Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Advanced Television Systems	)	
and Their Impact Upon the	)	**MM Docket No. 87-268**
Existing Television Broadcast	)	
Service	)	
	)	
Fifth Further Notice of	)	
Proposed Rule Making	)	

COMMENTS OF THE ADVANCED TELEVISION SYSTEMS COMMITTEE

July 11, 1996

SUMMARY

The ATSC emphatically endorses the Commission's tentative decision to adopt the ATSC DTV Standard and to require digital broadcast licensees to implement the standard in its entirety. Over the past nine years, the expectation that the Commission would adopt a single DTV standard based on the recommendation of its Advisory Committee has guided the industry and motivated its considerable investments of financial and human resources. We believe that it is imperative for the Commission to adopt a single DTV standard in order to provide clear and certain ground rules for broadcasters, manufacturers and consumers, and that the ATSC DTV Standard is the best possible standard to adopt and is more than fully adequate. After nearly a decade developing world-leading digital television technology, all that remains is for the Commission to approve the recommended standard in order to trigger a flood of investment that will bring the benefits of this bountiful new technology to the American people.

The ATSC DTV Standard based on the Grand Alliance system represents by far the world's best digital broadcast television system, with unmatched flexibility and unprecedented ability to incorporate future improvements. Implementing this technology will dramatically increase the technical quality of broadcast television, helping to preserve for consumers and for our democratic society the benefits of a vibrant and healthy free over-the-air television service in the future. In addition, deploying this technology will give consumers access to a host of potential information services that can help meet pressing needs in health care, education and other areas, and will create and preserve tens of thousands of high-skill, high-wage jobs and engender substantial economic growth.

The ATSC members strongly believe that *mandating* the use of the *complete* DTV standard by digital broadcast licensees is necessary in order to provide the certainty and reliability necessary for broadcasters, manufacturers and consumers to invest in digital television. By reconfirming its 1990 decision and its tentative decision in this NPRM to require the use of a single, complete broadcast standard, the Commission can promote a swift

transition to digital broadcast television, drive broadcaster and consumer costs down rapidly, and recover extremely valuable television spectrum as soon as possible.

Authorizing the use of the standard and prohibiting interference to it, but not requiring the use of it, and adopting a standard for allocation and assignment purposes only, are two wholly inadequate approaches which simply will not provide the certainty and clear direction required to get mutually dependent broadcasters, manufacturers and consumers to make consistent and mutually reinforcing investment decisions. The Commission's unfortunate experience with AM stereo radio service illustrates the folly of failing to establish a single clear standard.

Similarly, all layers of the ATSC DTV Standard should be adopted. The proposed standard represents the minimum essential requirements to provide broadcasters and equipment manufacturers the information and assurances they need, yet allows tremendous room for flexible use, and product and service differentiation and enhancements.

We strongly believe that concerns noted in the NPRM regarding the potential obsolescence of the standard are greatly exaggerated, and that a sunset provision on the mandatory use of the ATSC DTV Standard is unnecessary and would undermine the Commission's goal to promote a smooth and swift transition. For proposals to modify, to make nonmandatory, or eventually even to replace the ATSC DTV Standard, we believe the Commission should rely on its existing processes and on proposals from industry organizations such as the ATSC, where membership is open to all interested parties, and where a cross-industry consensus can be developed.

Over the past decade, and especially during the last five years, the Advisory Committee has worked extensively to ensure that its recommended standard maximized interoperability with alternative media, including computers and telecommunications. As a result, the ATSC DTV Standard is more easily interoperable, by far, with computers and telecommunications than any other digital television service on the planet. We are convinced that it provides *more than adequate* interoperability with alternative media, that no critical

interoperability problems remain, and that no further actions by the Commission are required to facilitate interoperability. None of the objections raised by some members of the computer and motion picture industries are new issues. They have been raised and debated thoroughly and repeatedly, and addressed fully in the Advisory Committee recommendation which was adopted without objection by the Advisory Committee members, including members of these industries.

Although the Advisory Committee's charter was to recommend a *terrestrial broadcast* ATV transmission standard, from the beginning the easy interoperability of the standard with cable TV systems was a key objective in the development of the Grand Alliance system and the ATSC DTV Standard. As a result, the ATSC members believe that as voluntary standards activities continue in the cable industry, as well as for other video delivery media, it's likely that many elements of the terrestrial ATV standard will also be incorporated in emerging standards in these industries. We believe that such voluntary standards will promote the early availability of digital television, including HDTV, over all of these other media as well as terrestrial broadcasts, without causing undue burdens on cable operators or other providers.

Regarding the potential need for the Commission to impose requirements on receiver manufacturers, the statements of manufacturers and broadcasters alike make clear that digital receivers will have all-format reception capability with or without any government mandate to do so. With respect to other aspects of the reception performance of receivers, the ATSC recently began an effort involving both broadcasters and receiver manufacturers to investigate whether receiver performance standards need to be adopted to satisfy the concerns of broadcasters. If such standards are deemed necessary, the ATSC will work with the Consumer Electronics Manufacturers Association to ensure that such standards are developed expeditiously. If minimum performance levels for DTV receivers are deemed necessary, whether they are established as voluntary standards or as FCC requirements, the development of such standards need not and must not delay the adoption by the Commission of the ATSC DTV Standard itself.

Throughout this process, the Advisory Committee, the Grand Alliance and the ATSC have taken great pains to assure that the recommended standard provides maximum compatibility with international standards. We believe the ATSC DTV Standard represents by far the world's best digital television technology, yet while this superior system awaits final Commission approval, far less capable, less computer-friendly systems are being adopted around the world, even for some digital television services in the United States. At this point in time, the most important thing the Commission can do to facilitate international compatibility and to promote export opportunities is to adopt the ATSC DTV Standard as rapidly as possible. Notwithstanding the broad industry consensus supporting the ATSC DTV Standard, any further delays in adopting the standard would squander the U.S. technological lead and risk seeing the U.S. "re-leap-frogged" in exploiting this innovative American-born technology.

Over the past decade, the Commission has championed a unique process, providing leadership, policy direction and support, while relying on private investment, competition and a volunteer army of experts and leaders from the affected industries to develop a stunning technological achievement. Through this open, thorough process, an extremely broad consensus has been achieved, delicately balancing the needs of consumers and the various industries involved. In sharp contrast, there is no consensus at all supporting the changes proposed by the few detractors of the proposed standard.

Now it is time for the Commission to act decisively, to follow through on the commitment it has made to industry repeatedly over the past decade to set a new broadcast television standard. The ATSC members implore the Commission to adopt the full ATSC DTV Standard as swiftly as possible and mandate its use by digital broadcast licensees. In so doing, the Commission will provide the certainty and reliability required by financiers, broadcasters, manufacturers and consumers to unleash the further substantial investments necessary to bring the benefits of this fertile technology to the American public and to spread those benefits throughout the world.

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COMMENTS OF THE ADVANCED TELEVISION SYSTEMS COMMITTEE

I. Introduction

The Advanced Television Systems Committee ("ATSC") respectfully submits these comments on the Commission's Fifth Further Notice of Proposed Rule Making ("NPRM") in its Advanced Television ("ATV") proceeding. The NPRM continues the Commission's efforts to usher in the next era of broadcast television: digital broadcast television, and seeks comment on the Commission's proposal to require the use by digital television licensees of the digital television standard recommended to the Commission by its Advisory Committee on Advanced Television Service ("Advisory Committee") and documented and endorsed by the ATSC and published as the ATSC Digital Television Standard.

The United States Advanced Television Systems Committee was established in 1982 by the Electronic Industries Association, the Institute for Electrical and Electronics Engineers, the National Association of Broadcasters, the National Cable Television Association, and the Society of Motion Picture and Television Engineers, and is presently composed of more than

fifty corporations, associations, and educational institutions, including terrestrial and cable broadcasters, broadcast and consumer equipment manufacturers, and members from the motion picture, computer and telecommunications industries.[1] The ATSC is a private sector organization engaged in developing and coordinating voluntary industry standards for a wide range of emerging Advanced Television Systems, including digital High Definition Television (HDTV) and digital Standard Definition Television (SDTV). In addition, the ATSC advises the U.S. Department of State on international television standards, and represents the U.S. in certain international standards bodies.[2]

The ATSC emphatically endorses the Commission's tentative decision to adopt the ATSC DTV Standard and to require digital broadcast licensees to implement the standard in its entirety. Over the past nine years, the expectation that the Commission would adopt a single DTV standard based on the recommendation of its Advisory Committee has guided the industry and motivated its considerable investments of financial and human resources. The members of ATSC believe it is imperative for the Commission to adopt a single DTV standard in order to provide clear and certain ground rules for broadcasters, manufacturers and consumers, and that the ATSC DTV Standard is the best possible standard to adopt and is fully adequate. After nearly a decade developing world-leading digital television technology, all that remains is for the Commission to act promptly to approve the ATSC DTV Standard recommended by the Advisory Committee in order to unleash a flood of investment that will bring the benefits of this fertile new technology to the American people.

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[1]The current members of ATSC are listed in Appendix A.

[2]In July 1996, in order to promote the use of its standards in other countries, the ATSC members approved modifications to the ATSC Charter to open membership to organizations with an interest in advanced television throughout North and South American and the Caribbean. Under this broadened structure, a caucus of the U.S. ATSC members will be convened to consider issues and standards that are specific to the U.S., including advising the U.S. State Department and the FCC. Other national caucuses (Canadian, Mexican, Brazilian, etc.) will also be formed as necessary.

II. The ATSC DTV Standard

The ATSC DTV Standard represents world-leading, proven technology that will deliver quantum improvements in the technical quality of broadcast television, giving broadcasters the means to compete effectively with other methods of delivering video in the decades to come, thereby helping to preserve free over-the-air broadcast television service for the benefit of the American public. And in the course of providing these improvements in entertainment, sports, education and news television through the introduction of HDTV and SDTV, the proposed standard also establishes a generalized flexible and extensible data delivery capability. Thus, when consumers invest in digital HDTV television receivers, they'll get dazzling pictures and terrific sound, and a whole lot more--a huge information "pipe" that can deliver 19.3 Mbps of data over each TV channel and a high resolution display which together can support a wide variety of innovative information services. In this manner, the deployment of HDTV will bring about a substantial improvement in the National Information Infrastructure, and consumer investments in HDTV receivers will help support the economical delivery of a broad range of other valuable information services.

The all-digital nature of the ATSC DTV Standard and its utilization of a packetized data transport structure, together with its emphasis on progressive scan transmission formats and "square" pixels, give the system unmatched compatibility and interoperability with computer and telecommunications applications, guaranteeing its suitability for a wide range of applications that go far beyond improvements in entertainment and news television service. Indeed, "the ATSC DTV Standard describes a remarkable system that is capable and flexible well beyond the expectations of a few short years ago. It is the product of the genius and persistence of its creators and is a tribute to their efforts." (NPRM, ¶49)

Not only is the development of the Grand Alliance HDTV system and the ATSC DTV Standard based upon it a towering technological achievement, the Commission's Advisory Committee process that produced these results represents an unsurpassed example of effective cooperation between government and industry. With strong leadership and support from all

of the Commissioners, including four FCC Chairmen, the Commission has been involved in the development of this standard throughout this proceeding (NPRM ¶30), providing the key policy decisions that have guided this effort, e.g., the decisions to use 6 MHz channels, to simulcast DTV transmissions during a transition period using the taboo channels already allocated to television service, to pursue full HDTV rather than mere enhancements of conventional television, and perhaps most important, the decision to establish the Advisory Committee under the able leadership of former FCC Chairman Richard E. Wiley to recommend an advanced television transmission standard.

With these basic guiding policies in place, through its Advisory Committee the Commission then relied on private investment in an open, competitive process, to evaluate 23 original proposals, with a final cooperative phase to combine the best attributes of four "finalist" all-digital systems into the *digital* HDTV Grand Alliance system. In 1995, at the encouragement of Chairman Hundt, the ATSC and the Advisory Committee developed a strong industry consensus around a set of formats for SDTV transmission to be added to the Grand Alliance HDTV formats and incorporated into the ATSC DTV Standard which the Advisory Committee then proposed to the Commission in its final report in November 1995. Throughout nearly a decade, hundreds of volunteers from dozens of firms in the television broadcasting, cable TV, broadcast equipment manufacturing, consumer electronics equipment manufacturing, motion picture, computer and telecommunications industries have participated in the Advisory Committee and ATSC processes, contributing their best efforts to specify system requirements, to develop and construct prototype hardware for the best advanced television system possible, and to verify its performance through exhaustive testing in laboratories established for this purpose as well as in subjective viewing tests and extensive field tests.[3]

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[3]The Grand Alliance estimates that the industry has invested approximately $500 million overall, including approximately $300 million from the Grand Alliance members themselves in this effort. *See* Statement of Robert K. Graves on Behalf of the Digital HDTV Grand Alliance before the Subcommittee on

Most of the participants in the Advisory Committee process and all of the members of the Grand Alliance are also members of ATSC, and ATSC has played a key supporting role throughout the decade-long process of developing a DTV standard. In the Commission's May, 1992 Second Report and Order/Further Notice of Proposed Rule Making ("Second NPRM") at ¶69, the Commission stated:

> Finally, we recognize that prompt disclosure of a winning system's technical specifications may be necessary to permit the mass production of ATV equipment in a timely fashion. The Advisory Committee indicates that industry efforts are underway to designate a standards-setting group to undertake the formulation of such specifications. We encourage such efforts and will monitor the progress of this industry activity.

In June, 1992 ATSC submitted to the Commission a document describing the various standards activities that would need to take place to implement the winning system along with a list of the standards organizations that had agreed to assume responsibility for each activity. In response, in the Commission's October, 1992 Memorandum Opinion and Order/Third Report and Order/Third Further Notice of Proposed Rule Making ("Third NPRM") at ¶79, the Commission noted the intention of ATSC to document the ATV technical standard as it would be implemented for broadcast transmission, and urged the ATSC to begin the actual documentation process as soon as it had sufficient data.

In early 1995, ATSC completed its work to document a broadcast transmission system based on the Grand Alliance system, and the resulting ATSC Digital Television Standard was submitted to the ATSC members for their approval. By letter ballot closing April 11, 1995, the standard was approved overwhelmingly by the ATSC members.[4]

In early 1995, responding to a request from Chairman Hundt, the Advisory Committee decided to attempt to incorporate SDTV transmission formats into its consensus recommendation. SDTV formats had not been included in the agreement among the Grand

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Telecommunications and Finance of the Committee on Commerce, U.S. House of Representatives, March 21, 1996.

[4]Forty-two members voted to approve the standard, two voted against approval, and six abstained.

Alliance members, nor in the Advisory Committee's specifications for the prototype best-of-the-best system to be constructed by the Grand Alliance and tested by the Advisory Committee. Consequently, ATSC, through its Technology Group on Distribution (T3) began work to develop an industry consensus around the SDTV formats to be added to the standard. Substantial progress was made, and this work was forwarded to the Technical Subgroup of the Advisory Committee which convened a widely attended industry discussion at which an overwhelming consensus was finally obtained in support of the SDTV formats now included in the ATSC DTV Standard. By letter ballot closing September 15, 1995, the ATSC members approved revisions to the ATSC DTV Standard to include the SDTV formats, again by an overwhelming margin.[5]

III. The Commission's Proposal to Mandate Use of All Elements of the ATSC DTV Standard Is Essential

The ATSC members certainly agree with the Commission that transmission standards, either *de facto* or *de jure*, convey many benefits. (NPRM, ¶21) A standard is required in order to provide the certainty and reliability necessary for broadcasters, manufacturers and consumers to invest in digital television, and a clear, unambiguous standard is necessary to provide a reliable basis for the design of broadcast and consumer equipment. Moreover, we strongly believe that an FCC requirement *mandating* the use of the DTV standard by digital broadcast licensees is necessary to achieve these goals.

In the first place, mandating use of the DTV standard would not be a case of an arbitrary government decision attempting to impose an unproven standard upon the marketplace. The ATSC DTV Standard has been developed after a thorough, competitive process, and the proposal has won an extremely broad consensus within the affected industries. Almost without exception the participants in those industries are urging the

[5]Forty-three members voted to approve the standard, one voted against approval, and nine abstained.

Commission to reinforce that consensus and provide the certainty and reliability to allow all segments of the industry to move forward rapidly and confidently to implement the service.

Moreover, as the Commission notes in the NPRM at ¶36, free over-the-air broadcast television service is entirely different from PCS, DBS and DARS. It is an established service upon which more than 98% of Americans rely, either directly or indirectly, not just for entertainment, but for news and information. As Commissioner Chong points out in her separate statement:

> . . . free over-the-air broadcasting is fundamental to the well being of a democratic society. Without question, television is an important and even unique part of our American culture. It gives us shared national experiences, entertains us, inspires us and informs us. . . . Nearly all Americans rely on television as an important part of their daily life; television for them is not a discretionary service.

When consumers are offered the opportunity to invest in digital televisions, it will be vital that they have assurances that those sets will operate properly, that they will receive all of the local channels, and that if they move across town or across the country, their investment will be protected. Without such assurances, consumers would be reluctant to make such investments, and the whole transition to digital television would be stultified or thwarted. For broadcasters, broadcast equipment manufacturers, receiver and converter manufacturers, and consumers all alike, a rapid transition is imperative to create an economically advantageous changeover to digital television. Any doubt or ambiguity about the standard to be employed will only retard the transition and increase costs, to the detriment of consumers and all segments of the television industry.

Any such doubt or ambiguity would also compromise one of the Commission's primary objectives in this proceeding -- the rapid recovery of valuable television spectrum. Removing doubt and ambiguity by adopting a single, clear transmission standard will promote a swift transition to digital television which will allow the Commission to repack the digital channels more tightly once analog NTSC transmissions cease and to recapture large,

contiguous blocks of nationwide spectrum that will be extremely valuable for a wide variety of wireless services.

As the NPRM makes abundantly clear, whether or not the Commission should set a single standard is not a new issue in this proceeding. We believe the Commission was correct in its 1988 Second Inquiry statement that the public interest compels a Commission role in the development of standards; and that establishing a standard has certain advantages such as pointing the various interested parties in the same direction, reducing the risk to both audiences and broadcasters of investments in systems that might become obsolete if a different system is introduced in the market, and overcoming reluctance to invest in new equipment. (NPRM, ¶23) And we believe that the predominant view among the commenting parties in the 1988 Second Inquiry favoring a single, mandatory standard is still correct, i.e., that such action would result in the most rapid development and acceptance of advanced television equipment, by promoting cost-effective receiver designs, thereby providing the largest audience for initial broadcasts of ATV programming. (NPRM ¶25) Furthermore, we believe the Commission was correct to conclude in its 1990 First Report and Order that "[c]onsistent with our goal of ensuring excellence in ATV service, we intend to select a simulcast high definition television system," and to reiterate that commitment in its 1990 Memorandum of Understanding with the Advisory Committee and the various ATV testing laboratories. (NPRM ¶26)

The NPRM highlights two "recent" developments that might arguably justify a different conclusion: first, the presence of a single consensus standard, in contrast to multiple competing systems in 1990, might make it unnecessary to mandate a single standard; and second, the opportunity afforded by digital transmission technology for each licensee to offer a unique set of services might make it less desirable to require a particular standard. (NPRM, ¶¶27-28) The first noted change is rather remarkable in that it overlooks the fact that the Commission's clear intention to select a single standard was central in motivating the Advisory Committee and the HDTV proponents to encourage and to form the HDTV Grand Alliance,

and in driving the subsequent actions of the ATSC and the Advisory Committee to forge a consensus around a broadened ATV standard that included SDTV formats. Removing the assumption that the Commission would mandate a single standard could threaten the industry consensus and certainly would inject a great deal of uncertainty, risk and delay that would jeopardize a rapid transition to digital television.

The second noted change, the development of an all-digital system, does *not* call into question the Commission's earlier decisions to mandate a standard, but reconfirms the wisdom of doing so. The all-digital system represented by the ATSC DTV Standard brings flexibility and extensibility undreamed of previously, so the Commission's earlier modest concerns about an *inflexible* standard have been fully addressed, there is no real dilemma about mandating a standard, and the strong consensus view expressed in 1988 and adopted by the Commission in 1990 applies *a fortiori* today.

Thus, the Commission's decision to require the use of a single broadcast standard is correct. A mandated single standard will promote a swift transition, drive broadcaster and consumer costs down more rapidly, and allow the Commission to recover extremely valuable television spectrum as soon as possible.

A. The Full ATSC DTV Standard Should be Adopted

The ATSC members strongly believe that all layers of the ATSC DTV Standard should be adopted. The Advisory Committee and ATSC have given careful consideration to what is essential in a standard. The proposal represents the minimum essential requirements to provide broadcasters and equipment manufacturers the information and assurances they need, yet allows tremendous room for flexible use, and product and service differentiation and enhancements. Any proposal to limit the mandated aspects of the standard only to certain layers of the standard would inject the kind of uncertainty and unreliability described above, jeopardizing a smooth and rapid transition to digital television.[6]

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[6]As discussed in Section VI-D, *infra*, the Commission is required by law to establish regulations that ensure that closed captioning can be offered by broadcasters. This would not be practical if the Commission did not

In addition, supplemental standards that build upon the basic ATSC DTV Standard have already been developed and adopted by the industry through the ATSC and more are in process. Once the basic ATSC DTV Standard is firmly established and its use mandated, these supplemental standards need not be mandated nor approved by the Commission.[7]

B. The Commission May Incorporate the ATSC DTV Standard by Reference

The ATSC DTV Standard can be incorporated into the Commission's rules by reference, and need not be incorporated in its entirety.[8] Two ATSC documents need to be referenced: ATSC Doc. A/53, ATSC DIGITAL TELEVISION STANDARD, 16 Sep 95; and ATSC Doc. A/52, ATSC DIGITAL AUDIO COMPRESSION STANDARD (AC-3), 20 Dec 95. In adopting the standard, the Commission should mention ATSC Doc. A/54, GUIDE TO THE USE OF THE ATSC DIGITAL TELEVISION STANDARD, 4 Oct 95, but it should not be incorporated into the Commission's rules.

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specify a complete standard that could provide a context for such a capability. Similarly, as discussed in Section VI-E, *infra*, the ATSC is providing technical assistance to the cross-industry task force that is developing a voluntary program rating system that would utilize the V-chip capability mandated by the Telecommunications Act of 1996. A functional voluntary program rating system could not be assured for the nation's emerging digital television system without a complete and reliable DTV transmission standard.

[7]The ATSC has published a guide to the use of the ATSC DTV Standard, and has adopted and published two supplemental DTV standards: Program Guide for Digital Television (ATSC Doc. A/55); and System Information for Digital Television (ATSC Doc. A/56). In response to concerns expressed by some members of the computer industry in the Commission's Fourth NPRM, the ATSC Executive Committee has directed its Technology Group on Distribution (T3) to commence work on a supplementary DTV standard specifying a protocol for data broadcasting. We are actively encouraging additional representatives of the computer industry to join ATSC to participate in this effort and in similar standards activities that will be increasingly important to the computer industry.

[8]In 1993, the Commission took a similar approach in amending its rules to provide for the optional transmission of a ghost-canceling reference within NTSC broadcast transmissions. Following an evaluation of competing proposals by ATSC, the winning system (developed by Philips Electronics) was adopted as a standard by a vote of the ATSC members, after which the Commission approved the ATSC recommendation and incorporated this new capability into its rules, publishing the technical standards for it in a technical bulletin of the Commission's Office of Engineering and Technology.

C. The Commission Should Rely Primarily on an Industry Consensus in Considering Future Changes to Its Rules Concerning the Standard

The ATSC members believe that the concerns expressed in the NPRM at ¶¶42-47 regarding the potential obsolescence of the DTV Standard are greatly exaggerated. The all-digital nature and the packetized data transport structure of the ATSC DTV Standard give it unprecedented flexibility and extensibility, i.e., the ability to handle a limitless variety of applications now, and the ability to incorporate new capabilities in the future without rendering earlier generations of digital receivers obsolete. Its ability to incorporate changes and improvements is orders of magnitude greater than that of the current analog NTSC system. To be sure, no standard can be expected to last forever, given our collective inability to predict what technological innovations will occur decades from now, but at that distant date, the need to implement an entirely new system will probably be as evident then as it is today.

Accordingly, the ATSC members strongly believe that a sunset provision on the mandatory use of the ATSC DTV Standard is unnecessary and would undermine the Commission's goal to promote a smooth and swift transition. Any suggestion now that the standard may soon become obsolete or superseded is wrong and would send inappropriate and counterproductive signals to broadcasters, manufacturers and consumers.

In keeping with the Commission's desire to rely on the private sector insofar as possible, we believe that proposals to modify, to make nonmandatory, or eventually even to replace the ATSC DTV Standard should be made initially through the ATSC, or an organization like it, where membership is open to all interested parties, and where a cross-industry consensus can be developed. Such modifications would then be submitted by the ATSC to the Commission for approval. In addition, of course, under the Commission's current processes, any party could petition the Commission to make modifications to its rules at any time, or the Commission could initiate its own review, however, the Commission should rely primarily on the private sector, as it wisely prefers to do, by looking to ATSC, the

industry standards body for advanced television, for guidance regarding the need to update or modify the standard, or even to make its use nonmandatory.

Given this reliance on the private sector, it should not be necessary for the Commission to review the standard at a specific time, including whether it remains appropriate to mandate its use. However, if the Commission does wish to schedule a review of the standard, an appropriate time for such a review might be when the transition is complete, including the repacking process, and the analog channels have been returned to the Commission, e.g., ten to fifteen years after DTV transmissions begin. In any such review, the burden of persuasion ought to be on those who may advocate changing the standard or removing the requirement to use it.

D. Alternative Approaches to Requiring Use of the Full Standard Would Not Be Effective

Authorizing the use of the standard and prohibiting interference to it, but not requiring the use of it, as referenced in the NPRM at ¶48, would not provide the certainty and reliability that are necessary to engender the substantial investments required of broadcasters, manufacturers and consumers for the conversion to digital television. Consumers must be assured that when they purchase a digital television receiver it will deliver the full designed performance anywhere in the country, and that their receiver will not be rendered obsolete by incompatible changes in broadcast equipment. Likewise, broadcasters must have confidence that widely available receivers from all manufacturers will be compatible with the signals they emit, and that incompatible improvements in receiver designs will not impair or prevent the reception of their broadcasts. Such a weak approach as this "allow, but don't require" option would not provide an adequate basis for design or purchase, and would likely render the transition to digital television stillborn and make it impossible for the Commission to recover valuable television spectrum.

The Commission's unfortunate experience with AM stereo radio service illustrates the folly of failing to establish a single clear standard. AM stereo systems were ready for approval

in 1982, but rather than authorize a single standard, the Commission decided to permit multiple standards and rely on the marketplace to sort out the best approach. Early attempts at multi-standard receivers were abandoned by manufacturers due to the cost and difficulty of achieving adequate performance and the impossibility of picking a sure winner. Agreement on a single standard was not achieved until 1993 at the direction of Congress, and the service has never taken off. In contrast to this AM stereo radio debacle, with FM stereo radio service the Commission established a single clear standard, and the service became an immediate success in the marketplace as broadcasters rapidly implemented the service and manufacturers quickly began making receivers.

By adopting a single DTV standard, the Commission can avoid the kind of market uncertainty that paralyzed the introduction of AM stereo radio service. Moreover, in this case, there is far more at stake for the public, because of the tremendous video and audio improvements and the associated information services available through the ATSC DTV Standard, and because of the intent to replace completely the analog system upon which the public relies in order to provide these benefits and to recover valuable television spectrum.

Another possibility mentioned in ¶48, adopting a standard for allocation and assignment purposes only, would be even worse than the "allow, but don't require" approach described above, suffering all of the same frailties, and in addition not even guaranteeing that one user of the broadcast spectrum would not interfere with DTV broadcasts in adjacent spectrum or in adjacent geographical areas, or with NTSC broadcasts during the transition period. Such an approach simply will not provide the certainty and clear direction that are required to get mutually dependent broadcasters, manufacturers and consumers to make consistent and mutually reinforcing investment decisions.

Similarly, mandating the use of only some layers of the ATSC DTV Standard would also be an inadequate and ineffective approach. In the lengthy Advisory Committee and ATSC processes of preparing and documenting a recommended standard, careful attention was paid to identifying what minimum aspects of the standard needed to be mandatory, and

what could be left for differentiation and innovation in the marketplace. The resulting recommendation provides the minimum elements that are required to provide the necessary certainty and reliability, with unprecedented latitude remaining for product differentiation and innovation. Requiring only the RF/transmission layer of the standard would guarantee against harmful interference, but would give broadcasters, manufacturers and consumers no assurance that a reliable, consistent, and compatible nationwide digital television service would ever materialize, creating tremendous uncertainty that would stifle investment and render DTV stillborn. The Commission's primary goal in granting licenses for digital broadcasts and in establishing a supporting transmission standard is to define a complete digital television *service*, including video and audio, that will enable a competitive universal free broadcast television service to thrive in the years and decades to come. This requires a stable, definite, *complete* standard. Another vital goal in establishing a standard is to foster innovation, which requires the flexible but agreed-upon packetized data format that offers unprecedented capability for providing other services as well, using the transmission and transport layers of the standard. The ATSC DTV Standard as a whole contains the elements necessary to satisfy both of these goals, but mandating only a portion of it would compromise the ability to achieve them.

The NPRM at ¶54 invites comment on the acceptability of the ATSC DTV Standard. The ATSC DTV Standard is not only acceptable, it represents by far the world's best digital television system. Complaints by some members of the computer and motion picture industries are not new issues and are not well-founded -- they have been discussed and debated thoroughly over a period of many years, with a remarkably strong inter-industry consensus forming around the Advisory Committee recommendation embodied in the ATSC DTV Standard. In sharp contrast, there is no consensus at all for the changes proposed by these parties, even within their individual industries, much less among the related industries that have an equal or greater interest in digital television, and these alternative approaches

have certainly not been committed to prototype hardware and thoroughly tested as has been done with the consensus Advisory Committee recommendation over the past several years.

As discussed in detail in Section V below, the ATSC DTV Standard is more easily interoperable, by far, with computers and telecommunications than any other digital television service on the planet. The Commission correctly recognizes the unmatched capability and flexibility of the system and the collective genius of its many creators, properly notes the years of thoughtful consideration and expert research and development in an open process in which all interests were able to participate, and correctly concludes that the burden of persuasion should be on any who would oppose the Commission's decision to mandate use of the ATSC DTV Standard. (NPRM, ¶54)

IV. Protection from Interference

A. Emission Mask

At ¶56, the NPRM seeks comment on a specific rigid emission mask designed to limit the out-of-channel emissions from a DTV station transmitter. If the Commission adopts a *rigid* emission mask, the ATSC recommends a somewhat different specification for such a mask. However, we believe that a better approach would be to utilize an alternative mask based on a weighting function that can be determined from interference data collected at the Advanced Television Test Center ("ATTC"). Our proposed rigid mask is defined in terms of Desired-to-Undesired ratio and a 500 kHz measurement bandwidth. This definition specifically recognizes that the required attenuation of ATV spectral sidelobes depends on the relative power levels of the ATV signal and an NTSC signal in the adjacent channel over the ATV coverage area. Our preferred alternative proposal bases the out-of-band specification on a weighting function for the effect of noise on an NTSC signal. This approach allows some flexibility in spectral sidelobe details not permitted under a rigid mask specification, while still achieving completely adequate protection of adjacent channels. The details of both of these proposals are included in Appendix B.

B. Frequency Offsets

At ¶57, the NPRM seeks comment on a requirement for a precise frequency offset between the ATV pilot carrier and the color subcarrier of the lower adjacent channel NTSC station. In fact, there are three interference mechanisms that need to be considered. These three cases are examined in Appendix B and specific offsets are recommended. These proposed offsets are not intended as modifications to the ATSC DTV Standard, but rather are specific solutions that account for interference effects encountered during the actual channel allotment process.

C. Power Measurements

At ¶58, the NPRM seeks comment on its proposals for specifying maximum power requirements and measuring actual power output. The ATSC agrees that maximum power should be measured as average power across the occupied bandwidth, and in Appendix B we propose a specification for allowed variation in average power as well as considerations for use of conventional instrumentation.

V. The Interoperability with Alternative Media Provided by the ATSC DTV Standard Is Far More than Adequate

In the NPRM (at ¶62), the Commission requests comment on the Advisory Committee's conclusion that the ATSC DTV Standard provides adequate interoperability with alternative media, on whether any critical interoperability problems remain, and on what other actions, if any, the Commission might take to facilitate interoperability. The ATSC members have been heavily involved, especially during the last five years, in extensive efforts to ensure that any recommended standard maximized interoperability with alternative media, including computers and telecommunications. After these years of effort and progress, we're convinced that the ATSC DTV Standard provides *more than adequate* interoperability with alternative media, that no critical interoperability problems remain, and that the Commission need not take any further actions to facilitate interoperability. None of the objections raised by some

members of the computer and motion picture industries are new issues. They have been raised and debated thoroughly and repeatedly, and addressed fully in the Advisory Committee recommendation which was adopted without objection by the Advisory Committee members, including members of these industries. Moreover, the Advisory Committee recommendation enjoys a remarkably broad consensus, as evidenced by the nearly unanimous endorsement of the ATSC DTV Standard which embodies that recommendation.

A. Computer Interoperability

Any discussion of interoperability must begin by recognizing that the digital HDTV Grand Alliance system and the ATSC DTV Standard recommended to the Commission by the Advisory Committee represent by far the most interoperable broadcast television system ever conceived. Various subcommittees and working parties of the Advisory Committee, including a special working party dedicated to this topic and two specially organized interoperability review panels, labored long and hard over the past five years and more to ensure that the DTV standard maximized interoperability with other media, including computers and telecommunications, and their work and conclusions benefited greatly from substantial input and participation by computer and motion picture industry representatives.[9] Three of the key

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[9]Under the early organization of the Advisory Committee, Working Party 4 of the Planning Subcommittee ("PS-WP4"), "Alternative Media Technology and Broadcast Interface," focused primarily on ensuring interoperability of the broadcast ATV standard with cable and satellite systems. In 1991, responding to concerns expressed to the Commission and to Congress by members of the computer industry, especially Apple Computer and members of the Committee for Open High Resolution Systems (COHRS, later called DOHRS), PS-WP4 was reorganized and under the chairmanship of Robert Sanderson of Eastman Kodak began a comprehensive effort to investigate interoperability, extensibility and scalability of proposed advanced video systems. This group worked actively and extensively over the next two years, with heavy participation by Apple Computer, Digital Equipment Corporation, IBM and other members of COHRS/DOHRS, to ensure that the selected ATV system maximized compatibility and interoperability with computers and telecommunications. One of the first contributions of this group was to establish the need for a system of headers and descriptors as part of the digital data stream as a fundamental requirement for achieving interoperability, extensibility and scalability. In September, 1992, PS-WP4 conducted a detailed interoperability review, evaluating the compatibility and interoperability features of five competing ATV systems. Following the formation of the Grand Alliance in 1993, the Advisory Committee's Technical Subgroup formed a Joint Experts Group on Interoperability, which among other things, sponsored an Interoperability Review Panel in October, 1993. Sixty-eight people participated in this review of the Grand Alliance system, including representatives of Apple Computer, Hewlett-Packard, IBM, Digital Equipment, DemoGraFX, Sun Microsystems, Delta Information Systems, C-Cube, DOHRS, MIT, Siggraph, Disney, Sony Pictures, Eastman-Kodak, Bell Communications Research, AT&T, MITRE, Rand, ARPA, NIST, and the

criteria used by the Advisory Committee in evaluating DTV proposals related specifically to interoperability. In developing the final specifications for the Grand Alliance prototype system in 1993, first the Grand Alliance members and then the Advisory Committee through its interoperability review panel worked to ensure that the final system incorporated the best interoperability features of the predecessor competitive systems, plus additional modifications that further promoted interoperability. The Grand Alliance system's all-digital layered architecture, its packetized data transport structure, its use of headers and descriptors, its support of multiple picture formats and frame rates with a heavy emphasis on progressive scan and square pixels, and its compliance with MPEG-2 international compression and transport standards, give it unprecedented and unmatched interoperability with computers and telecommunications.

Indeed, in May, 1994, approximately 180 participants in the "Advanced Digital Video in the NII" Workshop, sponsored by the Clinton Administration's Technology Policy Working Group ("TPWG"), the National Institute of Standards and Technology ("NIST"), the Electronics Industries Association, the Institute of Electrical and Electronic Engineers-USA, the Society of Motion Picture and Television Engineers, the Cross-Industry Working Team, and last but not least, the ATSC, recommended rapid adoption of a terrestrial broadcast transmission standard based on the Grand Alliance system, noting the significant contributions the system would make to improving the National Information Infrastructure (NII). Subsequently, in January, 1995, this recommendation was approved by the Administration's full Information Infrastructure Task Force ("IITF"), the grandparent committee of the TPWG. The IITF endorsed the report and recommendation of the TPWG which found, *inter alia*, 1) that rapid implementation of advanced digital television is critical to building the future video-

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White House. This panel reached a consensus that the Grand Alliance proposal demonstrated significant commitment to interoperability through incorporation of concepts of major significance, namely, all-digital implementation, layered architecture, header/descriptors, packetized data structure, and MPEG-2 based video compression. The panel also identified areas for further investigation, some of which led to modifications of the Grand Alliance proposal and improvements in the system ultimately recommended by the Advisory Committee.

rich NII, 2) that the Federal Government should fully support the FCC Advisory Committee process and the Grand Alliance's efforts to set an advanced digital television standard, and 3) that the Advisory Committee/Grand Alliance proposal for HDTV is the best available alternative -- "superior to . . . incrementally deploying a system that involves digitizing today's television signals, but not changing the fundamental picture formats and other technical parameters of the current broadcasting infrastructure."[10] These conclusions and recommendations endorsing the Advisory Committee/Grand Alliance approach were made after thorough deliberations of the interoperability features of the proposed ATV/HDTV standard.

Moreover, as Richard E. Wiley, Chairman of the Advisory Committee, stressed in his December 1995 *En Banc* Hearing testimony in this proceeding, these interoperability objections are not new. They have been considered and reconsidered and have not withstood the scrutiny of peer review in a consensus driven process. Furthermore, the features of the ATSC DTV Standard that are the subjects of these complaints are *not* significant barriers to compatibility. Indeed, the ATSC DTV Standard, far more than any other digital television development in the world, abundantly provides features to promote interoperability with computers and telecommunications, yet some in the computer industry want to *prohibit* features that other industries deem vital to promote interoperability with systems and equipment used in *their* industries.

The principal concern raised by these parties is the inclusion of interlaced formats in the proposed transmission standard.[11] They argue that interlaced scanning is not sufficient for

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[10]See *Workshop on Advanced Digital Video in the National Information Infrastructure*, NISTIR 5457, Georgetown University, May 10-11, 1994, and *Advanced Digital Video and the National Information Infrastructure*, Report of the Information Infrastructure Task Force, Committee on Applications and Technology, Technology Policy Working Group, February 15, 1995.

[11]Interlaced scanning is a video compression technique that sends one-half of the picture information in each of two fields -- first the odd-numbered lines and then the even-numbered lines. With progressive scanning, the lines are scanned in sequential order. The report of the 1993 Interoperability Review Panel stated that "[p]ersistance of interlace transmission (one of six formats) in the Grand Alliance proposal sustains the debate on interoperability. Neither the interlace nor progressive scan advocates have generated sufficient justification

text or computer generated images, so including such formats will stifle the development of educational, scientific, and other services that seek to incorporate both video images and computer-based information.

In the first place, the Grand Alliance HDTV system emphasizes progressive scan, utilizing progressive scan for five of the six HDTV formats. All material originally produced on film, including all motion pictures and approximately 80 per cent of today's prime time television programming, will always be transmitted using progressive scan. Other video material such as news and sports programs may or may not be broadcast in progressive scan at the discretion of the broadcaster. In addition, all of the HDTV formats, including the single interlaced format, are square pixel formats, an important characteristic for facilitating interoperability with computers.[12] The SDTV transmission formats proposed by the Advisory Committee also stress progressive scan, comprising nine of the twelve SDTV formats in the ATSC DTV Standard.[13] This means broadcasters and others can easily use progressive scan transmission formats for program material where it offers better performance, or for applications that use text and graphics, or for other video that is likely to be viewed on computers.

In the second place, most of these parties confuse transmission formats with display formats that may be implemented in receivers. In a digital system, transmission and display formats are no longer linked and need not be the same.[14] The expressed concerns center around display formats, yet it is the transmission standard and not a display standard that is at issue before the Commission. Some recognize this, but argue that transforming interlaced

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or rationale to converge their positions and every proposed format in the Grand Alliance proposal has supporters and detractors."

[12]"Square pixels" means that picture elements are equally spaced in the vertical and horizontal direction, a condition that simplifies computer processing of images.

[13]Thus, 14 of the 18 DTV formats are progressive scan formats.

[14]On June 25, 1996 Lucent Technologies and Mitsubishi announced an agreement to develop a set of semiconductor chips that will perform all of the functions needed for next-generation high-definition television sets for the U.S. market. One of the five application-specific integrated circuits being developed is a display processor, which transforms decoded video signals into various display formats.

signals into progressive signals at the receiver is an imperfect and expensive solution. However, these concerns are greatly overstated. Advisory Committee tests of the Grand Alliance prototype system demonstrated conclusively that de-interlacer performance is essentially transparent,[15] and the cost of receiver de-interlacers was a concern of several parties until a cost study undertaken by the Advisory Committee concluded that the concern was unwarranted.[16,17]

Finally, although the ATSC members generally agree that progressive scanning is the *preferred* mode for text and graphics material, we do not agree that interlaced scanning is *inadequate* for services involving computer-based information, even where signals are transmitted *and* displayed in interlaced format. Perhaps because some computer applications in the past rendered text and graphics inadequately by not including proper anti-aliasing techniques, interlaced scanning was given a bad reputation in the computer industry. As the Grand Alliance demonstrated conclusively at the Commission's December 1995 *En Banc* Hearing, small-sized text can be delivered with crispness and clarity even when it is compressed, transmitted, and displayed in interlaced format. Moreover, several computer companies have recently announced joint ventures involving the provision of information services using DBS and other television delivery media. These ventures all utilize interlace scan, and presumably offer acceptable performance.[18]

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[15]*See* Record of Test Results, *digital* HDTV Grand Alliance System, October 1995, at page III - 45.

[16]One of the members of ATSC has worked with a major computer manufacturer to develop a single integrated circuit that converts among a wide variety of current video formats, including the ATSC DTV Standard formats. This chip has shown superb performance in private demonstrations, and will soon be announced publicly.

[17]Perhaps understanding that even if all transmission formats were progressive, some consumers might still find interlaced displays attractive, some but not all of the members of the computer industry raising these complaints have called for the Commission to ban interlace formats in all ATV *displays*. This proposal violates a long-standing, widely supported computer industry policy opposing government regulation of the features of consumer electronics products. Moreover, banning interlace displays would deprive consumers of the option to purchase less expensive receiver models using such displays, an option that may be attractive to many consumers.

[18]For example, Compaq and Thomson Consumer Electronics recently announced joint development of a TV/PC product, illustrating that even the analog, interlaced NTSC transmission standard is not an overwhelming impediment to the potential convergence between PCs and television receivers. Further, Microsoft and DirecTV have announced their cooperation for the delivery of computer content via the

Ignoring the benefits that interlaced scanning can provide for many types of traditional television programming would unduly limit applications of proven importance to broadcasters and viewers. For the vast amount of archival video material originally produced using interlaced scanning, broadcasters will generally find it more efficient to transmit using an interlaced format, and during the transition period broadcasters may prefer an interlaced transmission format for some DTV/NTSC simulcast material. While interlace scanning may not be optimum for computer text and graphics applications, it can deliver good performance for such applications if implemented correctly. Indeed, in today's analog television system, interlaced scanning delivers text and graphics required for broadcast programs effectively every day. Interlaced scanning has a long track record of proven value and successful use in traditional television broadcasting, and it has many staunch defenders. In addition, broadcasters must be concerned about the interoperability of a DTV transmission standard with currently available HDTV production equipment and with the installed base of NTSC production and studio equipment, virtually all of which employ interlaced scanning. Furthermore, in the case of SDTV where the objective may be to transmit multiple programs simultaneously over a 6 MHz channel, for non-film-based video, the use of interlace scanning will generally permit more simultaneous programs to be carried than if progressive scanning is used.[19,20]

DirecTV DBS system, again showing that the predominant use of interlaced formats in the DirecTV system has not proven to be a barrier to TV and computer company collaboration to deliver content. When adoption of the ATSC DTV Standard makes both progressive and interlaced formats available to deliver these types of applications, the marketplace will dictate which formats are most advantageous for which applications.

[19]Thus, for certain types of low-budget programs likely to be produced in SDTV video and broadcast during non-prime time hours, e.g., education programs, children's programs, public access programs, local public affairs programs, high school sporting events, etc., prohibiting interlaced transmission formats would reduce the number of such programs that could be transmitted simultaneously by a local broadcaster.

[20]Accordingly, William Schreiber is mistaken in claiming that the introduction of a progressive scan HDTV camera removes the last remaining argument for including an interlaced format in the digital broadcast television standard. (*See* letter of William F. Schreiber to Chairman Hundt, May 9, 1996.) While the introduction of such a product is an important and welcome development, it does not negate the substantial benefits, outlined above, of including interlaced scanning formats in the ATSC DTV Standard.

In evaluating pleas to ban interlaced transmission formats from the ATSC DTV Standard, the Commission must bear in mind that with today's technological limitations such an action would mean that a 720-line format would be the only format for HDTV live video programs. There is a substantial body of broadcasters and others who believe that a high-definition format must have more than 1,000 lines to be successful. Any action to eliminate the 1080-line interlaced HDTV format from the proposed standard would cause a substantial loss of industry support for the overall DTV proposal. Moreover, it is ironic that the proposed ATSC DTV Standard is the *only* digital television development effort in the world that stresses interoperability with computers and telecommunications, e.g., by primarily using progressive scan and square pixels. If the Commission were to delay adoption of the Advisory Committee recommendation out of a concern with interlaced scanning, it would only serve to entrench interlaced scanning as the predominant mode for digital television throughout the world.[21]

Regardless of the technical arguments about the acceptability of interlaced formats for certain classes of applications, continued insistence on *banning* interlaced formats is unwarranted. The ATSC DTV Standard contains numerous progressive scan and square pixel formats to support the applications that benefit from those attributes.[22] Neither program producers, broadcasters, nor consumers will be forced to *use* an interlaced format simply

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[21]In response to the development of all-digital HDTV broadcast systems in the U.S. first announced in 1990, the Digital Video Broadcasting ("DVB") Project was formed in Europe in 1993 and has since developed a family of digital television standards for satellite, cable, terrestrial and other delivery media. The project has expanded around the world, and now has over 200 members in 29 countries, including Apple Computer and many other U.S. computer, telecommunications, and consumer electronics companies. DVB Satellite services began in 1995 and are currently being used in Europe, Africa, Asia, North America and Australasia. DVB Cable services commenced operation in Europe and Australia in 1995, and DVB Terrestrial services are expected to begin in 1997 in Europe. Current DVB standards focus on SDTV, using interlaced scanning formats and non-square pixel arrays. Likewise, efforts to date to develop and offer satellite and cable digital television services in the U.S. have focused on SDTV, using interlaced scanning and non-square pixel arrays.

[22]As Chairman Wiley noted in his December 1995 *En Banc* Hearing testimony, "Fortunately, the Grand Alliance technology is flexible enough to incorporate both scanning modes in the standard (at minimal additional cost). There was overwhelming consensus for this approach, which reasonably meets the needs of all affected parties. Conversely, there was absolutely no record of support for dropping either mode." (emphasis in original)

because it exists in the standard. On the other hand, there is no doubt that broadcasters will transmit tremendous amounts of material using progressive scan -- motion pictures and most prime time programming at a bare minimum. And for non-film-based video, if judged superior by the marketplace, the use of progressive scan transmission formats will surely proliferate. Likewise, progressive scan displays will predominate among consumers if they offer better price/performance characteristics. Indeed, several members of the ATSC who manufacture televisions already plan to include progressive scan displays in their initial ATV product offerings, and some broadcasters have stated that they are leaning toward the use of progressive scan transmission formats for HDTV.[23]

Some members of the computer industry have also complained about the 60 Hz transmission rate, again confusing transmission formats with display formats. For example, Apple states ". . . the proposed *transmission rate* of 60 Hz is of particular concern. A 60 Hz *display rate* has not proven to be sufficient for the display of text and fine graphic information with the resolution expected by computer users."[24] These complaints are unwarranted from any perspective.

From a broadcaster and regulatory perspective, a 60 Hz transmission rate is certainly adequate to ensure smooth motion rendition in transmitted signals, which is the extent to which a transmission standard should concern itself with either source or display picture refresh rates. Further, the adoption of a higher frame rate than 60 Hz would have to come either at the expense of reduced spatial resolution or increased compression artifacts in order to continue to fit the coded signals within a 6 Mz terrestrial channel, neither of which is a desirable alternative.

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[23]ABC, a member of ATSC, has expressed a tentative preference for progressive scan transmission, however, ABC sees value in the interlaced formats, especially for transmitting material from the immense archives of video originally produced with interlaced scanning. ABC strongly supports rapid adoption of the ATSC DTV Standard, including all of the formats contained therein.

[24]Fourth NPRM Comments of Apple Computer at 7 (emphasis added).

From a television receiver perspective, it will be possible to make receivers with higher display refresh rates if the marketplace warrants the additional expense. However, a 60 Hz display rate is not a problem for traditional television viewing of typical motion video material, which will continue to comprise the bulk of DTV viewing use. Further, a 60 Hz display rate is not likely to be a problem for still images with text and fine graphic information, given the greater viewing distances and lower lighting levels that are associated with a television viewing environment (as opposed to an office/desktop environment).

From a computer perspective, computers (or televisions used in computing applications) are not prevented from using conversions to display the transmitted signal at any desired rate. For still pictures, the screen can easily be refreshed at any high rate desired, as is done today. For the display of motion video in a computer, it is possible easily and accurately to convert 60 Hz DTV signals into a 72 Hz display rate by employing the same frame rate conversion techniques commonly used to convert 50 Hz PAL and SECAM television around the world to 60 Hz NTSC television used in North America and Japan.[25] Further, motion pictures and the majority of prime time programming are produced in 24-frames-per-second film, which in DTV will be transmitted directly at the 24 Hz rate, which is easily converted to a 72 Hz display rate. (Indeed, the simplicity of this conversion is the motivation for the selection of 72 Hz by its proponents.)

Finally, in all events, the Commission should not regulate the features or performance of displays, as the computer industry has long held.[26]

The Commission's overriding goal in this proceeding is to preserve and enhance free over-the-air television service, including the adoption of policies that will allow digital television infrastructure and applications to contribute to improving the NII. Contrary to the

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[25]Conversion from 60 to 72 Hz requires a 5:6 frame rate conversion, the same as required for the conversion of 50 to 60 Hz. (i.e., 60:72 = 50:60 = 5:6).

[26]In addition to the ability of the proposed standard to handle text and fine graphics even with interlaced transmission formats, it should be noted that some text and graphics will be coded and carried over the channel as data, not as video images.

implicit assumption of some members of the computer industry, the Commission's goal *is not* and *should not* be to make the digital HDTV receiver -- already the most computer-friendly, interoperable entertainment/NII appliance ever developed -- indistinguishable from a desktop personal computer.

B. Aspect Ratio

Some cinematographers have objected to the 16:9 aspect ratio included in the ATSC DTV Standard, saying that it will limit broadcasters' ability to display the full artistic quality of their work. As explained fully in the August 28, 1995 letter of Stanley Baron, President of the Society of Motion Picture and Television Engineers, and also head of the ATSC Technology Group on Distribution (T3),[27] this decision was reached more than a decade ago after extended and careful deliberations with extensive participation by the motion picture and television production community. The final 16:9 ratio (1.78:1) was in fact wider than the 5:3 ratio originally sought by the electronics manufacturing industry, and utilizes three-quarters of the total screen height for 2.4:1 material (the widest of the commonly used motion picture aspect ratios) and three-quarters of the screen width for 4:3 material (the standard NTSC format).

The 16:9 aspect ratio has been adopted by a variety of international standards bodies, and manufacturers around the world have been building CCD sensing arrays, camera lenses, production equipment, picture tubes, and widescreen receivers in the 16:9 format for years. Because of the wide variety of aspect ratios used by the motion picture industry in the United States and throughout the world, and because an aspect ratio wider than 16:9 is not ideal for some other types of programming such as newscasts and one-on-one interviews, it is impossible to select a single aspect ratio that perfectly satisfies every need. However, as Mr. Baron's letter makes clear, it has been demonstrated that there is no difficulty in accommodating program material or motion picture films of any reasonable aspect ratio within

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[27] *See* NPRM at ¶50, fn 44.

the 16:9 format either for production, post-production, distribution or display. Changing the aspect ratio for broadcast DTV at this late date would cause unacceptable and unnecessary delays in implementing DTV service, would severely damage many parties who have already made significant investments leading to DTV service, and ironically would entrench the current 4:3 aspect ratio in new non-terrestrial broadcast digital television services.[28]

C. Interoperability with Cable and Other Delivery Media

Although the Advisory Committee's charter was to recommend a *terrestrial broadcast* ATV transmission standard, from the beginning the easy interoperability of the broadcast ATV standard with cable TV systems was a key objective in the development of the Grand Alliance system and the ATSC DTV Standard. Indeed, the Grand Alliance developed and evaluated high-data-rate modes, i.e., 16-VSB and 256-QAM, for possible use in cable and other transmission environments that can support higher data rates than terrestrial broadcast. This capability would be utilized to deliver approximately twice the payload capacity achievable over 6 MHz terrestrial channels. Accordingly, such capabilities could support, for example, two simultaneous live-action HDTV sports programs over a single 6 MHz cable channel.

Throughout the nine-year Advisory Committee process, the cable industry has made significant investments and contributions to ensure the suitability of the standard for carriage over cable systems. A significant portion of the Advisory Committee's laboratory and field tests were conducted by Cable Television Laboratories, Inc. ("CableLabs"), including testing of the selected 16-VSB mode. The testing focused on ensuring that the digital HDTV system developed for terrestrial broadcast would also meet the needs of the cable industry. As a result, the ATSC members believe that as voluntary standards activities continue in the cable

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[28]*See* Mark Shubin, "The History of the Perfect Aspect Ratio," Proceedings of the 137th SMPTE Technical Conference and World Media Expo, September, 1995, finding, *inter alia,* that there is no perfect aspect ratio, but if there were, it would be 16:9; that the 16:9 ratio has already been chosen and is in use around the world; that 16:9 should only be changed for compelling reasons and his research has found none.

industry,[29] as well as for DBS, MMDS and ITFS services and open video systems, it is likely that many elements of the terrestrial ATV standard will also be incorporated in emerging standards in these industries. We believe that such voluntary standards would promote the early availability of digital television, including HDTV, over all of these other media as well as terrestrial broadcasts, without causing undue burdens on cable operators or other providers.

VI. Other Issues

A. Receiver Standards

In the NPRM at ¶66 the Commission inquires whether it should require that receivers (and set-top boxes designed to receive ATV broadcasts for display on NTSC sets) be able to receive adequately all DTV formats. In comments on the Fourth NPRM, receiver manufacturers stated their belief that marketplace forces would dictate that all DTV receivers (and set-top converters) would be capable of *receiving* all DTV formats, although some receivers might well *display* high-definition signals in a lesser resolution format.[30] In comments on the Fourth NPRM and in public comments that have followed, including Congressional testimony, broadcasters have made clear that they intend to broadcast substantial amounts of HDTV programming over their DTV channels. It would be foolhardy for any manufacturer to offer digital sets in the marketplace that go dark for any programming, much less a substantial amount of broadcast programming. Consequently, the statements of manufacturers and broadcasters alike clearly suggest that digital receivers will have all-format reception capability with or without any government mandate to do so.

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[29]For instance, the Society of Cable Television Engineers has recently launched a digital television standards engineering subcommittee.

[30]In ¶66, the NPRM cites concerns that an all-format reception requirement might have a large effect on either reception quality or receiver costs, somehow attributing these concerns to the Electronic Industries Association and its Advanced Television Committee (EIA/ATV) and to Zenith Electronics Corporation. In fact, neither EIA/ATV nor Zenith expressed any such concerns, but both parties expressed the belief that digital sets would receive all of the digital formats without any Commission mandates. (*See* Fourth NPRM Comments of EIA/ATV at 15 and Comments of Zenith at 4.)

With respect to other aspects of the reception performance of receivers, the broadcaster members of ATSC are particularly anxious to ensure that the actual performance of receivers is adequate to obtain the coverage predicted by the models used in allotting and assigning digital broadcast channels. The receiver manufacturer members of ATSC share this concern, but point out that the same marketplace forces that operate today to ensure that television manufacturers provide adequate reception performance will motivate manufacturers to compete to provide high-quality receivers.

The ATSC has recently charged its newly-formed Implementation Subcommittee, which includes both broadcasters and receiver manufacturers, to investigate whether receiver performance standards need to be defined to satisfy these concerns. If the Subcommittee determines that such standards are required, it will work with the Consumer Electronics Manufacturers Association (one of the founding members of the ATSC) to ensure that such standards are developed expeditiously. If it is determined that minimum performance levels need to be established for DTV receivers, it is vital that the development of such standards not delay the adoption by the Commission of the ATSC DTV Standard. Whether any such standards are the subject of voluntary industry standards, or whether the Commission finds it appropriate and necessary to codify an industry recommendation into its rules, the Commission need not and must not delay adoption of the transmission standard itself.

B. Licensing of Technology

As the Commission notes in ¶67 of the NPRM, the Advisory Committee's testing procedures required that the proponents of any DTV system agree (a) to make a license available without compensation to applicants desiring to utilize the license for the purpose of implementing the standard, or (b) to make a license available to applicants under reasonable terms and conditions that are demonstrably free of any unfair discrimination. To this end, as part of its effort to establish and document the DTV standard, ATSC sought and obtained from each member of the Grand Alliance and from Dolby Laboratories in February 1995 a written commitment to abide by this requirement. Furthermore, we believe that pending

patents of these entities would fall under the same reasonable and nondiscriminatory licensing requirement. The ATSC is not aware of any problems that would require the Commission to take further action to ensure easy and nondiscriminatory access to the intellectual property necessary for a rapid implementation of the ATSC DTV Standard.

C. International Trade

As the Commission has noted (NPRM, ¶68), the Advisory Committee and the Grand Alliance took great pains to maximize compatibility with international standards, including the use of MPEG-2 video compression and MPEG-2 transport. Providing compatibility for these two elements is most important in providing a high degree of international interoperability. It is less important and less likely that some other aspects of the system, such as the modulation scheme and the picture refresh rate be common among all nations or regions. Beyond these structural commonalities, expeditiously authorizing a single DTV standard for use in the United States will *enhance* the export opportunities of U.S.-based content providers and equipment manufacturers, because the focus by broadcasters, manufacturers and consumers on a single well-defined standard will promote a rapid introduction of the service, which in turn will promote its use in other countries around the world. Indeed, the most important thing the Commission can do to facilitate international compatibility and to promote export opportunities is to adopt the ATSC DTV Standard as rapidly as possible.

As discussed previously, the ATSC has recently modified its charter to permit parties throughout North and South America and the Caribbean with an interest in digital television to become members. ATSC also has other activities under way to promote the use of the ATSC DTV Standard beyond the U.S., especially throughout the Americas. We believe that the ATSC DTV Standard represents the best digital television technology in the world, fully encompassing both HDTV and SDTV as well as a host of other applications, and offers by far the best interoperability with computers and telecommunications, through its use of a packetized data transport structure and its emphasis on progress scanning and square pixels.

Yet, while this superior system awaits final approval from the Commission, the European DVB system -- which presently implements only SDTV using interlaced scanning and non-square pixels exclusively -- has been adopted and mandated in Europe and is being heavily promoted around the world, and has even been selected for use in some U.S. DBS services. Moreover, efforts to promote the ATSC DTV Standard for use elsewhere in the world encounter the obvious obstacle that it still has not been adopted for terrestrial television in the United States.[31]

Just as certainty and reliability are required to galvanize the industry toward implementing digital broadcast television, such certainty and reliability are necessary to motivate other countries to utilize the ATSC DTV Standard for terrestrial television, or to motivate parties here and abroad to implement all or part of the standard for nonterrestrial applications. Notwithstanding the broad industry consensus supporting the ATSC DTV Standard, further delays by the Congress and the Commission threaten to squander the technological lead that the U.S. fought so hard to achieve and see the U.S. "re-leap-frogged" in exploiting this innovative American-born technology.

D. Captioning

The Decoder Circuitry Act of 1990 directed the FCC to establish rules to ensure that closed captioning decoders were provided in television receivers, and specifically to ensure that such capability was made possible for ATV services then on the horizon. Under the Commission's rules adopted pursuant to this law, all television receivers 13" and above must include closed captioning capability. Over the course of the last several years, the Advisory

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[31]One bright spot has recently developed in this otherwise discouraging international scene. Following the Commission's tentative decision in this proceeding to adopt the ATSC DTV Standard, in June 1996, the Digital Audio/Visual Council ("DAVIC") selected the ATSC DTV video and audio specifications as the basis for the DAVIC 1.2 standard for "higher quality video and audio." DAVIC is a non-profit association based in Geneva, Switzerland, with more than 200 member companies in more than 25 countries, aimed at promoting the success of digital audio/visual applications and services based on specifications that maximize interoperability across countries and across applications and services. Further success in promoting the ATSC DTV Standard in DAVIC and in other international settings will require continued clear signals and expectations that the standard will indeed be formally adopted by the Commission for use in the U.S.

Committee and ATSC have worked closely with the affected communities to ensure that closed captioning needs were fully addressed in the standard to be proposed to the Commission so that receiver manufacturers could reliably build closed captioning capability into their ATV receiver designs. We believe that the proposed ATSC DTV standard fully provides all the capability necessary for broadcasters and receiver manufacturers to provide closed captioning.

E. Content Advisory Information

As previously noted (*see* fn 6, *infra*), the ATSC is providing technical assistance to the cross-industry task force that is developing a voluntary program rating system that would utilize the V-chip capability mandated by the Telecommunications Act of 1996. The flexibility inherent in the packetized data transport structure of the ATSC DTV Standard ensures that such program rating information can be easily incorporated into digital broadcasts. Once the cross-industry task force has completed its work, the ATSC will spell out the details for incorporating this capability into the standard.

VII. Conclusion

The ATSC DTV Standard represents by far the world's best digital broadcast television system, with unmatched flexibility and unprecedented ability to incorporate future improvements. Implementing this technology will dramatically raise the technical quality of broadcast television, helping to preserve for consumers and for our democratic society the benefits of a vibrant and healthy free over-the-air television service in the years and decades to come. In addition, deploying this technology will enable consumers to access a host of potential information services that can help meet pressing needs in health, education and other aspects of our society, and will create and preserve tens of thousands of high-skill, high-wage jobs and engender substantial economic growth for our nation.

Over the past decade, the Commission has championed a unique process, providing policy direction and support, while relying on private investment, competition and a volunteer

army of experts and leaders from the affected industries to develop a stunning technological achievement. Through this thorough, open, and extended process, an extremely broad consensus has been achieved throughout the affected industries, delicately balancing the needs of consumers and the various industries involved. In sharp contrast, there is no consensus supporting the changes proposed by the few detractors of the proposed standard.

Now it is time for the Commission to act decisively, to follow through on the commitment it has made to industry repeatedly over the past decade to set a new broadcast television standard. The ATSC members implore the Commission to adopt the full ATSC DTV Standard as swiftly as possible and mandate its use by digital broadcast licensees. In so doing, the Commission will provide the certainty and reliability required by financiers, broadcasters, manufacturers and consumers to unleash the further substantial investments necessary to bring the benefits of this fertile technology to the American public and to spread those benefits throughout the world.

Respectfully submitted,

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APPENDIX A: ATSC MEMBERSHIP LIST

ADVANCED TELEVISION SYSTEMS COMMITTEE

MEMBERS

AT&T
Baylor University - Telecommunications
Bell Communications Research
CBS Broadcast Group
Cable Television Laboratories
Capital Cities/ABC
Consumer Electronics Manufacturers Association
David Sarnoff Research Center
Digital Multimedia Compression, Inc.
Dolby Laboratories, Inc.
Eastman Kodak Company
Florida Atlantic University
Fox Inc.
GTE Telephone Operations
General Instrument Corporation
Hitachi America, Ltd.
Home Box Office
Ikegami Electronics USA, Inc.
Institute of Electrical & Electronics Engineers
Intel Corporation
Koichi Sadashige & Associates
Lucent Technologies
MIT Advanced TV & Signal Processing Group
Maximum Service Television
Mitsubishi Consumer Electronics America
Motion Picture Association of America
National Association of Broadcasters
National Broadcasting Company
National Cable TV Association
Panasonic ATVL
Panasonic Broadcast Systems Company
Philips Electronics North America Corp.
Pioneer New Media Technologies, Inc.
Public Broadcasting Service
SBCA
Scientific Atlanta
Sharp Electronics Corporation
Snell & Wilcox
Society of Motion Picture & Television Engineers
Sony Advanced Systems Company
Sony Pictures Entertainment
TV/COM International
Tektronix, Grass Valley Products
Tele-TV Systems
Texas Instruments
Thomson Consumer Electronics
Titan Information Systems
Toshiba America Consumer Products, Inc.
Tribune Broadcasting Company
Universal City Studios, Inc.
VLSI Technology Inc.
Viacom International Inc.
Zenith Electronics Corporation

OBSERVERS

Argonne National Laboratory
Asia-Pacific Broadcasting Union (ABU)
Canadian Broadcasting Corporation (CBC)
ETRIUS
European Broadcasting Union (EBU)
Federal Communications Commission
NASA
The White House
US Army Night Vision and Electronic Sensors
US Department of State

APPENDIX B: PROTECTION FROM INTERFERENCE

A. Emission Mask (¶56)

ATSC proposes a specification for a rigid emission mask that is somewhat different from that proposed by the Commission, and also encourages consideration of an alternative mask based on a weighting function that can be determined from interference data taken at ATTC. The ATSC-proposed rigid mask is defined in terms of Desired-to-Undesired ratio (D/U) and a 500 kHz measurement bandwidth. This definition specifically recognizes that the required attenuation of ATV spectral sidelobes depends on the relative power levels of the ATV signal and an NTSC signal in the adjacent channel over the ATV coverage area. The alternative proposal, which ATSC prefers, bases the out-of-band specification on a weighting function for the effect of noise on an NTSC signal.

RIGID MASK SPECIFICATION:

We believe that the following specification captures the Commision's intent and also includes the effects of the 500 kHz measurement bandwidth and the "smearing" effect of the measurement bandwidth at the channel band edge.

Out-of-band emissions of an ATV transmitter as measured in a 500 kHz bandwidth centered Δf MHz from the edge of the assigned channel shall be attenuated below the average ATV transmitted power output according to the following schedule:

(a) For 0.25 MHz $\leq \Delta f \leq$ 6 MHz:

$$\text{Attenuation in dB} = 58 + \left(\frac{D}{U}\right)_{db} + \frac{(\Delta f)^2}{1.44}$$

(b) For $\Delta f \geq 6$ MHz:

$$\text{Attenuation in dB} = 83 + \left(\frac{D}{U_{db}}\right)$$

WHERE:

Δf is the deviation in MHz of the *center* of the 500 kHz measurement bandwidth from the edge of the assigned ATV channel

and

$$\left(\frac{D}{U}\right)dB = 10\log_{10}\left(\frac{Average\ Power\ of\ the\ ATV\ Signal}{PK.\ Sync\ Power\ of\ Adj.\ channel\ NTSC\ Signal}\right)_{MAX}$$

i.e., the maximum ratio of received ATV power compared to an adjacent NTSC channel power at any location within the ATV coverage area where the NTSC channel's coverage must be protected. This D/U ratio is -12 dB for equal coverage, collocated ATV and NTSC stations.

ALTERNATIVE TO A RIGID MASK SPECIFICATION: WEIGHTING FUNCTION

The mask given above is sufficient to guarantee proper coexistence of ATV and adjacent channel NTSC. Nevertheless, an alternative "weighting function" approach has merit and is recommended by ATSC. This approach allows some flexibility in spectral sidelobe details not permitted under the rigid mask specification, while still achieving completely adequate protection of adjacent channels.

This approach is based upon measurements made at the ATTC to determine NTSC's Threshold of Visibility (TOV) for 500 kHz wide noise sources centered at

various points across the NTSC channel. This work determined an appropriate weighting function, which is rounded to the nearest dB to obtain this alternative specification.

Additional work done at ATTC showed that noise with a flat spectrum across the 6 MHz NTSC channel which has a power that is at least 51 dB below NTSC peak of sync was adequate to avoid TOV interference with the NTSC signal. Weighting such a flat spectrum of noise with the weighting function results in a weighted TOV power level which is 5 dB lower, or at 56 dB below NTSC peak of sync power.

For various shaped noise distributions across the NTSC channel, it has been verified that as long as the weighted noise is at least 56 dB below NTSC peak-of-sync power, then TOV is avoided. Here, the NTSC noise interference is viewed as arising from the spectral sidelobes of an adjacent channel ATV transmitter. If the ratio of ATV average power to NTSC peak-of-sync power is $\left(\frac{D}{U}\right)_{dB}$, then to avoid NTSC TOV the ATV sidelobes in the adjacent NTSC channel, when weighted and summed across the channel, must be attenuated below average ATV transmitter power by at least $\left(56+\left(\frac{D}{U}\right)_{dB}\right)$ dB. For example, *in the collocated, equal coverage DTV/NTSC/NTSC case,* $\left(\frac{D}{U}\right)_{dB}$ = -12 dB, so the weighted ATV sidelobe power in an adjacent channel needs to be attenuated at least 56 - 12 = 44 dB below average ATV signal power for this collocated case.

Further work done at the ATTC determined that in order to avoid the Threshold of Audibility (TOA) on the NTSC audio channel, the power measured in the upper 500 kHz

segment of the NTSC channel must be attenuated at least 48 dB below NTSC peak of sync power, or $48 + \left(\frac{D}{U}\right)_{dB}$ dB below the ATV average power. This was for a ratio of audio-to-video carrier powers of -13 dB. Proportionally less attenuation is required for higher audio-to-video ratios.

The protection of the adjacent NTSC channel against TOV and TOA leads to the following alternative out-of-band ATV spectral emission regulation:

(a) To protect against adjacent channel NTSC TOV, out-of-band ATV spectral emissions measured in an adjacent 6 MHz wide channel, when weighted by the weighting function, shall be attenuated below the ATV average transmitter power by at least $56 + \left(\frac{D}{U}\right)_{dB}$ dB.

(b) Additionally, to protect against adjacent channel TOA, the power measured in the uppermost 500 kHz segment of an adjacent channel shall be attenuated below ATV average power by at least $48 + \left(\frac{D}{U}\right)_{dB}$ dB. This assumes an audio-to-video carrier power ratio of -13 dB.

(c) Finally, the weighted power in any non-adjacent 6 MHz channel shall be attenuated below ATV average power by at least $56 + \left(\frac{D}{U}\right)_{dB}$ dB in that non-adjacent channel.

WHERE:

$$\left(\frac{D}{U}\right)dB = 10\log_{10}\left(\frac{Average\ Power\ of\ the\ ATV\ Signal}{PK.\ Sync\ Power\ of\ Adj.\ channel\ NTSC\ Signal}\right)_{MAX}$$

i.e., the maximum ratio of received ATV power compared to an adjacent NTSC channel power at any location within the ATV coverage area where the NTSC channel's coverage must be protected. This D/U ratio is - 12 dB for equal coverage, collocated ATV and NTSC stations.

This alternative regulation based on the weighting function avoids a slavish adherence to a rigid mask's detailed sidelobe requirements and instead substitutes a requirement leading to adequate TOV protection of the adjacent channel based upon the weighted noise power caused by the ATV sidelobes in the adjacent channels. This reasonably relaxes the burden on manufacturers to produce ATV transmitters which can coexist with adjacent channel NTSC without unduly focusing on unimportant fine-structure details of the spectral sidelobes as can occur with a rigid mask specification.

B. Frequency Offsets (¶57)

ATSC believes that in selecting the ATV frequency assignments there are several interference mechanisms that must be considered. These are (1) ATV-to-ATV co-channel, (2) NTSC-to-ATV co-channel, and (3) ATV-to-NTSC upper adjacent channel. Other interference effects (i.e., lower adjacent, taboos, ATV-to-NTSC co-channel, etc.) are insensitive to frequency offset. In each case, the dominant interference will determine which frequency offset will have precedence. The ATV offsets in each case below track the assigned offsets to the NTSC station (i.e., -10 kHz, 0 kHz, + 10 kHz).

These proposed offsets are not intended as modifications to the ATSC Standard. Rather, these offsets are specific solutions that account for interference effects encountered during the actual channel allocation process.

CO-CHANNEL ATV-TO-ATV OFFSET RECOMMENDATION

In the ATV co-channel interference condition, it has been found that an ATV frequency offset that is an odd multiple of half the ATV segment rate provides improved interference rejection. There are several choices that meet this requirement. An offset of 1.5 times the segment frequency (i.e., 19,403 Hz) appears to provide the best performance. The frequency tolerance of the ATV transmitters is ± 10 Hz.

CO-CHANNEL NTSC-TO-ATV OFFSET RECOMMENDATION

For the NTSC-to-ATV co-channel interference condition, the best performance is obtained if the ATV signal is aligned such that the NTSC visual carrier is located near the notch of the receiver comb filter. Additionally, the ATV receiver clock recovery performance is most robust if the visual carrier location is chosen to be near an odd multiple of half of the segment frequency. It has been shown that the choice that places the ATV pilot below the NTSC visual carrier by 70.5 times the segment frequency (i.e., 911,944 Hz) provides the best performance. This has a tolerance of ±1 kHz.

UPPER ADJACENT CHANNEL ATV-INTO-NTSC OFFSET RECOMMENDATION

For interference caused by the upper adjacent ATV-into-NTSC, tests at the ATTC have shown that the ATV pilot carrier may appear as a chrominance beat in the NTSC image on some sets. An improved alignment between the ATV pilot and the NTSC chroma subcarrier is selected to be an odd multiple of half the NTSC line rate. This causes the chrominance beat pattern to alternate at the NTSC line rate. This reduces the visibility of the chroma beat interference. The offset proposed by the ATTC is 95.5 times the NTSC horizontal rate. This allows a tolerance of ±1 kHz on both the NTSC and ATV

transmitters. The frequency of the ATV pilot can be expressed in terms of the frequency of the NTSC visual carrier on the lower channel and the NTSC horizontal rate.

$$F_p(n) = F_v(n-1) + \frac{455}{2} F_h + 9.55F_h$$

The ATTC found that when this frequency is chosen as the offset, an underlying high-frequency luminance beat of 5.0821678 MHz is also then produced. This interference was most visible during the ATTC test since only a pilot carrier, and not the full ATV signal was tested. The ATTC has proposed an additional refinement to the offset between the ATV and NTSC signals to produce an alternating beat pattern at both the NTSC frame and line rates. This proposal specifies a difference between the ATV pilot and the NTSC chroma carrier of 95.5 times the NTSC line rate minus the NTSC frame rate.

$$F_p(n) = F_v(n-1) + \frac{455}{2} F_h + 95.5F_h - 29.97$$

This additional refinement provides a further reduction in visibility of upper adjacent ATV interference into NTSC, but it requires a tighter frequency control on the NTSC transmitter to maintain a frequency difference within ±3 Hz.

C. Power Measurements (¶58)

ATSC proposes that the average power of the transmitted signal be specified and measured as follows:

The present NTSC service allows a power variation ranging between 80% and 110% of authorized power. These values correspond to -0.97 dB and +0.41 dB respectively. Because of the so-called "cliff effect" at the fringes of the service coverage

area for an ATV signal, the allowable lower power value will have a direct effect on the ATV threshold. A reduction of 0.97 dB in transmitted power will change the ATV threshold of 14.9 dB (which has been determined to cause a 3×10^{-6} error rate) to 15.87 dB, or approximately a one mile reduction in coverage distance from the transmitter. It is proposed that the lower allowed power value be 95% of authorized power and that the upper allowed power value be 105% of authorized power.

A conventional full-wave rectifier type of power meter will register approximately 1 dB lower than the true power on "white" noise. It has not been determined what the reading will be when measuring ATV power, but it is likely to be different than with "white" noise. It is suggested that ATV stations use a calorimeter type true power measurement method to re-calibrate the rectifier type of power meter if used. The power reading should have an uncertainty no worse than 5%, and preferably better, in order to have minimum impact on ATV coverage.

Measurements made on the 8 VSB signal with a commercial rectifier type watt meter indicate 1 dB higher power values than the actual power. A transmitter measured with such a watt meter will provide approximately 1 mile less coverage than the authorized power would allow.

It is proposed that the quality of the emitted signal be specified and measured by determining the departure from 100% eye opening. This departure, or error, is made up of three components: 1) circuit or "white" noise; 2) intermodulation noise caused by non-linearities; and 3) intersymbol interference; and is measured and specified by an error vector magnitude.

An error vector magnitude of minus 27 dB relative to the authorized power will reduce the ATV threshold by 0.25 dB, or approximately 1/4 mile in coverage distance from the transmitter.