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87-268

UNITED STATES GOVERNMENT

MEMORANDUM

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DATE: March 30, 1990

REPLY TO

ATTN OF: Rita McDonald *RM*
Policy and Rules Division

SUBJECT: Distribution of the Advisory Committee on Advanced Television
Third Interim Report

TO: Delores Wise
Chief, Facilities Management Branch

The Third Interim Report of the Advisory Committee is currently being produced and should be ready for distribution after 1:00 this afternoon. Because each copy is a total of more than 700 pages, I would appreciate it if the Mail Section could handle distribution of the copies as follows:

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Thank you for your assistance.

April 26, 1989

**SECOND INTERIM REPORT OF THE
FCC ADVISORY COMMITTEE ON
ADVANCED TELEVISION SERVICE**

**Richard E. Wiley
Chairman, FCC Advisory Committee**

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I. Introduction

The Advisory Committee on Advanced Television Service ("ATV") was established by the FCC in November of 1987. Organizationally, it is composed of twenty-five regular members,¹ and several ex officio members (including representatives of other federal government bodies). The Committee's substantive functions are conducted primarily through three Subcommittees (Planning, Systems and Implementation), each of which has a number of Working Parties (and, in some cases, Advisory Groups).

The Advisory Committee filed its first Interim Report to the FCC in June of 1988. Pursuant to the request of Congress, it also issued a report on February 4, 1989 dealing with the general subject of an American involvement in ATV (i.e., basically, the so-called U.S. "competitiveness" issue). This document represents the Advisory Committee's second Interim Report to the Commission. Attached to the Report are individual reports from the three Subcommittees (each of which also has filed with the Advisory Committee Chairman full reports of its constituent Working Parties and Advisory Groups).

¹ There have been some changes in the membership during the life of the Committee. A current roster is attached as Appendix A.

II. Life Span of the Advisory Committee

Consistent with the Federal Advisory Committee Act, the Advisory Committee was chartered by the FCC for a maximum of two years (until November 1989). Given the complexities of the Committee's assignment and also the myriad unfinished tasks involved, it is recommended that the FCC re-charter the Advisory Committee for another two years. While the Committee believes that significant progress has been made toward the development of a new terrestrial broadcast standard for ATV (and, generally, in assisting the Commission to understand the technological, economic and spectrum trade-offs that must be considered in attaining such an objective), it is apparent that much more work lies ahead.

The Advisory Committee believes that this work (including testing of proponent systems, further spectrum analysis, and standard recommendations) can be completed by November of 1991. Thus, by extending the life of the Committee, the FCC should be in a position to establish a single terrestrial ATV standard sometime in 1992 and also to consider whether to establish standardized ATV interfaces between broadcasting and other video delivery media.

III. Support Activities

The Advisory Committee (and, we believe, the FCC) has been well served by the innovative and productive efforts of

numerous private sector individuals and organizations involved in the work of the operating Subcommittees and their subgroups. The Committee also has received important support, encouragement and policy guidance from the FCC's staff (most notably, from the Commission's Chief of the Mass Media Bureau and its Chief Engineer). In addition, the Advisory Committee wishes to acknowledge gratefully the leadership exhibited by a number of broadcast entities in establishing the Advanced Television Test Center ("ATTC") which has agreed to assume the principal burden (technologically and financially) involved in testing the various proponent systems that have been advanced to date. The Committee also expects to receive continued support from the Cable Laboratories, established by the cable industry, and from other trade and industry groups.

Moreover, the Committee would be remiss in not recognizing the pioneering efforts of the proponents themselves: those organizations which have exhibited the ingenuity and courage to introduce system concepts in a new and technologically complex environment. Without their inspiration and initiative, the American people would not be able to look forward to a greatly enhanced era of video delivery.²

² To date, fourteen proponents have advanced a total of 23 different ATV systems. In alphabetical order, the proponents are as follows: Avelex, Broadcast Technology
(continued...)

Finally, the Advisory Committee notes that significant national competitiveness, trade, security, and investment issues are [presented] RAISED FOR DISCUSSION by ATV developments, both at home and abroad. These issues are being given careful consideration by executive branch agencies and the congress. Moreover, the Advisory Committee has been well served by ex officio representation from the departments of commerce and state.

IV. Work in Progress

Since the Advisory Committee's first Interim Report some ten months ago, all three Subcommittees have been engaged in continuing and substantial efforts. In particular, these efforts have included intensive technical and economic analyses, leading up to the initiation of the crucial testing phase of the Committee's work very early next year.³

² (...continued)

Association, the Del Rey Group, Faroudja Laboratories, High Resolution Sciences, Massachusetts Institute of Technology, New York Institute of Technology, NHK, North American Philips, Osborne Associates, Production Services Inc., the David Sarnoff Research Center, Scientific Atlanta, and Zenith. In addition, Quanticon has proposed a video compression technique, and Digideck and Dolby each have proposed audio subsystems.

³ The Systems Subcommittee held an intensive workshop in November 1988 at which all proponents were given an opportunity to present their systems and critique the approaches of others. Thus, the Advisory Committee has initiated an interactive process, through screening and self-assessment, of determining which proposed systems should pass to the testing stage. A second workshop session is planned within the next several months. Based (continued...)

In particular, the Planning Subcommittee (chaired by Joseph Flaherty of CBS) has sought to establish a test parameter plan working closely with the private sector testing bodies, especially ATTC, and with various industry representatives. This plan involves an identification of the necessary test attributes applicable to the terrestrial broadcast media as well as to alternate media. It also encompasses the application of various parameters in specific tests, including test materials, test signals, and ranges to be tested and recorded.

Based on test parameter planning, the Systems Subcommittee (under the leadership of Chairman Irwin Dorros of Bellcore) has been tasked with the primary responsibility of specifying a test procedures plan and a test management plan. The test procedures plan will identify the step-by-step procedures required in the testing of proponent systems (including equipment types and data recordation details) while the test management plan will describe the required laboratory arrangements, responsibilities of various testing groups, the content and format of test reports and, importantly, detailed scheduling deadlines.

In addition, elements of the Planning Subcommittee have been analyzing the potential availability of spectrum

³(...continued)
on the expected availability of test facilities, the promised delivery of system hardware, and particularly the readiness of proponent systems, the target date to begin testing is January 1990.

capacity for ATV service, defining the requirements for an interface between ATV transmission systems for various video delivery media, and identifying economic factors involved in the market penetration of ATV systems. Meanwhile, other Planning Subcommittee Working Parties are engaged in fashioning plans for subjective tests, including psychophysical evaluations and ATV system market research. Finally, the Planning Subcommittee's two Advisory Groups have continued to define the requirements of the creative community with regard to advanced television systems and also the potential impact of alternative ATV policy strategies on the U.S. economy.

The Systems Subcommittee (through its constituent Working Parties) also has been active in establishing estimates of the costs associated with the distribution of advanced television service by various systems and in beginning the work of recommending standards for the transmission of ATV. Finally, the Implementation Subcommittee (chaired by James Tietjen of the David Sarnoff Research Center) has dealt with the policy and regulatory issues associated with the introduction of advanced television service and with the transition process that may be required in the evolution from NTSC television to some form of enhanced or high definition service.

As indicated, complete reports of the Planning Subcommittee (Appendix B), the Systems Committee (Appendix C)

and the Implementation Subcommittee (Appendix D) are included with this Report. Each is supported by individual statements of various Working Parties and Advisory Groups which are summarized in their respective Subcommittee reports.

In all, the work being performed by these three Subcommittees is comprehensive and exhaustive, and the challenges facing them are daunting. The Advisory Committee wishes to recognize and commend the meritorious efforts being made by the individuals involved and, in particular, the tremendous leadership exercised by the three Subcommittee Chairmen.

V. Findings and Conclusions

A. Test Plans

As previously indicated, procedures that will govern the testing of proponent systems are in the process of being formulated by both the Planning and Systems Subcommittee. While drafts of the test parameters, test procedures and test management plans are being formulated, they cannot be finalized until additional developmental work is performed on source material, further discussions are held with proponents and laboratory officials, and other details are worked out. These efforts should be completed shortly and, thereafter, the testing plans will be circulated to the members of the Advisory Committee for consideration and approval.

B. Test Stages and Criteria

The testing program itself will encompass four phases:

- (i) radio propagation tests;
- (ii) objective tests to assess the technical characteristics of ATV systems, including subjective tests of their interference performance;
- (iii) subjective (psychophysical) tests to assess how viewers perceive the various proponent systems; and
- (iv) broadcast and non-broadcast field tests.⁴

Ideally, assuming all candidate systems were ready for testing, it would be desirable to conduct a single and complete evaluation of each, thereby facilitating the collection of all relevant data required to compare the various systems. This procedure also would be favorable from the standpoints of both time and expense. System testing will require specialized equipment, skilled professionals, and source material produced solely for this task. Any measures that can be taken to limit the cost and time involved, without sacrificing the development of data needed

⁴ Working Party-7 of the Planning Subcommittee is preparing a detailed plan for market and audience research testing. Upon completion of its work, this area may become an additional phase of testing.

to analyze thoroughly the systems presented, should be given serious consideration.

Unfortunately, this idealized approach may not be feasible. The single item that may involve the greatest expenditure of time and money is the production of suitable source material (i.e., picture content and technological formats) for use in subjective testing. Because several different line/field rates (with interlaced or progressive scanning) are employed by various proponent systems, the selection of appropriate source material has been controversial and remains currently undecided. Further delay in this area could result in delay of the overall testing program.

Two [generally accepted, but] different[,] methods exist for developing the source material required for testing diverse systems. The first is to produce programming in one format (e.g., 1125/60 high definition video tape) and transcode that programming into the formats used by different systems to be tested. The other method is to produce material recorded originally in all required formats, thus avoiding the need for transcoding. Both methods are likely to be time consuming. With the first method, transcoders have to be designed and built for conversion to all of the production standards required for testing and, with the second method, substantial time will be needed to create the required material. Moreover, with the first method, concern

exists that the transcoding process would create artifacts that could skew test results unfairly while, with the second method, it is not yet certain that images that are sufficiently close to being identical can be created by the available technology.

In an effort to resolve this matter, the Planning Subcommittee is arranging an evaluation of the two approaches sometime this fall. The Advisory Committee will defer a final recommendation on this matter pending completion of the test and any input from the Commission that may be provided.

In the meantime, and to serve the dual purposes of making efficient use of limited testing resources while developing relevant empirical data as effectively as possible, the Advisory Committee recommends that testing be divided into two stages. The first stage would include the propagation tests, objective tests, and subjective tests related solely to interference performance.⁵ The second stage would include the bulk of the subjective evaluations as well as field testing.

Until a system qualifies under the first phase of testing, it would not be considered in the subsequent phase. Qualifying criteria would include interference characteristics and quality parameters (e.g., static and

⁵ Interference performance obviously is a particularly important element of ATV systems given the limitation on available spectrum.

dynamic resolution), [spectrum availability,] and other relevant factors.

The development of these qualifying criteria, and their measurement benchmarks, is being assigned to the Planning and Systems Subcommittees and their respective Working Parties. However, to assist the Subcommittees in their efforts, the Advisory Committee offers the following guidance.

With regard to the interference characteristics, the work performed to date by Working Party-3 of the Planning Subcommittee and by the FCC's Office of Engineering and Technology has indicated that the interference and noise performance of an ATV system that requires additional VHF and UHF spectrum must be significantly better than the existing NTSC television system. Moreover, on the basis of their work thus far, these entities have concluded that it will not be possible to provide a sizeable minority of existing broadcasters with additional spectrum capacity that is immediately adjacent to their present assignments.

Accordingly, the interference-related benchmarks should establish two important elements. First, it must be ascertained that a system qualifying under the first stage of testing is benign and immune to both existing NTSC signals and the particular ATV signal under test, even when broadcasting on taboo channels or at co-channel spacings of

160 km.⁶ Second, in the case of augmented systems, it must be demonstrated that transmission impairments do not deteriorate performance significantly, even when non-collocated transmitter sites are employed and the frequency spacing between main and augmented channels is significant.

With regard to quality parameters, the Advisory Committee believes that a proponent must deliver a substantially complete set of video/audio equipment⁷ for testing and also demonstrate that its system provides for the delivery of NTSC images with no noticeable degradation under typical NTSC picture viewing conditions. Beyond these basic quality-related characteristics, two general sets of qualifying criteria are envisioned.

One set would be applied to those systems that require no additional spectrum capacity (either bandwidth or energy). As a class, such systems offer enhancements to the quality of video images. Hence, the applicable performance benchmarks would seek to establish whether, in fact, a particular

⁶ As indicated, the Planning and Systems Subcommittees, and their respective Working Parties, will develop the precise numerical definitions of these interference-related benchmarks. Some important work has already been completed, however, and it appears that interference improvements over NTSC on the order of 30 dB will be required. In addition, the results of taboo analyses will be further verified through testing.

⁷ See the Report of Working Party-2 of the Planning Subcommittee.

proponent system could deliver a video/audio signal with quality better than NTSC.

The other set of criteria would be applied to the remaining systems (i.e., both augmentation and simulcast proposals). Since these systems would require the assignment of additional and very valuable spectrum, it is reasonable to expect that they would also offer higher performance than the other class of systems. Therefore, the performance benchmarks for these systems would seek to establish whether a particular proponent can deliver a video/audio signal with substantially greater quality than NTSC.

VI. Further Issues to be Decided

In addition to the matter considered above, there are three other issues of importance on which the Advisory Committee seeks guidance from the Commission: (a) the minimum number of audio channels required of systems; and (b) the schedule that should be followed in making these tests; and (c) the question of testing fees and performance bonds. All three must be resolved in the near future if the testing phase of the Committee's overall efforts is to proceed on schedule.

A. Minimum Number of Audio Channels

As indicated, Working Party-1 of the Planning Subcommittee has been considering the attributes of ATV

systems. In defining the attributes of the audio system, the Working Party's consensus was that the actual number of audio channels should be the prerogative of the individual system designers because the more audio channels that must be provided for, the less capacity which is available for transmitting video information.

As the Planning Subcommittee Chairman's Report has observed, maintaining compatibility with NTSC would seem to require four analog audio channels alone (a stereo pair, a SAP channel, and one channel for analog data). Thus, the Committee seeks guidance from the Commission as to the minimum number of high quality digital audio channels, both primary and secondary, that an ATV system would be expected to provide.

B. Timing

It is becoming increasingly evident that some form of deadline must be established for the testing phase of this inquiry. A deadline has the obvious benefit of preventing the testing process from continuing indefinitely. Of perhaps equal importance, however, is the fact that it also would help to organize the process more formally by encouraging the establishment of several intermediate deadlines.

On the basis of the work performed to date, a target date of 1991 for the completion of testing does not appear to be inherently unreasonable (and also would accord with the

completion of the Advisory Committee's proposed extended life span). To have any hope of achieving this time goal, however, proponents must complete assessment of their attributes by mid-1989, the facility that will test the systems must order appropriate equipment very soon, and testing must commence very early in 1990.

C. Testing Fees and Performance Bonds

The Advisory Committee also takes note of ATTC's apparent intention to require testing fees and performance bonds of system proponents. While the Committee would welcome any views that the FCC may have in this area, our initial reaction is that such measures would appear to represent good business practice and also may contribute to the expeditious performance of the testing process. However, the Advisory Committee wishes to ensure that such fees and bonds are reasonable and that they do not force the withdrawal of underfunded proponents that may put forward innovative and potentially significant system concepts. Accordingly, the Advisory Committee would recommend that ATTC consider the employment of some kind of exemption or "scholarship" program where such may be appropriate.

VII. Future Advisory Committee Efforts

Obviously, the most important and immediate task for the Advisory Committee is to finalize the test parameters, test

procedures, and test management plans. As discussed, this work will be completed in the near future, and will be reviewed and finalized by the Committee.

Moreover, as indicated previously, the Planning and Systems Subcommittees will fashion the criteria, and their measurement benchmarks, to be used in the first stage of tests that will qualify ATV systems for the final round of subjective and off-air evaluations. The Planning Subcommittee also will be continuing its work on spectrum analysis and on subjective evaluations. The latter task includes arranging for a test, later this year, between the two methods of developing multiple-format source material.

The Advisory Committee also believes that plans for testing cable and other non-broadcast delivery systems must soon be put in place. It is also expected that the interfaces between broadcasting and these media will be clarified in the near future.

In addition, the Advisory Committee anticipates that the Implementation Subcommittee will engage in two important tasks in the near term. One is an analysis of implementation strategies, in conjunction with the Planning Subcommittee, that could be employed in the event insufficient spectrum capacity is available to accommodate all broadcast licensees. The Committee's goal clearly is to permit all broadcasters to provide ATV, if they elect to do so. We nevertheless must recognize that spectrum is a scarce resource and that the

Commission ultimately may adopt a plan which does not accommodate all licensees, or accommodates them under modified service planning factors. Thus, preparations at least must be made for such undesirable possibilities.

Further, the Implementation Subcommittee as well as the Systems Subcommittee will be expected to examine the standards question from two different perspectives, each from the standpoint of its own area of responsibility. First, they should consider the feasibility of developing a standard structure which provides sufficient "headroom" to accommodate technological improvements over time that can be formally introduced in a systematic manner.⁸ Second, the possible interfaces between a single terrestrial broadcasting standard and other video delivery media should be studied. In this regard, consideration may be given to a variety of approaches including: establishing a "family" of standards, adopting standards governing the receiver display device, and developing a multi-port receiver to accommodate different media.

Finally, the Advisory Committee notes that discussions need to be initiated with Canada and Mexico in order to establish border criteria for ATV service.

⁸ In arriving at a standards recommendation to the FCC, it is possible that a single "winning" system may not emerge. Instead, the analytical and testing process might lead to the emergence of a standard based on a combination of attributes found in several candidate systems.

VIII. Conclusion

In concluding this Report, the Advisory Committee wishes to commend the FCC, and its Chairman, for initiating a process by which the introduction of ATV (and, in particular, its application to terrestrial broadcasting in this country) is being considered in an orderly and comprehensive manner. The Committee believes that its three Subcommittees, and their constituent elements, have made substantial and very important progress in the last year and a half. The Committee looks forward to continuing its efforts through 1991 if the FCC deems it appropriate for the Committee to be rechartered.

Respectfully submitted,

Richard E. Wiley
Chairman, ATV Advisory Committee

C. Work Statements for Planning Subcommittee Working Parties



Advisory Committee on Advanced Television (ATV) Service

Doc. No. PS-043Date August 14, 1989

PLANNING SUBCOMMITTEE WORK STATEMENT FOR THE 3RD PERIOD OF ACTIVITY

PLANNING SUBCOMMITTEE WORKING PARTY 1

Following the inability of WP-1 to reach a consensus on the minimum number of audio channels which proponents should provide in ATV systems, the FCC has declined to make such a determination, but, in a letter to the chairman of the Advisory Committee dated 7/18/89, has made the following statement.

"In examining the quality improvements presented by the various ATV transmission schemes, the Commission will likely assess both video and audio performance. The Committee should assist us in this regard by ensuring that tests of these systems will develop data on audio performance, including cross talk between analog and digital channels. Thus, system proponents would be well advised to emphasize the audio component of their systems sufficiently so as to both maintain service to NTSC receivers and deliver the high quality we anticipate from ATV systems.

Beyond the basic requirement that the quality of the ATV system ultimately selected by the Commission be higher than that of an NTSC system, the Commission does not specify any minimum number of audio channels at this juncture. Because the testing process is fundamentally a comparison of competing ATV systems, the number and quality of each system's audio channels will likely be among the significant comparative factors that will help in ranking these systems. This likelihood should motivate proponents to provide a high quality digital audio signal in their systems even in the absence of standards for minimum numbers of audio channels."

WP-1 should consider what further action should be taken in the matter, beyond the obvious need to make all proponents aware of the significance that the FCC attaches to the number and quality of audio channels provided by proponents in the course of the comparative assessment of ATV systems submitted.

WP-1 should further define the attributes of an ATV system required for ghost elimination, a feature to be introduced in future NTSC receivers, and one which should be available also in ATV system. The parameters involved should be defined.

PLANNING SUBCOMMITTEE WORKING PARTY 2

In coordination with the work of PSWP-1, PSWP-2 should develop the test procedures necessary to assess the effectiveness of ghost elimination systems provided by proponents.

Secondly, the test parameters plan submitted to the Systems Subcommittee and to Chairman Wiley should be reviewed and updated or amplified as necessary, in coordination with PS WP-4

PLANNING SUBCOMMITTEE WORKING PARTY 3

The on-going spectrum-availability studies should continue with special attention given to the impact of the following parameters/conditions on the availability of spectrum for ATV:

- (i) Protecting IF-related and/or inter-modulation related taboos.
- (ii) Protecting existing vacant allotments.
- (iii) The need to protect the channels proposed for land mobile.
- (iv) Allowing transmitter co-location (and near co-location) for adjacent, IF-related and Inter-modulation related taboos.
- (v) Consider the possible deletion of protection for existing land mobile channels.

In addition, the working party should undertake the following studies:

- (i) Develop a channel assignment plan based on inputs from the System Subcommittee and your working party's agreed upon technical planning factors for ATV.
- (ii) Review the results of the ATTC propagation and channel characterization tests at VHF/UHF, 2.5 and 12 GHz, and complete the work relating to the availability of spectrum above 1 GHz, including the possibility of using government spectrum.
- (iii) Determine the spectrum requirements for ATV terrestrial and satellite distribution systems. (ENG, ICR, STL, etc.).
- (iv) Develop the necessary software programs to illustrate the effect of interference on existing NTSC and new ATV services.
- (v) Develop technical guidelines for sharing of the VHF and UHF spectrum for ATV along the U.S./Canadian border.

In summary, Working Party 3 should:

- (i) Further refine the effects to be expected from the elimination of "taboos".
- (ii) Determine the interference reducing characteristics which proponents systems should have in order that they may operate at closer than present spacings to existing NTSC stations and to each other.
- (iii) Study the problems associated with 2 channel ATV systems, where the channels are separated by plus or minus 2 channels. The scenario developed for a co-channel spacing of 160 Km and 30 dB reduction of the effect of an interfering ATV signal is based on the goal of providing an additional 6 MHz channel to 99.7% of all present TV stations. While this 30 dB reduction in co-channel interference is a goal, anything less than a 30 dB reduction of the interfering signal is likely to result in a major reduction in the number of existing stations which can have an additional 6 MHz channel, particularly in major metropolitan areas.

PLANNING SUBCOMMITTEE WORKING PARTY 4

Continuing studies are required to determine the practicality of the multipoint receiver approach to a universal display interface, leading to the specification of parameters and values required.

These activities should be conducted in close coordination with PSWP-2 and the Systems Subcommittee as necessary.

PLANNING SUBCOMMITTEE WORKING PARTY 5

It is of critical importance that PSWP-5 continue to respond to the needs of SS WP-3, as defined by the memoranda from the Chairman of SS WP-3, (Larry Thorpe).

Because ATV is defined to include IDTV, EDTV, and HDTV, which represent a rising scale of technical excellence, and because the cost of the consumer is different for each of these categories, WP-5 should now reassess the assumptions which led to their first estimate of the rate of penetration of ATV service.

In fact, given the difference in consumer appeal and the consumer cost for each category of ATV, projections of market penetration for each category should now be developed.

PLANNING SUBCOMMITTEE WORKING PARTY 6

WP-6 has now defined 32 test scenes to be used in the subjective assessment program, and a draft of a subjective test procedures manual has been prepared.