special issue on

CABLE TELEVISION

(Proceedings of the IEEE Vol. 58 No. 7 July 1970)

Meetings with Exhibits

● **As a service both to Members and the industry, we will endeavor to record in this column each month those meetings of IEEE, its sections and IEEE groups, which include exhibits. For a more complete listing, including meetings without exhibits, see the monthly feature "Calendar" in IEEE Spectrum.**

July 14–16, 1970

International Electromagnetic Compatibility Symposium, Grand Hotel, Anaheim, Calif.

Exhibits: Mr. John Merrell, Glenair, Inc., 1211 Airway, Glendale, Calif. 91201

August 24–27, 1970

Anniversary Meeting of Mexican Society of Electrical and Mechanical Engineers, Mexico City, Mexico

Exhibits: Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas 78228

August 25–28, 1970

Western Electronic Show & Convention (WESCON), Los Angeles Hilton Hotel, Hollywood Park and Sports Arena, Los Angeles, Calif.

Exhibits: WESCON, 3600 Wilshire Blvd., Los Angeles, Calif. 90005

September 2–4, 1970

Seoul International Electrical & Electronics Engineering Conference, Korean Institute of Science and Technology, Seoul, Korea

Exhibits: Prof. S. K. Chung, c/o KIST, P. O Box 131, Cheong Ryang, Seoul, Republic of Korea

September 7–11, 1970

International Broadcasting Convention, Grosvenor House, Park Lane, London, England

Exhibits: EEA Headquarters, Berkeley Square House, Berkeley Square, London W.1, England

September 20–25, 1970

Intersociety Energy Conversion Engineering Conference, Frontier Hotel, Las Vegas, Nev.

Exhibits: Mr. A. J. Smith, AFWL (WLAS 3–A), Kirtland AFB, New Mexico 87117

September 21–24, 1970

International Conference on Engineering in the Ocean Environment, City Marina Auditorium, Panama City, Fla.

Exhibits: Mr. Lewis Winner, 152 W. 42nd Street, New York, N.Y. 10036

October 5–7, 1970

UMR—Mervin J. Kelly Communications Conference, University of Missouri, Rolla, Mo.

Exhibits: Mr. J. R. Betten, University of Missouri, 123 EE Bldg., Rolla, Mo. 65401

October 26–28, 1970

Electronic & Aerospace Systems Convention (EASCON), Sheraton Park Hotel, Washington, D.C.

Exhibits: Mr. Ray Forbes, General Electric Co., Valley Forge, Pa. 19406

November 4–5, 1970

Symposium of the Affiliation of North Carolina Sections, Convention Center, Winston-Salem, N.C.

Exhibits: Mr. P. J. Nahser, P. J. Nahser Co., Inc., Burlington, N.C. 27215

November 4–6, 1970

Northeast Electronics Research & Engineering Meeting (NEREM), Sheraton Boston Hotel and War Memorial Auditorium, Boston, Mass.

Exhibits: IEEE Boston Office, 31 Channing St., Newton, Mass. 02158

November 4–6, 1970

Nuclear Science Symposium, Statler Hilton Hotel, New York, N. Y.

Exhibits: Mr. J. A. Coleman, National Bureau of Standards, Washington, D.C. 20234

November 12–13, 1970

Canadian Symposium on Communications, Queen Elizabeth Hotel, Montreal, Quebec, Canada

Exhibits: Mr. H. H. Schwartz, Electrodesign Ltd., 9124 St. Lawrence St., Montreal, Quebec, Canada

November 15–19, 1970

Engineering in Medicine and Biology Conference, Washington Hilton Hotel, Washington, D.C.

Exhibits: Mr. W. T. Maloney, Prof. Rel. & Res. Inst., Inc., 6 Beacon St., Boston, Mass. 02108

November 17–19, 1970

Fall Joint Computer Conference, Astro Hall, Houston, Texas

Exhibits: Mr. H. G. Asmus, AFIPS Headquarters, 210 Summit Ave., Montvale, N.J. 07645

November 17–20, 1970

Magnetism & Magnetic Materials Conference, Hotel Plaza, Miami Beach, Florida

Exhibits: C & M Associates, P. O. Box 68, Maple Glen, Pa. 19002

December 6–9, 1970

National Electronics Conference, Conrad Hilton Hotel, Chicago, Illinois

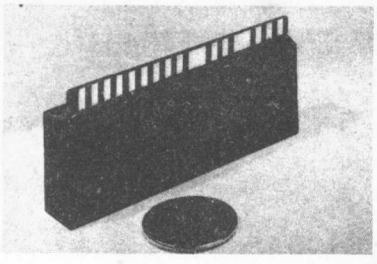
Exhibits: National Electronics Conference, Oakbrook Executive Plaza #2, 1121 W. 22nd St., Oak Brook, Illinois 60521

News New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your IEEE affiliation.

Series of high-speed, high-gain miniature dc-coupled video preamplifiers introduced

Series 1000, miniature nanosecond high-gain bipolar, linear preamplifiers are designed for use with fast analog-to-digital converters, oscilloscopes, channeltrons, photomultiplier tubes, and various solid-state detectors. The dc-coupled video preamplifiers offer a combination of stability, speed, and compactness not heretofore available in any commercially available device, it is reported.



Nonoverloading, the stable, direct-coupled, encapsulated pulse-amplifier modules are said to offer a unique combination of fast risetime (2.5 ns max.), high gain (5 to 200 standard), low power requirements (±12 volts), and excellent temperature stability (within 15 mV, 25 to 80° C) in compact card-edge packages only 7.5 cm. long by 4.0 cm high by 1.5 cm wide. Bandwidth is 0 to 150 MHz. Linearity is 1 percent integral. Both input and output dc levels are at ground potential for easy interconnection with other direct-coupled circuits. Full power supply decoupling is provided within the module.

Series 1000 preamplifiers allow several optional characteristics. The standard modules are noninverting with gains of 5 to 200 and output amplitude of ±500 mV. If desired, models having gains higher than 200, inverting versions, high output amplitude, and impedances other than the standard 50 ohms can be supplied.

Details concerning the preamplifiers may be obtained by writing **LeCroy Research Systems Corp.**, 126 North Route 303, West Nyack, New York 10994.

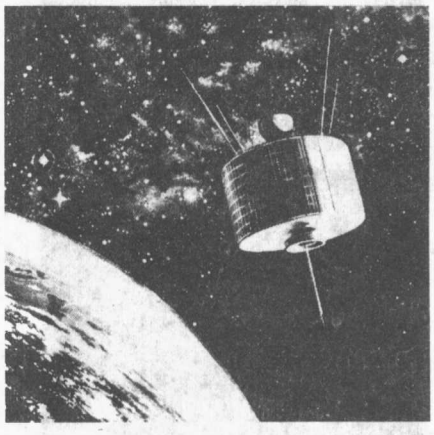
Digitally programmable dc source available

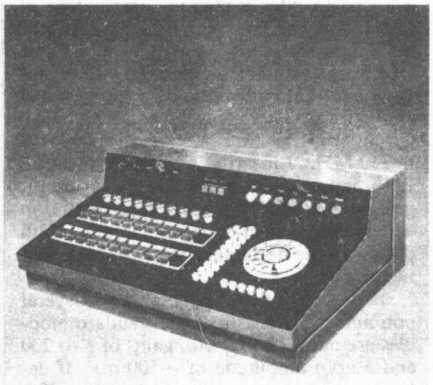
Model CS-210, a digitally programmable dc device source, is said to be a precision constant-current reference supply programmable for current range and setting, voltage limit and output polarity. Five bipolar current ranges—0.01/0.1/1/10/100 mA—are provided with four-decade resolution and four compliance-voltage levels of 25/50/75/100 V.

Current regulation is reputedly 50 ppm

(Continued on page 8A)

Communications are our concern





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SPECIAL ISSUE ON CABLE TELEVISION

contents

SCANNING THE ISSUE ..... *G. N. Penwell, Guest Editor* 961

PAPERS

A U.S. Government View of CATV and Its Future, *K. A. Cox* 963
The Emergence of CATV: A Look at the Evolution of a Revolution, *E. S. Smith* 967
Wired-City Television Revisited, *E. Greenberg* 982
A Satellite System for CATV, *Q. B. McClannan and G. P. Heckert* 987
Distribution of Electronic Mail Over the Broad-Band Party-Line Communications Network, *W. B. Gross* 1002
A Compatible High-Resolution TV System for Cablecasting, *E. W. Herold* 1013
Dial a Program—an HF Remote Selection Cable Television System, *R. P. Gabriel* 1016
Frequency Band Assignments Free of Second-Order Beat Interference, *J. Shekel* 1024
A Digital Video System for the CATV Industry, *D. Kirk and M. J. Paolini* 1026
Structural Return Loss Phenomenon in Coaxial Cables, *J. A. Olszewski and H. Lubars* 1036
The Optimum Gain for a CATV Line Amplifier, *K. A. Simons* 1050
Second-Order Distortion in CATV Push–Pull Amplifiers, *W. H. Lambert* 1057
Cross-Modulation Figure of Merit for Transistor Amplifier Stages, *D. Lieberman* 1063
The Decibel Relationships Between Amplifier Distortion Products, *K. A. Simons* 1071
Field Testing the Performance of a Cable TV System, *A. S. Taylor and L. H. Janes* 1086
Color Television Signal Demodulation and the *K* Rating, *B. W. Osborne* 1103
Ultralinear UHF Power Transistors for CATV Applications, *O. Müller* 1112
A Co-Channel Filter for CATV, *D. Z. Dworkin and T. Chuang* 1122

CONTRIBUTORS 1126

PROCEEDINGS LETTERS

Cable Television

Comments on "Structural Return Loss Phenomenon in Coaxial Cables," *W. L. Roberts* 1130
On AGC Transient-Response Behavior in Cascaded Amplifiers, *M. L. Zelenz* 1130

Electromagnetics and Plasmas

A New Technique for Short-Pulse Compensation in Phased-Array Scanning, *D. E. Barrick* 1133
Extension of Boundary Relaxation for Finite-Difference Solution of Field Problems, *S. L. Richter* 1146
A Ferrite-Metal Surface Wave in a Rectangular Guide Loaded with a Ferrite Slab Placed Against a Broad Wall, *M. Albani and P. Bernardi* 1175

Circuit and System Theory

Computation of the Transient Response of Linear Systems to Step and Ramp Inputs, *L. W. Cahill* 1169
Nonlinear Resistors that Generate Subharmonics, *M. R. A. Erdey* 1174

Electronic Circuits and Design

Further Comments on Digital Bandpass Filtering, *R. K. Otnes* 1136
Frequency Limitations on an Operational Amplifier Realization of All-Pass Transfer Functions with Complex Poles, *A. Budak and P. Aronhime* 1137
A Minimal Sensitivity Circulator Using Differential Transconductances, *W. H. Holmes and C. Sripaipan* 1143

Electronic Devices

Double-Drift-Region (p^+pnn^+) Avalanche Diode Oscillators, *D. L. Scharfetter, W. J. Evans, and R. L. Johnston* 1131
High-Power Millimeter Wave IMPATT Oscillators with Both Hole and Electron Drift Spaces Made by Ion Implantation, *T. E. Seidel and D. L. Scharfetter* 1135
Experimental Verification of Approximate Large-Signal Theory of IMPATT Diodes, *D. Delage-beaudeuf* 1140
Comment on "Phase Mismatch in Traveling-Wave Parametric Amplifiers," *D. Raicu* 1149
Photoinjection in MOS Structures: Interference Interferes with Observation of Band Structure, *R. J. Powell, C. R. Viswanathan, and S. Ogura* 1151

contents continued

Two-Watt CW GaAs Schottky-Barrier IMPATT Diodes, *Y. S. Lee and C. K. Kim* 1153
Unusual Transient Properties of a Wide Silicon p-i-n Diode, *D. Leenov* 1156
On the Gate Current and Noise Behavior in Pinched-Off Silicon Junction Field-Effect Transistors, *M. Nakahara and I. Kobayashi* 1158
Self-Pulsed High-Efficiency Avalanche-Diode Oscillators, *S. G. Liu and J. J. Risko* 1159
A 1 to 2 μm Silicon Avalanche Photodiode, *F. D. Shepherd, Jr., A. C. Yang, and R. W. Taylor.* 1160
An Evaluation Circuit for Fundamental and Harmonically Tuned GaAs Devices, *P. Troughton.* 1165
Excess Gate Current in a Junction-Gate Field-Effect Transistor, *D. L. Mo* 1166
A New Noise Equivalent Circuit for the Junction FET with Uncorrelated Noise Sources, *R. Kässer.* 1171

Optics and Quantum Electronics

The Number of Resolvable Spots in a Photoelastic Beam Deflection System, *H. E. Sweeney and W. E. Budd* 1162
Interrelationship Between Terms of the Born and Rytov Expansions, *K. Mano* 1168

Communication Theory

Comments on "The Distribution of FM-Discriminator Click Widths," *D. Yavuz* 1133
Direct Computation of Distribution Functions from Characteristic Functions Using the Fast Fourier Transform, *A. A. G. Rqeuicha* 1154

Control Systems and Cybernetics

A Feature Extractor for Curvilinear Patterns, *K. Fukushima* 1145
Lagrange Stability and Higher Order Derivatives of Liapunov Functions, *J. A. Heinen and M. Vidyasagar* 1174

Communication Technology

Signal-to-Noise Enhancement Using a Superconducting Time-Variant Filter, *G. D. Arndt* 1138
Correlation Detection of Impulse Noise for FM Threshold Extension, *G. D. Arndt and F. J. Loch* 1141
Forced Oscillations in a Van der Pol Oscillator and Comments on "The Effects of Noise in Oscillators," *G. Bertrand and E. Hafner* 1148
Two Calibration Satellites, *R. R. Zirm* 1155

Miscellaneous

100 MHz Bandwidth Love Wave Dispersive Delay Lines, *C. Lardat and P. Tournois* 1150
Color Contrast Cross-Grid Displays Using Undisturbed Cholesterics, *R. A. Soref* 1163
Optimal Operation of Distribution Networks by Quadratic Programming Methods, *A. Kuppurajulu and K. Raman Nayar* 1172
Correction to "Comment on 'Calculation of the Distribution of Relaxation Times From Experimental Data,'" *M. Fox* 1176

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BPA

Contributed Papers

The PROCEEDINGS welcomes contributed research and review papers in all areas of electrical engineering. To qualify for publication, such papers must be previously unpublished, meet high standards of technical scholarship, report on original work (in the case of research papers), and either (i) be broad enough to span the interests of several IEEE Groups or (ii) treat a subject not covered by one of the existing IEEE TRANSACTIONS or JOURNALS.

July 1970 *Vol. 58* *No. 7*

Proceedings of the IEEE

Scanning the Issue

SPECIAL ISSUE ON CABLE TELEVISION

When E. W. Herold of the Technical Activities Board (TAB) of the IEEE first suggested that a special issue of the PROCEEDINGS be devoted to cable television my reaction was one of considerable excitement. Having been personally involved in the development of this technology since its formative years, I had long felt cable television was too often considered a mere stepchild of the broadcast industry. Here, at last, was the opportunity to discuss, in a great engineering forum, the problems and the potential for an industry that evolved from little more than an improved television reception service in 1949 to what the Electronic Industries Association (EIA) defined twenty years later as a "Broadband Communication Network" (see the IED/EIA filing with the Federal Communications Commission Docket 18397, Part V, October 28, 1969).

TAB had already appointed an *ad hoc* advisory committee on cable television to explore the manner in which to best accommodate cable television engineers and technicians, with an identity of their own, within the framework of the IEEE. Committee members were selected from each of three Groups representing the disciplines most directly involved: Archer S. Taylor for the Broadcasting Group, Eli Cohen for the Broadcast and Television Receivers Group, and John O. Norback for the Communication Technology Group. I was appointed Chairman and also represented the National Cable Television Association, Inc. The *ad hoc* committee then accepted the further responsibility to organize and edit the special issue on cable television.

Since special issues are earmarked as much as two years in advance, the normal course of events would have led to the appearance of this issue some time in 1971. The committee felt the topic to be of such current interest, however, that an attempt should be made to schedule the issue for publication at the earliest date possible even though a strictly complete and definitive exposition of cable technology might not be the result. Changes in the U. S. telecommunication policy were being discussed at the highest levels, alternatives to open-circuit broadcasting were being sought, and the time was ripe for the broaching of this new subject. The understanding cooperation of the PROCEEDINGS Editor enabled the committee to achieve the desired timely publication in this July issue.

Although a call for papers was issued the schedule was so tight that most of the papers were invited. The intent has been to provide in this issue a basis for the enlargement of the technical issues confronting the industry, to indicate the state of the art of cable technology, to document some of the political interdictions to the devlopment of the industry, and to flavor the issue with a few of the exciting future possibilities.

The first three papers provide some insights into the political, legal, and social aspects of cable television: Commissioner Cox provides a federal government viewpoint, E. Stratford Smith a well-documented chronology of the emergence of CATV as a separate and distinct communications force, and Professor Greenberg raises some thought provoking questions about national telecommunications policy.

Surely one of the most important technical developments will be the city-to-city interconnection of many video channels that can be accomplished via a domestic satellite system. A national interconnection of 10 to 20 video channels opens the door to program diversity such as not even major metropolitan markets now enjoy. The technical question is also raised "What are the system parameters for a satellite designed to distribute to 5000–10 000 cable television head-ends?" McClannan and Heckert have given us the first glimpse of a system optimized for CATV needs.

Concurrent with national interconnection is the exciting possibility of electronic mail origination and delivery for as little as 10¢ per letter as discussed by Gross. Still another preview of what the future may bring via cable television is the high-resolution compatible color system proposed by Herold. Gabriel discusses a switched-video system which has been used in England with considerable success. The switched-video system runs counter to the traditional frequency-division multiplexing of video on a single coaxial cable seen in the United States. However, some recent activity indicates that switched-video systems are being built or designed for at least three U. S. locations.

Simons' paper on the decibel relationships and Olszewski and Lubars' on the analysis of VSWR in coaxial cable are both definitive and fundamental to the understanding of cable television system design. The several other papers by Lambert, Shekel, Simons, Lieberman, and Dworkin and Chuang address specific system or device analyses. It is not well appreciated outside the CATV industry that the technology is to a large extent device limited. Since the broad-

cast signal received and distributed through RF amplifiers is a vestigial sideband amplitude modulated signal, there is a tremendous burden of linearity placed upon the system. Manufacturers are currently designing amplifiers so linear that distortion products are commonly suppressed 90 to 100 dB below amplifier output level. This is also pressing the state of the art in measurement methods of such low distortion levels. One major device limitation has been that of transistor design optimized for cable television needs; i.e., at once, high output power capability, large bandwidth, and ultralinearity. The paper by Müller indicates that we may be about to see a significant step in overcoming this device limitation.

The combination of the cumulative effect of distortion products and *ktB* noise through successive RF amplifiers in a system limits the trunk-line transmission distance for a given signal quality. Fifteen miles would be a typical trunk-line limit. Kirk and Paolini have outlined an alternative approach to trunking long distances—the digital approach has some interesting tradeoffs.

In the paper by Taylor and Janes we have for the first time a record of measured system performance and a discussion of test methods. Osborne further discusses video testing as applied to cable systems and suggests some minimum standards interpreted in terms of the *K*-rating.

The subject of standards will be further elaborated upon when the Federal Communications Commission proposes or adopts rules and regulations on these matters. But there is a growing realization that standards for cable systems, which are but one link in the system chain of studio video to home receiver, cannot be considered apart from a reallocation of tolerances throughout the system.

This issue concerns itself primarily with the development of cable television in the United States. We recognize, however, that CATV is not a unique U. S. phenomenon. There is considerable activity in Canada resulting in a household penetration far greater than that in the United States at present. Outside North America, with a few exceptions such as the United Kingdom, the Benelux countries,

cable television has been on a smaller scale, with a proliferation of apartment size master antenna systems (MATV) rather than city-wide distribution systems as are common in the United States and Canada. This development has not been without technical interest, however, and the techniques, such as direct UHF distribution, initiated by some of our European counterparts will hopefully be reported in future issues of IEEE publications.

Many readers of this issue may wish to delve further into certain aspects of cable television or to follow its future development. Within the IEEE, the Broadcasting Group, the Broadcast and Television Receivers Group, and the Communication Technology Group are concerned with technology relevant to CATV. In fact, the December 1969 issue of the IEEE TRANSACTIONS ON BROADCASTING was entirely devoted to this subject. There are also a number of commercial broadcasting and electronics publications that cover CATV developments.

E. Stratford Smith has rightly referred to CATV as the evolution of a revolution. The technical revolution may be just beginning. Deep-rooted changes in national telecommunications patterns are about to take place as the United States moves toward a "wired-city" concept. Assaults upon the VHF and UHF spectrum are coming more frequently. Open-circuit broadcasting must make more efficient use of the spectrum or develop alternatives. As the EIA filing with the FCC puts it "we look upon such (cable) systems as being of 'national resource' dimensions and the development of these resources as a national goal." We heartily agree.

G. NORMAN PENWELL
Chairman, Guest Editorial Committee

G. Norman Penwell (*A'48–M'55–SM'64*) *was born in Belgrade, Mont., on December 12, 1924. He received the B.S. degree in engineering physics from Montana State College, Bozeman, in 1948.*

During the early 1950's he built and operated several cable television systems in Montana, a radio station in Bozeman, and was part owner of a television station in Kalispell, Mont. He was also an Engineering Consultant on broadcast and CATV system design. From 1960 to 1964 he was employed as a Senior Engineer with Bell Aerosystems Co., a division of Textron, where he designed experiments for radio frequency interference analysis at Tucson, Ariz. He then spent four years with the IIT Research Institute in Annapolis, Md., as contractor for the development of the Electromagnetic Compatibility Analysis Center (ECAC). He has been Director of Engineering for the National Cable Television Association, Inc., Washington, D. C., since 1968.

Mr. Penwell is a member of the Society of Motion Picture and Television Engineers, the National Association of Educational Broadcasters, and the CATV Pioneers.

A U.S. Government View of CATV and Its Future

KENNETH A. COX

Abstract—This paper traces the development and regulation of cable television from the early 1950's to the present. It illustrates the increasing impact on broadcasting of expanding cable capacity and the Federal Communications Commission's regulatory response thereto, including the requirement of carriage and nonduplication of local signals, and regulation of the importation of distant signals. It considers the Commission's pending regulatory proposals, as well as proposed Congressional revision of the copyright law. It outlines the Commission's efforts to encourage the cable industry to provide true diversity of programming through local origination and leasing of channels to others, as well as the relationship between CATV and the telephone industry, and the Commission's efforts to prevent the latter from abusing its control of the poles which are normally essential to cable operation. Finally, the paper looks briefly at the future of cable regulation.

TWENTY years ago, I am sure no one would have anticipated that some people would be suggesting today that cable television (CATV) may become the basic service, substantially displacing broadcast television, and may even grow to challenge the telephone industry for the many services which broad-band technology can, at least theoretically, make available in the future. True, the first CATV systems were then in operation, bringing up to three signals into communities which lacked dependable service either because of distance or terrain obstruction. But the public was rapidly buying sets to enjoy the offerings of the 108 prefreeze stations, which were beginning to do very well financially, while the Commission was working on a greatly expanded allocation table to bring more service to the country. At that time cable seemed simply a supplemental means of bringing television to remote areas, like the then illegal VHF (very-high frequency) boosters in use in many places in the West.

In the early 1950's, the principal problems were interference to off-the-air viewing due to radiation from the early cable systems and, conversely, interference to CATV headends from the boosters. The confrontations—of which there were not many—were largely at the local level, between supporters of different modes of extending big city television service. The television stations themselves were largely above the dispute, but were happy to accept the extension of their signals to additional audiences. I can recall that when I first entered the communications field in 1956 as special counsel to the Senate Commerce Committee, some leaders of the CATV industry regarded their service merely as a stopgap until UHF (ultra-high frequency) television established itself and were concerned primarily that they be allowed to amortize their investments.

Manuscript received February 18, 1970.

The author is Commissioner of the Federal Communications Commission, Washington, D. C. 20554.

However, things began to change. The Commission granted microwave facilities for "special" carriers to serve CATV systems, thus permitting the signals of Denver, Colo., Salt Lake City, Utah, Spokane, Wash., Albuquerque, N. Mex., and Phoenix, Ariz., to be carried all over the Rocky Mountain area—and beginning the extension of New York City, Los Angeles, and other big city signals into dozens of communities which could not pick them up off the air. The manufacturing arm of the CATV industry developed five channel cable and improved amplifiers which made possible entry into larger communities, with one or two local stations. For the first time, broadcasters became concerned about CATV—but only those in the smaller markets, who were unable to enlist the support of big broadcasters or the National Association of Broadcasters (NAB). At their request, the Senate Commerce Committee conducted hearings in the summer of 1958, on the basis of which I wrote a report "The Problem of Television Service For Smaller Communities." This suggested that the FCC should assert jurisdiction over all methods by which television service is brought to the public, including CATV, and that the latter could have adverse impact on local service in small television markets, with particular loss to rural viewers who cannot get CATV service.

The Commission had first had a question raised as to its jurisdiction over CATV in the early 1950's. It initially approached that issue in terms of common carrier regulation and decided—contrary to the recommendation of its staff—that it did not have jurisdiction over cable operations. Even after the 1958 Senate hearings, the FCC continued to question its authority to act, though it suggested that CATV could adversely affect the public interest in a growing over-the-air television service. It supported a legislative proposal in 1959 to give it authority over CATV, but the measure failed of passage in the Senate by one vote.

So when I became Chief of the Commission's Broadcast Bureau in 1961, the Commission was still doing nothing about CATV—except continuing to authorize microwave facilities to alleged common carriers which, however, usually served only affiliated CATV systems. One of our smallest broadcast stations, in Riverton, Wyoming, challenged an application for improved microwave facilities to import signals from Denver, Colo., alleging serious impact on its ability to continue its service. Our Broadcast Hearing Division attorneys, taking a position directly contrary to our Common Carrier Bureau, persuaded the Commission to deny the application unless the carrier required its cable "customer" to carry the local station and protect it against duplication of its programs by the imported signals. The

Courts sustained this ruling and this action, in the *Carter Mountain* case, marked a shift in the Commission's position with respect to cable regulation.

First, the Commission adopted rules in 1965 applying its carriage and nonduplication requirements to all microwave-fed CATV systems, and at the same time proposed to extend its jurisdiction to the remaining systems which simply pick their signals up off the air. Then, in 1966, it finalized that proposal in our so-called "Second Report and Order," slightly restricting its nonduplication requirements but adding a ban on the importation of non-Grade B signals into the top 100 markets unless it were found, in a hearing, that such importation would be consistent with the healthy development of local television service. Our jurisdiction over all of CATV—on the ground that it is an element in the interstate transmission of intelligence by wire and radio—was sustained by the Supreme Court in *United States* v. *Southwestern Cable Co.* Specific provisions of our rules have been upheld by a number of Circuit Courts of Appeal—in our protracted litigation with the cable industry we have lost only two or three minor cases involving details of our carriage and nonduplication rules.

Actually, those rules are generally accepted in principle by cable leaders. However, they have strongly contested our distant signal policies, arguing that they constitute a freeze on the development of cable technology. This is because further advances in that technology have led to the development of twelve channel cable, which has permitted the development of systems with capacities of 20 or more channels. So just about the time the FCC adopted its Second Report and Order in 1966, cable entrepreneurs were seeking franchises to wire-up major cities like Philadelphia, Pa., Cleveland, Ohio, Akron, Ohio, Buffalo, N. Y., San Diego, Calif., and many others—since they could now carry three to five local signals and still attract a high level of subscriber support *if* they could fill up their channels with signals from other markets, preferably larger ones. This threatened invasion of the major television markets finally brought the big broadcasters into the battle. The NAB and the Association of Maximum Service Telecasters mounted vigorous campaigns before the Commission and the Congress. Many individual broadcast companies followed suit, though others decided to enter the cable field themselves.

Our distant signal rules were, therefore, subjected to a running attack. Many cable operators asked us to waive them and, on the advice of the Commission's CATV Task Force, a majority of my colleagues granted a substantial number of these requests. In my judgment, this pattern of waivers has seriously eroded the policies we had adopted to promote the public's interest in the maintenance and expansion of its over-the-air television service, since only this form of television is available to all within range of the station's signal, free of direct charge and regardless of whether the set owner lives in a town or on a farm.

One of the bases for our distant signal policy was the belief that the unregulated importation of such signals constituted a form of unfair competition, since the local stations have to pay for their programming, while a cable operator would bring in many signals to fragment their audiences without paying a penny for the programs involved, and often in violation of the local stations' rights to exclusive exhibition within their market. This is obviously related to the question of copyright. Even prior to our Second Report and Order, Congress had been considering the first major revision of our copyright system in some 60 years. In a measure presented to the House of Representatives in 1966, the Copyright Subcommittee of the Judiciary Committee proposed to make provision for CATV in a way largely in accordance with our rules and policies. However, a jurisdictional dispute arose, and as a result the House passed the measure only after eliminating the section relating to CATV. The legislation has been under consideration by the Senate Subcommittee ever since, leading to its reporting of a bill last December which takes an approach much more favorable to the cable industry. It features, for example, compulsory licenses for cable operators, at very nominal fees bearing no relation to what they would have to pay in the market, and with only partial protection for the broadcasters' exclusive rights.

Meanwhile, our hearing-waiver processes for handling the distant signal problem had bogged down in a maze of pleadings and lengthy hearings. The Commission, therefore, issued proposals for a new approach in December, 1968 (Docket No. 18397). We undertook to avoid disputes over the location of contours and the availability of signals by proposing a fixed zone with a radius of 35 miles around a reference point in each city to which an operating television station is assigned or for which a construction permit has been granted. I agree with this go-no-go concept, but think that 35 miles provides far too little protection for the critical heart of a television market, since it excludes from our proposed rules as much as two-thirds of a station's Grade A contour—that having been the standard used in the Second Report and Order.

What we propose is that no distant signal may be imported within that 35 mile zone *unless* the cable operator has obtained the distant station's consent for the retransmission of its signal. This parallels Section 325 of the Communications Act, which prohibits rebroadcast of programming without the consent of the originating station. It also bears a relationship to copyright, though it creates no cause of action for the use of copyrighted material and fixes no rules of compensation. Instead, it merely conditions the carriage of distant signals on the making of arrangements with the originating station or with those who own the rights to further use of the programs it broadcasts. The cable industry complains that this ignores the Supreme Court's ruling in the *Fortnightly* case that a CATV system's use of off-the-air signals does not violate existing copyright law, and that it would involve the cable operator in burdensome dealings with a host of different copyright owners. As to the former contention, the Court clearly contemplated that the FCC has authority to regulate cable operations in the public interest, having just sustained our jurisdiction a short time

before—and in any event its decision did not deal with microwaved signals which are becoming increasingly important. As to the second point, copyright clearance for a distant channel will be no more difficult than it was for the broadcaster who arranged for the presentation of that program service. The only reason that a cable operator faces a more complicated problem is that, for his own profit, he has elected to present multiple signals, thereby correspondingly increasing the programming for which he would have to seek clearance. But only if he can make such arrangements will he be competing fairly with the local station for audience.

We also propose that cable systems, in importing distant signals, be required to carry the nearest available station in a particular class, our so-called "anti-leapfrogging policy." This is designed to promote our basic allocations concept of local stations deriving support from their surrounding areas, and to avoid making cable communities appendages of more distant big cities. And we propose, for the first time, to protect stations in markets below the top 100 by limiting signal importation to those necessary to give the cable community three full network services, an independent service, and an educational service. Finally, we propose to put into our rules a policy as to overlapping markets which is set forth in Footnote 69 in the Second Report and Order. This is designed to prevent a cable system in Washington, D. C., from carrying Baltimore, Md., signals, thereby equalizing them with the local signals and significantly altering local viewing, even though the Baltimore stations provide theoretical Grade B service to Washington. Just since the first of this year, the Court of Appeals for the District of Columbia has approved this policy as we had applied it to protect the San Diego, Calif., stations against extension of the carriage of Los Angeles, Calif., signals on local cable systems.

Pending finalization of these proposals—which we tied directly to Congressional consideration of copyright legislation—we have suspended all hearings and all consideration of distant signal waiver or hearing requests. We have indicated that we would grant, on an interim basis, only those applications which are entirely consistent with our proposals. However, a majority of my colleagues have again undercut our policies by granting waivers—particularly with respect to leapfrogging.

In our December, 1968 proposals we raised a number of basic questions about the future role of cable television, emphasizing our hope that it would become less dependent on distant signals and could provide more really diverse programming by generating on-cable programming, often called cablecasting. A good many CATV systems now carry automated time-weather, news ticker, and stock ticker services, and industry leaders have long claimed that they can program to meet special needs that broadcasters cannot serve. We, therefore, initiated an inquiry into these matters.

Last October we adopted a First Report and Order in Docket No. 18397 in which we authorized cable operators to originate programming (*requiring* it of systems with at least 3500 subscribers beginning January 1, 1971), to sell commercials at natural breaks in such programming, to lease channels to others on a common carrier basis so that they can originate programming (either on an advertiser-supported or a pay television basis), and to interconnect their systems so that the pooling of their audiences in a form of cable-networking can sustain the development of top quality programming to supplement that produced for broadcast television. These actions were generally welcomed by the cable industry—and generally opposed by broadcasters, who object that cable operators have built a business by appropriating broadcast signals, and will now be allowed to compete for advertising funds in order to finance programming which will further fragment broadcast audiences. However, I think that economic realities will provide built-in restraints on such competition. While our policies will permit the cable industry to add new diversity to television fare—including, hopefully, specialized programming for minority tastes—this will come about only if funds are forth-coming to support such operations. There are clearly limits to what advertisers will pay for more and more programs which will, for the most part, attract fewer and fewer people, and even sharper limits on what the average television family will pay directly to obtain subscriber-supported programming so long as free service is available. So I do not think cable television will carry as many or as diverse program services as its proponents claim, or as the broadcasters fear. But to the extent that CATV can finance its own programming the public will benefit—and this will be fair competition, which I think broadcasters must accept. There is one possible exception—small market stations may need some ceiling on the number of programs with which they are to be required to compete.

The development of cable television has impinged on another industry which we regulate—the telephone industry. Although a few CATV operators have obtained franchises to erect their own poles—or, more recently, to install buried cable—most have had to go to the local telephone and electric companies for consent to attach their cables to the utilities' poles. At first I suspect this was simply a minor nuisance for the telephone companies, since there may be problems in sharing poles with a completely separate operation. At the same time, however, this was a source of some revenue, since the cable operator pays a fixed annual rental per pole.

However, as the capacity of CATV cable expanded, the telephone companies became concerned that these operations might eventually compete with them for some of the services which scientific dreamers foretell for the wired city —automatic meter reading, security surveillance and alarm systems, display and purchase of merchandise, access to computers, teaching machines, and libraries of filmed and printed materials, the checkless society, facsimile reproduction of newspapers in the home, etc. So telephone companies began to insert provisions in pole attachment agreements prohibiting CATV use of their poles for anything except transmission of broadcast television signals, began to lease wide-band facilities to cable operators in lieu of letting them append their own systems to the utilities' poles, and

(except for A. T. & T., which is barred from doing so by a consent decree) began going into the CATV business themselves, either directly or through affiliated companies. In short order, the Commission received complaints that telephone companies withheld or delayed agreement as to pole attachment rights until one of their leased facility customers got a head start over others seeking cable franchises in a particular community. Other conventional CATV operators protested that they could get nowhere in pole attachment negotiations, and would suddenly find that a telephone company affiliate was offering cable service. We designated a number of these cases for hearing. However, we decided that this was an unnecessary waste of time and ruled, just last January 28, 1970, that telephone companies may not engage in CATV operations, either directly or through affiliates, in areas where they provide exchange service. They can still offer to lease CATV facilities if an entrepreneur prefers to take that route instead of investing in his own plant—but must show that the customer and his franchising authority understood that the option of getting pole attachment rights was reasonably available. If a telephone company wants to experiment with this technology, or wishes to realize the profits of CATV operation, it may engage in this business in some other company's operating territory.

More recently, A. T. & T. and the General Telephone Company having relaxed their pole attachment policies, our Common Carrier Bureau inquired whether this constituted the offering of a communications service for which a tariff should be filed. The companies dispute this and the matter is still under consideration. Meanwhile, we heard of plans to impose sharp increases in pole attachment charges, and so wrote asking deferral of such action pending our examination of the matter. The California Public Utility Commission has started its own inquiry and has asked us to leave regulation of pole attachment agreements to the states. Only two states—Connecticut and Nevada—have had any record of trying to regulate cable television, though I believe that Vermont has just passed legislation to that effect. Efforts have been made in many other states to authorize their utility commissions to regulate CATV, but the cable industry has been able to defeat them. But just weeks ago the Supreme Court left standing a Court of Appeals decision affirming the power of the State of Nevada to regulate those aspects of CATV which have not been preempted by the FCC. We have never tried to exercise total jurisdiction over cable television, so there are a good many areas left for state action.

If cable television grows as its enthusiastic supporters believe it will, it seems likely that its channel capacity will grow, that it will achieve two-way communications capability, and that it will develop at least limited switching facilities. If such systems are built in major cities and then are interconnected by microwave—or by domestic satellite—their operations will begin to look more and more like competitors to the telephone companies. Indeed, cogent arguments have already been advanced for complete common carrier regulation of cable television, with the owner of cable facilities restricted to leasing them to others under tariffs providing equal access to the services he undertakes to provide, but barred himself from providing services directly to the consuming public. Certainly, some difficult problems will be posed as to the proper relationship between cable television and the telephone industry.

Thus as we enter a new decade, the cable television industry has come out of the mountains and great plains and is seeking entry to the major metropolitan centers. Its expanding technology has a potential which encompasses both broader horizons for television viewers and a variety of promising nonentertainment services as well. But its future development depends on its ability to find economic support for its growth and diversification. Many of its leaders say that they must be allowed to import a substantial number of distant signals into the major television markets, with only nominal payment for the programs involved, in order to win the popular support and revenues needed to maintain and modify their systems to provide all the wonders of the wired city—despite the possible impact of this unfair competition on existing and potential free television service in these communities. Other cable spokesmen believe they can move ahead in an orderly way simply on the basis of improved signal quality for local stations, automated services, programming originated by themselves or others who may lease channels from them, and the simpler nonentertainment services (e.g., meter reading, surveillance). Certainly I hope the latter course is the one that will be followed. The potential of cable technology is so great that I think it has bedazzled some academic students of communications, leading them to unreasonably optimistic prognoses of what it will provide for the public. But much of this is highly speculative, and I do not think the Commission can afford to risk serious damage to our existing television system. It has many flaws, and should be regulated to require it to perform more closely to its unrealized potential. Whatever cable may bring, it cannot provide a substantial information and entertainment service without direct charge to the viewing public while making its services available to better than 95 percent of all American homes. Advertiser-supported television now does that, and can do better if we can successfully develop the UHF allocations. And judging from the concern expressed by Congress over the alleged threat of over-the-air pay television, I do not think it will tolerate the much more serious danger posed by multichannel cable television if it is not fitted fairly and cautiously into the existing system.

I think cable television does have a potential which the FCC should encourage. But I think it will have to compete fairly and pay its way.

The Emergence of CATV: A Look at the Evolution of a Revolution

E. STRATFORD SMITH

Abstract—The growth of CATV or cable television has often been characterized as "explosive." Since 1952, the first year in which reliable statistics were accumulated, the number of CATV systems have multiplied 35 times and it is now estimated that over 4½ million families are receiving CATV service from approximately 2350 cable TV systems. This growth is especially impressive when it is considered that the CATV industry, whose very existence has depended upon the existence and viability of the TV broadcast industry, has been locked in a bitter struggle with that industry throughout most of its 21-year history. Unquestionably the two most important factors influencing the growth and posture of the CATV industry today have been the uncompromising demands of the public for a greater diversity in choices of TV programming than the broadcast industry has been able to provide, and the competitively motivated opposition, vigorously prosecuted before congressional committees and the FCC. This has resulted in a series of investigations and Reports and Orders by the Federal Communications Commission that have produced a comprehensive regulatory scheme designed by the Commission to maintain CATV as a supplementary service to broadcasting, and conversely to protect the broadcast industry, particularly UHF broadcasting, against any adverse economic impact by CATV that would endanger the viability of the broadcast service. Whether or not this concern is economically justified and if so, the nature and extent of regulation necessary, were the principal contentions between the two industries over the years.

The first formal rules became effective in 1965 but were applicable only to cable systems using microwave radio relay services. In subsequent years the Commission was able to establish firmly its jurisdiction over the entire CATV industry and the Commission's rules and policies has now evolved to the point that virtually all cable television developments in the top 100 television markets have stopped. The Commission has, however, been the subject of increasing criticism from outside the CATV industry for its restrictive CATV regulatory policies. This criticism appears to be effective and more recent actions of the FCC indicate that it clearly recognizes an exciting potential for cable technology in furnishing a variety of television and other communication services between homes, businesses, and information libraries. The critical issues today are how to secure the optimum services from both the broadcast and cable technologies.

Introduction

IN TERMS of human life, at least, the 21st year is that of full legal age. Cable Television (CATV) reaches its 21st birthday this year, 1970. A review of the first 21 years of the business life of CATV reveals that it has indeed become legally responsible to the public and its government. Although many of the problems in the emergence of cable television turned upon defining its legal status under local, state, and Federal legislation, it was not the law as such that determined the current posture of cable TV. It was a combination of socio–politico–economic forces to which the law reacted when the forces were brought to bear on the Federal and state legislatures and the courts and regulatory agencies. It is strikingly clear from this look at the evolution of CATV that reaching the age of legal responsibility is, as in human life, not to be equated with maturity. The evolution is continuing at a rapid rate and the ultimate posture of CATV as a public service and under the law is yet to be determined.

As used here, the term "cable television" and the acronym "CATV" are generally synonymous and refer to that system of television signal reception and distribution originally conceived of as "community antenna television," but which is now, under the combined impetus of modern cable technology and public demand for entertainment, educational, and convenience advantages of television as a communications medium, breaking free of its early conceptual bonds to encompass a number of diversified cable services, most of which still involve television retransmission.

With the spawning of modern technology in the early 1800's, man has embarked upon an inventive course to utilize fully his available resources in providing for the multitude of human needs and management of his environment. Mass communication in recent years has undergone an internal revolution of its own to the point where it now constitutes an indispensable part of our economic and social life. CATV is an integral part of that change. Dr. J. R. Pierce, Executive Director of Research in Communications Sciences at Bell Telephone Laboratories has made this point dramatically: "If you are looking for revolutionary change, satellites are not that change. The real revolution is right in front of you. It's the revolution of bringing a large number of channels into virtually all parts of the country and this cannot be done by radio; there just aren't enough frequencies. It's been done while people weren't watching. It's the CATV revolution...."[1]; in the same vein. Dr. A. Puckett, Executive Vice President of the Hughes Aircraft Company speculated that within 10 years 80 percent to 90 percent of American homes will be served by cable because "the superior quality of service cable can provide is going to be in demand."[1] Added to these voices is that of Fred W. Friendly, Consultant to the Ford Foundation who advised the House Commerce Committee in hearings on the Public Broadcasting Bill: "I think by 1975 the whole profile of

Manuscript received April 28, 1970. This paper does not purport to be an analysis of the rules and regulations of the Federal Communications Commission applicable to CATV. Two major aspects of the Commission's rules, i.e., required and permissible carriage of signals and nonduplication protection of local stations' signals, are used to trace the historic conflict between television broadcasters and CATV system operators.

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[1] In a discussion printed in *Television Magazine*, September 1967.

how we communicate in this country is going to be changed greatly by CATV . . . CATV might revolutionize television as much as satellites, as much as television has revolutionized radio."[2] "CATV has great promise. It should be permitted to grow" said Alan Novak, former Executive Director of President Johnson's Telecommunications Task Force.[3]

Finally the Federal Communications Commission indicated its cautious agreement by saying,

> . . . tentative conclusions recognize the great potential of the cable technology to further the achievement of long-established regulatory goals in the field of television broadcasting by increasing the number of outlets for community self-expression and augmenting the public's choice of programs and types of service. They also reflect our view that a multipurpose CATV operation combining carriage of broadcast signals with program origination and common carrier services, might best exploit cable channel capacity to the advantage of the public and promote the basic purpose for which the Commission was created.[4]

In view of this highly qualified speculation and the almost precipitous advance of CATV systems in public acceptance, inducing fears for the economic security of various broadcast, theater, copyright and manufacturing interests, and the exciting multichannel potential of cable technology to provide a variety of new and improved services to the average family, CATV is a particularly fitting subject for economic, legal, and social appraisal at this time.

In the Very Beginning

It can fairly be said that the CATV industry is a phenomenon on the American business scene. The service initially grew far more out of the insistent demand from the disenfranchised TV public for more and better television service than from any preconceived design or marketing plan of large commercial interests. The industry had its genesis in the late 1940's and early 1950's, a time when there were few television stations in operation and these only in the larger metropolitan areas.[5] There is some good-natured dispute among pioneers in the industry concerning who built the first cable system. The writer, who represents two of the East Coast contenders professionally, will not jeopardize his rapport with either of them by taking sides. However, L. E. "Ed" Parsons (who is no longer in CATV) has the best documented claim and is generally credited with having constructed the first cable system in the country at Astoria, Ore., in 1949.

Parsons, then the operator of Radio Station KAST in Astoria, reportedly responding to the challenge of his wife who wanted "pictures with [her] radio," went "searching all over Clatsop County, Ore." with signal-survey equipment for the signals of television station KRSC-TV, 125 miles away in Seattle, Wash. He finally settled, oddly enough, for an antenna site on the roof of the two-story John Jacob Astor Hotel in the center of downtown Astoria where he was living in a top-floor apartment; he discovered a fairly reliable but not very strong signal. After once developing a "watchable" picture in his apartment, Parsons developed a three-tube sending unit and extended service to the hotel lobby and then to a nearby music store. Soon other locations including residences were attached and the service developed thereafter essentially as a cooperative. An installation charge of $100 was collected from each person, who was then regarded as owning the cable facility required to extend service to him from the immediately proceeding connection. Parsons also sold television sets to those persons whose residences were connected to the cable.[6]

CATV was also developing simultaneously, or nearly so, on the East Coast in the mountainous areas of Pennsylvania independently of any connection with Parsons, apparently. Among the very early community antenna systems on the East Coast were those at Lansford, Mahanoy City, and Pottsville, Pa. None of the three communities, all of which are in the mountain regions of the state, had an operating television station and only the most marginal reception, if any, from nearby or distant stations. The original owners and operators in each instance were also engaged in retail sales businesses and were motivated initially in their efforts to provide antenna service by the desire to sell television receivers. Thus, from an economic or commercial point of view, community antenna television was started by persons who did not immediately conceive of CATV as an independent business for profit in its right. This changed quickly, however, when the television-excited public literally clamored for the opportunity to pay high fees for a connection to the cable. CATV pioneers will testify that there is no question that it was community demand for first, improved, or increased television service in fringe or marginal reception areas that supplied both the initial impetus and the drive, which resulted in today's cable television industry.

The early economic structure of CATV provides ample evidence that it was the public that demanded the service and brought about its birth and development rather than the research and development and marketing departments of the corporate giants. Since CATV technology was in its infancy, the long-term demand for the service was in doubt, and the industry was unknown outside of a few small communities, the financial risks in building cable systems were great and significant capital was not available from financial institutions and very little from private investors for CATV. Thus, the users of cable service almost literally provided the capital with which CATV systems were built during the first several years of the

[2] Hearings before the Subcommittee on Communications and Power of the House Committee on Interstate and Foreign Commerce, 90th Cong., 1st Sess., at p. 408, 1967.

[3] Address before Federal Bar Association, Washington, D. C., March, 1969.

[4] *First Report and Order*, Docket No. 18397 20 FCC2d 201 202, (1969).

[5] At the time the FCC imposed its "freeze" in 1948 on new station construction there were only approximately 100 operating television stations in the United States.

[6] The claim to being first and the "L. E. Parsons' Story" are documented by Dr. Mary Alice Mayer, "An historical study of the issues and policies related to the educational application and utilization of community antenna television," Ph.D. dissertation, Northwestern University, Evanston, Ill., 1969.

industry. Funds for construction were obtained by collecting a relatively high installation or connection charge from each subscriber. The usual connection charge levied by the early operators ranged from $125 to as high as $200, or more in unusual cases. Until the U. S. Tax Court later declared the practice to be unacceptable,[7] most system owners treated these charges as "contributions-in-aid-of-construction," thus seeking to avoid payment of income taxes on these funds, which could then be fully available for capital construction. Although, as indicated above, the Internal Revenue Service ultimately refused to accept this tax treatment, if the industry had not been able to finance its construction in this fashion during its early years, CATV's growth would have been drastically slowed, if not permanently stunted. Local banks did participate to a very limited extent in early CATV financing, but their principal contribution to the economic development of CATV at the time was in financing the installation charges for subscribers—and these more often than not had to be guaranteed by the system owner. Monthly service charges in these early days were relatively low, the mean range being $2.50 to $3.75 per month.

It is equally interesting to note that for the most part CATV generated its own manufacturing arm. The starting point for equipment development was the master antenna systems being developed and installed to serve hotels, apartment houses, TV service shops and dealer's showrooms. And indeed, that amplifying equipment was used in the first cable systems. Although RCA and Philco both worked for a short period of time with pioneer CATV operators in the early 1950's to develop amplifying equipment and hardware for community antenna use, both lost interest and terminated their developmental and sales efforts at an early date. The pioneer manufacturers who developed the highly specialized head-end receiving equipment, amplifiers, and related gear necessary to transmit signals successfully at TV broadcast frequencies through miles of cable from mountain top or tall tower to thousands of homes, and who started CATV on the road to technical and commercial success, were primarily CATV oriented. Jerrold Electronics Corporation, Philadelphia, Pa., the original pioneer manufacturer, Entron, Inc., Silver Spring, Md., organized by an engineer who came from Jerrold, and AMECO, Inc., Phoenix, Ariz., started by a certified public accountant, all are prominent examples, but by no means constitute the entire list.

Perhaps the low level of interest of the large established manufacturers of electronic equipment in CATV resulted from a widely held belief that community antennas were a temporary system for obtaining television service to be supplanted in due course by off-the-air television reception. It is to be remembered that the first CATV systems came into being in the interim from 1949 to 1952 during which the Federal Communications Commission had imposed a "freeze" on the licensing of new television broadcast stations while it devised a national television channel-allocation plan. During this period there was no new television station construction and, as previously noted, only about 100 stations operating in the entire nation. It was widely thought, and indeed it was the intention of the FCC, that the Television Allocation Plan adopted in 1952, would make possible a nationwide system of commercial television broadcasting that would enable all but the smallest communities to have their own local television station or at least one nearby service.[8] It is an interesting fact that although CATV was known to the Commission in 1952, it is not mentioned in the FCC's *Sixth Report and Order* promulgating the Television Allocation Table and played no part in its formulation.

No discussion of the beginnings of CATV can omit reference to the telephone and power utilities. Some of the early systems, including the one at Astoria, Ore. attached their cables to trees, fence posts, commercial buildings, and houses. At Mahanoy City, Pa., the system operator attached the cables to poles of the Pennsylvania Power and Light Company without permission. This company later ruefully discovered that it did not dare—out of fear of the public wrath—enforce its order to the cable operator to remove his facilities from the poles. Although there were isolated instances of unauthorized attachments and considerable reluctance to allow nonutility companies to attach to poles, both the telephone and utilities companies early recognized the insatiable public demand for better television and permitted cable attachments. The telephone companies at the time were too fully occupied trying to meet post-World War II demands for telephone service to recognize the natural alliance between themselves and CATV—an oversight they still deeply regret. Perhaps they also underestimated the future need for CATV and the potential of cable technology. Coaxial cable to most people in those days was simply what telephone companies put in the ground to provide long distance telephone service and carry television programs between cities.

To gain access to the poles, the would-be CATV operators were required, as they are today, to assume all costs relating to rearrangements of telephone and power lines to accommodate the CATV cable and amplifiers and any pole replacement necessary to meet code requirements, as well as to provide sufficient bonding and liability insurance to hold the utilities free from any possible liabilities. Although CATV operators resented what they considered excessive requirements, the attachment space charges, which initially ranged from $1.00 to $2.00 per pole per year, were acceptable and the industry was off to a good start. The telephone industry did attempt to protect itself against possible competition by strict prohibitions against any kind of communication over the CATV cable except transmission of broadcast signals received off the air. Later reference will

[7] *Teleservice Company of Wyoming Valley* v. *Commissioner of Internal Revenue*, 27 T. C. 84 (1958).

[8] *Sixth Report and Order*, Docket No. 8736, 1 Pike & Fischer Radio Regulation 91:601, para. 63, (1952).

be made to the breakdown of these restrictions and to the telephone industry's efforts to establish itself as an operating part of CATV.[9]

The public appetite for television also enabled the fledgling cable industry to overcome what could have otherwise been a formidable legal obstacle to its development. Never willing to accept legal status as a public utility, the CATV operator nevertheless required permission to cross public streets and alleyways, a privilege usually only available under most state laws to franchised utilities. Even so, with relatively little opposition from law officers, community after community issued "franchises" or adopted ordinances purporting to grant cable entrepreneurs authority to use the public right of ways. They were seldom challenged, and then usually only by a competing applicant. "Franchising" by municipalities is now so widely accepted as the means for securing initial permission to build a cable system and systems have operated under such authorizations for so many years, that it is doubtful that any court would nullify a franchise on the grounds that local governing council lacked the power to adopt it.

Although franchises issued today in larger metropolitan areas are complex documents spelling out many demands for specialized services and exacting substantial franchise fees and other payment to the municipality, early franchises were relatively simple. They neither specified rates for service nor did they provide any type of rate control. They were simple ordinances granting permission to cross streets and alleys and some limited rights to set poles. Municipal authorities were quick, however, to respond to the natural public resentment at being required to "pay" for television and it was not long before it became a common practice to specify connection and service charges and to prohibit increases in charges without permission from the franchising authority. However, municipalities did not exercise utility-type rate-making powers. To this day CATV systems experience extreme difficulty in increasing their charges and usually only attempt to do so when the cable system is being reconstructed with modern equipment and new services are being added which can be argued to justify the increases.

Industry Growth

Factual data concerning the growth of CATV were not systematically or reliably accumulated prior to 1952. *Television Factbook*[10] lists 70 systems in existence as of January 1, 1952 serving an estimated 14 000 subscribers. As Table I shows, the same publication today records 2350 systems operating as of January 1, 1970 serving approximately 4 500 000 subscribers. Thus, the number of CATV systems has multipled 35 times since the lifting of the FCC freeze on television station licensing in 1952. The largest system in the United States has 35 000 subscribers and 16 systems have more than 14 000, the total number of subscribers served by the industry in 1952.

TABLE I
Growth of the CATV Industry
(As of January 1 of Each Year)

Year	Operating Systems	Total Subscribers
1952	70	14 000
1953	150	30 000
1954	300	65 000
1955	400	150 000
1956	450	300 000
1957	500	350 000
1958	525	450 000
1959	560	550 000
1960	640	650 000
1961	700	725 000
1962	800	850 000
1963	1000	950 000
1964	1200	1 085 000
1965	1325	1 275 000
1966	1570	1 575 000
1967	1770	2 100 000
1968	2000	2 800 000
1969	2260	3 600 000
1970	2350	4 500 000

Television Factbook, vol. 39, p. 79–a.

The continued growth of CATV following the resumption of licensing did not surprise those in the CATV industry to extent that it did outside observers. Resumption of station licensing simply made more stations available for reception, enhancing the services of existing systems and, as stations were placed in operation in areas previously without off-the-air service, it became feasible to build new systems in nearby communities which prior to that time were too distant from existing stations to obtain usable signals. The number of CATV systems more than doubled in 1952 as did the total number of subscribers served; both figures doubled again in 1953. The continued growth of the industry thereafter, illustrated in Table I, has been characterized by the FCC and others as "explosive."[11] During the period beginning January 1, 1954, and ending January 1, 1970, the number of commercial television stations increased from 354 to 677, whereas cable systems during the same period increased in number from 300 to 2350.[12] With few exceptions, each new CATV system generally indicates a new community with its first cable service. However, FCC records show that of the 402 net increase in the number of television stations on-the-air as of January 1, 1970 from January 1, 1954, only 154 were the first stations in their respective markets. The Television Allocation Table made provision for 654 commercial UHF stations and 595 commercial VHF stations. Only a little more than one half of these potential stations (677) have been built. It is therefore evident that the con-

[9] See discussion in text accompanying notes 81–86.
[10] Vol. 39, p. 79–a.
[11] *Second Report and Order*, Docket No. 14895, 2 F.C.C. 2d, 725, 738 (1966).
[12] To keep the CATV industry as it exists today in proper size perspective, it should be remembered that the estimated total number of CATV subscribers in the United States (4.5 million) is less than the net weekly circulation of a single New York City television station (WNBC-TV has a net weekly circulation of 5 685 700. Vol. 39 *Television Factbook* at 516-B).