# COST DESIGN FACTORS FOR RURAL DISTRIBUTION

FREDERICK G. GRIFFIN, P.E.

FREDERICK G. GRIFFIN, P.C.
3229 Waterlick Road
Lynchburg, Virginia 24502

ABSTRACT

This paper describes design features for rural CATV systems, using the sub-low technology. The problem, the technology, the solution, and an example are discussed. Also covered are maintenance techniques and ingress detection procedures.

## THE PROBLEM/CHALLENGE

The rural designer is typically working in a rugged terrain area which is on the edge of the "B" contour of stations, and with a modest subscriber base.

The system designer then is challenged with a minimum cost design in general, but more specifically, the head end cost is a substantial portion of a small system. This head end cost is composed of substantial monies for new roads, building and utility construction.

The rural community is typically distant from major markets which dictates that the designer is faced with the option of trying to find an optimum high elevation head end site. Oftentimes, the top of a mountain is either not developed or not satisfactory for low level distant signal detection.

Since people typically live on the side of the mountains or in the valley, it is relatively inexpensive to gain access to the side of the hills. With this tenet, often two head end sites can be found facing in different azimuths and sometimes down valleys to pick up the distant receive signal.

## THE TECHNOLOGY

Using two lower elevation sites that have limited peripheral access to RF signals is acceptable, if they can be tied together with modest expense.

Using this type of configuration, road costs and utility costs are minimal or non-existant. Typical road costs can run anywhere from $10 to $100 per foot in rough terrain, plus the cost of power line construction and other factors. If the situation present dictates, there can be little or no increase in the cable plant investments and no head end site cost.

The technology tool available to the rural designer is the sub-low configuration. Sub-low configuration of trunk and distribution amplifiers has been known for some time now in the cable industry. However, the application and discussion typically has been in the urban market for either return from the home usage or dedicated channels such as teaching, education, traffic control, and so forth.

With a sub-low return up to four channels can be received at a remote site and trunked back via the sub-low technology to a main head end site where they are reprocessed and distributed.

The radiation sleeve series connectors and the integral ferrule connectors used in the urban markets can be used in the rural area to allow the satisfactory use of channels T7, T8, T9, and T10 in the presence of short wave, ham, and CB bands.

## THE SOLUTION

A solution to the head end site selection, then, is not to go for the highest peak with the cost of non-revenue producing trunking, road construction, etc., but rather go for an optimum configuration of two or more sites close to the population pocket and tie these together through the subscriber cables.

An Example

An example of the application and implementation of this type of rural sub-low design is the system our firm recently designed for Giles CATV, Inc., which serves the small community of Narrows, Virginia, located in the New River Valley near the Virginia-West Virginia line. Figure 1 shows a simplified composite of significant terrain features, received signals, and the community served.

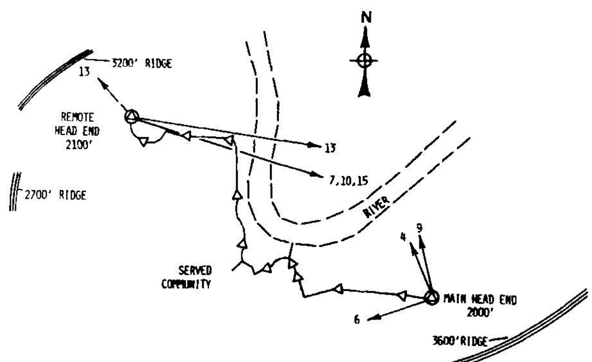


FIG. 1.0 TWO WAY PATH

Two sites were selected (Photo 1 and 2), one on the east side of Stockpin Mountain to the west of the served community, and one on the north side of Angels Rest Mountain to the east of the community, thus eliminating costly road construction.

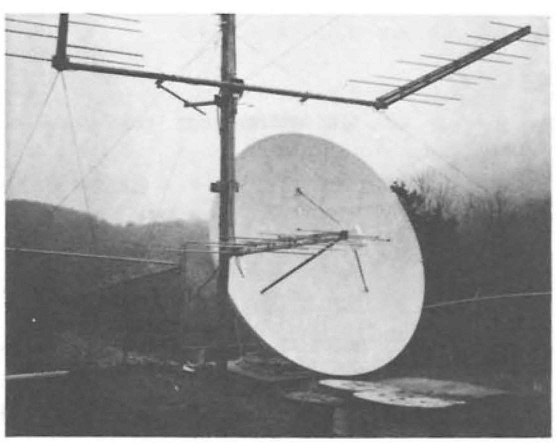

Photo 1.

Photo 2.

These two sites were then connected by ten sub-low return amplifiers. The Stockpin location, which is the remote site on Stockpin Mountain, was not constructed of a building, land, rack, etc., as is typical CATV, but was rather a designed and fabricated pole-mounted facility. The block diagram of this four-channel pole-mounted head end is shown in Figure 2.

The metal enclosure is a catalog purchased item from Acrodyne. This type of enclosure is typically used for television translators (Photo 3.) The box power control panel was removed and four signal processors were mounted inside. This unit comes complete with ventilating fans. The test points for the antennas were mounted on the left rack channel, and the forward and reverse test points were mounted on the right channel racks (Photo 4). It was found that more stable performance was achieved by placing an attenuator in the outgoing path, such that the signal processor operated near their typical head end design levels rather than a substantially reduced level.

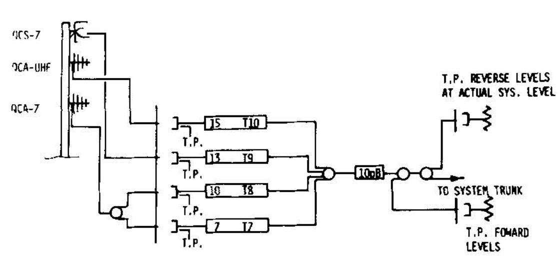


FIG. 2.0 REMOTE HEAD END

Photo 3.

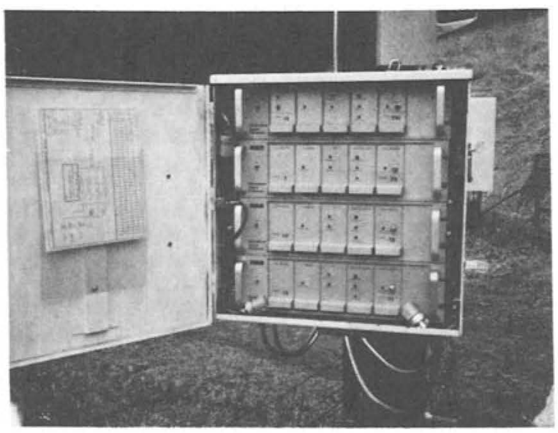

Photo 4.

It is interesting to note that both head end sites have subscribers within the first amplifier span spacing; thus, there was revenue produced almost in the first foot of cable. No non-revenue producing trunking to get to the head end!

The sub-low channels at the remote site were loaded into the system with a 1/2 dB slope T7 to T8 and T8 to T9, with T10 being loaded the same level as T9.

This has proved to be a satisfactory relationship and the ten amplifier cascade was easily aligned and equalized.

## MAINTENANCE TECHNIQUES

Several maintenance techniques are helpful in the rural systems where most of the new personnel are not familiar with cable, and where bucket trucks may not be in the initial budget of a small system.

° Pocket cards: Shown on Tables 1, 2 and 3 is the data that has been put on 3 x 5 index cards to be used for a rapid acquaintance of the system.

Card 1 of 3 is a line card with actual system meter levels given and boxed.

Card 2 of 3 is an installer's card with instructions reduced to paces on when to use RG-59 or RG-6. For rural areas and long drops, RG-6 is a cost effective application.

Card 3 of 3 is a cable and component loss card for trouble shooting used with system as-built drawings.

| | SYSTEM LEVELS | | | | BRIDGER | |
|---|---|---|---|---|---|---|
| | TP/Meter | In Put | Out Put | TP/Meter | Out Put | TP/Meter |
| W | -20 | 10 | 32 | +2 | 50 | +20 |
| 13 | -16 | 14 | 30 | 0 | 48 | +18 |
| 2 | -12 | 18 | 26 | -4 | 44 | +14 |
| T-10 | - 3 | 27 | 17 | -13 | | |
| T- 9 | - 3 | 27 | 17 | -13 | | |
| T- 8 | -3.5 | 26.5 | 17.5 | -12.5 | | |
| T- 7 | - 4 | 26 | 18 | -12 | | |

TRUNK — B

Card 1 of 3

LINE EXTENDER

| | High Gain | | Standard | | | | |
|---|---|---|---|---|---|---|---|
| | TP/Meter | In Put | TP/Meter | In Put | | Out Put | TP/Meter |
| W | -10 | 20 | -6 | 24 | Line Ext. | 50 | +20 |
| 13 | - 8 | 22 | -4 | 26 | | 48 | +18 |
| 2 | - 4 | 26 | 0 | 30 | | 44 | +14 |

Tap +15db min. @ Ch. 13

Subscriber 0db per min all channels

Table 1.

DROP INSTALLATION

Tap +15 Min — 1-2 Drop

RG-59 use for up to 60 paces 180'

RG-6 use for 60 to 100 paces 180' to 300'

---

Tap +15 Min — 3-4 Drop

RG-59 use for up to 35 paces 105'

RG-6 use for 35 to 75 paces 105' to 225'

Card 2 of 3

---

DROP EXTENSIONS

"CORRECT RECORD PRINTS AFTER RETURN TO OFFICE"

RG-59 each db Tap decreased

Adds 7 paces 21'

---

"CORRECT RECORD PRINTS AFTER RETURN TO OFFICE"

RG-6 each db tap decreased

Adds 9 paces 26'

Table 2.

TAP INSERTION LOSS

| Tap Value | 8 | 11 | 14 | 17 | 20 | 23 | 26 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|
| 2 Way | 3.8 | 1.9 | 0.9 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 |
| 4 Way | - | 3.8 | 1.9 | 0.9 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 |
| 8 Way | - | - | 1.9 | 1.9 | 0.9 | 0.6 | 0.6 | 0.6 | 0.5 |
| Label Color | GRY | BRN | YEL. | PUR | BLK | ORN | BLU | WHT | RED |

Card 3 of 3

---

CABLE LOSS db/100'

| | 300MW3 | Ch.13 | Ch.2 | T10 | T7 |
|---|---|---|---|---|---|
| Trunk 3/4" | .895 | .745 | .34 | .26 | .10 |
| Distribution 1/2" | 1.32 | 1.10 | .50 | .38 | .15 |
| RG-6/U | 3.8 | 3.1 | 1.5 | 1.2 | .45 |
| RG-59/U | 4.8 | 3.8 | 2.6 | 1.4 | .55 |

| DIRECTIONAL COUPLERS | | LINE SPLITTERS | |
|---|---|---|---|
| DC-8 | 2.3db | SP-2 | 4.3db |
| DC-12 | 1.5db | Sp-3 | 6.3db |
| DC-16 | 1.3db | SP-3U | (2)6.3db |
| | | | (3) 4.3db |

Table 3.

° Pole drops: The input, output, and bridger test points are cabled down to the four-foot level for use in trouble shooting and are color coded: green is trunk output; blue, bridger output; and input is unmarked (Photo 5).

° Head end levels: To simplify the output level setting of the head end, scraps of distribution cable were spliced together to be equivilent to 1/2 trunk amplifier spacing and brought back to the head end (Figure 3). This, then, is a flat all-channel test point for meter reading.

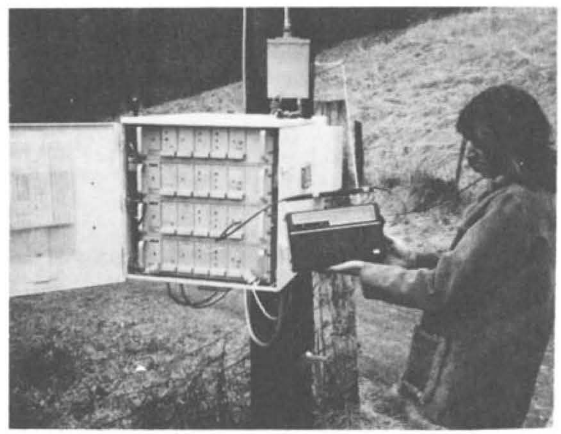

Photo 5.

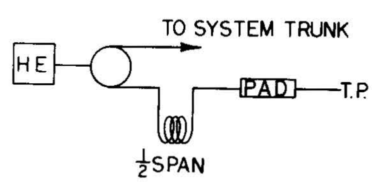


FIG. 3.0 HEAD END ALIGNMENT

° Highpass matching transformers: Figure 4 shows the simplified "off" position of a two-way system. The problem is that the all pass matching transformer connected to a TV set acts like an antenna to back feed into the return path. The only isolation up to the first line extender is one switch which terminates the input reverse amplifier. After that you have two in a series --either a trunk and bridger, or a line extender and bridger. As a preventive measure, the first cable span from a bridger has a high pass matching transformer install on all sets to safeguard ingress.

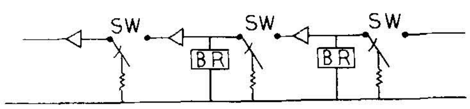


FIG. 4.0 "OFF" REVERSE PATH

- Full tap design: The USDA, REA has proposed a single cable taped trunk design for lightly populated areas. We feel that the introduction of connectors into the trunk add to unreliability; however, if a complete area design is performed and the taps are left out until they are needed, substantial savings can be accomplished by deferring both material and labor costs.

INGRESS

It was found that the higher frequency (mid band) detectors showed a tight system while there was still viewing impairment from short wave broadcast. This was later tracked by the techniques listed below to too-long center conductors which left a sheath vacancy in "not" bottoming of the radiation shield connectors. The short wave signal appears to travel on the surface.

A second level of detection for sub-low integrity was a relatively inexpensive battery powered short wave receiver (in the $50 range). This is used by jacking in at a pole drop and tuning to either carrier and then unplugging to see if there is still an audio signal in the receiver (Photo 6). The banding strap at the end of the lashing cable is a good place to find an area of non shield integrity, then track either way to the egress fault source.

Even with the short wave receiver, there were initial construction defects which were not detected. These were principally improper splices where the sheath was not up inside the connector as a result of the center conductor's being left too long. The ultimate method of detecting these was to mount a mobile test setup as shown in Figure 5, and track the signal from the sub-low source pole by pole comparing visual impairment from input to output. This mobile setup was by far the most sensitive and responsive. It was our experience that each connector needs to have a final visual quality control inspection by taking off the compression nut after installation.

Photo 6.

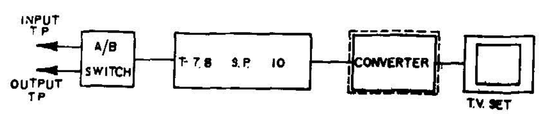


FIG. 5.0 MOBILE TEST SET