INTERFACING CABLE TELEVISION AND BROADCAST SUBSCRIPTION TELEVISION

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One of the primary technical advantages with coaxial cable television for telecommunication purposes is the cable system's technical compatibility with most of the newly developed communication systems in addition to existing communication systems now being given renewed priority consideration as a result of the public demand for premium subscription programs.

Cable television systems may be confronted with some technical compatibility problems if required to carry both the Broadcast Subscription Television (BSTV) station's premium and "free" programs. While there may not be a channel capacity problem in offering more than one type of premium program, there are compatibility problems involving the delivery of BSTV and cable premium programs over the same cable system.

By Public Notice dated November 15, 1977, the Commission identified seven (7) BSTV systems which had received "advance system approval." These systems are not compatible. Moreover, there are applications presently pending before the Commission for a waiver of "the one BSTV station to a community" rule. If this rule is waived, this would further complicate the compatibility/interfacing problem between cable and BSTV. Cable systems may choose to carry other over-the-air premium signals with little or no technical interfacing problems. This is evident from system carriage of: HBO's programs via satellite, and Multipoint Distribution Service (MDS) signals. This paper will only focus on premium BSTV program carriage on cable systems.

BSTV premium carriage on cable systems presents varying degrees of technical problems for all cable systems since all the BSTV systems involve encoding both the video and audio. This paper will address some of the technical, compatibility problems between various types of cable systems and specific hypothetical encoding and decoding techniques which could be proposed by BSTV stations, how interfacing can be accomplished, circumstances under which piracy can occur, and what can be done to minimize piracy.

History

On February 10, 1955, the Commission adopted a Notice of Proposed Rule Making in Docket 11279, FCC __-___, __ FCC 2d ___, in response to a petition filed by Zenith Radio Corporation and Teco, Inc. (proponents of the "Phonevision" subscription television system); Skiatron TV, Inc. (proponent of the "Subscriber-Vision" subscription television system); and other television licensees and permittees. While no specific proposals for rules were contained in the Notice, it did include questions of law and facts designed to ascertain whether the Commission should adopt rules to authorize television stations to transmit programs paid for on a subscription basis. This Notice defined BSTV simply as the transmission of programs intended to be viewed only by those who pay a charge.

On May 23, 1957, the Commission adopted a Notice of Further Proceeding in Docket 11279, FCC 57-530, 22 F. R. 3758, announcing that it had statutory authority to authorize the use of television frequencies for subscription operation if it found that such a decision would be in the public interest. However, the comments submitted per the February 10, 1955 Notice failed to provide an adequate basis for concluding either that subscription television should or should not be authorized. Therefore, in the NPR of May 23, 1957, the Commission was persuaded that trial demonstrations would be indispensable and invited comments to aid it in deciding the conditions under which trial operation should take place.

On October 17, 1957, the Commission adopted a First Report and Order in Docket 11279, 23 FCC 532, 16 RR 1509, detailing the basis for the statutory authority and also announcing that the Commission was prepared to accept applications for authority to conduct trial subscription television operations prescribed therein. A Third Report adopted in 1959 amended the First Report in three important respects:

(1) it allowed trial of a specific subscription TV system in only one market instead of up to three;

(2) it allowed only one system to be tried in a market instead of more than one; and

(3) it precluded operators of trials from requiring the public to purchase equipment (a question left open in the First Report). 1/

After a five-day en banc hearing before the Commission on February 23, 1961, the first BSTV application (filed on June 22, 1960, under the terms of the Third Report) was granted to RKO General Phonevision Company (then known as Hartford Phonevision Co.,), licensee of UHF station WHCT, Hartford, Connecticut. The Commission's WHCT authorization permitted a three-year trial operation of subscription television using Zenith Phonevision equipment. 2/ The operation commenced on June 29, 1962. Then on May 21, 1965, the authorization was extended for a period of three years or (if it occurred sooner) until such time as the Commission terminated the outstanding rule making and "enters an order with respect to the authorization."

Zenith Radio Corp., manufacturer and holder of the patent for Phonevision equipment, and Teco, Inc., patent licensee of Zenith, filed a joint petition for further rule making on March 10, 1965 to authorize nation-wide subscription television which, among other things, contained detailed information about the first two years of the Hartford trial.

On March 21, 1966 the Commission adopted a Further Notice of Proposed Rulemaking and Notice of Inquiry in Docket 11279, 7 RR 2d 1501, in which the Commission stated, inter alia: (1) that it "...has statutory authority to authorize subscription television on a permanent basis..." and the court decision in the Hartford case is not limited to upholding the Commission's authority to authorize trial operations only, and (2) that subscription television constitutes "broadcasting within the meaning of Section 3(o) of the Act and therefore, it is not a common carrier service. Moreover, aside from deciding the two issues above, the Commission invited comments on other questions such as:

(1) Should Subscription Television be Permitted in All Markets and Should There be a Limitation on the Amount of Time that Stations May Devote to Subscription Broadcasting?

(2) Should Subscription Television be Limited to UHF Stations or Otherwise Limited with Respect to Stations?

(3) Should Subscription Television be Permitted Over More Than One Station in A Community, and if So, Should Such Stations be Permitted to Broadcast Subscription Programs Simultaneously?

(4) Should Subscription Television be Limited to a Single Technical System?

The Commission for the first time enlarged the BSTV proceeding, and invited comments pertaining to wire or cable subscription television. Questions raised regarding a hypothetical situation for a community with no off-the-air TV signals and a single cable system were as follows:

(1) Would it be necessary to have built-in antennas in the decoders attached to sets of subscribers?

(2) Would a single decoder attached to the cable system which delivered the unscrambled signal to subscribers suffice?

(3) If so, what arrangement for collection of subscription fees could be made?

(4) Would the rules on carriage of signals of local stations over cable systems apply to carriage of BSTV premium programs?

On December 12, 1968, the Commission concurrently adopted a Fourth Report and Order and Third Further Notice of Proposed Rulemaking in Docket 11279, 3/ wherein the Order established a nation-wide, over-the-air subscription television service, and with the exception of technical standards, adopted rules governing the BSTV service. This Order also discussed the question of carriage by cable systems of BSTV signals and announced that although the Commission is not presently requiring such carriage, it is issuing the instant Third Further Notice inviting comments

1/ The Third Report, adopted March 23, 1959, amended the First Report in some respect, and otherwise "readopted and reaffirmed it. 26 FCC 265, 16 RR 1540a.

2/ In Connecticut Committee Against Pay TV v. FCC, 301 F2d 835 /23 RR 2001/ (D. C. Cir.) cert. denied, 371 US 816 (1962) the United States Court of Appeals for the District of Columbia Circuit affirmed the action of the Commission in authorizing this trial.

3/ FCC 68-1174, 15 FCC 2d 466 and FCC 68-1175, 15 FCC 2d 601, respectively.

on a proposal to require it. The Third Further Notice proposed that cable systems operating within a BSTV station's Grade B contour carry both the coded and uncoded programming of the BSTV station exclusive of decoding the coded signal at the cable system headend. 4/ This proceeding also proposed the cable system carriage of BSTV station to within the station's Grade B contour.

Recently, the Commission issued a Notice of Proposed Rulemaking and Inquiry in Docket 21502, FCC 77-848, __ FCC 2d ___ calling for comments on the possible effect multiple BSTV service would have in a given community. The Third Further Notice in Docket 11279 and the recent Notice and Inquiry in Docket 21502 considered in conjunction with the growing market of pay cable premium programming in the country, indicates to some extent, the degree of the non-technical problems and issues the Commission must resolve in considering whether to require carriage of the encoded premium programming of BSTV stations by cable systems. However, the focus herein will be on the technical compatibility problem of BSTV with the various types of cable systems.

Types of Cable Systems

For the purpose of examining specific types of cable systems in conjunction with BSTV stations, we will assume that the Commission has a rule requiring cable systems to carry BSTV stations coded programming if the cable system serves a community located within the BSTV station's Grade B contour.

Technically, there are three basic types of cable television systems. They are: (1) the Single-Cable-Non-Converter cable system; (2) the Multi-Cable-Switcher-System; and (3) the Converter-Cable-System. The Single-Cable-Non-Converter system attaches directly to a matching transformer for connection to the back of the subscribers receiver at the 300 ohm input antenna terminal. This system has a maximum TV channel capacity of the standard 12 VHF television channels. Moreover, the cable operators normally remove the off-air-antenna when a cable connection is made (see Figure 1).

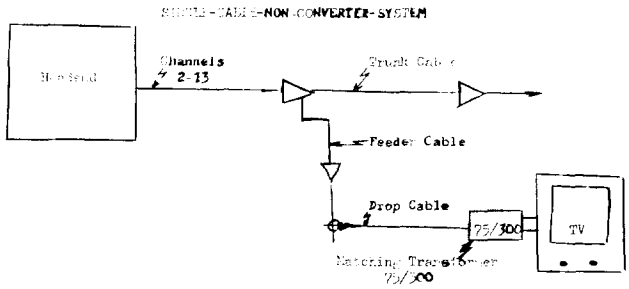

FIGURE 1

The Multi-Cable-Switcher-System utilizes two or more cables on the distribution plant up to the subscriber's terminal, where a switch is then installed containing a single 75 ohm cable output which is attached to a matching transformer containing a 300 ohm twin lead that connects to the back of the subscribers receiver at the 300 ohm input antenna terminal. This system channel capacity depends on the number of distribution cables, with a maximum of 12 TV channels per cable. The majority of Multi-Cable-Switcher-Systems are dual cable systems with a capacity of 24 TV channels selected from "A" and "B" cables using a switch at the back of the subscriber receiver. (See Figure 2)

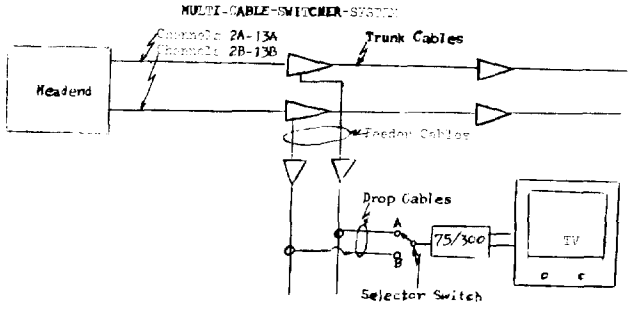

FIGURE 2

The Converter-Cable-System is a system utilizing a converter at the subscriber terminal which attaches to the receiver preempting the television set tuner. This system's TV channel capacity is normally in excess of 30 depending on, the type of converter and/or the number of distribution cables utlized (see Figure 3).

4/ Issues pertinent to this paper are BSTV rules codified in Volume III, Part 73, Section 73.641-73.644 which state: (1) BSTV is a broadcast service; (2) BSTV stations licensed to or proposing to operate in communities located wholly within the Grade A contour of five (5) or more commercial TV stations, including the applicant station, would be eligible to receive BSTV authorization; (3) only one BSTV station will be authorized in a community; (4) BSTV stations are also required to broadcast at least the minimum amount of uncoded programming required to conventional TV stations pursuant to Section 73.651 of the Rules; (5) BSTV stations are required to provide premium programming service to all requesting persons within the station's Grade A contour; and (6) comply with an interim system equipment and performance approval procedure pending further amendment of the rules establishing a type acceptance procedure.

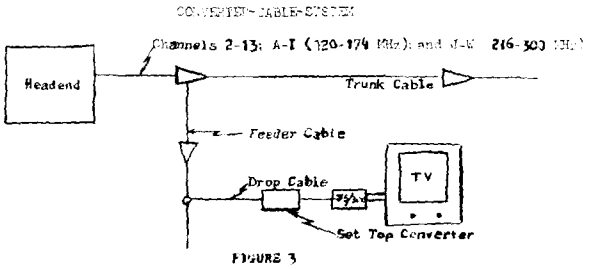

FIGURE 3

These three types of cable systems and the combination of the Multi-Cable Switcher and Converter-Cable-System constitute the vast majority of cable systems in operation throughout the country. Therefore, interfacing of BSTV premium programming over cable systems will be limited to a discussion of these three systems.

Types of BSTV Premium Systems

By Public Notice dated November 15, 1977, FCC-91486, the Commission identified seven (7) BSTV systems which had received "advance system approval." 5/ As indicated earlier, these systems are not compatible. Using three imaginary, hypothetical premium systems, the non-compatibility characteristic of premium systems can be demonstrated. These hypothetical systems were constructed by extracting technical data from available data submitted to the Commission. The propriety of the material would not allow the author to specifically discuss any of the type approved systems.

These premium systems are not intended to describe any of the BSTV systems which are pending or which have secured system approval from the FCC. These are imaginary, hypothetical systems described here to focus on the problems confronting cable systems if the Commission were to require carriage of BSTV stations premium programming. The premium systems are described in a manner to include a close replica of a premium system which may be utilized by a BSTV station, Multipoint Distribution Service (MDS) station and/or a premium satellite signal (e.g. HBO). These imaginary systems will be identified as STV-Model-1, 2, and 3 premium systems.

5/ The systems are: (1) Zenith Radio Corp.-Phonevision; (2) Blonder-Tongue - Number 4745; (3) Feature Film Service, Inc. - Model FFS-2000; (4) Oak Industries, Inc. - Model I; (5) Pay Television Corp. - PTV System 3; (6) Teleglobe, Inc. - Number 410; and (7) System Development Corp. - SDC Pay TV System. One other system is pending from MELCO which proposes to only scramble the audio, and the Commission has denied one system filed by Tanner Electronics.

STV-MODEL-1

The MODEL-1 system encodes by cutting the conventional 525 line television picture into many horizontal segments of a specific number of lines each. Alternate number of line segments are continuously shifted back and forth horizontally, while the divisions between these specific number of line sigments randomly shift their position producing a visual effect of picture segments moving up and down vertically. The combination results in a satisfactory breakup of the picture with little intelligibility. In addition the video signals are transmitted with the black and white inverted similar to a photographic negative.

Video segments not shifted in the coding process are shifted in the decoding process, while segments that are shifted in coding are not in decoding making the video coding process at the transmitter complementary to the video decoding at the receiver.

The audio accompanying the encoded video is scrambled by shifting the audio in frequency. The decoding of the audio is accomplished by shifting the audio back to its original frequency.

The video coding is varied from program to program. Therefore, the coding pattern information needed by the decoder will likewise change from program to program. The coded broadcast signals cannot be decoded without the combined use by each subscriber of the following combined steps:

> A "Pressure" signal is transmitted over the air as part of the MODEL-1 broadcast and both subscribers and non-subscribers can receive this "Pressure" signal. However, decoding does not occur until a ticket, which is mailed to all subscribers, is inserted into the decoder. (See Figure 4)

STV-MODEL-2

The MODEL-2 system multiplexes discrete spectrum bandwidth for transmission of visual, chrominance, barker aural, digital control, and digital aural signals. The visual, chrominance, and barker aural information are transmitted together on a single channel as is standard for NTSC color transmission. However, a second grouping of signals is utilized for transmission of a digital, frequency-shift keyed signal containing a stream of specified bit serial binary data and a digital frequency-shift-keyed signal containing a stream of specific bit serial binary data.

The MODEL-2 system frequency-division multiplexes the frequency-shift keyed signals with the visual portion of the television signal in a single broadcast TV channel. The carrier frequency of the amplitude modulated visual signal, frequency

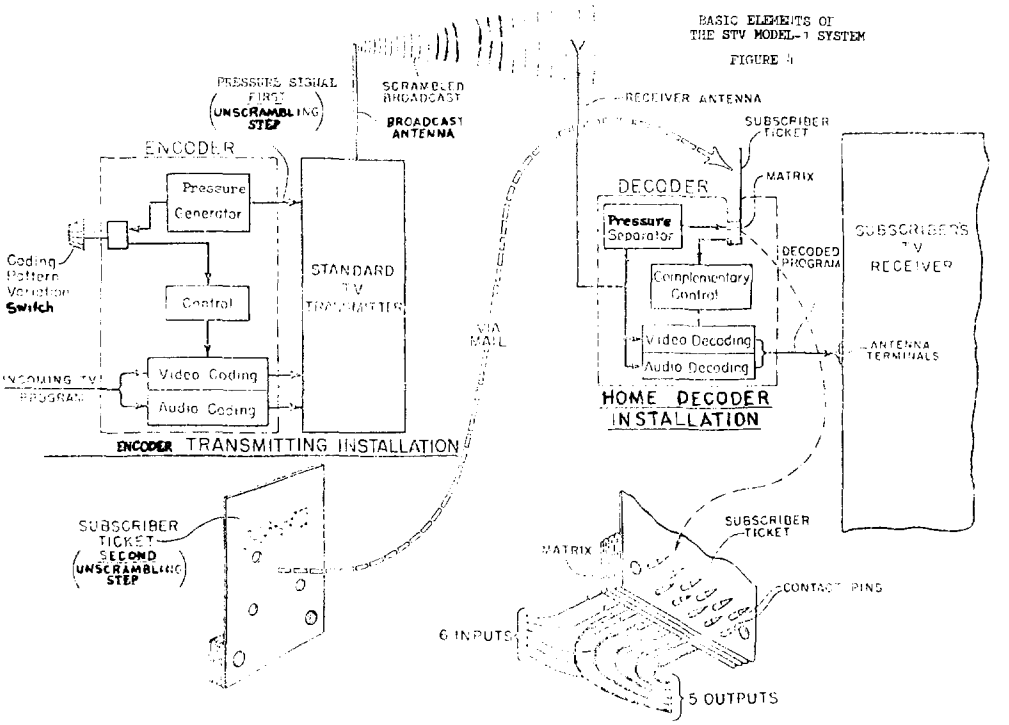

FIGURE 4

modulated control signal, frequency modulated aural signal, and phase modulated chrominance signal all occupy the same bandwidth, but at different center frequencies.

Separate discriminator and synchronous detector circuits in the receiver's intermediate frequency amplifier and detector circuit boards sort out the four signal components. This method of overlapping AM and FM signals is identical in principle to recently proposed methods for broadcast of stereo on the AM standard broadcast band channel.

The STV-MODEL-2 decoder attaches to the subscriber receiver 300 ohm antenna lead, and to a standard 4 prong telephone socket. When a subscriber requests service, he depresses a button on his decoder. Automatically his decoder places a telephone call to the broadcaster's facility, and sends data over the telephone network containing the subscriber's account number and requested code.

A computer at the broadcaster's site stores this data and the telephone call is terminated. At the appropriate time, the broadcaster sends the control signals to unlock the subscribers decoder box and the otherwise scrambled audio and video on the television receiver is restored. When the broadcaster no longer sends the account code of a particular decoder box in his control signal, the decoder automatically locks up and only a coded picture can be viewed.

STV-MODEL-3

The MODEL-3 system employs a method which uses an interference signal impressed on the normal composite video signal, including the intercarrier audio signal, in a phase relationship to the horizontal sync pulses reducing the amplitude of the sync pulses and simultaneously increasing the video content between pulses.

A receiver seeing this encoded signal will attempt to achieve horizontal lock on the highest instantaneous signal level detected which is now in a new position from a normal television broadcast signal transmitted in the United States. The randomness inherent in video information will add to the receiver's difficulty in achieving horizontal lock and the resulting picture is unwatchable because of improper lock and horizontal tearing.

The decoder, which attaches to the subscriber's receiver, 300 ohm antenna terminal, is activated by simply turning a switch on the unit to the premium mode.

Interfacing

If the Commission were to require cable systems to carry the BSTV stations premium program, the Commission should also require that the BSTV station premium system comply with the technical, transmission standards codified in Section 73.682 of the Rules for conventional television broadcast stations. Moreover, a premium system

receiving "system approval" from the Commission, does not necessarily mean that when the system is installed and operated by the BSTV station, the station will comply with the transmission standards codified under Section 73.682 or 73.644. Section 73.644 of the Rules contains technical standards applicable to BSTV stations equipment and system performance.

Existing cable systems have been designed and built to carry television station signals meeting the requirement of Section 73.682 of the Rules. Cable systems carrying stations meeting the standards under Section 73.682 require that the cable system be designed and built in accordance with certain specifications, utilizing specific types of active and/or passive equipment in order to comply with the cable television technical standards codified under Section 76.605 of the Rules.

While it appears relatively easy for the premium signal out of the BSTV station subscriber's decoder to violate Section 73.682, especially in reference to overmodulating the audio, an assumption will be made that the three hypothetical premium system transmit signals in compliance with Sections 73.682 and 73.644 of the Rules. 6/ However, it must be emphasized that if the Commission decides to create separate technical standards for BSTV premium signals out of the decoder, no requirement pertaining to cable system carriage of BSTV premium signals should be instituted without ascertaining the impact on cable systems.

Therefore, assuming that the STV-MODELS-1, 2 and 3 premium systems meet the standards under Sections 73.682 and 73.644, one can then proceed to examine how these imaginary premium systems can be carried on the three types of cable systems identified above.

The operator of the Single-Cable-Non-Converter (S-C-N-C) system can carry any one of the three types of hypothetical premium systems with little or no technical difficulty. BSTV premium signals can be carried and unscrambled on a cable system in two ways: (1) unscrambling the signal at the headend; or (2) unscrambling at the subscriber's terminal.

6/ While this assumption is being made for these three hypothetical premium systems, field tests are the only true way to determine compliance. In this regard, it is noted that the Commission has authorized only eight BSTV stations. Of these stations, only the Newark, New Jersey, and Corona, California stations have actually begun operation. In addition, there are at least 23 applications pending for premium authorizations in at least fourteen other communities. Many of these pending applications must be designated for comparative hearing since the "one-to-a-community" rule has made them mutually exclusive.

S-C-N-C Headend

Unscrambling at the cable system's headend for distribution purposes can be accomplished two ways. The first is to unscramble the BSTV premium signal at the headend utilizing a decoder compatible with the BSTV station's encoder and redistributing the unscrambled BSTV station's premium signal on a vacant VHF channel to all subscribers. This approach involves the least expense to the cable operator in purchasing new equipment. However, it may not be the simplest technique to administer since it appears under this approach, that the cable operator may have to pay the BSTV program supplier a flat, bulk rate for the premium program, possibly, based on his number of annual subscribers. However, this unscrambling technique is the least expensive regarding equipment installation, and it appears to pose the least technical problem, since all three of the hypothetical premium systems can interface with S-C-N-C cable systems when unscrambling is accomplished in this manner. (See Figure 5)

S-C-N-C CABLE SYSTEM

(Where the BSTV premium signal is unscrambled at the headend and distributed unscrambled to all subscribers).

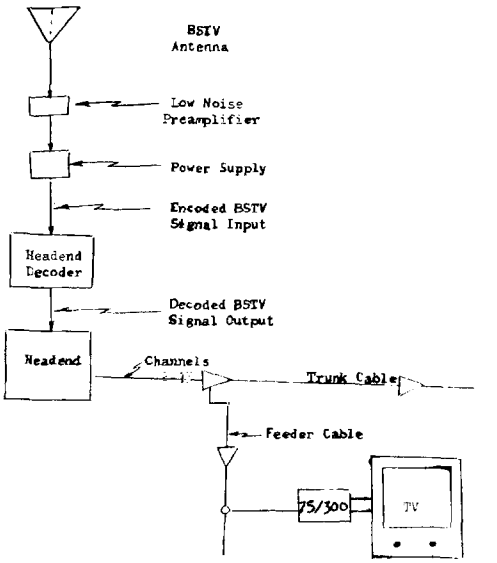

FIGURE 5

This approach has the disadvantage of possibly forcing all S-C-N-C subscribers to pay for and receive the BSTV premium programming whether he wishes to subscriber or not thereby exempting the cable subscriber from the freedom of choice available to non-cable subscribers.

The second way unscrambling at the cable headend is accomplished is by unscrambling the BSTV premium signal at the headend using a decoder

compatible with the BSTV station encoder, and then the S-C-N-C operator recodes the premium signal and converts the BSTV premium signal to a vacant VHF channel for distribution to only interested subscribers. This technique appears to be more practical, but it also appears to be more costly. (See Figure 6). When the S-C-N-C

S-C-N-C CABLE SYSTEM

(Where the BSTV premium signal is unscrambled and then rescrambled at the headend for distribution to subscribers equipped with a decoder).

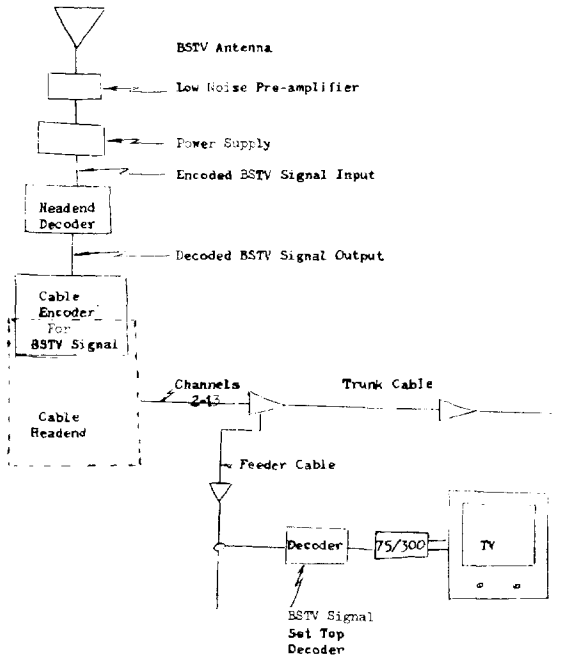

FIGURE 6

operator uses this approach, there are two rate and service approaches used by the BSTV station, codified in the form of affiliate agreements, involving the expense for purchasing, installing, and maintaining the encoder/decoders equipment on the cable system. These two approaches can be seen from an affiliate agreement between one operating BSTV station, WTVG-TV, and a cable system operating within the station service area. Under the first approach the BSTV licensee offers the cable system an affiliate agreement for a license fee of $5.00 or 50% of the premium program service charged per month, per subscriber depending on which fee is greater. This agreement specifies that the cable operator will purchase and install the necessary decoding devices and maintain total subscriber service for the BSTV premium program subscribers. Moreover, when the cable operator wishes to use a decoder other than that used by the BSTV station, the station will own the master headend decoder, and the cable operator will own all other headend components.

The second approach involves the same license fee, however, the BSTV station has a service agreement for cable operators, including those offering other premium program services, which state that the cable operator "...will purchase and install the necessary headend equipment to receive and deliver..." the BSTV station premium programs, "...and provide all installations, servicing and disconnects." The BSTV station will market, and provide the appropriate decoder for each BSTV subscriber on the system. The BSTV station will pay the cable operator $7.50 per installation and $2.00 per month per BSTV subscriber. In the event the BSTV premium program supplier sells his program to a BSTV subscriber, who is passed by the cable operator and not a cable subscriber, the BSTV supplier will pay the cable operator $10.00 for the BSTV premium program installation and $3.00 per month for servicing of the single channel. If the BSTV subscriber becomes a cable subscriber, the BSTV station will then pay $2.00 per month as above. In this case, the cable operator remains a contractor for installation/maintenance.

S-C-N-C Subscriber Terminal

The second way the S-C-N-C cable system can carry and unscramble a BSTV premium signal is at the subscriber terminal. In this way, the S-C-N-C operator can install the appropriate cut-to-channel receiving antenna, low noise preamplifier, and power supply at the cable system headend, converts the BSTV encoded signal to a vacant VHF channel and deliver the coded BSTV signal to all subscribers. Subscribers wishing to view the BSTV programs must be furnished a decoder which is compatible with the BSTV station's encoder. As indicated above in the second approach of the BSTV/cable system affiliate agreement, the BSTV station will market and provide the appropriate decoder for each BSTV subscriber on the system. Moreover, the BSTV station will also pay the cable operator for servicing, installation, and maintenance of the BSTV decoder equipment. This approach centralizes all servicing and maintenance at the subscriber's terminal by affording the cable operator almost exclusive jurisdiction. Having this jurisdiction, can possibly eliminate subscriber complaints resulting from allowing parties, other than the television repairman and the cable system technician, to tamper with the subscriber terminal equipment.

Without addressing the legality of BSTV station/cable systems affiliate agreements, if the Commission were to require cable systems to carry BSTV premium signal placing a Grade B contour over the cable community, the Commission should simultaneously address the cable system access to and responsibility for the BSTV premium signal decoders. It is noted that the S-C-N-C and the Multi-Cable-Switcher-System (M-C-S-S), unless furnishing a premium unscrambled signal to all subscribers, will have no active auxiliary equipment attached to the

subscriber receiver (See Figure 1 and 2, respectively). Therefore, a decision as to S-C-N-C and M-C-S-S operators' responsibilities for securing the decoders must be ascertained. Should the cable operator be required to purchase these decoders from the premium system manufacturer or BSTV station? Or, should the responsibility for the decoders fall on the BSTV station whose signal the cable system is required to carry. The S-C-N-C and the M-C-S-S systems can carry premium programming on his system without installing a decoder at the subscriber terminal. This technique involves the installation of traps at the non-premium subscriber's terminal. These traps can prevent a non-premium subscriber from receiving the premium programming being delivered, unscrambled, over the cable system.

Traps

A trap is placed in the cable drop, usually remote from the interior of the non-premium subscriber's home. In communities where the percentage of subscribers of premium programming is high, a trap system, theoretically, probably makes more sense. The trap is inexpensive, relatively easy to install and virtually maintenance free since it is not an active device but a passive one. It should be noted however that the trap only weakens the video signal, hopefully, so the non-premium subscriber cannot see it, and normally does nothing to the audio.

An economic disadvantage to using traps can be illustrated by the following example.

A cable system, with 10,000 subscribers 2500 of which are subscribing or would like to subscribe to the premium programming, must trap 7500 homes at a cost of approximately $7.00 per home (which is the average cost of the most inexpensive trap). Therefore, approximately $70,000 is needed to purchase and install the traps, and this amount must be invested before the premium channel is activated and a sale made. Therefore, in this example, the cost of a trap is approximately $21.00 per premium program subscriber based upon 25% saturation of homes connected to the S-C-N-C and/or M-C-S-S cable systems.

Aside from the economical disadvantage, traps can easily be physically damaged by non-premium program subscribers to pirate the signal. In addition, the installation of traps require a trained technician. However, since the non-premium program subscriber may not allow this technician access to the home, it is difficult to assess whether the trap has removed the premium signal from the receiver.

Signal Leakage

Regardless of whether the BSTV station or the S-C-N-C and/or M-C-S-S operator has responsibility for the decoders at the subscriber's terminal, there is a potential problem of signal leakage from the BSTV signal decoders. Presently, cable systems are plagued with the fact that television receivers are not well shielded from radiation of off-air-signals. This means that the receiver is capable of picking up a signal through the receiver's tuner and this undesired signal will cause interference to the desired cable signals utilizing these same off-air-channels. The S-C-N-C and/or M-C-S-S cable systems avoid this interference by utilizing channels on the system which are not utilized off-air in the area. Television receivers also radiate signals including the cable television signal, but this is not necessarily the responsibility of the cable operator. The cable systems' responsibility for cable radiation go up to, and includes, the equipment of the cable system at the subscriber's terminal designed to interface the drop cable with the subscriber's television receiver. Nevertheless, the cable system attempts to control radiation from the receiver by delivering a minimum visual signal level of 1 millivolt and/or 2 millivolts across a 75 ohm and/or 300 ohm terminating impedance, respectively, but below a maximum level such that signal degradation due to overload in the receiver does not occur.

If, however, radiation occurs at the point where the drop cable interfaces with the subscriber's receiver, the cable operator must take steps to insure that the maximum field does not exceed 20 microvolts per meter, 10 feet from the cable. (See Section 76.605(a)(12) of the Commission Rules).

However, with the addition of a decoder between the drop cable and the subscriber's receiver, cable systems may no longer be able to meet the cable radiation standards specified in Section 76.605(a)(12) since the cable operator may not control the decoder.

MULTI-CABLE-SWITCHER-SYSTEM (M-C-S-S)

The same problems pertaining to the S-C-N-C cable system would be involved with a M-C-S-S cable system and therefore will not be covered separately. However, there are more abstruse policy and technical compatibility problems pertaining to the Converter-Cable-System (C-C-S) as will be demonstrated below.

CONVERTER-CABLE-SYSTEM (C-C-S)

As can be seen from Fig. 3, the C-C-S system utlizes a set top converter as an input to the subscriber television receiver. The cable converter is a well shielded unit, containing among other things, a tuner which is utilized in place of the receiver tuner, which is not well shielded. The Converter-Cable-System is utilized primarily in areas requiring cable systems with large channel capacities, and/or in areas where a number of television broadcast stations furnish strong off-air signals which can be picked up by the television receiver absent the receiver's own antenna. There may be a few C-C-S systems providing subscribers with

converters capable of receiving a premium channel, but not yet providing that programming. In such cases the C-C-S operator could simply unscramble the signal at the headend and deliver the signal to interested subscribers on a vacant premium channel. If however, the system is already offering a premium program service, adding the BSTV premium signal would involve the most difficult interfacing problems and the greatest equipment expense. Additional or modified equipment at both the headend and the subscriber's receiver would be necessary because of the type of decoders and converters currently in use. Most converters now in use only have circuitry capable of decoding one scrambled channel. Therefore, the addition of a BSTV premium signal would necessitate the addition of more unscrambling equipment at the headend and a second piece of equipment, the decoder, at the subscriber's terminal. (See Figure 7).

Carriage and unscrambling of a BSTV premium signal on a C-C-S system can be accomplished by unscrambling at the headend or at the subscriber terminal. Unscrambling at the C-C-S headend can be accomplished by either: (1) distributing the unscrambled BSTV premium signal on a mid- or super-band channel and furnishing interested subscribers with a special converter on a key and/or card which allow the subscriber to access the mid- or super-band channel containing the BSTV programming; or (2) unscrambling the BSTV premium signal and then rescrambling the BSTV station premium signal at the cable headend for distribution to subscribers equipped with a BSTV decoder in addition to the cable converter. Figure 7 indicates how the latter unscrambling method can be accomplished. The BSTV decoder must be placed in series with the cable converter. Moreover, the cable subscriber now becomes functionally dependent on the cable converter and the BSTV decoder. Admittedly, the BSTV decoder is transparent and is activated only when the decoder switch is tuned to the premium channel. It simply acts as a non-active passive device for all other channels distributed over the cable system. However, the subscriber's access to all television could depend on whether this BSTV decoder operates free of any malfunctions. In addition, the BSTV decoder, installed as depicted in Fig. 7, will increase the possibility of signal leakage from all channels, including the BSTV channel, passing through this decoder. While the typical decoder does not contain an oscillator capable of radiating a signal, it must be well shielded to preclude the cable signal from radiating, and simultaneously prevent off-air signals from infiltrating the cable signals to cause interference. Therefore, the problem facing the S-C-N-C and M-C-S-S operators in adhering to the cable technical standard specified in Section 76.605(a)(12) will also face the C-C-S operator. The decoder is equipped with 75 ohm input and output leads similar to the cable converter. The 75 ohm output of the cable converter is attached to the 75 ohm input of the decoder and the 75 ohm

CONVERTER-CABLE-SYSTEM AND BSTV PREMIUM DECODER

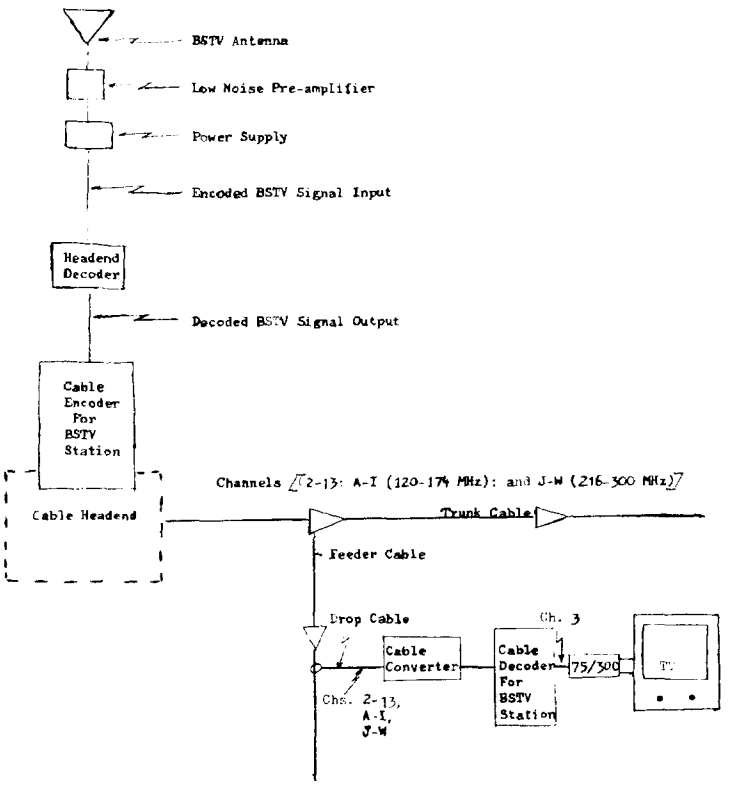

FIGURE 7

output of the decoder must be connected to a matching transformer which interfaces the 75 ohm decoder to the 300 ohm antenna terminal of the television receiver. Therefore, a cable subscriber wishing to view the BSTV premium program would tune the cable converter to the channel on which the BSTV signal is being distributed by the cable system thereby viewing a scrambled signal until the decoder is activated to unscramble the signal.

OFF-AIR RECEPTION OF BSTV SIGNAL BY CABLE SUBSCRIBER

Another alternative way to interface the BSTV premium signal with the cable system, is to install a separate BSTV station antenna at the cable subscriber terminal. (See Figure 8). This technique involves installing a UHF antenna at the subscriber terminal where the antenna output lead consists of a 75 ohm coaxial cable attached to a converter/decoder input jack. The converter/decoder unit which contains a converter and a decoder converts the BSTV, UHF signal to a vacant VHF channel, usually Channel 3, and the signal is unscrambled by the decoder in this unit and sent through the VHF output terminal. The converter/decoder VHF output terminal is a 75 ohm coaxial cable. This output lead can then be interfaced with the cable subscribers' receiver through an "A" and "B" switch connected to a 75/300 ohm matching transformer attached to the receiver antenna terminal. This technique allows the subscriber to receive both the cable system service which may include a pay cable channel and also receive the BSTV station premium programming over the same receiver. 7/ It does, however, call for a specific installation, maintenance, and service agreement between the cable operator and the BSTV station to avoid the possibility of having service delays or conflicts between the two services. The subscriber should in no way be caught between the two services when there is a malfunction or a complaint from a subscriber terminal.

It should be noted however, that since both services are using a converter, the converter's output channels may be identical depending on what off-air channel is vacant in the area. Therefore, the BSTV converter/decoder unit must furnish sufficient isolation to prevent reflections caused by open circuited or short-circuited subscriber terminals from producing visible picture impairments on the cable signals. 8/ It is suggested because of the close proximity of the two terminals that the isolation be in the vicinity of 50-60 db for the off-air BSTV system at the cable subscriber terminal. In addition, the BSTV system radiation must be substantially reduced so as not to cause interference to the cable system or any other receiver off-air reception. The cable system, as indicated above, must not radiate in excess of 20 microvolts per meter at a distance of 10 feet from the cable when utilizing channels between 54 and 216 MHz to distribute its programming. It should be pointed out that once this switch is installed and a

7/ There are other versions of this technique, for example, the BSTV station receiving antenna and a decoder could be attached to the receiver's UHF antenna terminal. However, the technique above is sufficient to address the interfacing problems.

8/ Cable systems are required to comply with Section 76.605(a)(11) regarding terminal isolation which states: The terminal isolation provided each subscriber shall be not less than 18 decibels, but in any event, shall be sufficient to prevent reflections caused by open circuited or short-circuited subscriber terminals from producing visible picture impairments at any other subscriber terminal.

OFF-AIR RECEPTION OF BSTV SIGNAL BY CABLE SUBSCRIBER

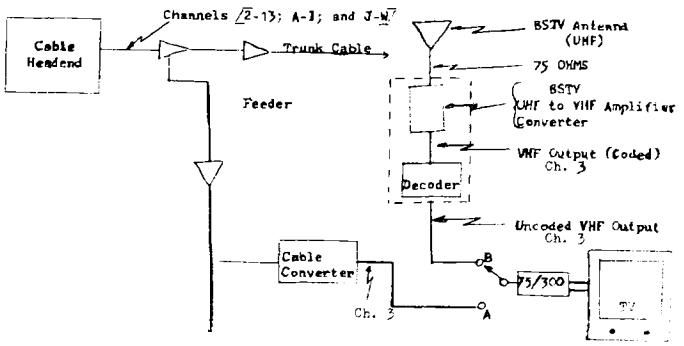

FIGURE 8

complaint from an off-air, non-cable subscriber alleges interference, it would be virtually impossible to determine which one of the systems is at fault. This further demonstrates the necessity for a service agreement between the systems. This BSTV off-air system appears to be compatible with all three types of cable systems regardless of the STV-Model system utilized by the BSTV station. However, in the M-C-S-S system a three way selector switch would have to be used with a dual cable system.

MULTIPLE BSTV STATION IN THE CABLE COMMUNITY

While the technical compatibility problems of interfacing cable with a single BSTV station are major, these problems become much more abstruse when two or more BSTV stations placing Grade B signals over the cable community may require carriage on the cable system. The Commission on December 15, 1977 adopted a Notice of Proposed Rule Making in Docket 21502 9/ in which it was stated: "Because of the significant interest presently being shown by broadcasters and the public in the operation of BSTV stations and the development of the industry since...1969, we are proposing to consider a change in the 'one-to-a-community' requirement specified in Section 73.642(a)(3)..."

Regardless of whether or not the Commission amends the "one-to-a-community" rule, cable systems may be receiving two or more BSTV stations with at least Grade A contour signals over their cable communities under the present rule. Therefore, if the Commission decides that cable systems must carry BSTV station's premium programs, additional equipment will be needed at both the cable headend and subscribers terminal. Since the premium encoding/decoding system discussed herein, as well as those already approved by the Commission, are not compatible, the subscriber terminal would have to be modified by either: (1) a decoder, whether connected to the drop cable or connected to a separate BSTV reception antenna, for each BSTV station carried on the system and requested by a subscriber; (2) traps, or (3) a new unscrambling unit would have to be developed and placed on the market replacing the present BSTV decoder as well as the cable converter. This multiple premium signal converter must be capable of receiving and decoding multiple premium program channels at the subscribers terminal. Currently, the cable converter is only capable of decoding one premium encoded channel. When other premium encoded channels are carried on the system, either: (1) a decoder is added in series with the cable converter; (2) a trap is used to weaken this extra premium signal on the non-premium subscriber receiver who is not interested in paying for and/or receiving this extra premium signal, or (3) off-air antenna(s) with the appropriated converter/decoder must be installed.

Cable systems should assume that if there is a potential market for multiple premium program channels, many of their cable subscribers may be willing to invest an additional $7.87 10/ per month above their average $7.50 per month basic cable subscription fee plus $7.87 for the premium cable program. This would involve a total monthly fee of approximately $23.24 from those cable subscribers wishing to view at least two premium programs. At this monthly rate, one would not expect to have very many multiple premium channel cable subscribers. However, if for some reason the monthly cost per premium channel starts to decline to a rate where there could be a potential market for multiple premium program channels from cable subscribers, the need for a new converter/decoder unit, capable of handling multiple premium program channels becomes more pressing. In this regard, it is noted that there presently exists a number of premium program companies 11/ attempting to make their product available to subscribers by using, in addition to cable systems, other distribution systems (e.g., Multipoint Distribution Service (MDS), 12/ Master Antenna Television (MATV)

9/ Memorandum Opinion and Order and Notice of Inquiry and Notice of Proposed Rule Making in Docket 21502, 67 FCC 2d ___, 43 F. R. 1516 (erratum 43 F. R. 2413).

10/ This fee was extracted from NCTA's Pay Cable Fact Sheet Information Bulletin. This represents a "Typical Pay Cable Rate."

11/ Some premium program suppliers are: Associated Press; Bestvision, Inc.; Broadband; Cinemerica, Inc.; Hollywood Home Theatre; Home Box Office; Optical Systems; P.R.I.S.M.; Pay TV Services; Reuters; Satoni Productions; Showtime-Viacom; Star Channel; United Press International; Warner Qube; and Home Theatre Network, Inc.

12/ MDS stations can utilize two adjacent channels in the top fifty markets. The band 2150-2156 MHz is designated Channel 1 and is available in all markets. The band 2156-2162 MHz is designated Channel 2 and is available in the top 50 markets. Therefore, it is conceivable that many cable communities within a 25-30 mile radius of the top 50 markets could be receiving at least 2 MDS stations offering different programs on each station. As of February 14, 1978 the Commission had granted 169 MDS construction permits throughout the country for Channel 1. There are approximately 360 pending construction permit applications on file; and 51 MDS stations licensed around the country.

systems, Common Carrier Satellites and Point-to-Point Microwave, and BSTV stations/. It is conceivable that all the above distribution systems could be offering different premium programming in the cable community and some cable subscribers may request one or more additional premium channels from the abundance of premium channels available.

Presently, it appears that a major market area could have the following compliments of premium program: two, MDS stations; two, satellite premium program channels (HBO and Viacom are two of the largest national premium program suppliers using satellite); and MATV systems in large apartments, hotels and motels are presently offering premium programming.

Therefore, with little or no government interference, cable systems operating in such diverse premium programming markets, are not presently encountering any difficult compatibility/interface problems which are not being handled.

PIRACY

Piracy is the curse of any premium program subscription service. Manufacturers are constantly examining new encoding/decoding techniques for their systems to minimize piracy. Nevertheless, piracy continues to occur. It is possible for a BSTV station signal utilizing either the STV Model-1, 2 or 3 system to be pirated. However, pirating may be easier and faster on the STV Model 3 system and much more difficult to virtually impossible on the STV Model 1 and 2 systems, respectively. In any event, pirating the BSTV station's signal by breaking the code used by any of the hypothetical models would involve varying degrees of sophisticated electronic equipment. Moreover, the equipment involved would probably be beyond the means of even the most competent TV repairman. 13/ Pirating the signal is further complicated when the premium signal encoding is varied from program to program as in the STV Model -1 and 2 systems.

Unscrambling the STV Model 3 system, involves the lest knowledge of electronics and/or electrical engineering. In the STV Model 3 system, if the interference signal impressed on the normal composite video signal and the intercarrier audio signal can be duplicated, the system can be defeated.

13/ Blonder-Tongue in an information brochure entitled How to Secure Your Pay TV Investment, estimates that the technician would probably need more than $15,000 of laboratory test equipment and a masters degree in electrical engineering to unscramble an encoded audio and video system using integrated circuits.

In the STV Model-1 system, which appears to be more secure that the STV Model 3 system, more knowledge of electronics is required to defeat this system. Since this system uses an inversion of the video raster in a fixed pattern, the pattern for the entire vertical frame appears to be during the vertical sync interval and/or is keyed into the horizontal sync period. Therefore, it appears that the circuitry to duplicate the decoder can be constructed by a competent electronic/electrical engineer. If duplication of the decoder, and the coded program select ticket can take place, the Model-1 system can be defeated.

The STV Model-2 system appears to be the most secure, however, it also is more expensive. This system provides, simultaneously, features that the Model-1 and 3 systems cannot. The Model-2 system provides the following features simultaneously:

1. Scrambling via inversion of some of the horizontal scan lines, producing a fuzzy picture which is unpleasant to watch. This method is undetectable by electrical means. This is not true for the Model-1 and 3 systems.

2. Specific program control of video and audio scrambling at the station. This allows the BSTV station to "turn on" or "turn-off" a large number of subscriber's decoders every minute.

3. Two-way communication is provided by telephone lines. This allows service requests from the subscriber to travel, by telephone interface, to the BSTV station, thereby, eliminating the need to make service requests well in advance of premium program transmission.

4. The functional dependence of the decoder on the BSTV station's control signal. The absence of a command signal directed at the decoder automatically causes the decoder to become disabled. Therefore, theft of the decoder or failure to pay for service can be countered with a quick disabling of the decoder. This avoids the need to physically travel to the decoder site.

It appears that unscrambling the Model-2 system can only occur by obtaining a decoder surrepetitiously and then duplicating the command signal from the BSTV station's. However, as indicated in the beginning of this section, the BSTV premium signal can be pirated, even though

the STV Model-2 system furnishes the most security. It appears that individuals who surreptitiously obtains a decoder for the Model-1 and 3 systems would have access to the unscrambled premium programming. In the Model-1 system, it is not difficult to duplicate the insert card. This form of piracy appear to be the primary way BSTV stations premium signals are being pirated. When a BSTV premium program subscriber using a STV Model-1 or 3 decoder moves from one location to another within the station's service area, and illegally takes the decoder, these decoders can easily be re-connected at the new location. Therefore, this former subscriber is now able to view the BSTV decoded premium programming without the knowledge of the BSTV station. Surreptitiously securing a STV Model-2 decoder would not automatically allow the person to view the decoded premium programming. It appears, therefore, that pirating can be virtually eliminated when the STV Model-2 system is utilized.

What problem would a mandatory carriage rule have on the cable system ability to receive a good quality BSTV station signal?

The proposed Commission rules regarding carriage of the BSTV station's signal by cable system have been directed at the station's predicted Grade B contour. As indicated in the history section of this paper, the Commission, on March 21, 1966, adopted a Further Notice of Proposed Rulemaking and Notice of Inquiry in Docket No. 11279, and invited comments on the question, inter alia, would the rules on carriage of signals of local stations over cable systems apply to carriage of BSTV premium programs? Moreover, in a Third Further Notice adopted on December 12, 1968, 14/ the Commission proposed that cable systems operating within a BSTV station's Grade B contour carry both the coded and uncoded programming of the BSTV station, exclusive of decoding the coded signal at the cable system headend. This Notice also invited comments on a proposed rule which stated that cable systems may not extend the BSTV station's premium programming beyond the station's Grade B contour.

The BSTV station predicted Grade B contour is simply that, a predicted contour. It is a statistical tool used by the Commission to define an area where 50 percent of the viewers, having an outdoor antenna 30 feet high, can expect satisfactory reception 90 percent of the time. The Grade B contour reveals nothing regarding the actual availability of a television station's signal in a given area. Actual field strength measurements and/or visual observation are techniques utilized by the Commission in the past to determine the actual availability and quality of a television station signal in a given area. Because of the terrain in certain areas, the Commission has been aware of situations where communities located only a few miles from television stations have been unable to receive these stations off-air signals even though the community was well within the station's predicted Grade A and B contours.

In addition, there is no way, absent actual field test, to determine whether the BSTV station premium signal coverage extends as far as the non-premium signal of a BSTV station. Under Section 73.644(b)(4), the BSTV station is precluded from transmitting its premium and non-premium programs at different signal strengths. The rule states:

> The technical system shall enable stations transmitting subscription television programs to produce visual and aural signal coverage and receive program quality not significantly inferior, in the judgment of the Commission, to that produced by stations using the normal . . . transmission standards . . . without employing additional effective radiated power for either the visual and aural signals.

Moreover, the quality of the STV signal must not be degraded as referenced in Section 73.644(b)(5) as follows:

> The encoded visual and aural programs shall be recoverable without perceptible degradation as compared to the same programs transmitted in accordance with Commission monochrome and color standards.

However, with the diversity of encoding/decoding system on the market and since there are only two operating BSTV stations in the country, the Commission should probably allow ample time to elapse to assess the practical feasibility of BSTV stations' compliance with Sections 73.644(b)(4) and (5) of the Rules. Therefore, it would be **premature without additional research for the Commission to formulate rules on cable carriage of BSTV premium programming based on the station's present Grade A and B contours.**

TRANSLATOR

It is also noted that when 100 watt television translator stations are used to rebroadcast a BSTV station signal, problems regarding the formulation of mandatory carriage rules become more complex. Presently, cable systems are required to carry 100 watt translators licensed to the cable community. One problem confronting cable systems is the translator frequency tolerance. Section 74.761(a) of the Commission's Rules states that a transmitter rated at not more than 100 watts peak

14/ Third Further Notice of Proposed Rulemaking in Docket 11279, FCC 68-1175, 15 FCC 2d 601.

visual power, shall maintain the output frequency within 0.02% of the visual carrier and the aural carrier center frequencies for the assigned translator channel. This translator tolerance has been especially troublesome to cable television systems. On April 20, 1977, the Commission in the Report and Order of Docket 20765, 64 FCC 2d 743, 746 (1977) relaxed certain frequency control standards for cable systems in receiving and retransmitting TV translator signals because these signals "in some cases are not required to have such close frequency control." Responding to comments of New York and New Jersey cable regulators that translator standards ought to be tightened, Commission said "we do expect to examine the question of frequency tolerances for low power translator stations, but we believe this matter should be dealt with in a separate proceeding."

Cable systems re-transmitting television translator stations must maintain the visual carrier frequency 1.25 MHz ± 25 KHz above the lower frequency boundary of the cable television channel when the first adjacent cable channels to the channel carrying the translator are used. 15/ Because these 100 watt translator's frquency tolerance can vary as much as ± 178 KHz for Channel 83, cable operators are required to capture this ± 178 frequency tolerance signal in a ± 25 KHz window and thereafter, deliver this translator signal to the subscriber terminal with the visual carriage frequency 1.25 MHz ± 25 KHz.

Moreover, with the Commission adoption on December 8, 1977 of the Report and Order in Docket 20539, FCC 77-836, 67 FCC 2d Pamphlet 3, 43 F. R. 1943 allowing translator to use modulation when a television signal is transported to a translator by FM microwave, the quality of the BSTV station signal traveling via translator becomes a critical issue for cable systems. Each demodulation/remodulation step in a television system affects the quality of the signal. Therefore, cable systems receiving a BSTV station signal via a 100 watt translator and demodulate the translator signal at the cable headend and then remodulate the signal for distribution over the cable system, may be delivering such a poor quality BSTV premium signal that no cable subscribers would be willing to subscribe to this premium programming. These are potential problems that only experience under actual operating conditions in the marketplace can hopefully furnish answers. It does appear however, that the translator problems become less critical when the off-air cable/BSTV system depicted in Figure 8 is utilized: Provide, however, That appropriate radiation and isolation standards are formulated to interface the BSTV premium system with the cable system: And Provided further, That the service, installation and maintenance agreement problem between the systems could be addressed to minimize the number of technicians allowed to tamper with equipment at the cable subscriber terminal.

15/ However, Section 76.605(a)(2) affords some relief to cable systems when the cable: (1) signal is received by means of a translator and (2) does not carry signal on neither of the first adjacent channels in frequency to the channel on which the translator signal is carried. In this case the visual carrier frequency shall be maintained 1.25 MHz ± (25 + T) KHz above the lower frequency boundary of the cable television channel where T is the frequency tolerance in KHz allowed the television broadcast translator pursuant to 74.761 of the Rules.

Conclusion

The author has attempted to give an overview of the interfacing problems that could occur if the Commission in all its wisdom, were to require mandatory carriage of the premium programming from BSTV stations. It should be evident from this paper, that any attempt to formulate policy and/or a set of rules at this time may result in curtailing the technological developments occurring in both the BSTV premium system and the cable system markets. The author is of the opinion that it would be pre-mature without further research for the Commission to get involved at this time. With technology changing at such a rapid pace, it is not unreasonable to assume that a reasonably priced, multiple premium signal unit at the subscriber terminal could be available within a few years: Provided, however, That a market exist and that it would be in the public interest. Cable operators should monitor closely any attempt by the Commission to: (1) standardize BSTV premium systems; (2) formulate additional or modified technical standards for BSTV premium encoder/decoder systems, and (3) establish a policy and/or specific rules ragarding mandatory carriage of BSTV station premium signals over cable systems. Moreover, cable systems should also: (1) monitor attempts by new and existing operating stations to interface their premium programming with cable subscribers within their service area, (2) comment on, and furnish technical data in, any proceeding from, or submitted to the Commission regarding cable carriage of a BSTV station premium programming, and (3) assist equipment manufacturers of both encoding/decoding and cable equipment in developing a multiple premium signal unit for the cable subscriber terminal.

Note: Statements which have appeared in this paper are those of the author alone, and does not necessarily represent the position of the Federal Communications Commission.

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