History of Cable Television Relating to Traps & Filters

In the late 1940's and early 50's, commercial broadcasting of television channels became a reality in the United States. No one could ever imagine, what enormous communication opportunities would evolve in the following years. With television stations and other forms of communications springing up around the country, it was necessary to form a national regulating commission. Thus, the, Federal Communications Commission, or FCC came into existence. It continues to be the main regulating body for all forms of communications in the United States.

Normal broadcasting of television signals through air space has a distance limitation of approximately 200 miles depending upon the terrain, being much less effective in mountainous regions. Television signals characteristically travel in a straight line, therefore homes located in a valley would completely miss any television waves being delivered over head. As channel usage increased, higher bandwidth frequencies were assigned, resulting in even poorer coverage.

Due to limitations on distance, signal quality and terrain restrictions, **the Cable Television Industry was born.** Entrepreneurs built repeater sites that allowed television channels to be received, amplified and sent out over the airwaves to the next repeater location. This procedure was duplicated up to 15 times, enabling locations 500 to 600 miles from a TV transmitter to receive excellent signal quality. At various locations, and/or towns along the way, a coaxial cable distribution system was developed. This cable system would deliver the imported TV signals to individual homes or businesses for a fee. Where mountainous and terrain restrictions were present, the cable entrepreneur placed a receiving dish at the top of the mountain, where signal strength was high and delivered the signal, for a fee to the homes in the valley below. The transportation of this signal, from the receiving dish, or head-end site, to the homes was delivered via an aluminum coaxial cable. Coaxial cables were attached to utility poles paralleling telephone or power lines wherever possible.

As the cities grew and newer communities developed, utility poles were eliminated, forcing cable television transmission lines similar to telephone and power lines, to go under-ground. As with air transmissions, television signals lose their strength as they propagate through coaxial cable, therefore requiring signal amplification. Amplifiers, spaced several hundred feet apart, are positioned in line with the coaxial cable and mount near the utility pole whenever possible. This allows the cable television technician easy access to the equipment for repair and maintenance purposes..

Broadcasters such as NBC, CBS,. ABC, FOX, independent TV stations and educational channels generally offered programming that included news, sports, game shows, movies and special events. In the 1970's, an entrepreneurial company called Home Box Office (HBO) entered the fray. HBO initiated a mail-order distribution service of top notch movies specifically marketed for cable television operations. HBO charged a separate fee for its movie services, which was over and above the basic cable television fee. This produced the birth of cable television, part two; **specialty programming**. As technology spurred on and HBO approached break-even, they elected to broadcast from a satellite therefore eliminating the mailing difficulties and degradation of film. Today, better than 60 channels of specialty programming are being offered in addition to basic programs.

As HBO movies were being offered to cable systems throughout the United States, some subscribers elected either not to view these movies or had no desire to pay the extra fee associated with the movies. Therefore, a method was required of prohibiting the movie channel from reaching some of the homes. The device that was developed for this specific requirement was called a negative trap or filter. This unit was mounted on the spigot or port on directional taps that were generally pole mounted in front of every home.

The device prohibited the HBO movie channel from entering the home but allowed all other channels, with some attenuation, to pass cleanly.

This concept has served the cable industry for over 20 years as the most convenient, most economical and most effective method of securing premium channels. The original traps were made from a 50' length of flexible drop cable. The cable was shorted from the outer sheath to the center conductor at prescribed intervals which determined the center frequency of the trap. The cable was coiled, held together with a tie wrap and mounted near the directional tap. This trap design had the distinct disadvantage of being extremely wide; requiring three full channels to trap a single center channel. Because of its wide response, the coil trap soon gave way to a new discrete component trap using capacitors and coils mounted onto a PC board. The PC board was inserted into a sheet metal can with two "F" connectors. Customers however, could easily squeeze the sheet metal can with vise grips and defeat the trap by adjusting the trap notch, therefore this trap design died quickly. In 1976, Mr. Alan Devendorf, of Eagle Comtronics, decided to place the PC board within a double metal cylinder, thus resolved the security problem. This design still remains as the basic construction of traps and filters as we now know them today. The diameter of the cylinder is such that every port on a directional tap can easily accept multiple traps mounted side-by-side including security shields.

Television first began in the United States under the control of the Federal Communication Commission. It established a format for what constitutes a television channel that includes a black and white component, a color component and an audio component. As other countries subsequently developed television, they took full advantage of the improvements in technology and positioned the three components slightly different than we had in the US, resulting in different standards. These standards are known throughout the world as NTSC (or US version), PAL and SECAM. Every TV channel regardless of the country standard includes a black and white picture portion called video, a color portion which duplicates all colors of the rainbow and a sound or audio component. More detailed information regarding these components will be described in later sections.

The most elementary function of a negative trap is to attenuate the black and white portion of a channel to a depth of 60 dB or more. This will virtually eliminate all of the picture, color and in most cases, the sound. Since television channels are assigned sequentially in frequency, the respective black and white components of each channel changes in frequency and hence a trap must be designed and manufactured to a specific channel or frequency. The most common negative trap is the single channel trap. It can be built from the channel 2, frequency of 50 MHz to the UHF frequencies of up to 800 MHz. In a cable television system, when the active subscriber number exceeds 51% or the popularity of a premium channel is high, a negative trap is recommended for eliminating the channel from a non-subscriber. When the premium channel is not as popular and the active subscriber level is low, a technique know as tiering can be utilized. The less popular channels are then grouped sequentially and offered together for a special price. Grouping less popular channels together may produce a tier which may then become an attractive package. A special, negative trap can be manufactured to attenuate all channels of the tier simultaneously and it is called a tier trap. Another tier trap design that is available for attenuating a particular band of high frequency channels and passing all low channels, is called a low pass tier trap. The opposite, which attenuates a particular band of low channels and pass all high frequency channels, are known as high pass tier traps. The plain or common tier trap is when a band of center channels are attenuated and pass channels below and above the attenuated channels. Band pass filters pass a specific center group of channels and attenuate everything above and below it.

An alternative to the negative trap was invented in the mid 1970's. This unit was designed to improve the cost effectiveness for trapping in areas where the active penetration level was less then 15%. The unit is called a positive trap or decoding filter. At the headend a jamming carrier or carriers are inserted into the center of the premium channel. The net result will be a scrambled picture and sound, if the jamming carrier is not removed before the signal reaches the television set. If the carrier or carriers are removed with a sharply tuned trap at the jamming carrier frequency, the picture and sound is not affected and will appear

normal. Many cable systems today, successfully utilize single channel negative traps, tier traps and positive filters simultaneously.

To discourage theft, plastic and metal security shields are commonly used to encapsulate traps at the pole.

In the early days of television, metropolitan areas suffered a phenomena called ghosting. Television signals bounced off tall buildings and entered the antenna of a television set several times on the same channel causing the picture to have a series of ghosting effects which made the picture either unpleasant or un-watchable. Set top converters were invented to remedy this problem.

The set top unit converted any cable channel to a channel that was not an off air channel, therefore, eliminating the problem. It was quickly learned that the set top converter could easily expand the number of cable channels it could receive to more than the 12 channels that early model television sets were limited to. Millions of converters are in use today.

In the 1970's an addressable converter-descrambler was invented as an alternate form of premium channel security. At the cable system headend, the synchronization portion of a channel is removed and then transmitted with the channel in a different format with a specific address. At the consumer's home, the channel signals first passes through the addressable converter to a constant channel output, channels 2,3, or 4. It then passes to the descrambler portion and when remotely authorized, the synchronization portion is added to the channel which then produces a normal picture.

This expensive form of premium channel control is used in the US. Because converter-descramblers are located inside the home, they are extremely vulnerable to tampering and some are easily defeated. Cable operators have used traps mounted on the utility pole in many cases to additionally back up the security of addressable converter-descramblers. The addressable converter-descrambler has been perfected to offer premium programming through an option called impulse pay per view. Selecting a premium event can be accomplished by a return path utilizing the coaxial television cable itself or telephone lines.

In the late 1980's, a new form of premium channel security was invented called interdiction. At the utility pole, a scrambling signal was inserted into every non-subscribers channel. The security proved excellent but did not become popular due to its towering costs and high power consumption.

Two additional concepts of cable television distribution to the homes directly emerged in the late 1980's. One was over the air transmission at extremely high frequencies called MDS (Multiple Distribution Systems) and the other was DBS (Direct Broadcast from a Satellite). MDS uses a small dish at the home to receive channels while an electronic descrambler box inside the home decodes the scrambled channels. Neither system requires cables to be strung between poles as do the conventional cable plant, but additional television sets present a problem and security has not yet been proven. When return path transmission (home to headend) develops, the above two systems have additional limitations**.**

The mid 1990's introduced yet another concept of premium channel control and channel expansion. It is called compression and can be used on land cable systems, over the air systems and satellite systems. Two to ten channels can be compressed into one channel depending upon the quality of the channel. Seventy channel systems could become 700 channels systems. As of June, 1996, these decoder boxes have just become available and the cost is extremely high, four to five times conventional converter descrambler boxes. Practicality and security remain as major issues yet to be resolved.

In all of the previously discussed electronic decoding systems, the decoder, an expensive piece of equipment, again, is required inside the home and subject to tampering and theft of service. Additionally, whenever considerable dollars are involved, such as in subscribing to premium services, the illegal market will invest huge sums of money to attract potential customers and compromise these services. When all is said and done, the most secure system to date, as employed by the cable systems, is a cost effective trap mounted on or near a utility pole and out of the reach of potential illegal forces.

The mid 1990's ushered in a new and exciting application for traps other than normal

downstream premium channel control. They're called ingress suppression traps, an application that removes unwanted signal from being fed back to the cable system, from the home. The consumers enormous appetite for new services such as telephone on cable, banking, shopping at home, world wide web, exchange of information and numerous other services require a return signal path from the home to the communication focal point. A return spectrum of 5 to 42 MHz is currently being investigated. Unfortunately this 5 to 42 MHz band is full of man-made unwanted noise or electrical signals from ham operators, two way radios, world radio transmitters, microwave ovens, plus a long list of other disturbances, which often interfere and sometimes totally obliterate the return path signals. To isolate the return path from these unwanted signals, high pass filters or high pass with window traps are used. They appear to be the only economical solution to the current dilemma and may be required in every cable home.

EAGLE COMTRONICS INC.

Corporate Headquarters: 4562 Waterhouse Road, Clay, NY 13041
Telephone: (315) 622-3402 Toll Free 1 800-448-7474 *Fax:* (315) 622-3800
U.S.: Antec Corp. *Telephone:* 1-800-252-2288 *Fax:* (708) 439-8531

Canada: Antec Corp., *Telephone:* 1-800-665-1482 *Fax:* (905) 507-6496 **Distribution:** Argentina, Belgium, Brazil, Canada, Chile, Denmark, Egypt, France, Germany, Israel, Italy, Korea, Mexico, Norway, Poland, Portugal, Romania, South Africa, Spain, Sweden, Taiwan, Turkey, UK, and Venezuela. *Call for additional information.*

Pub No. 696-2 Printed in USA