RURAL EXTENSION TECHNIQUES AND SYSTEMS

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The difficulties of extending cable TV service into low density areas have plagued cable TV operators and small town residents since the construction of the first community antenna television system in 1949. The principal problem was that the low density of rural America coupled with the high cost of constructing cable systems made it financially uninteresting for cable operators to build systems in rural areas and outside the denser portions of towns. Furthermore, in recent years when substantial amounts of risk capital began flowing into the cable industry, all of the attention was turned to the major urban areas where the existing vast television markets are located. As a result, by]972 when the new FCC Report and Order was promulgated, most of the activity and excitement centered around efforts to win franchises in suburbs and central cities located in the major urban markets.

In this talk, I would like to turn your attention away from central cities to the sizeable and as yet untapped markets which exist in rural, small town, and fringe suburban areas.

Two types of market exist in these areas. The first is the market for extension of service from existing systems in small town and suburban areas. The second is the market for new cable systems largely in rural and suburban areas.

The magnitude of the market involved is tremendous; almost 40 million households are in rural, small town, and suburban areas. Contrast this with the present approximately 7 million cable subscribers outside of central cities. The cable industry could triple in subscribers without even touching cities of 50,000 population or more.

The need for expanded telecommunication service is even more important than in urban communities because of the isolation of the people and the and the distances involved. Telecommunications can be used to deliver medical, legal, educational and other social and governmental services directly to the home. The added factor of gasoline shortage makes it even more imperative to substitute the transportation of electronic signals in place of transporting people.

This market must be served -- if not by cable TV then by other technologies. A recent study shows by OTP[1] translators to be an efficient means for delivering broadcast television to rural homes. It discusses the need for variances in federal regulations to make translators viable funding, suggested sources of funding, but I can assure you that if there continues to be a lack of TV service in rural, small town, and suburban areas, -- there will be more pressure by farm organizations, regulatory agencies, and others for alternative means of television distribution.

In this talk, I want to suggest that the so-called problems of system extension and new construction in rural, small town, and suburban areas should be viewed as opportunities by the cable industry to provide more service to more subscribers and, consequently, opportunities to make additional profits.

The Cable Television Information Center feels the main barriers to system extensions and rural area service have been economic and technical; that there is a rather substantial "information gap" in which it is difficult for small system operators to keep track of the rapidly changing equipment capabilities, construction techniques and system design. There has also been a lack of understanding of the results in savings to an operator and of extended distance of possible service due to improvement of amplifiers and cable. Keep in mind that there are already some operators today that have been serving areas with densities of 9 households per mile or less; as examples: Joe Gans in the Poconos of Pennsylvania and Less Biederman in Traverse City, Michigan. I am sure there are others but the numbers are far to few.

What are some major cost reducing factors? First there needs to be an understanding that undergrounding which can cost $12,000 to $100,000 per mile in central areas of cities can cost less than $1,000 per mile in rural areas. There are vibratory plows today that eliminate the separate actions of trenching, laying cable, covering and compacting. The equipment is available with accessories for under $15,000 but for those opera-

1. Denver Research Institute, "Braodband Communications in Rural Areas", Nov. 1973.

tors who prefer to contract out the construct-tion, bids vary from 12 to 18 cents per foot. To this must be added about $100 per black top crossing -- but there are few of these per mile in rural areas. Another important long term saving by undergrounding is the elimination of pole rentals. The $175 per mile yearly cost is a major cost factor when there are only a few subscribers per mile.

Another saving for low density areas is in the use of system design where a single cable tapped trunk is substituted for standard separate trunk and feeder cables. The major saving is in elimination of the parallel cable and construction. Using tapped trunk design, figure 8 cable (with messenger included) is applicable and therefore the need for linemen to climb poles is reduced. With earlier construction techniques the lineman climbs to install the strand, again for the cable and again to lash them together. Using figure 8 cable the lineman need climb each pole only once.

The suggestion of tapping the trunk is contrary to past CATV practice where this technique has been rejected as a source of reflections. Conditions have changed; the coaxial cable today has a return loss of 30 dB, in contrast, for many years the manufacturers refused to release this specification: probably becasue measurements snowed cable to have less than 20 dB return loss. The amplifiers used today are terminated both at input and output -- or years that of many suppliers had a high impedance output; finally the tap-offs used today are directional with a good impedance match at in/out and thru terminals. For low density household areas, it is reasonable to use the same cable for both trunk and feeder for a saving of several hundred dollars per mile.

Another important saving in system design is applicable to long haul rural areas where several small communities are served. Typically costs of microwave between towns is added to the distribution costs making a proposed system non-viable. The center recommends the use of low-sub amplifiers with a top frequency of 108 MHz. This permits transportation of 12 TV channels plus FM over a distance of more than 60 miles -- still meeting a Signal/Noise of 43 dB and Signal/Intermodulation of 57 dB. The same transportation cable is used for distribution of signals enroute such that two levels of service are delivered. For a lower fee, the subscriber receives only the 5 VHF channels plus FM. Those also desiring the 7 high VHF channels would buy a set converter. Upon reaching a community the operator has the option of splitting the system and converting the distribution section to 12 channels and so eliminated the need for set converters.

The feasibility of such long haul cascades contradicts much application design criteria of the past where 10 to 15 miles was the maximum.

Todays amplifiers are far better than those of the past and being solid state require improved power supplies for protection of the transistors or IC's; as a side effect they have a better than 20 dB improvement in reduced hum modulation. Over the years the power handling capability has also improved -- a very important factor since a 6 dB improvement permits a doubling in amplifier cascade. Finally solid state devices tend to have a relatively flat amplitude versus frequency response across a wide range of frequencies. The amplifiers are also designed with well matched input and output circuitry, recognizing the importance of minimizing reflections.

Likewise coaxial cables are improved; the attenuation being reduced, frequency range increased, and reflection characteristics improved.

Finally accessory devices such as cable connectors, splitters and tap off devices are designed to be well matched to the 75 ohm coaxial cable and are no longer major sources of reflections. Another factor is the use of directional coupler subscriber taps that provide isolation of TV receiver discontinuities from the downstream signals.

Even for extension of service, advantage can be taken of improved amplifier capabilities to reduce costs. Today's better line extenders use similar IC circuitry as in the trunk amplifiers -- with slightly lower performance capability. Some line extenders include equalization, gain and slope control and are of push-pull circuitry to permit use of the mid and superband frequencies. These line extenders are superior in performance to trunk line amplifiers of only a few years back and for low density areas where minimum cost is very important; can supplant trunk amplifiers.

Keep in mind that for top 100 urban markets the present system design is necessary, providing extra reliability, redundancy, standby power, modulator capability and future two-way. For rural America areas where limited channels and one-way services are acceptable, there are available lower cost amplifiers of better capability than is generally recognized. As for two-way, these subscribers will presently settle for use of the telephone.

The CTIC is making a study of techniques, costs and profitability of investment for eleven different options descending from a top 100 market, two-way aerial system down to a low cost rural underground system at$2,150 per mile. We have separated them into two categories: the first category is extensions from existing systems where certain assumptions are made; (1) that there need be no additional headend cost, (2) that cable system facilities can be used for office warehousing of material, (3) that equipment and cable list prices shall be used as a base for calculations even though there may be a discount of up to 30% for amplifiers for large volume users, (4) that a markup of 25% for overhead is included in installation costs, permitting the construction to be contracted out, (5) that the cost of tree trimming and pole rearrangement in top 100 markets are assumed to be $700, (6) that the cost of pole rearrangements in areas of lower household density are assumed to be $200 per mile, and (7) that annual pole rental is $175 per mile in top 100 markets and $140 per mile in areas of lower density.

The second category is construction of new systems in currently unbuilt rural areas, where the costs of headend, office and warehouse need to be added to the distribution system. Here too lower cost headend equipment can and should be used where warranted. However for a long system with many subscribers the added cost per subscriber for improved headend equipment is not an important factor.

Here are a few graphs showing one of the Options Options (#9) covering the cost, design, equipment used, and the rate of return on investment depending on subscriber density, installation charge and monthly fee. Since the expected subscriber penetration for any area is know by the operator, he can convert subscribers per mile to household density per mile.

In conclusion the center feels that operators need no longer limit their service to areas of 40 households per mile which at 50% penetration is 20 subscribers per mile. We calculate a possible rate of return on investment of better than 15% for areas of only 7 subscribers per mile using a $25 installation fee and amortizing costs over 10 years.

In short, cable operators now have the opportunity to increase their subscribers and profits by using modern methods to build in rural, small town, and suburban areas. Central cities may have to wait for new cable services to attract subscribers. Low density areas offer millions of subscribers who are ready now.

Finally, I would like to extend my appreciation to many operators and to Cadco for providing construction techniques and costs and I hope that this information will be helpful, to such that this year the cable industry will make an all out effort to wire up the low density areas of America.