SMALL EARTH STATIONS
Protection of Service

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This paper examines the protection of programming and service for the small earth station for the Cable Television Business.

A review of the CATV Companies and the growth of the business over the last few years shows that the availability of new programming sources has produced industry growth. A quick examination of what is available in the programming area is provided. This growth has and will continue to require more equipment to handle the added service.

A discuss of protection of programming and service is provided. This includes some block diagrams of service protection techniques used with discussions of each. The techniques covered include schemes for protection of low noise amplifiers, video receivers, polarities, power etc. Protection of programming is discussed briefly. Techniques used are controlling the satellite video receiver via clock, telephone, in-band switching, out of band switching, micro-processor control.

1.0 Introduction

The technology advances in the past few years have brought satellite communications to a reality. More recent advances have brought the cost within the reach of the cable television industry. With the advances, the quality and quantity of the service has increased tremendously. The protection of service and programming is paramount to management of a cable system. This protection is divided into two areas: the first is the protection of the service and the second, protection of the programming.

Recently RCA has announced the launch of a third satellite because of predicted business . Their "Cable Bird" (Satcom 1) is almost saturated with programming. Earth stations having more than five video receivers are becoming commonplace. The need for wide band cable system is here and the programming is available. A problem in using the programming available is that the common carriers, RCA, Western Union, etc. typically rent/lease a channel for a certain number of hours per month. Most contractors do not specify which transponder (channel #) or satellite. Thus the service can be moved around and the Earth Station operator must be flexible.

Not all of the program originators have rented the channel they use on a 24 hour a day basis. This allows the common carriers to rent this channel to another programmer during other hours of the day. Since most cable operators hardwire their Satcom recievers to a cable television, modulator, most transponders are distributed to the public 24 hours a day. The FCC has stated that the cable operator is responsible to squelch the output of video receivers picking up unwanted signals (Programming). That is the cable operator must distribute only programming he is authorized to distribute. This can be done by retuning the video receiver to desired programming or by turning off the receiver or suppressing the output of the receiver or cable modulator. No matter what vehicle is used the cable operator is "responsible" to insure that he distributes only programming he is contracted to receive.

Expanded program availability has led to multichannel earth stations making protection schemes important to the smooth operation of a cable system. FCC requirements placed on cable operators compels interest in Program Protection schemes.

2.0 The Cable Television Market

Cable Television had its early start in providing video programming to areas without the benefit of commercial television. This was done by high quality reception of distant TV stations, and/or microwave of video programming, and/or coupled with the bicycling of video tapes.

In recent years the cable television market has blossomed into a thriving business. Technical advances combined with the FCC approval of 4.5 meter antennas have provided economical earth stations which are profitable for even the smallest of cable systems. Additional programming and services distributed via satellite combined with the entrepreneural aggressiveness of cable operators has spawned a phenomenal expansion of the cable television market.

Currently, the cable market reach some 20 million homes with a variety of services. Cable systems are being installed in major metropolitan areas

because it is becoming profitable in almost all communities. Cable television franchise are being applied for in most communities at an increasing rate. These indications point to projections that cable will reach 80 million homes by 1984.

The technology of space (Satellite) communications and the availability of good video programming are both responsible for the boom in the cable business. The technology is here to stay but the quality of programming could be subject to degradation. But this author feels that with the quality and diversity of programming in a free market place there will be an improvement in programming to which the public will benefit. The programming available today is in the form of end movies, HBP, Fanfare, ASN, super stations: WGN Chicago, WTCI Atlanta, etc, News and weather via audio subcarriers (slow scan video), Christian broadcasting: PTL, CBN, Trinity broadcasting and special events.

The special events range from Fanfare and Hughes sports to Robert Wold, to PBS, to SIN. Some of the special events are for broadcasters only,but cable can use them on a "non-interference" basis which will become more attractive as the cable systems continue to expand. Remember cable systems have multi channel capacity while broadcasters are limited to one channel. These multi channel capabilities of the cable systems require multi sources. As the market grows, cable system operations will continue to grow in size and complexity. Techniques discussed in this paper provide some solution for service protection of multi channel satellite earth stations.

3.0 Protection of Service

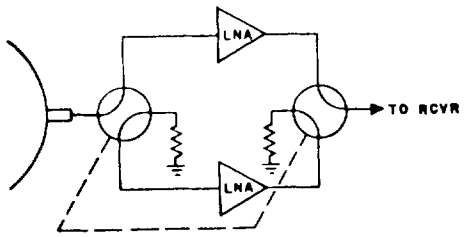
The most important thing in the cable business is the (uninterrupted) distribution of programming to the customer. Obviously, cost has a lot to do with the amount of redundancy and spare equipment on hand. But the protection of service is foremost in the minds of the cable companies.

A discussion of some redundancy of equipment follows.

Low Noise Amplifiers for Earth Stations

The Low Noise Amplifier (LNA) is a key element in the satellite earth station. There are three types of LNA's, but for the smaller earth stations used for video reception, the solid state (transistorized) will be the one disucssed here.

Most of the earlier/more expensive earth stations had redundant LNA's; redundant LNA's being defined as a 1 for 1 hot standby. That is, two LNA's and a waveguide switch mounted at the antenna. There are two good techniques for "switching LNA's". The first is the detection of a failed LNA from a fault indication, which is a summary alarm generated internally by the LNA. This requires a small amount of logic to determine whether the failed LNA is on line or not. If the failed LNA is on line (active), the waveguide switch should switch in the other LNA; otherwise, do nothing.

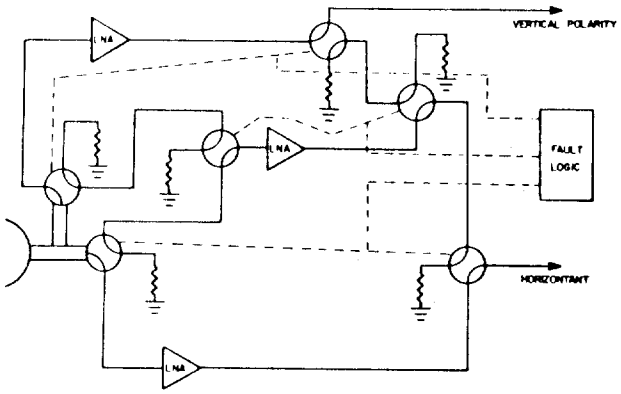


I:I LNA SWITCHING

This method allows this LNA switching to be remoted by the use of a dry contact very easily.

The second method is to monitor the fault output of all of the video receivers. If all the receivers have a fault (loss of RF) simultaneously (within one second), then generally one of two things has happened. First, either the satellite failed, or there was a failure in the LNA. If the satellite failed, it does not matter what you do. If the LNA failed, then the off line LNA (standby) should be switched on line. This method is not as popular as the other method. It will become even less popular because the widespread use of both polarities on the RCA satellite require more effort to implement.

To carry this discussion of LNA protection one step further, if protection of two polarities is required, what is the best method? The trend for earth stations with reasonable access time seems to be to go with single LNA's for each polarity used and to have a shelf spare. Then,upon failure, a technician can change out the device in about 15 minutes. For a focal point feed mounted LNA, this can be longer. Earth Stations using dual polarities and requiring protection, i.e., hot standby LNA, the thought of using one LNA to protect two LNA's for each polarity has come up repeatedly. A diagram of how this could work is provided.



1:2 LNA SWITCHING

The cost of an extra waveguide switch, special plumbing (waveguide bends), and extra logic/cable would cost more than full redundancy for each polarity. A suggestion made frequently is to utilize full redundancy on the polarity where the majority of revenue producing traffic is, and use a signal LNA on the other polarity.

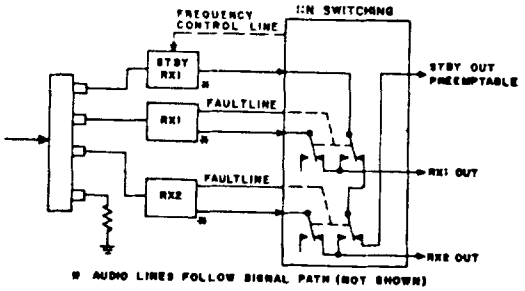
This provides 50% chance of protecting the

This provides 50% chance of protecting the failed polarity and if the single LNA dies per chance, then all is needed is to manually swap the hot standby with the failed LNA, thereby restoring service.

Video Receivers

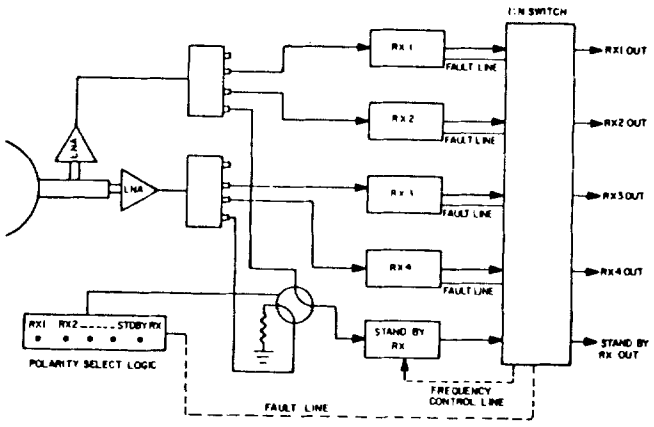
The protection of radios in general has historically been by having more radios than required, so that a failed unit can be swapped out or relieved of its assignment. Critical assignments have required one for one protection of radios; that is, one hot standby protecting the on-line radio. The need to protect more than one radio, coupled with the cost of a video receiver, has caused the development of a one for N switch to be used with satellite Earth Station video receivers.

This baseband switch allows one frequency-agile video receiver to be the hot standby radio for more than one on-line receiver. Two companies making a switch are Scientific Atlantic and Collins/Rockwell International. They are one-for-seven and one-for-eight switches respectively. The block diagram shows a one for N switch used with a single polarity Earth Station. The block shows two on-line receivers with a hot standby.



1:N RECEIVER SWITCHING

This protection of receiver can be carried a step further. The previous discussion was for multiple receivers on one polarity. But the switch can be used to protect multiple receivers on two polarities. The figure below shows a dual-polarity system with two receivers on each polarity, with the standby receiver receiving its RF signal from a coax switch that selects the RF signal from the same polarity as the receiver that fails. This additional function requires some manually programmable logic. The polarity select logic requires that the polarity of each reciever be set. This allows the polarity select logic to position the coax switch so that the standby receiver receives the correct RF signal (vertical or horizontal). Communication Properties Inc. has installed approximately fourteen of these dual-polarity video protections setups in their cable television earth station.

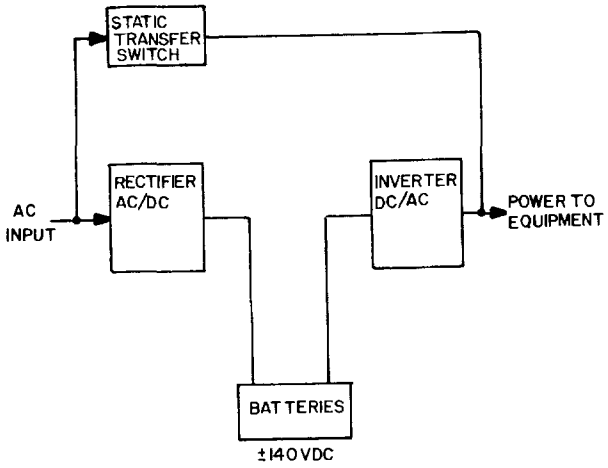


DUAL POLARITY RECEIVER PROTECTION

Communications Properties has also installed two antennas at their Midland, Texas, Earth Station location. The antennas and equipment are used as two separate systems, but for purposes of economics one could use any assortment of antennas, LNA's and one to N receiver protection schemes to best suit his requirement for protection of service.

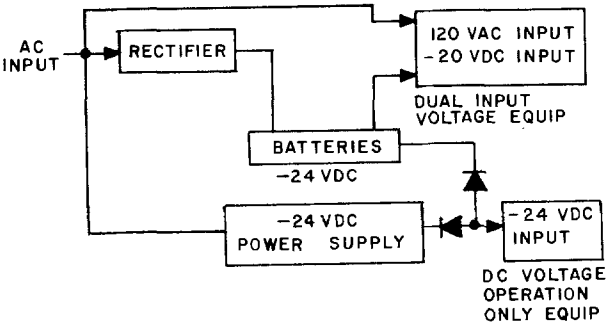
Power

There are many techniques for providing uninterrupted power systems (UPS) for communications equipment. There are three popular techniques shown. The first is typical UPS for large systems which provide an uninterruptable source of A.C. power. D.C. supplies are powered from the A.C. source. This is very expensive and generally not needed for video type reception (CATV type video).



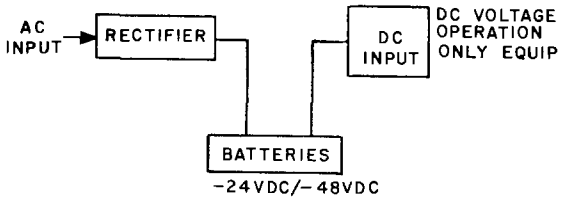
TYPICAL UPS SYSTEM FOR LARGE EARTH STATION CAPACITIES RANGE FROM 10 KW TO 500 KW

The second type is the DPS with D.C. backup which holds down the size of the invertor (which is the largest cost element) and allows the D.C. powered equipment to operate off the battery!



TYPICAL UPS SYSTEM FOR SMALL EARTH STATION WITH DC BACK-UP

The third type of system shown is the ideal situation where all equipment is D.C. operated. This is the most economical and most reliable type of backup.



TYPICAL POWER SYSTEM FOR MICROWAVE SYSTEM OR SMALL EARTH TERMINAL

The diagrams do not point out than an emergency generator can be used in conjuction with all the techniques to compliment long power outages. However, as one cable operator implied, it doesn't do much good to have emergency power at the earth station/Head-in if the cable distribution system is also having a power failure. This is especailly true in smaller communities.

Telephone

The telephone is an excellent real time tool for changing channels on a video receiver or turning the programming on and off. Some of the PBS Earth Stations capability on their remoted earth stations. Other Satcom users have discussed this capability, but to date it is not in widespread use. One reason is that it requires someone to monitor all broacasts and actually make the equipment changes real time.

Signals Contained in Programming (Out of Band)

Some of the program originators have agreed to put test tones on subcarriers as "trailer" to end of their daily programming. This would trigger a "switch-off" of the video receiver or a change in the frequency. An example of this would be that at the end of a movie, a special test tone would be put on the aural subcarriers for a period of time. This would be detected and cause the receiver to tune to another source of programming (like CBN or PTL) which allows 24-hour use of the equipment at a minimum cost for programming.

Signals Contained in Programming (In Band)

The other type of switching via transmitted signal is In Band switching. This is information contained within the video information that is picked out and used to control the video receiver. For example, Holiday Inn has requested that their upcoming 300 Earth Stations have information contained In Band that would control the frequency (channel) being received. This would be done by having the uplink source (program) put the information required in the programming for change to the next program source. The next source would be responsible for returning the receivers to the original channel moving another frequency. This would be done in concert with the program sources.

Microdyne reports that Microdyne, Scientific Atlanta, Holiday Inn, Home Box Office and RCA will perform tests to determine the best In Band technique for switching the Earth Stations video receiver frequency. By best method, we mean the best for Holiday Inn's application. Their opinion is that digital information on the vertical internal will allow the most latitude and be the best choice. Tests are scheduled for late April 1979.

Microprocessor control of the Earth Stations is immeninant. The widespread application of microprocessors has brought this technology within the reach of the small cable operation. The capability to fulfill numerous tasks is well within the capacity of the microprocessor. Examples of these tasks are:

- o Control Frequency of video receiver by the time or signals rec.
- o Control protection or redundancy of equipment.
- o Monitor Security.
- o Monitor ambient temperatures.
- o Control heating and cooling.
- o Interface with telephone to receiver command inputs or provide complete status of the Earth Stations and/or cable headin.

Program Coding

There is increasing requirement to secure that transmission of video programming. This requirements for both satellite and cable transmission.

ITT Space Communications has announced a Gray scale Sync Video processing system. This system is for improving signal to ratio, multiplexing audio channels into the video and implementing secure video transmission by switching the polarity of the alternate video scan lines. This has good potential and could be required to receive satellite transmission within two or three years. Because this would allow the programming houses like HBO, Fanfare, etc. to secure the transmission of their product, thus insuring that only subscribers receive the programming.

A less sophisticated technique which is perfect for cable distribution is the strip sync technique. Magnivox now sells a unit that strips the sync from the video programming and transmits the sync via a pilot carrier. The customer then installs a very inexpensive (CATV provide) demodulator at the input to his TV receiver which takes the sync information the pilot camera and inserts it back into the video information.

Conclusion

There are no such techniques of providing failure free service. There are many fine techniques of providing redundancy and control of equipment. The best solution to your operational needs must be determined by you. This includes consideration of cost, maintenance, equipment life, and others. A suggestion is made that consideration for protection schemes be made as you build or expand your systems. Most reputable equipment suppliers can help with solutions for protection, if not then system suppliers like Scientific Atlanta or Collins/Rockwell International will gladly assist you in selecting a protection scheme for your system.