THE URBAN MARKET: PAVING THE WAY FOR TWO-WAY TELECOMMUNICATIONS

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City of Syracuse

The City of Syracuse, by reason of its recent decision in favor of a sophisticated two-way cable system with the capability of delivering both entertainment and services to its subscribers, has become at once a testing ground for the application of this totally new concept to the major urban market.

All indications are that the future growth and, perhaps the very survival, of the cable industry will rely heavily on its willingness to accept the challenge to be responsive to the ever-increasing needs of the subscriber, particularly the urban dweller. The cities of the nation, by the very nature of their populous composition, are the obvious choice for a two-way telecommunication system capable of fulfilling these needs, while at the same time providing the cable operator a good rate of return on his investment.

While the earlier consensus was that cost would be a prohibitive factor in considering the delivery of services, even should the idea prove technically feasible, there has been a reversal on this theory. The idea has proven technically feasible, and marketing surveys have indicated that the cost factor will be a positive rather than a negative consideration, even with a conservative rate of penetration. This means that the provision of extensive services to the urban subscriber need not -- in fact, will not -- diminish the market's attractive financial outlook, but will, rather, enhance it, thus making the major urban market an attractive one, indeed, to an increasing number of cable operators.

But how can success be insured in such an innovative venture? And what are the necessary steps and precautions that must be taken to make such an undertaking economically and practically feasible?

Using the City of Syracuse as a model, this presentation will explore the various stages in the development of a total two-way cable system, particularly as it applies to the urban market. In so doing, we will examine the criteria that has thus far been, and continues to be established, as the system envisioned for Syracuse now enters the realm of reality.

Before commencing, it should be stressed very strongly at this point that such a system must be designed specifically and uniquely for that particular area or market it will serve. This will entail considerable pre-engineering, to ensure the avoidance of the problems and ptifalls previously encountered in efforts to provide municipalities with a two-way communications system.

Analyzing and determing the ideal concept which might yield the ultimate CATV system relevant to performance, flexibility, reliability, expandability, economical and marketing feasibility is indubitably a Herculean task. It's significance of importance is second to none in the preliminary ground rules set forth for attaining the aggregate requirements of any cable system.

In many instances, the geographic limitations within a community will indicate the appropriate system concept. Specifications for performance criteria might also constrain the number of potential design techniques.

System "concept", in this sense, does not involve determining the provisions for number of channels, distortion parameters, subscriber performance specifications, municipal/private access, pay TV, etc., but a means of delivering these predetermined specifications and services in the most efficient manner.

Geography without a doubt plays a powerful role in determining the concept of a cable plant. Its existence is, in fact, suggestive. Master-Headend, Master-Hub, Sub-Headend, Slave Hub, Microwave, Mid-Split Interconnect, Long-Haul Transportation, these familiar configurations are typically pertinent to geographic limitations. What is ideal for the City of Syracuse.

Long-Haul, Microwave, and Interconnecting Hubs are commonplace in an abundance of urban markets. This precedence is primarily due to the magnitude of these markets. When is a Hub-type system, regardless of interconnect design, most applicable? A Hub-type system is necessary when:

A. The overall distance from one central distribution point to the extremities of the system produces a cascade (the number of mainline amplifiers in succession) of such proportion that end system performance becomes electrically unattainable.

B. The total number of amplifiers exceeds the tolerable limit of "noise funneling" (the combining distortion effect in the return path of a bi-directional system). A Hub-type system essentially divides the total number of amplifiers by a factor equal to the number of hubs.

C. Environmental boundaries such as rivers and lakes or man-made structures such as railroads or superhighways, obstruct or eliminate a convenient path for an economical distribution system via direct cable path.

D. Restrictions within the community (school districts, political districts, etc.) dictate proportioning of the cable plant.

These four points represent only a few examples, but they are the most influential variables in evaluating the ideal concept for the City of Syracuse.

Before analyzing these variables and their relationship to our City, let us consider a few of the basic facts surrounding the attractiveness of this particular market.

The City of Syracuse, geographically speaking, cries out for cable television. It includes all the necessary ingredients for a viable and profitable cable system:

- High density
- Excellent strand continuity
- Condensed mileage
- Limited local off-air reception
- Primed subscriber base
- Low percentage underground plant.

Concept

The first conceptual alternatives we shall consider is s Hub-type system. Is there a requirement based on the parameters previously stated.

A. The maximum distance from a centralized distribution point to any extremity of the system will not exceed four miles. NO REQUIREMENT.

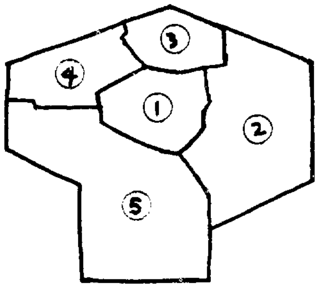
B. Noise-funneling from a total of 300 miles of plant would severely burden bi-directional performance. REQUIREMENT

C. Existing environmental boundaries include only Routes 81 and 690 which are elevated highways for the most part, therefore, they are not obstructing strand continuity. NO REQUIREMENT.

D. POSSIBLE REQUIREMENT.

The limits of bi-directional performance do indicate the necessity for a hub-type configuration. In order to achieve tolerable performance in the reverse direction of a bi-directional cable system, the total nubmer of amplifiers "funneling" from any one sector should be limited to 100 to 130 active devices (amplifiers). A good rule of thumb in estimating the quantity of amplifiers in a system is approximately 2 amplifiers for every mile of plant. This estimate would provide a total of 600 amplifiers (2 x 300 miles) for the City of Syracuse, or the requirement for 5 hubs (600 ÷ 120). The question now remains, where would these hubs be best situated?

Five hubs - five councilmatic districts. Let us investigate how this puzzle might fit. Quite frankly, this concept was a "shot in the dark" initially. The boundaries of the council districts could have very easily been disastrous for this concept. Contrarily, once again, the City of Syracuse opened up its arms to cable television. Another ideal situation for the application of a cable system.



Shown above are the approximated locations of the five districts (a scaled map with precise boundaries has been laid out and is available at the Office of Electronic Communications). Five district areas encompassing an area of approximately 60 strand miles each. How do we then apply a hub-type configuration to these sectors?

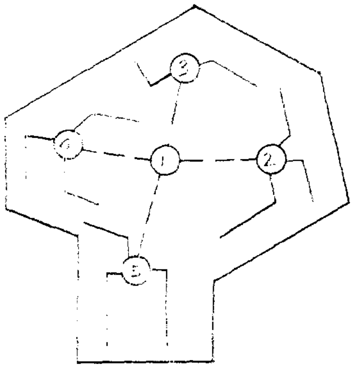
Hub-Type Configuration

In reviewing once again the need for a hub-configuration, it has been established that its necessity is dictated by the requirements of: (1) meeting bi-directional performance; and (2) providing individual trunk feeds to the councilmatic districts. Distance or cascade is not a limitation. Why is this important?

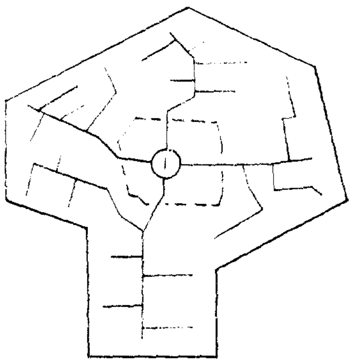
Throughout this evaluation, a "Hub-type configuration" has been stressed in lieu of a "Hub". The end result of this systems concept can be achieved in numerous ways. The end result being a division of the system into five sectors, and those five sectors being the councilmatic districts. A hub is normally a source of distribution remotely located so as to best service a definitive area, independently and interconnected to a master Head-end/Hub via microwave, long haul transportation, etc. This Hub locations can be passive, (a pole location where an amplifier diverts signals to that area's subscribers) or it may be active (located within a building with its own antennae receiver and processing equipment for local origination, etc.). If these sectors were located 10 to 15 miles from the master hub site, this configuration would be appropriate, however, distance or cascade is not a limitation.

This may lead to some confusion, so let's look at this situation graphically.

"Option 1"

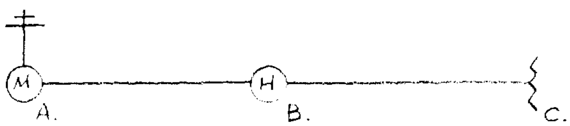


"Option 2"



Option 1 and Option 2 provide identical service. In both examples, (1) indicates the master headend/hub. In Option 1, information is transmitted from (1) to remote hubs via microwave or low frequency RF transmission (bi-directional). This path would carry all signals unavailable locally. At each hub site additional local channels and local origination would be combined with the signals on the interconnect path and then distributed throughout the sector to its subscribers. This is a costly venture, yet a necessity in a system where cascade presents a problem.

As an example, let us compare two cable systems to fully understand the relation of cascade to a system's performance.



	Cable City USA	Syracuse, New York
A-B Distance from master site to centrally located hub:	50,000 (10 mi.)	10,000 (2 mi.)
B-C Distance from hub to extremities of system:	50,000 (10 mi.)	20,000 (4 mi.)
I. A to B @300 Mhz:	20 amplifiers	4 amplifiers
B to C @300 Mhz:	20 amplifiers	8 amplifiers
Total A to C:	40 amplifiers	12 amplifiers
II. A to B @108 Mhz:	11 amplifiers	2 amplifiers
B to C @300 Mhz:	20 amplifiers	8 amplifiers
Total A to C:	31 amplifiers	10 amplifiers
Decrease in cascade utilizing low-frequency interconnect:	9 amplifiers	2 amplifiers

This is an effective demonstration of the relevance of distance to hub utilization. In "Cable City, USA", the extreme distance from Master site to system extremity warranted a low-frequency interconnect, rendering a reduction of nine amplifiers in cascade. This reduction could increase the distribution amplifiers output level sever dB ($70 to $100/mi. savings).

In the case of Syracuse, the reduction only rendered a savings of 2 amplifiers. This would have no impact whatsoever on distribution levels since cascade will not become a determining factor to system levels until it exceeds at least 20 amplifiers. So what does all of this CATV jargon imply? In one simple paragraph it implies:

A Master Hub to Hub interconnect via microwave or low-frequency transportation is absolutely unnecessary. A geographic/demographic division of the City is necessary. This division should be accomplished by providing five multiple trunks from the Master site to each of the councilmatic districts with subscriber distribution commencing once each trunk enters its designated district (see Option 2).

The final alternative to consider is the type of system to be incorporated into this concept of multiple sectors.

There are two obvious choices, and other than these two variations, I would seriously doubt if any other type system would provide all the services and flexibility required for the Syracuse system. These two choices are a Mid-split, dual-trunk with single feeder, and Sub-split, dual-trunk with dual feeder. It is difficult to evaluate which system will be the ideal one for Syracuse, as both are highly sophisticated bi-directional plants. The final decision will more than likely be made in analyzing how the franchise applicant proposes to execute either of these two options.

Seldom does the opportunity arise for the application of a dual plant. Existing dual cable plants throughout the country probably number less than 2%. Why such a low percentage? A dual cable plant is unequivocally a financial disaster without the proper DENSITY and CONTINUITY.

Initial cost of dual versus single plant can be evaluated by applying the following formula:

Where: D_s = Cost per mile of single plant distributions.
D_d = Cost per mile of dual plant distribution.
x = Difference in cost per mile of single vs. dual.
S_s = Cost of subscriber installation in single plant.
S_d = Cost of subscriber installation in dual plant.
y = Difference in cost of subscriber installation.
n = Number of subscribers per mile.

IF: $X > (yn)$ = Single Plant
$X < (yn)$ = Dual Plant

Formula:

$$D_d - D_s = x$$

$$S_s - S_s = y$$

* $>$ = Greater than
$<$ = Less than

Assume:

D_s = $5,500

D_d = $8,000

S_s = $55

S_d = $30

n = 50 subscriber miles

Applied:

$D_d - D_s$ = x or $8,000 - $5,000 - $2,500

$S_s - S_d$ = y or $55 - $30 = $25

x = $2,500
y = $25
n = 50
yn = $1,250

IF: x = $>$ (yn) = Single plant
x = $2,500
yn = $1,250

THEN: $2,500 $>$ $1,250 = Single plant

IF: n = 100; yn = $2,500; = Single or dual plant

n = 150; yn = $3,750; = Dual plant

In analyzing the point of crossover for single versus dual plant it becomes apparent in applying the formula that the value of "x" is most critical. Its importance becomes even more critical as the value of "n" decreases.

The value of "x" and "n" will fluctuate in different cable plants. "X" relative to continuity and "n" relative to density. "Y" will remain constant in any system. The cost of subscriber materials is in no way effected by system parameters. The value of "y" is derived as shown below.

Subscriber Material	Single Plant	Dual Plant
Cable($3,500/100')	3.50	7.00
Gro Block (.40/ea.)	.40	.80
Transformer (.45/ea.)	.45	.45
"F" connectors (.08/ea.)	.56	.88
Labor	12.50	18.50
Converter	40.00	--
A-B Switch	--	4.50
Total	$57.41	$32.13

Y = $25.28

The better the strand continuity, the smaller the value of "x" will be. The higher the density, the higher the value of "n" will be. What then is the approximate application for Syracuse?

Syracuse- 223 homes passed/mi. @ .45% Penetration - 100 subscriber/mi.

IF: y = $25 (known)
n = $100 (known)
yn = $2,500

IF: x $>$ $2,500/mi. = Single Plant
x $<$ $2,500/mi. = Dual Plant

at 50% penetration yn = $2,800
at 60% penetration yn = $3,350
at 70% penetration yn = $3,900

The value of "x" will always be greater than $2,000 in any system, regardless of how the system appears geographically. Recognizing this, along with the constant value of "y" at approximately $25, if "n" is ever less than 80 subscribers per mile a dual plant is generally unaccpetable. Remember that "n" is subscriber/mile and not homes passed/mile. Assuming a penetration of 50% a cable system requires the equivalent of 160 homes passed/mile in order to justify a dual cable plant. Hence, less than 2% dual plants nationwide.

Recognizing the definite possibility of a dual plant system for Syracuse because of its

Marketability

Advantage	Disadvantage
- Two tier basic service	- Eliminates remote control
- Two tier pay service	- Additional wiring required
- Rate versatility	- For multiple units (pre-wired).

Flexibility

Advantage	Disadvantage
- 8 return video channels accessible at any location in city.	- 18 channel max forward.
- 40 return channels total	- Multiple drops pottential.
- Private access via converters	- Environmental eyesore
- Lower maintenance costs.	

Here we encounter the barriers which counterbalance the previously mentioned economic advantages of a dual plant. This is not to say they totally eliminate the execution of this concept, but their importance must be evaluated. This evaluation is quite simple. The questions to be answered are:

1. As a consumer, and being presented with a choice, would you prefer the convenience of a remote control device (converter) rather than an A-B type switch controlling the TV set channel selector?

2. As an apartment building owner, would you object to having to pay the additional costs of wiring your complex for dual system having already expended the money for your existing MATV system?

3. Does the Syracuse market require more than 18 cable channels?

4. Will the ecology mindful citizens of the community object to the excessive required for a dual plant?

If your response to any of these questions was "yes", your evaluation has rendered a veto against a dual plant concept.

Our final consideration then is a single plant concept, actually a modified single plant, incorporating a second parallel trunk for bi-directional capabilities.

This system is capable of delivering:

- 35 channels in the forward direction of the "A" turnk.
- 4 channels in the return direction of the "A" feeders.
- 20 channels in the forward direction of the "B" trunk.
- 12 channels in the return direction of the "B" trunk.

Obviously, there are no limiting factors here in relation to channel capacity. These 35 channels would be delivered to the TV set by a set/top or remote control converter. This type system would also fit into the previously determined hub-type concept.

This configuration would also enable the activation of the alarm system from any subscribers dwelling within the city. Municipal access may be incorporated via the return feeders of cable "A" or via the return trunk of cable "B".

Marketing of this system might also be a two-tier concept. Tier #1 offering up to 9 channels without converters at oneprice and Tier #2 offering up to 35 channels utilizing the converter at an optional price.