

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

In the Matter of)
)
Advanced Television Systems)
and Their Impact Upon the)
Existing Television Broadcast)
Service)

MM Docket No. 87-268

Fifth Further Notice of)
Proposed Rule Making)

**REPLY COMMENTS
OF THE
ADVANCED TELEVISION SYSTEMS COMMITTEE**

August 12, 1996

SUMMARY

A careful review of the extensive comments filed in response to the Fifth NPRM shows a broad consensus supporting the Commission's tentative decisions. The great majority of commenters -- including virtually every one of the parties *directly involved* in the provision of broadcast television service -- join ATSC in strongly endorsing the Commission's tentative decision to establish a single, complete, mandatory transmission standard for broadcast DTV, and enthusiastically support the ATSC DTV Standard, based on the Grand Alliance system and recommended by the Advisory Committee, as the best possible choice and far more than fully adequate.

A minority of commenters -- *not directly involved* in broadcast television -- urge the Commission either to adopt only portions of the recommended standard, or not to adopt any standard at all. Some of these parties argue further that if the Commission does adopt a standard, it should not adopt the ATSC DTV Standard recommended by the Advisory Committee. However, these arguments against adopting a standard and the complaints specifically lodged against the ATSC DTV Standard are unfounded, misguided and unconvincing. In some cases they may reflect a desire to minimize any chance that the Commission might attempt to impose a DTV standard on non-broadcast video delivery industries. In other cases they clearly reflect a total lack of concern for the Commission's primary objective in this proceeding -- to upgrade the technical quality of broadcast television in order to help preserve free over-the-air television service in the decades to come.

In particular, the strident objections raised by some members of the computer industry amount to a complaint that the standard was not designed *exclusively* to meet their narrow needs. They claim, erroneously, that the proposed standard does not provide adequate interoperability with computers, yet they stubbornly refuse to recognize the many other interoperability needs that the standard must satisfy (e.g., with cable, DBS, and existing

NTSC services), or even the essential needs of the primary broadcast television application. Moreover, their complaints about a lack of interoperability with computers are entirely unfounded and completely misdirected when aimed at the ATSC DTV Standard -- unquestionably the most computer-friendly digital television system on the planet. Ironically, while their complaints about interoperability risk delaying the introduction of terrestrial broadcast digital television here, far less interoperable digital systems are being adopted and deployed in the U.S. and throughout the world.

In opposing the recommended standard, these members of the computer industry offer cost estimates that purport to show that adopting the ATSC Standard would cost consumers many billions more in the aggregate than a supposedly simpler, less expensive alternative offered by them. But their cost estimates are embarrassingly flawed, combining greatly overestimated unit costs with grossly overstated consumer sales volumes to produce a very high number that has absolutely no basis in reality. In fact, reliable cost estimates prepared by members of ATSC who have extensive experience manufacturing and selling equipment using similar technology, show conclusively that the ATSC DTV Standard will allow consumers to purchase a range of cost-effective DTV receivers and converters, and that at both the low and high ends of this performance range, prices to consumers will be *lower* than they would be under the allegedly less expensive alternative suggested by these members of the computer industry.

The counterproposal they offer is a layered system that would initially only offer "affordable" standard-definition ("SDTV") capability as part of the standard adopted by the Commission, but broadcasters could add additional layers to the bit stream later when HDTV becomes affordable, if there is a demand. They claim this is a far better approach, yet as far as we know, not a single broadcaster in the nation has embraced their proposal. That is because the proposal completely ignores the needs of broadcasters, beginning with two critical requirements.

First, notwithstanding the cornucopia of other valuable services that a digital television system can provide, the principal goal of broadcasters and of the Commission in this endeavor is to upgrade the technical quality of broadcast television *significantly* so that free over-the-air television service can compete with other means of delivering video in the years and decades ahead. This means that broadcasters must have HDTV capability *guaranteed* in any DTV standard from day one. And HDTV will be eminently affordable to consumers from the beginning of the transition, especially in light of the benefits it delivers.

Second, broadcasters need a complete, proven, tested standard in order to move forward. The industry has spent something over \$500 million and most of a decade to satisfy this need. To suggest at this late date that broadcasters or anyone else involved in this historic process accept a last-minute, unproven, unembodied proposal with dubious performance claims is quite simply a non-starter. And to suggest that the process of proposing, evaluating, constructing, testing and selecting from competing systems start all over again, based on these unreliable claims, is just as unthinkable.

Indeed, neither the computer companies' counterproposal, nor anything else in the voluminous comments on the NPRM provides a sound basis for changing the Commission's tentative decision to adopt the ATSC DTV Standard as the single standard for use by digital broadcast television licensees. In fact, a thorough analysis of the comments demonstrates conclusively that the Commission should fully embrace the recommendation of its Advisory Committee and adopt the ATSC DTV Standard in its entirety. By so doing, the Commission will unleash a flurry of investment within the involved industries that will support a rapid implementation of digital broadcast television, quickly bringing the fruits of this beneficial new technology to the American public.

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**REPLY COMMENTS OF THE
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I. Introduction

The Advanced Television Systems Committee ("ATSC") hereby replies to the comments filed on July 11, 1996 in response to the Commission's Fifth Further Notice of Proposed Rule Making ("NPRM") in its Advanced Television ("ATV") proceeding.

A careful review of the extensive comments filed in response to the NPRM shows a broad consensus supporting the Commission's tentative decisions. The great majority of parties filing comments join ATSC in strongly endorsing the Commission's tentative decision to establish a single, complete, mandatory transmission standard for broadcast DTV, and enthusiastically support the ATSC DTV Standard based on the Grand Alliance system and recommended by the Commission's Advisory Committee on Advanced Television Service ("Advisory Committee") as the best possible choice and far more than fully adequate.

A minority of commenters urges the Commission either to adopt only portions of the recommended standard, or not to adopt any standard at all. Some of these parties argue further that if the Commission does adopt a standard, it should not adopt the ATSC DTV Standard recommended by the Advisory Committee. As demonstrated in the following reply comments, the arguments against adopting a standard and the complaints specifically lodged against the ATSC DTV Standard are misguided and unconvincing. In some cases they may reflect a desire to minimize any chance that the Commission might attempt to impose a DTV standard on non-broadcast video delivery industries. In other cases they clearly reflect a lack of recognition of or concern for the Commission's primary objective in this proceeding -- to upgrade the technical quality of broadcast television in order to help preserve free over-the-air television service in the decades to come. Indeed, these complaints seem to flow from concerns with narrow, non-primary applications of the recommended standard to non-broadcast industries, showing little regard for the essential needs of the primary broadcast television application. Moreover, the alleged inadequacies of the standard for supporting these non-primary applications are technically inaccurate and unfounded, and the cost estimates used to attack the ATSC DTV Standard and to support alternative approaches are obviously flawed, in part, because they don't reflect work that has been done by individual ATSC members to develop cost-reduced consumer receivers and converters. In fact, far more reliable cost estimates prepared by members of ATSC show conclusively that the ATSC DTV Standard will allow consumers to purchase a range of cost-effective DTV receivers and converters, and that at both the low and high ends of this performance range, prices to consumers will be *lower* than they would be under the allegedly less expensive alternative imagined by some members of the computer industry.

In opposing the ATSC Standard recommended by the Advisory Committee, these members of the computer industry, with endorsements from a few other parties, offer a counterproposal which they claim is a far better approach. Yet, as far as we know, not a

single broadcaster in the nation has embraced this proposal. That is because the proposal completely ignores the needs of broadcasters, beginning with two critical requirements.

Notwithstanding all of the other valuable services that a digital television system can provide, the principal goal of broadcasters and of the Commission in this endeavor is to upgrade the technical quality of their service *significantly* so that free over-the-air television service can compete with other means of delivering video in the years and decades ahead. This means that broadcasters must have HDTV capability *guaranteed* in any DTV standard from day one.

Furthermore, broadcasters need a complete, proven, tested standard in order to move forward. The industry has spent something over \$500 million and most of a decade to satisfy this need. To suggest at this late date that broadcasters or anyone else involved in this historic process accept a last-minute, unproven, unembodied proposal with dubious performance claims is quite simply a non-starter.

Indeed, neither the computer companies' counterproposal, nor anything else in the voluminous comments on the NPRM provides a sound basis for changing the Commission's tentative decision to adopt the ATSC DTV Standard as the single standard for use by digital broadcast television licensees. In fact, a thorough analysis of the comments demonstrates conclusively that the Commission should fully embrace the recommendation of its Advisory Committee and adopt the ATSC DTV Standard in its entirety. By so doing, the Commission will unleash a flurry of investment within the involved industries that will support a rapid implementation of digital broadcast television, quickly bringing the fruits of this beneficial new technology to the American public.

II. The Commission's Proposal to Mandate Use of the Full ATSC DTV Standard Is Essential

A. The Commission Should Mandate a Standard

In our initial comments, we explained that a standard is required in order to provide the certainty and reliability necessary for broadcasters, manufacturers and consumers to invest in digital television, that a clear, unambiguous standard is necessary to provide a reliable basis for the design of broadcast and consumer equipment, and that an FCC requirement *mandating* the use of the DTV standard by digital broadcast licensees is necessary to achieve these goals.

The great majority of commenters strongly supported a mandated standard, stressing the need for clarity, confidence and certainty by investors, broadcasters, manufacturers and consumers in order to engender a rapid transition to digital television. For example, the U.S. Department of Commerce and National Telecommunications and Information Administration ("NTIA") at 1, explains that:

"Digital television promises American consumers a greatly improved and very flexible television service, one that will include the ability to receive a range of new and exciting services. Digital television also promises myriad benefits for the U.S. economy. These benefits will accrue, however, only if the Commission acts rapidly to adopt a digital television transmission standard so that the transition to digital television can begin promptly.

Commission adoption of a transmission standard will provide certainty to consumers, broadcast licensees, and equipment manufacturers, which in turn will help alleviate the "chicken and egg" problem inherent in adoption of any totally new system. The knowledge that equipment will not soon be rendered obsolete will encourage rapid investment in the new system, investment that is needed to facilitate the transition to digital. Adoption of a transmission standard also will eliminate the need to purchase duplicative equipment or numerous conversion devices, thus keeping consumer, broadcaster, and manufacturer costs down. One need only look to America's experience with AM stereo to realize that the acceptance and likelihood of

success of new broadcast technologies are greatly enhanced when a standard is adopted."¹

Similarly, 91 broadcasters and broadcast organizations describe in convincing detail why a standard is essential, saying "The wide array of players critical to the success of DTV will not participate in the transition to DTV unless they are confident that there is a real opportunity for a *comprehensive* transition. Establishing a standard is the most important step to be taken toward securing the confidence of *producers . . . , equipment manufacturers . . . , investors and financial institutions . . . , broadcasters . . . , and consumers*"

(Broadcasters' Comments at *i, ii*, 1-2, 15-20, emphasis in original.) The National Consumers League (at 1) also urges the Commission to adopt the proposed transmission standard for HDTV, saying "[w]e agree that manufacturers of digital receivers and broadcasters need certainty before they will make the required investments for HDTV. Consumers also need certainty more than anyone else, for it will be consumers who will drive the marketplace." Numerous other parties also offer compelling arguments urging the Commission to adopt a single standard.²

¹Many other parties, as well, urge the Commission not to repeat the stereo AM debacle by failing to set a single standard. *See* Comments of the Executive Office of the President, Office of Science and Technology Policy at 2; Comments of 91 Broadcast Organizations at *ii*, 19; Digital HDTV Grand Alliance ("Grand Alliance") Comments at *ii*, 12; Thomson Consumer Electronics Comments at 7, fn. 1; Philips Electronics Comments at *iv*, 6, 8; Matsushita Electric Corporation of America Comments at 4; Sony Electronics Comments at 1; and Comments of Hammett & Edison at 4. The Computer Industry Coalition on Advanced Television Service ("CICATS") claims that not mandating a standard would not repeat the AM Stereo problem, because in this case there is motivation to establish a voluntary standard, since once NTSC transmissions cease, consumers will be forced to upgrade in order to receive TV. This logic of this claim is circular and unavailing. The Commission certainly would not order NTSC transmissions to cease if the transition to DTV had not been successful because of confusion and uncertainty caused by the lack of a standard.

²*See* Grand Alliance Comments at *i*, 2, 6; Comments of the Electronic Industries Association and EIA Advanced Television Committee ("EIA/ATV") at *ii*, 7; Comments of the Advanced Television Technology Center ("ATTC") at 2-3; Comments of Thomson Consumer Electronics at 1, 4; Comments of Zenith Electronics at 2-5; Comments of General Instrument at 2-3; Comments of Philips Electronics North America at *iv*, 1, 3-6; Comments of Dolby Laboratories at 3, Comments of Tektronix at 2, Comments of Sony Electronics at 1, 7, 8, 11; Comments of Hitachi America at 2-4; Comments of Mitsubishi Consumer Electronics America ("MCEA") at *i*, 2; Comments of Matsushita Electric Corporation of America ("MECA") at 2, 6; Comments of Advanced Broadcasting Systems of Canada ("ABSOC") at 2; Comments of Citizens for HDTV at 4, 12; Comments of the Department for Professional Employees, AFL/CIO at 1; Comments of the Association of Federal Communications Consulting Engineers ("AFCCE") at 2; Comments of Hammett & Edison ("H&E") at 1; Comments of Cohen, Dippell and Everist ("CD&E") at 4, 5; Comments of Circuit City at 3, 5; Comments of Jae Lim at 1; and Comments of John Carroll at 1, 4.

Several parties stress the positive impacts on jobs and economic development that will flow from a Commission decision to adopt a standard. For example, OSTP (at 3) states "There is a well known maxim of the international technology [marketplace:] international capital and R&D investment, technical and creative talent, new manufacturing, plant siting, and resulting job growth all flow to the country that grabs the early technological lead," and NTIA (at 1) notes that "[a]doption of a digital transmission standard promises to spur the American economy in terms of manufacturing, trade, technological development, and international investment -- including job growth." Philips (at 2), Thomson (at 2) and Citizens for HDTV (at 5, 8, 16-17) echo these views.

Several parties who generally support the specific ATSC DTV Standard, but with one or more caveats, also endorse the need for a mandated standard. For example, the Information Technology Industry Council ("ITI"), a leading computer industry trade association, (at 2) supports a mandated standard, but objects to any inclusion of interlaced formats. And although he objects to some aspects of the recommended standard, William Schreiber (Vol. II at 1) says that a mandated standard is absolutely essential at the outset of the service in order to provide certainty.³

In contrast to this prevalent view endorsing a mandated standard, the National Cable Television Association ("NCTA") (at 1), a founding member of ATSC, joined by Tele-Communications, Inc. ("TCI") (at 1), says it would be an irreversible mistake for the government to adopt a federal technology standard for digital TV, noting "well-established drawbacks" of freezing technology and innovation, and reducing competition and consumer choice. Stressing that its comments should not be read to be critical of the particular DTV standard recommended by the Advisory Committee, NCTA (at 3-5) acknowledges the substantial investment of sweat and capital equity by many, including many in the cable industry, but states that even when advised by industry representatives, the government

³Universal Studios (at 2), Polaroid (at 2), and TelQuest Systems (at 2-3, 6)

should not substitute its judgment for that of the marketplace. NCTA argues that a thriving market is developing in cable and DBS without any government standard, and NCTA and TCI both note the error that would have been made if an analog HDTV standard had been rushed through before all-digital capability was proven.⁴

The non-cable members of ATSC wonder if this somewhat surprising opposition by the cable industry to FCC adoption of a *terrestrial broadcast* standard may not flow from the concerns of the cable industry that the Commission might impose the same DTV standard on the cable industry, as indeed some parties to this proceeding have proposed. This is unfortunate, because as we explained in our initial comments (at 27-28), we believe that as *voluntary* standards activities continue in the cable industry and with other video delivery 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 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. Indeed, the ability of these other competitive delivery media to introduce compelling new technologies without FCC review and approval will continue to provide pressure to ensure that universal broadcast television service implements the technology required to remain responsive to consumer needs.

Recognizing that the cable industry has concerns over the impact on its business of mandating a terrestrial broadcast transmission standard, nevertheless, we don't believe their arguments negate the compelling need for the Commission to establish a *terrestrial broadcast* transmission standard. First, the Commission is not being asked to substitute its judgment for that of the marketplace, but rather to endorse and adopt a broad industry

⁴The recent dramatic success of DBS illustrates the strong consumer demand for the improved technical quality and greater program choices available through digital television technology, however, in considering the different case of universal, free over-the-air broadcast television, the DBS experience highlights the need for a single standard. Presently, each competing DBS service utilizes different receiving equipment, incompatible even for the same intended use. If consumers wish to change DBS providers, they must scrap their investment and purchase new receiving equipment. This model may be effective for a subscription, premium service like DBS, but we believe it would be not be acceptable for universal free over-the-air television.

consensus that will allow all parties to move forward confidently and productively in the rapid implementation of digital broadcast television. Indeed, the cable industry has contributed mightily to developing, evaluating and testing that consensus, and does not oppose the specific ATSC DTV Standard for terrestrial broadcast transmission. Second, we do not believe that adopting the ATSC DTV Standard will freeze technology and innovation, or reduce competition and customer choice. As we explained in our initial comments, the ATSC DTV Standard based on the Grand Alliance system offers unprecedented flexibility to accommodate new applications and uses, and unmatched headroom for growth to include new technological improvements. Third, rapidly adopting a broadcast DTV standard now would not be like rushing to adopt analog HDTV before the advent of all-digital capability. Digital television systems are rapidly being deployed here in the U.S. and throughout the world. And we believe that we have the world's best terrestrial broadcast television technology firmly in hand, with proven, thoroughly tested performance and tremendous flexibility and headroom for growth. For the Commission to delay or withdraw now would be a grave mistake, we believe, and would mean turning away from its obligation to help preserve free over-the-air television in the years and decades to come.

Comments by the members of the computer industry are mixed regarding the advisability of setting a standard. ITI (at 1) urges the Commission promptly to adopt and implement a standard, along with policies to stimulate the development of National Information Infrastructure ("NII") applications, although it favors the exclusive use of progressive scan transmission formats.

In sharp contrast, several other computer industry commenters strongly urge the Commission not to mandate a DTV transmission standard. Microsoft (1-2) says imposing the ATSC DTV Standard would be a public policy disaster, and that the marketplace, not government, is the best avenue for development of a DTV standard. The Business Software Alliance ("BSA") (at 1-2, 6) echoes these sentiments, but says that it has no objection to standards adopted through industry consensus.

The Computer Industry Coalition on Advanced Television Service ("CICATS") (at *i*, 1-2)⁵ urges the Commission not to adopt a DTV standard, especially not the ATSC DTV Standard, favoring voluntary standards instead. However, if the Commission does adopt a standard, it should adopt the minimum standard necessary to protect spectrum users from interference, and if more is adopted, the Commission should adopt no more than the CICATS "refinement" of the Advisory Committee recommendation, i.e., a single baseline standard-definition (SDTV) format, leaving any further enhancements to the marketplace. CICATS (at 10) says the U.S. should not rush in to set a standard because technology is changing so rapidly.

Compaq (at *i-ii*, 1-2) also urges the FCC to reject the ATSC DTV Standard, saying any mandated standard would disserve the public interest, by stifling innovation and inhibiting competition, but if the Commission insists on adopting a standard, it should adopt the CICATS proposal. Compaq (at 6, 10) argues that voluntary industry standards can provide sufficient certainty, and that all parties have incentives for adopting a voluntary standard, because broadcast television is an established service.

Although some of these computer companies fill page after page describing dire consequences of government-imposed standards, their arguments miss the mark and are entirely unconvincing. The Commission is *not* being asked to substitute its judgment for that of the marketplace, but to endorse and adopt an extremely broad consensus joined in by virtually all of the participants who have a direct stake in upgrading the technical quality of terrestrial broadcast television. This is precisely the type of industry consensus to which BSA states it has no objection.

Furthermore, every participant in this decade-long historic process would be dismayed to hear the final stage of this effort characterized as "rushing in to set a standard." After an incredibly deliberate and careful process, evaluating competing proposals and then

⁵CICATS has fewer members than it did when it filed comments on the Fourth NPRM in this docket. CICATS now includes Apple, Compaq, Dell, Intel and Microsoft.

incorporating the best attributes of each, refining and improving digital video compression technology over the past six years, and building and exhaustively testing actual prototype equipment, we have in hand the world's best digital television technology, with unmatched flexibility for additional applications and headroom for growth. While less capable digital TV systems are spreading throughout the world, it would be foolish for broadcasters to turn away from the best, proven technology because something better will come in the future. All that is needed now is for the Commission to follow through on its commitment to set a standard, so that investors, broadcasters, manufacturers and consumers can all move forward together with certainty that their investments will be mutually beneficial.

OSTP (at 2) sums up the issue succinctly:

"We recognize that some argue that the adoption of a single digital television standard would freeze the current state of technology. That is simply wrong. The ATSC DTV standard is sufficiently flexible that it can accommodate new developments in either interlace or progressive scan display formats. The FCC process always is open to review new alternative standards. In point of fact, a technological freeze will be occasioned only upon the *failure* to adopt a standard. The lesson of AM stereo should be clear to all of us: failure to adopt broadcast standards leads to failure to develop new broadcast services. American consumers and workers suffer." (emphasis in original)

Although some members of the computer industry stress their opposition to government-imposed standards and their strong preference for voluntary standards instead, their strident opposition to the Advisory Committee's recommendation -- an extremely broad industry consensus developed through an unprecedented, deliberate and totally open process - - strongly suggests that it is the Advisory Committee's recommendation itself that they oppose, and that their opposition to an FCC-mandated standard for broadcast television is only a means to force modifications to the proposed standard or to thwart its rapid adoption entirely. Indeed, the very architect of the CICATS counterproposal to the Advisory Committee recommendation urges the Commission *not* to let the market decide, because that would mean getting the Advisory Committee standard, but rather the Commission should

adopt a standard, but should not adopt the Advisory Committee proposal nor allow it.

(Comments of DemoGraFX ("Demos") at 3.)

The Coalition of Film Makers (at *i*, 3), although misinformed and consequently misguided, we believe, in its opposition to the proposed standard, is straightforward, saying it's imperative for the FCC to adopt a standard, because failing to do so would result in a *de facto* standard developed by "foreign manufacturers" prepared to capture the U.S. market.⁶

Many parties note the special nature of free over-the-air broadcasting which makes it essential that the Commission adopt a standard.⁷ General Instrument (at 4) argues that the general issue of the proper role of the FCC in setting standards should be examined in a separate proceeding, but that the universal broadcast system is not the place for application of a new policy. MECA (at 5-6) says it's legitimate and proper for broadcasters to request the FCC to facilitate this transition, and argues that failure to act would likely bring no standard or a less inclusive *de facto* standard. Hitachi America (at 3, 5, 6) points out that failure to adopt a standard will sacrifice the U.S.'s hard-won leadership position, and that concerns re stifling innovation and limiting competition, and fears that rapid advances will soon render the standard obsolete are unwarranted. The Grand Alliance (at *ii*, 10-11) and Dolby (at 3) also extol the flexibility and extensibility of the standard, stating that concerns regarding obsolescence of the standard are greatly exaggerated. And EIA/ATV (at *ii*, 5) and ATTC (at 4-6) stress the value of a mandated transmission standard to spur price and features competition that will build sales volumes and lower prices to consumers.

⁶This reference, unfortunately, is but one of several in the comments where detractors of the proposed standard have attempted to recruit support by mischaracterizing and discrediting the work of the Advisory Committee, calling it some kind of plot by foreign manufacturers. *See, e.g.*, Comments of the American Homeowners Foundation at 1-2. First, it is the Advisory Committee and especially broadcasters who have dictated the specifications for the standard, including requiring substantial modifications to the original Grand Alliance proposal. Furthermore, most, if not all, of the manufacturers active in the Advisory Committee process, including those owned by foreign corporations, maintain extensive R&D and manufacturing facilities in the U.S., collectively employing many tens of thousands of American workers in their operations.

⁷*See, e.g.*, Broadcasters Comments at 15-20, Thomson Comments at 5, Zenith Comments at 4, General Instrument Comments at 3, Philips Comments at 4-5, MECA Comments at 6, EIA/ATV Comments at 6, ATSC Comments at 7, ATTC Comments at 2, Citizens for HDTV Comments at 6, Benton Foundation Comments at 4, and Consumer Federation of America/Media Access Project ("CFA/MAP") Comments at 2.

TCI (at 2, 6-8) and NCTA (Owen Appendix at 14) argue that if the Advisory Committee is correct in claiming there is no superior alternative, then the market will adopt the proposed ATV standard without any FCC mandate. We believe this argument misses the point. While there is a strong consensus supporting the proposed standard among the most directly affected parties, adoption of a single standard by the Commission is still necessary to give the confidence and certainty to the many different groups who need to make timely, mutually reinforcing investment decisions. And at this point, after years of anticipation, any step away from the expected Commission endorsement of its Advisory Committee's recommendation would send a strong negative signal that would heighten concerns and uncertainty and paralyze investment, jeopardizing a swift transition to digital television and the rapid recovery of valuable television spectrum. Indeed, positive Commission action is needed now more than ever to dispel uncertainty and avoid delay, in light of the strong (though unfounded) objections by some members of the computer industry.⁸

Indeed several parties stress the importance of the Commission living up to the covenant it made with industry to adopt a standard. For example, William Schreiber (Vol. II at 2) states "[a]fter all this time and effort, a statement by the Commission that no new standard is needed would be greeted with dismay. It would make it very difficult to carry out a similar process in the future. In effect, the Commission has asked the industry to develop a new standard, and the industry has complied. The Commission should therefore issue a new standard," (but should scrutinize the proposal with great care). General Instrument (at 2, 5) similarly urges the Commission to act, saying "[i]ndustry has committed vast financial and manpower resources in the valid expectation that the Commission would adopt a standard for advanced television. Industry shouldered the burden of minimizing technical uncertainty

⁸The Broadcasters (at 20), Thomson (at 5), Hitachi America (at 4), and the Grand Alliance (at 8) all agree, arguing convincingly that the existing broad consensus doesn't negate the need for a mandatory standard.

with the expectation that the Commission would shoulder the burden of minimizing marketplace uncertainty."⁹

The weight of all of these comments demonstrates convincingly that the Commission should finalize its tentative decision to mandate a single DTV transmission standard as rapidly as possible.

B. The Full ATSC DTV Standard Should be Adopted

The majority of commenters agree with the ATSC that the Commission should adopt the proposed standard in its entirety, rejecting the idea of adopting only some layers of the standard. However, some parties urge the Commission to adopt only certain parts of the standard, if it adopts anything at all.

Michael Bove, *et al* (at 1) advise the Commission to specify a modulation standard and a bitstream layer transmission standard only. Intel (at 8) says the Commission should require an RF/transmission layer once its ability to transmit executable code is confirmed, leaving the market to determine the most efficient coding and compression technologies. Microsoft (at 3) argues that if the Commission adopts a standard at all, it should do so only to the extent necessary to prevent interference, or it should adopt a modified version. Microsoft (Mundie statement at 7) also states that it would not object to a standard that included a modulation technique and a low-level bitstream format absent a specified video format.¹⁰ The Benton Foundation (at 3) urges the Commission to adopt no more than the minimal rules needed to protect spectrum users from interference, but that if the Commission must adopt more, it should adopt SDTV which allows multiple programs, and not HDTV.

⁹MECA (at 13) urges the Commission to "continue to act in good faith, as it always has, with industry by moving rapidly forward and adopting the full ATSC ATV standard." The Broadcasters (at 21), Zenith (at 17), Thomson (at 17), the Grand Alliance (at *iv*, 33), and Sony (at 9) also make similar comments urging the Commission to honor its covenant with the industry to adopt a DTV standard.

¹⁰Although CICATS objects mightily to the video formats of the standard, it states (at 14) that only these video formats would create material technological difficulties for the computer and software industries, and that if the Commission adopts a DTV broadcast standard, CICATS would not oppose adoption of the video coding, audio coding, packetized data transport, or RF/transmission components of the proposed standard.

The Broadcasters (at *ii*, 2, 23) oppose partial adoption, saying there is no risk inherent in adopting the entire standard because of its flexibility and headroom for improvement. They say that no potential innovation has been identified that the proposed standard cannot accommodate. Tektronix (at 3) says adopting the entire standard doesn't limit broadcasters, because additional standards such as data delivery can be used in place of or in addition to the video layer. MECA (at 2-3) stresses that the recommended standard is a total system, not a menu of subsystems, and that to change a piece would alter the balance of the carefully crafted whole. MECA (at 3) also notes the early Advisory Committee decision to evaluate and test *complete* working HDTV proposals, not partial or paper proposals. The Grand Alliance (at *i*, *ii*, 9, 13) explains how all layers of the proposed standard are required for the Commission to achieve all of its goals. And Sony (at 13) echoes a point we made in our initial comments that a full standard is required in order for the Commission to satisfy its statutory obligations to ensure that closed captioning and program rating (V-chip) services can be provided.¹¹

During the course of the lengthy Advisory Committee process, all of these issues were examined in determining exactly what should be included in the standard to be adopted and what should be left open for the marketplace to determine. As we explained in our initial comments, adopting only some of the layers of the proposed standard would create delay and uncertainty that would chill investment and postpone, if not jeopardize entirely the transition to digital television. Moreover, the video formats layer of the standard was one of the most thoroughly examined aspects of the standard and was central in the Advisory Committee's successful effort to forge a broad industry consensus. To leave that layer out of the standard would be tantamount to not adopting a standard at all. MECA and MCEA's views are persuasive: without all of the layers, and particularly without the video formats layer, there

¹¹CD&E (at 4-5), Thomson (at 1, 6, 7), Zenith (at 2, 3, 5, 7), MCEA (at 2), Hitachi America (at 6), Sony (at 2, 12), EIA/ATV (at *ii*, 2, 14), ATTC (at 6, fn. 4), and Citizens for HDTV (at 4, 12) also argue persuasively that the full standard should be adopted by the Commission.

is no consensus and no reliable basis for moving forward. Accordingly, the Commission should act rapidly to *adopt all layers* of the ATSC DTV Standard.

III. The ATSC DTV Standard Represents the World's Best Digital Television Technology and Is Far More Than Adequate

In the NPRM, the Commission sought comments on its tentative decision to adopt the ATSC DTV Standard recommended by its Advisory Committee, specifically asking whether the proposed standard is adequate to meet the Commission's objectives. In response, virtually all of the broadcasters, manufacturers and broadcast engineers directly involved in the broadcast television business, as well as many other parties, praise the proposed standard, while several commenters in the computer industry and some commenters in the motion picture industry register a variety of objections to the proposal, and several MIT researchers offer their opinions regarding radically different approaches to the provision of digital broadcast services, usually with no particular focus on television service.

A theme of these divergent views is strikingly apparent from the comments: the parties opposing the ATSC DTV Standard consistently show little or no interest in the future of free over-the-air television, rarely if ever mentioning broadcasters and the challenges they face in making a successful transition to digital television. Instead, these parties focus *exclusively* on whether the standard is ideally suited to *their* narrow purposes, with little or no regard for the needs of other industries.

Some of these parties do include estimates of the costs of receivers and converters for consumers, but these estimates are based on demonstrably false assumptions about equipment costs and performance issues, and as a result are completely erroneous. Several members of the computer industry, along with a few other parties who have accepted these erroneous estimates at face value, mount strenuous objections based on them, while ignoring the consensus solutions developed through solid scientific methods within MPEG, ATSC, the Advisory Committee, and the International Telecommunication Union ("ITU") over the past

several years. As these reply comments, and no doubt others, will show, the objections to the ATSC DTV Standard are unsound, and the ATSC DTV Standard is indeed far more than fully adequate for its intended purposes, and should be adopted posthaste.

The Broadcasters (at *ii*, 3, 6) say the standard is universally acknowledged as exceptional, providing a wide range of functions today that can be extended to provide innovations in the future, and that its technical virtuosity maximizes spectral efficiency, interoperability and growth. They emphasize (at 9) that supporting multiple formats greatly expands the value of DTV to consumers while adding very little to the price of consumer equipment.¹² Canadian broadcasters who have also been heavily involved in the Advisory Committee and ATSC processes reinforce this view, noting that the standard meets key requirements, including flexibility and extensibility. (ABSOC at 9)¹³

MECA (at 4) and Hitachi America (at 2-3) tout the proposed standard as representing the best digital video technology in the world, stressing its capabilities for flexible evolution. EIA/ATV (at 8, 9, 15) argues that any notion that the standard might discourage innovation or impede competition is plainly mistaken, that it eliminates the threat of technological anarchy by providing a baseline for innovation, and that EIA/ATV is unaware of any service that the ATSC DTV Standard could not provide. H&E (at 1) finds the standard entirely adequate, with ample flexibility to accommodate future technological improvements. AFCCE supports the standard, noting its flexibility and interoperability features which ought to satisfy even those from non-TV industries who clamor for an inflexible standard based on a single scanning mode.

The Grand Alliance (at *i*, 2-3) calls the standard the best possible, more than fully adequate, with unmatched flexibility and unprecedented ability to incorporate future

¹²The broadcast community knows this, because they initiated and participated in Advisory Committee working groups focused specifically on this concern. Those parties who stridently claim otherwise are simply misinformed and mistaken, as these comments will demonstrate.

¹³*See also*, Reply Comments of the North American National Broadcasters Association, August 9, 1996, saying the Grand Alliance system has had significant review by American, Canadian and Mexican broadcasters and represents world leading technology, formally urging adoption of the ATSC DTV standard for all of North America.

improvements, able to support a wide variety of information services in addition to news, sports, education and entertainment television. The Grand Alliance (at 10, 14) also believes that the standard offers the world's best digital television technology, and that concerns regarding obsolescence are greatly exaggerated. Philips (at 9) calls the standard a towering technological achievement. Thomson (at 2, 8) and Zenith (at 3, 7) also extol the virtues of the standard, noting its flexibility and headroom for growth, and arguing that adopting and implementing it will preserve free over-the-air TV, enable a host of NII applications, permit a more efficient refarming of television spectrum, and preserve and create jobs and engender economic growth.

A. Computer Industry Complaints about the ATSC DTV Standard Are Unfounded

In sharp contrast to the nearly universal support for the proposed standard among broadcasters and the parties who have the most direct interest in broadcast television and who have labored for almost a decade in the Advisory Committee and ATSC processes, some members of the computer industry, led by CICATS, mount an all-out assault on the ATSC DTV Standard, making almost any claim, no matter how distorted, that might discredit the standard and the historic process that led to its creation. The Commission, as the creator and leader of the Advisory Committee process, with its staff carefully monitoring the work over the years, will itself recognize some of the baseless accusations as readily as any of the participants. Nevertheless, these reply comments and undoubtedly the reply comments of other participants in the Advisory Committee process will show conclusively that these complaints are unfounded and that the Commission can proceed swiftly and confidently to adopt the proposed standard.

CICATS (at 5) claims that the Advisory Committee recommendation would stifle innovation, and hurt the national economy and the competitiveness of U.S. firms nationwide. Saying that government-mandated standards are often the product of political compromise and interest group politics, rather than thorough and unbiased analysis, CICATS (at 7) calls

the Advisory Committee process a textbook example of this phenomenon, producing a proposed standard that is flatly inconsistent with the convergence of computers and televisions.

This claim is demonstrably false, and an insult to the hundreds of industry volunteers who labored mightily in dozens of industry specialist groups to specify requirements for a DTV system and then exhaustively and thoroughly evaluated and tested competing proposals. The constant goal of each of these groups and the only basis for including or excluding aspects of the standard was the technical merit of a proposal, i.e., the extent to which it would satisfy clearly defined criteria designed to provide the best possible advanced broadcast television service, including easy interoperability with other media, including computers and telecommunications. And while "convergence of computers and televisions" was not an explicit goal of the effort, nor should it have been, no less than three of the clearly defined objectives for the standard were directly focused on ensuring the greatest possible compatibility and interoperability with computers and telecommunications, and the proposed ATSC DTV Standard undeniably offers *unmatched interoperability* as compared to any other digital television system on the planet.

CICATS' real complaint is that the Advisory Committee did not develop a standard designed exclusively for computers. However, the principal goal of the Advisory Committee was to develop a standard that would bring quantum improvements to terrestrial broadcast television service in a manner that consumers would find attractive, including the ability to provide a host of innovative information services beyond traditional television services. The proposed standard was carefully designed to be *inclusive* in order to meet the needs of many constituencies, including the computer industry. As we described in detail in our initial comments (at 17-19), the proposed standard benefited greatly from the substantial efforts of a number of members of the computer industry to ensure that their needs were met. To characterize the efforts of the Advisory Committee to be inclusive of the needs of different industries as "political compromise and interest group politics" is a gross and intentionally

misleading distortion. The broad industry consensus in support of the proposed standard speaks volumes about the integrity of the process, as reflected by the adoption of the Advisory Committee's final report *without a single negative vote*, even from members of the computer industry.¹⁴

CICATS (at *iii*, 5, 28) and some of its members find great fault with the Advisory Committee proposal, including interoperability issues that we will address in later sections of these comments, but one of the fundamental flaws, they claim, is that the proposed standard unnecessarily boosts broadcaster and consumer costs by forcing them to leap beyond SDTV to more expensive HDTV, denying consumers any role in choosing. They claim the aggregate cost to consumers over a seven-year period would be \$91 billion, whereas implementing a CICATS counterproposal to implement SDTV would only cost \$44 billion, saving consumers almost \$50 billion.

Although we do not include an analysis of the CICATS cost figures here, we are aware of several analyses that individual members of ATSC plan to submit as part of their individual reply comments. These analyses show convincingly that CICATS bases its unit cost figures on completely erroneous assumptions and then uses other totally unrealistic volume sales assumptions to create large aggregate numbers that it expects will impress the Commission. But quite apart from their erroneous cost estimates, they are comparing apples and oranges -- their cost of providing SDTV to the ATSC Standard's cost of delivering HDTV and SDTV. Consumers could save billions by buying bicycles instead of automobiles, but that hardly argues for adopting an automobile standard that features two wheels and a foot-powered chain-drive mechanism. More important, CICATS' cavalier treatment of HDTV gets to the heart of the matter and clearly identifies two key fallacies that underlie their complaints about the standard.

¹⁴CICATS (at 1, fn. 1) is mistaken in saying that both Advisory Committee members representing the computer industry abstained in the vote. The representative of Digital Equipment Corporation cast an affirmative vote.

If the Commission adopts a standard, CICATS (at 32-33) counterproposes a “mere refinement” to the Advisory Committee standard. They propose a single 480-line progressive scan baseline format, with unspecified aspect ratios and temporal layering for variable frame rates, and a layering technique they claim would allow broadcasters to provide resolutions comparable in quality to the highest resolution formats in the Advisory Committee standard. Under their proposal, only the baseline format would be part of the standard, but they indicate that individual broadcasters could layer additional video data to add HDTV into the bit stream if demand existed.

In this comment the first key fallacy of the CICATS counterproposal is starkly revealed. Broadcasters must make an assessment of what their viewers will demand and what level of quality they must provide in order to remain competitive with other video delivery media, and they must make that assessment before adopting a standard and before implementing DTV. Indeed, Broadcasters made that assessment years ago, and demanded that top-quality HDTV be provided on day one by any system proposed as the basis for a new standard. Moreover, the Commission long ago made a clear decision to incorporate full HDTV in the standard it would adopt unless that proved technically impossible. Broadcasters have made clear, particularly in the last nine months, that HDTV is and should be the centerpiece application of their DTV service. HDTV is what consumers want and what broadcasters must provide in order to remain competitive in the future.^{15,16} It is

¹⁵Unlike broadcasters and consumer electronics manufacturers, CICATS has completely overlooked the viewing public's desire for higher quality.

¹⁶CICATS, quoting every negative statement William Schreiber ever made about the proposed standard, evidently overlooked his view (Vol. I at 7) that it is vital to include HDTV from day one, in order to motivate consumers to make the transition to digital television. CICATS also ignores the admonition of the Clinton Administration's Information Infrastructure Task Force flowing out of the 1994 government/industry Advanced Digital Video Workshop, saying 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." CICATS also ignores the benefits of deploying high-resolution displays used for HDTV for improving the NII. See Grand Alliance Fourth NPRM Reply Comments at 39, *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.

characteristic of the complaints raised by these members of the computer industry that they remain so completely oblivious to the needs of broadcasters in this endeavor, and it is telling that 91 broadcasters and broadcast organizations gave a ringing endorsement of the ATSC DTV Standard, while not a single broadcaster in the country has embraced the CICATS counterproposal.^{17,18}

The second key fallacy underlying these complaints is the mistaken notion that the ability to decode all of the ATSC DTV formats, including the HDTV formats, will make receivers prohibitively expensive for most consumers. As individual ATSC members will describe in detail in their reply comments, the costs of receivers *will be lower* using the ATSC DTV Standard than under the layered approach CICATS advocates, for *both* SDTV-quality low-end displays and HDTV-quality high-end displays.

CICATS (at 18, 28, 30) stridently complains about the Advisory Committee's proposal to support 18 formats¹⁹, saying it will cost consumers tens of billions more per year, will result in inferior products, will limit high-value growth, will restrict development of advanced applications, and that it appears to have been designed to guarantee huge financial rewards for TV receiver manufacturers.

All of these claims are wrong, and the last one, in particular, is an uninformed, irresponsible charge as the Commission who has shepherded this process knows full well. Broadcasters and equipment manufacturers and everyone else involved in the Advisory Committee process have fought hard at every turn to develop a system that keeps costs as

¹⁷There is no chance of an industry consensus forming around any proposal that does not deliver proven HDTV performance from day one.

¹⁸CICATS (at 33-34) claims that unlike the Advisory Committee's "supply push" approach, their proposal is based on "demand pull" where consumers' tastes will guide the industry in adopting higher resolutions. But how would consumers ever express a desire for HDTV? Which manufacturer would offer the first HDTV receiver that could receive no broadcasts? And which consumer would buy this useless receiver? What would motivate any broadcaster to begin broadcasting in HDTV to zero viewers? Does CICATS mean that if HDTV ever became widespread in cable or DBS services, broadcasters could try to catch up before they lost all of their viewers?

¹⁹Several parties express dismay over the supposed great complexity inherent in decoding 18 different formats. In fact, there are really only three fundamentally different formats -- 1080, 720, and 480 vertical lines. The number eighteen comes by counting each combination of frame rate and aspect ratio associated with these vertical line rates as a different format.

low as possible, because all of us know that getting prices down is vital in order to stimulate massive consumer demand. HDTV is the main goal of the Grand Alliance system upon which the ATSC Standard is based, and the ability to support other formats as well at almost negligible additional cost is vital to the standard's ability to address multiple needs. Moreover, effective techniques have already been demonstrated by Hitachi America,²⁰ and others are being developed, to process all of the DTV formats, including the HDTV formats, with a cost-reduced decoder that can deliver lower-definition, lower cost receivers and converters.

Moreover, careful scrutiny of the CICATS Technical Description appendix (at 7-9) shows that their own proposal does not have only one format as they claim. They propose a reference decoder that accommodates variable aspect ratios and decodes any format up to 1024 x 512, at frame rates that include 24, 36 and 72 Hz. This means that far more formats and frame rates must be accommodated by a CICATS receiver than an ATSC receiver -- hardly the single format that they claim while lambasting the ATSC standard for being "unnecessarily complex and detailed"! (CICATS at 28)!²¹

CICATS (at 35) presents a false Hobson's choice, saying consumers must either pay too much for an all-format receiver or risk not getting programming sent in higher resolution formats. CICATS should be relieved to learn that there is a strong consensus that all DTV receivers should and will decode all formats, and that they can do so economically for both low-resolution and high-resolution displays. As discussed later in these reply comments, no one, except possibly CICATS, opposes providing all-format capability in receivers.

CICATS (at 39, 41) claims that ATSC DTV receivers and set-top boxes will need four to five times more memory and processing speed than the CICATS baseline format

²⁰Hitachi America (at 8-9) explains that "[i]n order to meet the needs of set-top decoders for existing receivers and to provide a variety of price points, a low-cost all-format decoder is necessary. . . . [Hitachi America] hopes that its public demonstrations have helped establish the existence of an effective all-format decoding technology."

²¹Examples of valid CICATS formats include 640 x 480, 656 x 480, 672 x 480, . . . 1024 x 480, as well as 640 x 512, 656 x 512, 672 x 512, . . . 1024 x 512. These combinations alone number 48 different formats, not even counting CICATS' three frame rates.

which will provide equal or better quality than ATSC SDTV. CICATS puts forward cost comparisons, focusing first and foremost on set-top converters and then on receivers, concluding that the CICATS proposal offers dramatically lower costs than the ATSC Standard.

First, as discussed above, CICATS is evaluating the wrong question. Broadcasters demand HDTV capability on day one in any standard, but the CICATS proposal hardly mentions HDTV, and CICATS offers no cost estimates for high-definition receivers in their proposal. Indeed, their focus on 1996 converter prices demonstrates their preoccupation with SDTV, not HDTV. Under an HDTV-focused transition plan, the initial prices of receivers and how rapidly those prices can be expected to decline are key benchmarks, while the prices of converters become increasingly relevant as the *end* of the transition approaches.

Second, the CICATS numbers are wrong, in any event, because they completely ignore the fact that memory and other costs can be substantially reduced entirely within the ATSC standard, decoding *all* ATSC formats, using approaches such as one that has been developed and demonstrated to the Commission and the public by Hitachi America. Indeed, detailed cost estimates included in the reply comments of individual ATSC members generally show that the ATSC standard can deliver SDTV picture quality (from any of the formats, including the HDTV formats) at about the same cost or less than the CICATS proposal, and can deliver HDTV picture quality at a substantially lower cost than the CICATS approach, all while providing HDTV capability from day one of the transition to digital television. Thus, contrary to CICATS' assertions, there is no significant penalty for receivers (or converters) in providing the capability to decode all ATSC formats from day one, and for high-end receivers the ATSC standard costs less than the CICATS proposal.

But even making these cost comparisons risks lending undue credibility to the CICATS proposal. The CICATS proposal is just that -- a proposal -- and not a proven, implemented and tested system such as the Advisory Committee long ago decided was necessary as the basis for a DTV standard to which the entire industry would convert.

Furthermore, extensive work in the MPEG standards process and elsewhere has firmly established that layered coding (the CICATS proposal) is less efficient than direct coding (the ATSC standard).²² Consequently, it is extremely doubtful that the CICATS proposal, if ever embodied in prototype equipment, could deliver acceptable HDTV picture quality over a 6 MHz channel.²³

Moreover, the CICATS proposal violates the international MPEG-2 standard in numerous ways. Strict compliance with MPEG-2 is vital because it ensures that integrated circuits developed in conformance with the MPEG standard from a variety of suppliers will be able to decode the standard. Thus, compliance with this international standard will help ensure the lowest possible cost for both broadcast and consumer equipment. Conformance with MPEG is also an important characteristic for promoting interoperability and use of the U.S. standard elsewhere in the world. Indeed, one of the changes ordered by the Advisory Committee in the initial Grand Alliance proposal was the elimination of techniques that were not included in MPEG-2.

Appendix A to these reply comments reviews these MPEG compliance issues, giving a brief summary of violations of the MPEG standard and some discussion of the consequences. One salient conclusion of even this cursory review is that by prohibiting various frame rates and non-square pixel formats, all of which exist in MPEG and are embodied in currently available video products purchased by consumers, *CICATS receivers and converters would be unable to receive every known bit of digital TV that is currently*

²²In addition, some question the need for this type of technique in light of the rapidly falling cost of memory.

²³One of CICATS' own references states "[f]rom the HDTV experiment, it can be concluded with a good accuracy that the quality of the HDTV pictures in an embedded [layered] system at 20 Mbit/s is equivalent to the HDTV quality of a simulcast [direct] system at 16 Mbit/s. The difference in bitrate, for similar quality, is therefore 20% of the embedded [layered] system bitrate." See "A Comparative Study of Simulcast and Hierarchical Coding," J. De Lameillieure and D. Pallavicini, Feb. 1996, European RACE project. As the Advisory Committee test results demonstrated, a 20 percent penalty in bit rate means a very substantial penalty in picture quality. Indeed, because of these inefficiencies, it is our understanding that serious development of layered coding approaches has ceased around the world. To argue, as Demos does (at 5), that layered coding is *more* efficient than direct coding, challenges reason. If this were true, wouldn't a 240-line baseline format yield even better results? And wouldn't a 120-line baseline format be even better?

transmitted in the U.S. via satellite, cable, MMDS, DVD or telephone company video delivery systems.

As it did with consumer costs, CICATS (at 43-45) also presents similarly unreliable cost estimates for broadcast transmission equipment, concluding that broadcasters would save billions in the aggregate if they did not broadcast HDTV. They also claim (at 45, Selwyn appendix) that adoption of the Advisory Committee proposal will cost the public billions more by delaying the return of spectrum, since the transition to DTV under the Advisory Committee proposal will be much slower than under the CICATS approach with its alleged lower costs.

Of course, broadcasters could save money by not investing in HDTV capability. They also could save billions in the aggregate by ceasing operations, but neither course would preserve free over-the-air television in the years and decades to come, and neither course would be in the public interest. This comment again shows an utter disregard for the needs of broadcasters to remain competitive in the future, and helps explain why not a single broadcaster supports the CICATS proposal. And of course, lower costs will indeed spur demand, just as will the superior image quality offered by HDTV, and since the ATSC Standard offers the ability to get superior image quality from day one, with costs as low or lower than under the CICATS approach, it is the ATSC Standard, not the CICATS proposal, that will hasten the transition to DTV and free up valuable spectrum.

Never tiring, CICATS (at 46-49) argues that the Advisory Committee standard will adversely affect the competitiveness of the computer and entertainment industries by imposing requirements that limit their compatibility with DTV, saying “it makes no economic sense to penalize two of our country’s most vital industries to reward the handful of electronics manufacturers that dominate the Grand Alliance.”

As shown conclusively in the sections on interoperability that follow, the proposed ATSC Standard does not limit DTV compatibility with computers, and in any event, the specifications for the standard were developed by the Advisory Committee in a consensus-

driven process, and were established principally by broadcasters assessing the needs of their consumer viewers.

CICATS (at 51-57) says the claims of the Grand Alliance that adopting the ATSC DTV Standard will create and preserve jobs and promote economic growth are flimsy, and that the Advisory Committee standard will stifle growth of the U.S. computer industry, will bring the convergence of television and computers to a screeching halt,²⁴ will eliminate U.S.-based manufacturers from the competition with non-U.S. television manufacturers, may dissuade U.S. computer hardware manufacturers from entering into the PC-TV business, and will threaten the appeal of U.S. films and undercut the motion picture industry.

None of these arguments has any merit, and the hyperbole of these claims belies their validity. It defies belief to argue that a new broadcast television standard of any kind, much less the most computer-friendly broadcast standard ever devised, could possibly *stifle the growth* of the U.S. computer industry. And the attempt to paint these issues as foreign TV manufacturers vs. American computer makers is completely baseless. First, the standard is driven by the needs of broadcasters and consumers, not manufacturers; second, except for what precious little profit flows to the owners of the highly price-competitive U.S. TV manufacturing industry, the industry is largely American;²⁵ and finally, to the extent that the deployment of broadcast television becomes a catalyst for the convergence of televisions and personal computers, no one doubts the ability of Microsoft and other computer and software companies to compete effectively.

CICATS finally concludes (at 58-60) by saying that it should be obvious that they are committed to using DTV to its fullest potential and to the greatest advantage of the public,

²⁴CICATS asks the Commission to believe that the convergence of TVs and computers is currently going just fine with analog NTSC television and several interlaced scan, non-square pixel digital television services, but that the introduction of the only digital television system on the planet that uses progressive scan and square pixels predominantly will bring this progress to a screeching halt.

²⁵Although this whole discussion ought to be irrelevant, it's worth noting that the vast majority of personal computer monitors are imported from Asia.

and that adopting their approach does not entail reinventing the wheel and would not incur any delay in implementing DTV.

On the contrary, their comments show no focus on or interest in free over-the-air television, HDTV, or the problems of broadcasters. Since broadcasters rightfully insist on a proven, tested system, adopting the CICATS approach would incur years of delay for assessment, development, testing and evaluation of an actual working system, with no real prospect that the resulting system would equal the proven performance of the Grand Alliance system already in hand. Meanwhile, other digital video standards that are far less interoperable with computers and telecommunications, including DVB, would take root here in the U.S. and throughout the world.

Demos (at 2, 5, 7), the architect of the CICATS counterproposal, in his own lengthy submission, urges the Commission not to adopt the Advisory Committee proposal, saying his firm has developed a better approach that outperforms the Advisory Committee proposal by a substantial margin in every video format. Demos (at 6) urges the Commission to submit his materials to an independent and unbiased outside group for an expert evaluation which he believes could be completed within a few weeks.

As Mr. Demos well knows, the Commission already established a process and procedures for evaluating the claims of system proponents -- its Advisory Committee. Despite his active involvement in the Advisory Committee during the last several years, his system was never proposed to the Advisory Committee and therefore, was never subjected to the rigorous and thorough Advisory Committee processes for certification, evaluation and testing. His claim that an evaluation could be completed within a few weeks is disingenuous. There is no support among broadcasters, the primary users of a terrestrial DTV standard, for any system that does not have proven, tested performance, including top-quality HDTV, and even if there were any reason to believe that the Demos approach could deliver such performance, it would take years, not weeks, to repeat the type of thorough evaluation and

testing of prototype equipment that broadcasters require.²⁶ The Commission has no valid basis for further consideration of Demos' proposal, and certainly none for scrapping the entire Advisory Committee process in favor of these last-minute, unproven claims.²⁷

Throughout the nine-year Advisory Committee process there has been no shortage of impressive sounding claims about what systems could be devised if only the particular visionary involved had enough time and money to make the proposal work. Early on, the Advisory Committee determined to use a careful, open process to scrutinize various proposals, relying on peer review by technical experts in a variety of specialists' committees headed by impartial leaders, and to accept only a system with proven, tested performance as the basis of a standard. This process served the involved industries and the public well, yielding breakthrough digital technology and ultimately the world's leading digital television system. There is absolutely no basis for the Commission to depart from this careful process now, based on the fallacious cost estimates and the dubious performance claims surrounding the CICATS proposal. The Commission should reject the CICATS counterproposal.²⁸

²⁶In Appendix A we note one deficiency of the proposed system which could easily be overlooked in a simulation, but would have been readily apparent if the system had been implemented in real-time hardware.

²⁷Demos (at 2, 7-8) finds fault with almost every aspect of the ATSC DTV Standard, and urges the Commission to adopt a lengthy list of restrictions that go even beyond the CICATS proposals, including a variety of requirements on receivers, something the members of CICATS generally oppose. For instance, he urges the Commission to reject the colorimetry aspects of the Advisory Committee recommendation and to give the task of defining appropriate colorimetry to "a qualified committee." We believe that the Society of Motion Picture and Television Engineers (SMPTE) and the International Telecommunication Union (ITU) which have standardized the default colorimetry are in fact highly qualified committees. The ATSC and MPEG standards provide the means to signal alternative colorimetry to receivers, once again highlighting the flexibility of the standard.

We note a clear pattern with Mr. Demos. He does not have any respect for any standards committee that does not completely adopt his views. The only committee he considers "qualified" is a committee of one, himself.

²⁸Microsoft, Compaq, CompTIA and BSA generally repeat the same positions reflected in the CICATS Comments, often with the same kind of distortion and hyperbole that characterizes the CICATS submission. Compaq (at *ii*, 15) criticizes the ATSC Standard first for supporting *too many* formats, and then for *not enough* aspect ratios. Intel (at 1-2, 7), although a member of CICATS, takes somewhat more moderate positions. Intel advises against adopting the standard in its entirety, but if the Commission does, it should ensure that the transport system includes the ability to deliver executable code; it should recommend, not require, image formats, and should consider incorporating the CICATS approach; it should allow alternative coding and compression techniques; and it should not regulate receivers beyond ensuring that they don't interfere with each other. Compaq (at 21) and CICATS (at A-12) join Intel in noting the need for ensuring that the transport system includes the ability to deliver executable code, saying that the Commission need not postpone adoption of a standard pending completion of this work. Intel has recently joined ATSC and a representative of Intel chairs a working group within ATSC that has begun work on a supplemental data broadcast standard to meet this need.

B. Other Complaints about the Standard Are Also Unfounded

The Film Makers Coalition (at *i*, 3) follows the CICATS line, urging the Commission to make "relatively minor" changes to the Advisory Committee recommendation and adopt a 480-line, progressive scan, flexible baseline transmission standard with picture refresh rates of 24, 36 or 72 Hz, and a requirement that broadcasters transmit all films in their original aspect ratios. Along with Robert Primes (at 3, 4) they discuss at length their concern about potential cropping of their motion pictures for display on televisions.

We needn't repeat here all of the reasons why a single-format baseline transmission standard should not be adopted. However, we are puzzled that these members of the motion picture industry speak so passionately about the artistic integrity of their work in the context of potential cropping of their pictures, but seem perfectly willing to forgo high-definition resolution in a transmission standard. With the ATSC DTV Standard, using the 720-line and the 1080-line progressive scan transmission formats, for the first time in history film makers will have the ability to display something like movie theater resolution on home television screens. Everything they say about the emotional appeal of their content would seem to apply with at least as much force to the resolution of pictures as it does to the aspect ratio. We would expect film makers to be the last people on earth to support the CICATS baseline standard, because it fails to guarantee proven HDTV performance from day one of the transition to digital television.²⁹

CFA/MAP (at 2, 6, 8) also endorses the progressive scan baseline standard proposed by CICATS, saying it will reduce the cost of digital receivers and converters and will permit the convergence of video and computer technology. They repeat the erroneous and misleading CICATS cost figures, and parrot back some of the unfounded hyperbole spouted by others, including claims that the Advisory Committee proposal would freeze technology

²⁹One reason these film makers support the CICATS proposal appears to be their desire to have their movies transmitted in progressive scan. They may not be aware that the Grand Alliance system video encoder contains a feature that automatically detects material originally produced in film and transmits it using the 24 frames per second progressive scan format.

in the 20th century, and that the dispute over the standard is about who gets a monopoly on receivers. As demonstrated above, these claims have no merit.

William Schreiber (Vol. II at 1-3) says that if the Grand Alliance system works as generally expected, it will deliver benefits fully commensurate with the expenditures involved, but that the standard is not perfect: He registers strong objections on some aspects of the standard (discussed in later sections), but other "imperfections" are mentioned, we believe, more by way of an academic tutorial on his view of the perfect system than as essential changes that must be made.

PCUBE (at 1-3) opposes the Advisory Committee recommendation, saying it will stifle innovation and the rapid development of new services and technologies, favoring instead a modular, open systems approach and giving various specifications for what might be included at each layer, in many cases quite similar to the ATSC DTV Standard. Here again, PCUBE has been heavily involved in the Advisory Committee process for years, and knows full well that the time for specifying the architecture of the perfect digital terrestrial broadcast system is long since past. Broadcasters, manufacturers, and consumers need to act now on the basis of proven, effective technology to begin a rapid transition to digital television.

Digital Theater Systems ("DTS") (at 1) argues that the ATSC DTV Standard must not require conformance with Dolby AC-3, saying that the Dolby AC-3 technology is obsolete, is incapable of recreating the artist's intent, and is poised to limit further innovation. DTS (at 4, 6) finds fault with the Advisory Committee test procedures, says subjective assessments have been conducted that prove better efficiency for its system, and makes a specific alternative proposal, including standardized hardware for an audio decoder. Universal Studios (at 1) supports the proposed standard, but urges that Dolby AC-3 not be permitted exclusively, claiming that the DTS system is superior.

Like other claims of superior technology, this proposal comes too late, and its benefits are asserted, not proven. Several other excellent audio systems, including three developed by

members of the Grand Alliance themselves, were considered and in some cases evaluated as part of the Advisory Committee process, but the Dolby AC-3 audio system was selected as the clear winner by the Advisory Committee. There is no consensus within the industry for opening up the standard to another audio system or to multiple audio systems, and no compelling reason to believe that the present standard is not as good or better than any other.

McKnight and Bailey (at 1) urge the Commission to adopt a less complex and less costly progressive scan version of the standard, while the Research Program on Communications Policy ("RPCP") (at 5) advises the Commission to choose a system with progressive scan, square pixels, specifiable aspect ratios and frame rates, and digital coding, but no specific compression scheme³⁰. As with proposals discussed above, the Commission should reject these suggestions, since supporting multiple formats is neither substantially more complex nor costly, and the time to design the ideal theoretical DTV system is long since past.

Digital Imaging (at 3) urges the Commission to reject the ATSC DTV Standard and any other proposal that is not compatible with NTSC, and Blue Mountain Translator District (at 2) also urges that any DTV system be backward compatible with existing equipment. The Commission wisely determined many years ago to adopt a simulcast approach to enable a smooth and rapid transition to advanced television, and the Commission should follow through on that plan. The advantages of digital technology make it overwhelmingly clear that the days are and should be numbered for the analog NTSC transmission system, even though it has served the nation well for more than 50 years.

We believe that these extensive comments on the Advisory Committee's recommendation emphatically confirm that the ATSC DTV Standard represents the world's best digital television technology and that it is *far more than adequate* for the nation's next

³⁰While supporting multiple defined picture formats in a receiver does not add any appreciable cost, supporting multiple compression techniques would be extremely costly. The Commission should adopt the full ATSC DTV Standard, including the compression specifications.

generation of broadcast television service. A remarkable consensus in favor of the standard exists among those parties directly involved in broadcast television, and the arguments raised against it by parties less directly involved, although voluminous and sometimes extravagant, lack merit and reflect a myopic concern with supposed interoperability difficulties while ignoring the Commission's fundamental objectives in this proceeding. All in all, the comments articulate a compelling case for adopting the ATSC DTV Standard in its entirety, just as the Commission's Advisory Committee has recommended.

IV. The Advisory Committee Process Warrants Adoption of its Recommendation

Many commenters join ATSC in praising the Advisory Committee process. NTIA (at 2) calls it an open process, to be commended, while the Grand Alliance (at *iv*) says 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. The Broadcasters (at 3), Dolby (at 2) and MECA (at 2,7) state that the standard was developed through a uniquely open and inclusive process. Hitachi America (at 3) describes the concerted effort that included representatives of all affected industries, and Sony (at 1) describes the process as fair, open, deliberate, and dedicated to searching out the best solutions. Philips (at *v*, 12) says the process was perhaps as impressive as the technology it produced, and that the goal was always to get the system that best serves the needs of the American people.

Schreiber (Vol. II at 1, 8) says that although the Advisory Committee has done its job well it has been hampered by the fact that almost all the participants work for companies with a financial interest in the outcome. Saying the public has been inadequately represented, Schreiber urges the Commission to appoint a small panel of independent experts, including FCC staff, to make the final desirable modifications to the system, with the Commission making the ultimate decisions. These experts must have business knowledge of both

industries (computer and TV), as well as technical expertise on the matters to be decided, not necessarily in the same individuals, but they must not have any financial interest in the outcome. Primes (at 13) makes a similar suggestion, urging the Commission to delay acceptance of the Advisory Committee proposal until the potential problems he's identified can be verified independently by parties without vested interests in the results.

These suggestions are silly and an affront to the hundreds of volunteers who labored diligently in the Advisory Committee for almost a decade. It is not only necessary, but desirable in such a process to involve all of the parties who have a stake in the outcome, and more often than not, the best experts in a particular field are actually employed by themselves or someone else in that field. The members of the Advisory Committee were chosen by the Commission to represent a broad spectrum of interests and expertise, but proponents of specific systems were not allowed to vote on the recommendation, and impartial leaders who operated fairly and openly were selected for every Advisory Committee working group and avenues of appeal were established and frequently used. Furthermore, as so many of the participants testified in the comments summarized above, the constant focus of every group within the Advisory Committee was to achieve a standard that best met the needs of the public. Between the Advisory Committee and the Commission's own review in this docket, all of the bases are covered to ensure that the Commission's decision is in the public interest.

CFA/MAP (at 1) laments that the Advisory Committee didn't include even one member of the public (even though the subcommittees and working parties were open to all interested parties).³¹ All of the thousand or so participants in the Advisory Committee process are members of the public, TV viewers, and consumers. Moreover, the consistent focus of the whole process was to develop the best system possible whereby broadcasters

³¹CFA/MAP complains about being excluded from the Advisory Committee process, yet they have embraced a completely unproven proposal formulated by a few computer companies behind closed doors with no input at all from the public or from other interested stakeholders. As a consequence, they have repeated false claims and endorsed unsound technical proposals that would actually harm consumers. The checks and balances inherent in the peer review-oriented Advisory Committee process would have prevented this kind of mistake.

could provide the most useful and attractive services to the viewing public through the most effective and affordable consumer equipment possible.

Demos (at 2) says that the Advisory Committee remained insular to his input, and didn't accept his ideas and that "the participants who developed the ATSC DTV proposal were a relatively closed group who did not cooperate with those outside of their group" (25), that "the Advisory Committee testing process at the ATTC was neither thorough nor appropriate for the digital television systems" (14), that "the Advisory Committee process never established any process or mechanism for working to adjust the Grand Alliance proposal" (16), and that "the Grand Alliance proposal remains unmodified since it was originally proposed in mid-1993." (16)

Although Demos has been a long-standing participant in the Advisory Committee process, he never proposed a system to the Advisory Committee. That his specific suggestions may not always have been adopted says more about the merits of his ideas than about the fairness of the process, since virtually every other participant in the process attests to the openness and fairness of the process. We will not respond to every erroneous statement in his submission, but we will address some of the outright falsehoods. From its own monitoring of the Advisory Committee process, the Commission knows that the standard was in no way established by a closed group. And contrary to his assertion, the Advisory Committee established an elaborate set of specialist groups within its Technical Subgroup to evaluate every detail of the Grand Alliance proposal, and the Advisory Committee required *significant* changes in the Grand Alliance system as a result, e.g., the requirement to increase the 960-line formats to 1080 vertical lines, the requirement to use only square-pixel formats for HDTV, and the requirement to modify the system to conform strictly to the international MPEG-2 standard for video compression. The Advisory Committee also played a key role in the final selection of the transmission sub-system, including consideration of a potential alternative system, and in the final selection of the audio system.

Demos can hardly expect the Commission or anyone else who knows the truth about the Advisory Committee process to believe his unsubstantiated technical claims, when he so flagrantly misrepresents the process itself.

The Advisory Committee performed an invaluable service for the Commission and for the industries involved by forging a strong consensus over the course of nearly a decade for an advanced television transmission standard. By virtually all accounts, the process was remarkably open, thorough, fair and successful. Such a consensus cannot be lightly ignored or cast aside, but should guide the Commission's final decisions in this manner. The excellence and integrity of the Advisory Committee process fully warrants the Commission's acceptance of its recommendation. Accordingly, the Commission should act swiftly to adopt the ATSC DTV Standard recommended by the Advisory Committee.

V. The Commission Should Rely on Existing Processes in Making Modifications to the Standard

In our initial comments, we stated our strong belief that a sunset provision on the mandatory use of the ATSC DTV Standard is completely unnecessary and would undermine the Commission's goal to promote a smooth and swift transition. Every other party who addressed this issue also urged against adopting a sunset provision on the mandatory nature of the standard, finding no good reason for any such provision.³² Most of these parties also argued against (and no one argued for) setting a specific schedule whereby the Commission would review the standard, saying that any indication now of a need to modify the standard is premature and would be counterproductive to establishing the certainty that is required for the rapid implementation of digital television service. Many of these parties urged the

³²See, e.g., Broadcasters Comments (at 24), Thomson Comments (at 6), Zenith Comments (at 5), Tektronix Comments (at 3), MCEA Comments (at *i*, 4), MECA Comments (at 7), Hitachi America Comments (at 6), Sony Comments (at 36), EIA/ATV Comments (at *ii*, 10-12), Grand Alliance Comments (at *ii*, 11-12), and ATTC Comments (at 5).

Commission to rely on its existing processes and on industry groups like the ATSC for recommendations as to modifications to the standard.

Accordingly, the Commission should not adopt a sunset provision on the mandatory use of the standard and should not schedule any specific reviews, but should rely on industry organizations such as ATSC and on its existing processes to make any necessary modifications to the standard.

VI. The ATSC DTV Standard Provides Far More Than Adequate Interoperability

A. Computer Interoperability

In our initial comments, we described in detail the extensive efforts in the Advisory Committee to promote easy interoperability, saying that after these years of effort and tremendous progress, we're convinced that the ATSC DTV Standard provides *far 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. Here again, virtually all of the parties directly involved in the provision of terrestrial broadcast television service agree, but some parties less directly involved oppose various aspects of the standard, claiming they limit interoperability with computers.

The Broadcasters (at 7-8), urging the Commission to keep in mind its main goal -- the preservation and enhancement of free over-the-air TV, note that interoperability was emphasized from the beginning, and that the proposed standard excels in the areas of interoperability and compatibility. NTIA (at 2) praises the flexibility, interoperability and headroom for growth offered by the proposed standard, and AFCCE (at 2) says the interoperability aspects of the standard should satisfy even those non-TV industries clamoring for an inflexible standard based on a single scanning mode.

The Grand Alliance (at *ii*, 14, 16-26) states that the standard is more interoperable by far than any other digital television system on the planet, and that the Commission need take no further action in this area. Thomson (at 8-10), Zenith (at 7-9), ATTC (at 2, 6), EIA/ATV

(at 5), and Philips (at 8-9) make similar strong statements, with Philips noting a big payoff for NII applications that might be lost if further FCC delays mean that DVB becomes entrenched. General Instrument (at 6-8) gives an excellent discussion of the flexible capabilities of the standard and explains how the ATSC DTV Standard supports interoperability without limiting flexibility.

MECA (at 5-10) notes the standard's ability to enable a host of NII applications and its tremendous flexibility for future improvements, saying that interoperability is a matter of degree, and that the ATSC Standard strikes a balance that delivers interoperability unparalleled in the world. Hitachi America (at 4, 7) says that interoperability has been designed into the standard to a degree unprecedented in a universal service, noting the computer images that were included as part of the Advisory Committee tests.

Tektronix (at 6) argues that changes advocated by some in the computer industry are not in the public interest. Sony (at 3) states that critics of the standard offer nothing positive and stubbornly ignore the grueling tests to which the system was subjected and the strong industry consensus around the result, saying these critics would deny the benefits of the proposed standard without offering a practical alternative. Sony (at 9-10) also states that first and foremost the standard is a television standard, and those who criticize virtually all primary technical parameters of the standard show either a profound lack of understanding of all that constitutes a television system, or a cynical and parochial dismissal of the critical priorities of the television industry. The ATSC Standard and the Grand Alliance system provide truly exemplary interoperability, but even so, interoperability debates almost by definition are destined to be interminable, and there is no rational technical resolution to this debate that can fully satisfy all factions. (Sony Comments at 35)

The Motion Picture Association of America ("MPAA") (at 4) says that the Advisory Committee proposal strikes the best balance between various technical considerations and the needs of different industries, and Universal Studios (at 2) endorses the MPAA comments regarding interoperability considerations. However, the Film Makers Coalition (at 2, 6)

parrots the CICATS comments, saying (mistakenly) that the Advisory Committee standard is not open and flexible and doesn't have headroom for future technologies.

The American Homeowners Foundation (at 2) states that some computer companies told them that the Advisory Committee proposals could add \$400 to the price of a personal computer to make it compatible with the Advisory Committee standard, but it would add very little if the CICATS approach were taken. Similarly, CFA/MAP (3-4) says that the Advisory Committee system provides for few, if any, changes, and that only the CICATS baseline standard is capable of convergence. They claim that consumers will have to buy two boxes, not one, because interlaced scanning, non-square pixel spacing, and low frame rates make convergence cost-prohibitive.

McKnight and Bailey (at 1) refer to receivers, VCRs and production equipment that use progressive scan as "interoperable," while any equipment using interlaced scan is called "noninteroperable," saying the standard will fail if it includes interlaced scanning.

Carver (at 2) says the proposed transmission is specific to television, and though it contains hooks for transporting alternative data, it departs greatly from state-of-the-art data transmission and communications practices -- a weakness that will surface to jeopardize the entire system.³³ Bove, *et al*, (at 3) say that the Grand Alliance standard is fatally flawed in its over-specificity and lack of extensibility.

Intel (at 3) says the proposed standard limits interoperability between computer and TV systems, and that the use of interlaced scanning, non-square pixels, and 60 Hz frame rates does not permit the use of graphic and textual images necessary for computer applications. Compaq (at *ii*, 3) says the 18 formats with inferior technology (interlaced scanning, non-square pixels, computer unfriendly picture rates and limited aspect ratios) interfere with

³³We agree with Carver that the standard is focused primarily on television, but we strongly disagree that this is a weakness that will jeopardize the system. We believe that digital television service will be a powerful base upon which a host of other potential information services can flourish.

computer compatibility, while BSA (5) says ATSC DTV is incompatible with personal computer applications.

Demos (at 1,3) says the proposed system has complete incompatibility with computers. He quotes the prices of NTSC/PAL converters at \$50,000 to \$250,000 depending on quality, and more for HDTV conversion, concluding that the barriers against computer compatibility are practically insurmountable.³⁴

These opposing comments make clear, as several parties warned, that the debate on computer interoperability is often characterized by absolute statements and hyperbole that shed no light at all on the real issues involved. Labeling progressive scan equipment "interoperable" and interlaced scan equipment "noninteroperable" is a semantical ploy designed to win adherents simply by the advantageous choice of labels. And those who simply claim that a standard that includes any interlaced scanning will surely fail, offer nothing but a bald assertion, and seem to ignore the fact that numerous *exclusively* interlaced digital television systems are thriving while we debate whether to permit four of the eighteen ATSC formats to be interlaced.

The absolute statements in these opposing comments, such as "not open and flexible," "doesn't have headroom for change," "provides for few if any changes," "is fatally flawed in its overspecificity and lack of extensibility," "consumers will need two boxes," "only CICATS is capable of convergence," "incompatible with personal computer applications," and "does not permit use of graphics and textual images" are demonstrably false and should not convince the Commission of anything.

Another theme of these comments is also apparent. Various parties are being "told" false or misleading information about the interoperability issues surrounding the standard.

³⁴Demos' conclusion is completely unfounded. Incredibly, he seems to be suggesting that it will cost \$50,000 or more in a consumer receiver to provide high-quality conversion of an interlaced DTV format for use on a progressive scan display! As the reply comments of individual ATSC members will show, high-quality deinterlacing required for HDTV receivers will probably cost no more than \$35 in 1998 when DTV service begins, will fall to about \$5 by 2002, when all stations will be on the air, and will be negligible by 2004 when significant penetration of the market is attained. Such gross exaggeration does little to inspire confidence in any other of Demos' estimates and claims.

As we discuss further elsewhere in these reply comments, an estimate of \$400 to make a personal computer compatible with the standard is wildly inaccurate. Moreover, home owners might better inquire what cost-effective options they might lose if valuable capabilities are banned from the standard.

As we have explained before, the ATSC DTV Standard based on the Grand Alliance system is first and foremost a broadcast television system, but it also offers better interoperability with computers than any other digital television system ever conceived. It offers the maximum interoperability with computers possible without sacrificing its ability to fulfill its primary purpose and to provide *other* types of interoperability that are also important. For example, although it has virtually limitless ability to carry data, it is not and never was intended to be a general purpose data communications system, nor should it be.

B. Progressive vs. Interlaced Scanning

The debate over progressive vs. interlaced scanning occupied a great deal of attention in the Advisory Committee over the course of several years, and the breakthrough finding that an interlaced format could be included within a predominantly progressive scan system, at an almost negligible added cost, was pivotal in forming the Grand Alliance and in the ability to achieve a strong industry consensus around the Advisory Committee recommendation. On this ever-contentious issue, most of the commenters directly involved in the provision of broadcast television service and equipment offer strong support for the Advisory Committee recommendation to include interlaced scanning formats, including many who fought hard to achieve a primarily progressive scan system. However, a number of other parties continue to register strong objections to the inclusion of any interlaced transmission formats.

As we stated in our initial comments, we believe that *interlaced scanning formats should not be prohibited*, and that any further debate on this issue ironically will serve only to entrench the many completely interlaced scanning television systems that are rapidly being adopted in the U.S. and throughout the world.

The 91 broadcasters and broadcast organizations who are among the primary users of the proposed standard (at 10-11), favor the inclusion of interlaced scanning, saying that far from detracting from the DTV Standard, inclusion of the interlaced format actually adds value. The Broadcasters state that "[t]he inclusion of interlaced scan as an option accommodates the interests of the broadcasters who favor it for some applications while still accommodating the needs of others in both broadcasting and computer and film industries that favor progressive technologies." MPAA (at 2), supported by Universal Studios (at 2), also endorses the inclusion of both progressive and interlaced transmission formats.

A wide range of other participants in the Advisory Committee process and other parties strongly endorse the Advisory Committee's recommendation to include some interlaced formats in the predominantly progressive-scan ATSC transmission standard.

Thomson (at 10) and Zenith (at 10) argue that by supporting both progressive and interlaced scanning, the standard meets the needs of a broad range of different users. General Instrument (at 7) echoes this view, noting how the standard meets the special needs of the computer industry, but observing that "[w]e are amazed that some computer industry proponents, who have no stake whatsoever in the broadcasting industry, would presume to limit the flexibility of the ATSC standard and dictate technologies to be used by broadcasters." Thomson (at 11-12), Zenith (at 10-11), and the Grand Alliance (at 19-20) note the emphasis of the standard on progressive scanning and stress the great amounts of material that will be transmitted using progressive scan formats, including all material originated in film (all movies and about 80% of prime time programming). Thomson (at 10), Zenith (at 10) and the Grand Alliance (at 23) reinforce our own view that any delay in adopting the standard out of interoperability concerns will only serve to entrench interlaced scanning in the U.S. and throughout the world.³⁵

³⁵Expressing some bewilderment with those who still claim the standard lacks interoperability in spite of all of these features, Thomson (at 11), Zenith (at 11), and Sony (at 24) suggest that some in the computer industry are simply trying to derail the Commission's standard setting process for anticompetitive purposes.

Tektronix (at 5) notes that it has strongly advocated the adoption of progressive scan formats, but does not oppose the inclusion of interlaced scanning, saying it's not practical to demand that all video displays resolve fine text and graphics when viewed from short distances. "There are some who advocate a system whose parameters are chosen solely to facilitate operation with computers, and suggest that any concession to interoperability with existing television systems is inappropriate. Tektronix believes that such an approach is not in line with the Commission's intent, nor is it in the public interest."

MCEA (at *i*, 2) believes proposals to excise interlaced scanning lack merit and would impede ATV, while MECA (at 5) views the issue as one of idealism vs. pragmatism, saying there is great genius in the proposed solution, and the Commission shouldn't tamper with it.³⁶ Hitachi America (at 4) notes the emphasis of the proposed standard on progressive scanning, saying that interlaced is included as a practical means of optimizing delivered image quality.

Sony (at 2, 14-25) offers an extensive and convincing discussion, saying that interlaced scanning deserves whole-hearted support and simply must be preserved as a critical component of our flexible new standard, that the inclusion of interlaced is essential to the timely marketplace acceptance of HDTV, and that only the inclusion of interlaced and progressive scanning will permit the immediate broadcast of both film and live events TV in full high-resolution HDTV.

The Grand Alliance (at 21-22) defends the inclusion of interlaced formats, saying they are useful for transmitting archived interlaced material and for interoperability with current high-definition production equipment and the installed base of NTSC production and studio equipment, and that for video not originally produced on film, more SDTV programs can generally be offered simultaneously using interlaced scan.

³⁶MECA (at 8-9) also states that all-progressive HDTV production is the goal and they are investing resources to achieve it, and that the continuing debate on the comparative advantages of interlaced and progressive scanning is pertinent only to HDTV production.

Many parties, including the Broadcasters (at 10), MECA (at 9), MPAA (at 6), Sony (at 27), and the Grand Alliance (at 20, 24), point out the ability in a digital system to separate production, transmission and display capabilities in a total system, in some cases criticizing the opponents of interlaced scanning for confusing transmission formats with display or production formats. Sony (at 23), the Grand Alliance (at 20) and MECA (at 9) stress that deinterlacers work well and are affordable.³⁷ ATTC (at 7) states that with the cooperation of several manufacturers it "has demonstrated to the Commission that consumer-level technology is now available for products that will enable consumer receivers to display selectively a wide range of field rates, aspect ratios, type of scanning , and even colorimetry characteristics independent from the parameters chosen for production or transmission. Such technology makes it both feasible and affordable at the consumer level to combine computer scanning and any of the broadcast video scanning standards on any chosen display, regardless of its native characteristics . . ."38

Notwithstanding all of these compelling reasons for including both progressive and interlaced scanning formats in the standard, a number of parties continue to oppose any inclusion of interlaced scan in the transmission standard. They raise a wide variety of complaints, ranging from unfounded assertions that amount to little more than name calling, to highly technical claims about compression and coding efficiencies, backed up by "supporting" papers that often contain data that calls into question their conclusions or that don't support the referenced conclusion at all. We do not attempt to address every error or misconception expressed in the comments, nor every opinion that differs from ours, but we

³⁷Sony has demonstrated to the Commission a commercially available HDTV home receiver that accepts a 60 Hz interlaced scanned input television signal and displays it at full 60 frame progressive. "We emphasize that such de-interlacing is today a well-known art -- cost effective, implementable in VLSI, already available in some receivers, and finally, as the Commissioners recently witnessed, it works very well." (Sony Comments at 23) Similarly, Carroll (at 3) says deinterlacing is no longer a big deal, because converters can output progressive or interlaced regardless of how the signal is received, since the hardware (memory) cost of storing a frame is trivial.

³⁸See Letter of Lawrence Petak to the Acting Secretary of the Commission re an oral *ex parte* presentation by IBM and Snell & Wilcox describing their *Multi-Media Bridge*, a device capable of processing any current broadcast standard as input and displaying any desired picture standard as output.

do address enough here to demonstrate the folly of any attempt by the Commission to adjudicate every claim and counterclaim in what is practically a religious debate. That's why the Commission established an Advisory Committee, and the Advisory Committee did a superb job forging a consensus. That several vocal detractors remain *in industries not directly involved in the provision of free over-the-air television* should not deter the Commission from bringing a successful conclusion to this historic effort.

One of the most responsible comments, even though we disagree with it, is made by ITI (at 2). Although they support the rapid adoption of a DTV standard, they state that the Commission can minimize the cost of DTV investment by going directly to progressive scanning, and that including interlaced scanning will perpetuate an inferior technology and delay the convergence of technologies. As described in our initial comments, we believe that including some interlaced formats in the predominantly progressive scan standard offers important benefits to broadcasters. And as explained more fully below in our responses to other complaints about the standard, we believe concerns that incorporating some interlaced scanning formats in the standard will delay the convergence of technologies are completely overblown.

In one of the least responsible comments, McKnight and Bailey (at 1) state that failure to eliminate the costly and unnecessary interlaced formats will cost consumers billions of dollars, and may in fact doom the whole enterprise to failure, saying Japan introduced an interlaced HDTV system which failed in the marketplace; Europe introduced an interlaced HDTV system which failed in the marketplace; and there is no reason to believe that the Grand Alliance standard will not meet a similar fate unless interlace is eliminated. McKnight further adds that the Commission will accelerate the abandonment of broadcast TV by including interlaced scanning.

Logic such as this could easily prove that pigs can fly! No informed observer of digital television developments believes that the presence of interlaced scanning is the cause of slow growth of analog HDTV. For example, the lack of programming is clearly the most

significant factor in the slow growth of HDTV in Japan, where years after introduction of the service, there is still only one channel available. And apart from the obvious hyperbole in these statements, they take no account of the rapid adoption in the U.S. and elsewhere of digital television systems that use interlaced scanning *exclusively*. Indeed, as we continue this endless debate, interlaced scanning is becoming entrenched here and around the world. Furthermore, it seems unlikely to us that McKnight and Bailey know more about what is needed to help preserve broadcast television than the collective voice of the entire terrestrial broadcast community that is united in its support for the proposed standard.

Other "experts" on this issue believe interlaced scanning must be banned for just the opposite reason. Compaq (at 16) says "[c]ommentators have cautioned that the inclusion of interlaced scanning will doom progressive scanning to extinction, despite the technical and economic advantages of progressive scanning. Compaq attributes this opinion to Delogne, but Delogne's paper does not make this assertion at all, but in fact compares the U.S. situation *favorably* to that in Europe *because* of the inclusion of progressive scan formats here. CICATS (at 12-13, A-5) makes an argument similar to Compaq's assertion.. Both parties also reference a similar statement made by William Schreiber in March, 1996, but his more moderate statement in these comments (Vol. I at 2, 4) is that the presence of interlaced scanning formats will inhibit the migration to progressive scan, although he does mention his earlier statement regarding "the danger that progressive scan will never be used if interlaced transmission is permitted." Schreiber also argues that including interlaced scan will eliminate the possibility for the system to be improved over time in a manner that does not make unusable much of the equipment first deployed, especially receivers in the hands of the public. And Demos (at 1-2) urges the Commission to forbid interlaced transmission formats, or else they'll get the Japanese interlaced standard for HDTV and the NTSC format for SDTV.

None of these allegations bears scrutiny. That they are repeated frequently, but not supported, does not make them true. In the first place, as we've explained, there will be a

tremendous amount of progressive scan transmission from the first day, if for no other reason than the fact that all film-originated material (all movies and 80% of prime time programming, including most commercials) will be transmitted in progressive scan. And we expect a great many video programs to be transmitted in progressive scan also. So any claim that interlace will cause the extinction of progressive is wrong on its face. We believe the industry will migrate toward more and more progressive scan transmission over time, but if we're wrong, and interlace transmission thrives, then presumably it would reflect real needs being met in the marketplace. And Schreiber's claim that including interlaced scanning will eliminate the possibility for the system to be improved over time without rendering first generation equipment useless does not bear scrutiny. We and many others have described in detail the unmatched extensibility given to the system through the use of packet headers and descriptors. This capability exists independently of any particular scanning format.

Microsoft (at 6) says that interlaced scanning and non-square pixels make the standard incompatible with computers. Microsoft (Mundie attachment at 7), along with Compaq (at 17) and CICATS (at 23), also claims that even if one computer unfriendly format is included, receiving equipment will need to perform additional conversions and decoding to enable interaction with computer applications. CICATS (at A-4) boldly estimates the aggregate cost of this conversion to consumers at \$85.6 billion, by assuming \$400 (!) for the cost of a quality de-interlacer, times 214 million receivers.

First, an absolute statement that including interlaced scanning formats makes the standard *incompatible* with computers is wrong on its face. Combination PC/TV products exist in the market today using analog NTSC technology. Interoperability with computers would be tremendously enhanced compared to these offerings even if the standard supported interlaced transmission formats exclusively, which of course it doesn't.

Second, for the next ten to fifteen years or so, every television using a progressive scan display will need to incorporate a de-interlacer in any event if for no other reason than

to receive and display NTSC transmissions during the simulcast period. Thus, at least one so-called "computer unfriendly" format is guaranteed.

Third, CICATS' estimated cost of a high-quality de-interlacer is grossly inflated. The Grand Alliance has developed detailed cost estimates for a range of ATSC DTV receivers that are representative of the products a manufacturer might include in its DTV product line.³⁹ As part of this analysis, the Grand Alliance estimates that the incremental parts cost of a high-quality de-interlacer in 1996 is \$28 to support a high-end receiver with a high-resolution 720-line progressive scan display, and \$2 to support a mid-line receiver with a 480-line progressive scan display. Applying Moore's Law⁴⁰ to reflect anticipated improvements in integrated circuit technology price/performance means the high-end receiver figure will be totally negligible by 2004 when substantial market penetration occurs. Thus, these parties' claims that expensive conversions required by the presence of any interlaced scanning format will render the standard incompatible with computers are groundless.⁴¹

Finally, although little more needs to be said, CICATS' estimate assumes that *every* TV in America will utilize a progressive scan display and therefore need a de-interlacer. We believe that a great many receivers with progressive scan displays will be sold for a variety of reasons, however, it's likely that there will also be a market for less costly models using interlaced displays.

CICATS (at 25, 27) further claims that off-shore manufacturers were primarily responsible for the decision to include interlaced scanning, and that including interlaced

³⁹See Reply Comments of the Grand Alliance, Fifth NPRM, August 12, 1996, at Appendix A.

⁴⁰Moore's Law predicts that the capabilities of integrated circuit technology will advance by a factor of two every 18 months. We use a more conservative assumption here, a factor of two every two years.

⁴¹Similarly, Polaroid's claim (at 2) that de-interlacing at home is either expensive or poor quality, and RPCP's contention (at 3) that interlace requires costly and complex signal processing to make text and fine-line computer graphics acceptable though still impaired to the human eye, are greatly overstated.

scanning will raise costs, making it harder for computer companies to compete against incumbent receiver manufacturers for whom the standard was tailored.

Once again, it is the Advisory Committee, and especially broadcasters, who defined the requirements for the ATSC DTV Standard, and the Advisory Committee recommendation reflects a strong and broad consensus among the parties directly involved in the provision of free over-the-air television, achieved only after years of debate on these very issues and others. Furthermore, we believe that the processing required to make these conversions will be incorporated in widely available integrated circuits at competitive prices from a variety of sources. These claims that the proposed standard puts computer companies at an unfair competitive disadvantage have no basis in fact.⁴²

William Schreiber (in his May 9, 1996 letter to the Commission), asserts that with the recent introduction of a progressive scan camera by Polaroid, "the last remaining argument for including an interlaced format in digital television has now been removed." Polaroid (at 2) and RPCP (at 4) make the same claim, while CICATS (at A-4) argues that this development negates the Grand Alliance's claim that an interlaced format is necessary for high-quality HDTV.⁴³

While the development of this camera, based on ATSC and SMPTE parameters, is a welcome technical achievement that will help facilitate even greater use of the progressive scan formats in the ATSC DTV standard, it in no way removes the fundamental tradeoffs between progressive and interlaced scanning that make each of them advantageous and desirable for certain

⁴²Having been misled, we believe, by detractors of the standard, CFA/MAP (at 4, 7) repeats this fallacy, saying that the inclusion of interlaced scanning effectively insulates incumbent TV receiver manufacturers from new competition. However, they also find it inconceivable that a solution cannot be found to convert interlaced to progressive and vice versa. Indeed, as shown above, they are absolutely right. Cost-effective means to perform these conversions are already in hand.

⁴³CICATS (at A-4) also states that Polaroid has introduced the world's first progressively scanned HDTV camera, the performance of which has been judged "superior to the 1080-line interlaced HDTV format in the [Advisory Committee] standard." This camera, developed by Polaroid, Philips/BTS, and MIT, though *not* the first progressive scan camera, offers performance characteristics that are greatly improved over earlier designs. CICATS' comparison of the camera to a transmission format is confusing, but assuming they mean interlaced cameras that output that format, their comparison is not based on independent, objective testing, but on the opinions of the justifiably proud developers of the new product. The marketplace will determine exactly how good this new product is for various applications.

applications and under certain conditions. For example, the existence of a progressive camera does not mean that such a camera exhibits the same level of low-light sensitivity as an interlaced camera, a performance aspect that is vitally important for Electronic News Gathering (ENG) use. More fundamental to the critical issue for this transmission standard, no camera development can influence the compression related impact of interlaced scanning, which presents the compression encoder with one-half the number of pixels to compress compared to a progressive scan format of the same temporal rate and the same number of vertical lines. While interlacing causes the well-known interline flicker artifact, it must also be considered that compressing twice as many pixels in a progressive scan format would result in other compression artifacts, typically increased blockiness and noise in the picture. It is by no means established that either of these data reduction approaches (i.e., interlacing or greater data compression) is consistently preferable to the other. In fact, ATTC test results from the first round of testing clearly show that each approach offers advantages with different types of picture material. For such reasons, the Grand Alliance decided upon the inclusion of both formats, so that each content producer and broadcaster (collectively, the marketplace) could select their preferred format.

Moreover, Schreiber totally ignores the fact that the interlaced and progressive formats do *not* have the same horizontal resolution. He states "However, in the case of ATV, we are talking about coded digital systems, in which the data rate for the P and I formats are the same. In that case, the 720-line P format will have the same resolution as the 1080-line I format, as well as freedom from all interlace artifacts." Recalling that the DTV formats he is referring to are 1280 x 720 and 1920 x 1080, even if we were to agree with Schreiber that the vertical resolution is identical (and we're not convinced it is), his statements do not account for the increased horizontal resolution and resulting increase in picture quality that is provided by 1920 horizontal pixels compared to 1280.

Schreiber also claims (Vol. I at 11) that progressive scan doesn't require more channel capacity, because higher correlation permits a *doubling* of the compression ratio so that the

same coded data rate is required for either scanning technique.⁴⁴ The references he attaches are not convincing, either because they proffer no such conclusion or because their results suggest different conclusions than they draw. In this case, we seem to have an existence proof that casts great doubt on his assertion. The Grand Alliance developers used every means possible within the MPEG-2 compression standard to get the best picture quality possible, and the 1080-interlaced format, presenting the encoder with 93.3 Mpixels/second (1920 x 1080 x 30 x 1.5 (a factor to reflect both luminance and chroma information)), and the 720-progressive format, presenting the encoder with 83.0 Mpixels/second (720 x 1280 x 60 x 1.5), delivered approximately equal quality, at least as judged by non-expert viewers subject to the quality limitations of the particular receivers utilized. At the maximum 19.3 Mbps payload of the transmission channel used for both formats, this means the encoder required .21 bits per pixel for the interlaced format, and .23 bits per pixel for the progressive format, i.e., the coding efficiency for progressive was about the same, or a bit less, but certainly not double that for interlaced. Indeed, if Schreiber's claim were true, we could transmit a 1080-line, 60 Hz, progressive scan format today within a 6 MHz terrestrial channel, and this tiresome debate would be over, at least for high-definition television. But we cannot, as he himself admits.⁴⁵

One further point merits mention. Retaining the SDTV interlaced formats in the ATSC Standard is important, because they provide compatibility with the prevalent digital video products and services available today, e.g., digital DBS, MMDS, DVD, cable and telephone company-delivered services. All of these products and services rely on MPEG-2 Main Profile at Main Level encoding, which includes 480-line interlaced capability, but not 480-line progressive.

⁴⁴Specifically, Schreiber (Vol. II, cover letter) claims that "[a] progressive-scan signal having the same frame rate as an interlaced signal, and the same number of lines/frame, and therefore having twice the analog bandwidth, when coded by MPEG, uses exactly the same data rate for compression."

⁴⁵See Reply Comments of William Schreiber, August 6, 1996, at 5. (Such capacity could be achieved, but only for "downtown" viewers, by using a multiresolution "layered" system in which receivers recover a variable amount of data depending on the signal quality.)

These debates about coding efficiencies, various coding artifacts and means to avoid them, measurable delivered resolution, and a host of other factors, have been going on for years and are likely to continue. The genius of the Grand Alliance system and the ATSC DTV Standard, is that it is inclusive. No broadcaster is obligated to use any particular format (although all 24 Hz transmission must be in progressive scan format). Rather, broadcasters will use the formats that best meet their needs. It is the marketplace, through competition and innovation, that will decide which formats are used for what purposes, and the Commission should not interfere with this process by banning interlaced transmission formats.

Several detractors of the standard, intentionally or unintentionally, continue to confuse transmission formats and display formats, e.g., BSA (at 6) says "[a]pproval of a *display* standard that permits use of interlaced technology would result in lower quality text and graphics making the product less useful and less appealing to consumers," and Microsoft (at 7, 8) says the FCC should be concerned about the quality of text and graphics *displayed* . . ., the Advisory Committee proposed standard also includes a 60 Hz *display* rate, and urges the FCC to adopt a 72 Hz *display* rate. Siggraph (Attachment) urges the Commission to mandate progressive-only *displays*, saying that to allow the interlace option is tantamount to eliminating the other options for our lifetime, since a cheaper, non-compatible standard is embraced and produced first. Demos (at 2) says the Advisory Committee standard is clearly biased toward display of all formats on 60 Hz interlaced displays, and that the Commission should forbid the use of interlaced display in all new digital television receivers.

As we have explained before, the inclusion of interlaced *transmission* formats does not preclude the use of progressive scan *displays* where deemed desirable. Receiver and converter deinterlacers that offer excellent performance at reasonable cost already exist in the marketplace and others are expected very soon. Siggraph is clearly mistaken that the existence of interlaced displays will eliminate the availability of progressive displays. Experience in both the computer and television industries proves otherwise, and numerous

television manufacturers have already announced their intention to offer progressive scan displays in their initial HDTV offerings. We strongly urge the Commission to reject the proposals of Siggraph and Demos to ban the use of interlaced displays in DTV receivers.⁴⁶ Such an action would deprive manufacturers and retailers of the ability to market a broad range of useful products and would eliminate valuable options for consumers. Limiting manufacturer and consumer options would also extend the transition to digital television and delay the return of valuable spectrum.

For all of these reasons, the Commission should not attempt to relitigate the complex debate surrounding progressive versus interlaced scanning, but should adopt the consensus approach developed over the course of several years in protracted discussions of these issues within the Advisory Committee and the ATSC. The Commission should adopt the ATSC DTV Standard in its entirety, including the four interlaced scan transmission formats, and should summarily reject proposals to require all DTV receivers to incorporate progressive scan displays.

C. Square Pixels

As part of their opposition to the proposed standard, several parties strongly object to the inclusion of non-square pixels in some of the SDTV formats.

Microsoft (at 7) says that the use of non-square pixels in two of the formats is a problem that contributes toward making the Advisory Committee standard incompatible with computers. Compaq (at 17) says that requiring both pixel formats will increase the complexity and costs of consumer equipment. CICATS (at A-6) claims that converting non-square pixel material adds costs and degrades picture quality, and that this may be good news for set manufacturers, but is bad news for consumers and those who want demand for convergent products to take off. CICATS (at A-8) says it will be much less expensive in the aggregate for broadcasters to make the conversion, and that equipment manufacturers'

⁴⁶Indeed, the computer companies whom Demos represents have long opposed government regulation of the performance or features of displays.

existing production standards may well have influenced the decision to include this enormously suboptimal feature in order to preserve the value of existing investments. RCPC (at 4) urges that all images be transmitted as square rasters, with any necessary production conversions taking place at the transmitting end, to be perfectly compatible with future display technologies such as light valve projectors and flat screens.

But as MECA explains (at 8-9), a non-square pixel SDTV format is necessary to provide backward compatibility, e.g., to enable the production of a montage digital television program where the producer chooses to include clips from old, non-square pixel NTSC programs. Consequently, to eliminate non-square pixels would restrict the creative options of future program producers and the program options of future viewers. Sony (at 3, 34) points out that the ITU-R-601 4:2:2 digital 525/625 studio origination standard was adopted almost 15 years ago, and the enormous reality of digital SDTV production -- in all 525 and 625 countries -- means that the non-square pixel SDTV format, based upon ITU-R-601 and the MPEG-2 standard, is vital to an orderly U.S. transition to digital SDTV transmission and must be maintained.

Thus, once again these complaints provide a stark example of how these commenters opposing the standard want every design decision made to maximize their narrow objectives, and seem oblivious to any impact on *television service*, or to the needs of broadcasters or any other affected industry. And even the alleged negative impacts on the narrow applications they do consider, as usual, are grossly exaggerated. No informed party in this debate believes that the inclusion of some non-square pixel formats is "enormously suboptimal," nor does it render a digital television system "incompatible" with computers.⁴⁷ And asserting

⁴⁷Although he favors square pixels, Schreiber (Vol. II at 5) says square pixels are less important to the computer industry than progressive scan, and it would not be the end of the world to permit the 480 x 704 SDTV format. Carroll (at 1) says that non-square pixels should be a self-liquidating temporary measure, provided only for backward compatibility at lower performance levels. This is the case. All of the HDTV formats use square pixels exclusively, but as explained above, some of the SDTV formats include non-square pixels to provide backward compatibility with existing 525/625 television standards.

that set manufacturers or anyone else would benefit from adding unnecessary costs to receivers is preposterous, and more so with each repetition.

Liberty Imaging (at 2) urges the Commission to add a square-pixel version of the 704 x 480 SDTV format, i.e., 848 x 480, saying that it will be very useful for defense and other government uses. In the ATSC and Advisory Committee deliberations that eventually led to the broad industry consensus on SDTV formats, careful consideration was given to a wide variety of needs, and multiple formats were included in order to support them. Many other formats, including this one, each having some useful application, were proposed and evaluated, but ultimately not included in the consensus list. Though Liberty's suggestion is well-intentioned, we believe that these needs can be accommodated fully within the included formats. We see no compelling reason to add additional SDTV formats at this late date.

For all of these reasons, the Commission should adopt the industry consensus embodied in the ATSC DTV Standard, including the SDTV formats that contain non-square pixels.

D. Refresh Rate

The same collection of computer companies and film makers objects to the picture refresh rates included in the ATSC DTV Standard.

CICATS (at *iii*, A-11) claims that by not permitting broadcasters to transmit at rates above 60 Hz, the Advisory Committee standard guarantees that every DTV broadcast will have to be converted in computer-compatible displays. Compaq (at 18) says picture rates of 30 and 60 Hz can be upconverted for display on computer monitors, but it requires costly additional processing power and degrades picture quality. Microsoft (6) and BSA (at 6) make similar complaints about the need for higher rates. Demos (at 1-2) urges the Commission to reject the obsolete 29.97, 30, 59.94, and 60 Hz frame rates, and also recommends 72 Hz as a more natural *display* rate.⁴⁸

⁴⁸Once again, CICATS (at A-11) states that existing manufacturing standards may have influenced the Grand Alliance's selection. This is silly. In the first place, the Advisory Committee, not the Grand Alliance,

Once again, these complaints demonstrate a myopic focus on the narrow DTV applications of interest to these parties, showing a complete disregard for any impact of their proposals on the ability to provide high-quality television service over 6 MHz terrestrial channels. Increasing transmission frame rates from 60 Hz to 72 Hz increases the pixel rate a video coder must handle by 20%, and this cannot be done without paying the piper somewhere else.⁴⁹ In the case of the highest resolution formats, this can only show up as a degradation in quality and it is a very substantial degradation indeed. And to claim that this is pure speculation, as CICATS and others do, is nonsense. Anyone who has ever built a digital video encoder knows otherwise.

To be sure, some cost will be involved in making personal computers capable of receiving DTV broadcasts (e.g., the cost of MPEG-2 and AC-3 decoders), just as it will involve added costs to make digital televisions capable of handling information services that go beyond traditional television services. But this doesn't mean that every television should be required to bear the cost of doubling as a computer monitor, nor that the quality of terrestrial broadcast television services should be sacrificed in order to make computers that handle DTV transmissions marginally less expensive.^{50,51}

recommended the standard. Beyond that, choice of a frame rate is a tradeoff between many factors, and for the primary application of broadcast television, 60 Hz is fully adequate. And as we explained in detail in our initial comments, transmission rates need not be the same as display rates, and those applications that require a higher display rate can easily make the necessary conversions. Indeed, Hitachi America (at 4) states that 60 Hz is appropriate for the transmission standard, but actual *display* rates are not limited by the standard, and Sony (at 26) explains that any refresh rate desired can be utilized in displays, noting that they have already marketed a 28", 16:9, 72 Hz, 1920 x 1080, progressive scan computer display.

⁴⁹As Sony points out (at 3, 26), the 60 Hz transmission rate ensures full resolution HDTV transmission through the narrow 6 MHz channel, but the critics of the 60 Hz refresh rate appear oblivious to the fundamental linear relationship between television frame rate and the bandwidth required to sustain that frame rate.

⁵⁰Carroll (at 3) says accommodating the desires of computer companies for a higher refresh rate is a tougher problem, and suggests that computers fall back to 60 Hz when displaying broadcast signals simultaneously with computer output. Schreiber (Vol. I at 10) first says that the computer industry's preference for 72 or 75 Hz is much harder to satisfy, that upconversion at the receiver is possible but expensive, and that it's too late to make fundamental changes. In his second submission (Vol. II at 1), however, he mentions including any frame rate that is a multiple of 12 as an improvement that could be made to the system. For the reasons outlined above, we do not agree that changing the frame rate to include any multiple of 12 would be an improvement to the system, but we certainly agree that it's too late to make fundamental changes, particularly such ill-advised changes.

⁵¹Thus, Demos' suggestion that the Commission regulate DTV receivers to require a 72 Hz display rate should be rejected. The Commission should not regulate the performance or features of displays, as the computer industry has long held.

On this issue the motion picture industry is again split. MPAA (at 7) says complaints about the 60 Hz transmission rate are unwarranted. However, the Film Makers Coalition (at 9) supports the 24 Hz refresh rate in the Advisory Committee proposal, but expresses concern regarding the 30 Hz and 60 Hz rates, fearing that broadcasters might use these rates with the 3-2 pulldown technique rather than the 24 Hz rate to transmit film.

The Film Makers should be reassured that broadcasters will always transmit motion pictures in progressive scan at a 24 Hz refresh rate. The 24 Hz rate was specifically included in the standard to take advantage of the fact that film is produced in 24 Hz and can therefore be sent at that low frame rate, yet displayed at higher rates in receivers, and the ATSC DTV Standard requires 24 Hz transmission to be progressive scan. An ATSC DTV encoder can automatically detect any material that was originally produced in film, including all movies and about 80% of all prime time television programming, and send that material using one of the 24 Hz, progressive scan formats. Broadcasters will be highly motivated to use 24 Hz progressive scan transmission for film-originated material, since it will allow them to save bandwidth which they could use to improve picture quality or to send auxiliary services.⁵² The 60 Hz rate, of course, is the rate for video, not film, and it will be used to carry live video and recorded video material.

In our initial comments (at 24-25) we discussed this issue from a broadcaster and regulatory perspective, from a television receiver perspective, and from a computer perspective, showing conclusively that the refresh rates included in the ATSC Standard are not a problem. The other comments strongly reinforce our conviction that the Commission should adopt the ATSC DTV Standard without requiring any modifications to the transmission picture refresh rates, and that the Commission should not impose any requirements whatsoever regarding the refresh rates of displays.

⁵²The 30 Hz rate, like the 24 Hz rate, is a film mode supported by the DTV standard. Television commercials are often shot in 30 Hz film. As with 24 Hz film, the system will automatically detect material originally produced in 30 Hz film and send that material using a 30 Hz progressive scan format.

E. Aspect Ratio

Some members of the motion picture industry and the coterie of computer industry complainers raise strong objections to the 16:9 aspect ratio incorporated in the proposed standard. Other members of the motion picture industry and most other parties staunchly defend 16:9.

Addressing the complaints, the Broadcasters (at 11-14) state that this flurry of dissatisfaction with the 16:9 aspect ratio comes late in the process, and reflects a disregard for the needs of the vast majority of television programming and the realities of set design. They state that 16:9 is the best choice, by far, and preferred around the world; that with screens of equal diagonal measurement 2:1 would be marginally better for the widest 20% of films, but would be worse than 16:9 for the remaining 80% of films and all other 16:9 or 4:3 television programming; and that for screens of equal height 2:1 would entail a 12.5% greater display area, which would mean 30-50% heavier TV sets, with greater weight and memory adding considerable cost to receivers.

The Grand Alliance (at 25-26), Thomson (at 12-13), and Zenith (at 11-12) add that changing the aspect ratio at this late date would increase costs to manufacturers and ultimately to consumers, and that sets with wider aspect ratios would be far more expensive. Sony (at 3, 31-32) explains that an aspect ratio must accommodate original 4:3 material, vintage motion pictures, and different widescreen formats, and still make displays affordable, and that 16:9 is an excellent choice to satisfy these multiple objectives.

Within the motion picture industry, MPAA (at 2, 4) supports the 16:9 aspect ratio, saying that it appears that a wider aspect ratio would represent a net loss to the public, both in terms of the cost of digital receivers and the overall amount of original material that can be displayed without panning and scanning or "letter boxing."⁵³

⁵³Universal Studios (at 2) endorses the MPAA comments with respect to the proper aspect ratio.

In contrast, the Film Makers Coalition (at *i*, 4) urges the Commission to require that broadcasters transmit all films in their original aspect ratios, and that if receiver standards are adopted, they should include a 2:1 aspect ratio. They argue (at 3, 5) that because the Advisory Committee proposal limits broadcasters to transmitting in 1.78:1 or 1.33 :1, widescreen feature films (at 1.85:1 and wider) would be *unable* to be viewed in their original formats. They claim that for films wider than 1.78:1, broadcasters would be forced to cut down the images to fit in the more narrow aspect ratio, and that this panning and scanning technique fundamentally alters the dramatic impact of widescreen images. Thus, under the proposed standard, they claim (at 7) that they must either produce images based on more narrow aspect ratios or acquiesce in the destruction of their work when displayed on DTV. As an example, they discuss how many apostles might be eliminated from Da Vinci's The Last Supper if cropping were used to accommodate poor choices of aspect ratio.

The claims that widescreen feature films would be *unable* to be viewed in their original aspect ratio, and that film makers must either use narrower aspect ratios or acquiesce in the destruction of their work, are simply wrong. Beginning with the first movie transmitted over DTV, films can be shown in any aspect ratio desired by the movie owner by using letterboxing in the film-to-video transfer process.⁵⁴ With 16:9 (1.78:1) widescreen receivers (the deeply embedded worldwide standard), this would require minimal black bands (4% of the screen height) for the 80% of movies that are produced with a 1.85:1 aspect ratio, and larger black bands (25% of the screen height) for the 20% of movies produced with a 2.4:1 aspect ratio. Indeed, after making all of these complaints, the Film Makers Coalition (at 6, fn. 8) casually mentions the letterboxing solution in a footnote.

Furthermore, until someone invents a receiver that changes its physical shape on demand, the only way to show *all* films in their original aspect ratio is to use letterboxing.

⁵⁴Schreiber (Vol. I at 10) states that a 2:1 aspect ratio is much too wide for much material that is used today, and that aspect ratios wider than 16:9 can be accommodated by the letterbox method. Carroll (at 3) says aspect ratio is not such a big issue, discussing windowing options that can be used to show video on squarish PCs.

However, this is strictly a matter for film owners and broadcasters to work out between themselves. If a film maker insists that his or her widescreen film be shown in its original aspect ratio, he or she can insist upon letterboxing rather than panning and scanning in any agreement reached concerning DTV broadcasts of that material. There is no valid reason for the Commission to interfere in such private negotiations.^{55,56}

Primes generally echoes the comments of the Film Makers Coalition, but further argues that 1.33:1 material is generally comparatively low resolution television, so it isn't as much of a problem to have side curtains and lower resolution on such material, and therefore, the aspect ratio should be weighted toward the wider media because wide material needs to be magnified and fill the screen and squarer NTSC material simply does not. But as the Broadcasters articulated in the comment noted above, Primes' proposal for a wider aspect ratio would be marginally better for the widest 20% of films, but would be worse for the remaining 80% of films and for all 16:9 HDTV and all 16:9 or 4:3 SDTV video programs. This is one more example where a complaint about the standard reflects a desire to satisfy one particular point of view without due regard for other important needs. The Advisory Committee's recommendation, by contrast, must and does provide a balanced solution to meet a wide variety of needs. In addition, the ATSC DTV Implementation Subcommittee is in the process of reviewing areas such as this to determine if Recommended Practices are warranted. We have invited cinematographers to participate in this activity, and are hopeful that they will offer their knowledge and perspective.

Compaq (at 18) and CICATS (at 25) argue that specifying only two aspect ratios is unnecessarily restrictive and ill-considered, and that the proposed standard is incompatible

⁵⁵The Film Makers Coalition (at 7) argues that a government requirement that film images be forced into an artificial aspect ratio is inconsistent with the Telecom Act and other important principles. Of course, no one is proposing anything of the sort. Film makers can produce in any aspect ratio they desire and can insist that their work be shown in its original aspect ratio, if they wish, by using letterboxing.

⁵⁶The Film Makers Coalition (at 6) also claims there is no flexibility in the standard -- present or future -- with respect to the aspect ratio. Once again, this is simply not true. Letter boxing provides complete flexibility from day one; and for the future, the ATSC DTV Standard would permit new aspect ratios to be incorporated by defining new packet identification headers in the transport system, however, such additions could not be made lightly, because of backward compatibility problems. See EIA/ATV Comments at 15.

with motion pictures and will perpetuate their adulteration.⁵⁷ CICATS (at 26) states "Because many films have wider picture aspect ratios than the two prescribed by the ACATS standard, presentation on DTV of many films . . . would require amputation of part of the filmed image -- losing as much as 45% of the image of a widescreen movie on a 4:3 screen and resulting in viewer confusion and impairment of artistic quality. . . . Such adulteration of one of our country's most vital art forms should be avoided." (footnotes omitted)

In the first place, the ATSC DTV Standard emphasizes the widescreen 16:9 aspect ratio, and uses it exclusively for all of the HDTV formats. (One of the primary reasons for including a 4:3 aspect ratio for SDTV formats is compatibility with 4:3 computer displays!) The availability of 16:9 aspect ratio formats alleviates the problem tremendously and is a substantial improvement over today's single choice of 4:3.

It is, in fact, the CICATS proposal that would wreak havoc with artistic considerations. If a wide variety of aspect ratios were transmitted without any established default transmission standard aspect ratio, each television receiver manufacturer would probably handle them differently: some would letterbox, some would "auto pan-and-scan" and some would crop arbitrarily. The result of the CICATS proposal would be complete loss of artistic control by the creative community. As CICATS notes in its Technical Details exhibit (at 4), "[w]hen these constraints are removed, then any aspect ratio image can be sent through the channel. It would then be up to the receiver to display what it can by either pan-and-scan or letterboxing, or a combination of the two."⁵⁸

Primes (at 7-8) states that deep within MPEG-2 there is a mechanism for viewers to watch panned and scanned versions of programs, and urges that this code be disabled, saying the public should not be given the choice to eliminate part of the picture.⁵⁹ Once again, this

⁵⁷Again, we find it remarkably inconsistent that Compaq and CICATS would vehemently criticize the proposed standard for supporting too many video formats, and at the same time criticize it for supporting too few aspect ratios.

⁵⁸Primes (at 7) also advocates not specifying an aspect ratio, but as explained above, we believe his recommendation would mean far *less* artistic control over the content consumers ultimately view.

⁵⁹Note that this MPEG provision is solely for the purpose of displaying a 16:9 picture on a 4:3 screen.

seems to be a request for the government to intervene *a priori* in negotiations between content owners and content deliverers. Such panned and scanned versions of programs will not exist unless the licenses granted by owners give broadcasters the right to show films in this format. This is a matter for film owners and broadcasters to resolve by themselves, but viewers should certainly not be deprived of the capability to choose if film makers agree to make choices available.

Given the great, genuine concern that film makers rightfully feel for maintaining the artistic integrity of their creations, we can't help but express again our puzzlement that some of them do not adamantly demand that any DTV standard *at least* ensure the availability of full HDTV resolution from day one of the transition to digital television. For the first time in history, HDTV offers them the ability to deliver to viewers in the home pictures with resolution comparable to that available in movie theaters. And although most ATSC members are not film makers, we would expect that conveying the full resolution of a picture would be at least as important as maintaining its full spatial extent in terms of preserving artistic integrity. Isn't it at least as important to see a tear in Jesus' eye as to see all twelve apostles?

We believe that the logical extension of the Film Makers' aspect ratio arguments to picture resolution would have them ask the Commission to impose a requirement that all movies be delivered in their full original *resolution*, i.e., in HDTV. While we would not endorse such a policy, we are amazed that some of them have chosen to embrace the unproven CICATS counterproposal -- a proposal that does not incorporate HDTV at all in the baseline FCC standard, but only promises HDTV in future enhancement layers if market demand develops and if doubtful, untested technical claims bear fruit. These members of the film industry seem to be swatting at the aspect ratio gnat, while swallowing the resolution camel!

For all of these reasons, we urge the Commission to adopt the ATSC DTV Standard, including the aspect ratios recommended by the Advisory Committee.⁶⁰

F. Need for a Data Broadcast Standard

As noted previously, several parties, including Intel (at 3), CICATS (at 17, A-12), and Compaq (at 21), express the need to ensure that the ATSC DTV Standard can deliver computer data, including executable code, but they intend to pursue this in appropriate industry groups and state that this work needn't postpone action to adopt a standard.⁶¹

In our initial comments we described the effort it has begun within ATSC to define a data broadcast standard, including our efforts to involve more members of the computer industry in this activity. Indeed, since that time, this ATSC working group, chaired by Intel, has held its first meeting and begun this important work to develop a supplement to the ATSC DTV Standard.⁶² While Intel does not support portions of the ATSC Standard, they have shown significant leadership by committing to work with the television industry on development of new standards and services. We are hopeful that other members of the computer industry will participate in this exciting area of development."

G. Interoperability with Other Delivery Media

In our initial comments we noted the significant investments and contributions of the cable industry throughout the Advisory Committee process to ensure the suitability of the standard for carriage over cable systems, saying that as a result we believe that as voluntary standards activities continue in the cable industry, and for other video delivery systems, it is

⁶⁰As Appendix B to these reply comments, we provide the Commission with Mark Schubert's very informative paper, "Searching for the Perfect Aspect Ratio" regarding the debate over the appropriate aspect ratio for advanced television displays. Although his paper focuses on the aspect ratio for *displays*, the historical information he includes and the analysis he provides give useful insight into the debate on the proper transmission format aspect ratio as well. His paper finds that there is no clear evidence of an aesthetic or physiological reason to choose any one display aspect ratio over another, and after noting several advantages of the 16:9 ratio, including the fact that it has been chosen and is in use around the world, he concludes that his research has found no compelling reason to change any existing choice of aspect ratio.

⁶¹Demos (at 8) also urges the Commission to refer the transport portion of the standard to a competent committee for additional work to provide error-free data delivery, while Hitachi America (at 7) highlights the flexibility provided by the ATSC DTV Standard for defining data services different than video services.

⁶²As we made clear in our initial comments, this type of supplemental standard need not be part of the basic DTV standard adopted by the Commission.

likely that many elements of the terrestrial ATV standard will also be incorporated in emerging standards in these industries. We further stated our belief 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.⁶³

The Broadcasters (at *iii*, 2, 24-32) take a different view, urging the Commission to take all steps necessary to ensure that the cable industry adopts the ATSC DTV Standard, or achieves maximum commonality with it, saying that in addition to adopting the terrestrial broadcast standard, other measures may be necessary to bolster consumer confidence that the sets they buy will be compatible with cable and other video transmission technologies. The Broadcasters describe in some detail the benefits they see flowing from intermedia compatibility forged by a common standard. They prefer a regulatory alternative whereby the Commission would require cable systems and other video distribution systems to adopt the DTV standard, but say that the next best, but far less preferable, alternative would be to require intermediate levels of commonality. They advocate specific requirements for various scenarios that will occur during and after the transition to DTV, and urge the Commission to adopt firm principles in this proceeding, but work out the details in a separate proceeding, so that expeditious licensing of DTV channels is not further delayed.

ABSOC (at 3) notes the importance that standards adopted for ATV and for other delivery media, including cable, satellite, and telecommunications networks, include a maximum degree of commonality, to ensure both interoperability and acceptable levels of cost to consumers and service providers. Similarly, Schreiber (Vol. II at 3) says the standard should discourage the proliferation of noncompliant receivers for cable, DBS and niche markets. Receivers for any new TV service should be usable for all new TV services.

⁶³The Grand Alliance (at 27) argues further that the ability of these other competitive delivery media to introduce compelling new technologies without FCC review and approval will continue to provide pressure to ensure that universal broadcast television service implements the technology required to remain responsive to consumer needs.

In contrast to the Broadcasters, most manufacturers favor relying on market forces, but note the benefits that rapid adoption of the ATSC terrestrial broadcast standard would provide for encouraging compatibility with other delivery media. For example, MECA (at 10-11) states that market forces will provide an incentive to non-broadcast industries to support the ATV Standard if it is promptly adopted, and urges the Commission to act rapidly before proprietary technologies become entrenched, while Dolby (at 4) argues that a strong FCC mandate for the ATSC DTV Standard would promote interoperability with other media.

The Grand Alliance (at *iii*, 26-27), Thomson (at 14), and MPAA (at 8) echo the view that as voluntary standards efforts continue for other video delivery media, it is likely that many elements of the terrestrial ATV standard will be incorporated in emerging standards in these industries. Zenith (at 13) and Thomson (at 14) state that the ATSC DTV Standard should provide the core of these other standards. General Instrument (at 8) notes that the ATSC standard is highly interoperable with non-broadcast transmission media without limiting the flexibility of those media. While 8 VSB modulation was selected for broadcast television, satellite systems employing the same digital audio and video compression will use QPSK, while cable TV is deploying 64 QAM and eventually 256 QAM. In this way, manufacturers can take advantage of maximum commonality of components without sacrificing the special benefits of different transmission media.

Zenith (at 13) states "[i]n light of the fact that approximately 60 percent of all television viewing in cable TV homes is of broadcast television stations, it is vital that the Commission assure that cable transmission and other video delivery methods are compatible with the broadcast DTV standard, i.e., that cable signals are compatible with ATSC-compliant receivers, based on known standards. Zenith adds that in the case of modulation, cable compatibility will be assured as consumer electronics manufacturers introduce cable-compatible DTV receivers that operate with both ATSC terrestrial 8-VSB and ATSC high-data-rate 16-VSB signals, and by Commission requirements that DTV signals on cable are to be "passed through" to the DTV receiver in ATSC-compliant 8-VSB or 16-VSB form.

Ultimately, Zenith believes, receivers and converters that perform both VSB and QAM demodulation may be feasible, but the cable industry needs to agree upon a single QAM approach.

EIA/ATV (at 16-17) argues persuasively that the rapid implementation of the broadcast ATV standard will create momentum that should facilitate the resolution of many technical issues without Commission intervention, and that DTV implementation should not be delayed pending resolution of all of the nettlesome cable interoperability issues. Once the ATSC DTV Standard is adopted and several additional minor steps have been taken, EIA/ATV believes that marketplace forces and the voluntary standards-setting process will foster resolution of the remaining issues.

Commenters in the cable industry oppose applying the standard to cable or other video delivery media. NCTA (at 12, Owen appendix at ¶38) argues strongly that the Commission need not become involved in assuring compatibility between digital broadcast standards and digital standards for cable and other delivery media. NCTA argues that while the standard may *work* on cable and other media, there is no reason to believe it is optimal for the public, the vast majority of whom receive video by means other than terrestrial broadcast.

TCI (at 3) states that imposition of the ATSC standard would be especially ill-advised for non-broadcast multi-channel video program distributors (MVPDs), and that TCI and other MVPDs have invested billions of dollars in state-of-the-art digital technologies that would be undermined by a government-imposed digital broadcast standard. TCI (at 20) notes that even if different transmission standards are employed by broadcasters and cable, if all new digital receivers can receive both broadcast and cable digital transmissions, or if subscribers can use set-top boxes to receive cable transmissions, consumers need not be concerned about being stranded, noting that CableLabs has patented a hybrid VSB-QAM demodulator that could be built into digital TV receivers for an incremental cost of approximately \$15.

Similarly, Pacific Telesis (at 1) opposes any extension of the "Grand Alliance" DTV standards or application of any required transmission standards to new video technologies such as MMDS.

In light of all of these comments and the complicated issues surrounding compatibility with cable and other delivery media, we agree with those parties who believe that the best possible course for the Commission is to promote the resolution of these compatibility concerns by swiftly adopting the ATSC DTV Standard for terrestrial broadcast service.⁶⁴

VII. The Commission Should Not Impose Receiver Requirements

The Broadcasters (at *iii-iv*, 32) urge the Commission to adopt receiver standards as are necessary to ensure that consumers can choose equipment that matches at the receiving end the performance levels the standard promises at the transmitting end. They state that sets must receive all formats and reject interference, and must live up to the performance capabilities of the Grand Alliance prototype system, and that the Commission has the authority to impose such requirements. Island Broadcasting (at 3) urges the Commission to require receiver designs that will maximize protection to adjacent NTSC channels from DTV channels.

A. The Commission Need Not Adopt an All-Format Receiver Requirement

In our initial comments, noting the significant amount of HDTV programming that broadcasters intend to provide, we stated that it would be foolhardy for any manufacturer to offer digital sets in the marketplace that go dark for any programming, much less a

⁶⁴TelQuest (at 4-5) disagrees that the ATSC standard is suitably interoperable with other video delivery systems, and urges the Commission not to mandate a modulation scheme for terrestrial broadcast service, but let the industry develop a single modulation scheme other than VSB. The Commission should reject this suggestion. As explained by General Instrument in the passage quoted above, different modulation schemes are appropriate for different applications. The VSB modulation scheme was incorporated in the Advisory Committee's recommendation because it best met the needs for terrestrial broadcast service. There is no reason to think that "the industry" should, could or would adopt a single modulation scheme for all video delivery media.

substantial amount of broadcast programming. Consequently, we said, digital receivers will have all-format reception capability with or without any government mandate to do so.

EIA/ATV (at 18-19) argues that nowhere in its final report did the Advisory Committee Technical Subgroup advocate an all-format requirement, that the FCC lacks authority to impose such a requirement, and that it is unnecessary in any event, because the marketplace will ensure a robust market for digital receivers and converters capable of receiving all DTV formats. MECA (at 11-12) similarly argues that with a transmission standard in place, a receiver standard is not required, and that market forces will ensure that receivers support all formats. They see a fundamental difference in that broadcasters specifically asked the Commission to adopt a standard, but manufacturers did not. Zenith (at 4) and Thomson (at 15) say a requirement is unnecessary, while General Instrument (at 4, fn. 2) argues that receiver requirements can and should be left to the marketplace. The Grand Alliance (at *iii*, 28) says all-format capability will be offered without any government mandate to do so, and the Commission need not and should not impose such a requirement.

Hitachi America (at 8-9) believes that the capability is essential and that all consumer electronics manufacturers will recognize this and act accordingly, but if not, the FCC may need to take steps. Tektronix (at 4) supports such a requirement, i.e., that all DTV receivers and set-top boxes be required to provide picture and sound from any of the DTV formats, arguing that it will do no harm.

ITI (at 3) urges the Commission to adopt a requirement that all DTV receivers receive, but not display, all formats. However, Intel (at 9, fn. 5) opposes a requirement that only all-format receivers be used, saying "If a computer equipped with a TV tuner were considered a receiver, which Intel believes is not the case, the Commission would be doing a great disservice to the computer user by first selecting several formats not suitable for computer display and then forcing the consumer to buy an expensive device that attempts to correct the problem."

After reviewing these comments we remain convinced that manufacturers will be amply motivated by marketplace forces to provide all-format reception capability, with or without any government mandate to do so.

B. The Commission Should Not Impose Other Receiver Requirements

In addition to the Broadcasters, AFCCE (at 2) supports further requirements on ATV receivers, including minimum requirements for such characteristics as noise figures, equalizer range, and adjacent channel signal immunity, among others, so that the planning factors on which channel allotments are based will result in the best possible service to the public. Carroll (at 7-8) says there is no reason to tolerate bad receiver design for an instant.

MCEA (at *i*, 5) urges the Commission to avoid establishing performance standards for receivers, and MECA (at 12) says there clearly is no need for such requirements. Tektronix (at 4) argues that quality standards should be the subject of voluntary industry standards. The Grand Alliance (at 28) states that if it is determined that any minimum performance levels need to be established for DTV receivers, they should be the subject of voluntary industry standards, just as they have been with the current analog system for many years.

In our initial comments (at *iii*, 29) we explained that the ATSC Implementation Subcommittee, consisting of broadcasters, receiver manufacturers, and others, is examining the need for such requirements related to the reception performance of receivers, and that if they are deemed necessary, we will work with the Consumer Electronics Manufacturers Association to develop such standards, but that such considerations need not and must not delay the adoption of a standard, whether such standards are voluntary or become the subject of FCC regulations.⁶⁵ Considering all of the comments, we remain convinced that this is the best course to pursue. Accordingly, we urge the Commission not to adopt any performance standards for receivers at this time.

⁶⁵Thomson (at 15) and Zenith (at 15) endorse this position, but they believe that any such standards should definitely be voluntary.

Regarding other potential receiver requirements, Siggraph urges the Commission to adopt progressive scan as the one acceptable method of *display*. Microsoft (at 7-8) asks the Commission to require that text and graphics *displayed* on a DTV meet the requirements for text and graphics currently in use for computers, and to incorporate a 72 Hz *display* rate, yet CICATS (at 22) says it does not want the Commission to mandate *display* standards. And Demos (at 2) (the architect of the CICATS counterproposal) urges the FCC to forbid the use of interlaced displays in all new digital television receivers. Intel (at 9) opposes all receiver requirements beyond those necessary to prevent cross-interference between equipment, and PCUBE (at 4) urges the Commission not to mandate any receiver requirements.

With respect to displays, we strongly urge the Commission not to impose any requirements whatsoever, a position that the computer industry has held for many years. Any such requirements would interfere unnecessarily with the competitive market for receivers and would deprive consumers of valuable options and increase prices.

VIII. Rapid Adoption of the Standard Will Promote International Trade

In our initial comments we highlighted the efforts within the Advisory Committee to promote international compatibility of the standard, and stressed the benefits of promoting use of the standard around the world, concluding that the most important thing the Commission could do to facilitate international compatibility and promote export opportunities is to adopt the ATSC DTV Standard as rapidly as possible.⁶⁶ The other comments on this topic strongly support these conclusions.

NTIA (at 1-2) explains that "[a]doption of a digital transmission standard promises to spur the American economy in terms of manufacturing, trade, technological development and international investment -- including job growth," and "will provide U.S. industry an

⁶⁶We also described recent changes in the charter of ATSC to facilitate our ability to promote the adoption and use of the ATSC DTV Standard in other countries, noting that our efforts encounter the obvious obstacle that the standard has not yet been adopted for terrestrial television in the United States.

opportunity to regain a larger share of the world's consumer electronics market." NTIA (at 2-3) also describes the growing momentum of DVB, and the likely negative impact if the U.S. government delays or forgoes adoption of the standard, saying "[t]he Commission must act rapidly to ensure that American industry and consumers are able to fully capitalize on the years of hard work that have gone into the development of a new advanced television system. If we fail to act now, the window of opportunity may be closed by the success of competing foreign standards."

OSTP (at 1-3) calls attention to the ever-diminishing "window of opportunity" for the U.S. to define a worldwide standard, describes the threat that inaction will leave the field to DVB, and gives a powerful recitation of the global economic benefits that will flow to the U.S. by prompt adoption of the standard, but will be drawn away by foreign competitors if the Commission fails to act rapidly.

The Broadcasters (at 7), Thomson (at 16), Zenith (at 15-16), and the Grand Alliance (at *iv*, 29-30) all echo the view that the most important thing the Commission can do to promote international trade is to adopt the ATSC DTV Standard as swiftly as possible. Philips (at *v*, 16) sees America on the brink of relinquishing its lead to international competitors, and asks whether the U.S. will become an exporter of DTV and its spin-off technologies, or become an importer of an inferior foreign standard. Philips (at *v-vi*) and Thomson (at 2) stress the importance of adopting a standard for preserving and creating jobs for American workers. Citizens for HDTV (at 12) reiterates these concerns, noting that the European Commission has already issued a binding directive that a single digital transmission standard (DVB) will be used in cable and DBS, and a similar directive is expected soon for terrestrial broadcasts.⁶⁷

⁶⁷See also, Reply Comments of the North American National Broadcasters Association, August 9, 1996, saying that further delay in establishing a standard will only hurt North America's ability to participate optimally in the benefits of leadership associated with digital transition.

General Instrument (at 8-11) summarizes the history of the international trade aspects of the HDTV proceeding, and urges the Commission to help ensure that the standard is finalized expeditiously, promoted first throughout North America and then in South America and Asia, and supported in specific cases where DVB, although inferior to the ATSC Standard, is making crucial inroads.

Sony (at 11-12) argues powerfully that a critical issue of American leadership is at stake, and that a mandated standard is essential. Dolby (at 4) observes that a small delay can be explained, but failure to mandate a standard could soon cripple efforts to export the ATSC standard. Universal Studios (at 2) notes that by incorporating the standard in its rules, the FCC will lay the foundation for enhancing the position of U.S. program producers, and MPAA (at 8) argues that the standard will facilitate international program exchange.⁶⁸

All of these comments demonstrate conclusively that the rapid adoption of the ATSC DTV Standard will promote international trade and improve our nation's international competitiveness, spurring economic growth and the creation and preservation of high-paying jobs for Americans.

IX. Conclusion

As these reply comments have amply demonstrated, none of arguments against adopting a complete standard, and none of the complaints raised against the ATSC DTV Standard in particular, and certainly not the CICATS counterproposal, nor anything else in

⁶⁸A few parties to this proceeding have embraced the mistaken notion that adopting the ATSC Standard would somehow help our foreign trading partners at the expense of Americans. For example, the American Homeowners Foundation (at 2) says that more jobs for American homeowners will be created by policies that increase the U.S. demand for computers than will be created by policies that increase demand for TVs, since more demand for the latter mostly creates jobs for workers of our trading partners. This type of strained, convoluted comment arises out of erroneous and misleading statements made by some members of the computer industry with respect to interoperability issues. The Commission's goal is not and should not be to handicap one industry against another, nor would any of the interoperability issues in this proceeding have that effect, contrary to the assertions of some. The Commission's primary purpose in this proceeding is to oversee the upgrading of free over-the-air television, and to ensure that a competitive marketplace operates to give consumers cost-effective options for accessing that service, including the option to buy a low-cost, basic TV, a more expensive top-of-the-line TV, or a combined PC/TV product.

the voluminous comments on the NPRM provides a sound basis for changing the Commission's tentative decision to adopt the ATSC DTV Standard as the single standard for use by digital broadcast television licensees. In fact, this thorough analysis of the comments demonstrates conclusively that the Commission should fully embrace the recommendation of its Advisory Committee and adopt the ATSC DTV Standard in its entirety. By so doing, the Commission will unleash a flurry of investment within the involved industries that will support a rapid

implementation of digital broadcast television, quickly bringing the fruits of this beneficial new technology to the American public and beyond.

Accordingly, the Commission should adopt the ATSC DTV Standard for terrestrial broadcast transmission as rapidly as possible.

Respectfully submitted,

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APPENDIX A: CICATS MPEG COMPLIANCE ISSUES

A. Fundamental violations of the MPEG standard (and some discussion of consequences):

- 1) Temporal level enhancements, which are proposed by CICATS to be sent in a pure B-frame bit stream, are incompatible with the MPEG standard. It is also not clear how the CICATS system identifies where the temporal enhancement B-frames belong in the image sequence.
- 2) Spatial enhancements, as proposed by CICATS, are incompatible with the MPEG standard. As we understand the CICATS system, it requires more expensive interpolation filters. CICATS' interframe coding of enhancement information requires more precision and dynamic range than MPEG spatial scalability.
- 3) CICATS would prohibit interlace scan, frame rates of 23.976, 29.97, 30, 59.94, and 60 Hz, and non-square pixel formats at 4:3 and 16:9, all of which exist in MPEG and are embodied in currently available video products purchased by consumers. *CICATS receivers and converters would be unable to receive every known bit of digital TV that is currently transmitted in the U.S. via satellite, cable, MMDS, DVD or telephone company video delivery systems.*

- 4) B-frames are disallowed in the CICATS base level. This necessarily limits encoder flexibility in facilitating reduced-cost decoding of the base level. Prohibition of B-frames also limits options for support of necessary consumer VCR functions, including extraction of subsets of the video data for trick play functions. The restriction should be particularly onerous to computer CPU-based decoders, since it removes a number of options for graceful decoder degradation. In addition, it is well-accepted that the inclusion of B-frames provides higher quality images for a given bit rate. This is especially true for more critical video sequences.¹
- 5) No maximum bit rates are specified. Clearly specified maximum bit rates are needed to ensure interoperability.
- 6) CICATS requires that film color primaries must be supported, in contrast to MPEG's support of video color primaries. Since the video transmitted is not intended for film transfer, this would seem to be an unnecessary burden on receivers.
- 7) CICATS appears to require display functions (e.g., overlay capability) that will add cost.
- 8) The CICATS system is poorly specified, with ambiguities and missing information. This stands in sharp contrast to the formal specifications of the MPEG and ATSC Standards. The MPEG standard (and its ATSC derivative) also had the benefit of dozens of the world's experts on video compression

¹"Performance Evaluation of MPEG-2 Video Coding for HDTV," Daniel Lauzon, Andre Vincent and Limin Wang, Communications Research Centre, IEEE Transactions on Broadcasting, June, 1996.

checking each others' work and documentation, including interoperability experiments and objective quality experiments.

B. Violations of any currently defined MPEG profile or level:

- 1) The only frame rates allowed in any currently defined MPEG profile or level are 24, 25, 30, 50, and 60 Hz (and the 23.976, 29.97, and 59.94 Hz “TV-rate” variations). Thus, the 72 Hz and even the 36 Hz CICATS base level formats are not compliant with any existing MPEG-2 profile or level.
- 2) CICATS allows up to 2048 horizontal pixels, whereas the MPEG-allowed maximum is 1920.
- 3) The CICATS base level specifies a 1 Mbit channel buffer. This is too small to permit high quality video decoding. MPEG-2 MP@ML specifies a 1.835 Mbit channel buffer, which is at least 4.4 bits/pixel, but CICATS only allows 1.9 bits/pixel. We note that this issue of channel buffer size can easily be overlooked in simulation. Had DemoGraFX implemented its system in real-time hardware, the situation would have become apparent.

C. Violations of MPEG Main Profile and Main Level:

- 1) MPEG MP@ML specifies a maximum pixel rate of 10.368 Mpixels/second. CICATS allows up to 18.88 Mpixels/second in the base level. CICATS claims that there are MPEG-2 MP@ML decoders that "will go as fast as 20 Mpixels/second or more". We have been unable to find any.

- 2) The CICATS base level can have a horizontal pixel count as high 1024, but the corresponding MPEG-2 MP@ML limit is 720.