MODERN SYSTEM DESIGN CONCEPTS

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ABSTRACT

The purpose of this paper is to exploit a new amplifier concept which leads to more cost effective system design through the increase of plant feeder-to-trunk ratio.

STATING THE PROBLEM

The decision to provide new or expanded cable services in any area is based on public demand and technical feasability. Weakness in either area is prone to affect the profitability of the system.

Technical feasability encompasses many engineering considerations, among which is the ability of the proposed cable network to provide quality reception throughout the area to be served. Although standards for permissable levels of noise and distortion in a system may vary, there is a limit beyond which picture quality is considered unacceptable, and it is within this limit that the cable system must be designed to perform.

Typically (and traditionally), cable networks are comprised of two or three line extender amplifiers in cascade at any system extremity, all of which are connected back to the headend through a bridger amplifier and as many trunk stations as are required to make the signal path complete. The viewer located the greatest distance from the headend receives a signal which has been amplified the greatest number of times, and consequently, this viewer receives a signal which has been subjected to the greatest exposure to noise and distortion.

The trunk portion of the system (that segment from the headend through the last trunk station) is the greatest contributor of system noise because of the lower RF levels usually found in the trunk. The distribution portion (from the bridger amplifier through the line extenders) contributes the greater to distortion because of the higher levels of RF usually carried in that segment. The right mix of low level trunk and high level distribution forms a completed system with "acceptable" levels of noise and distortion, and this has been the basis for the industry trend toward limiting the number of line extenders in cascade. So long as the high level distribution segment of the system is permitted to contribute to quality degradation at such a disproportionate rate, the system architect is "trapped" into limiting the use of line extenders in cascade.

A STEP TOWARD THE SOLUTION

Noise and distortion are predictable elements in the operating cable system so long as RF levels are maintained constant. However, fluctuations of ambient temperature affect both cable attenuation and frequency response of the system's various components. This causes RF power levels to fluctuate (in proportion to frequency), and the resulting instability makes noise and distortion levels unmanageable. The modern trunk network minimizes this effect with automatic gain and slope control in the trunk amplifier. This provides a satisfactory solution to maintaining constant RF levels on the trunk, but it stops short of giving the distribution segment the stability it needs to make its operating characteristics more predictable over the same excursions of temperature. Therefore, while automatic gain and slope control in the trunk provides an improved "total system", the system is limited to a few line extenders in cascade because of the inherent instability of the distribution segment.

ANOTHER STEP IN SOLVING THE PROBLEM

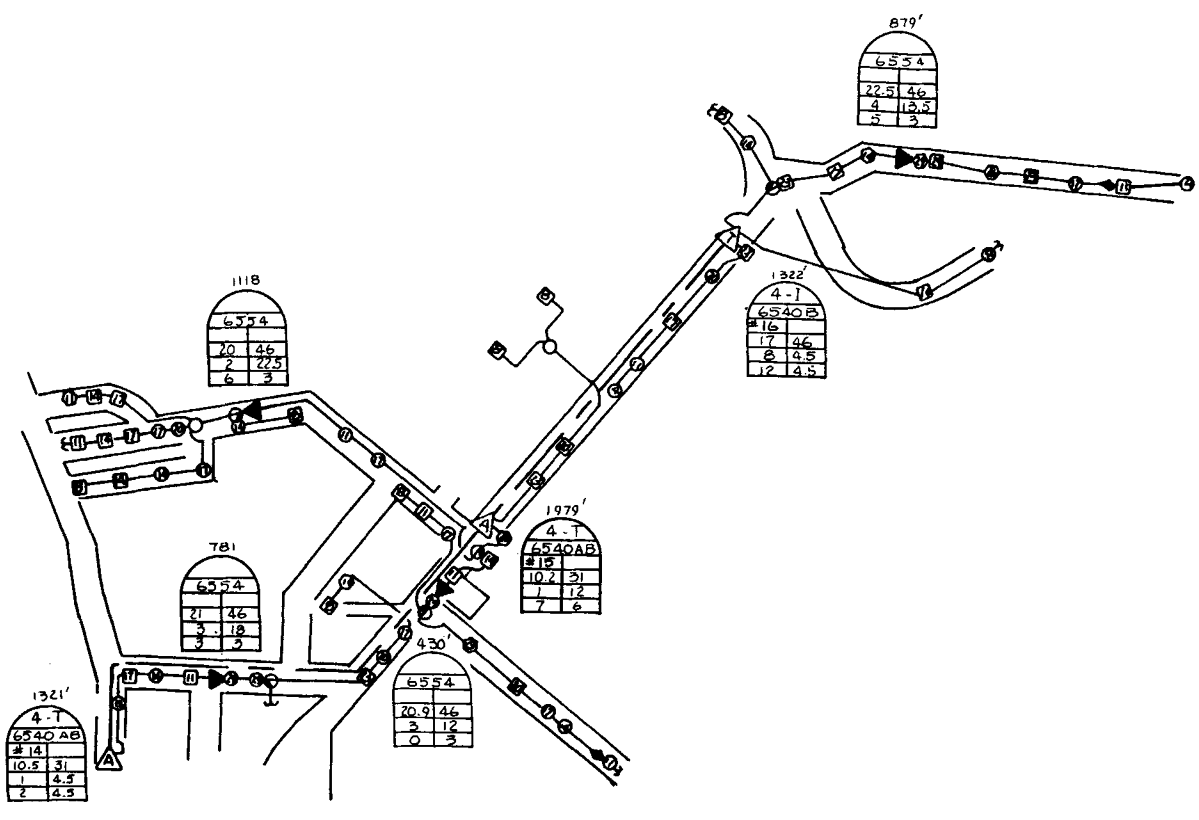
One of the measures of a system's cost effectiveness is the ratio of distribution mileage to trunk mileage. A distribution-to-trunk ratio of 3 or 4 to 1 is typical, and usually the higher this ratio, the more cost effective the plant. While this number will vary with the geography of the system and subscriber density, the only positive means of improving this distribution-to-trunk ratio is in altering the performance of the distribution amplifier and serving a given area with more distribution type plant and less trunk.

THE SOLUTION

A trunk station with automatic gain and slope control may cost 2 to 3 times the price of a typical distribution line extender without these same control features. Obviously, the investor would prefer to use more of the less expensive line extender amplifiers and fewer of the more expensive trunk stations, if he could be assured of similar performance standards. The introduction of the 6501/6502 system amplifier by Scientific-Atlanta provides that assurance to such degree that a new philosophy of system architecture is herein considered. This new amplifier concept provides pilot-referenced automatic gain control, a high degree of gain-dependent slope regulation, and a per-station cost that approximates that of the standard line extender. The advantages of its use are readily apparent in the illustrations shown.

Figure 1 is the extremity of a 16 amplifier + 1 bridger + 1 line extender cascade.

FIGURE 1



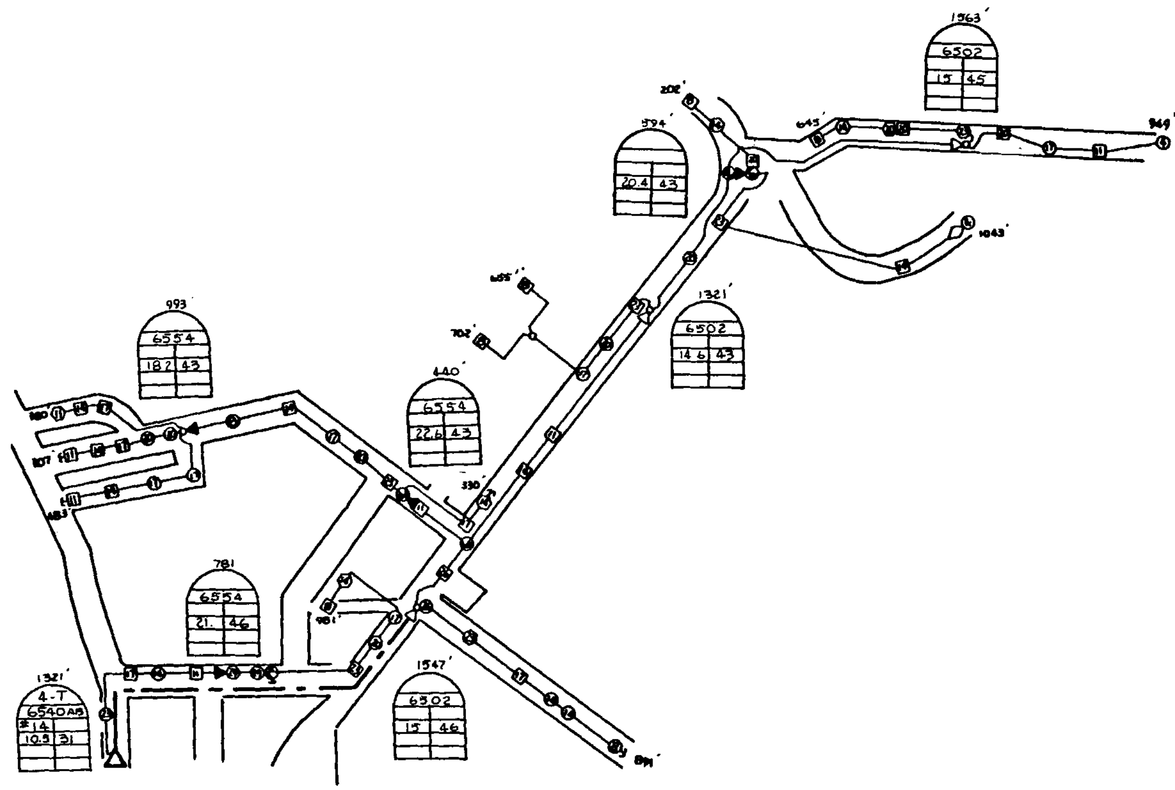
The system segment shown contains 1.9 miles of distribution plant fed by .62 miles of trunk, rendering a distribution to trunk ratio of 3:1.

With 54 channels in the bandpass of 50-400 MHz, system performance through the line extender is:

Carrier/Noise	44.3 dB
Composite Triple Beat	53.9 dB

Figure 2 is the same system redesigned with the 6502 amplifier. The terminating bridger amplifier has been eliminated, and trunk station Number 15 has been replaced by a 6502 amplifier operating at 46 dBmV output.

FIGURE 2



Performance characteristics at the same reference point are:

Carrier/Noise	45.3 dB
Composite Triple Beat	53.9 dB

The system model contains the same 1.9 miles of distribution plant with an increase in backfeeding of only 278 feet. Trunk cable useage has been reduced to .29 miles, rendering a distribution to trunk ratio of 6.5:1.

It has been stated that the distribution to trunk ratio has a direct and proportionate effect on system cost. Having demonstrated an improvement in ratio from 3:1 to 6.5:1, the resulting cost reduction may be shown.

Figure 3 deals only with those material items which were altered by redesign: cable, electronics and passives.

FIGURE 3

	Traditional Design	Revised Design
AGC Trunk Bridger (@ $725.00)	$1,450.00 (2)	$ 725.00 (1)
Terminating Bridger (@ $545.00)	545.00 (1)	---
6554 Line Extender (@ $265.00)	1,060.00 (4)	795.00 (3)
6502 AGC System Amplifier (@ $294.00)	---	882.00 (3)
2-Way Splitters (@ $18.00)	18.00 (1)	72.00 (4)
.750 GID III (@ $.35/ft.)	1,155.00 (3,300')	541.00 (1,545')
.500 GID III (@ $.165/ft.)	1,881.00 (11,400')	1,927.00 (11,678')
TOTALS	$6,109.00	$4,942.00

Cost Reduction Over 1.9 Miles: $1,167.00

Cost Reduction Per Mile: $ 583.50

Obviously, this cost improvement would be diluted by those system segments which don't lend themselves to redesign. Experience has shown, however, that the 6501/6502 Series AGC system amplifier may be used to advantage in a variety of applications.