THE JCIC AD HOC COMMITTEE ON TV BROADCAST ANCILLARY SIGNALS -- WHY IT WAS ESTABLISHED, AND WHAT IT EXPECTS TO ACCOMPLISH

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ABSTRACT - Over the years, the Federal Communications Commission has authorized the transmission of a variety of special signals inserted into or "piggybacked" along with the television program signal. Several proposals are currently pending at the Commission which request authorization for additional such signals, and, what is of most importance, there is an awareness within the industry of the wide variety of special signals that could be accommodated within the time and frequency domains of the television signal -- without, of course, in any way adversely affecting the integrity of the program signal itself. In view of an obvious need for an overall system study of the entire question of these "ancillary" signals, the JCIC Ad Hoc Committee on Television Broadcast Ancillary Signals was established to study the overall question with the goal of a recommendation to the FCC , for their consideration, of a master plan to accommodate the various requirements in the most efficient and desirable manner. Some of the special signal functions under discussion relate directly to the cable television industry--virtually all involve a common industry interest.

I. INTRODUCTION

Some of the special "piggybacked" signals that have been authorized in the past include unobtrusive audio tones for alerting network affiliates to special announcements or for starting station tape or telecine equipment; vertical interval test and reference signals for the surveillance of video quality on the networks, and more recently, on the signals radiated by remotely-controlled television broadcast stations; time-diplexed signals in the picture area intended for electronic identification of programs and commercials; and frequency diplexed signals in the picture area, to provide an emergency backup for the associated audio. Many other types of special signals are currently under consideration, and still others continue to surface.

It appeared to many in the industry that the techniques that have been authorized to date on a piecemeal basis do not, necessarily, at this point in time, represent the most desirable or efficient methods of accomplishing the desired functions. Also, there existed considerable concern as to the affect on the industry of the emergence of a variety of conflicting proposals for the "valuable real estate" contained within the television signal. Consequently, the Joint Committee for Inter-Society Coordination (JCIC), established an ad hoc committee to study the overall question of these special signals -- now referred to as "ancillary" signals -- with the goal of a recommendation to the FCC from the industry, of an overall plan for efficiently accommodating the various requirements. The Committee was designated the JCIC Ad Hoc Committee on Television Broadcast Ancillary Signals, and the National Association of Broadcasters (NAB) was selected as the host organization to administer the project. Mr. George W. Bartlett, Vice President for Engineering at NAB, was designated as Secretary, and the author was appointed Chairman.

Membership has been drawn from the JCIC organizations primarily, as well as from other organizations. Additionally, two members of the FCC staff, and a representative of the Canadian Broadcasting Corporation sit on the Committee as observers.

For those who might not be familiar with the JCIC, this is an industry committee comprised of the five leading technical organizations which meets on call, to deal with a particular problem which embraces all disciplines within the industry. The membership consists of the Electronic Industries Association (EIA), the Institute of Electrical and Electronics Engineers (IEEE), the National Association of Broadcasters (NAB), the National Cable Television Association (NCTA), and the Society of Motion Picture and Television Engineers (SMPTE).

II. CHARGE GIVEN THE COMMITTEE

In its Reply Comments to the FCC in Docket 19314 (which concerns a proposed revision or deletion of the FCC Rule regarding the active picture area space available for coded program identification patterns) the SMPTE pointed out some of the possible functions in addition to the familiar test and reference signal functions, which could be served by the use of video or audio signal coding. An abbreviated version of this list of 13 suggested functions is

shown on Slide No. 1.

POSSIBLE ADDITIONAL FUNCTIONS

1. NETWORK ALERTING
2. EQUIPMENT CUE
3. LOG PRINTOUT
4. PROGRAM ID
5. MAIN SOUND
6. OTHER AUDIO
7. CAPTIONING
8. CATV NON-DUPL, UHF ID
9. EMERGENCY NOTIFICATION
10. VT START IN SCHOOLS
11. DATA
12. FACSIMILE
13. PRECISE TIME, FREQUENCY

SLIDE 1

In these same comments, the Society indicated its intention of calling a meeting of the JCIC to set up an industry committee to study the overall question of these ancillary signals. Such a meeting was held and a charge to the new Ad Hoc Committee was prepared. An abbreviated version of the seven-point charge is shown in Slide No. 2.

COMMITTEE'S CHARGE

1. EXAMINE REQUIREMENTS
2. ESTABLISH PRIORITY
3. IDENTIFY AVAILABLE DOMAINS
4. ESTABLISH TESTING GUIDELINES
5. DELEGATE TASKS
6. EVALUATE RESULTS
7. RECOMMEND OVERALL PLAN

SLIDE 2

III. FOUR POTENTIAL "HOMES" AND WHAT HAS BEEN DONE TO DATE

With respect to the identification of possible "homes" or locations within the television program signal technically available for the accommodation of ancillary signals, the committee has identified the following four areas:

- the horizontal blanking interval
- the vertical blanking interval
- the program audio signal, using time and/or frequency diplexing techniques
- the program video signal using time and/or frequency diplexing techniques.

It should be noted that the possibility of additional subcarriers on the broadcast aural carrier is not included in this list. There are two other industry committees looking into the possibility of using this technique for additional sound channels. It may be, however, that some additional capacity would remain for ancillary signals, and accordingly, the ancillary signal committee is maintaining liason with these other two committees.

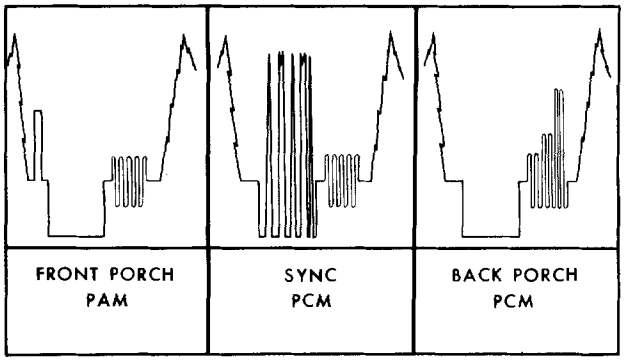
Four subcommittees have been established to study these areas and, quite logically, the studies have started with a review of what has already been done or proposed.

A. The Horizontal Blanking Interval

Obviously this section of the video waveform contains the potential for much additional information, based on the various proposed time division multiplex techniques for adding the program audio, or perhaps a second audio channel. These techniques to date involve the transmission of the audio over network distribution facilities -- but not the subsequent broadcast of any such signals by the transmitter. However, after the program audio has been stripped and the horizontal blanking interval restored at the network affiliate's studio, it would appear feasible to re-use the space for some ancillary functions -- particularly such functions as would relate to the local station (and not the network). One such possibility might be a relatively simple channel identification signal for the automatic tuning of receivers which could also provide, at desired intervals, a momentary flashing of the station's channel number on the picture tube. Such a system could help maintain the identity of a UHF station, which is carried on a VHF channel on a cable system.

As an indication of the potential communication capacity, and some of the techniques for exploiting this capacity, Slide No. 3 shows the basic concept for a few of the systems.

ILLUSTRATIVE H-BLANKING SYSTEMS



SLIDE 3

1. TIDI Sound (TIme DIvision)

This system was developed by the Bell Telephone System many years ago. The technique employs a positive-going pulse, 0.5 usec wide, which is added on the front porch and amplitude modulated in accordance with the sampled audio. For various reasons, the system was never implemented but it remains an imaginative technique for adding

about a 6-7 kHz signal to the video.

2. Sound-In-Syncs

This system is now installed in both networks of the BBC in Great Britian. The audio signal is sampled at twice the line frequency and information is stored and coded into two groups of positive-going binary-coded pulses inserted in the tip of sync. The leading and trailing edges of the horizontal sync pulse are retained with the remainder of the time allocated to 20 2T sine-squared pulses, plus a marker pulse. Because of the double sampling rate, an audio bandwidth of 14 kHz is possible. This system was developed by the BBC for the 625-line television system, but equipment is now also made for the 525-line system, and some studies have been conducted on its possible use in the U.S. and Canada.

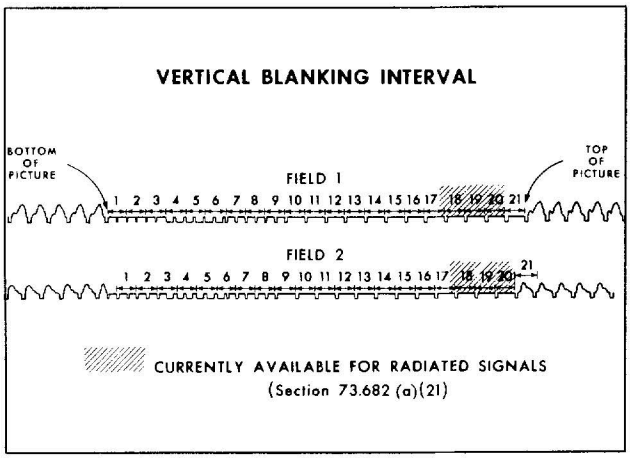
3. Japanese PCM System

In this system the audio signal, coded into two groups of six digit, ternary-coded pulses, modulates an elongated reference burst. The system is capable of accommodating two quality sound channels with an upper frequency limit of about 14 kHz.

Several other techniques have been developed in other countries, but these three examples -- one involving the front porch, one the sync pulse and the other the back porch -- attest to the communications potential of the horizontal blanking interval.

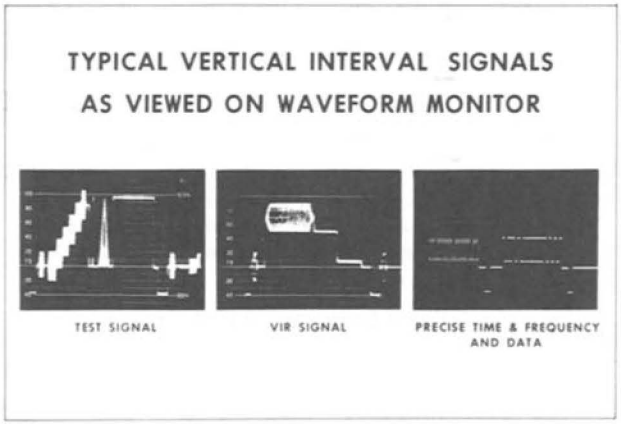
B. The Vertical Blanking Interval

Perhaps the greatest relatively untapped portion of the television signal for future additional communication is the vertical blanking interval, where up to twelve lines of each field -- each line having a potential communication channel capacity, if fully exploited, of 12 kHz -- are technically available for special signals. Slide



SLIDE 4

4 shows a diagram of the entire vertical blanking interval, as well as the area permitted under current FCC Rules for radiated signals, for the specific uses of test, reference, cue and control signals. Actually, after the second set of equalizing pulses has been completed, the only function of the remaining time is to allow the scanning beam to be returned to the top of the picture without being visible on the home receiver. However, for this reason only a few lines, near the end of the blanking period, may be used for ancillary signals which must be radiated, in order to prevent any such signals from being visible on the home receiver. As indicated on the slide, present FCC Rules set aside the last 12 microseconds of Line 17 plus all of Lines 18, 19 and 20 for such signals. One of the major problems at hand will be a suitable allocation of these lines for the various ancillary signals. Some of the proposed vertical interval signals are shown on Slide 5 -



SLIDE 5

1. The new combination test signal.
2. The vertical interval reference signal.
3. Precise time, frequency signals and data signals.

C. The Program Audio Signal

Several systems have been informally authorized by the FCC which permit the national networks to transmit "subliminal" audio tones to their affiliates in order to alert them to news flashes and program changes, and to start station projectors or tape machines. Additionally, the FCC has under consideration formal proposals to use similar techniques for program or commercial identification. Slide 6 shows the basic details on these various systems.

ILLUSTRATIVE PROGRAM AUDIO SYSTEMS

SYSTEM	DETAILS	FUNCTIONS
A	3 tones, 2100-3100 Hz, 50msec, -30dB	1,2
B	2 tones, about 4900 Hz, 1 sec, -30 dB	1,2
C	tone in 200 Hz window about 2900 Hz, 3 sec, -40 to-50 dB	3
D	tone in 90 Hz window, about 150 Hz, 60-120 msec over 4 sec, +10 dB	3
E	16-mode "subliminal signalling"	1,2,3,4

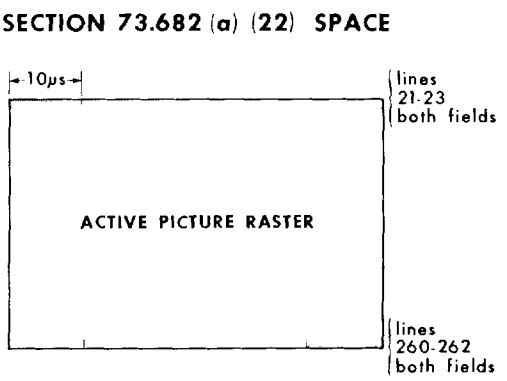
1. ALERTING 3. PROGRAM ID
2. CUE 4. PERFORMANCE TESTING

SLIDE 6

These various techniques are potentially capable of providing some of the ancillary signal functions -- although obviously to a more limited extent than the other areas under consideration. Some of these techniques have been used by radio networks, which in general, use the same audio transmission facilities as do the television networks, namely, the basic Schedule A service involving a nominal bandwidth of 100-5000 Hz. Serious considerations are currently in progress, looking towards a greater bandwidth for television network audio transmission. In view of this development, the techniques just described may have to be reconsidered, and perhaps new techniques, geared to a greater audio bandwidth, will evolve.

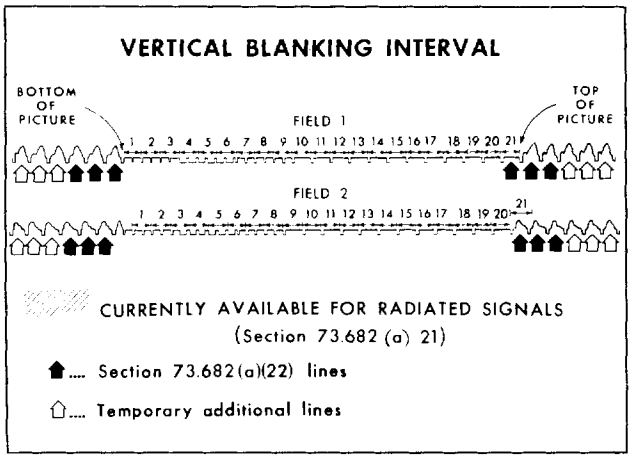
D. The Program Video Signal

Section 73.682(a)(22) of the FCC Rules currently permit a certain portion of the video signal to be used for "coded patterns for the purpose of electronic identification of television broadcast programs and spot announcements".



SLIDE 7

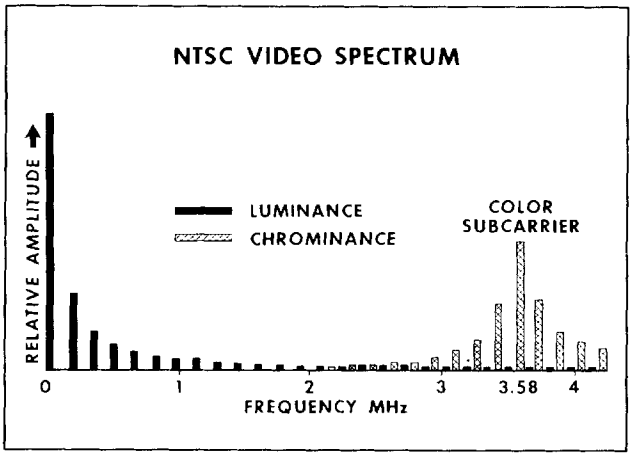
Slide 7 shows this area which is located in active picture time. As an indication of how these lines relate to the vertical blanking interval, Slide 8



SLIDE 8

shows the previously shown chart of the vertical interval on which has been added the lines permitted by Section 73.682(a)(22), as well as some additional lines permitted under a temporary waiver of the rules currently in effect.

The above described Rule provides for a time division diplexed signal. Another technique for adding information in active picture time would be a frequency diplexed system -- which is, of course, the method used to add the entire dimension of color to the television signal, without any increase in the required bandwidth.



SLIDE 9

By way of review, Slide 9 shows a greatly simplified spectral display of the monochrome television signal, shown in black, with relative amplitude as the ordinate and frequency out to 4.2 MHz as the abcissa. Since the scanning process determines the basic energy distribution of the signal, this frequency domain display shows bundles of energy centered about harmonics of 15 kHz, the nominal line scanning frequency. (If each of these bundles were displayed in greater detail, there would also be shown 60 Hz sidebands on both sides of the line-frequency harmonics, representing modulation by the field scanning process.) When NTSC color was added, the color subcarrier frequency was chosen to be an odd multiple of half-line frequency so that the subcarrier and its components, shown crosshatched, fell in the "troughs" or "slots" between the components of the luminance signal, and in an area of the baseband spectrum where there is little luminance information. The "slots" below the chrominance information, that is below approximately 2 MHz, represent a tremendous information potential for added signals. One of the major television networks has for many years used one of these slots, the one between the 113th and 114th harmonic of H, to provide an emergency program audio signal on their New York to Los Angeles network. Just recently a new system has been developed and demonstrated that can provide up to 25 kilobits per second of information, frequency diplexed in the picture in such a fashion as to be completely invisible to the home viewer.

IV. COMMITTEE'S FUTURE WORK

The Committee has held four meetings to date and considerable progress has been made, particularly with respect to the first three (3) points of the seven-point charge:

1. The Committee has examined existing and future uses of ancillary signals and has a reasonably complete feeling for overall requirements.
2. The Committee has established that program-related functions should bear a higher priority over non-program related functions.
3. The Committee has identified the above described time and frequency domains of the television program signal as being technically possible for meeting ancillary signal requirements.

The remaining four points -- admittedly the most difficult aspects of the study -- deal with: 1) establishment of guidelines for the testing and evaluation of new techniques; 2) delegation to industry committees, as appropriate, the task of evaluation of specific proposals; 3) the development of an optimum overall plan to meet all requirements; 4) a recommendation of an overall plan to the industry and to the FCC. This overall study will, of course, require a fair amount of time to complete. However, in view of the considerable input available to the Committee with respect to vertical interval signals, the Committee expects to issue a preliminary report by September 1, 1973 relating to this aspect of its overall study.

V. CABLE TELEVISION ASPECTS

As was indicated in the original list of possible requirements for ancillary signals, two suggestions dealt specifically with cable television: automatic operation of non-duplication switchers and UHF station channel identification. It may be that through NCTA's participation in the work of the Committee, additional requirements will evolve. However, a fact of even greater importance is the common interest that the broadcasting and cable television industry share in providing television service of the highest quality to the viewing public. The prime function of these suggested ancillary signals relates to that objective.