

as it displays a normal transmission. This is the meaning most frequently assigned to the term 'compatibility.'"

Level 4 is the highest level of compatibility that theoretically could be obtained between an HDTV transmission and an NTSC set receiving that transmission.

"The next lower level (LEVEL 3) is represented by a system whereby a receiver accepts HDTV transmissions and displays the picture with somewhat reduced performance compared with a normal transmission."

Level 3 was the level of compatibility that was achieved between existing monochrome television receivers and color television transmission standards when they were adopted in 1953. That is, monochrome sets were able to accept the NTSC signal with color added and display a somewhat degraded black-and-white picture.

"The next lower level (LEVEL 2) is represented by a system whereby a current receiver requires an inexpensive adapter box to display HDTV transmissions... ."

The Commission alludes to the possibility of converters for existing receivers if compatibility could not be achieved, instead of more appropriately citing inexpensive converters as a way (not ideal, perhaps) to achieve compatibility. (Notice at ¶87.) In fact, Level 2 represents the type of compatibility exemplified by the early use of UHF adapters with television sets that hitherto

could receive only VHF transmissions. A current example is the compact disc player, which may be added to a home stereo system without replacing the receiver and speakers.

"The next lower level (LEVEL 1) is represented by a system whereby the adapter box is expensive, perhaps so expensive that the consumer would prefer to purchase a new receiver designed for the new HDTV system. In the case of LEVEL 2 and LEVEL 1, it is assumed that the new receiver can be designed to operate on both the current television standard and the HDTV system."*

"The lowest level (LEVEL 0), which could be called 'non-compatible', is represented by a system whereby the current receiver is unable to display, in any form, HDTV transmissions and the HDTV receiver is unable to display NTSC transmissions."

The value of conceptualizing "compatibility" as a relative term is that it acknowledges the trade-offs of technical quality and degrees of compatibility that usually accompany the introduction of new technology. That is, ATV systems that promise the highest technical quality are least likely to be of "Level 4" compatibility with NTSC receivers (or, for that matter, to be transmittable over a 6 MHz channel). Conversely, "Level 4"

* Future set designs could provide additional built-in decoding units so that more than one ATV system could be received on the same set, provided, of course, that the modulation formats of the ATV systems are known at the time of manufacture.

compatibility is most likely to be achievable by those systems promising the least technical improvement.*

Other than this useful generalization, CBS has no preconception about whether the claims of NTSC compatibility and technical quality by all the various systems proponents can and will be demonstrated in a timely manner. However, CBS urges that the Commission avoid a "go/no go" approach to compatibility that would not sufficiently take into account the importance of instituting a terrestrial HDTV broadcasting system of competitively high quality.

B. The Commission Should, If Necessary, Consider HDTV/NTSC Simulcasting As An Alternative Way To Achieve The Underlying Purpose Of Compatibility.

The results of the testing program and the inventorying of available spectrum may lead to the conclusion that Level 4 or Level 3 compatibility between NTSC and HDTV is an unattainable goal, given the characteristics of the candidate transmission systems and the amount and type of spectrum that can be used for terrestrial HDTV broadcasting. Under these circumstances, the

* As noted, "Level 4" describes the situation normally associated with full "compatibility." Indeed, that is the working definition of the term that has been adopted by the CCIR study group. It is interesting that the color television standard -- which is universally cited as an example of compatibility -- did not achieve that level, since the reception on black-and-white receivers exhibited noticeable, but acceptable, degradation.

Commission should recognize that the goal of receiver compatibility -- i.e., the ability of consumers to continue to receive NTSC "versions" of HDTV programming -- can be met in another way.

The Notice acknowledges that an alternative to compatible ATV/NTSC transmissions that would "eliminat[e] viewers' dislocations in the transition to ATV" would be "to allow for the simultaneous broadcast (simulcast) of programming in both NTSC and ATV formats." The Notice suggests, however, that "this alternative may also result in short term uneconomic spectrum use." (Notice at ¶ 85.) CBS has been careful in these Comments not to prejudge any of the questions that can only be resolved after appropriate propagation, laboratory and field tests have been completed. One of these questions is whether UHF/VHF or microwave spectrum will turn out to be the best practicable choice to implement terrestrial HDTV broadcasting. If UHF/VHF channels are not available in sufficient quantity for terrestrial HDTV transmissions or no candidate systems turn out to provide a satisfactory combination of high technical quality and compatibility using that spectrum, the Commission should not reject microwave spectrum on the basis that some preconceived goal of compatibility with NTSC cannot be achieved.

Rather, if microwave transmissions of terrestrial HDTV prove to be technically feasible, a transitional period of simulcasting

should be seriously considered. Such simulcasting characterized the transition to a self-standing FM radio service and it is by no means certain that the use of microwave spectrum for HDTV would be "uneconomic" at all. Rather, that judgment must await the gathering of information on the amount of spectrum needed, the technical quality attainable, the competing needs for immediate use of the spectrum and the projected length of the transition period.

In sum, the Commission should take a flexible approach on compatibility that allows for appropriate consideration of trade-offs for optimal technical quality and that does not foreclose the possibility of discarding the conventional notion of compatibility entirely in favor of a transitional system of simulcasting. The Commission states that "as a presumptive matter, [it attaches] great weight to the ability of an ATV system to be viewed on an NTSC receiver." (Notice at ¶83.) The Commission should redefine its goal more precisely as facilitating "the ability of a viewer to have the choice of HDTV or NTSC broadcasts during a transition to an HDTV terrestrial broadcast system." Pursuit of this reformulated goal would protect the public's investment in television receivers while avoiding the straitjacket of an overly rigid approach to compatibility.

V. POLICY ISSUES

As the Notice recognizes, the Commission must take into account a range of public interest issues as it proceeds to pave the way for the implementation of advanced television systems by terrestrial broadcasters in this country. Although definitive policy decisions on many of these matters should not -- indeed, cannot -- be made at this early stage, CBS offers its preliminary views on issues raised by the Commission in the Notice.

A. It Is Strongly In The Public Interest That Existing Broadcasters Be Allowed an Opportunity to Broadcast Terrestrially In HDTV.

The basic purpose expressed in the Communications Act of 1934, as amended, is "to make available, so far as possible, to all the people of the United States a rapid, efficient, Nation-wide... communication service."* To this end, Congress established the Federal Communications Commission and directed it to distribute licenses and frequencies "among the several States and communities as to provide a fair, efficient, and equitable distribution of radio service to each of the same."**.

* 47 U.S.C. § 151.

** Id. at § 307(b).

The central duty of the FCC has thus been the establishment and protection of "a widely dispersed radio and television service,"* in which "all communities of appreciable size have at least one television station as an outlet for local self-expression."** As recently stated by the U.S. Court of Appeals for the D.C. Circuit, "preservation of local television is a cornerstone of [the FCC's] regulatory policy" under the Act, with the Commission assigned "to guard...the economic viability of free, local broadcasting."***

The imminent arrival of HDTV in non-broadcast formats poses a substantial threat to local broadcasting's continued vitality and service. As discussed above, HDTV represents a quantum leap in the video and audio quality of television programming. With its radical improvements in television resolution, color, screen size, and sound, HDTV is at least as striking, and as important, a change as the arrival of stereo phonographic sound and color television. HDTV will inevitably, and irrevocably, change the landscape of television. Those who cannot deliver television programming of HDTV quality will simply not be able to compete effectively on this new landscape -- just as a programmer reduced to black-and-white

* S.Rep. No. 923, 86th Cong., 1st Sess. 7 (1959).

** H.R. Rep. No. 1559, 87th Cong., 2d Sess. 3 (1959).

*** Quincy Cable TV, Inc. v. FCC, 768 F.2d 1434, 1455 (D.C. Cir. 1985). See also id. at 1454 n.43; Capital Cities Cable Co. v. Crisp, 467 U.S. 691, 714 (1984); United States v. Southwestern Cable Co., 392 U.S. 157, 173-77 (1968).

delivery could not hope to be an effective competitor in the age of color television.

The most important question before the Commission is the availability of the necessary spectrum to allow free over-the-air broadcasters to deliver HDTV programming to their existing audiences. If broadcasters are not permitted to provide HDTV-quality programming because the necessary spectrum has not been assigned, they will be reduced to second-class status in the television market. Like silent pictures, monophonic records, and black-and-white television, today's standard quality television will become technologically outdated.

Much more is at stake than the financial interest of individual broadcasters or the broadcast industry as a whole. If over-the-air broadcasting founders, the ultimate cost will be in service to the public. For this country's system of free, universally available, locally licensed over-the-air television provides unique public benefits. It delivers a unique mix of local and national programming, news and entertainment, to virtually all homes in America. It is available without charge to nearly anyone with a television set and antenna. And -- by nature and by legal obligation -- it is responsive to local interests, local conditions, and local needs.

Congress has made clear in the past that the weakening of this system of free, over-the-air, locally based broadcasting would be "a matter of real and immediate public concern."* The same is true today. None of the non-broadcast services preparing to deliver programming in HDTV is available to virtually all Americans. None of those services is available free of charge. And none -- not videocassettes, not cable programmers, not DBS -- provides the kind of local news and entertainment programming that has been the hallmark of today's system of broadcasting.

It remains to be determined whether broadcasters will be able to provide signals of HDTV quality without an additional spectrum allocation -- that is, within the current 6 MHz channel allocation. As discussed above, however, proposals to accomplish this are all at this stage highly speculative, present difficult technical problems, and appear to involve significant quality trade-offs. If, indeed, it proves impossible for broadcasters to provide an HDTV-caliber service within the current 6 MHz channel, CBS believes it will be incumbent on the Commission, in the public interest, to take those steps necessary to provide sufficient spectrum to broadcasters to enable them to compete effectively in the HDTV television marketplace.

* Quincy Cable TV, Inc. v. FCC, 768 F.2d at 1454 n.43 (quoting S.Rep. No. 923, 86th Cong., 1st Sess. 7 (1959)).

CBS urges the Commission to move forward, with all possible speed, to gather and evaluate the necessary information to determine -- based on the criteria outlined above -- the most appropriate method for terrestrial HDTV broadcasting, and then to act to make such broadcasting possible. Accordingly, CBS urges the Commission not to prejudge at this early juncture the suitability of particular microwave or other spectrum for terrestrial HDTV broadcasting, and not to take any action that would limit its options for eventual allocations decisions.

B. No Potential Competing Use Of The Available Spectrum Space Presents Such Compelling Public Interest Considerations.

The Notice requests comment on the weighing of potential alternative uses of available spectrum against the need of broadcasters seeking to deliver programming of HDTV quality. The question of how to assess such competing spectrum claims is, we believe, premature at this point, since it is not clear how much -- if any -- additional spectrum may be required for terrestrial HDTV broadcasting and which spectrum source or sources may be appropriate for such purpose. However, if additional spectrum allocation proves necessary for terrestrial HDTV broadcasting, we believe that the public importance of such allocation would far surpass that of potential competing claimants.

As discussed above, the ability to deliver programming of HDTV caliber is likely to be necessary to assure broadcasters' continued

economic vigor and service; preservation of free, universally available, locally based broadcasting is the Commission's paramount regulatory responsibility and a matter of the highest public import. Accordingly, the question is not simply whether a technologically improved television service is to be preferred over competing claims for UHF/VHF or microwave spectrum. Rather, the question is the more basic one of comparing those competing spectrum claims against the Commission's bedrock responsibility to preserve free over-the-air broadcasting. None of the potential alternative spectrum uses mentioned by the Commission -- land mobile radio, DBS, additional UHF broadcast stations -- appears to have so compelling a public interest basis.

1. Land Mobile Radio

CBS and others have demonstrated that allocation of UHF spectrum to land mobile would cause significant degradation of existing UHF television operations.* In addition, various studies have shown that the needs of land mobile can be fulfilled within presently allocated spectrum through implementation of existing new technologies.**

2. DBS -- As discussed above, the demand for and use of the 12 GHz band for DBS purposes has lagged far behind expectations, and

* See, e.g., Comments of CBS Inc., filed July 10, 1986, in GEN. Docket No. 85-172.

** Id., at 2.

prospects that much of that spectrum will be utilized for DBS continue to diminish. This situation is reflected, for example, in the apparent lack of progress by remaining permittees and the suitability of the Fixed Satellite Service as an alternative vehicle for satellite transmission services to the home. Under these circumstances, it is unreasonable to assume that the full complement of 12 GHz spectrum presently allocated to DBS will ever be needed for direct-to-home satellite services. It should also be noted that DBS services would likely be offered on a pay basis and thus not be universally available.

3. Additional UHF Stations -- Another possible use of available spectrum noted by the Commission is the allotment of additional UHF broadcast stations. However, there would be little point and little public benefit to allocating additional television licenses if those licensees -- and all others in their market -- were to be deprived of HDTV capability and therefore relegated to inferior status as providers of television programming. The Commission earlier this year prudently placed a freeze on the allotment of television frequencies in certain areas in order to preserve "possibilities for providing additional spectrum for advanced television." As the Commission noted, this restriction on allotment was necessary only in those areas "where high densities of existing TV stations leave relatively limited spectrum available for the new technologies

(i.e., advanced television);"* such densely served areas, concurrently, have less need for additional broadcast outlets. CBS believes that allotment of additional UHF stations in such markets cannot be of greater public importance than the preservation of the ability of existing broadcasters in those markets to serve the public with HDTV-quality programming.

C. Sufficient Spectrum To Enable Terrestrial HDTV Broadcasts Should Be Allocated To Each Existing Broadcaster.

The Commission suggests in the Notice that any allocation of additional spectrum to enable broadcasts of HDTV spectrum should be allotted in such a way as to give every broadcaster an opportunity to provide such service. CBS fully supports such a fair and equitable approach.

The Commission further proposes that broadcasters be granted the discretion to use such additional spectrum for either HDTV or non-HDTV purposes. Alternatively, the Commission notes that it might limit broadcaster discretion to use the allocated spectrum in the manner that it has limited use of DBS spectrum -- i.e., by imposing deadlines by which the spectrum must be used for HDTV or surrendered, as well as other restrictions. (Notice at ¶108.)

* Advanced Television Systems, RM-5811, released July 17, 1987, at 2.

CBS agrees with the Commission that for a variety of reasons -- including considerations of cost and market conditions -- individual broadcasters are likely to progress toward HDTV at different speeds and should be granted some flexibility in making this transition. Decisions concerning the appropriate extent and duration of this flexibility -- e.g., whether any additional spectrum allocation might be used for non-HDTV purposes during a transition period -- should await further evaluation of the methods and spectrum space to be employed for terrestrial HDTV broadcasting.

D. It Is Premature At This Point to Consider Permitting Private Arrangements Between Broadcasters Regarding Interference Levels.

The Notice also raises various questions regarding the possibility of voluntary arrangements by licensees to alter their interference protection if either the NTSC standards or the UHF taboos were relaxed. These questions involve a complex set of issues such as the term for which such waivers would be effective, the assignability of waiver agreements, the overall degradation of broadcast spectrum, and possible diminution of service to certain areas.

CBS believes that, while it may later prove to be appropriate to pursue these difficult issues, it would be premature to consider them at this time. Rather, such consideration should await the results of the testing of various HDTV proposals and determinations

concerning the system to be used, the spectrum allocations necessary for such use, and appropriate modifications in technical standards. If the Commission does determine that relaxation of interference levels is appropriate, it must be sure to establish careful standards of satisfactory performance levels and signal quality and to identify specific circumstances and criteria in which such levels or interference standards might be relaxed.

CONCLUSION

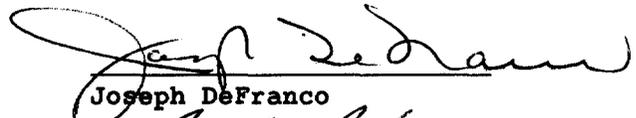
The issues involved in the implementation of a terrestrial HDTV broadcast service are complex, important and pressing. By instituting this Inquiry, appointing an Advisory Committee and acting to preserve UHF spectrum allocation options, the Commission has taken necessary first steps toward enabling local broadcast licensees to enter this new era of television as fully competitive participants in the video marketplace. There must now be an orderly but expedited effort by government and industry to decide on the most appropriate HDTV transmission standard and to deal with the spectrum allocations and policy issues that are interrelated with that decision. CBS has here provided its initial views on these

matters and looks forward to an active role in the ATSC and the
FCC's Advisory Committee as this critical work proceeds.

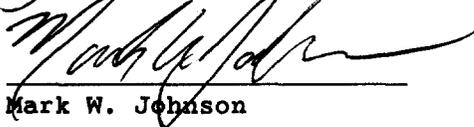
Respectfully submitted,

CBS Inc.

By:



Joseph DeFranco



Mark W. Johnson

1800 M Street, N.W.
Washington, D.C. 20036



Jayaram Ramasastry
CBS Operations and Engineering
CBS Broadcast Group



John W. Zucker

51 W. 52 Street
New York, N.Y. 10019

Its Attorneys

November 18, 1987

APPENDIX A

Documents

CCIR Study Groups
Period 1986-1990

Doc. 11/105
July 1987
Rev. 1 - 8/6/87
Original. English

CBS
STATUS OF HDTV PRODUCTION SYSTEM

INTRODUCTION

At the XVith Plenary Assembly, the Administrations present could not agree on a production standard for High Definition Television (HDTV). As a result, the 1125 line 60 fields per second system proposed by the USA and other administrations and forwarded to the Plenary Assembly by Study Group 11 was added to Report 801 as Annex II. Since that time, the television program production industry has found sufficient merit in HDTV and the 1125/60 system to acquire HDTV equipment and to use it to advantage.

This report will review the current status of HDTV In production for television and the cinema.

EQUIPMENT

Currently there are at least 25 companies manufacturing production equipment to the 1125/60 standard, covering the full range from cameras and recorders to switchers and special effects devices. (See Annex). Of these companies 8 are Japanese, 10 are North American and 7 are European. Sony, the major supplier of cameras and recorders, states that as of July 1987 they have sold and delivered 65 video tape recorders and 25 cameras.

Sony/PCL in Tokyo, Japan has opened a facility to convert HDTV tapes to 35mm film using their Electron Beam Recording (EBR) system. They also are converting HDTV tapes to NTSC. This facility is operating on a commercial basis. Sony America plans to open an equivalent facility in the U.S. The facility will be ready to convert HDTV tapes to NTSC by the fall of 1987 and their EBR film recorder will be converting HDTV to 35mm film early in 1988.

NAC/NHK is also setting up a commercial facility in Japan to convert 35mm film to HDTV, HDTV to 35mm film and to convert HDTV to NTSC and PAL.

The manufacturers are finding a ready market for their HDTV equipment not only with TV production companies but also with allied industries such as medical imaging, printing and computer graphics.

PRODUCTION

As soon as the first developmental HDTV cameras and recorders became available, TV production companies started experimenting with HDTV productions. Their efforts were demonstrated at many technical conferences and conventions. When production equipment became available, television production companies started commercial operation. The first such company was a studio called Voir, Captain Video, in Paris, headed by Mr. David Niles. This company is producing music videos, television commercials and documentaries. Operating costs are a fraction of the cost of producing the same commercials in the film medium. Mr. Niles has now opened HDTV production facility in New York and plans a future facility in Hollywood under the name of 1125 Productions, Inc. Another company, Rebo High Definition Studio, Inc. started in operation in New York in 1986 and is currently engaged in a full range of production including feature films. In April, at the NAB Conference, the formation of a new HDTV production center in Dallas, Texas was announced by Mr. Dennis Ormer, to be called HD Studio Dallas. This center will have two HDTV editing suites, off-line editing, digital audio recording and a mobile HDTV recording van. In addition, there are at least four HDTV production facilities in Japan. All the major Hollywood program production centers are experimenting with HDTV production.

Currently there are a variety of major productions recently completed or in process. These include:

- "Julia and Julia" a feature length film for theatrical release produced by the Italian national broadcaster, RAI.
- "Chasing Rainbows" a 13 hour mini-series being produced by the Canadian Broadcasting Corporation (CBC) and Northern Light and Picture, Corp.
- "Do Up" a feature film being produced by Rebo High Definition Studio, Inc.

SUMMARY

Although the CCIR has not been able to agree on an HDTV production standard this has not stopped the TV production industry from putting into use the only HD production format available. The amount of production in process and the escalating sales of 1125/60 HDTV equipment are establishing the 1125/60 system as the de facto standard. CCIR Study Group 11 should recognize this current and expanding activity using the de facto standard in their continuing deliberations.

Companies Exhibiting and/or Manufacturing 1125/60 HDTV Equipment

ANNEX

<u>COMPANIES</u>	<u>COUNTRY</u>	<u>PRODUCTS</u>
ASACA/SHIBASOKU	JAPAN	MONITORS TEST SIGNAL GENERATORS LARGE SCREEN PROJECTOR
BARCO	BELGIUM	MONITORS
BROADCAST TELEVISION SYSTEMS (BTS)	FRG	HDTV CAMERAS
CANON	JAPAN	CAMERA-LENS
DYNAIR	U.S.A.	ROUTING SWITCHER WIDEBAND DISTRIBUTION AMPLIFIER
GENERAL ELECTRIC	U.S.A.	LARGE SCREEN LIGHT VALUE PROJECTOR
GRETAG	SWITZERLAND	LARGE SCREEN EIDOPHOR PROJECTOR
FUJINON	JAPAN	LENS-CAMERA
GRASS VALLEY	U.S.A.	ROUTING SWITCHERS PRODUCTION SWITCHERS FIBER OPTIC LINK
HITACHI	JAPAN	DIGITAL HDTV RECORDERS (EXP) 60" REAR PROJECTOR HDTV CAMERA
IKEGAMI	JAPAN	HDTV CAMERA TELECINE
MAGNI SYSTEMS	U.S.A.	TEST SIGNAL GENERATORS
MATSUSHITA/PANASONIC	JAPAN	LARGE SCREEN PROJECTOR
NAC/NHK	JAPAN	LASER-TELECINE LASER FILM RECORDER
NEC	JAPAN	LARGE SCREEN PROJECTOR

ANNEX CONT'D

<u>COMPANY</u>	<u>COUNTRY</u>	<u>PRODUCT</u>
NIKON	JAPAN	CAMERA-LENS
PANAVISION	U.S.A.	CAMERA-LENS
PORTA-PATTERN	U.K.	OPTICAL TEST PATTERN
QUANTEL	U.K.	GRAPHICS PAINT BOX
RANK CINTEL	U.K.	TELECINE
SONY	JAPAN	LARGE SCREEN PROJECTOR MONITORS VTR FILM RECORDER IMAGE ENHANCER PRODUCTION SWITCHER FIBER OPTIC CAMERA CABLE SYSTEM
TOSHIBA	JAPAN	VTR
TEKTRONIX	U.S.A.	WAVEFORM MONITOR
ULTIMATTE	U.S.A.	MATTING SYSTEM
UTAH SCIENTIFIC	U.S.A.	ROUTING SWITCHER

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APPENDIX B

Preliminary Technical Evaluation Of Proposed ATV Systems

The systems that are currently known to be possible candidates for implementation of terrestrial ATV broadcasting are discussed in this Appendix. They are broken down for analytical purposes into the following groups and subgroups:

1. Single Channel, NTSC-Viewable
 - a. Improved NTSC
 - b. Enhanced Systems
 - c. Temporally Subsampled Systems;
2. Single Channel Plus, NTSC-Viewable;
3. Separate HDTV Service.

These groups and subgroups, and the proposed ATV systems falling within them, are discussed below.

1. Single Channel, NTSC-Viewable
 - a. Improved NTSC. By proposing improvements which retain the current rf transmission standard, the basic video parameters of the transmitted picture will be limited to a 4:3 aspect ratio, a 4.2 MHz luminance bandwidth, a 1.3 MHz "I" bandwidth and a 0.6 MHz "Q" bandwidth for the two color difference signals, 525 lines per frame and 59.94 fields per second. §73.682, FCC Rules. This set of parameters was optimized for small display screens available at the time, viewed from a distance of six times picture height. These

parameters establish the best performance achievable when all of the artifacts discussed in the Notice inherent in the NTSC encoding process are eliminated by improved processing in the television studio and in home receiving sets. In addition, of course, the existing NTSC transmission standard does not currently permit high quality digital sound to be carried with the video.

In CBS's view, the problem with proposals, such as that of Faroudja,* to improve the NTSC standard is that, even if they work,** the result will almost certainly be noncompetitive with the technical quality which will be available from nonbroadcast video sources delivering programming in an HDTV format. Even the best of pictures possible within this set of constraints will not have HDTV's wide aspect ratio, will have less than one-half of its vertical and horizontal resolution for static pictures, and will have less resolution for moving pictures. The average viewer comparing the improved NTSC picture with the HDTV picture will notice, for the same size picture and viewing distance, that the improved NTSC picture is narrow and fuzzy. The viewer will also notice that the color resolution of the improved NTSC picture is obviously poorer than the HDTV picture, and nonbroadcast HDTV

* "Improving NTSC To Achieve Near-RGB Performance," Faroudja and Roizen, SMPTE Journal, Vol. 96, No. 8, pp. 750-761 (August 1987)

** The degree to which claimed performance can be achieved for the improved NTSC proposals mentioned in the Notice cannot yet be determined because equipment embodying all of these proposed improvements has apparently not been built and tested.

systems will have the further advantages of compact-disc quality stereo sound.

b. Enhanced NTSC. Some proposals suggest that further improvements can be obtained in luminance and/or color resolution if the transmitted rf signal is modified, without changing the current channel spacing or interference criteria. If they can be achieved, these proposals would improve the quality of the existing NTSC signal on new television receiving sets designed for those improvements, but would not attain the quality of a true HDTV standard. They would be receivable on existing receiving sets with an unknown amount of visible degradation compared to the current NTSC picture. Typical of the work to improve the NTSC standard in this manner is that of Hitachi* and Matsushita.**

In the referenced paper by Messrs. Fukinuki, et al., Hitachi proposes to increase the NTSC performance by interleaving additional information in the same manner as the color subcarrier in frequency areas normally unused, permitting only about 1 MHz of additional information. Hitachi proposes to use this additional information to increase the luminance resolution. When this technique is used in

* "NTSC Full Compatible Extended Definition TV Proto Model And Motion Adaptive Processing," Fukinuki, Hirano and Yoshigi, IEEE Document No. CH2190-7/85/0000-113, pp. 113-117 (July 1985). "Extended Definition TV," Fukinuki, 15th Annual International TV Symposium, pp. 175-186 (June 1987).

** "An Extended Definition Television System Using Quadrature Modulation Of The Video Carrier With Inverse Nyquist Filter," Yasumoto, Kageyama, Inouye, Uwabata and Abe, IEEE Transactions On Consumer Electronics, Vol. CE-33, No. 3, pp. 173-180 (August 1987).

combination with a progressive scanned display it is claimed that significant performance improvement will result. Although the Hitachi improvement in picture quality would be noticeable when compared with a current NTSC picture, the degree of improvement is minimal when compared to a MUSE picture.* Further, the improvement in the picture using a receiver designed for the modified signal would not be gained without some loss in picture quality when received on current NTSC receivers. The amount of that degradation depends on the precision of the color demodulator. At best the added information will appear as an increase in the background noise.

In the referenced paper by Messrs. Yasumoto, et al., Matsushita proposes to increase the information content in the NTSC signal by quadrature modulation of the vision carrier. The amount of information that can be added in this manner is limited by the truncation of the lower vision sideband in the vestigial sideband system used. This again limits the information added to only about 1 MHz. Matsushita proposes to use the additional information bandwidth to provide a wide aspect ratio picture, although it indicates that other uses for the information space are possible. Again the increase in information carried in the NTSC signal is not without countervailing problems. The degree of interference in current receivers will depend on the type of vision detector used.

* CBS occasionally refers to the MUSE system for comparison in this Appendix because it is the only system that has been demonstrated using terrestrial broadcast channels, in addition to satellite and cable links. These references are not intended here to imply CBS's endorsement of the MUSE system, or any other system, for terrestrial HDTV broadcasting.

If, as in top-of-the-line receivers, a synchronous detector is used the interference will appear as an increase in background noise dependent on the content of the additional information inserted. The resultant performance improvement may not be competitive with MUSE-based systems.*

Recently GE/NBC announced a new enhanced NTSC proposal. This system is under development at the David Sarnoff Research Center (DSRC), now a part of Stanford Research Institute (SRI).** This proposal utilizes a combination of several approaches to achieve a wide aspect ratio enhanced NTSC picture which would be viewable on current NTSC receivers. To achieve the wide aspect ratio GE/NBC proposes to compress the low frequency information in the area beyond the 4:3 aspect ratio into narrow bands at each edge of the

* While the Hitachi and Matsushita proposals discuss methods of enhancing the NTSC picture, the quality of the sound signal to be provided is also essential. Any new ATV system should include improvements in the sound system. The current television system has been recently upgraded to include stereo sound by the Multi-channel Television Sound (MTS) system. However, advances in sound quality available in pre-recorded music have outpaced even the performance of the MTS system. Indeed, MUSE incorporates a digital sound quality comparable to that of compact discs. Recently, Dolby Laboratories has proposed adding an additional subcarrier to the NTSC signal for digital sound signals. "A Compatible Digital Audio Format For Broadcast And Cable Television," Todd, IEEE Transactions And Consumer Electronics, Vol. CE-33, No. 3. pp. 207-305 (August 1987). While that system looks promising, its potential problems are that it may cause interference with the next higher channel lower vision sideband and may cause interference in the adjacent nonbroadcast band for channels at the upper end of the allocated band.

** "A Single Channel, NTSC Compatible Widescreen EDTV System," Isnardi, Fuhrer, Smith, Koslov, Roeder and Wedham, HDTV Colloquium (October 1987).