

FINANCING, MODELING, AND DESIGNING CATV
FOR
THE REA MARKET

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INTRODUCTION

REA developed an interest in television and other video services for rural areas as an outgrowth of its work in bringing improved telecommunications service to people living in rural areas. One of the earliest attempts to develop this capacity was a paper distributed in 1962 by Claude Buster, Chief of the Transmission Branch at REA, to the communications industry.

In this paper Claude recognized the tremendous potential capacity of coaxial cable and explored the idea of a total integrated communications facility that could deliver voice, video and data services using analog transmission techniques to the home. This idea was slowly nurtured and by 1977 the 3M Company was actively developing its analog CS² system which would provide a total integrated communications system over coaxial cable to the home. Also, in May 1977 the Office of Telecommunications Policy, now part of the National Telecommunications and Information Agency (NTIA), formed an interagency task force on Rural Communications to which REA was invited to participate. This task force in its report recommended that in order to improve rural communications that REA finance rural cable systems and that the cross-ownership ban on Telco ownership of cable systems be modified by the FCC. Up to that time REA had only financed a portion of the educational statewide television network in South Carolina.

Since that time the 3M Company has abandoned its CS² development as too costly. Another company has picked up the idea and is developing other equipment designs using digital transmission techniques to provide voice and data services directly to homes on coaxial cable facilities. The REA, while prohibited from directly financing commercial CATV systems under the RE (Rural Electrification) Act, did receive delegated authority from the Secretary of Agriculture to administer a loan program for CATV systems utilizing funding under the Consolidated Farm and Rural Development (CFRD) Act. Under the RE Act, REA can only finance educational television systems. The FCC in Docket 78-219 in 1978 eased the cross-ownership waiver requirements on Telco ownership of CATV systems and granted a rebuttable presumption of infeasibility for any system with an average density of 30 homes per route mile or less.

FINANCING RURAL CATV

The authority to administer CATV loans was delegated to REA on May 25, 1979. The funds were a portion of the amount budgeted for rural improvements under the Consolidated Farm and Rural Development Act. The CFRD Act provides two categories of financing. One category, Section 306, Community Facilities, provides funds for public bodies, qualified Indian tribes and not-for-profit organizations at a legislatively prescribed interest rate of five (5) percent. These same organizations and for-profit oriented organizations are eligible for financing under a second category of the CFRD Act, Section 310b, Business and Industrial Loans, with the interest rate based on the cost of money to the Government.

Previous to the transfer of authority, only one Section 306 loan was made by FmHA for a CATV system. This loan was to the Western Wisconsin Communications Cooperative to finance construction of a countywide educational TV system. Several CATV loans were made by FmHA using Section 310b authority. Similarly, REA had made only one direct TV loan in 1962 and that was to finance the portion of the statewide educational TV system in South Carolina furnished by the REA telephone borrowers. Since the transfer of authority and in the remainder of the fiscal year ending September 30, 1979, REA administered loans totaling \$6 million. In fiscal year 1980, \$34 million in loans and loan guarantees were made. For fiscal year 1981, \$34 million in loan authority is authorized. However, the Administration has proposed that this loan authority be reduced to \$18.0 million. Also, the Administration has proposed that no further funding be authorized under the CFRD Act. Should this happen, the direct financing of commercial CATV systems by the Department of Agriculture would cease as of September 30, 1981.

Financing for rural CATV systems would not stop but would be slowed down and become more expensive. REA could still finance educational TV systems which admittedly would probably be rare. Rural telephone systems would have to apply for funds from the commercial financing market. Similar financing opportunities are available to new entrepreneurs or existing CATV organizations.

The Rural CATV Market

REA has known for some time that a market existed for rural CATV systems from the interest expressed by the rural telephone industry. Until the availability of financing was announced in 1979, we did not know the size of the market. By the end of fiscal year 1979 we had received applications totaling almost \$100 million for rural CATV systems. These applications came not just from our current telephone borrowers, but a significant portion came from independent cable operators as well as from electric cooperatives. The CATV loan applications on hand at that time were as listed below in Table 1. Table 2 lists the loans made in fiscal 1980. An examination of Table 2 shows that the loans went to a mixture of cooperative and commercial organizations both cable operators and telephone systems.

TABLE 1

Area	CATV Loan Applications on Hand		
	End of		
	Fiscal Year 1979		
	Current Borrowers	New Applicant	Total
North Central	\$ 6,978,926 30%	\$16,000,000 70%	\$22,978,926
North East	975,000 54%	830,000 46%	1,805,000
South East	35,517,000 62%	21,484,000 38%	57,469,000
Western	1,781,000 69%	800,000 31%	2,581,000
South West	6,630,000 47%	7,573,500 53%	14,203,500
National	\$51,881,926 52%	\$46,687,500 48%	\$99,037,426

TABLE 2

CATV Loans Approved	
Fiscal 1980	
<u>Co-Op Loans</u>	
Oldtown Community Systems, Inc. Oldtown, Maryland	\$ 1,095,000
Canby Telephone Association Canby, Oregon	3,100,000
Rural Missouri Cable TV, Inc. Branson, Missouri	1,667,000
Western Wisconsin Communications Cooperative Independence, Wisconsin	4,138,000
Total	\$10,000,000

Table 2 Continued

Commercial Guarantees

Franklin Cablevision, Inc. Louisburg, North Carolina	\$ 135,000
Tipton CATV, Inc. Tipton, Indiana	342,000
Omniview, Inc. Blair, Nebraska	2,875,500
Hurst Systems, Inc. Osage City, Kansas	1,267,200
BRY-C.A.T., Inc. Durant, Oklahoma	672,300
Atra Cable Vision, Inc Chouteau, Oklahoma	810,000
Pine Rural Television Cable Co. Broken Bow, Oklahoma	1,425,600
Verona Cable Company, Inc. Madison, Wisconsin	267,300
Concord Cable Communications Company Concord, Tennessee	1,953,720
Millington CATV, Inc. Millington, Tennessee	3,969,000
Franklin Telephone Company, Inc. Meadville, Mississippi	459,000
T.V. Services, Inc. Hindman, Kentucky	2,421,000
Tel-Com, Inc. Harold, Kentucky	3,159,000
Jefferson Cable Television Corporation Wrens, Georgia	226,800
VI-TEL, Inc. Beggs, Oklahoma	810,000
Big Bend Communications, Inc. Alpine, Texas	675,000
Atlas Cable Television, Inc. Big Cabin, Oklahoma	1,836,000
Magic Window Cable Television, Inc. McLoud, Oklahoma	664,200
Total	\$23,968,620

The present backlog of loan applications on hand has reached approximately \$200 million despite the fact that REA has made loans with a cumulative total of over \$50 million. Because the loan applications were growing faster than available funds and now with the proposed cutoff of budgetary funding, REA is recommending no new loan applications be submitted at this time.

MODELING RURAL CATV

The REA technical approach to rural CATV systems has been similar to our approach to rural telephone systems. Our goal was to provide good quality CATV service to as wide a rural area as economically feasible at the lowest possible cost. The REA staff has produced technical standards for transmission and construction for rural telephone systems for the past 30 years. Our approach was to determine what a typical rural CATV model would look like in the market that REA might be called upon to finance. Once a model was established, engineering design goals could be set and different design approaches tested until the lowest cost design is determined.

System Model

In creating a system model, use was made of available REA statistics on current rural telephone borrowers adjusted for the estimated effect of cable operators. The first question to be answered was how big is the potential market to be financed and constructed. If all 919 rural telephone related entities decided to ultimately construct a CATV system to serve their present subscribers, over 3/4 of a million route miles of plant would be required. If the percentage of new applicants remained at approximately 50 percent as noted in Table 1 then a potential rural CATV model with a total of 1.5 million route miles of plant is possible.

Next of interest in the modeling process is how big would each individual system be and what subscriber densities could be expected. We had no way to estimate what the answers to these questions would be for cable operators except to assume they would be similar to what could be determined for the present telephone borrowers. Figures 1 and 2 were determined from our published telephone statistical data. Figure 1 shows that a large amount of cable would be required per company to provide total area coverage. The average company would use 839 route miles of coaxial cable. This gives us a rough perspective on the size of an individual construction project. Figure 2 presents the distribution of subscribers per route mile currently served by REA Telco borrowers. As can be noted almost all borrowers have system densities considerably lower than 30 subscribers per route mile. The average density per company is 5.1 subscribers per route mile. With the FCC standard of normal commercial feasibility being 30 homes per route mile or greater and the average REA telephone borrower density of 5.1 subscribers per route mile, the analysis of Figure 2 showed that REA technical standards were going to have to emphasize lower cost construction to serve the rural areas.

Route Model

Finally, a model of a typical route was needed on which to base technical standards and compare alternate designs. REA has in the past made sampling surveys of its plant facilities to determine what is out there and where the subscribers are. For CATV modeling purposes we are not interested in

the makeup of the existing voice facilities, but we do care where the subscribers are located as they would be the same subscribers in the rural CATV system model. Our statistical data determined that an average system would have 740 subscribers and that 98 percent of them are within 100,000 feet of the central hub distribution point. This established one of our technical goals that any CATV design concept must be capable of being implemented on a route as long as 20 miles. Our experience in system layout gave us the knowledge that the total number of subscribers are usually distributed over either two main routes if the system is a linear model or over four main routes if the system is an area model. We now have a general model of how many subscribers would be expected on a rural route and how long that route could be. The last item in the modeling picture is a concept of how these subscribers are distributed along the route. Our sampling data indicates the subscribers are distributed as noted in Table 3.

FIGURE 1

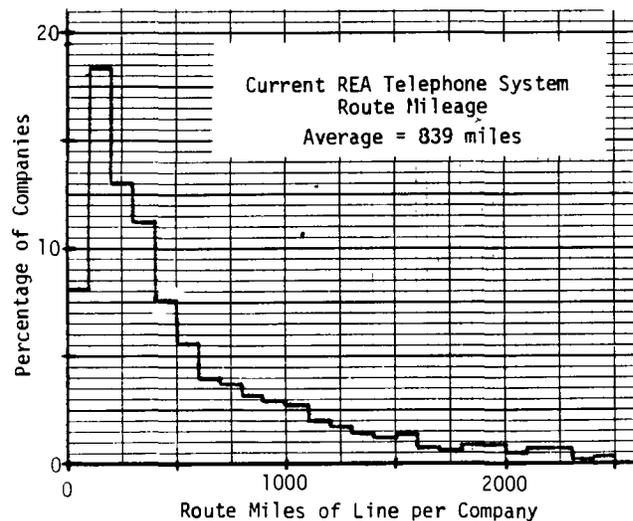


FIGURE 2

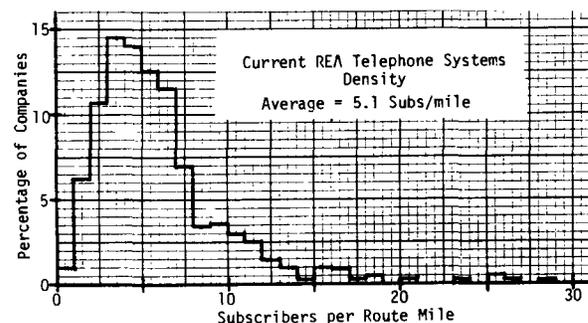


TABLE 3

Rural Subscriber Route Distribution

<u>Distance from Hub</u> (Kf)	<u>Percent Subscribers Remaining</u>
0	100.0
10	54.5
20	37.5
30	27.2
40	18.8
50	12.2
60	7.6
70	4.8
80	2.9
90	2.2
100	1.4

Design Objectives

After determining a rural CATV model, REA was able to create reasonable Engineering Design Objectives for all potential system designs. These objectives are as follows.

- A. Twenty mile route capability.
- B. Achieve minimum REA transmission standards.
- C. Low cost construction.
- D. Low cost maintenance.
- E. Environmentally compatible plant.
- F. Full VHF channel capability.
- G. Two-way transmission capability.
- H. Widest economical area coverage.

These objectives are listed in descending order of importance in our opinion with our goal to meet all of them in time. Our view is that at least the first three goals are necessary in today's designs so that future design developments can be incorporated to upgrade, expand, or extend the systems.

DESIGNING RURAL CATV

At the time that REA began researching the system design fundamentals for CATV and looking for ways to utilize, modify or adapt current urban design techniques for rural areas, we were fortunate to have Bill Grant join REA as a member of our Telecommunications Engineering and Standards Division. Bill has over 20 years experience in CATV design and operation with Jerrold Electronics and as Chief Engineer for several large CATV operators. With his experience and our engineering objectives he was able to quickly outline a low cost practical design concept for rural areas using directly tapped single coaxial cable outside plant. This concept has been refined and polished over the past 2 years and no basic discrepancy has been found in it. REA recognized that the major cost of a CATV system is the coaxial cable itself and that cost needed to be minimized in rural designs. An urban design with a grid type street layout could afford to pay more for a trunk so that the feeder cable can be less expensive. When trunk to feeder ratios were four to one or better, this created an economical design. However, in rural areas we have a large amount of linear routes with little opportunity for short side feeder legs. In these cases the trunk to feeder ratio could be close to one to

one which raised the construction costs considerably. Because of the economic pressures the single coaxial cable design developed. This design, like all other potential designs, must meet our transmission and construction standards. Some of the problems and questions that were raised are answered in a companion paper Bill is presenting at this convention. All of the problems have been resolved in a series of papers Bill has written since being with REA. Copies of these papers are available upon request to REA.

Fundamental Design Techniques

It was found that in order to meet the Engineering Design Objectives the proper choice of alternative design techniques could result in a more acceptable proposed design. Some of the alternatives chosen are as follows.

1. No excess C/N, X-Mod or CTB at end of route. With our goal of a 20 mile capability, it is important that no excess dB margin be allowed at the end of the route so as to keep construction costs as low as possible.
2. Maximum economical use of AGC. In long route systems there is more exposure to temperature created variations and we see the need for an AGC to manual amplifier ratio of no more than 1 to 2 and if economical, we prefer to have AGC capability in as many amplifiers as possible.
3. Minimum use of line extenders. These amplifiers have higher X-Mod than trunk type amplifiers and in a single cable design a lower X-Mod value is required so that C/N and X-Mod both meet transmission specifications at approximately the 20 mile design point.
4. Maximum use of mini-trunk amplifiers. The C/N and X-Mod values for these types of amplifiers are balanced such that, at the operating levels and channel loading we are designing for, the transmission specifications on both factors are met at the approximate 20 mile design point.
5. C/N ratio of 40dB and X-Mod ratio of 50dB are the REA minimum transmission standards. These standards were chosen by REA to give acceptable picture quality to the worst case rural subscriber at the lowest cost.
6. Maximize 1/2" and minimize 3/4" coaxial cable. Our economic studies show this results in the lowest cost system.
7. High gain amplifier output. This minimizes the number of amplifiers required and maximizes the subscriber tapping reach.
8. Preferred top design frequency of 220MHz. This maximizes channel carrying capability at the lowest possible cost. Higher top design frequencies are allowed only if the increased revenues would offset the increased costs.
9. Minimize use of set top convertors. This reduces capitalization and maintenance costs.

10. Maximum use of buried plant. This type of construction in rural areas results in much lower maintenance costs.

11. Minimize amplifier type, quantity, and operating levels. This reduces system maintenance costs.

12. Armored cable for buried cable in gopher areas. This prevents gopher damage and reduces system maintenance.

13. Pay TV capability. The increased investment results in a considerable increase in system revenues.

14. Phased construction. The design is capable of eventually serving the entire area, but system economics require that selected portions of the total area be constructed in a phased sequence.

Engineering and Construction Practices

Historically, REA has provided total engineering support to the rural telephone borrowers through its series of Engineering and Construction Practices, Equipment and Material Specifications, and List of Acceptable Materials. We intend to provide the same support for rural CATV borrowers. Many practices and specifications have been written in draft form and are available from REA for your guidance. At this time only one item is on the list of acceptable materials and that is Generation I coaxial cable. Two suppliers, Comm-Scope and Times Wire, have qualified to supply Generation I cable to REA borrowers. Generation III cable will probably be the next item to be on the list of materials. We are just beginning to work with the active equipment suppliers.

The practices and specifications when in draft form are subject to revision, but are expected to be used by rural CATV borrowers as guidelines in preparing their system designs for a loan application. Specifications when officially published are mandatory and practices when published in final form become the recommended standard design. Some of the more important CATV publications are as follows.

TE&CM 2205 - Final. This practice outlines the technical information required to be submitted to REA in a CATV loan application. Examples are given on how to present the information so as to ease the loan processing.

TE&CM 2206 - Draft. This practice presents guidelines for estimating the size of the potential CATV market.

TE&CM 2207 - Draft. This practice provides forms for the loan fund analysis.

TE&CM 2208 - Draft. This practice is a how-to-do-it tool to create a single cable rural CATV design.

TE&CM 2209 - Draft. This practice shows a method and examples of how to estimate standard unit costs for rural CATV construction. These unit costs can then be used to estimate the total project costs.

TE&CM 2210 - Draft. This practice provides a detailed design lay out process for a rural single cable design. The practice is written for a small operator who may want to manually lay out and design his own system. The process could easily be adapted to computerized techniques.

TE&CM 2211 - Draft. This practice details a method of providing ac power to the field located amplifiers.

Outside Plant Construction Packet #1 - Draft. This packet provides specifications for trunk and drop coaxial cables, construction and installation techniques, electrical protection, and unitized construction bidding.

Any or all of these publications are available upon request to the following address.

Director, TESD
Rural Electrification Administration
Washington, D. C. 20250

SUMMARY

Rural CATV is a service that is unfulfilled as demonstrated by the backlog of demand that quickly built up when the availability of financing to be administered through REA was announced. The fact that REA may not be furnishing future rural CATV financing does not mean that the demand will go away or be unserved. The effect will be a slow-down and an increase in cost to provide this service.

REA in a very short time has provided valuable technical support to the rural CATV industry with its identification and modeling of the market and its series of draft practices and specifications. We have pioneered and promoted updated lower cost design techniques for rural areas. These techniques are being used in systems in construction and we are confident the experience gained from operation of these systems will provide knowledge and economic benefits to the entire CATV industry in the years to come.