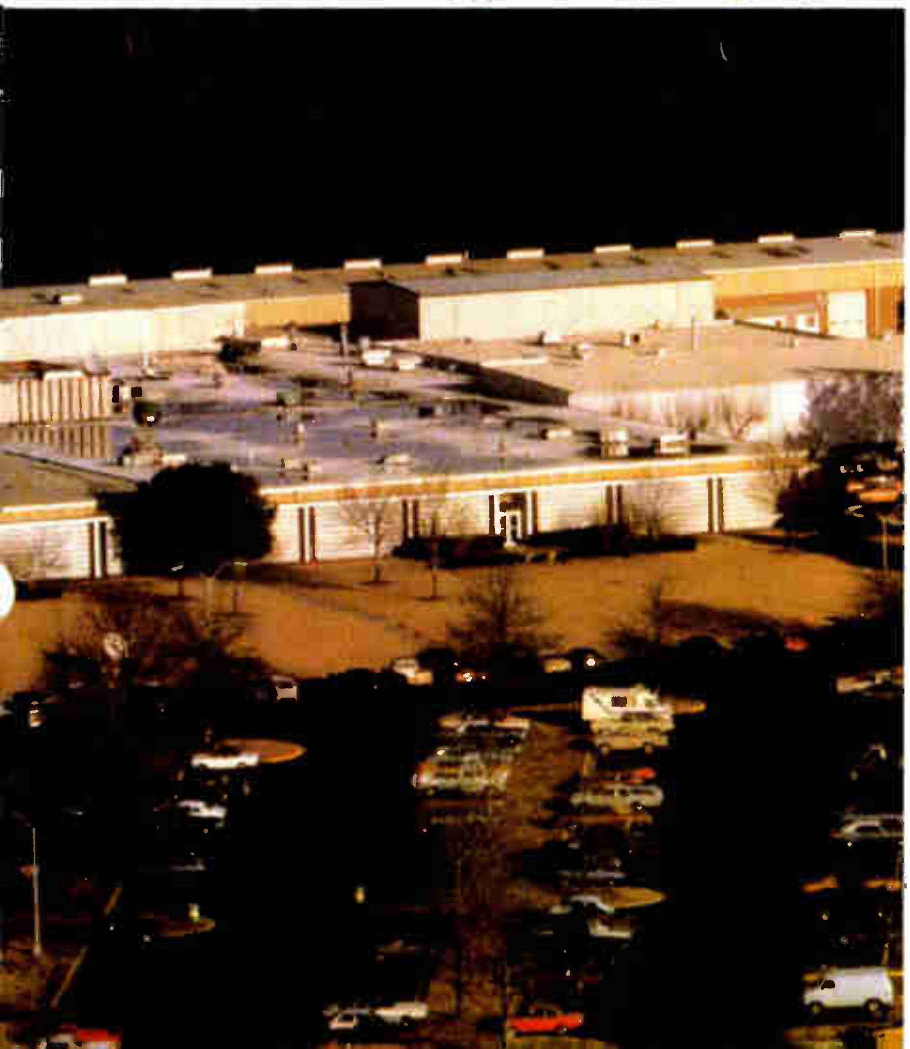

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DATA TRANSMISSION

By Robert V.C. Dickinson, President
E-Com Corp., Stirling, New Jersey

There is no doubt about it; CATV is in full swing throughout this country. Franchising and building are back to the fever pitch of some years ago and rapid expansion is occurring throughout the industry. Penetration ratios are increasing and profits are being made. At this time entertainment is king. Pay TV packages have literally been the salvation of the industry and continue to spur phenomenal growth and profits. Along with these strides, generally higher performance and quality are being offered by new systems which in turn improve the carriage of TV entertainment packages and increase their popularity.

Are there no uses other than entertainment for this high quality medium? Is it not possible that other services can be handled on a cable system which will benefit the community and the cable operator? These questions receive resounding affirmatives. CATV holds the key to the long sought wired city and is now more able to deliver than ever before. Cable systems are reaching out to cover larger portions of the community and are becoming a universal transmission medium to and from the residential, commercial and institutional sectors of the community. What services may be addressed by CATV? A part of virtually every response to this question includes the term "data transmission."

The first thought of data transmission on CATV may stimulate visions of video alphanumeric services such as news, weather, stock market, etc. Certainly this is data but since it is transmitted in a purely video format it will be excluded from the following discussion. In the CATV framework it is probably fair to include all non-video services under the framework of data. We will, however, restrict this discussion to "digital" data services since this category embraces the bulk of current and near term applications.

Some Data Buzzwords

"Digital" denotes a system where only a certain number of discrete levels are transmitted to convey information. Conversely in an "analog" transmission a continuous range of levels is transmitted such as the variable shades of grey obtainable in a television picture.

There are both digital and analog computers. Digital computers account for well over 99 percent of today's usage. Digital computers obviously lend themselves to digital communications for interconnection with data sources, peripherals and other computers. Over the past few decades digital data transmission has been increasing by leaps and bounds. Much digital transmission is done over telephone company facilities. The telephone companies, however, are not as fortunate as a cable operator in that their medium is subject to many degradations and lacks the capacity of CATV. Noise pick up on telephone twisted pair is usually far greater than the equivalent pick up on a well constructed and maintained coaxial CATV system. The capacity of a telephone circuit is normally one voice channel that perhaps, with sophisticated equipment can handle data at speeds as high as 9600 bits per second (BPS). The capacity of a CATV system is hundreds of megahertz as opposed to less than 100 KHz for a telephone pair. The CATV system can support many channels of television, radio, and data on a single coax rather than the one or more pairs per circuit required for telephone transmission.

The most common form of digital transmission employs only two levels and is called a "binary" system. The information to be passed is, by some predetermined procedure, encoded using (in the binary case) two states which may change periodically at what is known as the "data rate." The two states may be called "1" and "0," "Mark" and "Space," or "On" and "Off." It can be seen that it is much easier to distinguish between, say, 0 volts and 1 volt than it is to attempt to measure a specific value at some intermediate level as required in an analog system.

Due to the decisional nature of the detection process digital signals are more immune to noise interference than analog signals. On the other hand, to transmit some arbitrary intermediate value in a digital system requires enough digital bits to encode that level to the desired precision. This requires much more bandwidth than would be required to transmit the analog value to the same precision. Since it is well known that "you can't get something for nothing" it is not surprising to learn that the amount of information transfer possible in any communication system is a function of the bandwidth available and the operating signal to noise ratio.

A digital signal, when properly received, can be retransmitted with no degradation. It is therefore possible to transmit digital signals over indefinitely long paths as long as regenerator/repeaters are spaced close enough to avoid errors due to noise. On the contrary, analog signals once degraded by noise cannot be regenerated. As we all know, one can only transmit analog television pictures through so much CATV system before they become contaminated by noise to an unacceptable degree.

A few other data transmission parameters are of interest. On any type of circuit, signals may be transmitted in a number of basic forms. If the signals go one way only it is called a "simplex" circuit. A circuit which will handle transmission in both directions but only allow operation in one direction at a time is called a "half duplex" circuit. A typical "push to talk" two-way radio circuit is half duplex. In a "full duplex" circuit, transmissions may be carried on simultaneously in both directions. Full duplex telephone data transmission circuits are usually four wire circuits.

Data may be transmitted one bit after another on a single circuit. This is called "serial" transmission. A computer bus has 8, 16 or more parallel lines or circuits which suggest "parallel" transmission. Parallel transmission is often employed over relatively short distances. Where direct cable interconnection is practical, however, most data transmission involving longer distances employs serial data streams. Parallel data is usually converted to serial by the computer or communications controller.

There are two general serial transmission formats called "asynchronous" and "synchronous." In both of these formats the data is transmitted at a predetermined speed known as the "bit rate." In an asynchronous circuit the transmission is made up of discreet groups or characters. Each character (fig. 1) includes a "start" signal followed by a series of information signals and concludes with a "stop" signal. The receiving equipment in an asynchronous circuit idles until a start signal is received. Since the data rate is known, the receiving equipment, upon receipt of a start signal, initiates a sequence of timing intervals based on the data rate. Each data interval is sampled more or less at its mid-point in time and information is extracted. At the conclusion of the specified number of data intervals in the character the receiving equipment checks for a valid stop signal and concludes processing of that particular character. At this time the equipment awaits the receipt of the next start signal to repeat the detection sequence. Since the receiving equipment is ready to receive another character at any time after the conclusion of the previous character it can be seen that no particular timing relation is required between characters, i.e., it is asynchronous.

The asynchronous system is typified by a teletype machine. The teletype machine receives a steady mark signal from the line when no information is being sent. Upon the receipt of the first space signal a clutch is released and a series of cams and contacts sample the line signal at intervals timed to match the center of the data pulses. When the predetermined number of data pulses in the character has been transmitted, the character is terminated with a stop signal which is a mark signal. When the operating shaft of the teletype completes one revolution and the stop signal (mark) has caused disengagement of the clutch, the shaft stops. The next start (space) signal may come immediately, reinitiating the decoding operation, or it may be delayed for some time as might be the case with a slow typist on the transmitting end. These mechanical functions can be reproduced electronically by use of shift registers, timing circuits, UARTs and the like. Much data transmission is accomplished in the asynchronous format.

The synchronous format (fig. 2) is slaved to a continuously running data clock. The data system therefore must produce a new information bit for every clock period. Protocols must be developed for synchronous circuits to indicate the start and end of the message and other timing functions. There can be no slippage between transmit and receive clocks since this will result in failure to properly decode the received data. Synchronous circuits are somewhat more sophisitcated but more efficient in data handling due to the absence of frequent start and stop signals. They are being used more and more as the computer and the communications industries develop.

There are numerous data formats used in forming the actual data stream. These include "nonreturn to zero" (NRZ), "return to zero" (RZ), "alternate mark inversion" (AMI), "biphase," and many others. Each type of system has its own advantages and applications which are beyond the scope of this discussion.

Figure 1
a) Asynchronous Data (8 Bit ASCII)

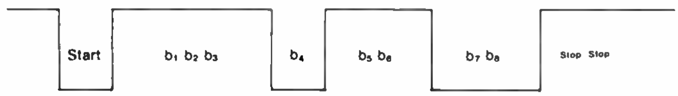


Figure 2
b) Synchronous Data

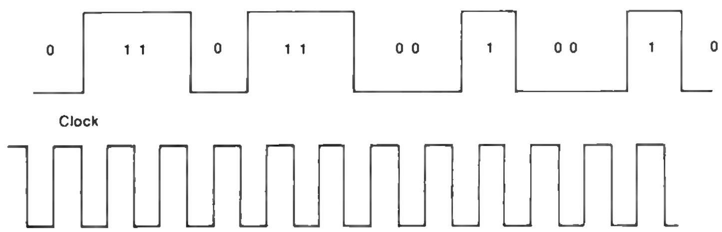
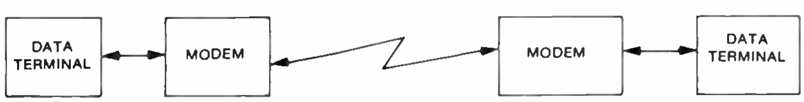


Figure 3
Point-to-Point Circuit

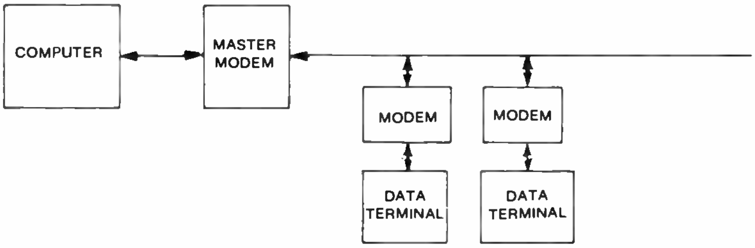


Data Circuit Configurations

Data circuits take on many forms as they are applied to various services and communications media. The most elementary form of a data circuit is known as the "point-to-point" circuit. As the name implies, a point-to-point circuit allows data transmission between two discreet points in the communications network (fig. 3). Point-to-point circuits include many current applications such as teletype to teletype on a dedicated line, computer port to CRT or other peripheral, police department to fire department, head-end to management office, etc. Point-to-point circuits are often implemented on dedicated telephone circuits. A dial-up telephone circuit is point-to-point during its period of operation since there are but two ends to the circuit and but two data terminals involved in the interchange.

A "polled" circuit (fig. 4) is generally utilized when it is necessary for a single device or terminal to communicate with a number of remote devices. The entire polled network is under the control of central polling equipment. A simple form of a polled circuit utilizes the central equipment to address each remote unit in the system in some predetermined sequence. When a remote unit receives a transmission including its unique address, it an-

Figure 4
Polled Circuit

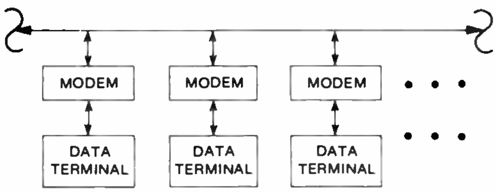


swers, thereby establishing the communications circuit. At that time information may be sent to or from the remote unit as the system may require. There are many variations of protocol in polled circuits. Polling sequences can be arbitrarily and dynamically changed. Group addressing and "all-call" functions are available. Various response formats and message lengths may be employed.

The polled system is designed to accommodate the maximum required throughput for the master unit by use of the proper data rate, formats, and protocol. In general the remote units operate only a small fraction of the time and handle relatively little data in contrast to the master unit. Polled systems find many applications, particularly in computer systems with a number of remote terminals. The entire polled system requires only one computer port, whereas point-to-point circuits to each of the remote units would require an equivalent number of computer ports to service the network. A polled system is a restricted form of "time division multiplexing" (TDM).

In a TDM system, time is divided among the remote terminals in such a way as to allow transmission of the required information. TDM systems with fixed formats operate with a synchronous data stream and assign time slots for each individual remote terminal. The telephone company's T1 digital voice transmission system will accommodate 24 voice channels. Each voice channel is allocated seven information bits and one framing bit in the overall repeating digital sequence. The data rate for each analog voice signal is 56 kilobits per second (KBS) representing the seven information bits per voice channel in the T1 system. Extrapolating this to 24 channels and adding some timing overhead produces a 1.544 megabit per second (MBS) data stream. This is typical of a fixed format TDM system. Many variations exist in TDM systems and more can be expected to appear as data transmission on cable progresses.

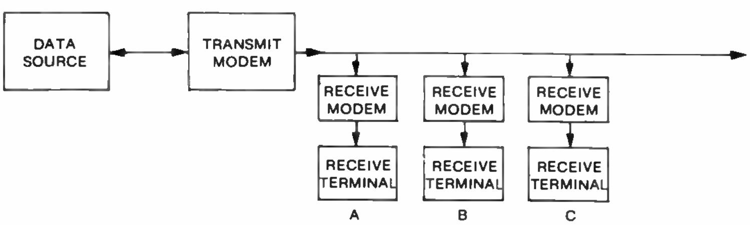
Figure 5
Contention Circuit



Another system designed for handling multiple users is the "contention" system (fig. 5). The protocol in the contention system allows seizure of the idle channel by the first unit requiring service. The same protocol limits the length of time available to any unit plus other restrictions to maintain acceptable availability and performance to all users.

The above are major general categories of two-way data services. One-way services are generally those that simply supply a stream of data such as the teletype news wire service. When more than one teletype is being fed, this becomes a "broadcast" service (fig. 6). This latter has many variations, including some versions which segregate users by codes in such a way as to transmit certain data to a certain user group and other data to another user group. These groups may at times overlap. Many variations of these basic circuit configurations exist providing a broad range of combinations able to accommodate virtually any type of data service.

Figure 6
Broadcast Service



Data Interfaces

In configuring data circuits there are generally two types of equipment at any location. There is a "data terminal" which may be a computer, CRT, teletype, printer, etc., and there is the "modem." The word modem is a contraction of the words "modulator" and demodulator." The modem is used to adapt or modulate the data to a suitable form for transmission on the communications network and to recover or demodulate the received data from the data transmission network. There are modems for telephone circuit operation as well as for CATV operation. There has been a great deal of standardization at the interface between the data terminal and the modem. This is fortunate because without this standardization it would become an impossible job to economically interface the widely varying data terminal outputs with the modems, and vice versa.

A number of organizations throughout the world have undertaken to provide interface specifications for data circuits. These include the Electronic Industries Association (EIA), the Consultative Committee for International Telephone and Telegraph (CCITT), the Bell system, the military, and others. Documents put out by these organizations specify the interface signals in terms of voltage or current, impedance, data format, data rate, various tolerances, and a multitude of control signals and circuits. As a result of this standardization it is generally sufficient to know which

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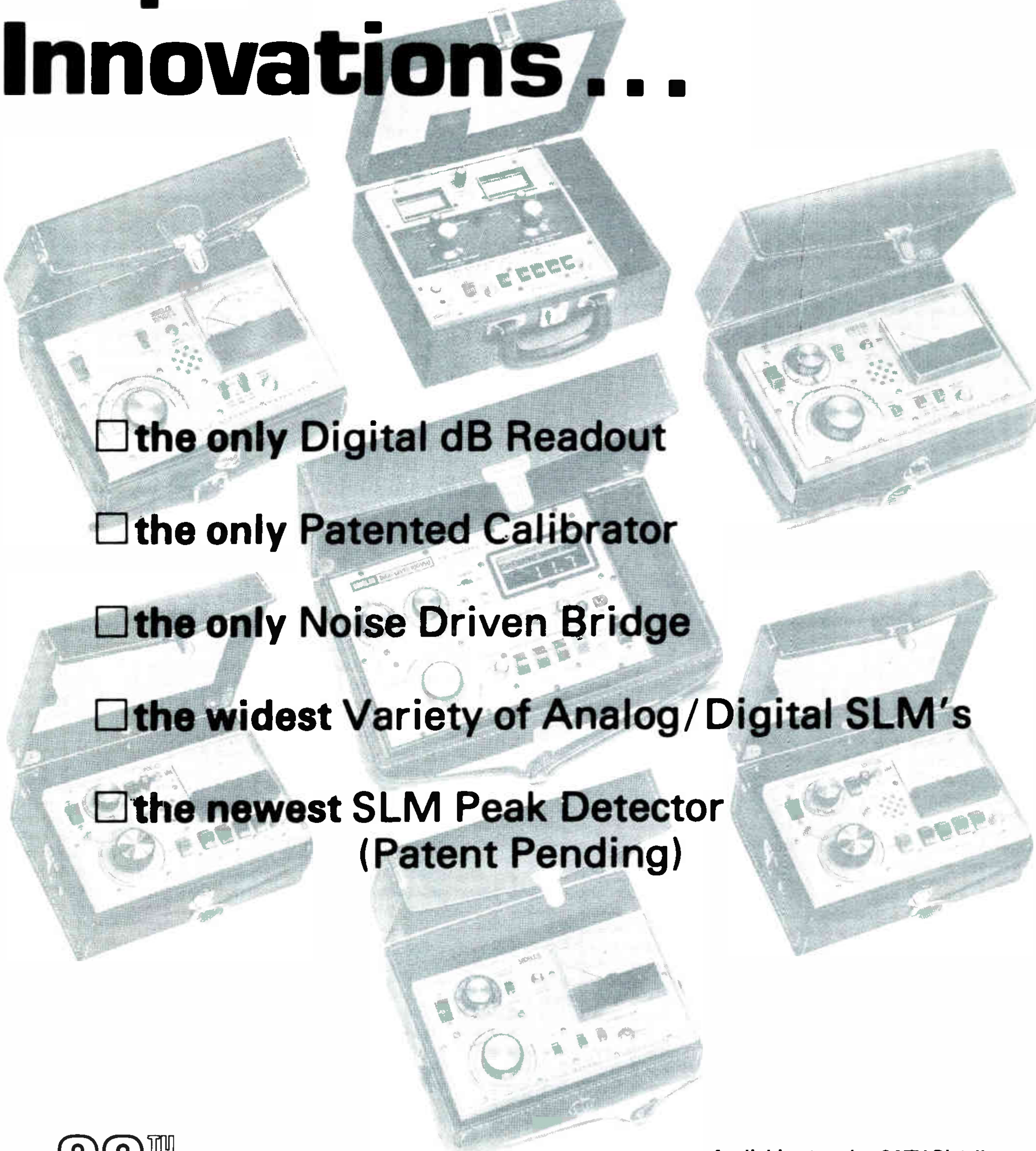

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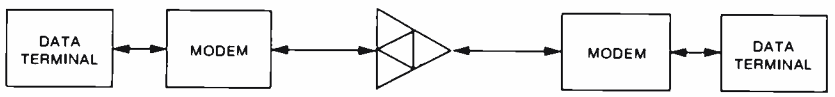
interface specification applies when interfacing a data terminal to a modem. The most common specification for low and medium speed data is EIA RS-232C. Others such as Bell 303 and DS1, CCITT V.24 and V.35 are commonly used. It should be noted that there are often many options associated with these specifications, particularly regarding the control signals. The data user and the transmission provider still must beware of possible confusion in application of these specifications.

Figure 7
Data Transmission on Single Cable



Data Transmission Implementation on CATV Systems

As in any other specialized area there are numerous factors affecting the use and performance of the CATV network for data transmission. A few general comments are in order to briefly outline the method of application of data transmission to CATV.

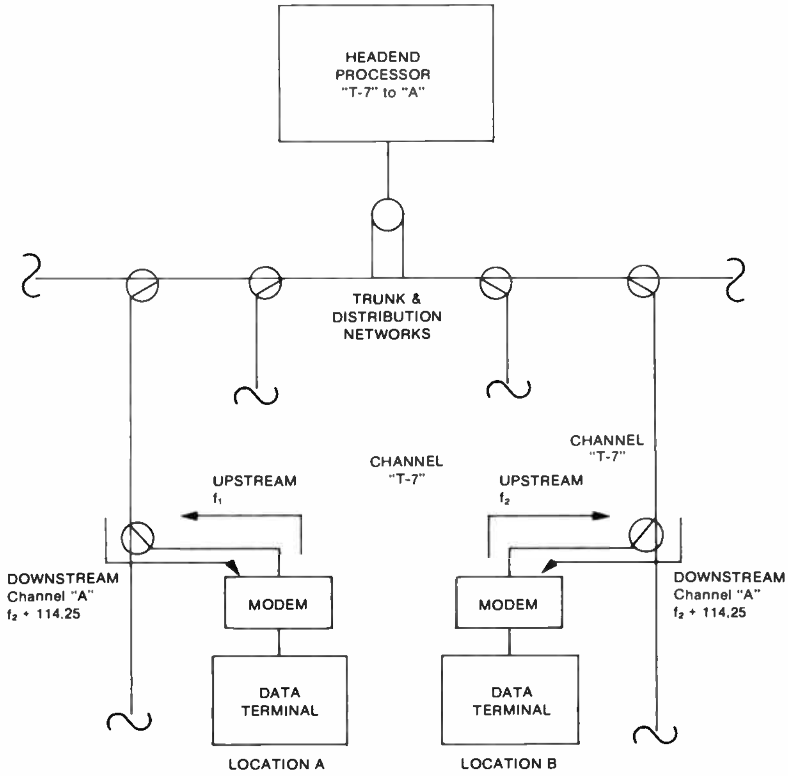
Generally speaking all signals on a CATV system are "frequency division multiplexed," i.e., separate signals are assigned separate non-interfering frequency allocations on the cable. This is just like channels 2, 3, and 4 operating on the same cable, each being received separately without interference from the others. In a point-to-point circuit the two modems are assigned two separate narrow frequency allocations in the overall available spectrum on the cable. Communications can be established between two points on any given piece of coaxial cable without amplifiers or with normally spaced two-way amplifiers (fig. 7). This is done by the assignment of appropriate frequencies for use in both directions. This simply says that a pair of modems can talk to each other if they are assigned frequencies allowing transmission from one and reception by the other and vice versa. In the general case, such a direct path does not exist since all cables emanate from a headend or a hub and the two points fall on separate branches of the CATV tree. The general solution to interconnect two users (fig. 8) requires that the transmissions from all modems go upstream to the headend, be translated in frequency and go downstream on the receiver frequencies of the appropriate opposite modems.

A full duplex circuit between users A and B requires the assignment of two separate upstream data channels (generally small fractions of a TV channel). Upon arriving at the headend or hub the two separate data signals are joined since the separate system branches join. These two signals (usually in the same portion of the CATV spectrum) are translated in a CATV type processor to the channel assignments for downstream transmission to complete the circuits to the opposite modems. In other words if the upstream transmissions were in Channel T7 and the downstream signals were in Channel A a CATV processor would translate the two upstream T7 signals to become two downstream Channel A signals. The specific frequencies assigned to the transmitters and receivers are normally arranged so that the translated upstream signal from location A will be received by the receiver at location B and vice versa. It may be seen that, in the general case, full duplex data transmission between two points requires two upstream data channels plus two downstream data channels. Polled circuits can be operated with the same four total channels regardless of the system size since all remote units are configured for the same frequencies and only one remote unit transmits at any given time.

There has always been great concern about data signals interfering with TV. Since TV interference can sometimes be seen when it is 60 dB or more below the TV carrier, great care must be taken to avoid interference from data services and sometimes the reverse. This problem is quite similar to that encountered with multiple TV signals, and involves the balancing of levels to achieve the best compromise between distortion products and signal-to-noise ratio. There are many facets to this problem which must be carefully considered before implementing data circuits on the cable system. The following rationale is a simplified approach which will give approximate signal level values for data.

Consider a 6 MHz spectrum allocation into which it is desired to insert a number of data channels. Let us assume that the modems for the desired data channels occupy 100 KHz each. Sixty such allocations could be made within a single 6 MHz channel. If we consider a normal TV signal for the system as a reference level of 0 dB it would be reasonable to allot 1/60 of that power to each data channel: $10 \log_{10} x (1/60) = -18$ dB. The data signals can therefore be run 18 dB below video

Figure 8
Data Transmission on CATV Systems



carrier and the total power will not exceed the power of the nominal video signal. This seems like a reasonable approach since data signals can now be substituted for TV signals on a basis which will not increase the total power impinging on the amplifiers.

Looking at signal to noise ratio we see that the total noise in the 6 MHz TV channel will be divided by the same 60 and will also be 18 dB less. The resultant data channel signal to noise will then be derived from a signal at -18 dB from the reference and a noise level at -18 dB from the TV noise level. In essence the signal to noise ratio is the same in each data channel as it was for the TV channel. It is probably fair to expect a signal to noise ratio of 40 dB or greater in a TV channel. Forty decibels signal to noise in a data transmission environment is generally more than adequate for very high performance.

As previously mentioned, the above discussion is rather cursory due largely to the fact that the production and distribution of intermodulation products is a very complicated subject. Experience has shown that operation of data circuits 4 to 6 dB below the criteria derived above is generally adequate to assure freedom from harmful intermodulation effects while providing signal to noise ratios conducive to high quality data transmission.

In summation, it can be said that application of data transmission to CATV systems can be done in a fairly routine manner and operation on a well maintained system will provide high quality services to the users.

Actual CATV Data Transmission Usage

Experiments have been underway for quite a number of years on CATV systems to demonstrate the feasibility of data transmission. At this time there are a number of companies which manufacture hardware for many types of CATV data applications. Modems for the more popular implementations are available competitively from several manufacturers. It is well to point out that a number of industrial users have gotten the jump on the CATV field by using what they call "broadband systems" in their plants. These are simply CATV systems supplying the desired video, audio, and data requirements throughout the plants. These include organizations such as General Motors, Dow Chemical, Ford Motor Company, Armco Steel, Mitre Corp., a number of military installations, certain telephone companies and others.

In the CATV industry the largest user of cable data transmission is Manhattan Cable where the major banks plus a number of other commercial users operate medium and high speed services. Probably the most used circuits and configurations are asynchronous and synchronous circuits up to 9600 bits per second in point-to-point and some polled configurations.

A very popular data transmission configuration for cable utilizes a polled network handling low average data rates in security and energy management applications. These systems are built to support thousands of remote terminals which are polled at frequent intervals to report the status of, and in some cases pass commands to, the remote locations. High speed polling and contention systems are gradually being supplied to industrial and institutional users in business, schools, hospitals, and the like. Interactive services for residential subscribers are being implemented on polled systems. A new banking and merchandising package offered by HomeServ, Inc. of New York City utilizes a home terminal which includes a microprocessor. The microprocessor oversees the data transmission in both directions and controls the functions within the terminal. Data is transmitted in blocks to the home terminal. The microprocessor, with the aid of a character generator, sets up the information to be displayed on the TRV set. This information is fed into a simple modulator allowing the TV set to be used as a CRT. The subscriber, using a keypad, may make requests or give commands, and the required information is transmitted downstream from the central computer and displayed on the TV set. This relatively sophisiticated application is a logical extrapolation of the principles reviewed previously.

Profitable applications of data transmission over CATV facilities are just beginning to develop in various areas of the industry. Because of the advantages of the cable as a transmission medium, this entire area can be predicted to increase very rapidly in the near future. Whereas data transmission is a subject of academic interest to many at this time, data transmission in one form or another will be employed on virtually all CATV systems in the foreseeable future. **C-ED**

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Comstar and Satcom I: Trouble Over Head

By Pat Gushman

As in a scene from the upcoming and much awaited sequel to the film "Star Wars," entitled the "The Empire Strikes Back," the FCC's Common Carrier Bureau has absorbed another onslaught of satellite applications and is now bracing itself for the ultimate challenge of what to do with them.

Present and would-be carriers have beaten the Commission's May 1 deadline for applications and the Bureau must now review the status of numerous proposals for replacement satellites, new satellites, repositioned satellites and, what's more, entirely new satellite systems.

Of immediate concern to the cable television industry, of course, is stil how the Commission will eventually respond to RCA's interim plan to use COMSTAR in the wake of the loss of SATCOM III which had been scheduled to be the primary carrier of cable programming services until it was lost, shortly after launch in December.

The Bureau has granted Southern Satellite Systems and RCA temporary authority to lease the last SATCOM I transponder to Ted Turner for the Cable News Network beginning June 1. Acting under delegated authority, the Bureau granted authorization from May 20 to December 1 for Southern Satellite and RCA to provide transponder capacity, but did not deal with complaints filed by two other competitors for access to the satellite, Spanish International Network has also filed a complaint which is still pending.

The petitions to deny the application for a transponder for CNN parallel the complaints, the Bureau said, which essentially involve RCA Americom's allocating procedures for assignment of transponders on its satellites. They do not warrant holding up service to CNN and the Commission will address questions of customer access in its forthcoming consideration of the complaints, the Bureau said.

"The grant of authority does not constitute an opinion on the claims for use of the channel," it said, and "is without prejudice to a Commission determination in this regard."

The 1979 complaints filed by Spanish International and Eastern Microwave centered on allegedly unfair methods used by RCA Americom to allocate transponders on SATCOM F-1 and F-3 to potential customers. National Christian Network, which was allocated a transponder on SATCOM F-3, has filed a complaint about the method which RCA Americom has proposed to allocate the capacity of that satellite's successor.

The successor, for now, appears to be capacity subleased on the COMSTAR system through AT&T. At presstime, in addition to National Christian Network, ten other potential cable programmers have been assigned transponders on COMSTAR D-2 including: ESPN, Rainbow Communications, Southern Satellite Systems, Showtime, HBO (2), Satellite Communication Network, Spanish International Network, Warner-Amex, and United Video. These assignments were accomplished by a lottery held on April 7.

The Common Carrier Bureau's statement said the temporary authority on SATCOM I for CNN was made under the provisions of the Communications Act requiring it to determine, in effect, whether there is a public need for the additional channel. It noted that the issue raised by the petitioners for denial "goes to the question of *who* should be served by the channel, not whether there is a need for it." That question, it said, "should be resolved via the complaint process which the petitioners have already invoked."

It recognized "there is considerable controversy surrounding the manner in which the customer, Cable News, came to be the entity for which the channel of communication is being sought." But the Communications Act does not require resolution of that controversy in the context of its provisions of authorization of a channel," the Bureau said.

If there is one thing that will get RCA and other carriers, as well as the FCC, off the horn, if you will, it is more capacity. RCA has applied to launch and operate another SATCOM III by June of 1981, SATCOM IV at 83 degrees west longitude by October 1981, and now has put in for SATCOM V for any slot that is available.

At the same time, RCA has submitted applications for replacements for SATCOM I and SATCOM II both of which are expected to reach the end of their lives sometime in 1983.

AT&T, which, for a while anyway, will be subleasing COMSTAR capacity to RCA for the second cable network has itself applied for a three satellite system to replace COMSTAR which also will be nearing the end of its life span during the next few years. GTE, AT&T's sometime partner with COMSAT, has also filed for its own system with three satellites of 16 transponders each in the K-band.

All of the proposed systems are estimated to be in the $200 million range.

Other carriers still very much in the picture are Hughes Communications with designs on 7, 79 and 132 degrees west longitude and Southern Pacific Communications which is after 83 and 132 degrees west longitude.

Western Union, meanwhile, has also filed to launch a fifth satellite for its system.

The Commission is expected to announce a full-blown proceeding with regard to the future structuring of the domestic satellite system. The carriers themselves are maintaining that each satellite is as important as the next in establishing and maintaining the effectiveness of their systems.

Engineers within the cable industry, meanwhile, admit to being cautious about what to expect from COMSTAR since few have dealt with it operationally. RCA officials dismiss that concern, however, because all communications will still pass through their facilities in Vernon Valley, New Jersey.

COMSAT General's original concept for COMSTAR was three in-orbit satellites and a ground spare. COMSTAR D-1 and COMSTAR D-2 were launched in May and July of 1976, respectively. The COMSTAR D-3 satellite was launched in June of 1978. COMSTAR D-9 could be launched as early as this fall if approval is given and a launch pad can be arranged.

D-1 is currently positioned at 128 degrees west longitude, D-2 at 95 degrees W.L. and D-3 at 87 degrees W.L. COMSAT General proposes the orbital slot of 128 degrees W.L. for D-4, with D-1 being co-located with D-2 at 95 degrees W.L. After the launch of D-4, it would be placed in the position of D-1. Then D-2 and D-1 would be co-located by moving the D-1 satellite to the D-2 satellite location, the powered transponders in each satellite will be reduced to 12 in order to conserve the batteries, and the combination D-1/D-2 then would be operated as one satellite at 95 degrees W.L. The D-3 satellite would continue to be operated at 87 degrees W.L.

AT&T will provide the 11 transponders to RCA on an unprotected, preemptible basis for one year terms beginning June 1. Subject to availability, the terms may be extended for at least six transponders until December 31, 1981. RCA Americom will access the transponders by means of authorized earth stations, in accordance with agreed upon technical standards and operating procedures. **C-ED**

C-ED's Satellite Derby

Degrees West Longitude	
55	Satcom V (open)
59	
63	
67	
71	
75	Hughes app;, Westar V app.
79	Hughes Application
83	Satcom IV app.; Western Union AW-2 app.; Southern Pacific app.
87	Comstar D-3; AT&T app.
91	Westar III; AW-1 app.
95	Comstar D-2 (and D-1 app.); AT&T app.
99	Westar I; Westar IV app.
103	AW-2
104	ANIK-I
109	ANIK-B
114	ANIK-III
119	Satcom II; Satcom II replacement app.
123.5	Westar II; Westar III app.
128	Comstar D-1; Comstar D-4 app.; AT&T app.
132	Satcom III (for F-3); Southern Pacific app.; Hughes app.
135	Satcom I
136	Satcom I replacement app.

K-Band

100	GTE app.
103	GTE app.

Operating Procedures

1. *General Requirements*

a. An orderwire must be provided at RCA Americom's expense between AT&T's Hawley, Pennsylvania Satellite Facility Management Center (SFMC) and RCA Americom's control station at Vernon Valley, New Jersey. The Hawley SFMC will be the AT&T contact for day-to-day operation of the satellite system.

b. RCA Americom will ensure the presence of a trained technician at all transmitter locations at all times transmissions are occurring.

c. Prior to initial illumination of a transponder by RCA Americom, at least 48 hours' notice must be provided to the Hawley SFMC by RCA Americom. Such notice must include the transponder configuration, such as switch pad value, coverage beam, power to saturate, etc.

d. Proper illumination of transponders is a responsibility of RCA Americom. Should improper illumination be detected by the Hawley SFMC, RCA Americom will be notified of this and corrective action must be taken immediately.

2. *Preemption*

a. Sun transit avoidance for protected transponders. The Hawley SFMC will inform the RCA Americom control center of the times for preemption associated with sun transit avoidance switching for protected transponders, at least thirty (30) days in advance of such preemption.

b. Other. When preemption is required, the Hawley SFMC will notify the RCA Americom station via the orderwire and RCA Americom will arrange to have the transmit carrier removed from the affected transponder immediately. When and if the regular facility for the protected service becomes available, the services will be restored to the regular facility and RCA will be notified as soon as possible thereafter that its transponder is available again for service.

3. *Maintenance*

Release of transponder for routine maintenance will be arranged by Hawley SFMC and RCA Americom's control center in such a manner as to minimize interruption of RCA Americom services.

4. *Contacts*

RCA Americom and AT&T will exchange office and home telephone numbers for the first three levels of operating management personnel prior to initiating service.

Abstracts of Technical Papers To Be Presented at the NCTA Convention

VISIONS OF THE 80s

For our special NCTA Convention issue, C-ED presents abstracts of the technical papers scheduled to be submitted to the NCTA Engineering Committee. Topics range from the exploration of satellite direct receive technology and expanded bandwidth to management and marketing techniques.

Cable Service: A Data Distribution Link

By Thomas G. Albright,
Printer Terminal Communications Corporation

Abstract

The following paper describes a potentially high profit business for well managed, forward looking cable companies.

There now exists a complete turn key data distribution system that can be simply added to existing cable operations. It requires no additional bandwidth as it can be added as a subcarrier to FM broadcast stations. It can show a substantial profit to the operator as it has the ability to deliver information to customers in a "broadcast" mode. This not only reduces distribution costs, but also allows simultaneous reception of information by a large number of users. This is a highly valuable feature for users of the system that have "time fragile" information (such as price changes) and want it sent to a relatively large number of recipients.

Receiving Auxiliary Services Via Satellite

By Thomas M. Keenze,
United Video, Inc.
Tulsa, Oklahoma

Abstract

The number and type of services to be offered along with video on satellite transponders will be large and varied. These will provide financial opportunities for carriers and CATV operators. This report deals with methods of transmission, types of services, and receive station capability requirements.

Many services other than television signals are now available on the satellites. All of the non-TV signals which are available now and will be made available in the future are being put there to make money for both the CATV companies and the carriers. In order to avail yourselves of the potential revenues sources which are and will be available, a CATV operator will have to have a satellite station capable of proper reception of this additional information.

Consumer Software Services Via Cable Television Systems

By Charles L. Dages,
Jerrold Division
General Instrument Corporation

Abstract

Application of digital integrated circuit technology to consumer products is increasing at an explosive rate. The wide selection and phenomenal demand for electronically based entertainment devices indicates the beginning of the long awaited "Home Computer Revolution" is at hand. The General Instrument, Jerrold Division's PlayCable™ system addresses this new market segment with a unique offering of advanced home video services with capabilities eclipsing the European Teletext/Antiope services. Specifically, the PlayCable subscriber video terminal system will be demonstrated to efficiently provide a large variety of entertainment, education and information services, and will provide the subscriber with a useful software service. Technical details of the PlayCable CATV data transmission system are presented, highlighted by a headend computer system which will be the basis for a host of future CATV data services. The unique time/frequency division multiplexing scheme employed to transmit the service will be shown to be spectrally efficient and frequency agile.

400 MHz—A Challenge For the Hybrid Amplifier

By G. Luettgenau, A. Morawski, and W. Inouye,
TRW Semiconductors
Lawndale, California

Abstract

The trend towards 400 MHz charges the hybrid manufacturer with the responsibility of providing increased performance without jeopardizing the high standards of quality and reliability required for profitable system operation. Thus, a prudent response lies in the gradual implementation of the new generation of hybrids.

The availability of chips providing gain and match out to 400 MHz constitutes the first step. Advanced circuit techniques and tighter process control are applied. Subsequently, the dynamic range will be increased by phasing-in more sophisticated semiconductors.

This paper previews the upcoming technical changes. It is intended to provide a basis for the evaluation of the impact of hybrid technology on system cost and performance.

Technical Considerations for Operating Systems Expanded to Fifty or More Television Channels

By Michael F. Jeffers,
Jerrold Division
General Instrument Corporation

Abstract

Phase Lock and Sync Lock are tools that can be used to reduce distortion and favorably change the subjective appearance of the interference seen in the background of a television chan-

nel. The use of these tools allows systems carrying fifty or more channels to serve the same geographical area formerly limited to thirty-five channel distribution. Effects of Cross Modulation and Composite Triple Beat will be discussed, and it will be proven that the Triple Beat mechanism is the predominant source of distortion. The phase-lock technique will be explained analytically showing the mechanism which causes the subjective transition of distortion from low frequency beats to sliding video frames. The report will also discuss further additional improvements in system tolerance using sync-lock and sync suppression.

Organizational Marketing®
By Thomas B. Cross,
Boulder Communications Company

Abstract

The role of management and the function of information will merge in the mid-1980s. Management structures creating environments in which people can work will cause evolutionary, if not revolutionary changes in corporate life. Developing these new concepts is one aspect of Organizational Marketing (OM)®.

Direct Reception:
The New Frontier
By Fred Hopengarten, President,
Channel One, Inc.

Abstract

Direct reception of Satellite TV signals attracts a great deal of attention, yet few people have distinguished between categories of private earth stations. No law requires fees from individuals engaged in short-wave listening, but MATV systems represent the next big market for paying customers. Programmers should ignore "backyard" terminals and prepare themselves to sell to apartments, condos, and motels beyond the reach of cable.

Cable Alarm System Economics
By Clifford B. Schrock,
CableBus Systems Corporation
Beaverton, Oregon

Abstract

How many subscribers does a cable operator need in order to profit from

alarms? What should he charge? How much will he make? The author uses a computer to examine an economic model of a cable system alarm operation. He presents analyses for potential alarm operations on cable systems in four cities.

Measuring Methods and Equipments for Data Packet Broadcasting

By Joseph J. Blineau,
Centre Commun d' Etudes de Télévision et Télécommunications
2, rue de la Mabilais — BP 1266 —
35013 Rennes Cedex
France

Abstract

Introduction to and description of new services using D.P.B. (Data Packet Broadcasting) on the TV channel. Definition of some parameters specific to the data signal and methods of measuring them.

Considered as an analog signal, the data signal can be examined as a video signal. However, due to its specific structure, it can be broken down in the time domain into a series of elementary intervals inside which the signal shape is perfectly determined at point of origin.

From a digital point of view, the data signal can be described as a bit sequence. Its quality is then measurable by parameters linked to binary states, the lowest level of information being the bit.

Some equipments required for both analog and digital measurements will be described.

Considerations for Implementing Teletext in the Cable System

By John J. Lopinto,
Home Box Office

Abstract

In a few years, commercial teletext service will begin in the United States. Technical standards, regulatory considerations and semiconductor designs will have been established to permit the feasibility of a teletext service for every market segment. The cable industry has an opportunity to exploit the versatility inherent in any teletext service. This paper is intended to identify the key parameters within the cable environment as they impact on the implementation of teletext.

Progress in Fiber Optics Transmission Systems for Cable Television

By A.C. Deichmiller,
Times Wire and Cable
CATV Division of
Times Fiber Communications, Inc.

Abstract

This paper reports the continuing progress achieved during the preceding year in fiber optics transmission systems applicable to CATV requirements.

Developments in transmitter/receiver design and signal conditioning are described. Also, included is a discussion of the operating experience and retrofit update of a 12 channel, eight kilometer fiber optic super trunk. A unique feature of the system described is that only one repeater location is employed in contrast with a conventional cable TV system which would require 12 repeaters to cover the same distance.

Specific fiber optic system constraints, including modal noise and carrier distortion, are discussed and the signal conditioning methodology employed to achieve exceptional CATV operational performance is outlined. The impact of these recently developed techniques on fiber optic satellite ground station links, super trunks, and office to headend transmission links is presented.

System Design Criteria of Addressable Terminals Optimized For the CATV Operator

By Thomas E. O'Brien Jr.,
Jerrold Division
General Instrument Corporation

Abstract

Pay TV has now emerged as a primary driving force for the rapid expansion of CATV subscriber growth. Effective control of subscriber access to premium programs can be realized through the availability of low cost subscriber terminals, capable of remote authorization of multi-tier subscription and eventually pay per view services. Providing reliable terminal equipment with increased capability at low cost, represents both a challenge and an opportunity for CATV manufacturers. The limitations of the traditional approach to data distribution are examined and compared to the emerging trends in newer system designs. The trade-offs and specific solutions to the problems of authorization speed and data format are presented. A headend distributed computer architecture is also discussed which results in lower initial cost and overhead while permitting the multiple system operator to exploit the advantages of simplified on-site upgradability and reduced spare part inventory. Techniques which permit simplified, cost effective solutions to the problems associated with cable system growth, are also discussed.

An Amplifier Status Monitoring and Control System

By Donald E. Groff,
Jerrold Division
General Instrument Corporation

Abstract

A trunk amplifier status monitoring and control system is described. Its features include an addressable receiver, a variety of control functions, including reverse feeder switching, and an independent upstream status signal. Addressing is done by means of an FSK'ed signal similar to a sound carrier. The status signal carried information on various aspects of the station status. The status signals are all on a common frequency, occupying minimal bandwidth, and are addressed exclusively, only one replying at a time. The command functions are described in detail, both as currently implemented and possible alternatives. A simple control unit is described as is a more sophisticated means of control.

Cable Audio Services— The (Hi-Fi) Sky's the Limit

By Ned Mountain,
UA-Columbia Cablevision, Inc.
San Angelo, Texas

Abstract

The time has come to re-examine the potential and impact of audio services within the cable television industry. This paper comments on several marketing and technical aspects of implementing quality service. A unique blend of technology, public demand for diversification, and new program services is rapidly coming together that will allow creative operators to develop an exciting audio product for their subscribers.


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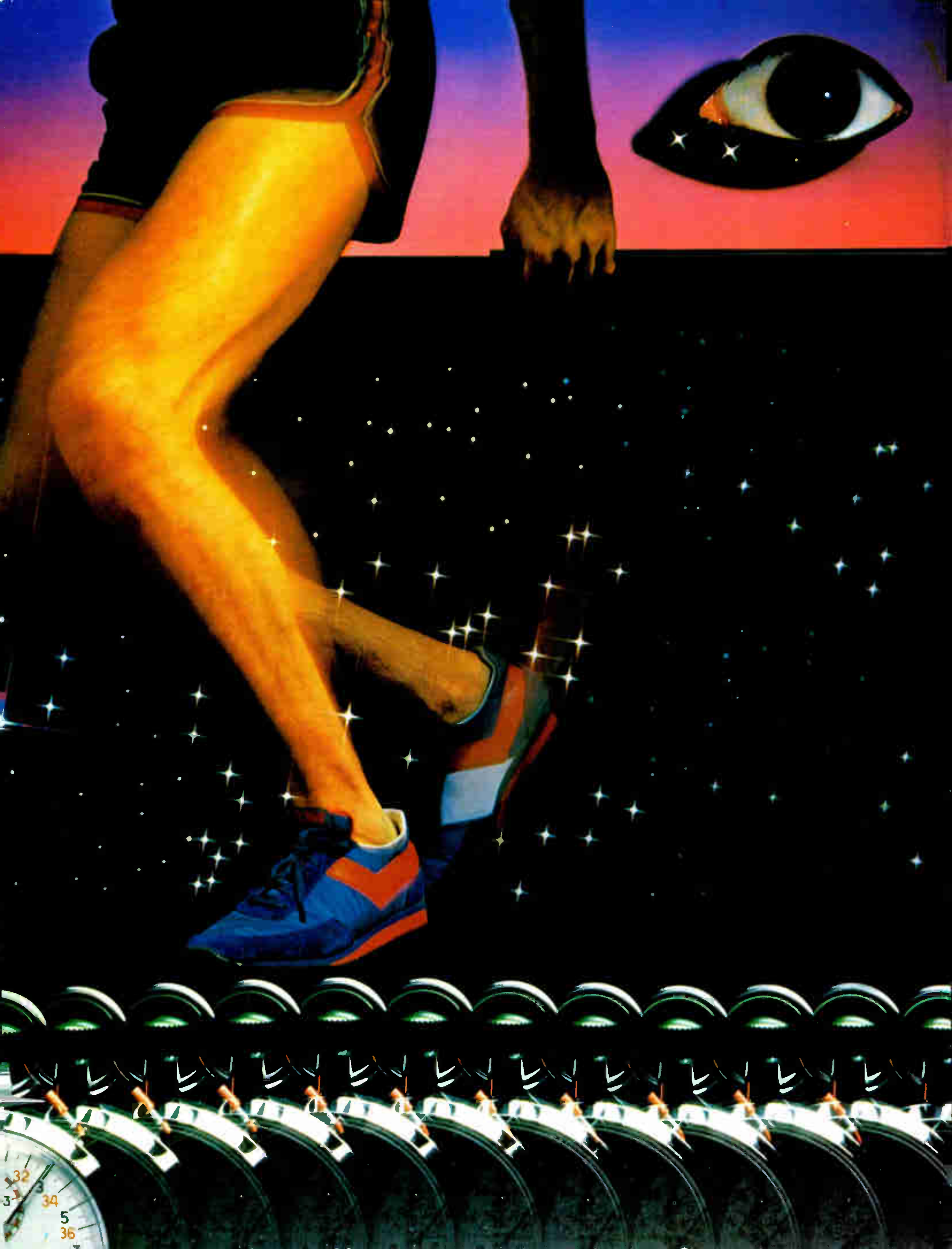
Communication Satellites

By Tom Humphries, Gardiner Communications Corporation

The evolution of communications satellites began in 1958, in the earliest days of the Space Age, when Score, the first "talking" satellite, broadcast President Eisenhower's voice around the globe. Score was followed by other experimental satellites until 1965, when INTELSAT I and Moiniya I initiated the first national and international public satellite networks. Today, a whole range of satellites is in use and improved models for the 1980's are being built, developed, or are on the drawing board and include many commercial and military satellites.

The so-called geostationary satellites represent a major breakthrough. These vehicles go around the Equator in a circular orbit of about 36,000 km (22,000 miles); the satellite's angular velocity in this geosynchronous orbit is the same as that of the Earth's rotation, which means that it appears to remain stationary at a fixed point above the Equator. This

Photo by Claus C. Meyer, courtesy of TV Globo.



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type of satellite is proving to be the ideal basis for a system providing continuous, direct communications links via ground stations in direct view of the satellite for most parts of the Earth. However, the USSR has had excellent results with satellites in elliptic orbit for communication at the high latitude where many Soviet cities are located.

The amazing aspect of the development of communications satellites is the development of a wide variety of diverse satellite systems. These include international systems such as INTELSAT and Intersputnik systems, regional and domestic systems, and military systems. The regional domestic systems also include privately owned satellites, such as Comstar, Satcom, and Westar, which carry a wide variety of industrially oriented traffic and data. Thus, the communication satellite era is no longer a struggling dream but an intensive technology area serving world-wide communications, and the satellite box score for all countries during the last twenty years is truly impressive, involving 917 Earth orbiting payloads of which 60 are geosynchronous communication satellites (excepting the Moiniya satellites which are in elliptical orbit) with a debris level of almost 3500 satellites of all types which have been flown, used and discarded or deactivated during this period.

Communications satellites now serve many users in addition to telephones, which alone do not support a satellite system. Many of the uses of existing and planned satellite networks include the following:

- Telephony—to interconnect thin route and heavy route telephone service including telex.
- TV Distribution—this serves to distribute TV signals into a network of cable television systems and local TV stations for broadcast to users.
- TV Broadcast—TV from space direct to the user facility or home.
- Educational TV—direct broadcast to schools from a central classroom.
- Industrial—to interconnect data systems.
- Teleconferencing—TV used to link industrial and business users together.
- Transoceanic and Point-to-Point Communications—to provide telephony and TV to areas which cannot be reached by terrestrial facilities.
- Newsprint Distribution—to provide wide-spread newsprint data for printing at remote sites.

The INTELSAT type 30-meter antenna has been a familiar member of the international satellite communications art for more than 10 years. More recently, because of the use of directed satellite antennas and spot beams which have increased the flux density into regional and specific national areas, it is now possible to utilize 10-meter earth terminals such as the INTELSAT Type B terminal very effectively for CCIR and CCITT quality voice communications. In addition, 5-meter antennas with FET amplifiers are now widely used for TV receive-only terminals for TV distribution at 4GHz.

The 10-meter antenna is now widely used and flourishing in various parts of the world. However, still another business area with great dollar potential is developing. That is, the small 10-15 ft. antenna terminal with G/T's from 14 to 20 dB. Such terminals can receive and display a medium quality TV image or can handle a small number of voice channels (up to 12). They are primarily intended for thin route areas where the small communications capacity is sufficient to handle a variety of applications from educational television, teleconferencing, disaster warning and health and welfare communications, and so on. In each of these cases, the minimum capacity requirements complement the low cost and small terminal that is being developed to meet these needs.

Small earth terminals have an enormous future; some of the countries of the world are now predicting requirements from 500 to 10,000 terminals as a means of introducing educational TV into various remote areas and/or providing at least one voice channel for local communications where up to now, communication is virtually impossible. The impact of numbers of terminals will drive costs even lower. Types of small antenna earth terminals include the following:

- Two-way TV and telephony—a small terminal that will allow both the transmission and reception of TV in addition to the transmission and reception of a number of voice channels.
- Exclusive two-way TV—a small earth terminal that will handle a single television channel on a receive and transmit basis.
- TV receive-only—this will probably be one of the more important of the terminals provided by this new business area since it serves the educational TV requirements of many parts of the world.
- TV receive-only and telephony transmit and receive—this type of terminal will provide both telephony communication and educational TV for many of the small hamlets of the world.
- Telephony receive and transmit only—this type provides much needed communications using very small terminals, well under 10 feet in diameter, which can be built at very low cost.

Earth terminal performance involves many different factors, ranging from earth terminal gain, to EIRP, to antenna and system noise temperature and G/T, to considerations of system noise.

In the up-link, development of sufficient EIRP to meet the up-link budget can be accomodated by increasing HPA power in addition to antenna diameter as a ground-base determination which minimized the demand made on satellite receiving system G/T. The requirement for increased cost in the ground segment to raise EIRP cannot be economically compared with the possible increase in satellite G/T which could involve a major satellite redesign or which may not be technologically possible. The down-link sensitivity problem is quite another matter from the ground system standpoint. Satellite EIRP is usually the most that can be produced by a particular satellite consistent with launch weight capability, DC power availability, antenna size, and power amplifier size, weight and efficiency. The earth terminal G/T, which must be achieved to extract information at the proper quality factor from the down-link signal, must be achieved by a complex of expensive devices such as antennas, feeds and LNA's, and must consider atmospheric contributions to antenna noise temperature in addition to the link attenuation due to rain and scintillation.

The satellite communication system is defined by a link budget, for either the up-link or down-link, or both (total link). These link budgets involve four major system parameters:

- Effective radiated power EIRP.

- Receiving terminal figure of merit G/T.
- Intervening losses.
- Signal-to-noise ratio presented to the final receiver.

The EIRP is the sum (in dB) of the antenna gain (G) and the output power level (P_0) of the power amplifier less losses between the amplifier and the antenna feed.

$$G/T \simeq \frac{(G)}{\{T_a + T_f + T_r\}} = \frac{G \text{ in dB/}^\circ K}{T_s}$$

where EIRP = $P_{pa} - L_{feed} + G$ in dB
- G = antenna gain in dB
- T_a = antenna noise temperature
- T_f = feed and diplexer loss in °K
- T_r = receiver or LNA noise temperature
- P_{pa} = power level at power amplifier output
- L_{feed} = feed and diplexer loss in dB
- T_s = System noise temperature in dB

EIRP is the critical up-link parameter; G/T is the critical down-link parameter since it determines the final S/N at the demodulator.

$$C/N = EIRP + G/T - L_1 - L_2 - K - B$$

where EIRP = satellite effective radiated power.
- L_1 = propogation and other down-link loss + 198 dB at 4 GH z.
- C = received carrier power
- L_2 = atmospheric loss
- K = Boltzman's constant = -228.6 dBW/°K/Hz
- B = noise bandwidth of transponder
- G = antenna gain
- T = system noise temperature

$$G/N = EIRP + G/T + 30.6 + 10 \log(B) - L_2$$

Total carrier to noise ratio (C/N) total:

$$(C/N)_{Total} = (C/N)_{Uplink} + (C/N)_{Interference\ noise} + (C/N)_{Downlink}$$

where all C/N are in dB and are added logarithmically.

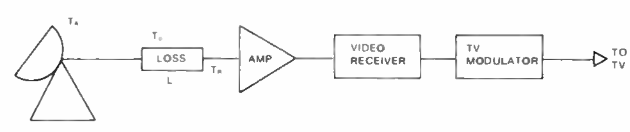
EARTH STATION G/T DESIGN

Importance of G/T is shown in the following equation

$$C/N = \text{Satellite EIRP} - \text{Path Loss} + \frac{(G)}{T}\frac{(1)}{KB}$$

where
- C/N = Downlink receive carrier-to-noise ratio
- G = Net Earth Station
- T = Net Earth Station Noise Temperature °K
- K = Boltzman's Constant J/°K
- B = Receiving Noise Bandwidth Hz

EARTH STATION G/T



$$G = n\frac{4\pi A}{\lambda^2}$$

- n = Antenna Efficiency
- A = Area of Antenna Aperture
- λ = Wavelength

Keeping up?

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5 meter*	2.44 meter
7 meter	3.0 meter*
	4.3 meter

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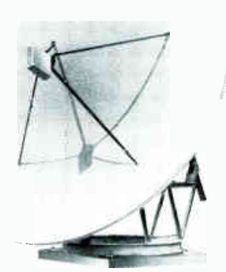

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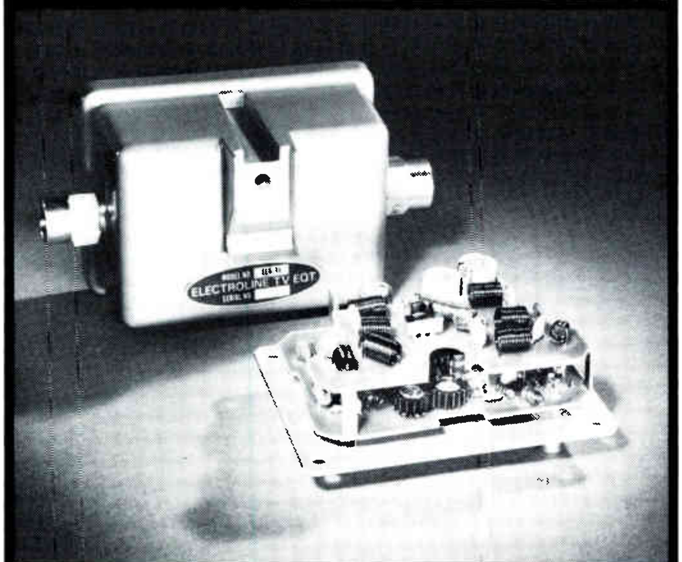

$$T = \frac{T_a}{L} + \frac{L-1}{L} T_o + T_r$$

T_a = Antenna Noise Temperature
L = Feeder Loss
T_o = Ambient Temperature
T_r = Receiver Noise Temperature

The principal RF parameters of a communication satellite or an earth terminal are its figure of merit (G/T) and its effective radiated power (EIRP). These parameters require consideration of both receive and transmit antenna gain and amplifier noise temperature, which is involved in total receiving system noise temperature T and power amplifier output level which, with antenna gain, determines the satellite or earth terminal EIRP.

Low noise amplifiers have seen many new and innovative developments since the early radio astronomy and radar antenna systems in the 1960's which used masers.

In 1974, a new competitor for low noise applications appeared when the FET amplifier was chosen to serve as the low noise amplifier in the procurement of 100 small C-band ground terminals by the state of Alaska to bring SCPC thin route communications into the Alaskan bush country. The 150°K noise temperature of these small amplifiers called attention to the fact that a simple and low cost replacement to the uncooled parametric amplifier had arrived and indeed, since that time, FET amplifiers have achieved noise temperatures from below 100°K at 4 GHz to 2.5-3 dB at 16-18 GHz, which have made the FET low noise amplifier the choice of virtually all earth terminal LNA's where the lowest noise temperature achievable by the more expensive and complex parametric amplifiers were not required.

All this has evolved quite dramatically for the cable TV industry. When HBO announced at NCTA in New Orleans in 1975 that they intended to use satellite distribution and UA-Columbia agreed to receive the satellite signal at several of its systems throughout the country, the first major step was taken. At that time the FCC rulings only allowed the use of 9 meter or larger receive antennas. Even with this restraint by December 1976 there were about 130 10-meter TVRO earth stations receiving HBO.

On December 7, 1976, the FCC issued a declaratory ruling allowing the use of TVRO antennas down to 4.5 meter in diameter. This decision was a landmark decision for cable TV. The cost of an earth station dropped overnight from about $75,000 to about $30,000. The price has continued down as the suppliers of components and systems have tooled up for what is now volume production allowing a basic system price about $10,000. This phenomenal reduction in price has only been matched in our technological area by the hand-held calculator.

As could be expected as the price made satellite reception more and more economical to the smaller system, the subscriber base grew and drew more and more program supplies into the market so that now we are facing a shortage of satellite channels to supply this explosive growth, even to the necessity now of utilizing more than one satellite.

As we move into this new and exciting decade I feel we have only scratched the surface as far as application of point-to-multipoint satellite communications. We hear of new ideas and uses almost hourly. If we moved forward in the coming years mindful of the experience we have gained in the past 10-15 years and retaining the desire to truly make this a closer, better informed and educated world, then that goal is certainly within our grasp. **C-ED**

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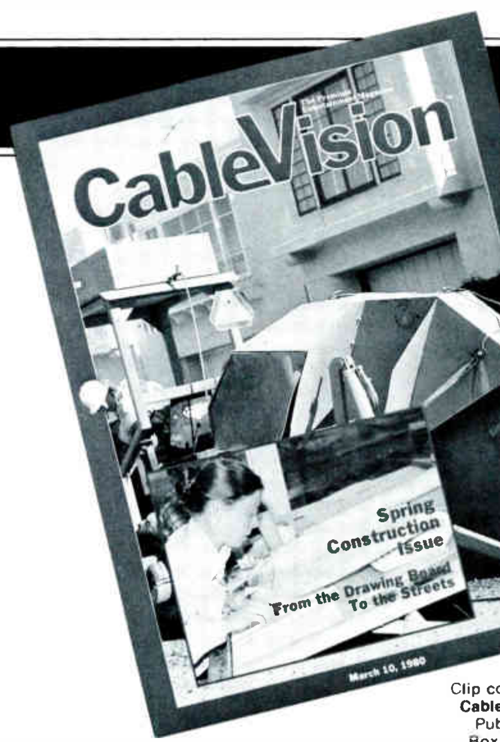

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Cable Programming for June

Signal	Day	Start/Stop	Alert Tones	Satellite/ Transponders
C-SPAN (times approximate)			195*/#	F1, #9
Mondays 9:00 a.m. to 6:00 p.m.				
Tuesdays 10:30 a.m. to 6:00 p.m.		Thursdays 9:30 a.m. to 6:00 p.m.		
Wednesdays 9:30 a.m. to 6:00 p.m.		Fridays 10:30 a.m. to 5:00 p.m.		
CBN		24 hrs.	No	F1, #8
ESPN Monday thru Thursday 6:00 p.m. to 4:00 a.m. Friday, 6:30 p.m., to following Monday, 4:00 a.m.				F1, #7
Front Row		2:30 pm-2:30 am	481*/#	E,C F1, #12 P,M F1, #10
HBO	1	3:30 12:30	Program	F1, #24
	2	6:00 2:16	729*/#	F1, #22
	3	6:00 2:18	Scramble	F1, #23
	4	5:00 2:15	835*/#	F1, #20
	5	5:30 2:05	Duplication	
	6	5:30 3:01	940*/#	
	7	2:30 3:46	Take-2 E.	
	8	3:00 2:00	592*/#	
	9	6:00 1:15	Take 2 W.	
	10	5:30 2:13	681*/#	
	11	6:30 2:03		
	12	5:00 1:10		
	13	6:30 4:09		
	14	3:30 2:45		
	15	2:30 2:15		
	16	5:30 12:55		
	17	6:30 2:45		
	18	6:00 1:43		
	19	6:00 1:45		
	20	6:00 4:42		
	21	3:00 3:16		
	22	3:00 1:21		
	23	5:00 2:45		
	24	5:30 1:45		
	25	6:30 1:45		
	26	5:00 3:00		
	27	5:30 4:00		
	28	3:30 4:09		
	29	3:30 1:17		
	30	5:30 1:01		
HTN		8 pm-10 (11) pm	517*/#	F1, #21
KPIX (time permitting)		2-4 hrs. per day	No	F1, #1
KTVU		7 am-1 am (weekdays) 7 am-4 am (weekends)	No	F1, #1
MSG Sports		Schedule not available at press time.	438*/#†	F1, #9

Signal	Day	Start/Stop	Alert Tones	Satellite/ Transponders
Modern Talking Pictures		12 pm-5 pm (weekdays) 7 am-12 pm (weekends)	048*/#	F1, #22
Newstime		24 hrs.	276*/#	F1, #6
Nickelodeon		9 am—11 pm (weekdays) 8 am—11 pm (weekends)	749*/#	F1, #11
PTL		24 hrs.	No	F1, #2
Reuters 4:00 a.m. to 7:00 p.m. Monday thru Friday			No	F1, #18
SPN 10 pm-8 pm (Mon.-Sat.) 24 hrs. (Sun.)		429*/# auto switch to commercial, on/off respectively; 517# end SPN, begin HTN; 517* end HTN, begin SPN		F1, #21
Showtime			576*/#††	E, C, F1, #12; P, M, F1,
	1	1:30 p.m.—3:23 a.m.		
	2	3:30 p.m.—2:13 a.m.		
	3	3:30 p.m.—2:09 a.m.		
	4	3:15 p.m.—2:24 a.m.		
	5	3:30 p.m.—2:30 a.m.		
	6	3:30 p.m.—3:50 a.m.		
	7	1:15 p.m.—2:22 a.m.		
	8	1:30 p.m.—2:02 a.m.		
	9	3:30 p.m.—2:15 a.m.		
	10	3:00 p.m.—3:01 a.m.		
	11	3:15 p.m.—3:20 a.m.		
	12	3:30 p.m.—2:52 a.m.		
	13	3:30 p.m.—2:39 a.m.		
	14	1:15 p.m.—2:32 a.m.		
	15	1:30 p.m.—2:45 a.m.		
	16	3:30 p.m.—3:00 a.m.		
	17	3:00 p.m.—2:56 a.m.		
	18	3:15 p.m.—4:20 a.m.		
	19	3:30 p.m.—2:05 a.m.		
	20	3:30 p.m.—2:22 a.m.		
	21	1:15 p.m.—2:33 a.m.		
	22	1:30 p.m.—2:20 a.m.		
	23	3:30 p.m.—2:43 a.m.		
	24	3:30 p.m.—3:00 a.m.		
	25	2:45 p.m.—2:30 a.m.		
	26	3:30 p.m.—2:46 a.m.		
	27	3:30 p.m.—3:33 a.m.		
	28	1:15 p.m.—2:32 a.m.		
	29	1:30 p.m.—2:38 a.m.		
	30	3:30 p.m.—3:05 a.m.		
SIN		24 hrs.	No	Westar II #6
The Movie Channel		24 hrs.	311*/#E. 519*/#W.	F1, #5
Trinity (KTBN)		24 hrs.	No	F1, #14
WGN		5:42 am-3 (3:30) am (Mon.-Thurs.) 24 hrs. Sat. & Sun. Ends 3 am on Sun.	No	F1, #3
WOR		24 hrs.		F1, #17
WTBS		24 hrs.	No	F1, #6

E = eastern
C = central
M = mountain
P = pacific

All program times are listed for the eastern time zone, unless otherwise noted.

† Commercial substitution 601*/#; Thurs. baseball 706*/#.
††On-line 679*/#; off-line 753*/#; access 843*/#.

Portable Microprocessor Training Lab Teaches Software and Interfacing

Designed to teach microprocessor software and real-time interfacing, the Portable Training Lab consists of 20 self-training modules (4 vols.—1650 pages) and a complete hardware systems for hands-on exercises.

The self-training texts include modules covering programming fundamentals, real-time interrupt handling, control of programmable interfacing devices as well as the implementation of closed loop control systems. Each module guides the student through hands-on experiments that involve the coding and execution of programs on the microcomputer and interfacing hardware provided in the training lab.

The training hardware consists of a fully assembled and tested 8080A-based microcomputer equipped with integral power supply, RAM and PROM memory, programmable I/O, keyboard, display and audio cassette interface plus multiple interval timers, programmable I/O ports, A/D and D/A converters, priority interrupt logic and communication interfaces. An experimental parts assembly including optical and thermal sensors, motor and other interfacing components is provided.

The portable Training Lab is mounted in a sturdy carrying case providing protection while permitting convenient use, transportation and storage. For free detailed brochure contact: Integrated Computer Systems, 3304 Pico Blvd., P.O. Box 5339, Santa Monica, CA 90405; Phone 213/450-2060.

New Optical Glossary Available

The National Telecommunications and Information Administration's new glossary of optical waveguide communications terms will assist in removing the ambiguity and impreciseness which have resulted from the growth of this specialized vocabulary. The report, "Optical Waveguide Communications

Glossary," is published as NTIA Special Publication 79-4.

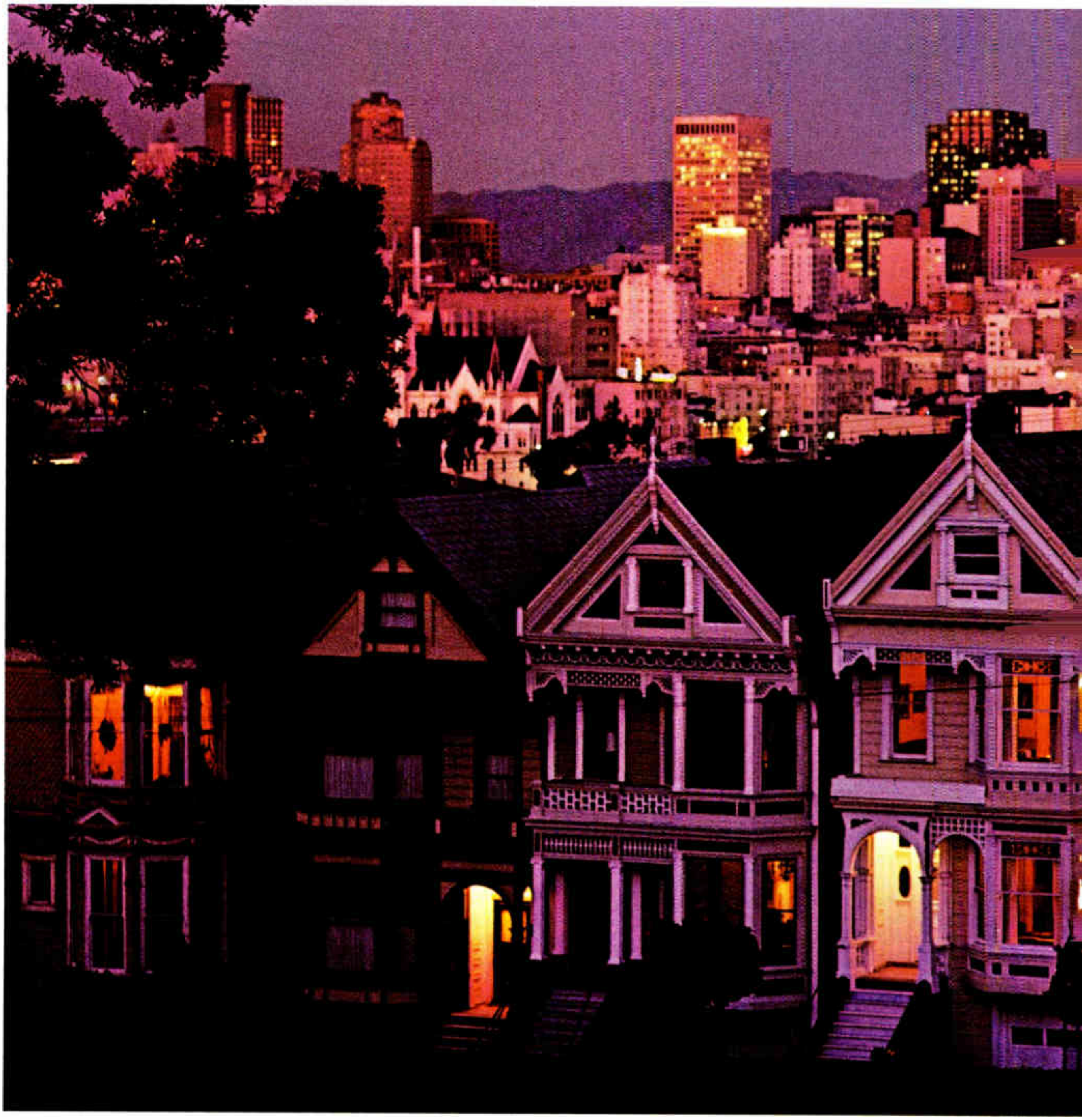
The vocabulary for the glossary, as well as the definitions presented, are a combined effort of NTIA, the National Bureau of Standards, and government and industry sources in the United States and Canada. The resulting glossary serves as a base for the development of a common language for this rapidly developing field.

Selection of terms for the glossary was deliberately restricted to avoid duplication of terms from telecommunications or optics that have been rigorously defined in other sources.

The 80-page publication is available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. The accession number is PB 80-112097; the price is $8.00.

New 96 Page Catalog from Klein Tools, Inc.

The 1980 edition of the Klein Tools & Occupational Protective Equipment Catalog No. 123 is 96 pages long. It is a concise and informative description of over 1,000 products available from Klein Tools, Inc. The products are organized into seven basic sections: 1) Hand tools, 2)Tools and equipment for iron workers, 3) Wire pulling grips for utility workers, 4) Occupational protective belts and harnesses, 7) Linemen's body belts and climbers. The catalog includes informative descriptions of various hand tools with respect to finishes, usage, construction and nomenclature. It also includes pertinent OSHA and ANSI editorial treatment pertinent to the use of tools and protective equipment such as belts and harnesses. The catalog is indexed numerically and alphabetically for easy reference. It incorporates dozens of new tools since release of the 1979 edition. For further information, write to Klein Tools, Inc., 7200 McCormick Rd., Chicago, Illinois 60645.



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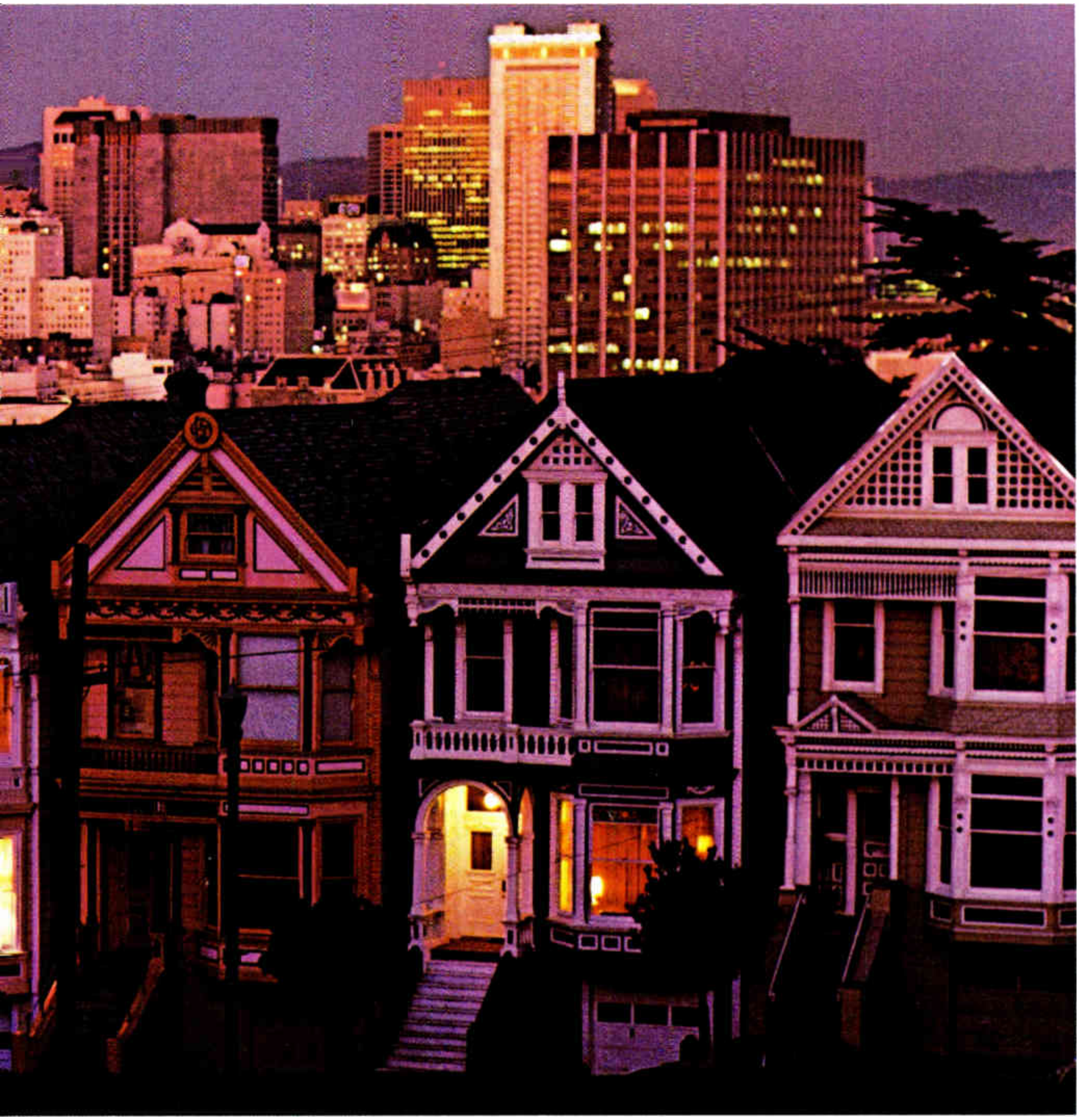

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Changes in transponder utilization, new proposed footprints and use of different satellites persuaded Gardiner that more surface, not less, was the way to go to assure you enough margin to deliver consistently good pictures, no matter what happens 22,300 miles away. Gardiner's new antenna delivers 55% more surface than a 4.5 meter antenna; 25% more than a 5 meter.

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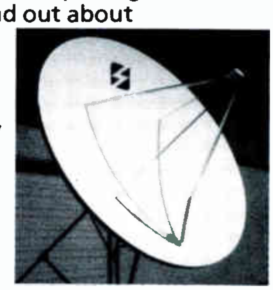

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Test Equipment

New Portable 100 MHz Oscilloscope and Optional DMM Unit Described in

The OS3600, a new lightweight, dual trace oscilloscope designed for lab or field measurements on both advanced digital and conventional electrical/electronic circuits, is the subject of a new two-page, illustrated bulletin from Gould Inc., Instruments Divison.

The Gould OS3600 features a bandwidth from dc to 100MHz (-3dB), vertical sensitivity of 5mV/cm over the full bandwidth (2mV/cm to over 85MHz), delayed time base, third channel trigger view and variable trigger holdoff. The large 8 x 10cm CRT operates at 16kV for bright displays even of narrow pulses occurring at low repetition rates, and an alternate timebase mode simultaneously displays delayed and intensified sweeps. The DM3010 3½-digit DMM add-on, when used with the scope, provides increased accuracy in amplitude, frequency, and delta time measurements.

Complete specifications of the OS3600 and DM3010 are covered in Bulletin 449-13, available at no charge from Marketing Services, Gould Inc., Instruments Divison, 3631 Perkins Avenue, Cleveland, Ohio 44114.

Engelmann Phase Locked Oscillator

Engelmann Microwave has designed a new phase locked oscillator featuring the crystal at the top of the unit as opposed to the bottom. The HC-18 type crystal used in the internal oscillator reference circuit is readily accessible and removed simply by unscrewing the cover plate. The location of the crystal at the top and the direct access cover plate allows easy crystal removal and operation of the oscillator within minutes without disconnecting the unit from the system.

The Engelmann Model LP-B87 fundamental transistor oscillator is mechanically tunable over the 3.63-4.13 GHz frequency range with a non-translating front panel shaft. The minimum output power is 10MW with a ± .0005% frequency stability from 0-50° C.

The unit offers excellent frequency spectral properties with a spurious response down 70dB min. The low noise characteristics make it ideal for use in communications and other applications where crystal characteristics are required and is intended for applications requiring long life and trouble free performance.

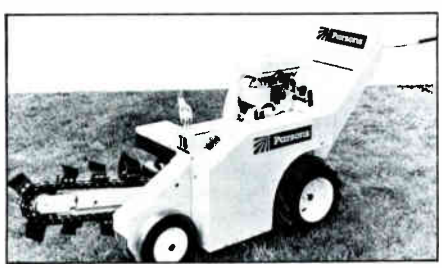
The Model LP-B87 also features a highly regulated internal power supply with reverse and over-voltage protection plus an alarm indicator circuit designed to alert the user to an impending alarm condition prior to the failure mode.

For additional information, contact Carl Schraufnagl, Engelmann Microwave Company, Skyline Drive, Montville, New Jersey 07045, (201) 334-5700.

Miscellaneous

New T-8 Trencher Added To Parsons Line

A new T-8 Parsons Trencher is now available from Seaman Company, a unit of Stowell Industries, Milwaukee, WI. The T-8 is a 7.5 HP self-propelled, handlebar-type trencher. Fully hydrostatic, the T-8 features infinite speed control that can be regulated to suit soil conditions.



The travel speed of the unit is equal in forward or reverse and is controlled by regulating the flow to the hydraulic motor. The T-8 has a digging depth of 24 to 30 inches and width up to 6 inches. Digging speed ranges from 0-10 fpm.

The drive wheels of the T-8 are connected to the axle with removable pins. Removal of one pin allows the unit to be free-wheeled. The digging chain is mechanically driven from the engine in a 3-step arrangement.

The digging boom of the T-8 can be raised or lowered manually with a handle-boom screw system. Dirt is continuously moved to the right, away from the work area, by means of an auger on the headshaft. An optional fourth wheel is available with the T-8 to provide better stability in soft earth.

For additional information on the new Parsons T-8 Trencher, contact: Seaman Company, a unit of Stowell Industries, P.O. Box 25331, Milwaukee, WI 53225. Telephone: 414/781-8900. TWX: 910-262-1188.

Earth Station

Low-Cost Satellite Reception Provided in New Hughes System

A new satellite receiving system, designed to provide for low-cost channel expansion of CATV systems and compatible with existing earth station receiving equipment, has been introduced by Hughes Aircraft Company's microwave communications products. The receiving system consists of separate downconverter and receiver modules. The downconverter, model IDC-472, converts the entire 3.7-4.2 GHz band to 0.95-1.45 GHz for input into the receiver, with cost savings obtained by connecting up to 12 agile receivers to a single downconverter on either horizontal or vertical polarization. The 24-channel receiver, model SVR-463, provides push-button channel selection, conversion to a second intermediate frequency, automatic gain control, demodulation and video/sound processing. Utilizing state-of-the-art microwave integrated circuitry, the receiver is an outgrowth of receiver-development work performed by Hughes for NASA. Additional standard features of the receiver include threshold extension, remote tuning capability, and built-in test/alignment circuitry. An AGC output terminal aids in locating and aligning the antenna to the satellite. The receiving system, when combined with an antenna, low-noise amplifier, and integration electronics constitutes a complete satellite video receive terminal. For complete details, contact Hughes Aircraft Company, Microwave Communications Products, P.O. Box 2999, Torrance, California 90509, (213) 534-2146.

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Help Wanted

HELP WANTED
CABLE TV NEWS DIRECTOR

NEWS DIRECTOR, tropical island Cable TV ENG with daily satellite news feed. Salary open. Some anchoring. Send tape and resume to Lee Holmes, Guam Cable TV, 530 W. O'Brien Drive, Agana, Guam, 96910.

HELP WANTED CABLECASTING MANAGERS

CABLECASTING MANAGER. To manage 35 member staff of News Team, Production, Commercial Sales, and Local Origination facility for award-winning Cable TV system on tropical island of Guam. Ideal advancement opportunity for an experienced Cablecasting or TV manager with strong administrative skills ready to move up into a first rate 18,800 subscriber Cable TV operation. Salary open. Send resume to Lee Holmes, President, Guam Cable TV, 530 W. O'Brien Drive, Agana, Guam, 96910. (671) 477-7304.

CHIEF TECHNICIAN

Young, independent MSO company in Texas is looking for a qualified hands-on, head-end and systems man to supervise construction, system turn-on and maintenance. Applicant must be a self-starter and work with minimum supervision. EXCELLENT GROUND FLOOR GROWTH OPPORTUNITY for the applicant who can fill the above requirements. Reply in confidence to box C-ED-0580-2.

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Sonic Cable TV, an expanding independent cable TV company located on the beautiful central California coast, has the following opportunities:

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- Design Engineer with a minimum of two years recent experience in design of two-way systems plus rebuilds.

Company offers excellent fringe benefits and salary. Interested applicants should send resumes in confidence to:

General Manager
Sonic Cable TV
P.O. Box 1205
San Luis Obispo, CA 93406

Sonic Cable TV is an Equal Opportunity Employer

CATV Corporate Engineer

Growth oriented Texas based MSO is seeking an experienced CATV technician to perform a variety of technical duties. Applicant must be experienced in headend maintenance and have a first class FCC license. This is a staff position reporting to the Vice President of Engineering. Excellent salary and benefits, limited travel. Send resume or call:

Bob Carter, Vice President/Engineering
Southern Cablevision Corporation
P.O. Drawer TV
Bryan, TX 77801
713-846-4704

SYSTEM MANAGER

Wanted to manage 70 mile, 4500 subscriber system and ten field and office personnel on the coast of northern California.

Managerial experience and technical and engineering knowledge required. Satellite services just initiated. Interest in acquiring and developing new franchises for which manager would have responsibility.

Salary commensurate with experience.

Contact:

Del Norte Cablevision (Crescent City, CA)
c/o John G. Camphouse
2719 Carol Lane
Bishop, California 93514
(714) 873-8354

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Help wanted: CATV construction personnel needed immediately. Openings in all phases of construction. Top wages. Send resume in confidence to or call:

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Equipment Wanted

Ad Index

★ **Oak Industries, Inc.**, has announced the appointment of **Michael G. Forys** as vice president, human resources, a new position.

He reports to Raymond W. Peirce, president.

Forys has been with American Can Company since 1971, most recently as director of employee relations for the technology and development/recovery systems and chemicals sector. Earlier positions included those of manager of compliance and training in the consumer sector and general supervisor of employee relations for a major manufacturing facility.

Before joining American Can, Forys served eight years in the U.S. Navy, attaining the rank of Lieutenant Commander.

Forys holds a bachelor of science degree in industrial psychology from Penn State University and a masters of science degree in industrial personnel management from George Washington University.

In his new position with Oak, he will be responsible primarily for manpower planning and personnel development, but will also supervise corporate wage and salary administration, compliance programs and other personnel related activities.

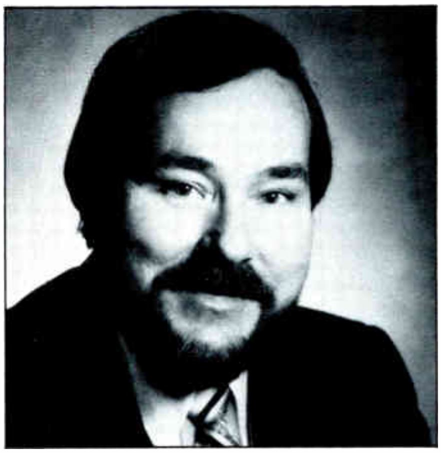
Forys and his family reside in Poway, California.

★ **Frank M. Drendel**, 35, has been elected Chairman of the Board of Directors of **Valtec Corporation**, a communications, fiberoptic and electro-optic company. Mr. Drendel, President and Chief Executive Officer of Valtec sionce 1978, also announced that **James R. Kanely**, 38, has been chosen as President and Chief Operating Officer of Valtec.

Kanely is a 17-year veteran of the telecommunications industry and has until recently been a regional vice-president for western operations of Superior Cable Corp., a telephone cable and apparatus manufacturer serving the independent telephone industry. Kanely has held a variety of other managerial and technical positions in his career, including Director of Engineering and plant manager with Superior Continental Corp., following 10 years with Western Electric Company.

Drendel, who will remain the Chief Executive Officer, said that Kanely's selection was part of a series of actions to further strengthen Valtec's position as a supplier of systems and components to industries such as cable television, telecommunications, data transmission, and defense.

Frank M. Drendel



James R. Kanely

"In the past, Valtec's growth was chiefly by acquisition of companies with complementary technologies," the chairman said. "Now we expect that growth during the 1980's will result from internal resource development and strong management."

★ **Willard J. (Bill) Wilmot** has been appointed marketing manager of **Belden Corp.'s** Richmond, Ind.-based Electronic Div. He replaces Ronald L. Stier, who was recently promoted to long-range marketing manager.

In making the announcement, Michael J. LaPorte, vice president-sales and marketing, also named **Charles B. Parker** as field sales manager of the Electronic Div.'s new Southeast region, and **Glen Grosser** as sales manager-CATV products, succeeding Parker.

As marketing manager, Wilmot, 40, will be responsible for annual sales/marketing planning, product line administration, monitoring of sales patterns, and sales forecasting for all electronic market segments served by the division.

He returns to Belden's Richmond office after almost two years as western field sales manager based at the Electronic Div.'s Irvine, Calif. regional sales office. Before that, he was field sales manager of the midwestern region in Richmond for two years.

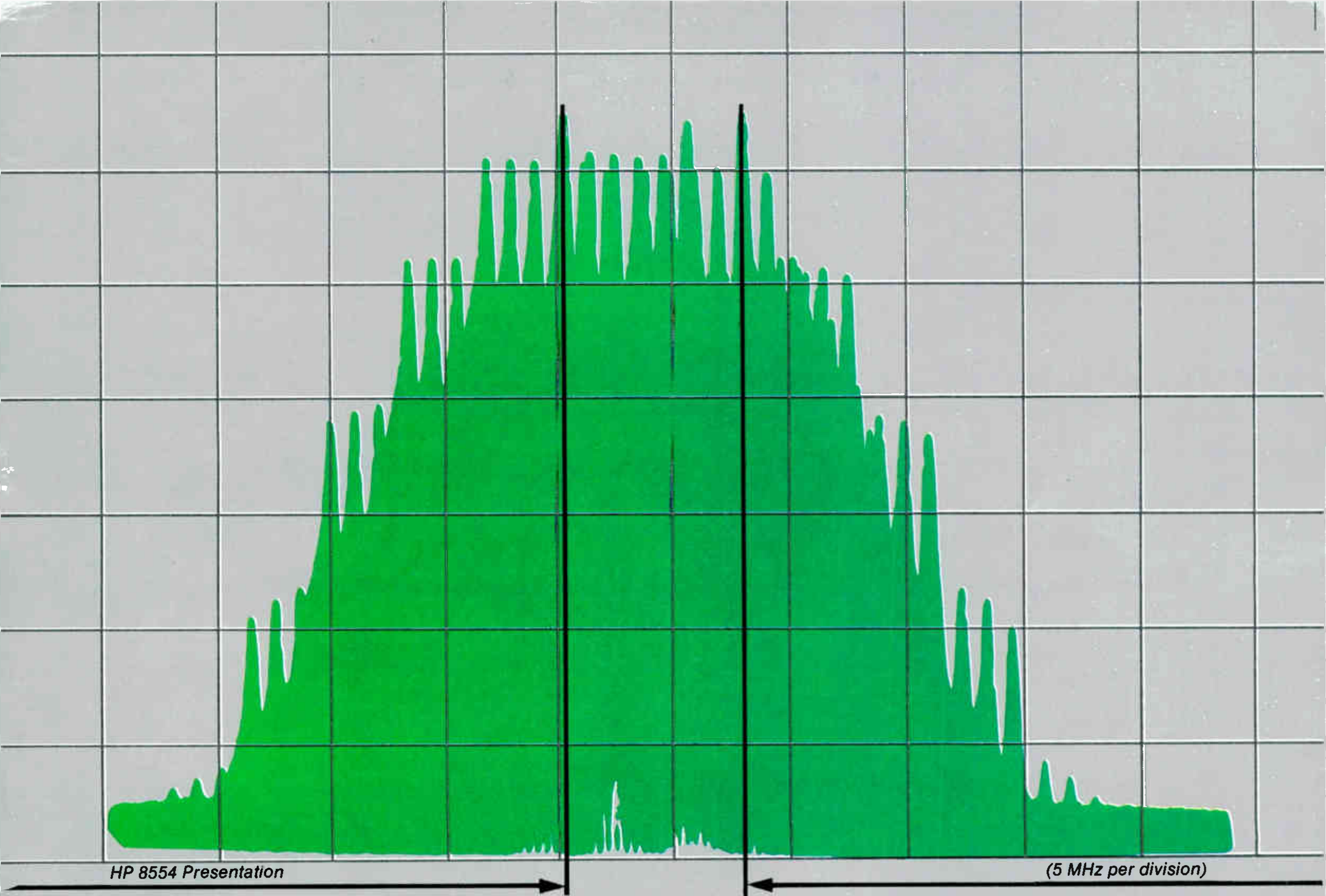
Wilmot joined Belden in 1966 and was a field sales representative in metropolitan New York until his appointment in 1974 as the division's first CATV sales manager. He attended Michigan State Univ. and Indiana Univ., and is a U.S. Navy veteran.

Parker, 34, will direct field sales activities in a newly organized sales region covering the southeastern U.S. He will be based in the Atlanta area and supervise a field sales force of seven representatives serving customers in a multi-state region from the Carolinas west to Mississippi.

After joining Belden in 1969 upon completion of U.S. Army service in Vietnam, Parker was assigned as a field sales representative to the St. Louis area. In 1977, he was named sales manager of CATV products, based in Richmond. The marketing graduate of Northern Illinois Univ. formerly lived in Manteno, Ill.

As sales manager-CATV products, Grosser, 29, will direct product development, marketing, and sales of Belden's cable products used in cable television and related markets. He joined Belden in 1973 and served as a field sales representative for five years in Pennsylvania and Maryland.

Grosser holds a bachelor of science degree in marketing and computer science from the Univ. of Illinois, and a master of business administration degree from Southeastern Univ. The Downers Grove, Ill. native recently relocated to Richmond.



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