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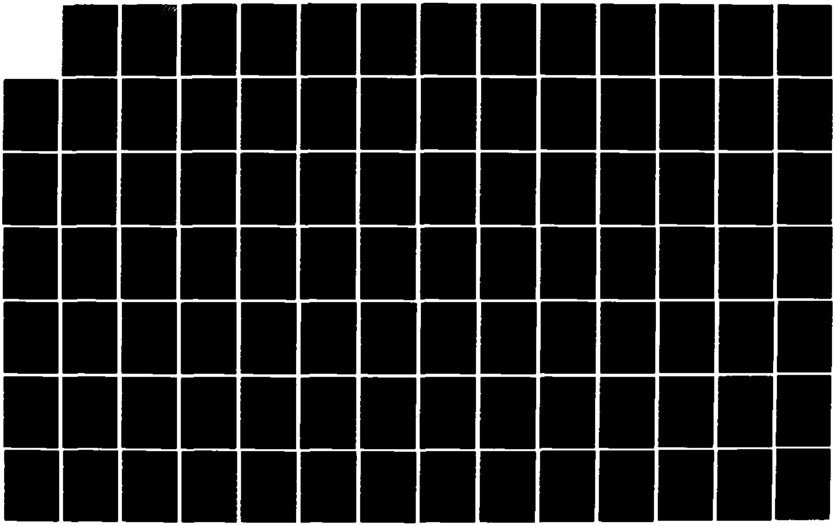

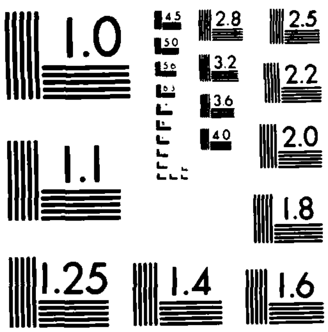

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POTENTIAL APPLICATIONS OF CABLE TELEVISION (CATV) TO THE FEMA COMMUNICATIONS MISSION

Final Report

for

Federal Emergency Management Agency

Washington, D.C. 20472

Contract Number EMW-C-0979

Unit Number 2217A

July 1983

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The history, technology, economics, regulation and vulnerability to electromagnetic pulse (EMP) effects of cable television are examined. Recomendations are made concerning FEMA integration of cable television systems into the FEMA emergency communications system and the protection of cable television systems from EMP effects.

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Donald D. Gilligan
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Stephen W. Frantz

Control Energy Corporation

"This report has been reviewed in the Federal Emergency Management Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Federal Emergency Management Agency."

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TABLES AND FIGURES

NOTE: Data included in this report is a compilation of research conducted by various private and public organizations and individuals. Among the sources used are: Television in Transition, by Watson S. James (Crain Books, Chicago, IL); Cable Communications, (Prentice Hall); and Cable TV and Telecommunications: Opportunities for Diversification and Cost Savings, (Edison Electric Institute). Sources are not cited in the text for the purpose of clarity.

1.0 HISTORY OF CATV

1.1 Early Days

Cable television (CATV) is nearly as old as broadcast television. The former began in Pennsylvania in 1948, when an appliance dealer who hoped to increase his TV set sales put an antenna on a hilltop and relayed the local broadcasting signals by wire to nearby homes with poor over-the-air reception. Small-scale entrepreneurs elsewhere soon discovered they could make a profit by wiring communities where hilly terrain or other obstacles made TV reception poor.

CATV thus began as a means for extending the range of local broadcasting stations, and it continued as such for some 20 years. The earliest systems offered three to four channels (or however many local broadcasting signals could be received) for less than five dollars per household per month. The market for early systems consisted of communities both poorly served by broadcasting and densely populated enough to be profitably wired. Because communities of this description were limited in number, CATV subscribers totalled only 14,000 in 1950 and grew to 750,000 (or only two percent of all TV households) by 1960.

Early CATV systems were small, locally-owned, technologically simple operations. Typical systems were bootstrapped. A local entrepreneur would wire a few blocks of houses, collecting $150-200 per house, which he would use to wire the next few blocks. A typical system consisted of:

- An antenna (or antennae) placed at a site with good reception of surrounding stations;

- A so-called head end, where signals received over the air were changed into pulses transmissible by wire;

- The coaxial cable itself--a core of copper wire ensheathed in aluminum tube with a layer of insulation between--plus amplifiers along its length to boost the signals; and, in systems with more than 12 channels,

- A converter, at the receiving end, that made the TV set tunable to the greater number of channels carried by the wire.

The first CATV systems could carry a maximum of 12 channels. This channel capacity, low compared with that of systems being built today, was determined not by the wire itself--which then, as now, could carry 60 channels of video with sound--but by the limitations of converters and amplifiers. Even 12-channel capacity, however, exceeded the number of local broadcast signals available for retransmission. Therefore, CATV operators began using microwave relays to import the signals of more distant, non-network stations in order to make cable service more attractive by increasing the customers' program choices. By importing signals of remote stations, cable operators made their first effort to offer something more in a specific market than the broadcast stations serving that market could provide.

These early attempts to increase television services were quickly squelched by the broadcast industry, which worried that new CATV channels would cut into local broadcasters' audience and ad sales. Broadcast lobbyists persuaded the Federal Communications Commission (FCC) to impede cable companies from importing distant signals. The FCC accomplished this by denying CATV companies licenses for the microwave links necessary to bring in outside signals. (The FCC at that time--1962--directly regulated microwave, which used the public airwaves, but not cable, which did not.)

This decision was one of the broadcast industry's several successful uses of the regulatory process to retard the growth of cable television. The industry's key argument, which the FCC ostensibly accepted, was that CATV would threaten local broadcasting, the strength of which was deemed by the FCC to be in the public interest.

The 1960s were the CATV industry's Dark Ages. The FCC assumed direct regulatory authority over cable in 1965 and adopted several rules that discouraged CATV operators from offering additional services. Systems were required to carry all "local" stations before bringing in distant signals--"local" meaning any station claiming to be "significantly viewed" in the area served by the cable system. These "must carry" stations sometimes filled up most of a CATV system's channel space.

Several other FCC rules also made life difficult for CATV operators. Systems were required to offer a minimum number of channels, to originate their own programs, to offer production facilities, and to pay copyright fees for certain programs. Although many of these rulings were successfully challenged in the courts, regulatory policies had a decidedly chilling effect on investment in CATV development.

Unfriendly regulators were not CATV's only obstacle. The industry itself was mainly a collection of small, pluralistically owned systems in rural markets. Winning new subscribers required offering programs unavailable on local broadcast stations, but such programming cost more than most small systems could afford, and FCC rules restricted the use of free programming from distant stations. Even had operators been able to buy programs comparable to those carried by local stations, they possessed no efficient means for receiving those programs: leased phone lines were too expensive, and communications satellites were not yet in widespread commercial use. Finally, sheer uncertainty about consumer demand for new services made CATV operators reluctant to assume the financial risks of developing those services: cable system owners were not programmers but enterprising technicians who knew how to make a profit installing wire.

To be sure, many operators providing the sole service to remote or signal-shadowed areas were doing quite well despite the constraints. A CATV system required substantial capital to install, but once installed, its operating costs were minimal. A small system of 10,000 subscribers paying $5 a month grossed $600,000 a year. Payback on the high-capital investments might take 10 to 15 years, depending on terms, but monthly cash flow, depreciation for tax purposes, and potential for adding new customers all made many cable systems financially attractive. Many risk takers became quite rich building systems in rural areas and selling those systems a few years later for a tremendous profit.

All that this mini-bonanza proved, however, was that CATV systems were profitable in captive markets, where people would pay a minimal monthly fee to receive the same channels that most people received free (save for the increases that advertising costs added to the prices of consumer goods). This fact came as no surprise.

What had not been proved was that CATV could be profitable in locations already well-served by broadcasting. Without something new and different to offer viewers, CATV service had little appeal, and, for reasons mentioned above, something new and different was hard to come by.

The CATV industry as a whole, therefore, entered the 1970s in a rather malnourished condition. Stock values were depressed, urban systems were showing marginal profits, and some companies were on the verge of going under.

This financial emaciation belied the promise of the multichannel technology, which had already been touted by media visionaries as "the television of abundance." CATV's large channel capacity, which solved the problem of frequency scarcity, could make television channels as diverse as magazines. Some of these channels would be reserved for governmental and educational uses, to increase extended learning and civic involvement. Others would be used to serve the needs of specialized audiences, such as the handicapped and the elderly. Still others would carry ethnic programming and cater to a variety of subcultures.

CATV's two-way capacity (a signal can travel up a wire as easily as down it) would make possible several "interactive" services. These included home shopping, home banking, electrical load management, and accessing of computer banks.

These were but highlights of the benefits described in the Sloan Report (1971), a seminal early document on the public service potential of CATV, and in other reports. Cable television could do everything but scrub the floors.

But what was the market for these services, and who would capitalize them?

These questions are still being answered today.

Meanwhile, in the early 1970s, those companies which had spent large sums constructing urban cable systems, only to find weaker markets and stronger restrictions than expected, were seeking ways to attract more subscribers. Their wishes were answered in the form of pay television, a service made possible by a technology as complex as CATV was simple--satellite.

Home Box Office, (HBO) owned by Time Inc., had begun on Manhattan Cable TV as a commercial-free entertainment channel featuring movies. In 1975, HBO leased a transponder (a receiving and transmitting device) on the commercial satellite Satcom I and began to send its programming to CATV systems across the country. Subscribers paid an additional charge for HBO (separate from the monthly charge just to be connected to cable), and HBO split these revenues with the CATV operator.

HBO's success is legend within the CATV industry. Within two years after beaming its movies from the bird, HBO was running in the black, a rare feat in the risky business of mass programming. During the three years prior to satellite distribution, HBO had managed to acquire only 200,000 subscribers; during its seven post-satellite years, the channel has collected nine million customers, at an average fee of $10 per month.

HBO's experiment changed the CATV business in several crucial ways. First, it interconnected a large number of geographically dispersed CATV systems, thereby amassing a large enough subscriber base to pay for the sort of expensive programming needed to attract still more subscribers. Satellite interconnection would henceforth allow CATV companies to become part of a system capable of reaching a mass national audience, with the resulting economies of scale necessary for purchasing competitive programs.

Second, HBO demonstrated that a significant number of subscribers would pay an extra monthly fee for a new program service. Channels for which the user paid directly had been tried before--both by means of scrambled broadcast signals and by microwave--but never on a scale portended by satellite-to-cable distribution.

Third, HBO established a financial arrangement by which the purveyors of new channels of programming would pay the CATV operator to carry that programming. The CATV operator was suddenly selling an audience to program vendors, just as local broadcasting stations sold audiences to the three commercial networks. Because the programmer considered the audience more valuable than the CATV operator did the programs, the cash flowed in the operator's direction.

HBO had created a new national network, small in audience compared to the three broadcasting nets but still unquestionably lucrative. Its success prompted competition. Within three years, Showtime and The Movie Channel, both offering commercial-free movies, were on the bird. Time Inc. launched a second channel, Cinemax. Still other pay services followed.

Other entrepreneurs found that charging the viewer a monthly fee was not the only way to finance a satellite network. Ted Turner created the first "superstation" in 1976 by using satellite to achieve national coverage for WTBS, his independent broadcasting station in Atlanta. Turner charged CATV systems 10¢ per subscriber per month to receive WTBS, which carried exclusive coverage of Atlanta Braves games. Many systems decided that the cost of acquiring this and other satellite channels would be more than offset by the new subscribers this programming would attract.

Yet a third way to support a satellite channel was through advertising. The Entertainment and Sports Programming Network (ESPN), owned by Getty Oil, is one example.

The satellite channels, whether pay channels or those supported by other means, allowed CATV operators, little by little, to build the varied program menu needed to attract subscribers in well-saturated media markets. At the same time, the regulatory climate brightened as FCC rulings were either reversed or stalled by means of litigation and more organized lobbying.

Both these trends put CATV on its feet. The larger media markets began to look good again, and more entrepreneurs gambled that the public appetite for new television fare was far from sated. A surge of wiring began as CATV companies competed for franchises in larger markets (franchising will be explained later on). CATV companies put in 14,000 miles of new cable in 1975, and this installation rate grew steadily year after year to a total of 89,000 miles of new cable laid in 1981. The industry's annual capital expenditures rose from $127 million in 1975 to $1.5 billion in 1981. Nationally, the percentage of households passed by cable (that is, the percentage to which cable is available, not those which actually subscribe) has risen from 30 to 60 percent since 1975.

1.2 A Profile of CATV Today

Thirty years ago, the CATV industry was a paltry collection of mom-and-pop-owned conduits for local broadcasting signals. Today the industry is somewhat closer to becoming a nationally interconnected broadband communications system capable of providing many services in addition to sports, light entertainment, and even high culture. Despite tremendous growth, however, the "wired nation" is still years away, and the average cable system, for all the hoopla, is hardly a high technologist's dream.

There are now about 5,000 separate cable systems in the United States. Although 60 percent of American households can now receive cable service if they choose to, only 34 percent actually do. In other words, nearly one out of every two households passed by cable chooses not to subscribe. Still and all, 34 percent penetration, triple the percentage in 1975, represents 28 million households. Furthermore, cable penetration has jumped 13 percentage points during the past two years alone--the annual rate of growth has increased dramatically. In absolute terms, about 140,000 new homes subscribed to cable each month during the mid-1970s; about 514,000 households became new subscribers each month during 1982.

Most of these new subscriptions are coming from the larger markets, but cable penetration remains higher in medium- to small-sized communities. Big cities, already rich in media and cultural activities, are riskier ventures, and more expensive to wire, than suburban areas in somewhat smaller markets.

As a result, several key cities have not yet been wired. Among the 20 most populated cities, major portions of Chicago, Detroit, Washington, Minneapolis, Denver, and Baltimore do not yet have cable. Within the big cities that are fairly well-covered, such as New York and Los Angeles, many of the poorer neighborhoods have not yet been wired, for the obvious reason that cable companies have sought out communities likely to pay more on leisure activities. At the other end of the population density spectrum, very rural areas are likewise neglected because of the high cost of extending the cable to each home.

The fundamentals of cable technology have changed little for the past 30 years. An antenna, headend and trunk line and tributaries still constitute the basic elements of a cable system. Nowadays, however, nearly all cable systems possess, in addition to an antenna for local reception, a microwave receiver for more distant signals and an all-important satellite receiving dish. Moreover, the potential for increased channel capacity has grown markedly: a 20-channel converter, developed in the 1960s, was followed by 36-channel, then 52-channel models for a single cable; doubling the cable now allows state of the art systems to carry 120 channels.

This tremendous channel capacity is far from realized, however. Despite rapid growth of the industry in recent years, most communities are still served by small, older systems. In spring of 1981, system size broke down as follows:

Channels Offered	Percent of All U. S. Subscribers
1 - 12	58
13 - 19	5
20 - 29	21
30+	16

If these percentages are multiplied by the 34 percent of all TV households (which include nearly all the households in the country) that presently subscribe to cable, national cable coverage looks like this:

Size of System	Percentage of TV Households	Number of TV Households
1 - 12 channels	19.7	16.2 million
13 - 19	1.7	1.4 million
20 - 29	7.1	5.9 million
30+	5.4	4.5 million

At this point, by far the majority of the nation's subscribers are reached by fairly primitive systems. These systems generally carry the network affiliate stations from the local and surrounding broadcast markets (often with much program duplication); one or two independent stations from distant markets; one or two public television stations; and perhaps one pay service, usually HBO or Showtime. Rarely is there excess channel capacity in these 12-channel systems, and this fact is significant for public agencies that would like to use cable to deliver services other than entertainment.

At the moment, the number of channels potentially available to cable via satellite outstrips the carriage capacity of most cable systems. Nearly 40 different channels of programming are now beamed from three different commercial satellites, and more than 20 new channels are being planned. New multiple beam antennae allow one antenna to receive signals from several satellites, but most cable systems cannot deliver all of the channels they are capable of receiving with just one dish. As might be expected, this bottleneck at the point of end-use has spurred keen competition among satellite channels offering similar programming to be carried on a maximum number of systems.

The cable systems with 20 or more channels usually carry several of the available satellite channels and offer their subscribers increments of channels known as "tiers." For example, the so-called basic service may consist of all the commercial and public broadcasting channels in the area plus two or three of the satellite-delivered channels. These latter might include advertiser-supported channels which are free to the cable system. The first "pay tier" might include HBO and another pay channel. The second pay tier might offer three other channels, and so on. The customer can choose as many or few tiers as he or she wants, paying extra for each one.

Tiering allows cable operators to respond to a much wider range of demand than would be possible with just one package. It also allows the operator to experiment with sales gimmicks--a channel once part of a pay tier may suddenly be offered as part of the basic package in an attempt to lure more subscribers. Moreover, a satellite channel delivered free to the cable system may be offered to viewers as a pay channel--the cable operator can charge what the market will bear, and the creative marketer can make big profits.

According to FCC data, cable subscribers across the country paid an average $7.69 for basic service and $9.13 for pay service in 1980. In that year, 42 percent of all basic cable customers subscribed to a pay service; that percentage had jumped to 57 two years later. In 1980, gross revenues from basic cable service totalled $1.5 billion for the industry, while gross receipts from pay services totalled $550 million. However, most observers expect pay services to outdistance basic within this decade. According to the more optimistic predictions, more and more households will pay more and more for new programming as cable's penetration rate increases. The notion that a significant number of households will pay an average of $80 or so per month for new TV offerings is not outlandish to many analysts of the cable industry. In fact, decisions to sink huge amounts of capital into the building of sophisticated urban cable systems have been predicated upon the assumption that households are willing to pay much more for cable-delivered services than they do now.

Cable's rapid growth rate in recent years has been accompanied by increasing concentration of ownership, as multiple system owners (MSO's) have bought out smaller independently owned systems and also squeezed out independents in the competition for new markets. The top ten MSO's are:

System	Number of Subscribers
1. American Television and Communications	1,950,000
2. Tele-Communications, Inc.	1,900,000
3. Group W Cable	1,760,000
4. Cox Cable Communications	1,164,000
5. Storer Cable Communications	1,063,000
6. Warner Amex Cable	1,000,000
7. Times-Mirror	715,000
8. Newhouse Broadcasting	646,000
9. Rogers-UA Cable Systems	560,000
10. Viacom Cablevision	543,000

These ten MSO's serve approximately 40 percent of the nation's cable subscribers; the 30 largest cable companies possess about 60 percent of subscribers. Concentration of ownership varies regionally. In upscale California, the most wired of states, six companies serve half the subscribing households, and 50 other companies serve the other half.

Dynamics of the Industry

Cable television is in a fairly early stage of its development as a major industry. It is one of the most tumultuous and ferociously competitive businesses in the country today. In simplest terms, two main objectives prevail: to achieve an ever larger share of the potential subscribers and to attain greater control over each step in the business of peddling programs--either to advertisers or directly to viewers--which is ultimately what the television game is about.

Whereas for the past few years the large cable companies have concentrated mainly on capturing new markets, they are now placing more emphasis on increasing subscriptions within the systems they already own. It has become a truism within the industry that the really profitable markets have already been claimed and that the big franchising wars are over. This point should not be exaggerated. With only 60 percent of homes passed, at least a few more plums remain, and the award of a new franchise in a potentially profitable market is always top news in the trade journals. It is true, however, that the greatest increase in revenue for a given amount of effort will come from gaining new subscribers in existing svstems and from enticing each subscriber to spend more each month on new pay services.

A second type of expansion is occurring in the form of vertical integration, as the larger MSO's seek to gain, or to secure, their control of satellite channels and of production companies to supply those channels with programming. Some examples:

- Time Inc. owns ATC, the largest of the cable companies, and HBO, the largest of the pay channels. It also owns Cinemax, another pay channel, and has a share of USA Network, a basic cable service. It supplies those channels with productions from Orion Pictures, in which it has a part interest, and it has recently made a deal with Columbia and CBS to start a new film studio.

- Westinghouse owns Group W Cable, third largest MSO, and Home Theater Network, the sixth largest pay channel. It also owns part of the Satellite News Channels and the Nashville Network, and it has its own production house, Group W Productions.

- Warner Communications owns Warner Amex Cable (in a co-venture with American Express), sixth largest MSO, and The Movie Channel, third largest pay service. It also owns basic channels Nickolodean and part of Music Television. It also owns a production company called Warner Bros.

- Viacom International owns Viacom Cable, tenth largest MSO, and Showtime, second largest pay service. It also owns Cable Health Network and its own production house.

There is further conglomeration within the conglomerates. Viacom has recently struck a deal with Warner Bros., American Express, MCA, and Paramount to link Showtime with the Movie Channel, the plan presumably being to join forces in giving HBO a run for its money.

Each of the above companies control most of the pathway from production studio to viewers' living rooms, and there are other, less complete monoliths in the making. ABC, NBC, and CBS have also sunk large amounts of capital into programming services for cable: each has attempted to market a satellite channel or channels, and each has formed partnerships to develop other types of cable services such as videotex (about which, more later).

Despite the promise of El Dorado, however, the market for new services is presently limited and uncertain. There have already been casualties. CBS Cable, an ad-supported system offering high-budget, lush productions of the best of high culture, failed after 11 months--even after reaching 5 million subscribers on 502 separate systems--for lack of advertising support. RCA-owned The Entertainment Channel, a pay service that had succeeded in securing exclusive rights to BBC productions, folded after eight months and a loss of $34 million; the service reportedly could not gain access to enough systems and was unable to attract subscribers for its mix of programming.

The cable industry is thus in a state of flux, and no one can predict the shape it eventually will assume, even though the beginnings of some trends are apparent. Compared to the broadcasting business, cable is still very segmented, despite some attempts to integrate. At the moment, program production, distribution to national and regional audiences, and final delivery to the consumer are accomplished by a welter of interdependent players, each of which controls a share of only one or two of the several elements required for the cable business to work.

Cable companies must compete not only among themselves for a share of the total cable market but also with other media for a share of the total entertainment market. And what many consider to be cable's arch opponent--AT&T and local phone companies--has only begun to enter the fray. (The phone company is the only other business that makes its profits by selling consumers access to a wire that can carry information; the cable industry's wire can carry more, and more various information, but the phone company's wire has 65 million more subscribers and is supported by a capital source and infrastructure considerably larger than the cable industry's).

Program services must compete for access to cable systems and for a limited amount of space on the available satellites. Once they succeed in reaching the TV set, they must compete for a share of the consumer's disposable income. There may be 40 channels bouncing off satellites today, but most analysts agree that only a handful of them will be beaming five years from now.

Cable seems to be off to a good start, but many things have to happen at the same time for it to match the trajectories of the optimists' projected growth graphs. Les Brown, for years the New York Times' television expert and now editor-in-chief of Channels magazine, has summed the matter up:

> "The real power of cable as a new communications medium will be felt when the biggest cities are wired and the oldest systems are updated. That will allow the satellite-distributed programming to attain something approaching the uniform national coverage that has been the strength of the commercial broadcast networks all these years."

Expanding the channel capacity of the nation's 2,600 12-channel systems--roughly half of all systems--and wiring the uncabled portions of the largest cities are tasks requiring copious capital. The availability of that capital will depend on the strength of consumer demand for new cable-delivered services. Thus far, only channels offering commercial-free non-stop movie programs have proved profitable, and there are only so many good movies available. The scores of other satellite channels are running on hope and borrowed money. The non-video services for which profitability is predicted--videotex, home security systems, home banking and shopping, and energy management, to name a few--are still in the market-testing stages.

Cable may yet prove to be the communications industry of the future, but at this point the returns are only beginning to come in. This is a point to be underscored when contemplating the many public benefits, including emergency management, that a nationally pervasive broadband communications system could deliver. That system is not yet in place. And assuming its development continues to depend primarily on market forces (rather than public financing), such a system will materialize in direct proportion to the growth of consumer demand for new services.

2.0 CATV TECHNOLOGY

2.1 Basic Technology of Cable Systems

Cable systems are simply television broadcast systems that transmit their signals down a wire (the coaxial cable) instead of radiating it through space. Both a cable system and a standard broadcast television station have central studios and transmitters. In a broadcast television station the transmitter is connected to a large antenna which radiates the signal through space so that it can be received by anyone with a television antenna and a television receiver. However, in a cable system, the transmitter is connected to the coaxial cable which is connected directly to the television receiver. The coaxial cable continues the television signals within the cable. It keeps the television signal from leaking out and also prevents unwanted signals (interference) from leaking in. This ability to continue and limit the distribution of television signals is the essence of the whole cable television business. The two major outcomes of the ability to continue the television signals are: 1) the whole radio frequency spectrum can be used to transmit television signals without interfering with other uses (such as aircraft communication and navigation, police radio, etc.). The cable system in essence doubles the size of the frequency spectrum (See Diagram 1). Secondly, because you can continue the signal, you can control who receives it. To receive the signals you have to physically attach a wire from the cable to the television receiver. This means that the person that wants to receive the signal can be charged for the privilege of connecting into the cable network.

Diagram 1

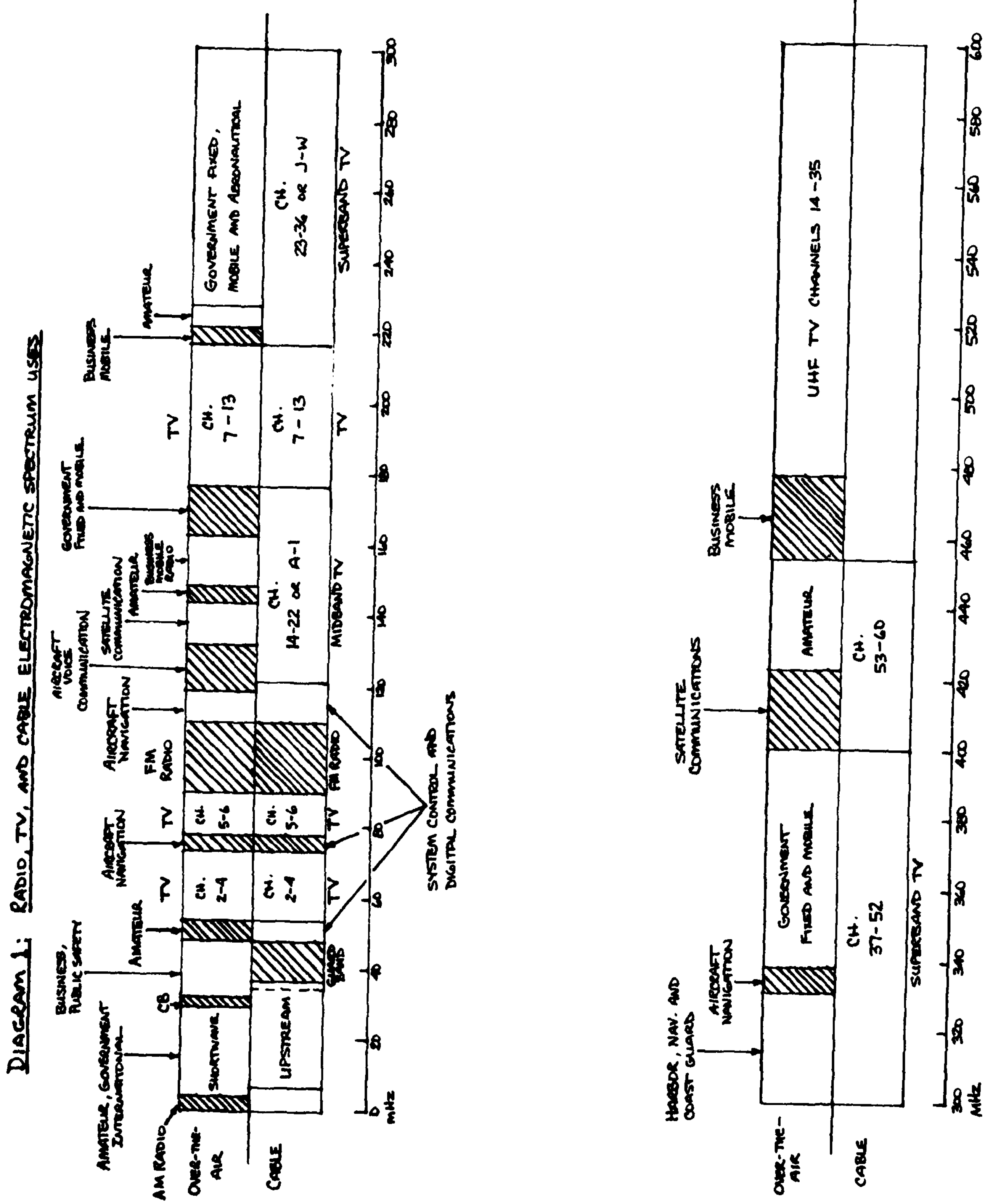
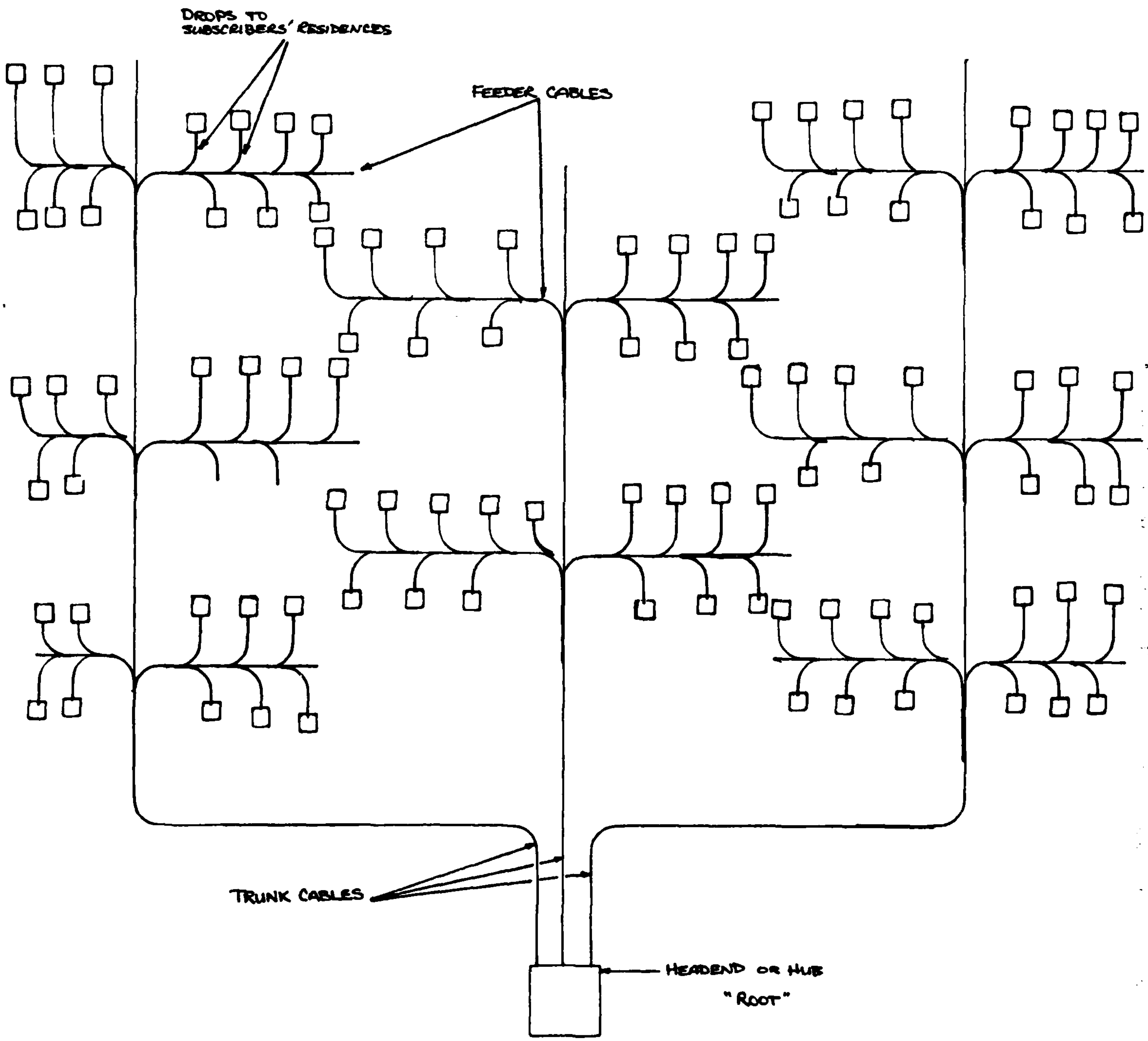


Diagram 1: Radio, TV, and Cable Electromagnetic Spectrum Uses
AM Radio
Amateur, Government International
Business, Public Safety
CB
Amateur
Aircraft Navigation
TV
FM Radio
Aircraft Navigation
Aircraft Voice Communication
Satellite Communication
Amateur
Business Mobile Radio
Government Fixed and Mobile
Business Mobile
Amateur
Government Fixed, Mobile and Aeronautical
Shortwave
CH. 2-4
CH. 5-6
CH. 7-13
Upstream
Guard Band
FM Radio
CH. 14-22 or A-1
Midband TV
CH. 23-36 or J-W
Superband TV
System Control and Digital Communications
Over-the-Air
Cable
MHz
Harbor, Nav. and Coast Guard
Aircraft Navigation
Government Fixed and Mobile
CH. 37-52
Satellite Communications
Amateur
CH. 53-60
Business Mobile
UHF TV Channels 14-35

Cable television systems are called the structured system. Diagram 2 shows what is meant by this. From the "root" or hub of the system the cable fan out through "trunks", "feeders" and "drops" to individual households much as trunks, branches and stems connect individual leaves to the tree. This particular architecture evolved in the early 1950s when cable systems were only community antenna systems that provided the normal broadcast channels to areas with poor reception.

The components of the cable system, as shown in Diagram 2, are principally the headend or hub; the trunk and feeder distribution network of cables and amplifiers; the multitap and drop to the subscriber's residence and the converter located (usually) adjacent to the subscribers television set. While the technology of each of these components has advanced considerably, the structure of a modern cable system is very similar to the early cable systems of the 50s and 60s. The cable systems of today differ from the early systems, the way a Boeing 747 differs from a DC-3. The basic principles are the same. The components, while considerably advanced, are generally all arranged in the same manner but the capacity of the system is much greater. Early DC-3's carried 40 passengers, a 747 carrys almost 400. Early cable systems carried 5 channels, modern systems can carry up to 120.

Diagram 2

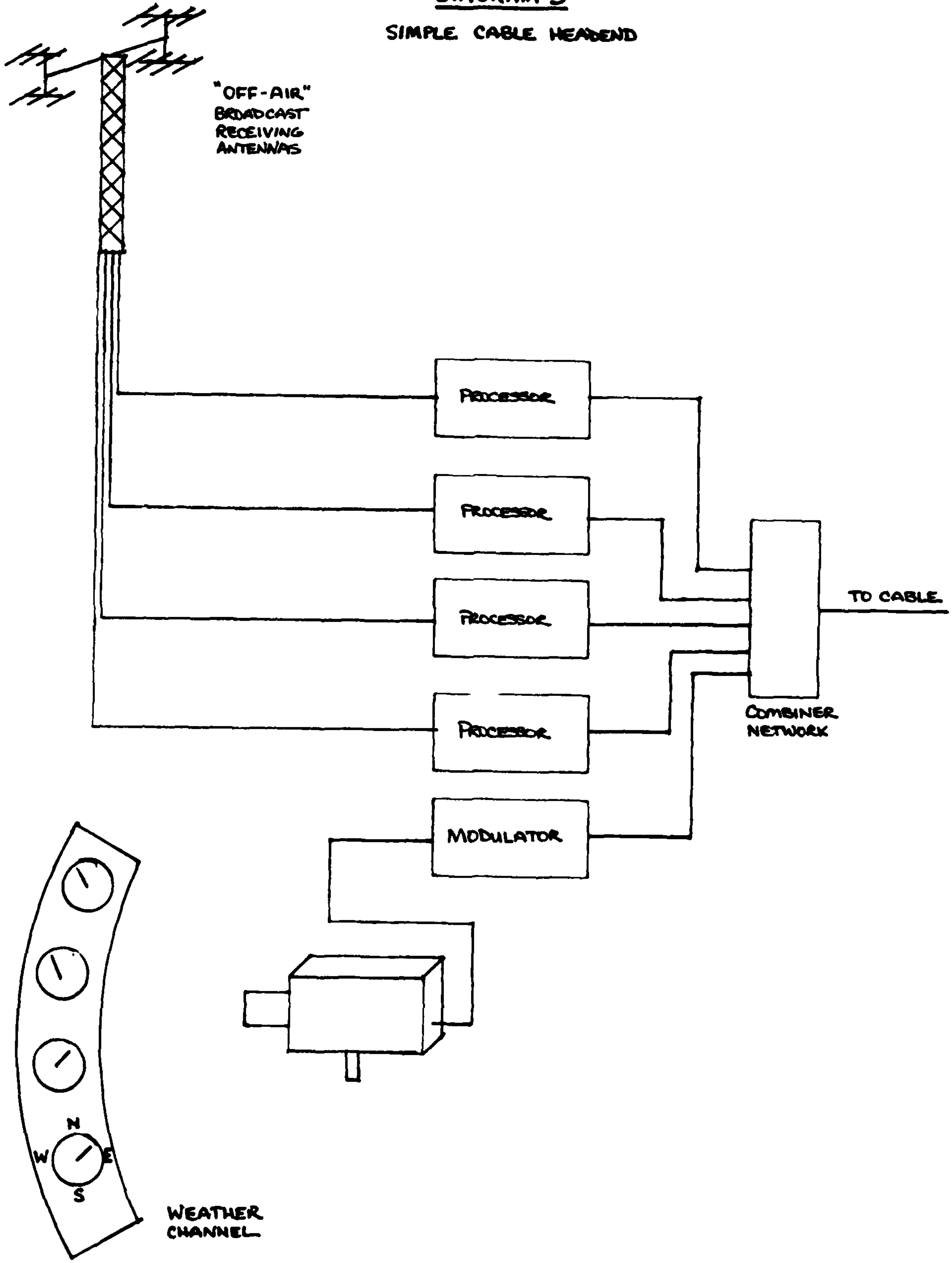

DROPS TO SUBSCRIBERS' RESIDENCES
FEEDER CABLES
TRUNK CABLES
HEADEND OR HUB
"ROOT"

2.1.1 The Headend or Hub

The headend is the originating point of all the services available over the cable. The early cable system headends consisted simply of an antenna on top of a mountain or some other location with good reception and a small building near the base of the antenna. The antenna received conventional TV broadcast signals and the signal processing equipment in the building amplified and "cleaned up" the TV signal for rebroadcast over the cable network. This headend was unmanned and the building contained perhaps ten pieces of electronic equipment costing fifty to one hundred thousand dollars. Eventually cable television operations began originating some of their own services, usually a time and weather channel with a few local advertisements thrown in. This consisted of a motorized camera that would rotate back and forth televising a thermometer, barometer, wind velocity indicator, clock and some handwritten advertisements. The output of this camera was fed into a modulator which generated the signal on the proper television channel. This signal was then combined with other TV signals and transmitted over the cable. At this level the headend was still a rather simple and inexpensive operation. This level was generally sufficient for cables with up to 12 channels of capacity. Diagram 3 shows the components of an early cable headend.

DIAGRAM 3

SIMPLE CABLE HEADEND



Several major events in the cable industry changed the headend from a small unmanned equipment shed into a multimillion-dollar facility manned twenty four hours a day. The technology of the cable equipment improved to the point where first 30 to 35 and then 50 to 100 channels could be transmitted over the cables. Since each channel requires a signal processor modulator the amount of equipment in the headend increased dramatically. Secondly, to fill up the new channels the cable operator had to find more sources of programming than simply retransmitting broadcast signals. To obtain this new programming the cable operator had to install microwave receiving equipment and satellite receiving stations. A third major event was the increase in requirements for local origination facilities. In order to win a franchise, the cable operator would promise to build and equip a television production studio that the community could use as it wished. The competition for franchises was fierce and these studios quickly grew from small operations to professionally-equiped and staffed studios.

Diagram 4 shows what a modern headend might consist of. Typically the following items might be incorporated:

2.1.1.1 Over the Air or "Off Air" Antennas

These are the same antennae the early cable systems used to receive regular broadcast channels and retransmit them over the cable. The FCC has many rules governing this aspect of cable. However the cable must carry all "locally broadcast" stations and all "significantly viewed" stations.

Diagram 4

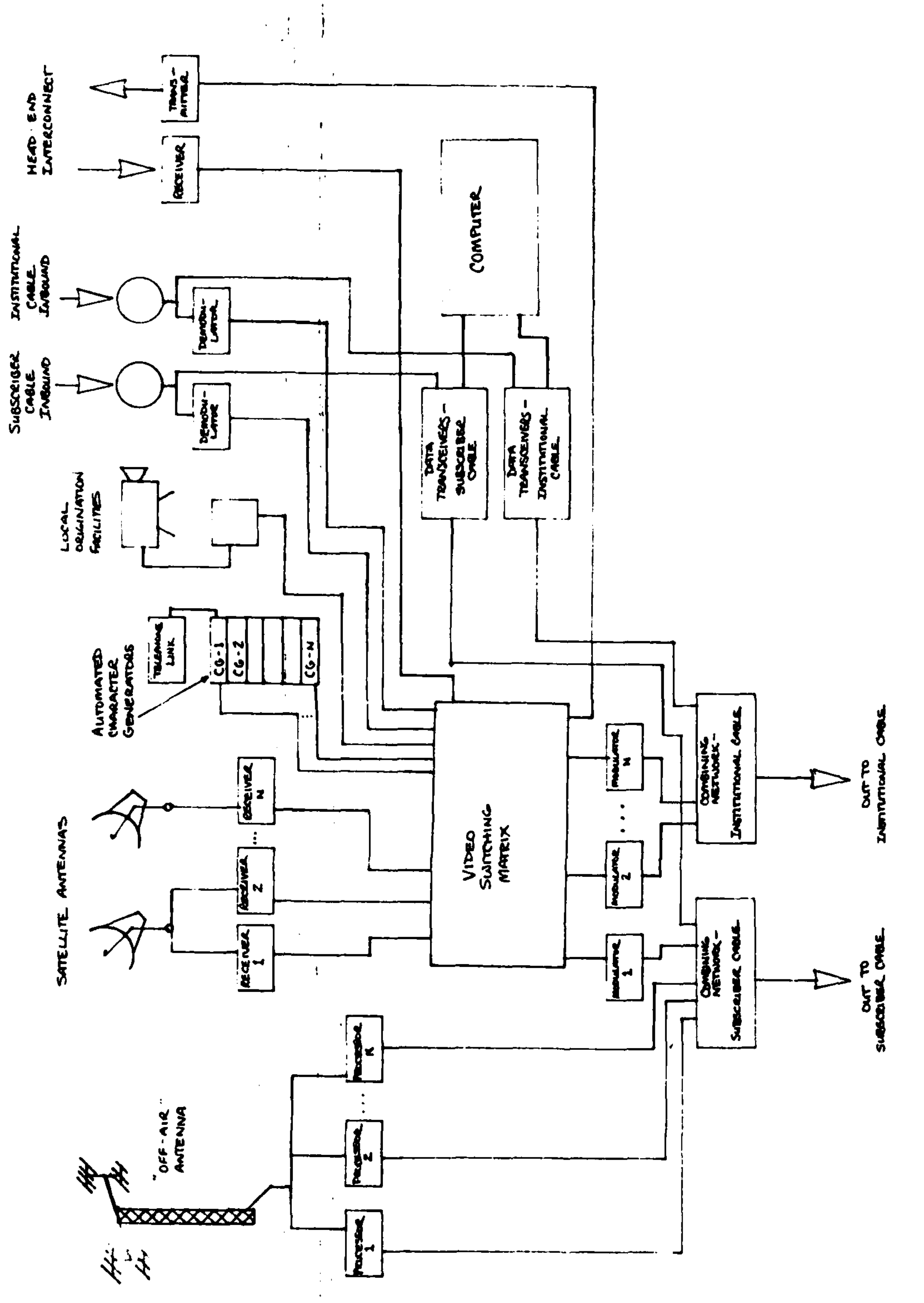


DIAGRAM 4: MODERN CABLE HEADEND

2.1.1.2 Microwave Receiving Equipment

If a cable operator wishes to provide distant television stations he may arrange to have the station transmitted over a microwave relay system by any of the common carrier microwave transmission operations. In addition, many of the cable operations are constructing their own microwave systems to exchange programming. In general a microwave signal can travel only 25 miles before it must be retransmitted.

2.1.1.3 Satellite Receiving Stations

Communication satellites are located in geosynchronous orbits 22,300 miles above the earth. At this altitude, they make one revolution every 24 hours. So they appear to be standing still in relationship to the ground. These satellites are broadcast relay stations containing transponders. The transponders pick up signals beamed at them from an uplink station and retransmit them back to earch to a receiving station often called an earth station, a TVRO CFV receive only) or simply a "dish". The major advantage of the satellite is that from one uplink station you can transmit to the whole United States. Because the signals from the satellite to the earth station are extremely weak a large diameter receiving antenna and sophisticated preamplifiers and receivers are required. When the cable operators first started using satellite the FCC required an antenna 9 meters (30 ft) in diameter. These earth stations cost in excess of $100,000 and only the largest cable systems (ones with 5,000 subscribers or more) could afford such a capital investment. When, in the late 70s, the FCC authorized the use of 4.5 meter (15 feet) antennas the price of an earth station dropped to approximately $8,500. At this price every single cable operator could afford an earth station and the number of subscribers buying TV programming transmitted via satellites jumped from 67,000 in 1974 to 9,000,000 in 1982.

Each satellite is capable of transmitting several TV channels and a single earth station (antenna plus pre-amplifier) is capable of receiving all of them. A receiver and modulator is needed in the headend for each channel to be received. Originally each earth station could only receive signals from one satellite, and several cable operators were installing several earth stations at each headend in order to take advantage of the programming available from several satellites. However new multiple beam antennas allow one antenna to receive signals from several satellites.

2.1.1.4 Automated Channels

The original automated channels were the simple weather and time broadcasts mentioned above. Through the use of character generators these automated channels were rapidly expanded to provide many alphanumeric services such as news, weather, sports, stock quotes, channel listings and community bulletin boards. A character generator is a special computer that accepts input from telephone lines or keyboards and formats the data into alphanumeric information to be displayed on the TV screen. The input to a character generator might come over a leased telephone line from one of the wire services such as The Associated Press or Reuters while the output is connected to a TV modulator. State-of-the-art character generators are capable of storing thousands of pages of information and programming 10 or more channels.

2.1.1.5 FM Radio

Cable systems usually provide local FM stations over the cable as well as special audio programming that is created especially for cable.

2.1.1.6 Local Origination Facilities

Until recently a cable system would install a small studio and control center consisting of a few low cost cameras and perhaps a portable videotape and camera unit (portapak). Such a studio would cost up to $100,000 and be operated on a part-time basis by normal cable system employees. However the major city franchise applicants have promised elaborate local origination facilities costing 1 to 2 million dollars. These studios would contain broadcast quality cameras, videotape and editing equipment, mobile production vans, mobile microwave gear and several portapaks. Some franchisees have promised 50 employees for local program production and operating budgets of several million dollars per year.

2.1.1.7 Switching and Computer Equipment

With many channels to fill, a multitude of program sources and many rules about blacking out certain programs (so as not to injure local broadcast stations) cable operators need to be able to switch almost any program source onto any channel. This requires fairly sophisticated video switching equipment which is now generally computer-controlled.

In addition, as pay per view television becomes more popular, computerized communication equipment is installed in the headend to transmit instructions to the equipment located in each individual subscriber's residence. These instructions allow reception of certain channels only if the subscriber is willing to pay for them.

As two-way cable becomes more popular the headend will become a true computer communications center switching data streams from any source to any destruction and interfacing to the rest of the worldwide communication network.

2.1.1.8 Multiple Headends or Hubs

Due to technological limitations described in the next section, transmission on a cable is limited to approximately five miles. After that distance the quality of the signal degrades to the point of unacceptability. This means that any headend can only serve an area with a radius of five miles. To service large franchises, a single headend is not sufficient. A hub system of multiple headends is used to cover the area. The decision must then be made on whether and how to interconnect the hubs. Several options are available including:

A. Virtual duplication of the entire master headend at each hub including off air antennas, satellite earth stations, etc. Each hub becomes in essence its own cable system. Microwave links are provided to feed certain channels to all of the hubs.

B. Master headend with simple retransmission hubs, all interconnected. The method of interconnection is critical since very little signal degradation is allowed over this path. For small systems, (12 to 30 channels) a simple multichannel microwave system is sufficient. For systems with a larger number of channels, special microwave links called amplitude modulated links (AML's) are required. AML systems deliver high quality pictures but are not reliable in areas of heavy rainfall. The rain attenuates the AML signal rapidly, noticeably degrading the quality of the signal. Other interconnection options include multiple cable "super trunks" that use a frequency modulated transmission technique. The most recent designs use fiber optics to interconnect the hubs.

Interconnection or duplication of headends is determined by cost and reliability. For small systems with less than four hubs it is usually less expensive to simply duplicate master headends. Above four headends an interconnected hub scheme is more economical. However, the interconnection method must be highly reliable and may even require redundant connections run over different physical routes.

2.2 The Distribution Network

As mentioned earlier, one of the essential elements of the cable system is the fact that the signals are broadcast over coaxial cable instead of through space. Coaxial cable is a unique transmission medium whose properties have determined the capabilities of the cable systems.

Coaxial cable consists of single metallic conductor centered within a circular outer shielding conductor. The communication signals travel on the inner conductor while the outer conductor keeps the desired signals in and the undesired signals out. The early cable had a copper inner conductor surrounded by a solid plastic insulator around which a braided copper outer conductor was wrapped. Modern cable has a copper coated aluminum inner conductor while the old braided copper outer conductor has been replaced by solid aluminum tube. The original solid plastic insulation has been replaced by a "gas injected foamed polyethylene" insulation.

The overriding property of coaxial cable is that it attenuates the signals transmitted on it. The attenuation is in proportion to the square root of the frequency. Typically a cable will have an attenuation of 0.5 dB/100 ft. at 55 mHZ. Because the signal is attenuated (reduced) it must be amplified (boosted) periodically along the cable. It is the improvement in the technology of amplification that has allowed for the dramatic increase in channel capability of the cable.

Each TV channel takes up 6 mHZ of space in the electromagnetic spectrum. As shown in Diagram 1, over the air broadcast TV takes place in three places in the spectrum. Channels 2 through 6 are broadcast between 54 and 88 mHZ, channels 7 through 13 are broadcast between 174 and 216 mHZ; while UHF channels 14 through 83 are in the range of 470 to 600 mHZ. The only way to get more channels is to use up more frequencies in the electromagnetic spectrum.

The first cable amplifiers of the early 50's were single channel vacuum tube units. The fact that each amplifier could only handle one channel limited the systems to three to five channels. The next generation (and all subsequent generations) of amplifiers were broadband amplifiers capable of amplifying several channels at once. It is the increase in band width of the amplifiers that has allowed the dramatic increase in channel capacity. Currently available amplifiers can successfully handle frequencies up to 450 mHZ allowing up to 60 television channels.

All amplifiers introduce a certain amount of distortion into the television signal. The greater the level of amplification (or gain) the more distortion is introduced. Amplifiers must be operated in a range of gain where the distortion is neglible. A gain of 20 db (which means that the output signal is ten times larger than the input signal) is the industry standard and allows the amplifiers to operate in a relatively noise and distortion free manner. If the attenuation rate of the cable is roughly 1.0 db per 100 ft. then every 2000 ft. the TV signal will be attenuated by 20 dB and an amplifier will be required to boost the signal to its original level. In fact that is the way modern cable systems are designed, requiring an amplifier approximately every 2000 ft.

Although the amplifiers are operated in a manner to minimize distortion, each amplifier does introduce some signal distortion and noise. As a result there is a limit as to how many amplifiers you can have cascaded together. With modern amplifiers, that limit is approximately 32 amplifiers in a row. With approximately three amplifiers per mile, the maximum cable length is limited to ten miles. In fact, conservative design rules limits the cable length to about five miles.

A modern cable distribution system consists of the parts shown in Diagram 5. Among those part are:

Diagram 5

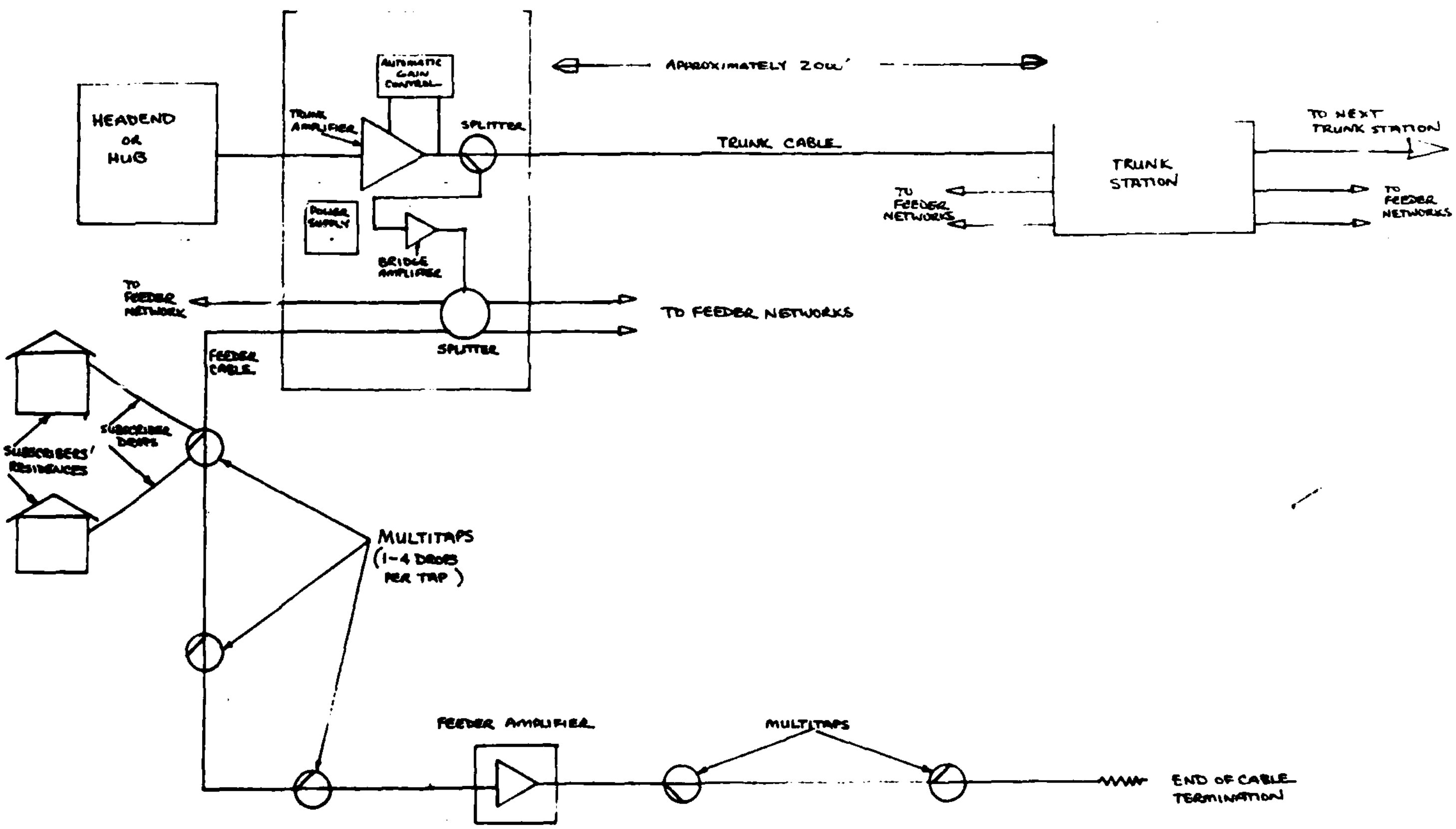


DIAGRAM 5: MODERN CABLE SYSTEM

2.2.1 Trunk Cable

The trunk cable consists of large diameter coaxial cable (3/4 to 1 inch diameter) that leaves the headend or hub and goes through the service area, eventually terminating at the far end of the service area. No subscribers are connected to the trunk; instead bridges amplifiers located along the trunk take signals from the trunk and feed them into the feeder networks. Typically there is one mile of trunk for every three to four miles of feeder cable.

2.2.2 Trunk Amplifiers

Every two thousand feet the TV signal must be amplified by 20 dB as discussed above. These trunk amplifiers are very high quality devices constructed with hybrid electronics technology (a mixture of integrated circuit and discreet components on the same substrate). Because the attenuation of the cable is temperature dependent (plus or minus 2 db per 2000 ft over normal temperature ranges) the amplifiers have an automatic gain control (AGC) module added to them. The AGC adjusts the gain of the amplifier so that the signal strength is maintained at proper levels.

2.2.3 Bridge Amplifiers

To feed the signals into the neighborhoods a bridge amplifier takes a small portion the signal off the trunk and then amplifies it to a level substantially greater than the level on the trunk. This amplified signal is then run through a splitter which divides the signal into four equal parts to supply the feeder lines. Bridge amplifiers usually are the same quality as trunk amplifiers but generally do not have AGC. The bridge amplifiers and splitters are usually located with the trunk amplifiers in a weather proof housing. This housing also contains the power supply. All this equipment together is generally referred to as a trunk station.

2.2.4 Feeder Network

The feeder system is the cable that parallels each street within a neighborhood to which subscribers connect. Feeder cable is usually one half inch in diameter, has higher attenuation than trunk cable but costs substantially less. Feeder lines may have amplifiers on them. These feeder amplifiers are much simpler and less expensive than trunk amplifiers and rarely are cascaded more than two in a row. Because of this the amplifier can run at a higher gain level (generally 30 to 35 db) and still provide acceptable distortion.

2.2.5 Multitaps

A multitap is a device that takes a small portion of the signal off the feeder line and feeds it to the TV sets of subscribers. Multitaps can service two, four or eight subscribers. Multitaps are available with different tap-off values that allow a different percentage of the signal to be tapped off. Close to the bridge amplifier or feeder amplifiers the signal is strong and only a small percentage need be tapped off. Close to the end of the feeder line the signal is quite weak and almost all of it must be used to drive the subscribers TV set.

2.2.6 The Subscriber Drop

Once the TV signal leaves the multitap it enters the drop line which is a small diameter (about 1/4 inch) coaxial cable. The signal then goes through a matching transformer which is in turn attached to the TV set. If the cable system carries more than 12 channels the drop line will generally be connected directly to a device called a converter which in turn is connected to the TV set.

As shown in Diagram 1, the first twelve cable channels are carried on frequencies that are the same as over the air broadcast channels. For a twelve-channel system the cable signal goes directly to the TV set and the tuner in the set selects the channel. For more than twelve channels the additional cable frequencies must be shifted to a frequency the TV set is built to handle. To do this a device called a converter is installed between the cable and the TV set.

There are two basic types of converters, block converters and tuneable converters. Block converters have a two-position switch. In the normal position the TV tuner selects any one of the normal 12 channels. In the mid band position seven different channels appear on channel 7 through 13 of the TV channel selector. Block converters are inexpensive and represent a low cost way of increasing cable capacity from 12 to 19 channels.

A tunable converter shifts all of the cable channels to an unused channel that the TV set can handle (typically channel 2, 3 or 4). All channel selection is done by the converter. With the introduction of microprocessor technology converters have become quite sophisticated, containing clocks and allowing selection of programs in advance.

The major advance in converters has been to make them addressable. A signal can be sent from the headend over the cable to the converter indicating which channels the converter should allow to be displayed. For instance, if a subscriber decides to receive HBO but not Showtime, the headend computer will instruct the addressable converter in that home to pass the channel containing HBO but block the one containing showtime. Addressable converters are new and have been installed in only a few systems. However as programming schedules become more complicated they are one solution.

A more primitive way of blocking certain pay channels is to use a device called a trap. A trap is simply a very precise filter located on the multitap that blocks a specific channel. If a subscriber desires a pay service the trap is removed and the channel can be shown on the set. Traps are very inexpensive ($5.00 to $10.00 each). However, they are expensive to install (you have to send a serviceman out to install or remove the trap). Simple 36-channel converters cost $45.00 while an addressable converter may cost up to $180.00

One of the major problems facing cable operators is the theft of pay television services. Addressable converters and traps are an attempt to solve the piracy problem. Another method that has been tried involves sending out a scrambled signal that requires special equipment to unscramble the signal and make a useful picture. However the cost of the discrambler equipment at the subscriber residence is a major problem. Simple scrambling schemes with inexpensive descrambling equipment can easily be defeated. Complicated and effective scrambling schemes require prohibitively expensive descrambling equipment.

Other methods of providing security for the cable signals involve placing all or part of the converter outside on the utility pole. This scheme has many disadvantages but will prevent theft of valuable programs.

In fact the next big advances in cable systems will come in the subscriber's drop area of the business. As discussed in later sections a more sophisticated subscriber drop than can process information as well as display pictures on the video screen represents the key to realizing much of the potential value of the cable network.

2.2.7 Other Features of Modern Cable Systems

2.2.7.1 Institutional Networks

Most new cable systems being built today have an additional cable network dedicated to general telecommunication users. This system, called an institutional cable or institutional network, is usually an entirely separate trunk cable that passes all the major institutions (public and private) of the community. This cable is usually installed as a two-way cable with the ability to carry an approximately equal number of channels in either direction. For instance a 400 mHZ institutional cable might carry 20 channels in one direction and 30 channels in the other direction. Thus the institutional network is a true bidirectional communications link. In addition, the institutional cable can also be connected into the normal subscriber cable network allowing programming that originates anywhere in the community to be transmitted over normal cable channels. Institutional network channels are usually provided free of charge to government and non-profit agencies as part of the franchising consideration.

2.2.7.2 Dual Cable

A number of cable franchises have been granted to companies proposing dual cable. This is simply a duplicate cable system, one cable constructed alongside of the other. Each piece of the system is duplicated, including the headend, trunk and feeder systems right down to a switch by the subscriber's TV set that selects the desired cable. The rationale behind dual cable systems is that they achieve twice the channel capacity at only a 50% increase in the cost.

2.3 Future Technologies of Cable

The cable systems currently being installed represent a high degree of technical maturity. The driving force behind the technology was the need (or desire) to increase the channel carrying capacity of the cable first from 3 to 5, then 12, then 35, 60 and, with dual cable, 120. This driving force is now gone because cable operators have found that they cannot economically fill up a 35 channel cable system. The economic assumptions behind the high channel capacity was that the subscribers would buy a considerable ($30 to $50 per month) amount of pay television services. Generally these assumptions have not been met. In addition, most of the major cities in the United States have already sold their franchise rights and few major markets remain to be wired. The above considerations indicate that for the most part cable technology has probably reached its economic limit.

What will evolve in the future are new services to fill up the channels available on the cable. Among these are:

2.3.1 Two-way Cable

The cable is intrinsically two way. The repeater amplifiers though are generally one way. However, by adding a second amplifier that amplifies signals going in the other direction, and by splitting the frequency spectrum into upstream and downstream bands, two way communications over the cable can be achieved. In addition, diplexing filters must be added to route the downstream frequency bands to the downstream amplifier and the upstream bands to the upstream amplifiers. A typical two way trunk amplifier is shown in Diagram 6.

Generally the frequency band from 5 to 36 mHZ is used for upstream communication while the spectrum from 50 to 450 mHZ is used for downstream transmission. Obviously the normal subscriber cable is heavily weighted in favor of downstream television broadcast type activities.

The major problem with two way cable is signal ingress, the leaking of over the air radio signals into the cable. The upstream frequency spectrum is in a frequency range where there are many fairly powerful CB, amateur shortwave, and government over the air transmitters. However, with proper cable system design, installation and maintenance, these problems can be solved.

Diagram 6

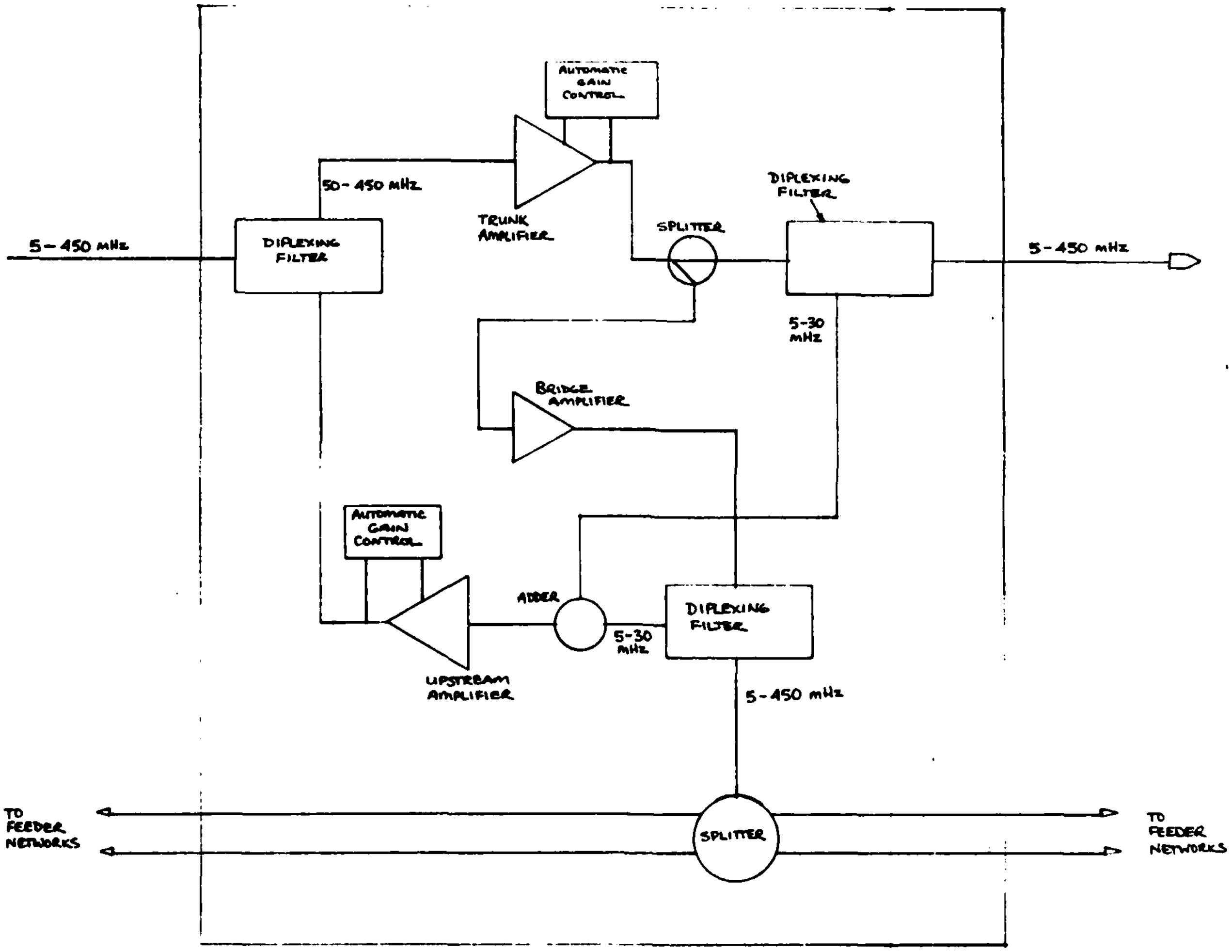


DIAGRAM 6: TWO-WAY CABLE TRUNK AMPLIFIER STATION

All cable systems will most likely become two way systems eventually. The major change over is the requirement for a second amplifier and diplexing filters at each feeder and trunk amplifier station. Generally the current amplifier enclosures have space for these components so that the change over to two way cable is not a massive investment. Two way cable systems have been in use since the early seventies. The largest two way system is the Qube system that is being installed in most of Warren Amex cable systems now under construction.

The major difference in two way systems is the equipment found in a subscribers home. Diagram 7 shows how a home terminal might operate and gives an idea of some of the services that two way cable might provide in the home. Among these are:

2.3.1.1 Utility Load Control and Meter Reading

Electric utilities have a strong economic incentive to be able to turn off certain major electrical loads during peak usage hours. Peak electricity is very expensive for utilities to generate and in some cases just not available. The ability to read meters remotely is also a major economic incentive to installing this kind of equipment.

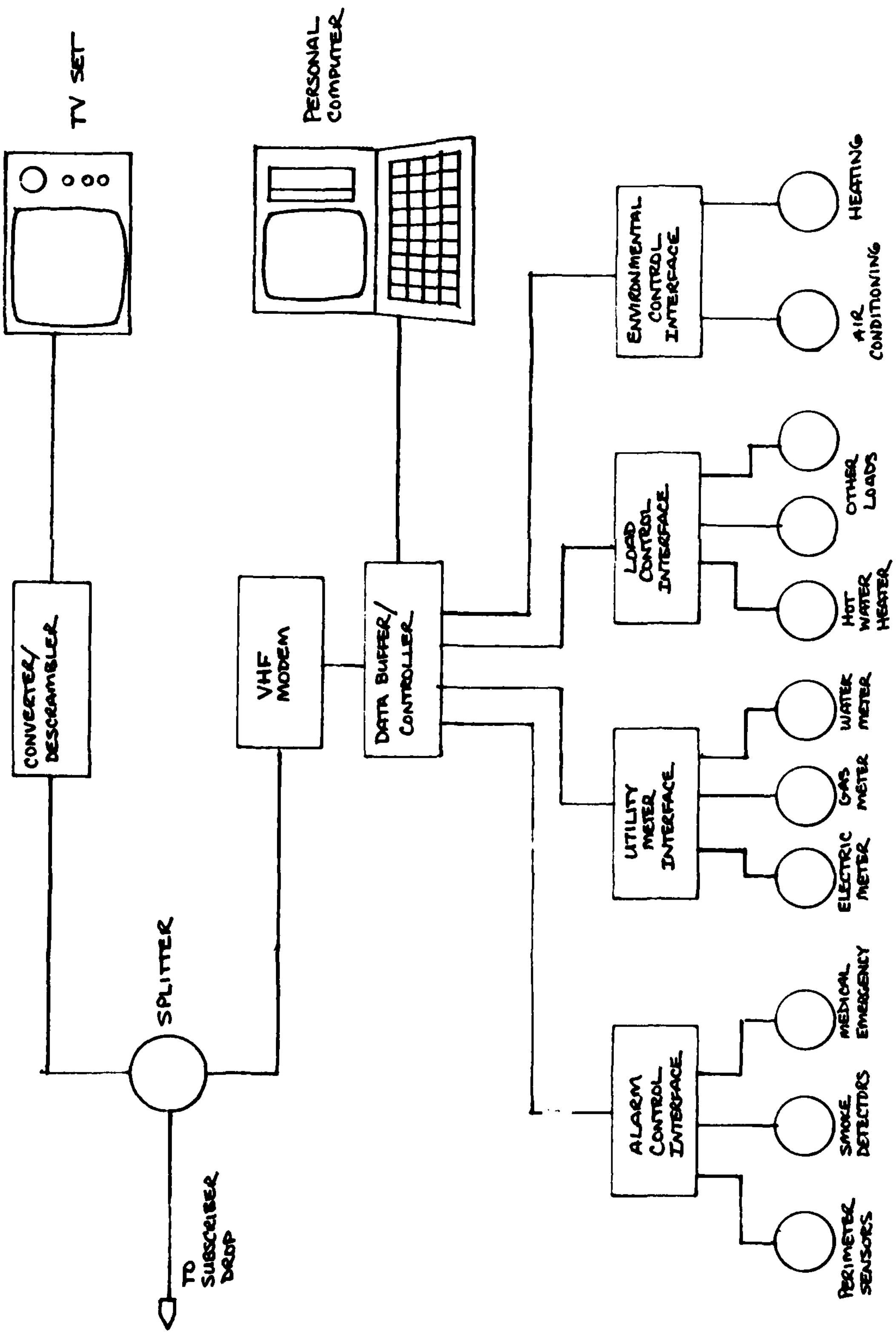


DIAGRAM 7: TWO-WAY CABLE SUBSCRIBER EQUIPMENT

2.3.1.2 Home Security Services

The home security business has significant potential for the cable industry. In fact as of 1981 over 15 cable operators were offering security services over the cable. Basically the cable replaces the telephone lines as the means of monitoring the home. One of the major drawbacks of monitoring over the cable is the unreliability of the cable networks themselves. Most cable security systems include a redundant telephone link to overcome this problem.

2.3.1.3 Videotext

With two-way videotext a subscriber can access hundreds of thousands of pages of information. Some headend computers will be interconnected into major computer data bases giving the subscriber access to millions of pages of information. This information may range from actual newspapers to airline schedules to prices at the local store.

2.3.1.4 Shop at Home, Electronic Funds Transfer, Home Computers

The "electronic cottage" represents a vision of the future. The homeowner would be able to examine almost any article over the video screen then indicate he/she wishes to purchase it from a small terminal next to the screen. The purchase transaction would be recorded electronically, deducting the money from his/her "electronic funds transfer" account at the bank and crediting the store. With a powerful household computer and a broadband communications link (i.e., the cable), many jobs could be performed at home instead of requiring the person to commute to a central location. The inherent limits to what can be done electronically are few. The key ingredient is a high capacity communications link. Current video cable systems approaches the high capacity data link necessary to implement significant pieces of the "electronic cottage". However, the cable has signficant drawbacks, principally its tree-structured network (see Diagram 2) approach. This makes the cable in essence one big party line. The signals are available to everyone. This network structure both limits the number of transactions that can take place at any one time as well as raises large problems of security of data.

The other major question behind all the services to be offered over the cable is the economic one. Many participants have to be involved to make the electronic services a reality. Banks, stores, utilities, etc., all need to be brought together at one time to create the services. This is a very difficult task.

2.3.2 Direct Broadcast Satellite (DBS)

This is not really a cable service but another extension of the cable concept. If several thousand cable operators can have $8500 earth stations to receive satellite broadcast programming, why not improve the technology, reduce the cost and broadcast directly to the subscriber. In fact the technology has improved to the point where a 3 to 5 ft "disk" antenna, roof top mounted, will be sufficient to receive the transmissions of the new satellites. Several manufacturers of communication hardware are introducing DBS receiving equipment and the first DBS satellite (a Canadian satellite to be used by United Satellite Communications, Inc.) is scheduled for launch in June. Using coaxial cable as a transmission medium is only feasible in areas in which there is a minimum density of potential subscribers. This restriction means that cable will only be available to 80 percent of the population of the United States. DBS may also be competitive with cable in some less-populated areas served by small cable systems. DBS should grow rapidly since the concepts of pay TV have already been proven by conventional cable.

2.4 Potential FEMA Uses of CATV

This section of the report will define the FEMA communications mission as it applies to typical emergency scenarios, generate a matrix analysis of the common characteristics of FEMA communications requirements and compare FEMA communications requirements to CATV system capabilities.

2.4.1 Definition of FEMA Communications Mission

The FEMA communications mission can be defined as the promulgation of information necessary for citizens and public service agencies to cope with and remedy emergency situations. This general definition can be made more specific by considering the types of emergencies for which FEMA provides information, the geographical extent of the emergencies, the duration of the emergencies, and the types of information required to cope with and remedy the emergencies.

2.4.1.1 Types of Emergencies

The types of emergencies for which FEMA provides information span a very broad range, including:

- Natural Disasters - floods, droughts, forest fires, earthquakes, insect infestation, severe heat or cold waves, tornadoes and hurricanes.

- Industrial Accidents - chemical, biochemical, and nuclear.

- Urban Disasters - situations, such as large-area fires, which are neither industrial accidents or natural disasters, which disrupt the lives of a large number of people.

- War or Threat of War - conventional and nuclear.

2.4.1.2 Geographical Extent of Emergencies

Generally speaking, an emergency situation will be either local, regional or national in scope. These geographical distinctions, however, must also take into account administrative factors which will impact how a particular emergency is handled. For example, federal disaster area declarations are issued by state, and thus a regional emergency, or even a local emergency in some major metropolitan areas, could impact more than one state. A local emergency could be located in a single densely-populated city or in a sparsely populated location of small towns and unincorporated areas. FEMA communications systems must have both the appropriate geographical coverage and the ability to interface with local and state government agencies.

2.4.1.3 Duration of the Emergencies

The FEMA emergency communications system must also take into account the duration of emergencies. At one end of the duration spectrum is the basic emergency warning to evacuate an area (in the case of a chemical spill or nuclear plant accident) or take immediate shelter (in the case of a tornado or enemy attack). In the middle of the duration spectrum are warnings which allow for some time for response and which require the citizen to take more concerted action. An example of this might be the evacuation of a low-lying coastal area in the face of an approaching hurricane; citizens would be instructed to gather emergency food and clothing and proceed, by designated routes, to temporary relocation centers. At the long-range end of the duration spectrum is the information required by local governments and citizens to rebuild after an emergency which has caused extensive property damage. This information might be required for a period of a few weeks or as long as 18 months from the occurrence of the emergency.

2.4.1.4 Types of Information Required

The range of emergencies for which the FEMA emergency communications system provides information requires two broad types of information: action messages and educational messages.

2.4.1.4.1 Action Messages

Action messages are those designed to prompt a specific action or set of actions. Examples of action messages are:

- Immediate Warning Signals - sirens, klaxons, television and radio spots.
- Planned Evacuation Messages - instructions about where to go, how to get there, and what to bring in the event of various types of emergencies.
- Long-term Assistance Messages - instructions about how to use federal, state, local and private agency services to facilitate repair and rebuilding after extensive property damage.

Depending on the type of emergency to be dealt with, messages must be either delivered instantaneously, through every available media or repeated for varying periods of times on media which citizens have ready (though not necessarily instantaneous) access to and knowledge of.

2.4.1.4.2 Educational Messages

Educational messages are those which are designed to prepare citizens and/or service agencies to respond to emergency situations which may arise in the future. Examples of education messages are:

- Access Messages - saturation advertising or promotional messages which teach citizens where action messages may be found in the event of emergencies.

- Common Emergencies Preparations - repeated instructions which teach citizens to take appropriate action in the face of commonly occuring emergencies - e.g., tornadoes in Kansas.

- Long-term Training - courses of instruction for volunteer or professional service agencies to teach them how to provide effective services in various emergency situations.

2.4.2 Matrix Analysis of FEMA Communications Requirements

The FEMA communications mission defined above can be rendered as a matrix analysis in which the types of emergencies FEMA deals with are compared with the characteristics of the communications requirements of those emergencies. From this analysis, a weighted value for each of the requirements can be devised.

COMMUNICATIONS CHARACTERISTICS

EMERGENCIES	Local Interface	Regional Interface	Short Duration	Medium Duration	Long Duration	Immediate Warning	Planned Evacuation	Long Term Assistance	Instantaneous	Repeated	Access Messages	Preparation Messages	Long Term Training	Local Coverage	Regional Coverage	National Coverage
Flood	X	X		X	X		X	X		X	X	X	X	X	X	
Drought	X	X			X			X		X	X	X	X		X	
F. Fire	X		X	X		X	X	X	X	X	X	X	X	X		
Earthquake	X	X	X	X	X	X		X	X	X	X	X	X	X	X	
Insect		X			X			X		X			X		X	
Temperature	X	X		X						X	X		X		X	
Tornado	X	X	X		X	X		X	X	X	X	X	X	X	X	
Chemical	X		X		X	X	X	X	X	X	X		X	X		
Biochemical	X		X	X	X	X	X		X	X	X		X	X		
Nuclear	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Urban Fires	X		X		X	X		X	X	X	X		X	X		
Other Urban																
Conventional War	X	X			X			X		X	X	X	X			X
Nuclear War	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TOTALS	13	9	8	7	10	8	6	11	7	13	11	7	13	9	8	2

The FEMA communications requirements characteristics, in order of importance in the matrix analysis, are as follows:

Occurrence	Characteristics
13	Local Interface
	Repeated Messages
	Training
11	Long-term Assistance Messages
	Access Messages
10	Long Duration Remedies
9	Local Coverage
	Regional Interface
8	Regional Coverage
	Short Duration
	Regional Interface
7	Medium Duration
	Instanteous Messages
	Common Emergencies Preparations
6	Planned Evacuation
2	National Coverage

2.4.3 CATV Capabilities

The capabilities of the CATV systems make a rather nice fit with the highest priority communications needs of FEMA, as identified in the matrix displayed above. There appear to be no technical problems which would prevent FEMA from making widespread use of CATV systems in the immediate future. The questions that confront FEMA are those of the appropriate choice of access routes to the CATV systems, the problem of channel access on small CATV systems, and the costs FEMA use of CATV. These questions are considered in detail below.

2.4.3.1 FEMA Access Routes to CATV Systems

The problem of FEMA access routes to CATV systems results from the fact that CATV system boundaries are political and to some extent arbitrary, and will rarely match the boundaries of any emergency with which the FEMA communications system is dealing. The access problem thus is the problem of simultaneous multi-system access. The choices available to FEMA are four, three of which are currently available and another which will be available in several years.

2.4.3.1.1 "Bicycle" Tapes

The simplest system for accessing multiple CATV systems is to send each system a videotape (known as bicycling) and ask or require the system to air the tape. This method may be suitable for a variety of high-priority FEMA messages, including training, long and medium duration assistance, and regular access messages. It is interesting to note that Home Box Office initially "bicycled" movie tapes to CATV systems. The cost of the tapes, however, seems to be significantly greater than the cost of alternative access routes.

2.4.3.1.2 Microwave Links

The second route for FEMA access to CATV systems is via microwave links. This system would seem to be most useful in dealing with emergencies that are confined to a relatively small geographic region. FEMA access would be either through a microwave common carrier or through local microwave "interconnects" which now link different CATV systems in some parts of the country. While cheaper than the tape circulation route, microwave access will probably involve a lot of management work on the part of FEMA, to make sure that the messages are properly distributed through a system made up of thousands of individual microwave links.

2.4.3.1.3 Satellite Transponder

By far the most flexible of the access routes currently available to FEMA is the use of satellite transponders. The use of these transponders merely involves FEMA transmitting its messages from their production site to the satellite up-link by microwave. Once the message is beamed to the satellite, all CATV systems in the country have instantaneous access to the message, and can tape it, air it immediately, or both. The problem with using this access route is that it is not clear that there are any transponders currently available on satellites, though that situation will soon be remedied by the private marketplace. As an interim measure, FEMA might consider piggy-backing its messages on the same service which currently airs the sessions of the U. S. Congress (C-span).

2.4.3.1.4 Direct Broadcast Satellite

The fourth route for FEMA access to multiple CATV systems is DBS or Direct Broadcast Satellite. This system does not currently exist, but is expected to be initiated starting this summer. DBS offers the same flexibility as the current system of satellite transponders, but unlike the transponders, DBS will not be limited to the 80 percent of households which will be served by CATV systems by 1990. DBS is available to anyone, in any region of the country, who is willing to spend the estimated $300-500 required to rig a satellite antenna on his/her home.

2.4.3.2 FEMA Access to CATV Channels

The problem of getting access to a CATV channel seems to be harder to solve than the problem of getting the FEMA messages to the CATV systems. Channel access is restricted by the lack of available extra channels on many of the nation's CATV systems. As of April 1981, more than 50 percent of the total of U.S. CATV subscribers were served by systems having twelve channels or less. Typically, these systems carry only the required local channels and one or two very popular pay services, such as Home Box Office. Getting these systems to carry FEMA messages thus will involve either a change in FCC rules relaxing the requirements for local "must carry" stations, or pre-empting a pay channel, which is probably very profitable to the system owner. Of the two choices, a change in FCC regulations is probably much more palatable to the system owners. Such a change could be incorporated in the pending federal legislation on CATV systems.

2.4.4 Model System for FEMA Use of CATV

A model system for FEMA use of CATV systems would be relatively simple, both conceptually and operationally. It would consist of production facilities, a distribution system and a feedback system. These elements are discussed below.

2.4.4.1 Production Facilities

The first element of the model system is a production facility, or studio, in which FEMA will make the messages it sends across the country. The studio can be as rudimentary as a single teletype machine, on which a FEMA staffer can generate printed messages, which when fed to Automatic Character Generators at CATV headend facilities, will produce written messages which "crawl" across the television screen. Or, the studio can be a fully-equipped television studio with state of the art cameras, editing equipment and computerized image-generating machines.

Some consideration should also be given to the question of whether the FEMA studio should be a single facility located in Washington, D.C., or whether the studio should in fact be a series of studios located in the FEMA regional offices. The advantage of the Washington location is that FEMA could, in one facility, have the best equipment and access to all kinds of experts and government officials who would be concerned with a particular emergency. The local Congressman, for example, might be brought to the FEMA Washington studio on short notice to participate in a program informing local citizens of FEMA programs to relieve the emergency. The option of regional studios would facilitate the involvement of local officials and experts in the emergency-relief communications program. A third option would be to have a Washington studio and one or more mobile studios--vans equipped with video production equipment which could be airlifted or driven to the site of an emergency. If FEMA used a satellite transponder access system, the mobile production facilities could form the basis of a two-way communications system. Teleconferences between Washington and local experts could be easily arranged or preliminary damage assessment could be performed by Washington staff without leaving their offices, by simply review incoming data produced in the field and beamed back to headquarters via satellite.

2.4.4.2 Distribution System

The distribution system for the FEMA materials would be based on one or more of the CATV access routes discussed in section above. Several FEMA staffers would become knowledgeable in the mechanics of the chosen access routes, so that a precisely-tuned distribution system could be made available on short notice in the event of an emergency. For example, let us consider a distribution system that could have been used to address the problems created by the recent Mississippi River flooding which affected several states. A FEMA staffer would receive preliminary reports of the extent of the flood damage, and would compare these reports to his/her CATV system map, generating a computerized listing of the CATV systems serving the affected areas. The CATV systems would be informed by an automatic message that a special program addressing flood relief would be available at 6 pm that evening. At 6 pm, a crawler message would appear on every operating television screen in the affected areas, telling viewers to turn to the designated emergency channel to receive the special program. The program would then begin with a short statement from the President, expressing concern and introducing the scope of federal relief services. Then FEMA staffers could take over, explaining what federal services would be available, where, when, etc. Local CATV systems would tape the program for periodic rebroadcast throughout the next few days. Another program might be addressed specifically to local, mayors, telling them about the federal programs and how municipalities would interface. A third program might be prepared for local health officials, addressing their concerns. All of this could be done from the FEMA headquarters in Washington, with the FEMA staff experts only having to walk down the hall to address their target audiences.

2.4.4.3 Feedback System

The final element in the FEMA CATV communications loop is a feedback system, which collects user or audience responses to FEMA informational programming and periodically feeds this information back to FEMA so that programming can be fine-tuned to audience needs. One of the significant things to note about the use of CATV through an access route like a satellite transponder is that FEMA has very little sunk cost in a particular program. Current communications limitations would dictate that FEMA would make, for example, a film about federal emergency relief services and their availability. The film would be relatively expensive to produce, very expensive to distribute, and prohibitively expensive to change after it had been distributed. In contrast, the program format described above involves very little "up-front" cost, modest distribution costs. Changing the format or content is as simple as getting all the participating FEMA staffers together, talking the program through, and deciding to emphasize different things the next time around.

3.0 CATV COSTS

3.1 Overview of CATV Costs and Revenues

The economics of CATV, like the technology of the industry, are in transition. The economic viability of many aspects of CATV - pay entertainment networks, non-entertainment communications services, even the basic system in some new franchise areas - is uncertain today.

The economics of CATV systems are fairly simple. The systems - cable, head-end facilities, repeater amplifiers, and user-end tuner/decoder devices - are installed by system operators on a speculative basis, that is, in anticipation of future revenues. Once a system, or, in most cases, a portion of the system, is constructed, the operator begins to sell services to customers. The operator must sell enough services to cover the carrying costs of system capital investment and produce a profit.

Historically, CATV systems have been profitable. This historical profitability, however, is somewhat misleading as a predictor of future profitability. As was described in Section 1.1 above, early CATV systems were located in smaller communities and were quite modest by today's standards. Most offered only 12 channels at a monthly cost of less than $5. They were profitable in terms of return on investment because they required modest capital investments and generated a substantial cash flow.

As CATV systems proliferated, from smaller communities with poor television reception to larger communities, system construction costs escalated, interest rates escalated, and the pressure to generate additional revenues consequently increased. The CATV industry expanded in scope from the basic community antenna concept to a very sophisticated entertainment industry. Specialized "networks" were organized by major national corporations - movie companies, publishers, broadcast television networks - to develop and/or purchase programming for distribution to CATV systems.

The apparent profitability of the industry encouraged the major national cable system operators (known as MSOs or Multi System Operators), and many locally-organized companies, to bid on major metropolitan cable franchises that became available in the late 1970s and early 1980s. This bidding process, typically supervised by local municipal governments or a specially-appointed local CATV commission, rapidly became a game of one-upsmanship. In attempting to win franchises, potential CATV system operators offered increasingly attractive services (more channels, free public and community institution access) at increasingly lower rates. This more-for-less trend was not justified by any increased productivity in the basic CATV service. On the contrary, it is generally much more expensive to build a metropolitan area CATV system. Rather, the basic service was increasingly viewed as a foot-in-the-door, which would allow the CATV system operator an opportunity to peddle, on an exclusive basis, various pay-TV entertainment networks and advanced communications services.

This franchise competition, and its accompanying speculative economics, perhaps reached its zenith in Boston, Massachusetts, which awarded its franchise in the spring of 1982. The winning bidder, Continental Cablevision, offered a 104-channel system, with widespread access for Boston citizens and the city's many non-profit institutions. The basic charge, for about 50 channels of programming, will be $2.00. The economic projections of Continental Cablevision foresee an average per-customer monthly revenue of about $35. Thus, Continental feels that its average customer will purchase more than $30/month in pay-TV services. This extraordinary revenue projection was made for a customer base which has a median annual income of less than $15,000, in a city which already has perhaps the most diverse broadcast television availability in the country, and in which two of the three existing pay services (currently using scrambled microwaves) were forced to merge recently for lack of revenues!

Many MSOs are reluctant to absorb the economic risk that Continental has taken in Boston. Over and above the Boston system economics, CATV systems are now subject to fierce competition, from telephone companies, low-power television systems, electric utilities, and others, for shares of the new revenues on which the speculative projections are based. Additionally, the exclusivity and renewability of cable franchises is currently being challenged in a series of federal court cases involving both freedom-of-speech and antitrust principles. All in all, CATV does not seem to be nearly as secure and profitable a business as it once was.

But the Boston CATV situation may offer FEMA an opportunity where there is clearly a need for FEMA communications. In the past five years, the Boston area has encountered virtually every form of emergency FEMA services:

- A winter storm which paralyzed the city for a week;
- A hurricane threat;
- Major coastal flooding which damaged about 10,000 homes;
- A chemical tank car leak which caused the evacuation of several thousand people and the closing of the major highway saving northern Boston suburbs;
- Two urban fires which destroyed 10 and 20 blocks respectively;
- A series of scares about genetic engineering company accidental discharges;
- The largest fine ever levied for a nuclear plant safety violation; and,
- The complete refusal of a municipal government to even consider the implementation of a FEMA nuclear war evacuation plan.

In each of these incidents, there was no comprehensive or reasoned analysis and action plan available to the majority of Boston citizens. Local television and radio news was restricted and largely sensationalized, as is normal. A FEMA communications service could have provided invaluable services to the community. This service would be welcomed by CATV system operators if FEMA paid even a modest amount for system access. Alternatively, such emergency access could be mandated by federal law in exchange for certain franchise protection concessions CATV system operators currently seek from Congress.

3.2 Typical Cable System Costs and Revenues

The following pages present financial analyses for two typical new CATV projects. These analyses were selected because they represent the reasonable state of the art in CATV systems, with two different ownership structures. The word reasonable is used to differentiate these projections from those used for the larger new metropolitan CATV systems, which can best be categorized as speculative, because they are premised on revenue streams larger than the average or projected revenues of existing systems.

3.2.1 Entertainment-based System

The first set of projections was produced by Cable Communications Consultants, Inc., of Falls Church, Virginia. It represents the financial analyses for a CATV system in suburban New Jersey which is to supply entertainment only to its subscribers. Note that the operation of this system does not generate a cash profit until the fifth year (Schedule A), and that pay-TV revenues per house range from \$11 per month in the first year to \$14 per month in the tenth year (Schedule C). Cable Communications believes that CATV systems such as this can be easily financed through a combination of equity investments, limited partnerships and bank debt.

Schedule A

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PRO FORMA INCOME - CASH FLOW STATEMENT

($000)	Pre-Operating	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
INCOME STATEMENT									
Revenues	-	$643	$1,495	$2,081	$2,373	$2,460	$2,793	$2,867	$2,911
Operating Expenses	161	623	863	1,113	1,229	1,311	1,419	1,473	1,509
Operating Cash Flow	(161)	20	632	968	1,114	1,149	1,374	1,394	1,402
Management Fees	(25)	(50)	(86)	(119)	(136)	(141)	(161)	(166)	(168)
Interest	(225)	(450)	(450)	(431)	(375)	(300)	(225)	(150)	(55)
Depreciation	-	(319)	(537)	(615)	(664)	(689)	(260)	(184)	(109)
Taxable Income (Loss)	(411)	(799)	(441)	(197)	(31)	19	728	894	1,070
CASH FLOW STATEMENT									
Add:									
Equity	300	300	300	300	-	-	-	-	-
Debt	3,000	-	-	-	-	-	-	-	-
Depreciation	-	319	537	615	664	689	260	184	109
	2,889	(180)	396	718	633	708	988	1,078	1,179
Deduct:									
Capital Expenditures	(535)	(1,709)	(476)	(481)	(146)	(132)	(87)	(104)	(108)
Closing Costs	(100)	-	-	-	-	-	-	-	-
Debt Retirement	-	-	-	(250)	(500)	(500)	(500)	(500)	(750)
Net Annual Cash	2,254	(1,889)	(80)	(13)	(13)	76	401	474	321
Cumulative Cash	2,254	365	285	262	259	335	736	1,210	1,531

SCHEDULE B

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PROJECTED HOMES PASSED AND SUBSCRIBER GROWTH

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Homes Passed (Residential)										
Aerial:										
Beginning	-0-	9,150	9,150	9,150	9,150	9,150	9,150	9,150	9,150	9,150
Added	9,150	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Ending	9,150	9,150	9,150	9,150	9,150	9,150	9,150	9,150	9,150	9,150
Underground:										
Beginning	-0-	1,350	1,450	1,550	1,650	1,750	1,750	1,750	1,750	1,750
Added	1,350	100	100	100	100	-0-	-0-	-0-	-0-	-0-
Ending	1,350	1,450	1,550	1,650	1,750	1,750	1,750	1,750	1,750	1,750
Total Residential Units	10,500	10,600	10,700	10,800	10,900	10,900	10,900	10,900	10,900	10,900
Homes Passed (Retirement-U.G.)										
Beginning	-0-	-0-	2,400	4,800	4,800	4,800	4,800	4,800	4,800	4,800
Added	-0-	2,400	2,400	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Ending	-0-	2,400	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800
Total Units Passed	10,500	13,000	15,500	15,600	15,700	15,700	15,700	15,700	15,700	15,700
Subscribers										
Residential Units										
Beginning	-0-	5,250	5,825	6,405	6,570	6,735	6,850	6,960	7,065	7,065
Added - Yr.1 Construct.	5,250(50%)	525(5%)	525(5%)	105(1%)	105 (1%)	105(1%)	105 (1%)	105 (1%)	-0-	-0-
Yr.2 "	-0-	50	5	5	-0-	-0-	-0-	-0-	-0-	-0-
Yr.3 "	-0-	-0-	50	5	5	-0-	-0-	-0-	-0-	-0-
Yr.4 "	-0-	-0-	-0-	50	5	5	-0-	-0-	-0-	-0-
Yr.5 "	-0-	-0-	-0-	-0-	50	5	5	-0-	-0-	-0-
	5,250	5,825	6,405	6,570	6,735	6,850	6,960	7,065	7,065	7,065
Retirement Units:										
Beginning	-0-	-0-	960	2,040	2,230	2,350	2,425	2,475	2,525	2,575
Added - Yr.2 Construct.	-0-	960(40%)	120(5%)	70 (3%)	50 (2%)	25 (1%)	25 (1%)	25 (1%)	25(1%)	25 (1%)
Yr.3 "	-0-	-0-	960	120	70	50	25	25	25	25
	-0-	960	2,040	2,230	2,350	2,425	2,475	2,525	2,575	2,625
Total Subscribers Ending	5,250	6,785	8,445	8,800	9,085	9,275	9,435	9,590	9,640	9,690
Revenue Units	2,625	6,020	7,615	8,620	8,940	9,180	9,355	9,510	9,615	9,665

SCHEDULE C

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PROJECTED SUBSCRIBER REVENUES

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Basic Subscribers										
Revenue Units	2,625	6,020	7,615	8,620	8,940	9,180	9,355	9,510	9,615	9,665
Additional Outlets (30%)	785	1,805	2,285	2,585	2,680	2,755	2,805	2,855	2,885	2,900
FM Supersound (15%)	395	905	1,140	1,295	1,340	1,375	1,405	1,425	1,440	1,450
Converter Option (40% of Outlets)	1,365	3,130	3,960	4,480	4,650	4,775	4,865	4,945	5,000	5,025
Revenues										
Basic @ $7.25	228,375	523,740								
@ $7.75			708,195	801,660	831,420					
@ $8.50						936,360	954,210	970,020		
@ $9.00									1038,420	1043,820
Additional Outlets @ $2.50	23,550	54,150								
@ $3.00			82,260	93,060	96,480					
@ $3.50						115,710	117,810	119,910		
@ $3.75									129,825	130,500
Total Basic Revenues	251,925	577,890	790,455	894,720	927,900	1052,070	1072,020	1089,930	1168,245	1174,320
Pay - TV Revenues (Sch.D)	343,860	790,620	1096,284	1240,860	1285,560	1438,020	1467,720	1488,300	1626,060	1637,640
FM @ $ .50	2,370	5,430								
@ $1.00			13,680	15,540	16,080					
@ $2.00						33,000	33,720	34,200		
@ $2.50									43,200	43,500
Converter Option @ $2.00	32,760	75,120								
@ $2.50			118,800	134,400	139,500					
@ $3.00						171,900	175,140	178,020		
@ $3.50									210,000	211,050
Installation/Reconnection	12,600	28,900	39,500	44,700	46,400	52,600	53,600	54,500	58,400	58,700
Advertising (net of expenses)	-0-	18,000	22,800	43,100	44,700	45,900	65,500	66,600	67,300	67,700
Total Revenues	643,515	1495,960	2081,519	2373,320	2460,140	2793,490	2867,700	2911,550	3173,205	3192,910

SCHEDULE D

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PAY TV REVENUES

Packages	%	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Revenue
A Maxi (1)	25%	655	1505	1905	2155	2235	2295	2340	2380	2405	2415	
B Maxis (2)	20%	525	1205	1525	1725	1790	1835	1870	1900	1925	1935	
C Maxis (3)	5%	130	300	380	430	445	460	470	475	480	485	
D Sports	5%	130	300	380	430	445	460	470	475	480	485	
E Maxi (1)/Sports	15%	395	905	1142	1295	1340	1375	1405	1425	1440	1450	
F Maxi (2) Sports	5%	130	300	380	430	445	460	470	475	480	485	
G Maxi (3) Sports	5%	130	300	380	430	445	460	470	475	480	485	
Revenues												
A. @ $8.00		62,880	144,480									
@ $9.00				205,740	232,740	241,380						
@ $10.00							275,400	280,800	285,600			
@ $11.00										317,460	318,780	2,365,260
B. @ $15.00		94,500	216,900									
@ $16.00				292,800	331,200	343,680						
@ $17.00							374,340	381,480	387,600			
@ $18.00										415,800	417,960	3,256,260
C. @ $22.00		34,320	79,200									
@ $23.00				104,880	118,680	122,820						
@ $24.00							132,480	135,360	136,800			
@ $25.00										144,000	145,500	1,154,040
D. @ $6.00		9,360	21,600									
@ $7.00				31,920	36,120	37,380						
@ $8.00							44,160	45,120	45,600			
@ $9.00										51,840	52,380	375,480
E. @ $14.00		66,360	152,040									
@ $16.00				219,264	248,640	257,280						
@ $18.00							297,000	303,480	307,800			
@ $20.00										345,600	348,000	2,545,464
F. @ $21.00		32,760	75,600									
@ $23.00				104,880	118,680	122,820						
@ $25.00							138,000	141,000	142,500			
@ $27.00										155,520	157,140	1,188,900
G. @ $28.00		43,680	100,800									
@ $30.00				136,800	154,800	160,200						
@ $32.00							176,640	180,480	182,400			
@ $34.00										195,840	197,880	1,529,520
Total Pay-TV Rev.		343,860	790,620	1096,284	1240,860	1285,560	1438,020	1467,720	1488,300	1626,060	1637,640	12,414,924

SCHEDULE E

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PROJECTED OPERATING EXPENSES

	PRE-OPEN	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Advertising/Promotion	10,000	104,500	37,600	39,900	23,900	22,100	19,800	19,000	19,300	16,400	16,400
Billing & Postage	-0-	15,800	36,100	45,700	51,700	53,600	64,300	65,500	66,600	67,300	67,700
Bookkeeping	600	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000	2,100
Copyright Fees	-0-	5,000	11,600	15,800	17,900	18,600	21,000	21,400	21,800	23,400	23,500
Dues,Subs,Pubs.,Contr.	-0-	500	500	600	600	700	700	800	800	900	900
Eng/Mkt.Services	20,000	24,000	26,000	28,000	30,000	32,000	34,000	36,000	38,000	40,000	42,000
Franchise Fees	-0-	8,200	19,100	26,200	29,800	31,000	35,100	35,900	36,500	39,300	39,700
Insurance-Group	3,400	9,700	11,500	15,300	17,000	19,700	20,700	21,600	22,500	23,400	24,300
-General	12,000	25,500	26,500	28,700	34,700	36,200	36,800	43,800	44,600	45,200	45,700
Office Supplies/Sund.	2,000	7,500	8,000	8,500	9,000	9,500	10,000	10,500	11,000	11,500	12,000
Payroll (Sch F)	49,000	138,500	163,600	218,200	242,500	281,900	295,000	308,100	321,200	334,300	347,400
Payroll Taxes	3,700	10,400	12,300	16,400	19,400	22,600	23,600	26,200	27,300	28,400	29,500
Professional Services:											
- Audit	6,000	8,000	8,000	9,000	9,000	9,500	10,000	10,500	11,000	11,500	12,000
- Legal	20,000	12,000	12,000	12,000	13,000	13,000	13,000	14,000	14,000	14,000	14,000
Rentals:											
- Office	12,000	12,000	12,000	12,000	14,400	14,400	14,400	19,200	19,200	19,200	24,000
- Poles	2,900	11,100	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400
Royalties:											
- Basic Service	-0-	6,600	15,100	19,000	21,600	22,400	23,000	23,400	23,800	24,000	24,200
- Pay TV	-0-	154,700	355,800	493,300	558,400	578,500	647,100	660,500	669,700	731,700	736,900
Pay TV Guides	-0-	7,900	18,100	22,800	25,900	26,800	27,400	28,100	28,500	28,800	29,000
System Maint/Eng.Sup.	500	2,300	3,600	4,500	4,700	5,400	5,400	6,100	6,100	6,800	6,800
System Power	1,100	4,500	7,800	8,400	9,400	9,500	10,200	10,200	10,900	10,900	11,600
Telephone	3,500	7,500	8,500	9,500	10,000	10,500	11,000	11,500	12,000	12,500	13,000
Travel/Entertainment	500	1,500	1,700	1,900	2,100	2,300	2,500	2,700	2,900	3,100	3,300
Utilities	4,800	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500	10,000	10,500
Vehicle Expense	6,000	12,000	15,500	22,400	26,400	30,600	31,500	32,400	33,300	34,200	35,100
Local Origination	-0-	16,000	18,000	20,000	22,000	24,000	26,000	28,000	30,000	32,000	34,000
Miscellaneous	3,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Total Expenses	161,000	622,900	863,100	1112,900	1228,800	1310,800	1419,100	1472,600	1508,800	1597,200	1632,000

SCHEDULE F

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PROJECTED EMPLOYER EXPENSES

	Pre-Open	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Technical											
Technical Manager	16,500	22,000	23,500	25,000	26,000	27,000	28,000	29,000	30,000	31,000	32,000
Distribution Tech	7,500	14,000	15,500	16,500	17,500	18,500	19,500	20,500	21,500	22,500	23,500
Servicemen:											
1st	3,000	12,000	13,000	14,000	14,750	15,500	16,250	17,000	17,750	18,500	19,250
2nd				13,000	14,000	14,750	15,500	16,250	17,000	17,750	18,500
3rd						14,500	15,250	16,000	16,750	17,500	18,250
Installation Supervis.				15,000	15,750	16,500	17,250	18,000	18,750	19,500	20,250
Installers											
1st	3,000	11,500	12,250	13,000	13,750	14,500	15,250	16,000	16,750	17,500	18,250
2nd			11,500	12,250	13,000	13,750	14,500	15,250	16,000	16,750	17,500
3rd					13,000	13,750	14,500	15,250	16,000	16,750	17,500
Warehouseman/Bench Tech	4,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000
Other		5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000
Office/Administration											
Office Manager	8,000	16,000	17,000	18,000	18,750	19,500	20,250	21,000	21,750	22,500	23,250
Customer Service:											
1st	2,000	11,500	12,000	12,500	13,000	13,500	14,000	14,500	15,000	15,500	16,000
2nd	2,000	11,500	12,000	12,500	13,000	13,500	14,000	14,500	15,000	15,500	16,000
3rd						13,000	13,500	14,000	14,500	15,000	15,500
Service/Install Clerk											
1st	2,000	11,000	11,500	12,000	12,500	13,000	13,500	14,000	14,500	15,000	15,500
2nd			4,000	11,500	12,000	12,500	13,000	13,500	14,000	14,500	15,000
Billing Clerk											
1st	1,000	9,000	9,300	9,600	9,900	10,200	10,500	10,800	11,100	11,400	11,700
2nd				9,300	9,600	9,900	10,200	10,500	10,800	11,100	11,400
Total:	49,000	138,500	163,550	218,150	242,500	281,850	294,950	308,050	321,150	334,250	347,350

SCHEDULE G

OCEAN CABLEVISION ASSOCIATES - LAKEWOOD
PROJECTED CAPITAL COSTS

	Pre-Open	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Head End/Super Trunk											
Jackson Expansion	100,000										
Maintenance			3,000		3,000		3,000		3,000		3,000
Distribution System											
Aerial @ 8500/mile	297,500	552,500									
Underground (Res)											
@ 14,000/Route Mile		210,000									
@ 14,500/Route Mile			21,800								
@ 15,000/Route Mile				22,500							
@ 15,500/Route Mile					23,300						
@ 16,000/Route Mile						24,000					
Underground (Retirement)											
@ 11,000/Route Mile			99,000								
@ 12,000/Route Mile				72,000							
Subscriber Connections											
Standard Converters		327,600	96,000	116,600	24,800	19,800	14,500	12,500	12,000	4,400	4,400
Optional Converters		300,300	87,500	103,800	22,200	18,000	13,000	11,100	10,400	3,500	3,500
Pre-Wires		60,000	52,800	57,600							
Contract Installation:											
@ $18.00		94,500									
@ $20.00			30,700	33,200							
Drop Materials											
@ $13.00		68,300	20,000								
@ $14.00				5,000							
@ $16.00					5,700	4,600	3,000				
@ $18.00								2,900	2,800	900	900
Local Origination		50,000	15,000	5,000	5,000						
Transportation											
Vehicles	25,000		8,500	18,500	9,000	11,000		22,000	23,000	24,000	25,000
Base Station	6,000										
Mobile Radios	5,200		1,300	2,800	1,400	1,500					
Bucket Truck	23,000										
Office/Shop/Misc.											
Furniture/Fixtures	8,000	2,000	2,000								
Test Equipment	15,000	1,500	1,500	1,500							
System Spares		15,000	5,000	3,000	2,000	2,000	1,000	1,000	1,000	1,000	1,000
Converter Repair/Repl.			25,100	32,500	41,300	43,200	44,700	45,800	46,700	47,600	47,900
Miscellaneous	5,000	7,000	7,000	7,000	8,000	8,000	8,000	9,000	9,000	9,000	10,000
Building Expansion	50,000	20,000									
Total Capital Costs	534,700	1208,700	476,200	481,000	145,700	132,100	87,200	104,300	107,900	90,400	95,700

SCHEDULE G (CONTINUED)

	Pre-Open	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Office/Shop/Misc											
Furniture/Fixtures	10,000	3,000	1,500			3,000			4,000		
Test Equipment	20,000										
System Spares		20,000	5,000	5,000	5,000						
Converter Repair/Rep.			45,000	57,000	72,008	76,000	79,000	82,000	85,000	87,000	89,000
Drop Churn				19,000	19,000	18,000	12,000	7,000	4,000		
Miscellaneous	5,000	10,000	10,000	10,000	10,000	10,000	5,000	5,000	5,000	5,000	5,000
Total Capital Costs	867,500	2,471,480	653,450	736,770	253,900	256,660	225,390	219,500	227,920	205,540	206,580

Total Capital Costs: $6,324,690

3.2.2 Hybrid System

The second set of projections was developed by a cooperative electric utility in Pennsylvania for a cable company which will be operated in close conjunction with the local utility. The economics of this system are such that the system cannot be supported by entertainment charges alone, because the relatively low population densities raise the per customer capital investment to about three times the per customer capital cost of the New Jersey system. Thus, the Pennsylvania system will depend for part of its revenues on non-entertainment services, such as alarms and electric load management. Interestingly, the managers of the Pennsylvania project assume about the same per house revenue ($8 per month) for pay-TV as do the consultants for the New Jersey project.

PRO FORMA STATEMENT OF OPERATIONS

	1st Year	2nd Year	3rd Year	4th Year	5th Year
INCOME:					
Installation Charges	$ 27,400	$ 5,400	$ 5,900	$ 6,450	$ 7,050
Service Fees	171,815	265,943	296,624	330,710	347,421
Total Income	$ 199,215	$ 271,343	$ 302,524	$ 337,160	$ 354,471
OPERATING EXPENSES:					
Administrative Costs	$ 50,303	$ 54,981	$ 60,094	$ 65,683	$ 71,792
Service Costs	70,103	93,223	101,893	111,369	121,726
Origination Costs	26,447	47,371	51,783	56,606	61,878
Franchise Fees	--	--	9,075	10,115	10,634
Total Operating Exp.	$ 146,853	$ 195,575	$ 222,845	$ 243,773	$ 266,030
FIXED COSTS:					
Depreciation	$ 57,872	$ 61,136	$ 64,704	$ 68,604	$ 72,876
Amortize Start-up Exp.*	12,500	12,500	12,500	12,500	12,500
Interest**	70,356	65,993	61,042	56,037	45,342
Total Fixed Costs	$ 140,728	139,629	$ 138,246	$ 137,141	$ 130,718
NET PROFIT (LOSS)	$ (88,366)	(63,861)	$ (58,567)	(43,754)	(42,277)

* Assumes that Scatcom will repay AEC for the portion of the start-up expenditures over a period of 10 years.

** Interest assumes a rate of 9% and paid off in 10 years.

OTHER NOTES: Administrative costs include AEC management fees.
Service costs include maintenance expense.
Origination costs include fees paid to satellite services, etc.
Franchise fees start, for the most part, applicable to the 3rd year of operations an payable within 30 after year end.

CAPITAL INVESTMENT PROJECTION

1st Year Flow								
1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Yr. Total	2nd Year	3rd Year	4th Year	5th Year
Phase I:								
$568,400	$ 9,000	$ 6,000	$ 6,000	$589,400	$ 26,232	$ 28,671	$ 31,337	$ 34,251
Phase II:								
-0-	$136,050	$137,440	$ 5,200	$278,690	$ 22,734	$ 24,848	$ 27,158	$ 29,684
Total:								
$568,400	$145,050	$143,440	$ 11,200	$868,090	$ 48,966	$ 53,519	$ 58,495	$ 63,935

INCOME PROJECTION

Phase I:								
$ 19,327	$ 41,435	$ 38,901	$ 40,728	$140,391	$154,654	$169,083	$184,858	$202,105
Phase II:								
-0-	-0-	$ 32,134	$ 26,690	$ 58,824	$116,689	$127,541	$139,402	$152,366
Total:								
$ 19,327	$ 41;435	$ 71,035	$ 67,418	$199,215	$271.343	$296,624	$324,260	$354,471

CASH FLOW PROJECTION

PHASE I*	1st Year Flow: 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	2nd Year	3rd Year	4th Year	5th Year
Cash on Hand	-0-	$ 15,912	$ 11,052	$ 3,336	$ 20,512	$ 26,090	$ 32,517	$ 39,509
Cash Receipts	$ 19,327	41,395	32,149	36,583	154,654	169,083	184,858	202,105
Investment Capital	580,000	-0-	-0-	25,000	-0-	-0-	-0-	-0-
Available Cash	$599,327	$ 57,307	$ 43,201	$ 64,919		$195,173	$217,375	$241,614
Plant Investment	$568,400	$ 9,000	$ 6,000	$ 6,000	$ 26,232	$ 28,671	$ 31,337	$ 34,251
Origination Costs	1,062	4,923	5,183	5,375	23,504	25,697	28,095	30,716
Payroll	6,000	7,500	7,500	7,500	32,800	35,572	38,970	42,477
Payroll-related	1,800	2,250	2,250	2,250	9,480	10,726	11,691	12,743
Payables	6,153	22,582	21,182	23,282	56,700	61,990	67,773	74,096
Cash Outlay	$583,415	$ 46,255	$ 39,865	$ 44,407	$148,716	$162,656	$177,866	$194,283
Ending Cash	$ 15,912	$ 11,052	$ 3,336	$ 20,512	$ 26,090	$ 32,517	$ 39,509	$ 47,331

*(NOTE: Neither Phase 1 or II includes principal, interest or start-up charges.)

PHASE II*	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	2nd Year	3rd Year	4th Year	5th Year
Cash on Hand	$ -0-	$ -0-	$ 12,050	$ 17,874	$ 29,477	$ 66,253	$ 96,450	$140,387
Cash Receipts	-0-	-0-	32,134	26,690	116,689	127,541	139,402	152,366
Investment Capital	-0-	150,000	120,000	-0-		-0-	-0-	-0-
Available Cash	-0-	$150,000	$164,188	$ 44,564	$146,166	$193,794	$235,852	$292,753
Plant Investment	-0-	$136,050	$137,440	$ 5,200	22,734	24,848	$ 27,158	$ 29,684
Origination Costs	-0-	-0-	4,446	5,459	23,867	26,086	28,511	31,162
Payroll	-0-	-0-	-0-	-0-	12,000	13,116	14,336	15,669
Payroll-related	-0-	-0-	-0-	-0-	3,600	3,935	4,301	4,701
Payables	-0-	1,900	4,428	4,428	17,712	19,359	21,159	23,127
Cash Outlay	$ -0-	$137,950	$146,314	$ 15,087	$ 79,913	$ 97,344	$ 95,465	$104,343
Ending Cash	$ -0-	$ 12,050	$ 17,874	$ 29,477	$ 66,253	$ 96,450	$140,387	$188,410

3.3 Costs of FEMA Access to CATV

A detailed examination of the costs of FEMA access to CATV or a justification of the costs and benefits of FEMA use of CATV is beyond the scope of this report. This section of the report will simply try to present some "ballpark" costs, with which FEMA officials can make preliminary judgments about the feasibility of pursuing the development of CATV-based emergency communications systems. In this section we will examine two types of costs--those costs associated with production facilities and those costs associated with the access routes to CATV systems which were presented in the discussion above.

3.3.1 Production Facilities Costs

FEMA could choose to approach the question of production facilities from either of two economic bases--purchase of facilities or contract rental of facilities. Facility purchase guarantees FEMA access at any time, and minimizes the contracting work involved in using rental facilities. Purchase, however, involves significant first costs which rental does not.

3.3.1.1 Facility Purchase Costs

The purchase or outfitting of a first-quality CATV production studio will cost about $150,000, including cameras, sound equipment, lights, editing equipment and transmission equipment needed to link the studio to a satellite up-link. A good mobile production van will cost about $100,000. Thus, a $1 million expenditure would enable FEMA to have a studio in Washington and a mobile facility in each of the federal regions in the continental United States.

3.3.1.2 Facility Rental Costs

Rental of a good quality studio or mobile production facility will cost about $750-$1,500 per day, depending on the area of the country where the rental occurs. If FEMA were willing to guarantee the supplier a minimum number of rental days on a monthly or annual basis, a more favorable rate could be negotiated. Rental costs include a full production crew. In reviewing these costs, it is important to note that in major metropolitan areas, these costs are not for broadcast quality facilities or equipment. FCC standards for broadcast television are very strict on technical specifications, but do not generally apply to CATV programming. The FCC standards apply to the technical aspects of picture quality, aspects which are imperceptible to non-expert viewers.

3.3.2 CATV System Access Route Costs

Without any prior notion about the frequency of FEMA CATV system use, it is difficult to generate meaningful numbers about the costs of the various access routes. General numbers can, however, give FEMA officials an idea of the relative costs of the routes.

3.3.2.1 Bicycling Tapes

A 15-minute video tape, duplicated at discount retail rates, costs about \$30. A half hour tape costs \$40-\$50. FEMA could expect some quantity discounts, but the process of duplicating tapes is not susceptible to massive economies of scale. The tape cassettes cost a minimum of \$10 or \$15, and each tape has to be individually duped, a process which requires hand labor. Thus, a training program for volunteer firefighters, made by FEMA and circulated to half of the volunteer firehouses in the country could have the following costs. Ten cassettes/program x 4000 firehouses x \$30 per cassette = \$1,200,000, plus production and handling costs. Subsequent FEMA programs could be produced more cheaply by recycling the tapes, but this process involves massive logistics (the above example uses 40,000 cassettes).

3.3.2.2 Satellite Transponders

A satellite usable in the transmission of television signals costs about $75 million to launch and has, using present technology, 24 transponders. These transponders have historically varied in cost, depending on market conditions. If the satellites are designated as common carriers, they have no choice as to which signals they carry, and federal regulatory procedures have established a price of $1.2 million per year as a reasonable rental for a transponder. On the open market, however, current transponders are worth considerably more, as much as $18 million for a seven-ten year life, or about $2-2.5 million per year. Transponder space is available through "resale carrier" and brokers who buy transponder time in bulk and resell it to users at prices in the range of $3,000-$5,000 per hour. Depending on FEMA's needs, purchase of transponder use on this basis may prove more economical than purchase of a full transponder channel. Alternatively, FEMA could purchase the channel to guarantee constant access and resell its unused time through brokers, probably at a profit.

4.0 CATV REGULATION

4.1 Evolving Nature of Community Interest

4.1.1 Overview

The nature of community interest and involvement in CATV has changed rapidly during the past ten years. Initial community involvement was limited to attracting investors and operators to construct and operate community facilities on an exclusive franchise basis. Generally, there was little competition, and communities with poor television reception felt fortunate if a firm would agree to service them. After about a decade of operating experience proved that these community antenna franchises were quite profitable, companies began to emerge which competed for new community franchises. As the communities saw this competition emerging, they began to put together formal bidding procedures. An industry-wide escalation dominated the seventies - operating companies offered more and more elaborate services to communities which in turn demanded more services for each new franchise. All of this escalation was premised on the continued profitability of the business.

By 1981, the escalation had apparently crested. Service demands from communities granting new franchises reached a level that discouraged some major national cable companies from bidding. In other areas, such as Detroit or Baltimore, the projected audience demographics are such that none of the major operators elected to bid. In other areas, CATV operators who won franchises in apparently lucrative territories "traded" or surrendered these franchises because, they said, the economics now seem unfavorable. A growing interest in direct community ownership of CATV systems seems to be another new trend, one which private industry operators are trying to combat. On yet another front, the legal ability of communities to grant exclusive franchises and/or to fail to renew existing franchises is being contested in state and federal court suits.

Overall, it is not yet clear how long-term community interest in CATV will be served. In the short term, it seems that community involvement has produced, in many communities, proposals to build CATV systems which are either financially or technically (or both) unrealistic. That a number of these unrealistic proposals have been accepted simply means that a number of communities will be disappointed during the next decade. Additionally, technical and market trends seem to be making local community concerns and regulations less and less a factor in the future of CATV.

4.1.2 Early (pre-1970) Community Interest

Early (pre-1970) community interest in CATV was very limited. CATV systems were first constructed in small, communities, in non-metropolitan areas, and simply provided better reception of major network and local non-affiliated broadcast stations to towns that were either remote or isolated by topographical boundaries. There appears to have been little knowledge of, or interest in, expanding the services CATV systems would offer, or in any way viewing CATV as a communications system with broad capabilities. Generally, there was not much competition to provide CATV services to a community. A local entrepreneur would promote the technology, lobby the local government and the utility company (for space on the poles to string cable) and obtain a franchise. Isolated communities felt lucky if they could attract such an entrepreneur.

In order to extend wire from a system's headend to a subscriber's home, a cable installer has to either dig ditches in municipally controlled property or string wire from publicly regulated poles. In either case, the cable company must ask local government's permission to use public rights-of-way. For this reason, government authority over cable came to rest first with local government.

If to dig or not to dig had been the only decision required of municipalities, the nuisance factor in building a cable system would not have exceeded that of any project that requires local permits. However, one major attribute of cable systems made matters more complicated: their high installation costs made them *de facto* monopolies. In most markets, installing just one cable system was considered a gamble; installing two competing systems was financial suicide. Capital intensiveness and long payback periods have indeed characterized most cable systems outside the really easy markets: Manhattan Cable was built in 1970 but turned a profit for the first time only last year. Although no law prohibits more than one company from entering a market, this situation has rarely occurred. Thus far, cable companies have respected each other's exclusivity in each franchise area.

For this reason, a local government's decision to let a company build was also a decision to create a local monopoly, which would provide sole service for the life of the franchise. This duration was usually at least 15 years, the minimum time cable operators felt they needed to gain a reasonable return for their investment; companies often asked for and received even longer franchise periods.

A cable system's monopolistic character did not present many problems during the industry's early years because often only one local entrepreneur was interested in putting in a system. A prospective operator would apply for a building permit and a business license, agreement would be reached on appropriate tithes, and wiring would begin. In most areas, cable operators were required to pay a yearly franchise fee amounting to a certain percentage of gross annual revenues. This fee was intended to cover the city's or county's costs of enforcing the terms of the cable contract.

Because authorities were awarding what amounted to an exclusive franchise, they incurred some responsibilities to the local citizenry that would be served by the franchisee. The resulting performance standards in these early years generally required only that the operator provide reliable service--that the viewer's TV set not go black every other day--and that the operator not gouge the consumer. To ensure against the latter, most local authorities required operators to obtain government permission for any increase in the monthly subscriber rate.

AD-A131 326 POTENTIAL APPLICATIONS OF CABLE TELEVISION (CATV) TO THE FEMA (FEDERAL EM.. (U) CONTROL ENERGY CORP BOSTON MA D D GILLIGAN ET AL. JUL 83 EMW-C-0979 2/2

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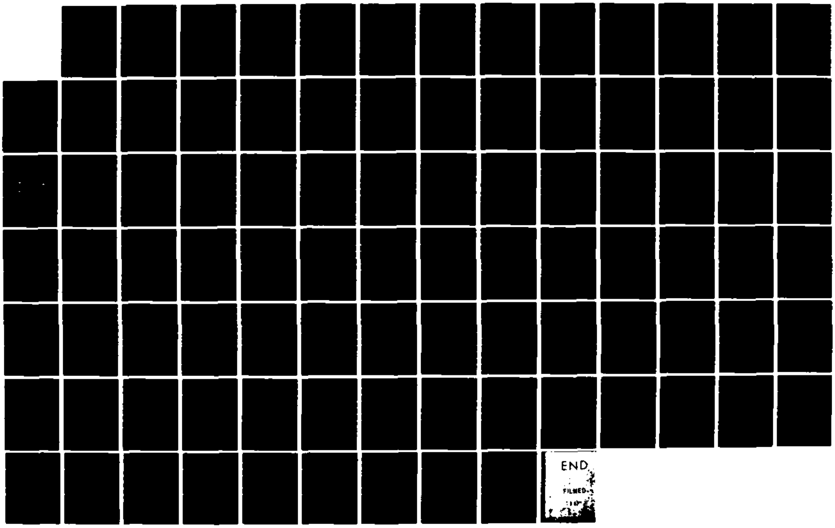
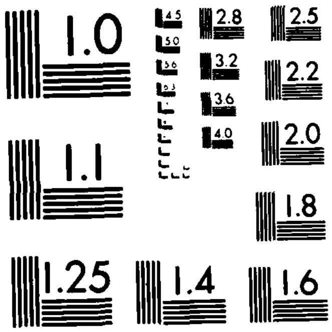




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

For at least two decades, local oversight of cable operations was either very cursory or nonexistent. The contracts themselves were minimal because municipal authorities tended to regard cable, at least in markets well-served by broadcasting, as a somewhat gimmicky experiment in home entertainment: if some go-getter thought he could make a few dollars bringing in additional TV channels, that was all right with the local satraps. Cable was nowise regarded as an essential public service (and, given what most systems were able to do, it wasn't). Moreover, no one in local government really understood cable. Its technology and economics were mysteries to the harried bureaucrat in the public works department or city administrator's office who had suddenly had cable regulation added to his or her more pressing responsibilities.

Such was the process of local cable regulation. A one-person, part-time complaint bureau might take the calls of a subscriber angry that he's been waiting two hours for the cable company's service rep--sometimes there was no complaint bureau at all. Requests for rate increases were generally rubber-stamped--how could city council members make intelligent decisions about a rate increase when they didn't understand, and usually didn't care to understand, the system's rate of return on investment? Local regulators had to believe what the system operators told them because there was no one around to offer a second opinion.

According to A. C. Nielsen, by 1970, there were only about 4 million homes on CATV systems, representing about 7.2 percent of the total U. S. TV households. The CATV systems were primarily in "B", "C" and "D" counties, rather than the top 25 SMSAs (Standard Metropolitan Statistical Areas).

4.1.3 Expanding Community Interest - 1970 - 1981

During the 1970s, two important things happened to change the nature of community interest in CATV. First, the experience of the early community antenna systems, with their handsome profitability, became known. Larger, more sophisticated companies began to see that CATV could be a profitable new business. Second, television technology advanced to the point that CATV could offer more than just antenna services - locally originated programming and pay television became technically and economically feasible. These new television technologies promised even greater profitability to CATV system operators. Sophisticated companies began to understand that the key to the business was the local franchise, which would tie up the customer base on an exclusive basis for 10-15 years. The race was on to obtain franchises.

A typical way for a major company to become involved in local cable television operators was to buy existing franchises from local entrepreneurs. Several of the biggest companies, such as Warner Amex, began this way. Other firms started by trying to convince larger communities to authorize CATV franchises. It became obvious to communities that the CATV franchises were valuable and could, in effect, be auctioned to the highest bidder. Communities could obtain both direct revenues, through so-called "franchise fees", and service benefits, through public access channels.

The techniques for obtaining local franchises assumed the familiar pattern of other business efforts to obtain local government contracts, except that CATV franchise profitability made the techniques more pronounced and expensive. Local politicians were wined, dined and hired as consultants. Local governments established various procedures for deciding franchise awards. Some had special commissions; some had legislation enacted by the city council; others left the decision solely to the mayor.

4.1.4 Crest of Community Involvement

Local governments are becoming more and more educated to the fact that a cable system can do much more than carry movies, sports, and news. Local officials are learning that cable can form the bedrock of a public communications network capable of delivering a variety of valuable services to many different constituencies. The visions of the Sloan Commission's report (which have been much expanded by more recent encomiums to the "information society") are finding their way into public policy. A few firms--such as the Cable Television Information Center in Washington--are doing a thriving business advising cities on franchising policy. Enough cities have hired their own cable experts to make possible a new professional society, the National Association of Telecommunications Officers and Advisors.

Moreover, competition between cable companies for the remaining most lucrative markets has become incandescent. In order to win a franchise, companies are proposing very advanced systems able to serve a variety of community needs.

In short, local governments are coming to expect more, and competing companies are willing to meet those expectations. As a result, franchising for a sizable municipality has become a multi-year battle in which contestants spend hundreds of thousands of dollars, submit proposals the size of the Old Testament, and commit themselves to building systems of a sophistication and cost that many observers consider grossly disproportionate to their expected financial yields.

Local authorities start the franchising process by issuing requests for proposals that include standard criteria for judging applicants: previous experience operating cable systems; sources of financing; quality of service in other communities; proposed subscriber rates, estimated construction time; number of channels to be offered, including pay channels and local government, educational, and community access channels; and facilities and production equipment to be provided for community use.

Competing companies base their proposals on assessments of community needs and demographics. The general strategy is to offer the greatest number of channels at the lowest possible cost; to meet the communications needs of the key local institutions--interconnecting the region's hospitals or helping the local community college produce telecourses, for instance; and to market some relatively exotic telecommunications service, such as a two-way channel that allows viewers to participate in instant polls.

Within these guidelines, the range of possibilities is vast, and proposals have become more and more inventive and lavish. One of the competitors in the recent, hotly contested franchise battle in Sacramento, California, offered a 54-channel basic service package which, for $19.50 a month, would include Home Box Office, a computer keyboard, and security monitoring in every subscriber's home (the company did not get the bid, which went to a company offering to spend three times more on community programming than any of the other contestants).

Procedures following the award of a franchise are still much as they were. Attorneys draft a local ordinance prescribing performance requirements based on the company's proposal. Franchises are still granted for from 15 to 30 years. The annual franchise fee ranges from three to five percent, maximum limits set by the FCC. Most local governments still regulate monthly subscriber rates, but rate regulation is restricted by FCC rules to only the basic service--companies may charge whatever the market will bear for their pay tiers.

What goes for initial franchising also goes for so-called refranchising, the process by which a company that has served an area renews its contract. Many cities and counties that have been served by 12-channel systems for the past two decades have heard news of the glamorous cable plants being installed in the virgin franchise areas, and they are therefore demanding substantial upgrading in their own systems as part of contract renewal.

Differences of opinion over just how much an existing system must be improved have caused rancorous struggles between some cities and the local cable company. Cities have threatened to open bids for completely new systems; cable companies feel about this possibility, known as an "overbuild," the same way that nuclear plant operators feel about meltdowns.

In Austin, Texas, for example, Capital Cable, after refusing for two years to rebuild its 12-channel, 20-year-old plant, just managed to avert a rebidding process by selling its system to ATC for $55 million; ATC has promised Austin it will spend millions on upgrading. Cox Cable in Santa Barbara, California, had already finished negotiating the terms for modernizing its 19-year-old, 12-channel system when a local partnership obtained permission to submit a new bid; Cox won out and will spend $18-20 million on improvements. In Arlington, Virginia, the ARTEC system was challenged by a small MSO and won a 14-year franchise extension only after agreeing to sink $12 million into improving its three-year old system.

In the harshest situations, cities have come to regard cable operators as shameless opportunists whose chief aim is to maximize their rate of return on each channel offered and to get by with the minimum capability necessary to make a bundle. Cable operators in turn see city officials as extortionists whose ignorance of the marketplace in which cable competes is exceeded only by the willingness to attack the local cable company for sheer political gain.

In fact, both these perceptions are caricatures. On the one hand, many cities are asking for very sophisticated systems with capabilities that far exceed what the local community presently needs or is capable of using; on the other hand, if cable becomes the invaluable public instrument that many hope it will, no city can afford to squander its communications future by agreeing to a system that shortly into its 15-year duration will be unable to deliver new educational and other services that may become available.

Likewise, it is true, on the other hand, that high-priced capital coupled with uncertain consumer demand for new services makes the cost of providing what some cities are asking for a very harrowing proposition; on the other hand, the potential for tremendous profits exists. The cost of wiring a medium-sized city of 250,000 households and of providing a certain number of community production facilities has been estimated, in the case of Sacramento, California, at $150 million. That is a large initial investment, but once built, that system, if it soon achieves a 50 percent penetration rate and averages $20-per-month subscription fees, will take in gross revenues of $450 million over its 15-year franchise.

Whatever the economic justice of the situation, the slow but steady increase in local awareness of a cable system's significance has caused many more advanced systems to be planned or built. For examples, see the following table.

City	Date Awarded	Winner	City Tailored Specials	Channel Capacity
Cincinnati, OH (161,000 homes)	November '80	Warner Amex Cable Communications of Cincinnati, Inc.	• Shared use of three full-color studios at Crosley Telecommunication Center WCET-TV Channel 48 • Four full-color neighborhood access studios • Two color access origination studios at Cincinnati's main public library branch and at the University of Cincinnati • Three mobile vans	Interactive 138 channels
Portland, OR (120,000 homes)	October '80	Cablesystems Pacific (Rogers Cablesystems)	• $400,000 in equipment and facilities dedicated to community access • $2.7 million in operating support over ten years above and beyond franchise fee	Interactive 108 channels
Dallas, TX (400,000 homes)	October '80	Warner Amex Cable Communications of Dallas, Inc.	• Estimated $2,144,000 • Five full-color studios • Five additional access centers • Three color-equipped mobile vans • 20 color portable packages • 50 portable modulators for origination of programming from any location connected with the institutional loop	Interactive 100 channels
Omaha, NE (125,000 homes)	September '80	Cox Cable TV of Omaha, Inc.	• One local origination studio • Four access studios • Two mobile vans • Capital investment over ten-year period for local origination and access production facilities totals $1.8 million • $251,000 in production to various colleges, universities, and hospitals throughout Omaha (Cox will also commit a ten year local origination budget of $5.4 million)	Interactive 108 channels
Pittsburgh, PA (181,000 homes)	January '80	Warner Amex Cable	• ($3.32 million for studios and equipment) • $1.16 million for exclusive community use • $236,000 for equipment and servicing a government TV studio facility located in the city county building • $200,000 grants made to the city to be used at its discretion in achieving goals of community communications • $165,000 in Honorarium for assistance in presenting community programming • Two mobile vans • Five color TV equipment studios • A full-time channel and over $60,000 in equipment for use in the production of local religious programming • 15 percent discount on cable services for senior citizens	Interactive 78 channels

Compounding these difficulties is growing uncertainty over the legal status of the exclusive franchises that communities have been granting CATV operators. These franchises have been challenged on two bases:

- Unsuccessful bidders have sued local communities disputing the communities' right to grant exclusive franchises;

- Current franchise holders, whose terms have expired or are about to expire, have sued to prevent the community from holding an open bidding process for the granting of a new franchise. In one such case, which went all the way to the Supreme Court, the Court ruled that the local community (Boulder, CO) is not immune to antitrust complaints resulting from its actions. Thus, the existing franchisee can sue, claiming damage from the city's monopolistic practices (granting a new exclusive franchise to another operator).

Experts now appear to agree that the ability of communities to determine what kind of CATV system is the best for them, and to compel CATV operators to provide services and prices which the community thinks it wants, is in serious jeopardy. The nature of community interest and involvement may have come full circle very fast.

4.2 New Economic Trends Which Affect Community Involvement

Several emerging trends in the CATV industry threaten to dilute community involvement, or to change the nature of the involvement. These new trends are discussed below.

4.2.1 Franchise Swapping

A basic marketplace trend threatens to severely dilute effective community control of CATV franchisees. This is the process of swapping or acquiring franchises, which is now being pursued by major CATV operators. The motivation for these activities stems from the fragmented nature of the current CATV industry. Because CATV franchises have all been granted by local governments, it has been historically difficult for any one company to aggregate large markets on a geographical basis. Yet this geographical aggregation seems essential to the development of advertising revenues and communications functions which will make CATV systems profitable. It is hard to imagine a CATV-based communications system in a metropolitan area which has twenty or thirty different CATV operating companies. So, more and more CATV operators are looking into either swapping or acquiring franchises to build large contiguous service territories. Local governments are predictably upset by this trend, because the concerns of each town or city will be lost in a large regional CATV system, much as they are now lost in the large utility systems or the telephone system.

Upset as they may be, local governments are usually powerless to stop the trading or acquisition of franchises. The franchises are contracts, the property of the franchisee, and can be brought and sold like other commercial properties. The trend seems to make sense from both the technical perspective (systems will become standardized) and from the economic perspective (duplicative costs will be reduced and larger markets aggregated for new services) so we can expect to see the trend accelerate in the new few years.

4.2.2 Electric Utility Involvement

Another trend is emerging in the form of utility interest and involvement in the operation of CATV systems. Utility interest stems from two sources. First, utilities already have the rights-of-way and the poles and/or conduits required for CATV cable routing, as well as regular contact with all of the potential customers for CATV system services. CATV becomes a rather natural expansion target for utilities which want to diversify, as many do in the face of the uncertain economics of the electric utility industry. Second, the communications capabilities of new CATV systems are useful to new utility load management and system distribution automation programs. Utilities are actively exploring the potential diversifying into CATV: the Edison Electric Institute, the national electric utility trade association, recently held a conference on the subject for its member utilities.

In several areas of the country, utilities are experimenting with CATV or are proceeding to actually build and operate systems. This trend is hampered somewhat by state laws and regulations, which often restrict or prohibit utility operation of CATV systems. There seems to be no compelling logic for these restrictions and prohibitions, but they represent the fears of CATV operating companies about potential competition from utilities. As larger utilities become involved in CATV operations, the local communities will lose control of essential system functions and system economics will no longer be locally determined.

4.2.3 Community Networking

One of the successes of community involvement with the process of constructing new cable systems, sophisticated communications capabilities for local service agencies and businesses, may lead to further erosion of community control and involvement. The form that these services usually take is community networks, in which, for example, a number of local hospitals and other medical facilities are linked, or the local school system is linked together. Since the new CATV systems generally have much more capacity than can be used for entertainment programming, it is reasonable to use CATV systems for sophisticated information and communications functions. New applications for these networks are being developed each day, and FEMA use of the networks is very logical. Cable systems currently offer significantly higher data rates and lower costs than phone systems, and so are very attractive to both businesses and service agencies with large-scale communications needs.

However, the deregulation of the telephone industry and the demonstrations of the viability of these communications networks promise to open the field to largely unregulated competition. Thus, community control will be short-circuited. Local Bell telephone companies are going to introduce, in about 18 months, a Local Area Data Transmission Service, using a new American Bell technology which will vastly increase the data rates of the phone system. The phone companies can be expected to operate LADTS strictly as a business, and will concentrate on the profitable business market of communication between computers. Needs of non-profit agencies will fall between the cracks. Bell system phone companies will also be faced with competition for basic telephone services from other telephone companies who will operate on CATV lines. Experiments are already underway in the midwest by MCI, which seeks to demonstrate the feasibility of using the local CATV system to provide phone service cheaper than the Bell affiliate can provide. Overall, the interests of the local communities, as expressed in CATV regulations and franchises, will tend to be swept aside in the free-for-all of marketplace competition.

4.2.4 Community Ownership

To counter these industry trends some communities are now considering, or implementing, direct community ownership of the CATV systems. In this type of structure, the local government establishes an authority or other agency to own and operate the cable system. An operating company is retained to perform the day-to-day management of the system, including programming and marketing. It is too early to tell if these community-owned systems will in fact provide better quality services and lower prices than the alternative commercially-owned systems. But it is likely that community ownership will only be implemented in communities with strong local governments with histories of progressive and innovative programs--not a large percentage of American communities.

4.3 Trends in Regulation

4.3.1 Current Confusion

Of the three levels of government--federal, state, and local--local government now exerts the most influential authority over the cable industry by virtue of its authority to make franchising and refranchising decisions and to regulate monthly subscriber rates.

At the federal level, court decisions have all but eliminated the once stringent FCC rulings. The U. S. Supreme Court has nullified the FCC's channel capacity and access rulings. Only three FCC rulings on cable now stand: systems must carry local channels and pay the Copyright Tribunal fees for copyrighted programs, and local governments may neither regulate the rates for pay programming nor charge a franchise fee greater than five percent of the company's gross annual revenues.

State regulation is patchy. Only 11 states regulate cable under comprehensive statutes: New York, Massachusetts, Minnesota, Alaska, Connecticut, Hawaii, Nevada, Rhode Island, Vermont, New Jersey, and Delaware. All of these states have assumed authority over rate regulation. Only two of them, New York and Minnesota, have set local franchise standards and encouraged local programming efforts.

Many groups interested in cable's public service potential argue for much stronger federal and state regulation in the belief that local governments, with some exceptions, do not have sufficient resources, expertise, and motivation to ensure optimal cable systems. However, events seem to be moving in the opposite direction. Deregulation is presently the watchword inside the FCC. Inside the Congress, numerous bills to revamp the Communications Act of 1934 have appeared during the past five years or so, and most of these bills suggest lesser, not greater, regulation.

Local government therefore remains the most significant locus of cable regulation at the moment. For that reason the cable industry, whose political clout has grown in direct proportion to its gross revenues, has concentrated its efforts on undercutting local authority by means of litigation and legislation.

Local authority over rate regulation, for example, has been successfully challenged in California, where state law makes systems meeting certain specifications immune from local rate regulation so long as that system agrees to contribute a minimal fee to a state community programming fund; thus far the law has worked to the distinct advantage of the cable industry.

Local authorities to grant exclusive franchises--certainly the most effective of a municipality's tools--has been seriously undermined by the so-called Boulder Decision. This decision was prompted when a cable company challenged the Colorado city of Boulder's right to delay the company's plans to wire a certain district. A federal court held that cities are not immune from antitrust suits (as are states). One logical implication of this decision is that cities have no right to decide on franchising whatsoever. This implication has not yet been put to the test.

Policy differences between municipalities and the cable industry have temporarily been resolved in a recent compromise between the National Cable Television Association, the industry's powerful lobbying organization, and the

National League of Cities. According to available reports, this agreement would give cities continued flexibility to award initial franchises but would give operators automatic renewal rights when the initial contract expires; the compromise would also deregulate rates for basic service in major markets. Cities could require government access channels and continue to charge franchise fees up to five percent.

One of the most debated issues concerned the use of available channels--to what extent will the system operator control access? With regard to this common carrier issue, the NCTA-NLC compromise would allow outside users to contract with cities for access to systems, and cities would regulate the rate for leasing channels.

4.3.2 Federal Legislation

Given the confusion in the current regulatory structure, and the apparent inability of the local communities to maintain regulatory control over a rapidly growing and evolving industry, it seems logical and reasonable that the federal government should establish the regulatory framework. There are precedents for such federal pre-emption of regulation, notably in the telephone and electric utility industries. In fact, legislation was introduced into the last session of Congress by Senator Goldwater of Arizona (S.2172). The legislation dealt with five areas of concern: rates, access, services, ownership and franchises. FEMA may wish to take an active role in the development of this legislation in order to ensure that the communications system which FEMA requires for its mission will be available. It certainly seems more productive for FEMA to concentrate on pending federal regulations than to attempt to impact the CATV system through local regulations or state legislation.

4.4 Summary

In summary, the nature of community involvement has gone through a rapid evolution--from the encouragement of local entrepreneurs to the structuring of very demanding local bidding procedures to what will perhaps be a sideline seat in a marketplace driven by large-scale technological and market considerations. Some communities with histories of strong, competent, progressive local governments will be able to maintain customized local CATV standards or operate local CATV systems, but these communities will be the exception. FEMA will have the most impact on the process of regulation at the federal level, by influencing pending legislation to ensure that legitimate local needs for emergency communications are provided for.

5.0 EMP PROTECTION OF CATV SYSTEMS

5.1 Overview and Introduction of EMP Threat

The effects of EMP (Electro-magnetic Pulse) on a large population center were first observed in Hawaii subsequent to a high altitude atomic test, some 800 miles away. The usual destruction associated with nuclear blasts had prevented the differentiation of EMP induced phenomena in the past. Seconds after the detonation, the power system in Honolulu, Oahu, and other widely separated areas was disrupted with burned out relays, blown fuses, and damaged transformers. Although only .1% of the energy of a nuclear explosion is associated with EMP, the resulting disruptions from a similar blast over the continental United States would be devastating. Figure 1 (Ref. 1) shows the area of coverage of EMP from 100 Km, and 400 Km high altitude detonations. While EMP is physically very similar to the electromagnetic phenomenon associated with nearby lightning strikes, its strength, and its instantaneous propogation capability over a wide geographic area, makes it a serious civil defense problem.

With increasingly integrated systems of energy distribution and telecommunications networks, and utilization of ever more delicate electronic circuitry in equipment, EMP-induced surges could cripple the communication networks of the nation. The susceptibility of CATV systems to EMP damage and functional disruption is reviewed and assessed in this section. A short introduction to EMP will be followed by identification of CATV subsystems and

Figure 1

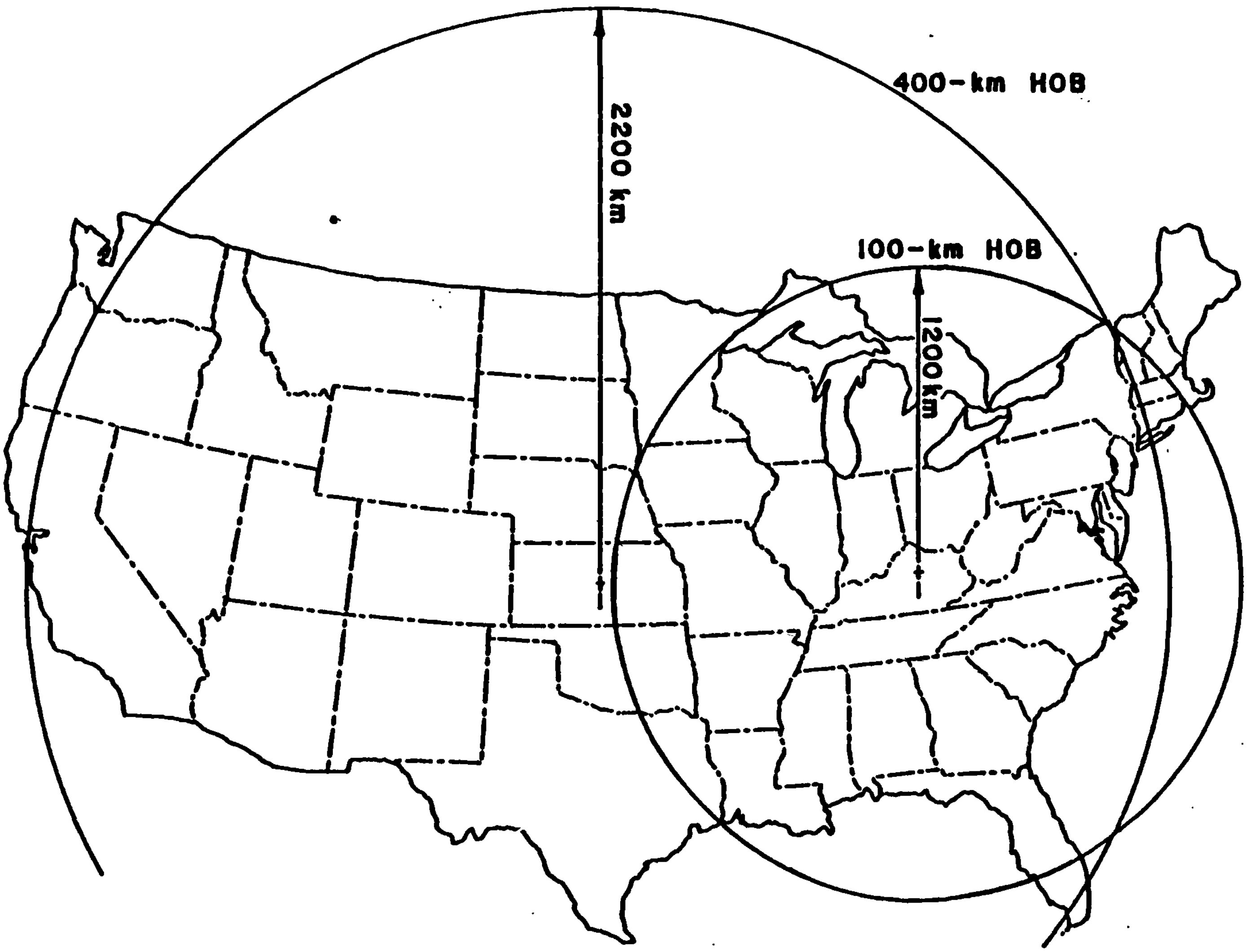


Figure 1. AREA OF COVERAGE OF EMP FROM HIGH ALTITUDE DETONATIONS

elements vulnerable to EMP. Protective options and design methodologies will be introduced and a matrix of potential solutions to protection and hardening of weak points will be presented. The matrix will form the basis of a technical discussion of potential FEMA options for protection of CATV systems and their ultimate utilization in case of an EMP-induced communication crisis.

5.2 EMP Characteristics and Effects

The physics of EMP associated with nuclear detonations has been the subject of many (References 2 - 8). The short introduction presented here is to discuss the effects of EMP rather than its generation which is due to the Compton collision of gamma particles with air molecules. The resulting charge separation and interaction with the earth's magnetic field, generates a radiating electro-magnetic field. When a weapon is detonated in the atmosphere the gammas are limited to a volume of about 6 Km in diameter. A high altitude burst, however, permits the gammas to travel unaffected by air molecules so that the source region can be up to 1,600 Km in diameter and 20 Km thick, covering the surface of the earth.

The spectrum of EMP ranges from extremely low frequencies to low ends of UHF. It has a faster rise time (9 - 10 nanoseconds) than nearby lightning as well as higher amplitudes. Figure 2 shows a typical EMP waveform (9). Based on calculations the amplitude of a high altitude burst of a large device could have an electric field strength of 90 Kv/m (kilovolts per meter) (10).

Figure 2

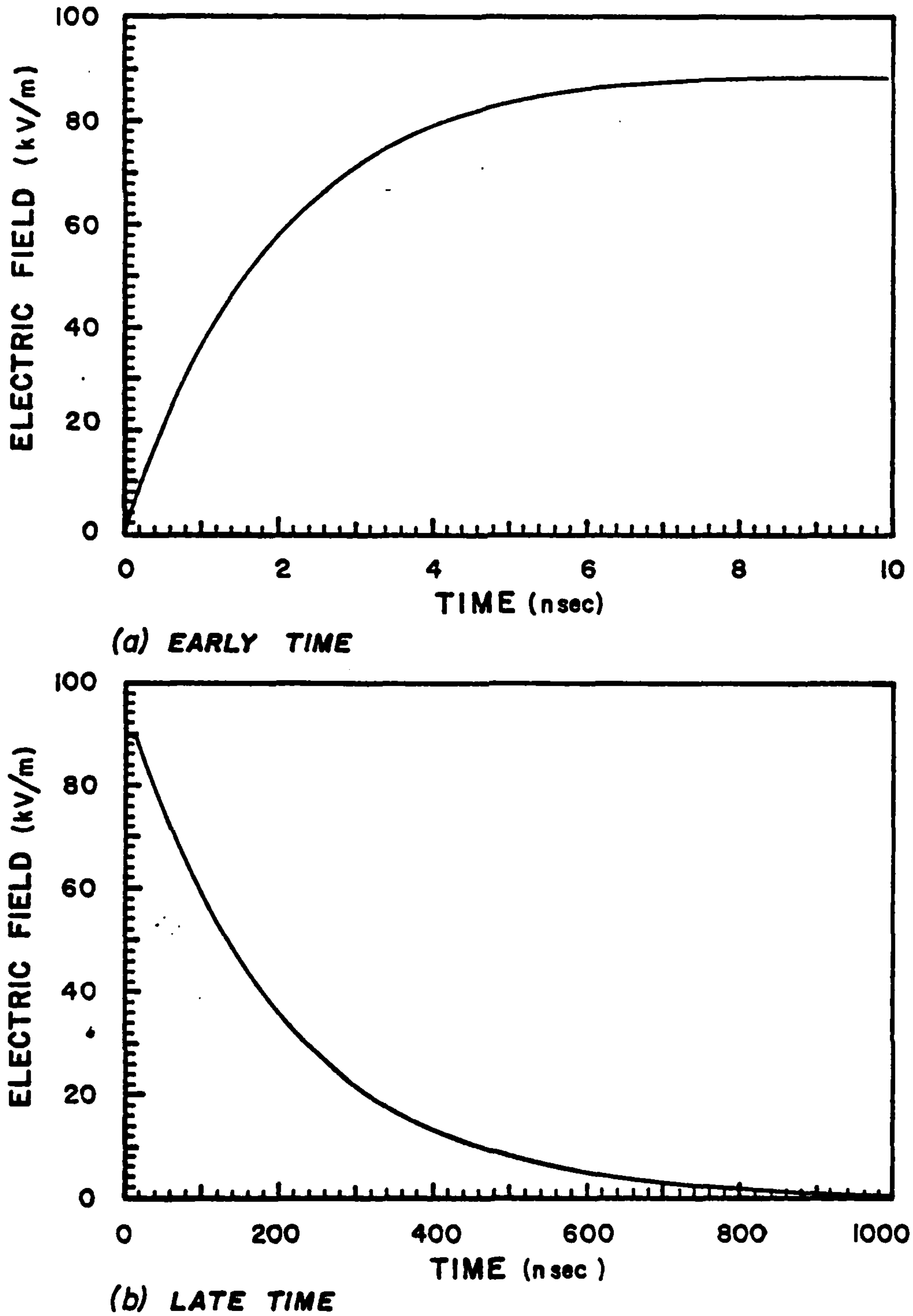


Figure 2 TIME HISTORY OF THE REPRESENTATIVE EMP.

The major EMP threats to electronic and electrical equipment are:

1 The large amplitude of its field;

2 The fast rise time; and

and 3 Its wide spectrum

The last characteristic complicates isolation of particular components and requires system-wide protection and hardening.

EMP penetrates or is coupled to a system or a component in three ways:

1 Electric induction which applies to linear conductors;

2 Magnetic induction applying to loops of conducting elements; and

3 Earth transfer impedance which applies to buried cables and components.

EMP is a function of so many factors, such as the size of the nuclear device, geographic location, orientation, atmospheric conditions, etc., that it is useful and convenient to assume a typical EMP. The suggested EMP (Reference 11) has:

1 A peak electric field strength at 100 Kv/m;

2 A time to peak value of 20 nanoseconds; and

3 A time to reduction to half peak value of 450 nanoseconds.

EMP collectors such as antennae, aerial and buried cable networks, steel structures and building reinforcing elements, are frequency selective so that in conjunction with the determination of EMP characteristics it is possible to predict the extent and the intensity of reception. The shape of a pulse for particular devices or systems can be obtained from the Defense Nuclear Agency.

Failure in a system or component exposed to EMP is caused primarily through:

1 Dielectric breakdown;
2 Thermal effects; and
3 Interconnection effects.

For a thorough discussion of failure modes specialized literature on the subject is available (References 12-14). All failure modes are in one way or another associated with excessive currents or voltages in the conducting circuits.

Protection from EMP is based on:

1 Prevention of EMP reception; and
2 Control of currents and voltages induced by EMP.

These will be discussed in more detail in subsection 5.4 below.

5.3 CATV System and Component Vulnerability to EMP

The CATV network system can be subdivided, in the order of protection hierarchy deemed appropriate, into three major subsystems:

- The CATV station;
- The local network; and
- Host connection and reception.

5.3.1 The Station

There would obviously be no need to protect and harden the entire CATV system unless a reliable and protected station could assure sustainable links to both the Civil Defence agencies and its own network. A simple model of a CATV station is shown in Figure 3. The important components are:

1 Microwave or other telecommunication reception;

2 Power supply;

3 Information and data processing and program preparation;

4 Link to CATV network - signal output; and

5 The envelope.

FIGURE 3

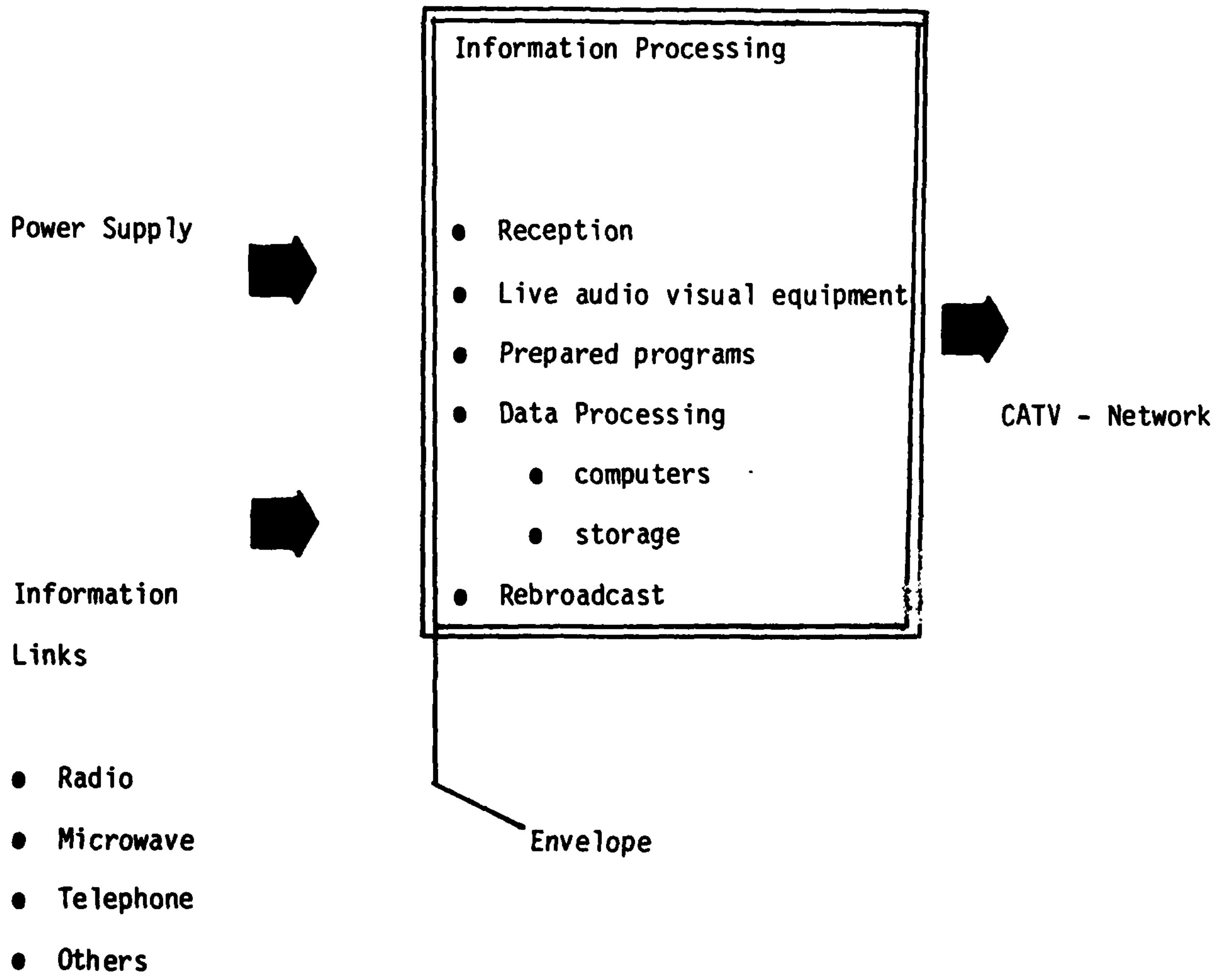


Figure 3 - CATV Station Functional Model

The major incoming links are the information reception via the microwave link, telephone, or radio, and the power supply link. If DIDS receive terminals are installed at the station the incoming information links are much less vulnerable. The reliability of the power supply has been the subject of other FEMA studies (Reference 15) and will not be dealt with in this study.

The microwave dish and especially the tower are susceptible to large EMP reception and the waveguide presents a serious EMP penetration port into the CATV facilities. The radio is probably less vulnerable than the telephone system given the small antenna size required and the complexity of the telephone network. However, fiber-optic circuits are immune from EMP and developments in fiber-optic circuit implementation will increase the reliability of telephone links.

The outgoing station link to the network is as vulnerable as the network itself and the potential for EMP penetration to the station is high unless protective measures are considered. The envelope is vulnerable to EMP penetration unless shielding measures are in place and incoming pipes are grounded properly.

5.3.2 The Network

The network is made up of:

1 The transmission lines;

2 The interconnecting and branching links;

3 In line amplifying/compensating components; and

4 Power supply of in line components.

Aerial cables, with extended lengths of linear conducting elements, and large loops that are inherent in any CATV network system act as perfect receptors for both the electric and the magnetic components of EMP. A CATV aerial network would certainly generate the type of current flows and voltage drops sufficient to induce thermal damage to interconnections if not actually the cable itself. The voltages would most likely be sufficient for dielectric breakdown of any semiconductor elements incorporated in either switching or branching components.

While the small size associated with amplifiers, automatic gain controllers (AGC) and automatic slope controllers (ASC) would rule out direct EMP susceptibility, the voltage drops created across these components will most certainly damage the internal circuitry. The power supply of these in-line components is highly susceptible to EMP. However, as was mentioned previously, the susceptibility of the power delivery system is beyond the scope of this study.

5.3.3 Host Connection and Reception

The elements of CATV individual connection and reception are:

1. The cable drop-line and subsequent branching in case of apartment buildings;
2. De-modulator or decoder;
3. The television set and its power supply

The interconnection between the CATV trunk line and the individual buildings is much less susceptible to EMP than the network at large. The short line length and lack of loops (in good designs) diminishes EMP reception. Drop cable shielding is presently recommended anyway and that might be sufficient although more detailed analysis is necessary. The demodulator and the TV set are both susceptible to direct EMP damage due to very complex and yet delicate designs incorporating semi-conductors, internal antennae, microcircuit loops, etc.

Figure 4 presented below shows the array of CATV system elements with regards to EMP vulnerabilities.

CATV elements: the station, the network, and the host receptors and their subsystems are shown in a horizontal array, arranged in order of their critical importance to the system. For each subsystem the vulnerabilities decrease from top to bottom. The station is considered as the most critical element, the station link with Civil Defense as the most critical subsystem, however, not the most vulnerable, since the information processing computers, and the electronic equipment within the station are more susceptible to EMP effects. An accurate assessment of all the vulnerabilities requires further study. However, the Figure 4 layout can be used qualitatively. The individual television sets, for example, are not critical to the overall system and notwithstanding the power surges in the electrical system or the antennas (for regular reception) relatively safe from EMP inductions. The same holds for all the circuits and components that are physically small enough to minimize EMP reception, the problem arises when these components are connected with long receiving cables, such the in-line amplifiers or signal conditioning devices which are part of CATV distribution network.

The more obvious "weak points" involve interconnections, sensitive components used in conjunction with large circuits, and computer controlled equipment and information.

Figure 4

More Critical

More Vulnerable

STATION			NETWORK			HOST RECEPTORS		
Information Links	Electronic Equipment	Power Supply Network Line	Transmission	In-line Components	Power Supply	Feed Line	Power Supply	TV-set Demodulator
	• Computers			Amplifiers		Interconnections at the network		
• Microwave tower	• Stored info			AGC/ASC				
	• Video equipment	• Link to network	• Inter-connection		• Transformers			• Demodulator circuit
• Telephone		• Power supply	• Aerial cables		• Power conditioners			
• Radio	• Audio visual		• Underground Intercon	• Feed connectors			• TV power supply	
	Electronics		• Underground cables			• Interconnection at host		TV circuits
• DIDS								

Figure 4 - CATV Element Vulnerabilities

5.4 Review of Available EMP Protection Technologies

EMP protection technologies can be classified in two major groups: shielding techniques and power surge control techniques. Shielding technologies involve the methods associated with minimization of EMP pickup by systems, circuits, or components. Power surge controllers involve the use of electrical devices designed to minimize the damage to sensitive components once EMP has penetrated the system and induces unsafe current/voltage levels.

5.4.1 Shielding

Shielding protection encompasses the strategies that prevent the induction of EMP electric and magnetic fields into high electric currents and voltages. All metallic objects of sufficient lengths can act as receptors for the electric field portion of EMP. The magnetic field portion induces currents in loops of conductors that are formed by transmission lines, networks present in circuits, or structural elements, and only properly designed ferrous shields can prevent induction of power surges.

Proper shielding should therefore be considered in conjunction with proper design. Good design encompasses:

- Proper grounding. It is very important that grounding circuits don't form additional loops. Shields should be grounded at a single junction.

- Clustering. Equipment should be tightly organized to prevent long circuits and large loops.

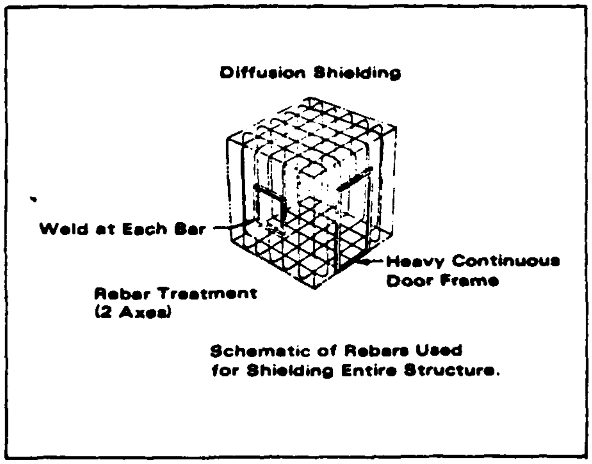
- Layering. Shields could be implemented in several layers. This is the most effective way of dealing with the magnetic fields.

- Cable layout and grounding cables should be designed to minimize induction forces. Methodologies have been developed such as the twisting of wires and proper grounding at junctions and terminals.

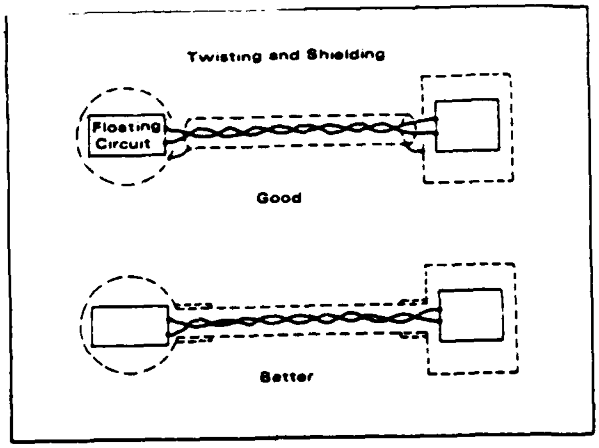
- Aperture Design.

Figure 5 shows some of the techniques that can be easily implemented. Diffuse shielding (5a) is present in most reinforced buildings. Proper twisting and shielding is shown in 5b. Balanced isolation is shown in 5c. These are only some of the examples of shielding protection. Many EMP protection handbooks are available (References 16, 17) for reference and detail description. The Office of Civil Defense report RW-100 suggests a continuous steel shield on the inside surface of communication system facilities. The 14 guage steel plate would be grounded at a single junction point to the building's electrical ground. All incoming pipes, metal connectors of any kind would be welded to the shield. Figure 5d shows an example of ideal and practical shields. (All figures adapted from reference 16) 5e shows an example of good installation.

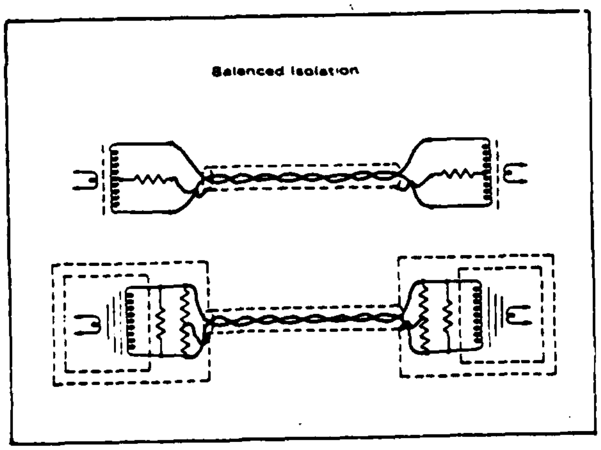
Figure 5: Shielding Techniques



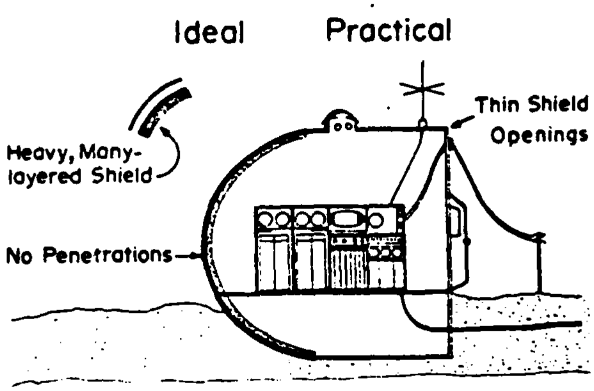
5a



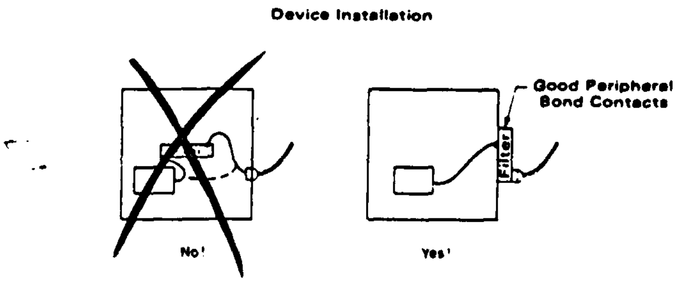
5b



5c



5d



5e

5.4.2 Power Surge Controllers

Power surge controllers are in turn divided into two groups: amplitude limiting devices, and spectral filtering. Among the amplitude limiting devices are:

- Spark plugs
- Gas diodes
- Zener diodes
- Silicon diodes
- Thyrite
- Fast relays
- Hybrids, and
- Crowbar circuits

The spectral limiting devices suppress certain frequency components of EMP induced signal. A knowledge of circuit characteristics and response should be known therefore if they are to be incorporated. Among the spectral limiting devices, we can mention:

- Capacitors
- Inductors
- Ferrite beads
- Transformers
- Bifilar chockes
- R.L.C. filters

For more detail on these and other power surge controllers refer to references 16, 17, and 19.

5.4.3 Automatic Switching

Automatic switching or isolation can be considered as a power surge control. It involves the isolation of vulnerable components or circuits through a signal prior to EMP illumination. The electric power industry is considering this form of protection assuming that a 15 minute warning is given. It can be used to protect the cable transmission network as well as the more sensitive in line components such as the amplifiers. Its use should be considered in conjunction with the power supply interconnections as well as the main station-network connections.

5.4.4 Shield Room

Another concept which has potential utilization for CATV stations is the creation of an ideal shield room, a small perfectly shielded space where sensitive components and spare parts for sensitive circuits can be stored so that post-EMP recovery can be assured.

5.5 Matrix of Available Technologies as Applied to CATV Protection Needs

EMP protection of CATV systems must be implemented for the vulnerable elements of the station, the network and individual receptors. On each level protection strategies must be optimized to include the most effective combination of shielding, power surge control, and automatic switching techniques. The matrix shown in Figure 6 is used as an organizational guideline in assessing optimum EMP protection.

The shielding or at least partial shielding of critical areas of the station is obviously stressed. Protection of computers, and sensitive equipment for audio-visual broadcast is vital and a combination of proper equipment, clustering and grounding, with added-protection amplitude limiters and filters must be used to insure continued operation of the station. Since the communication with Civil Defense authorities has been improved through many of the various programs in recent years, this critical link has been discussed only insofar as the microwave links are concerned. The microwave tower is a perfect EMP receptor and it should be protected through grounding and isolated from the rest of the station. New materials are being considered for construction of towers and perhaps these efforts should be encouraged.

Figure 6

	STATION	NETWORK	HOST RECEPTION
Shielding	• Computer Shielding • Control Room Shielding • Proper Equipment Clustering and Grounding • Microwave Tower Shielding • Waveguide Design	• Underground cabling with conducting asphalt cover • Interconnection shielding • Limiters for amplifiers AGC/ASC	• Interconnection shielding • TV and demodulator equipment • Short feedline design
Power Surge Controllers	• Amplitude Limiters at power supply • Limiters at network link • Filters in sensitive equipment • Limiters for all electronic	• Limiters at feedline connection • Limiters at m-line connections and power supply connections • Limiters for amplifiers AGC/ASC	• Limiters at host connection
Automatic Switching	• Automatic switching at network link • Automatic switching of all sensitive equipment	• Automatic switching in strategic locations to minimize EMP-induced current flows	

The underground cables are much less vulnerable than aerial cables and so are the many in-line components associated with the distribution network. Proper grounding and cable sheath connections can improve the reliability of underground networks.

5.6 Options for Policies and Programs to Reduce CATV Vulnerabilities

It has only recently been recognized that the cost of implementing EMP protection does not behave like those of other nuclear effects (Reference 16). Figure 7 adapted from reference 16 shows the price of achieving gradually increasing levels of EMP protection. The reasoning behind the development of data for Figure 7 is that the "price factor in EMP protection lies in the introduction of new elements and hardware" and that once a certain initial level is achieved, the protection level is not substantially increased until system wide protection measures are implemented. In case of the CATV system a minimum protection level can be achieved by:

1. Minimum shielding of communication/control room of the station
2. Proper clustering and grounding of equipment
3. Proper grounding of the outer sheath of all coaxial cables
4. Adding amplitude limiters to all sensitive equipment
5. Assessing a cost effective method of protecting in-line components.

Figure 7

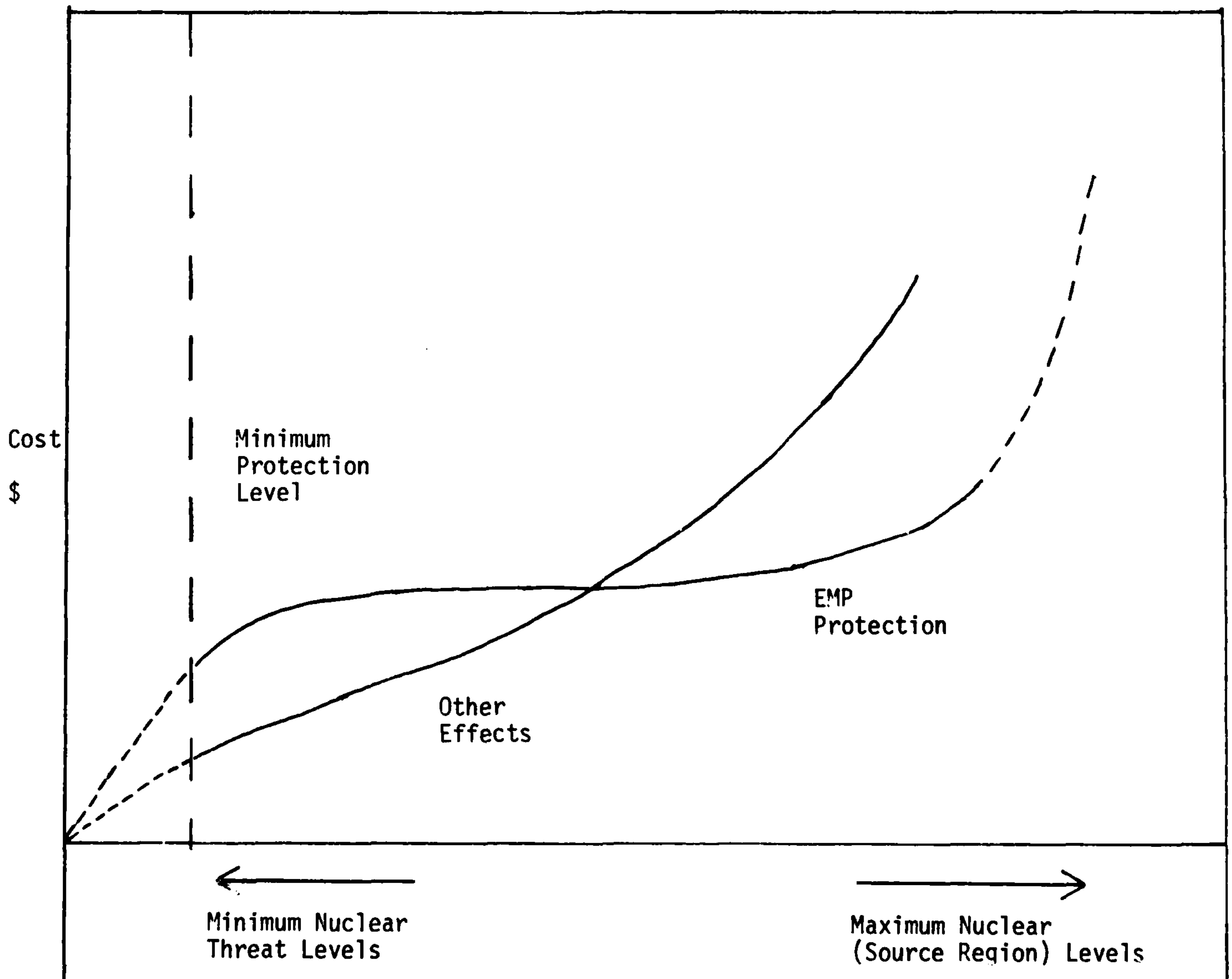


Figure 7 - EMP Protection Level

The policies that are required to assure higher level of EMP protection are:

1. Encouragement of underground CATV distribution network.
2. Improvements in shielding of the CATV standard coaxial cables.
3. Improvements in hardening of in-line equipment, shielding of the components, and improved junction box designs.
4. Addition of EMP protective layers.

A long term program that can effectively combine the utilization of various protective measures in conjunction with proper network design should be implemented to linearize the cost of EMP protection. Other measures that could help smooth the curve shown in Figure 7 involve:

1. Cooperation with component manufacturers for low cost EMP hardening of microcircuits. Perhaps this can be achieved with no additional cost but through designs that reflect awareness of EMP threat.

2. Cooperation with CATV operators to improve station design, network design, and implementation of educational programs for technicians.

3. Cooperation with home builders to improve grounding of conductor circuits and proper installation of antennas and surge protection devices.

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CIVIL PREPAREDNESS CIRCULAR

No. 75-3, July 15, 1983

USE OF CABLE TELEVISION (CATV) FOR EMERGENCY MANAGEMENT

PURPOSE

The purpose of this circular is to describe uses of cable television for local government officials and emergency management directors for emergency communications.

BACKGROUND INFORMATION

Cable television systems, or broadband communications networks (BCN), use coaxial cable to relay channels of television programming not readily available over the air. Cable makes more channels usable than do VHF-UHF electro-magnetic TV transmission systems. Cable systems range in size from simple 12-channel systems, which do little more than carry remote and local broadcast signals, to much more complicated 120-channel systems, capable of carrying more specialized information. The 12-channel systems are by far the most prevalent: nearly sixty percent of all U. S. cable subscribers are served by these low-capacity systems. By contrast, only a handful of systems of 100 or more channels have thus far been built. The trend, however, is towards increased channel capacity.

Cable now reaches about one-third of all American TV households. Subscribership varies greatly among markets. See Attachment A for cable penetration in the top 100 television markets in the country.

The many channels available in cable systems and the estimated 28 million subscribers as of 1980, represent a potential for numerous possible uses.

CABLE COMMUNICATIONS AND EMERGENCY MANAGEMENT

The key word in any emergency management activity is "communications" -- integrated and coordinated communication not only among those actively involved in coping with the consequences of an emergency, but also, and just as importantly, among these people and citizens who find themselves in need of warning and information. To date, there have been few adequate channels of communication between local officials and the community at large, but the increasing use of cable systems promises to respond to these needs.

Cable systems, as they pertain to emergency management needs, can be employed in houses, offices, hospitals, schools, etc., as a supplementary means of warning before a disaster occurs and as a method of communicating official information and directions to the public during and after an emergency. Because of the potentially large number of channels and the variety of uses to which the system can be adapted to fit a particular locality's needs, cable can provide access to the community as a whole or to any specific segment of the locality (police, fire, schools, hospitals) on a selective basis. There is a vast potential for the system's use in coordinating emergency communications between emergency operating centers (EOC's) and the departments of local government which provide emergency services. In many communities, cable can be highly useful in rapid dissemination of emergency information. It is hoped, therefore, that emergency management at the local and state levels will use this growing technology to the fullest extent for emergency warning and communications.

Many of the major decisions as to how this new communication means should be used must be made at the local level. In the past, FEMA has found it difficult to obtain and disseminate the necessary guidance in an unbiased and understandable form to local emergency management directors, who are finding themselves increasingly involved in the decision-making process of local governments in the granting and use of cable franchises. We hope the following summary will prove helpful. It includes information regarding various pertinent Federal Communications Commission (FCC) rules and regulations with which the local emergency management director should be familiar, several examples of how CATV can be utilized by emergency management, guidance on financial assistance, and source references for obtaining more detailed data on cable communication systems.

A. EMERGENCY MANAGEMENT USES OF CABLE COMMUNICATIONS

Local emergency management agencies should be considered among the prime users of available access channels. Many communities already have made specific arrangements in their franchises for emergency-use purposes. The following is an example of such an arrangement. Additional examples are provided in Attachment B.

> A telephone hot-line in a local emergency management agency office operating on a 24-hour-a-day basis is connected to the local cable system. Voice transmissions of emergency messages are made over the hot-line, preempting television sound over all of the cable channels and instantly cancelling audio and visual programming on the channel(s) as established in the franchise. In some areas, the cable company furnishes the emergency preempt capability and/or telephone hot-line to the local government without charge.

It should be noted that where the local emergency system provides for preemption of all cable channels, the FCC states that all channel preemption is limited to those channels not involved in retransmission of television broadcast programming. FCC further states that to provide for a minimum of disruption of the non-emergency channels, after all CATV channels are preempted to initially alert viewers, the viewers then should be advised to turn to a pre-designated emergency channel. The use of this procedure is quite widespread in tornado areas where people are conditioned to the emergency channel concept.

Obviously, the type of legal agreements drawn up will depend on the kind of arrangement the local emergency management director judges will best suit the needs of his community. For example, if the emergency management director has decided on a "hot-line with authority to preempt" type of arrangement, the following would represent a suitable agreement (additional examples are provided in Attachment C):

> "In the event of an emergency situation, as determined by the local government, said local government may interrupt signals otherwise being distributed by the cable television company for the delivery of signals necessitated by such emergency."

B. FINANCIAL ASSISTANCE

FEMA may provide financial assistance to state and local projects which would use cable as a supplementary emergency warning and communications system; however, experience indicates that often cable use for an emergency can be accomplished through well-coordinated programming efforts by the local emergency management director with local officials at little or no cost to local government. Where FEMA financial assistance is necessary, each project application will be considered individually to determine its cost competitiveness in comparison to alternate systems available. Details concerning financial assistance are provided in Attachment D.

C. ADDITIONAL INFORMATION ON CATV

State and local emergency management directors should encourage local government officials to include provisions for emergency use of the existing or planned cable systems through maximum use of access channels, when available - particularly the local government access channel - to the extent permissible under the local franchise agreement.

It is recommended that when a cable system is being considered by a community, the emergency management director present to local government officials the advantages and potential of the system for emergency communication and warning. Where a cable system is already in existence in the community, and the franchise agreement does not include an emergency-use provision, the local emergency management director should advise local officials of the system's advantages. Such emergency-use provisions can be added after the original franchise agreement is made. However, it is advisable to incorporate these local government uses before the agreement is consummated. In order for the emergency management director to become more knowledgeable about developing cable communications technology and how he can best employ it in his locality, access to the latest information and guidance on the subject will be helpful. This is available from the Urban Institute's Cable Television Information Center, 2100 M Street, NW, Washington, D.C., 20037. There is a charge for obtaining all publications of the Center. However, this FEMA circular on CATV should suffice if the community does not want to expend funds for the above mentioned publications.

As it becomes available, FEMA will disseminate additional information to state and local civil defense directors.

SUPERSESSION

DCPA Circulars No. 73-6 and 75-3, dated July 17, 1973, are hereby superseded.

DISTRIBUTION:

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ATTACHMENT A

MARKET PENETRATION OF CABLE TELEVISION (JULY 1982)

Rank	Designated Market Area	U.S. TV Households	% U.S. TV Households	% Cable Penetration	Index to U.S. Cable Penetration
1	New York	6,409,720	7.823	29.4	86
2	Los Angeles/Palm Springs	4,214,600	5.144	23.8	70
3	Chicago	2,944,860	3.594	9.8	29
4	Philadelphia	2,400,780	2.930	35.3	104
5	San Francisco/Oakland	1,950,270	2.380	42.4	125
6	Boston/Manchester/Worcester	1,920,160	2.343	24.9	73
7	Detroit	1,658,910	2.025	13.2	39
8	Washington, D.C./Hagerstown	1,467,620	1.791	17.0	50
9	Cleveland/Akron	1,402,020	1.711	30.7	90
10	Dallas/Ft. Worth	1,355,900	1.655	23.7	70
	Subtotal Top 10	25,724,840	31.396	25.5	75
11	Houston	1,255,010	1.532	28.6	84
12	Pittsburgh	1,202,490	1.468	50.1	147
13	Miami/Ft. Lauderdale	1,099,690	1.342	27.7	81
14	Seattle/Tacoma	1,093,860	1.335	40.6	119
15	Minneapolis/St. Paul	1,071,370	1.308	9.8	29
16	Atlanta	1,062,690	1.297	30.6	90
17	St. Louis	1,029,430	1.256	12.9	38
18	Tampa/St. Petersburg/Sarasota	1,028,780	1.256	29.2	86
19	Denver	858,930	1.048	18.2	54
20	Baltimore	835,150	1.019	14.4	42
	Subtotal Top 20	36,262,240	44.257	25.9	76
21	Sacramento/Stockton	833,700	1.017	30.7	90
22	Indianapolis	804,420	.962	29.6	87
23	Portland, OR	789,360	.963	25.3	74
24	Phoenix/Flagstaff	727,150	.887	21.5	63
25	Hartford/New Haven	707,180	.864	50.9	150
26	Cincinnati	707,560	.864	21.8	64
27	San Diego	699,110	.853	56.0	165
28	Kansas City	688,930	.841	37.0	109
29	Milwaukee	679,100	.829	14.5	43
30	Nashville/Bowling Green	675,810	.825	26.6	78
	Subtotal Top 30	43,575,190	53.182	26.8	79

Source: Television in Transition, Watson S. James, Crain Books

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MARKET PENETRATION OF CABLE TELEVISION (JULY 1982)

Rank	Designated Market Area	U.S. TV Households	% U.S. TV Households	% Cable Penetration	Index to U.S. Cable Penetration
31	Charlotte	613,470	.749	26.2	77
32	Buffalo	613,110	.748	53.8	158
33	Providence/New Bedford	601,880	.735	19.9	59
34	Orlando/Daytona Beach	595,990	.727	43.5	128
35	New Orleans	590,880	.721	28.5	84
36	Memphis	581,190	.709	29.3	86
37	Columbus, OH	576,840	.704	42.0	124
38	Greenville/Spartanburg/Asheville	574,160	.701	31.8	94
39	Grand Rapids/Kalamazoo/Battle Creek	566,750	.692	40.0	118
40	Birmingham/Anniston	563,670	.688	38.4	113
	Subtotal Top 40	49,453,400	60.356	27.8	82
41	Raleigh/Durham	530,890	.648	38.3	113
42	Oklahoma City	528,260	.645	43.1	127
43	Louisville	528,190	.645	32.1	94
44	Salt Lake City	522,960	.638	21.2	62
45	San Antonio/Victoria	502,930	.614	36.6	108
46	Charleston/Huntington	490,840	.599	56.0	165
47	Norfolk/Portsmouth/Newport News	480,380	.586	34.0	100
48	Harrisburg/Lancaster/Lebanon/York	473,620	.578	52.6	155
49	Wilkes-Barre/Scranton	469,230	.573	62.5	184
50	Albany/Schenectady/Troy	463,300	.565	49.2	145
	Subtotal Top 50	54,444,000	66.447	29.2	86
51	Dayton	460,350	.562	42.7	126
52	Greensboro/High Point/Winston Salem	449,510	.549	30.2	89
53	Syracuse/Elmira	446,770	.545	58.4	172
54	Flint/Saginaw/Bay City	443,610	.541	36.8	108
55	Richmond/Petersburg/Charlottesville	429,540	.524	26.8	79
56	Little Rock/Pine Bluff	429,150	.524	32.0	94
57	Shreveport	427,530	.522	42.8	126
58	Tulsa	420,190	.513	46.9	138
59	Wichita/Hutchinson	404,170	.493	54.2	159
60	Toledo	401,590	.490	39.8	117
	Subtotal Top 60	58,756,410	71.710	30.0	88

Source: Television in Transition, Watson S. James, Crain Books

ATTACHMENT A

MARKET PENETRATION OF CABLE TELEVISION (JULY 1982)

Rank	Designated Market Area	U.S. TV Households	% U.S. TV Households	% Cable Penetration	Index to U.S. Cable Penetration
61	Knoxville	392,380	.479	36.6	108
62	Mobile/Pensacola	383,590	.468	42.3	124
63	Jacksonville	371,510	.453	35.6	105
64	Fresno (Visalia)	365,030	.445	27.3	80
65	Roanoke/Lynchburg	360,390	.440	45.6	134
66	Albuquerque/Farmington	350,710	.428	34.0	100
67	Green Bay	347,130	.424	27.1	80
68	West Palm Beach/Ft. Pierce	345,320	.421	54.9	161
69	Des Moines/Ames	340,560	.416	36.7	108
70	Omaha	337,630	.412	27.3	80
	Subtotal Top 70	62,350,660	76.096	30.4	89
71	Rochester	333,520	.407	33.7	99
72	Spokane	331,800	.405	45.0	132
73	Portland/Poland Spring	322,720	.394	43.1	127
74	Davenport/Rock Island/Moline	320,030	.391	41.8	123
75	Champaign/Springfield/Decatur	316,150	.386	57.2	168
76	Cedar Rapids/Waterloo/Dubuque	313,950	.383	30.9	91
77	Johnstown/Altoona	312,520	.381	66.7	196
78	Honolulu	300,560	.367	53.6	158
79	Paducah/Cape Girardeau/Harrisburg	298,560	.364	40.5	119
80	Chattanooga	286,150	.349	34.8	102
	Subtotal Top 80	65,486,620	79.923	31.1	91
81	South Bend/Elkhart	277,660	.339	30.6	90
82	Tri-Cities; TN–VA	274,550	.335	44.5	131
83	Lexington	266,960	.326	40.3	119
84	Springfield, MO	264,190	.322	25.9	76
85	Jackson, MS	260,260	.318	41.4	122
86	Lincoln & Hastings/Kearny Plus	251,130	.306	42.1	124
87	Tucson (Nogales)	250,380	.306	19.2	56
88	Evansville	245,390	.299	45.7	134
89	Austin	242,380	.296	49.6	146
90	Hunstville/Decatur/Florence	239,160	.292	46.1	136
	Subtotal Top 90	68,058,680	83.062	31.4	92

Source: Television in Transition, Watson S. James, Crain Books

ATTACHMENT A

MARKET PENETRATION OF CABLE TELEVISION (JULY 1982)

Rank	Designated Market Area	U.S. TV Households	% U.S. TV Households	% Cable Penetration	Index to U.S. Cable Penetration
91	Baton Rouge	235,920	.288	43.3	127
92	Youngstown	233,880	.285	43.8	129
93	Ft. Wayne	232,140	.283	36.3	107
94	Columbia, SC	231,240	.282	37.5	110
95	Springfield/Holyoke	228,530	.279	49.1	144
96	Burlington/Plattsburgh	225,270	.275	45.4	134
97	Peoria	221,050	.270	51.4	151
98	Greenville/N. Bern/Washington	218,560	.267	37.5	110
99	Lansing	213,280	.261	45.9	135
100	Sioux Falls (Mitchell)	210,510	.256	35.8	105
	Subtotal Top 100	70,309,230	85.808	31.7	93
101	Waco/Temple	207,830	.254	55.1	162
102	Fargo/Valley City	207,010	.253	45.7	134
103	Colorado Springs/Pueblo	201,410	.246	37.9	111
104	El Paso	200,330	.244	45.3	133
105	Madison	199,140	.243	40.1	118
106	Augusta	196,950	.240	41.7	123
107	Lafayette, LA	194,310	.237	47.7	140
108	Las Vegas	190,550	.233	4.3	13
109	Rockford	185,820	.227	50.1	147
110	Wheeling/Steubenville	185,420	.226	61.0	179
	Subtotal Top 110	72,278,000	88.211	32.0	94
111	Savannah	182,700	.223	42.5	125
112	Monroe/El Dorado	181,550	.222	37.5	110
113	Montgomery	181,490	.221	44.6	131
114	Monterey/Salinas	179,660	.219	68.4	201
115	Charleston, SC	178,990	.218	37.8	111
116	Columbus, GA	174,100	.212	46.2	136
117	Duluth/Superior	173,440	.212	40.0	118
118	Terre Haute	172,980	.211	37.6	111
119	Santa Barbara/Santa Maria/San Luis	172,030	.210	77.6	228
120	Amarillo	170,890	.204	59.0	174
	Subtotal Top 120	74,045,830	90.368	32.4	95

Source: Television in Transition, Watson S. James, Crain Books

ILLUSTRATIVE LOCAL USE OF CATV FOR EMERGENCY MANAGEMENT AGENCY

1. A telephone hot-line from the local emergency management agency to the cable system. Voice transmissions of emergency announcements are made over this hot-line which, when used, preempts the sound on the local channel. This is the predesignated local emergency channel which residential and other subscribers are told to listen to in an emergency.

2. A telephone hot-line from each of the local emergency management, police and fire department headquarters to the local CATV system. The use of any one of these hot-lines preempts the sound on ALL channels on the local CATV system and voice transmissions of emergency announcements are then made.

3. A telephone hot-line in the police department (which is also the National Warning System (NAWAS) warning point) is connected to the cable system. It preempts the sound on ALL channels. Locally originated emergency information as well as warnings of tornadoes, hurricanes, floods, etc., and attack, received over the NAWAS system are retransmitted by hotline.

Attachment B

4. Two telephone hot-lines from the local emergency operating center (EOC). One hot-line is connected directly to the cable system for emergency announcements from the EOC over the CATV system. The second hot-line connects to an outlet in the CATV system studio so that messages not concerning immediate danger to citizens but of an emergency nature, may be broadcast as soon as practicable with due regard to commercial programming requirements, e.g., at station breaks.

5. A selected channel is used, after broadcasting has ended for the day, for emergency messages transmitted over the hot-line from the local EOC. This is done by the subscribers on the net leaving their sets turned on and tuned to the predesignated channel. Then, for example, during a severe weather watch, late at night, emergency information or warnings can be provided in the home, with a voice message alerting the people to the emergency.

6. A modification under consideration would include a special bell placed at each receiving outlet for ringing initiated by the CATV facility to alert people at the outlet location to turn to a predesignated emergency channel.

7. A versatile audio and visual satellite system which interfaces with the local cable system. The system includes a microphone, a camera, a monitor, and an interface control unit. The system can accommodate four additional satellite cameras, and is especially useful for visual chart

Attachment B

projection, etc. Also, the system permits local government to originate a warning signal on the cable system to be heard on home TV, provided the home set is turned on at the time the signal is sent and, also, local radio can be interfaced to receive the same audio information that would be broadcast on CATV.

8. One community is known to have the local National Weather Service Office provided with direct tie-in to the cable system. For example, when a tornado threat is urgent, the Weather Service preempts the cable system, displays their radar picture and announces the weather watch or weather warning.

9. One system uses a beeper box radio device to send a tone signal over commercial or other telephone line to activate the preempt system when the user is away from the hot-line location and therefore unable to use the hot-line.

Attachment C

EXCERPTS FROM LOCAL CABLE SYSTEM FRANCHISE AGREEMENTS

1. In the event of an emergency situation, as determined by the local government, said local government may interrup signals otherwise being distributed by the cable television company for the delivery of signals necessitated by such emergency. (Note: In this case, the local emergency management agency has been delegated the authority to preempt in emergency situations, and a hot-line telephone is provided for this purpose).

2. The cable company shall also provide basic service to one outlet on each floor of all courthouses, prisons, reformatories, detention centers, hospitals, police and fire stations, publicly owned day care centers and public schools located in the franchise area, without charge. This would apply to outlet installation and for continuing monthly service.

3. In the case of any emergency or disaster, the franchise (cable company) shall, upon request of the mayor of the city of ______________, or of his designated agent, make available its facilities to the city, for emergency use for the duration of such emergency or disaster.

4. The system will be engineered to provide an Emergency Audio Alert System. The system would allow certain authorized officials to automatically override the AUDIO signal on all channels and transmit and

Attachment C

report emergency information. In the event of any such use by the city, the city will hold harmless and indemnify the Grantee from any damages or penalties resulting from the use of this service.

5. The franchisee shall, in the case of any emergency or disaster, make its entire system available without charge to the city or to any other government or emergency management agency that the city shall designate.

Attachment D

FINANCIAL ASSISTANCE

1. FEMA may provide financial assistance for the portion of a state or local warning plan which would use cable communications as a supplemental emergency warning and information system where it cannot be accomplished without cost to the local government through agreement with cable company. Where the need is justified, FEMA may match funds for installation and recurring costs of hot-line or similar link-up from the local government to the cable station or other entry point used. This would cover the preempt interface for one or more channels, the camera and other interface equipment. The use of a single hot-line on the cable system for use in preempting the cable programming for delivery of a civil preparedness emergency message often is sufficient. The number of channels to be preempted will vary; the more channels the greater the coverage; however, initial costs will be more.

2. Criteria for any cable equipment for warning, including video, are:

   a. A definite need for warning the public will exist.

   b. The facility where the hot-line telephone is installed will be under the possession and control of a state or political subdivision having emergency management responsibilities.

c. The selected location will enable adequate utilization of the system.

d. There will be a definite plan for use of the system for attack warning.

3. Each matching fund project request will be considered on an individual basis to determine if it is cost competitive in relation to alternative systems, and, at the same time, to ascertain the emergency management use and benefits under National warning program policies. The justification also should show that the franchise company under the local government free-access channel agreement is unable or does not want to fund the telephone tie-in and other features of the system for emergency use. (The franchise companies may finance this telephone tie-in, etc., but are not obligated to do so.)

4. Cost of any cable interface system will depend on such variables as the distance from the local government broadcast originating point to the cable cut-in point, whether or not a television camera is to be purchased, etc.; thus, the costs for each locality would have to be estimated individually. Use of coaxial cable can escalate costs. For example, on the older, one-way cable systems, coaxial cable is required from the remote camera to the originating distribution amplifier. On new two-way systems now required by FCC, this cable cost is greatly reduced in most cases since the remote camera input can be processed through

Attachment D

miniature "head-end" equipment from an entry point anywhere along the regular cable and fed back to the distribution amplifier. However, ordinary telephone wire may be used for input of audio signals to the distribution amplifier if video transmission is not used. An estimated cost for a system to include one camera, control unit, microphone and monitor, plus cost of the coaxial cable or telephone line is estimated between $5,000 and $7,500.

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Johns Hopkins Applied Physics
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Johns Hopkins Road
Laurel, MD 20707

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Center for Planning and Research
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IIT Research Institute
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Chicago, IL 60616

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IIT Research Institute
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Institute for Defense Analyses
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The Head of
Civilforsvarsstyrelsen
Stockholmsgade 27
2100 Copenhagen 0
DENMARK

Direction de la Securite Civile
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18 Rue Ernest Cognac
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Bundesministerium des Innern
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BELGIUM

Jefe, Seccion de Estudios y Planification
c/Evaristo San Miguel, 8
Madrid-8
SPAIN

Ministero dell Interno
Direzione Generale della
Protezione Civile
00100 Rome
ITALY

Directeur de la Protection Civile
Ministere de l'interieur
36 Rue J.B. Esch
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LUXEMBOURG

Directeur Organisatie
Bescherming Bevoling
Ministry of Interior
Schedeldoekshaven 200
Postbus 20011
2500 The Hague
NETHERLANDS

The Head of Sivilforsvaret
Sandakerveien 12
Postboks 8136
Oslo-dep
Oslo 1
NORWAY

Servico National de
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1200 Lisbon
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Control Energy Corporation
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EXECUTIVE SUMMARY AND RECOMMENDATIONS

1. Cable television (CATV) has evolved from community antenna systems serving smaller communities to very complex multi-purpose communications systems serving major metropolitan areas. The evolution of cable television has been sporadic and the future of the industry is problematic.

2. Cable television technology has evolved from antenna systems which carry 3-5 channels to complex systems capable of carrying more than 100 channels of interactive data and television signals. The present state of cable television technology, with readily available microwave and satellite links to most stations, is well suited to many of the emergency communications needs of FEMA.

3. The economics of cable television vary according to the size and complexity of the system. Modest systems with less than 25 channels, operating in smaller communities, have been profitable historically and promise to continue that profitability. Complex systems in major metropolitan areas are founded on speculative economics, particularly the notion that the average cable television subscriber will purchase significant levels of optional pay-TV services. These speculative economics remain to be proven.

4. Regulation of cable television is largely a local matter, in the hands of local commissions or municipal councils. Local regulation in smaller communities has generally been laissez faire. Larger communities have actively regulated cable television systems, requiring substantial service levels and restricting rates. The cable television industry is ensnarled in a variety of litigation and pending federal legislation, which seeks to define or redefine the role and limits of local regulation.

5. Cable television systems are currently vulnerable to electromagnetic pulse (EMP) effects resulting from nuclear explosions. Cable television systems can, however, be protected from EMP effects by a series of improvements to the system components. These improvements appear to be both technically and economically feasibl at this time.

6. Our conclusion is that cable television is well-suited to become part of the FEMA emergency communications system. Cable television has advanced technical capabilities, modest access costs and the potential for advanced strategic security which FEMA requires. We recommend that FEMA proceed to assemble a cable-television-based emergency communications system by implementing the three follow-on tasks described below:

A. Formulation of EMP Protection Standards

President Reagan's recent initiative in the area of defensive missile systems has focused attention on the possibility of nuclear attacks aimed at essential communications systems rather than population centers. Previous FEMA studies have documented the vulnerability of major American communications systems to the EMP effect attendant to nuclear detonations. This vulnerability is emerging as a significant factor in national strategic planning.

Our report indicates that EMP vulnerability in CATV systems can be virtually eliminated by a series of technically and economically feasible improvements to the three major subsystems of the CATV system--the CATV station, the local network and the host connection and reception. Many CATV systems are currently being constructed or renovated. It seems appropriate to us to have these CATV construction projects involve EMP protection improvements, so that in a few years the nation will have a substantial communications system relatively impervious to EMP effects.

A set of EMP protection standards should be written for each major subsystem in CATV systems. The standards will equip FEMA to promulgate EMP protection on a voluntary or mandatory basis. The work should include sample design specifications for EMP protection improvements as well as cost estimates for each suggested improvement.

B. Assembly of a FEMA CATV Emergency Communications Network

Each year FEMA provides emergency services in a number of non-war emergencies and natural disasters in various sections of the country. FEMA services generally require sophisticated communications over an extended period of time to inform local public officials and the affected public about available relief services and procedures. Existing communications systems available to FEMA may not be optimal because they are vulnerable to interdiction (as in the recent Louisiana floods) and because they do not offer FEMA the depth and breadth of communications capacity which FEMA can use.

Our report outlines the technologies which can be linked together by FEMA to assemble and operate ad-hoc emergency communications networks of CATV systems in disaster-affected areas. We had expected our research to uncover significant technical and economic barriers to the immediate implementation of these networks, but we found none. We believe that FEMA can have a functioning CATV-based emergency communications network within 12 months.

FEMA should assemble this network by developing an implementation plan which details production facilities, network access routes and costs and priority communications tasks. This work should not generate a project report, but what is, in effect, a roadmap, in both printed and electronic formats, which FEMA can immediately use to provide emergency communications to disaster areas.

C. Definition of FEMA Interest in Federal CATV Legislation

The CATV industry is currently seeking federal regulatory protection to substitute for the patchwork local regulation to which the industry is subject. Several bills have been introduced into the Congress. The main thrust of the legislation is discussed in our report.

We believe that FEMA has a substantial interest in this pending legislation, insofar as federal regulatory protection for CATV systems should carry a quid pro quo. We suggest that CATV systems should agree to actively participate in a new FEMA emergency communications system by implementing EMP protection improvements and by cooperating in FEMA emergency communications networks. These relatively modest concessions by the CATV systems can be incorporated into pending federal legislation if FEMA has precisely defined the measures (see 1 and 2 above) and is up-to-date with Congressional and CATV industry thinking on the legislation.

FEMA should develop the technical materials derived from tasks 1 and 2 above in a form which can be used in discussing legislation with the Congress and the CATV industry.

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