video display formats was "partly political," intended to end debate among the four contenders "without jeopardizing the unified system."[33]

And in the process, consideration of the economic consequences to consumers was given short-shrift.[34] Once mandated, the costs of an ill-advised government standard are likely to remain for some time.

D. Voluntary Industry Standards Are Superior Because They Reflect Consumer Quality and Cost Judgments.

Reliance on market forces to establish standards not only avoids the costs of a government-mandated standard, but has independent advantages.[35] Most importantly, it allows the market (*i.e.*, consumers) to weigh the quality of a product against its costs, and it yields better information concerning production

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[33] Martin Levine, "HDTV's Grand Alliance: High-Definition Television", *Video Magazine* (August 1993) at 34.

[34] *See* Section IV A below for a discussion of the impact of the ACATS standard on consumers.

[35] The Commission has implied reliance on voluntary industry standards poses the risk that no standard will emerge. *See* Fifth NPRM at ¶ 32. This risk, however, is minimal. As reflected in these Comments and noted in the Fifth NPRM, there has been widespread discussion of and information exchanged among interested parties concerning ATV standards. This has lead to widespread agreement on many components of an ATV standard. Fifth NPRM at ¶ 31. The Commission's plan to eliminate NTSC transmissions will motivate industry coalescence on the remaining components and will stimulate consumer demand for digital television products, for both the broadcaster and the consumer, which might otherwise be lacking. Thus, elements conducive to the development of industry standards are present. *See* Besen & Johnson at 129. Moreover, the stimulated consumer demand for digital television products distinguishes this case from the *AM Stereo Proceeding, AM Stereophonic Broadcasting*, 3 FCC Rcd 403 (1988), in which the Commission refused to adopt technical standards for AM stereo and the product never took off. Consumers simply did not want to pay additional costs to receive AM stereo sound, and the market reflected the lack of demand for this product. *See* "Economic Considerations", Exhibit D hereto (noting the market for advanced television may be quite small if consumers perceive the benefits to be limited and the price to be quite steep). Unlike the AM case, once NTSC transmissions are ended, consumers will need to upgrade their television equipment (either by set-top devices or new digital receivers) to receive *any* broadcast television.

costs, and the inevitable tradeoffs between the cost and quality of the product, all of which have been minimized, if not virtually ignored in the proceedings to date.

Finally, the market can be relied upon to push consumer acceptance of a new technological standard as producers compete to capture the new demand, keeping early prices low, and helping establish acceptance of the new technology and products that incorporate that technology.[36]

As a threshold matter, the Commission should carefully weigh all the benefits of a voluntary standard against the serious costs of a mandated one, particularly one as restrictive as the ACATS standard.

II. The ACATS Standard Is Seriously Flawed.

If the Commission determines that adoption of a DTV standard would serve the public interest and create benefits that outweigh its costs, it should *not* adopt the ACATS standard. While certain components of the ACATS standard are noteworthy and well considered, other components are at best inadvisable and at worst inimical to the growth of Advanced Television and the services it could promote.

The ACATS standard comprises five components: video coding, audio coding, packetized data transport, RF/transmission, and a menu of video formats.[37] Of these components, only the 18 video formats would create

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[36] Joseph Farrell and Carl Shapiro, "Standard Setting in High-Definition Television", *Brookings Papers: Microeconomics* (1992) ("Farrell & Shapiro") at 28.

[37] *See* Fifth NPRM at ¶¶ 8-18.

material technological difficulties for the computer and software industries; therefore, if the Commission resolves to adopt a DTV broadcast standard, the members of CICATS would not oppose adoption of the proposed non-video-format components.[38]

The linchpin of the ACATS standard is the MPEG-2 video compression and transport standard created by the Moving Picture Experts Group of the International Organization for Standardization -- a non-government group.[39] MPEG-2 is a substantially satisfactory basis on which to plan and implement the interaction of computers and digital broadcasting that CICATS's members envision.[40]

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[38] The only caveats to this general statement, which will be explained in greater detail in exhibit to these comments, are that a more effective bit error correction mechanism should be include to facilitate more accurate data transmission, and a relatively minor adjustment should be made to the MPEG-2 compression and transport protocol to improve its ability to facilitate scalability or "layering" of data, *e.g.*, for enhancements, such as higher resolution pictures. A.R. Smith, *et. al*, "Technical Details of the CICATS Proposed Base-Line Format" ("CICATS Technical Details"), Exhibit B hereto, at 8-9. Neither of these adjustments would require delay in adoption of a standard. Bit error correction can be developed by the industry following adoption of the standard, though CICATS would urge the Commission to prescribe a procedure and deadline for its inclusion in the standard in the course of this proceeding. The "CICATS Technical Details", Exhibit B hereto, at 2-3, explains the manner in which MPEG-2 can be modified to permit scalability of data, and this modification can and should be incorporated in the standard if one is adopted. Others in the scientific community have endorsed similar methods of data enhancement. *See, e.g.*, William F. Schreiber, "Advanced Television Systems for Terrestrial Broadcasting: Some Problems and Some Proposed Solutions" (rev. December 22, 1994), *reprinted in Proceedings of the Institute of Electrical and Electronics Engineers,* vol. 83, no. 6 (June, 1995) ("Proposed Solutions"), Exhibit H hereto, at 958; Gary Demos, "Temporal and Resolution Layering in Advanced Television" (November 22, 1995) ("Demos Paper"), Exhibit I hereto; *Advanced Television Systems and Their Impact on the Existing Television Broadcast Service*, MM Docket No. 87-268, Tentative Decision and Further Notice of Inquiry, 3 FCC Rcd 6520 (released Sept. 1, 1988) at ¶¶ 29-35.

[39] *See* Fifth NPRM at ¶ 13 & n.10.

[40] "CICATS Technical Details", Exhibit B hereto, at 9; Demos Paper, Exhibit I hereto.

In sharp contrast, adoption of the 18 proposed video formats would create formidable compatibility barriers between digital broadcasters and the computer and software industries, result in excessive consumer costs, and arrest technological development. In short, adoption of a standard containing the 18 proposed video formats would:

- cost consumers more (*tens of billions more* per year) for receiving equipment than the minimum base-line format proposed by CICATS in these Comments;[41]
- result in a qualitatively inferior product;
- limit high-value job growth in the computer and software industries; and
- restrict the development of advanced applications for digital broadcasting technology, particularly applications involving computer technology, such as interactive educational programming [42]

The proposed 18 video formats have three principal failings: They incorporate inferior technology; they are overly complex and detailed; and they obstruct compatibility with computers. If the ACATS standard is adopted, these failings will impose billions of dollars of unnecessary costs on consumers transitioning to DTV

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[41] *See* S. Gabriel, "Cost Comparison of ACATS and CICATS Set-Top Converters, Receivers and PC Decoders" ("Cost Comparisons"), Exhibit C hereto (comparing the cost of set-top converter boxes, television receivers, and PC/TVs built to accommodate full ACATS standard with the costs of corresponding equipment built to accommodate the CICATS base-line standard)

[42] Stearns Written Testimony, Exhibit E hereto, at 5; Written Testimony of Craig Mundie (Microsoft Corporation) before the Senate Committee on Commerce, Science, and Transportation (June 20, 1996) ("Mundie Written Testimony"), Exhibit J hereto, at 7

A. The ACATS Video Formats Incorporate Flawed Technology.

Several of the 18 video formats ACATS proposes incorporate interlaced scanning and prescribed picture aspect ratios, which are technologically inferior to available alternatives and unnecessarily restrictive. Non-square pixel spacing, 30 Hz and 60 Hz picture rates (and, should it survive obsolescence) interlaced scanning are incompatible with computer applications and should therefore be excluded from any standard that the Commission chooses to adopt.

1. Interlaced Scanning.

Of the 18 proposed video formats, four incorporate interlaced, rather than progressive scanning. Interlaced scanning was developed over 50 years ago, and is indisputably inferior to progressive scanning, as the scientific community,[43] the computer and software industries,[44] the American Broadcasting Company television network,[45] ACATS,[46] and the Commission have

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[43] Eric Petajan, "A Video Compression Efficiency Analysis Using Progressive and Interlaced Scanning" (AT&T Bell Laboratories), Exhibit K hereto; William F. Schreiber (Professor of Electrical Engineering, Emeritus, MIT), Comments on Fifth Further Notice of Proposed Rule Making, MM Docket No. 87-268 (submitted June 24, 1996) ("Schreiber Comments"); Delogne Study, Exhibit G hereto; Philippe Guillotel (Thomson Multimedia R&D France) & Stephane Pigeon (Universite Catholique de Louvain), "Progressive versus Interlaced Coding," Exhibit L hereto, at 1 ("progressive pictures have higher vertical resolution, seem much more attractive than interlace for signal processing, and guarantee the compatibility with other multimedia applications").

[44] Stearns Written Testimony Exhibit E hereto; Mundie Written Testimony, Exhibit J hereto, at 5; *see* Tasker Testimony, Tr. 226-227.

[45] "ABC Believes Progressive Scanning HDTV Will Be Cheaper, Better," *Communications Daily* (June 7, 1996) at 3-4.

[46] ACATS Final Report at 14 ("A critical aspect of the scanning format scheme, unanimously recommended by the Technical Subgroup, is the availability of progressive scanning and square pixels.").

acknowledged. Although the Grand Alliance has defended interlaced scanning in earlier submissions in this proceeding, its arguments in favor of interlaced are not credible, as demonstrated below. Further detail concerning the failings of interlaced scanning are provided in Exhibit A hereto, "Technical Flaws with ACATS Standard."

When the Commission initiated this proceeding in 1987,[47] technology was markedly less sophisticated than it is today Still, the Commission recognized the failings of interlaced scanning. The continued inclusion of interlaced scanning in the National Television System Committee ("NTSC") broadcast television standard originally adopted in 1941 prompted the Commission to find that the NTSC standard

> reflects the technological limits of the early days of television development, and is perceived today as limited in video quality and audio fidelity. More importantly, it no longer represents the limits of the present and anticipated future technological possibilities in the home video delivery service. . . . [T]he NTSC standard still suffers from a number of defects that are inherent in its design . . . [[48]]

The Commission recognized *nine* years ago that progressive scanning, which it described as a "simple technique," would correct the foregoing problems.[49] At that time, technology was not sufficiently advanced to make

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[47] *Advanced Television Systems and Their Impact on the Existing Television Broadcast Service*, MM Docket No. 87-268, Notice of Inquiry, 2 FCC Rcd 5125 (released August 20, 1987) ("NOI").

[48] NOI at 5126, ¶ 6.

[49] NOI at 5127, ¶ 22.

progressive scanning an immediate and practical, cost-effective option. It is now, and it should therefore be the only scanning method incorporated in a DTV standard. Progressive scanning produces a higher vertical resolution and makes more efficient use of spectrum than interlaced scanning because it "gives the maximum technical image and sound quality for a given data rate" and allows the simultaneous transmission of more programming than interlaced scanning using the same bandwidth.[50]

It is unclear why the ACATS standard includes interlaced scanning, given the near-universal acknowledgment that progressive scanning is far superior. One explanation (advanced by ACATS) is that existing technology is insufficient to use the spectrum bandwidth allocated to each broadcaster for DTV to carry a progressively scanned, 1000+-line HDTV picture with a picture rate of 60 Hz, and ACATS believed that the standard should include a 60 Hz HDTV video format with more than 1000 lines.[51] Interlaced scanning may therefore have been incorporated in the ACATS standards to allow a 1080-line 60 Hz format. Despite its inclusion, ACATS has indicated a desire to migrate that format to progressive scanning when possible.[52]

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[50] Schreiber Reply, Exhibit F hereto, at 4, 8.

[51] ACATS Final Report at 14. CICATS believes that the ACATS 1080-line picture was unnecessary. According to Professor Schreiber of MIT, a 720-line progressively scanned picture will have equal or better resolution than a 1080-line interlaced picture, and will omit the other picture "artifacts" (imperfections) interlaced causes. Schreiber Reply, Exhibit F hereto, at 6. Since the ACATS standard includes a 720-line 60P video format, it seems unnecessary to have included a 1080-line interlaced format.

[52] ACATS Final Report at 14.

Professor Schreiber has explained that the ACATS standard includes interlaced scanning because "most of the attendees at most of the many HDTV meetings [he] attended have had, in effect, closed minds:"[53]

> This came about because they attended as employees of interested corporations. Their views were therefore dictated by their employer's current opinions, right or wrong, about what standards would be in that company's interest. I rarely saw anyone openly change his mind in any way as a result of discussions at these meetings

The Grand Alliance has attempted to justify the inclusion of interlaced scanning in its standard by disputing its interference with computer compatibility, even while admitting that "progressive scanning is the better mode for text and graphics."[54] The Grand Alliance's justifications for interlaced scanning are misleading, if not incorrect.

For example, the Grand Alliance incorrectly alleges that the computer industry "wish[es] to mandate progressive scan transmissions and displays -- a requirement that would force *all* consumers to bear the greater cost of a progressive scan display."[55] This claim is wrong on several counts.

First, the computer industry, as represented by CICATS, does *not* want to mandate display standards *or* transmission standards, but if a transmission

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53 Letter from Professor William F. Schreiber (Professor of Electrical Engineering, Emeritus, MIT) to Hon. Reed E. Hundt, transmitting Informal Reply Comments (March 11, 1996) ("Schreiber Letter"), Exhibit M hereto

54 Grand Alliance Reply at 41

55 Grand Alliance Reply at 41, n.58.

standard is mandated, the computer industry believes that it should be exclusively progressive.

Second, and far more importantly, if the transmission standard were all-progressive, consumers would pay less, not more (as the Grand Alliance claims), for receivers, because converting a progressive signal to an interlaced display (as in legacy NTSC receivers) is relatively simple and therefore inexpensive, while converting an interlaced signal to a progressive display (the display used on *all* computer monitors) is significantly more complicated and therefore more expensive. Moreover, interlaced programming can be converted to a progressive signal at television stations, rather than in progressive-scanned receivers, in which event "the converter cost would be negligible compared with the cost of the equipment required to enable any ATV transmission at all."[56]

Third, the Grand Alliance claims that interlaced scanning is necessary to prevent "motion judder" during camera pans and fast action, as in sports, when using high resolutions and low frame rates, and to increase clarity and sharpness at lower spatial resolutions. The Alliance also claims that with SDTV, progressive scanning would either create one of these two "penalties" or reduce the number of programs a channel could simultaneously carry.[57]

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[56] Schreiber Reply at 3; *see* Schreiber Comments at 6.

[57] Grand Alliance Reply at 42

As Professor Schreiber said in response to these and other claims, "[a]lmost everything in this paragraph is incorrect."[58] Indeed, Professor Schreiber has demonstrated that *all* of these claims are incorrect.[59]

Equally incorrect, according to Professor Schreiber, is the Grand Alliance's claim that interlaced scanning "enhances spatial resolution at a modest compromise in temporal frame rate."[60]

Yet another inaccurate -- but potentially enlightening -- justification proffered by the Grand Alliance for including interlaced scanning is that "broadcasters must be concerned about the interoperability of an ATV transmission standard with currently available HDTV production equipment and with the installed base of NTSC production and studio equipment, virtually all of which employ interlaced scanning."[61]

First, a progressive transmission standard will *not* render broadcasters' existing interlaced equipment and currently available interlaced HDTV equipment inoperable. According to Professor Schreiber, broadcasters can use interlaced studio equipment with an interlaced-to-progressive converter to transmit in a progressive format. "The cost of [such a converter] will be entirely negligible compared to the [broadcasters'] other costs of switching to digital

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58 Schreiber Reply at 4

59 Schreiber Reply at 4-6.

60 *Compare* Grand Alliance Reply at 42 *with* Schreiber Reply at 4-5.

61 Grand Alliance Reply at 42.

transmission,"[62] which have been estimated to be as high as $20 million per station.[63]

Second, and perhaps more interesting, is the inference one can draw from the admission that "virtually all" currently available NTSC and HDTV production equipment uses interlaced scanning. It is hard to resist the conclusion that the manufacturers of that equipment -- most, if not all, of which are offshore firms --- were primarily responsible for the decision to include interlaced scanning in the ACATS standard, since they already sell interlaced equipment.

Whatever the motivation of the Grand Alliance in including interlaced scanning, the decision should be reconsidered. Inferior and obsolete technology should be superseded by superior technology that is readily available and economical.

2. Prescribed Picture Aspect Ratios.

The ACATS standard's prescription of only two picture aspect ratios -- 16:9 and 4:3 -- is unnecessarily restrictive and highly undesirable for the film industry because the chosen ratios are not compatible with picture aspect ratios commonly used in feature films.[64] Indeed, the 16:9 aspect ratio does not

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62 Schreiber Reply at 5.

63 *See* Grand Alliance Reply at 28. Though *broadcasters* have provided the $20 million estimate, the Grand Alliance has suggested that it is excessive. Nevertheless, even the Grand Alliance estimates a broadcaster's costs of converting to ATV as being in the neighborhood of $8 million per station.

64 Oral Testimony of Rob Hummell (on behalf of Steven Spielberg, the Directors Guild of America, the American Society of Cinematographers, the International Photographers Guild, and Panavision) before the Senate Committee on Commerce, Science, and Transportation (June 20, 1996) ("Hummell Testimony"). Exhibit N hereto. Tr. 135-7.

correspond to *any* aspect ratio in which a movie has been filmed, according to a representative of the Hollywood film industry [65]

Because many films have wider picture aspect ratios than the two prescribed by the ACATS standard, presentation on DTV of many films -- including most of the films recently awarded "Best Picture" by the Academy of Motion Picture Arts and Sciences -- 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.[66]

Such adulteration of one of our country's most vital art forms[67] should be avoided. It is not necessary to prescribe any picture aspect ratio if the DTV standard is sufficiently flexible. ACATS's two prescribed picture aspect ratios are anything but flexible, and they should not -- and need not -- be included in the DTV standard.

B. Key Components of the Proposed Video Formats Are Incompatible with Computer Applications.

In addition to the technologically inferior video format components perpetuated in the ACATS standard, other components are incompatible with computer applications and should be excluded from the standard to maximize

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65 Hummell Testimony, Exhibit N hereto, Tr. 135-7

66 Hummell Testimony, Exhibit N hereto, Tr. 135

67 Hummell Testimony, Exhibit N hereto, Tr. 134

the benefits that will be achieved by the convergence of computers and digital television.[68]

The ACATS standard contains a number of fungible components that create serious obstacles to computer compatibility: (1) interlaced scanning, (2) non-square pixel spacing, and (3) cumbersome, slow picture rates that are difficult to convert to computer displays. This incompatibility is exacerbated by the ACATS standard's lack of an effective bit error correction mechanism. The first three of these items would require DTV-compatible computer equipment to perform complicated conversions using otherwise unnecessary processing power. The last item is essential because computers require reliable data transmission. The technical nature of the incompatibility all of these items cause is described in further detail in Exhibit A hereto, "Technical Flaws with ACATS Standard" ("ACATS Flaws").

CICATS does not contend that computers *cannot* perform the functions required to accommodate the first three items; but accommodating them will needlessly increase the cost, and impair the performance, of the computer industry's DTV-related products and services. Consumers will pay more than necessary for products and services merging computers with DTV. And the computer and software industries' ability to compete with incumbent receiver manufacturers -- for whom the DTV standard was tailored -- will be impaired.

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[68] A 24 Hz picture rate is of less concern, for reasons that are explained below.

CICATS's proposed base-line format (described in Section III, below) addresses all these problems and imposes little, if any, added inconvenience or burden on any affected party except perhaps interlaced set manufacturers, the buggy-whip producers of the information age.

C. The Complexity of ACATS's Video Formats Creates Unnecessary Consumer Costs.

As noted above, one of the fundamental flaws of the ACATS proposal is that its 18 video formats are unnecessarily complex and detailed. Such complexity and detail will increase consumer costs, decrease certainty in the market, and delay the transition to digital broadcasting and recovery of the analog broadcast spectrum. In other words, the public interest will be woefully disserved by adoption of the ACATS standard.

Professor Schreiber has recently written: "One has to wonder why so many formats are included in the proposed standard. *Without the slightest doubt, this will increase the cost of all ATV receivers, including the cheapest ones.*"[69] The effect of these costs on consumers and broadcasters is examined in Section IV, below, and Exhibits C and D hereto.

The ACATS standard appears to have been designed to guarantee huge financial rewards for TV receiver manufacturers. If it is adopted, consumers will be forced to pay unnecessarily inflated costs even for small, low-end digital

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[69] Schreiber Reply at 7 (emphasis added).

televisions, because, under the ACATS standard, "full decoding to baseband is required" even in small sets.[70] Professor Schreiber has explained:[71]

> The high-resolution image thus produced must then be processed to get the lower-resolution signal for the cheaper display. The need for a full decoder may well increase the cost of each set by several hundred dollars, and the selling price by even more. It would be better to have a coding system in which complete decoding were not required in low-performance sets.

A coding system such as that Schreiber describes, which helps control the cost of low-end sets, is a critical part of CICATS's proposed base-line format, described in Exhibit B hereto.

In comparison, the Grand Alliance's statements with regard to digital receiver costs only confirm consumers' worst fears. While urging the Commission not to require that all receivers be capable of *displaying* all 18 video formats, including those with the highest resolution, the Grand Alliance has stated that it "would support a requirement that all ATV receivers *receive* all ATV formats, including HDTV."[72] Indeed, the Grand Alliance has argued that

> it is critically important that all new ATV receivers and set-top boxes be able to decode all ATV formats, including HDTV, even if the receiver is designed to display the transmitted material only in a lower quality format, thus avoiding "black screens" whenever programming is received with higher resolution than the display capability.[[73]]

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70 Proposed Solutions at 963.

71 Proposed Solutions at 963.

72 Grand Alliance Reply at 33 (emphasis in original).

73 Grand Alliance Reply at 33-34.

If, as the Grand Alliance urges, all receivers must decode all formats, "it will not be possible to make inexpensive sets for today's less-critical applications," according to Professor Schreiber.[74] The reason: even in large sets signal processing is a large part of the cost, and in small sets will account for most of the cost.[75]

For all these reasons, adoption of the ACATS standard would frustrate the Commission's stated objectives in this proceeding, namely, "to increase the availability of new products and services to consumers," to encourage technological innovation and competition, and to minimize regulation.[76]

Furthermore, the ACATS standard does not address the Commission's concern about the proliferation of multiple competing standards. Despite the Commission's characterization of the standard as "only one system,"[77] in reality the "standard" is a hydra consisting of 18 alternative formats. Instead of remedying the problem of competing standards, the ACATS proposal will encourage their proliferation by inviting broadcasters to transmit material in any of the 18 different formats.

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[74] Proposed Solutions at 965.

[75] Proposed Solutions at 965.

[76] Fifth NPRM at ¶ 1

[77] Fifth NPRM at ¶ 27.

III. A Minimum Base-Line Format Standard Would Be Vastly Superior to a Hodge Podge of 18 Video Formats.

In contrast to the complexity and detail of the ACATS standard, in the event the Commission determines that a DTV standard should be adopted, CICATS proposes a streamlined, minimum base-line format that could be extensible (at broadcasters' discretion) and would provide flexibility for the marketplace to determine what quality enhancements are desirable.

Such a standard would seem to be consistent with the conclusions of MIT researchers who were intimately involved in the process through which the ACATS standard was developed and who, despite their work with the Grand Alliance, stated that:[78]

> [the] fatal flaw [of the Grand Alliance standard] is that it overly constrains future technical advances which could improve the quality and features of television. . . A streamlined FCC advanced television modulation standard, coupled with evolving industry standards for picture, sound, and ancillary data formats will enable broadcasters and others to reach the widest possible audience with programming incorporating the most desired features.

If there has to be a standard, a simplified, extensible standard is clearly better than an overly restrictive, detailed standard. The former would encourage innovation and greater interconnectivity, as in the computer industry and as seen in home entertainment systems. And a simplified standard would seem to be a

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[78] MIT Joint Comments at 4.

reasonable compromise between a detailed mandatory standard and no standard at all which could serve objectives on both sides of the debate.

A. Characteristics of CICATS's Proposed Minimum Base-Line Format Standard.

If the Commission finds that the public interest would best be served by adoption of a standard for DTV, it should not be the ACATS standard. In lieu thereof, CICATS proposes a *refinement*, not an *overhaul*, of the ACATS proposal. CICATS's proposal retains all the critical technical characteristics of that proposal, but selects only the best video format components to construct a minimum base-line format, which all broadcasters would include in their digital transmissions, but which broadcasters could enhance through the "layering" of additional data.

The minimum base-line format standard CICATS proposes (described in greater detail in Exhibit B hereto) would utilize all of the ACATS standard's specifications, but replace the 18 video formats with the following elements: (1) 480 vertical lines, (2) progressively scanned only, (3) with broadcaster-determined (*i.e.*, unspecified) picture aspect ratios, (4) square spacing of pixels, and (5) temporal layering for variable picture rates consistent with computer applications.[79]

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[79] An acceptable set of picture rates that could be achieved with temporal layering would be 24 Hz, 36 Hz, and 72 Hz. "CICATS Technical Details " Exhibit B hereto, at 6-7, 10-11; Demos Paper, Exhibit I hereto.

In addition, as explained in greater detail in Exhibit B hereto, the CICATS proposal would remove the restrictions ACATS has placed on the capacity of MPEG-2 to "layer" data, thereby providing broadcasters the ability to enhance programming, and as soon as possible, improved bit error correction developed by the industry.[80]

By eliminating the artificial limitations the ACATS standard places on the use of MPEG-2 and fully utilizing its bit rate capacity, CICATS's proposal would facilitate the "layering" of data to allow content providers and broadcasters to transmit enhanced pictures with resolutions greater than that of the base-line format, and comparable in quality to the highest-resolution formats in the ACATS standard.

The layering of data streams to produce enhanced transmissions built on base-line formats has been the subject of considerable research.[81] In the context of digital television, the principle advantage of such an approach -- rather than the ACATS standard's rigid prescription of defined formats -- is that it allows the marketplace to dictate the degree to which formats should be enhanced. Unlike the ACATS proposal, which is a producer-driven "supply-push" approach, CICATS's base-line and layering proposals would create a "demand-pull"

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80 "CICATS Technical Details," Exhibit B hereto at 9-10.

81 "CICATS Technical Details," Exhibit B hereto at 9-10; *see* Comments of DemoGraFX on the Fifth NPRM, Appendix K.

environment in which consumers' tastes would guide the industry and technical innovation would flourish.

B. Advantages of a Minimum Base-Line Format Standard.

1. Flexibility and Certainty.

One of the biggest advantages of the minimum base-line format standard CICATS proposes is that it would be flexible and extensible enough to permit broadcasters to transmit enhanced programming, such as HDTV, while simultaneously transmitting the same program in SDTV (base-line) format. Because every transmission would include the base-line format, consumers who did not wish or could not afford to purchase more costly equipment capable of decoding enhanced programming would still be able to receive all digital programming on relatively inexpensive base-line-compatible sets.[82] Those who so chose could always purchase more sophisticated and costly equipment to take advantage of enhanced programming.[83] But all consumers would not be forced to pay for capabilities they might neither want nor be able to afford. At a minimum, every consumer with a digital receiver could receive all programming, regardless of its degree of enhancement, in SDTV -- a major improvement over NTSC programming.

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82 "CICATS Technical Details," Exhibit B hereto, at 5

83 Consumer demand for higher quality DTV would dictate whether the minimum base-line format freezes the state of the art in DTV. With the ability to enhance quality through data layering, it is predictable that digital television technology would continue to improve notwithstanding the certainty of the base-line format

Such ubiquity would provide the marketplace certainty that is said to be a major objective of consumers, broadcasters, and equipment manufacturers.[84] Although the ACATS standard has been credited by some as providing such certainty,[85] it is illusory, compared to that which would result from adoption of a minimum base-line format standard.

Under the ACATS proposal, consumers would have a Hobson's choice: either purchase expensive receiving equipment whose cost is driven up by the processing power required to decode 18 different formats; or purchase less expensive equipment with less processing power and sacrifice any programming transmitted in a format the equipment does not recognize.[86] The result for broadcasters would be either smaller audiences due to inflated equipment costs or uncertainty that consumers are receiving programming with more enhanced formats because less expensive receivers are incapable of receiving all formats. Some certainty!

2. Computer Compatibility.

The other enormous advantage of CICATS's proposed minimum base-line format over the ACATS 18-format proposal is its compatibility with computer

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[84] Written Testimony of Robert C. Wright (NBC) before the Senate Committee on Commerce, Science, and Transportation (June 20, 1996) ("Wright Written Testimony") at 20. In this way, the CICATS proposal would satisfy the Commission's stated objective that manufacturers be encouraged to build receivers that are able to receive all digital transmissions. *See* Fifth NPRM at ¶¶ 12, 38.

[85] Wright Written Testimony at 18.

[86] Mundie Written Testimony, Exhibit J hereto, at 6; Stearns Written Testimony, Exhibit E hereto, at 3-5.

technology. Such easy interconnectivity has played a significant role in the growth and continual product improvements seen in the computer and software industries as well as in the consumer electronics industry, particularly with respect to audio equipment.

The Commission has long recognized that open network architecture and flexible standards for interconnectivity with the Public Switched Telephone Network ("PSTN") will stimulate competition, the introduction of new products and services, and lower prices for consumers.[87] A similar approach can be taken for Advanced Television, and, if the Commission finds that adoption of a standard would best serve the public interest, it should strive to adopt the most flexible, extensible standard it can.

At the December, 1995 *en banc* hearing in this docket, K.D. Horowitz of Viacom gave the Commission similar advice: adopt flexible, extensible standards so that consumers can take advantage of enhanced services combining digital TV with computers and other digital applications at affordable

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[87] *See, e.g., Petitions Seeking Amendment of Part 68 of the Commission's Rules Concerning Connection of Telephone Equipment, Systems, and Protective Apparatus to Certain Private Line Services*, 76 FCC 2d 246 (1980); *Second Computer Inquiry Final Decision*, 77 FCC 2d 384 (1980); *Expanded Interconnection with Local Telephone Company Facilities*, 7 FCC Rcd 7369 (1992); *Expanded Interconnection with Local Telephone Company Facilities*, 9 FCC Rcd 5154 (1994); *Bell System Tariff Offerings of Local Distributing Facilities for Use by Other Common Carriers*, 46 FCC 2d 413, 429, *aff'd sub nom., Bell Tel. Co. of Penn. and the American Telegraph and Telephone Company v. FCC*, 503 F. 2d 1250 (3d Cir. 1974); *Establishment of Policies and Procedures for Consideration of Applications to Provide Specialized Common Carrier Services*, 29 FCC 2d 870, *recon*, 31 FCC 2d 1106 (1971), *aff'd sub nom. Washington Utilities and Transportation Commission v. FCC*, 513 F. 2d 1142 (9th Cir. 1975), *cert. denied*, 423 U.S. 836 (1975); *see also Hush-a-Phone Corp. v. US*, 238 F. 2d 266 (D.C. Cir. 1956).

prices. Although Mr. Horowitz's primary concern was ATV compatibility with set-top converters, his words apply with equal force to ATV/computer compatibility:[88]

> So how can the Commission make this vision of new diverse digital applications available to all consumers and all Americans? . . . The Commission must act now to prevent technological roadblocks that could be used to exclude programmers or to favor one programmer or one delivery method over another. . . . This will ensure that no barriers can be erected between the providers of the digital content and the American public. In a digital world this flexibility is more possible than ever

IV. If Adopted, the ACATS Standard Will Cost Consumers and Broadcasters Billions of Dollars More than Necessary for Digital TV and Delay Return of Spectrum Now Used for NTSC Broadcasting.

The Commission can foster the transition to *digital* broadcast television without forcing consumers and broadcasters to pay the substantial premium cost of *high-definition* digital television. The CICATS minimum base-line format would accomplish this objective. The ACATS standard, however, would effectively force the cost of HDTV on unwitting consumers. And it would protract the time needed to transition to digital and free spectrum now used for NTSC broadcasting for other uses.

The critical flaw with the ACATS standard that results in unnecessary consumer costs is its prescription of four resolution levels containing 18 different video formats -- including high definition formats. As explained above, because broadcasters will be able to select from among any of these resolution levels and

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[88] Testimony of K.D. Horowitz (Viacom), *En Banc* Hearing before the FCC in MM Docket No. 87-268 (Washington, D.C., December 12, 1995) ("Horowitz Testimony") Tr. 157-58.

formats, consumers can only be assured of receiving all DTV programming if *all* television receiving equipment (including TVs, set-top converter boxes, and DTV-compatible PCs) can decode all prescribed formats -- a feat that adds significant costs.[89]

Though less expensive sets could be made by limiting their processing power, those sets would be unable to decode higher-resolution signals and would go black when such programming is transmitted.[90] Consumers who are unwilling to forego HDTV programming will be forced to pay the premium for more sophisticated decoding ability -- even in sets with standard definition screens on which HDTV's quality is imperceptible.

But even those consumers who would be willing to sacrifice HDTV programming to save money on equipment will not have that option, according to set manufacturers' comments in this proceeding; they anticipate production of only expensive sets capable of receiving all formats.[91] The Grand Alliance has stated: "[It is] our belief that all set manufacturers will build digital receivers that *receive* all ATV formats, including HDTV, without any FCC requirement to do so," though some less expensive sets may have lower resolutions.[92]

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89 "Economic Considerations," Exhibit D hereto, at 4-6.

90 Memo from Paul Misener, ACATS, to Fiona Branton (cited at Fifth NPRM at note 44) MM Docket No. 87-268 (filed May 30, 1996) at 7 ("the public [would] buy receivers that will unexpectedly and unexplainably (to them) not function when certain formats are transmitted"); Schreiber Reply at 7; Grand Alliance Reply Comments at 33-34.

91 *See, e.g.*, Grand Alliance Reply Comments at 33; Comments of Zenith Electronics Corporation, MM Docket No. 87-268 (filed November 20, 1995) ("Zenith Comments") at 4.

92 Grand Alliance Reply at 33.

Indeed, the TV manufacturers have sought to ensure that consumers are forced to pay for HDTV-capable sets by proposing that broadcasters transmit a minimum amount of HDTV programming each week -- one proposal being 25 hours per week, 15 of which would be in prime time or afternoons![93]

High definition television, however, is not a necessary part of the transition to digital broadcasting, as CICATS's minimum base-line format proposal demonstrates. Yet under the ACATS proposal, consumers would be denied the opportunity to weigh the quality of HDTV against its immense costs -- the industry, aided by a Commission-mandated standard, would make that decision for them.

As explained further in Exhibit C hereto to receive all of the ACATS proposal's video formats, receivers and set-top boxes will need four to five times more memory and processing speed than would be needed to receive CICATS's base-line format -- which itself would produce a picture of equal, if not better, quality, than ACATS's SDTV resolution levels (which comprise 12 video formats).[94]

Astonishingly, members of the TV manufacturing industry, admitting that the significant cost of receiving HDTV formats will discourage consumers from purchasing HDTV-capable sets, have used this point to urge the Commission

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93 Comments of the Grand Alliance on the Fourth NPRM, MM Docket No. 87-268 (filed November 12, 1995) ("Grand Alliance Comments") at 5

94 "CICATS Technical Details," Exhibit B hereto at 4-5