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

Federal Communications Commission
Office of the Secretary

In the Matter of)	MM Docket No. 87-268
)	
Advanced Television Systems)	RM - 5811
and Their Impact on the)	
Existing Television)	
Broadcast Service)	

To: The Commission

REPLY COMMENTS OF SONY CORPORATION

SONY CORPORATION

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SUMMARY

Sony Corporation is heavily engaged in the development and manufacturing of high technology products to serve the entire international professional video marketplace, including broadcasting. We are also very active in a parallel effort relating to Advanced Television Systems (ATV) and High Definition Television (HDTV). We view the future of ATV and HDTV as part of a unified movement in electronic imaging, as reflected in the present merging of needs among broadcasters and an increasingly sophisticated business/professional marketplace.

ATV has been the subject of intense industry-wide debate for the past several years. Broadcasting interests currently hold center stage in these debates, but the subject of ATV must be viewed from a much broader perspective. In particular, transmission can take place only following production. We believe that there must be a clear recognition that ATV transmission and distribution to the consumer may require a variety of encoding schemes to meet the specific requirements and constraints of different media. We further believe that all of these ATV transmission/distribution methodologies should be based on a well-defined single standard for studio origination.

It is our conviction that none of the proposed transmission systems will materialize in practice if the HDTV studio production standard is not firmly established. The cost implications of such an HDTV studio to the broadcaster are truly daunting. We believe these costs will remain prohibitive if a uniform HDTV studio signal standard is not adopted. These costs can only be reduced if large scale employment of that single studio standard is achieved across all imaging industries. We believe that the 1125/60 production standard is such a unified studio origination standard.

The HDTV studio production signal must be converted to any one of the proposed terrestrial transmission signal formats. The same HDTV production signal must also be capable of conversion to present-day 525 and 625/50 video and 35mm film. The 1125/60 studio production standard proposed by SMPTE/ATSC has been carefully structured to allow the flexibility needed to implement all of these different conversions.

Sony is convinced that even the best of contemporary band-width reduction techniques cannot allow a representative HDTV picture portrayal via a single 6 MHz transmission channel. We believe a channel bandwidth in the neighborhood of 8 to 9 MHz will be required to properly transport a home viewer version of HDTV.

The MUSE encoding system represents a viable, and today, a highly refined system, for transporting HDTV over narrowband transmission channels. We therefore urge the Commission to give due consideration to this system, and at the very least to recognize its quality as an important yardstick against which to measure other proposed ATV transmission systems.

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I. INTRODUCTION

Sony Corporation ("Sony") submits the following reply comments in connection with the Notice of Inquiry ("NOI") in MM Docket No. 87-268 released by the Commission on August 2, 1987. The purpose of these reply comments is to offer the perspective of a major participant in the development and manufacture of high technology products on three principal areas of concern raised by the opening comments:

1. The broad implications of the long term evolution of Advanced Television Systems (ATV), including High-Definition Television Systems (HDTV);
2. The technical implications of ATV as they relate specifically to broadcasting; and
3. The urgent need to develop solid voluntary technical standards both for studio production and for signal transmission.

Our central thesis is that the Commission must examine the transmission of ATV within the broader context of recent developments in the field of advanced electronic imaging.

II. BACKGROUND OF THE SONY CORPORATION AND ITS INTEREST IN ATV

Sony has been an active participant in the complex evaluations of and debates on the technical, regulatory, and other issues raised by various ATV proposals within the United States.

A. Research and Development Efforts

From approximately 1970 to 1975, the NHK (Japanese Broadcasting Corporation) Technical Research Laboratories conducted an extensive research program to develop an enhanced new television system tailored to the multiple needs of future societies. Impressed by the high promise shown by the embryonic HDTV system that ultimately emerged from this research, Sony, in 1976, entered into a vigorous program to develop equipment prototypes of the basic elements of this HDTV production system. We undertook this program primarily because we believed that the successful development of a high quality all-electronic imaging system would have profound implications for the future, and we saw a wide diversity of sophisticated market possibilities.

This undertaking was supported in concept by many of the leading broadcasters of the world who form an important segment of our customer base. Most important to the matter at hand, the North American National Broadcasters Association ("NANBA") unanimously supported the concept of such technological development. NANBA, which includes such broadcast leaders as Capital Cities/ABC, CBS, NBC, and PBS (and CBC, Commercial Canadian Broadcasters and Televisa of Mexico who share our present broadcasting standards as well as our borders), voted affirmatively for research leading to a single worldwide production standard at the 1983 Conference of World Broadcasting Unions. A broadcast equipment manufacturer cannot ask for a more commanding form of direction from the industry it serves.

It is also important to recognize that the Technical Committee of the 1983 Algiers Conference of World Broadcast Unions, which is comprised of the leading technical experts of broadcast organizations throughout the world (including those of NANBA), unanimously adopted a resolution stating that first a production standard should be adopted and the standard should be structured so that it could be transcoded into existing transmission standards throughout the world.

We believe our development work has shown that the 1125/60 HDTV production standard has exactly these qualities,

and can be transcoded into a broadcast standard for the United States.

HDTV was a solid investment for the future that we felt to be very consistent with our entry into the broadcast and professional video equipment marketplaces in the 1970s. Indeed, the decade of the 1970s saw a dramatic expansion of television techniques into all facets of the global business and industrial sectors, an expansion which continues unabated today. The use of professional television equipment today proliferates within many industry segments, including medical, scientific and educational, arts and cultural, corporate and industrial, motion picture, and computer industries, and, of course, within the broadcasting industry. Our own experience in providing high-technology television equipment to these business segments has led us to a position where we are today one of the world's major suppliers of such equipment.

During the 1970s and 1980s, Sony made substantial investments in two separate divisions of the company that were devoted to meeting the professional video needs of the broadcasting and industrial/business sectors, respectively. In the early 1980s, however, we recognized that the needs of these two sectors were rapidly coalescing. As a result, we recently restructured Sony to unify and centralize these efforts and to respond, as a single entity, to today's professional needs. We are known today in the United States

as the Sony Communications Products Company, which is a single company that services all broadcast and professional video needs. In all of our long range planning, therefore, we no longer view broadcasting in isolation. This philosophy has special significance today as we look toward HDTV and other ATV systems.

The parallel development of a broad range of basic HDTV production equipment with our general (and substantial) growth in the development of standard professional video products has given us an unusually broad perspective, and we have formed some firm conclusions about the future of television. We believe new broadcast television developments cannot, and must not, develop in isolation. Rather these developments must take place within the wider context of video imaging technology needed now and in the future by a highly sophisticated information society reaching toward the 21st century.

B. Participation on Technical Committees

In addition to a very high level of research and development activity in ATV, Sony has participated actively and extensively on all major industry technical committees and standard-setting organizations. This level of participation reflects our strong belief that private industry has much to gain from well coordinated and pragmatic technical

standards. Ours has been, and continues to be, an activist role rather than that of a mere observer on such committees. We currently have more than 40 professional employees serving full time on international broadcast and professional video technical committees.* Our active participation in all facets of the growth and advancement of television has sharpened our overall perspective on the relation of ATV to other developments within the existing 525-line TV system.** Because of this perspective, we have, from the outset, firmly endorsed the goal of a single worldwide standard for studio production of HDTV.***

* In the United States alone, Sony serves on four SMPTE working groups (Studio Video Standards, Television and Recording Reproducing Technology, High Definition Electronic Production, and Professional/Studio Picture Monitor Systems) and three ATSC working groups (T1 Technology Group on Improved NTSC, T2 Technology Group on Enhanced 525, and T3 Technology Group on High Definition Television).

** In addition to our personnel, Sony has invested substantial sums on laboratory studies, prototype construction, and extensive testing activities in both standard 525/625 television and in HDTV (perhaps at a level higher than any other manufacturer in the world) in support of the work of these committees.

*** The unfortunate splintering during the early 1960s of the world's color television movement into disparate and incompatible systems haunts us today. Sony manufactures broadcast and professional video equipment for all of these different standards today. Thus, we know only too well the cost burden, which is ultimately borne by the world's end users, imposed by the multiplicity of incompatible standards and the consequent inability to exploit fully the economies of scale in manufacturing using a single standard.

Sony has also been a prime mover on other technical committees engaged in finalizing the implementation of new digital component and composite studios. As a result of this participation, we see clearly the need to ensure that ATV standards are carefully dovetailed with the new digital standards currently being formulated. We will focus our comments, therefore, on drawing the attention of the Commission to a considerably broader perspective on HDTV than is currently the focus within broadcasting circles today.

III. HDTV: THE BROADER PERSPECTIVE

Central to our position is our own inescapable recognition that HDTV is being driven by a variety of major forces, most of which are outside the field of broadcasting, such as the motion picture industry, high resolution computer graphics, and a broad range of closed circuit industrial needs. We urge the Commission to recognize that ATV, and very specifically its HDTV embodiment, is a subject of enormous magnitude which will affect many diverse new multi-billion dollar enterprises in all walks of our advanced society. This we clearly see as an escalating dynamic within the total video industry in the future. Decisions, therefore, that are made today on technical details, and especially on technical standards, must be reached with the clear recognition that HDTV, while clearly embracing broadcasting, in fact goes far beyond. We therefore urge a broader view -- one that will

benefit the United States at large -- and one that will ensure a sensibly paced evolution of the broadcasting industry toward ATV. This latter evolution must parallel advances in the global electronic imaging industry. In particular, it must be recognized that HDTV production has far greater implications than simply the studio origination of signals exclusively for terrestrial broadcasting, and that the interests of all forms of production can be best served by the formation of a single, solid, studio origination HDTV standard.

Program production is a major business in the United States today. It spans many areas, including the motion picture industry, broadcasting, cable, videocassette distribution, corporate training and communications, and education. It also includes an enormous program export business. A very careful nurturing of the development of ATV must meticulously recognize the larger interests of all program producers.

While Sony is not directly engaged in the development of any over-the-air transmission ATV system, we have some specific viewpoints on this critical subject. These do not speak to the various issues directly relating to the transmission itself. Rather, they relate to the role of transmissions within the overall scheme, as ATV systems are developed that are fully expected to last well into the 21st century. In particular, we are concerned with the recent

trend among broadcasters to move away from considerations of great global importance as they focus on more parochial issues relating to terrestrial transmission exclusively within the United States. This is not consistent with the superb work done by SMPTE and ATSC over the past four years. Nor is it responsive to the realities of electronic imaging technologies which face us today.

Not only have we participated in committees around the globe, we have been the primary supplier of HDTV equipment to support the many tests conducted by these various organizations. We have worked strenuously within our own organization to sensibly separate the many technical issues from the many political issues. We therefore feel a very strong allegiance to the product of SMPTE and ATSC in the United States, as it was forged from a very long and fine industry effort.

We have also been involved with an extensive series of demonstrations, experiments, and test bed evaluations of HDTV systems for application in high-technology industries, including printing and publishing; flight simulation; ship and auto simulation; medical and educational; arts and cultural portrayal; museums; motion picture production; special effects for motion pictures; fashion and retail; and military. All of these industries (and many more) are in the business of producing programs using television. Many of them urgently

need electronic imaging systems which offer the very highest picture quality. Many of them employ sophisticated closed circuit systems which involve no over-the-air transmission. Many of them entail digital processing, storage, and retrieval. ATV has a vast role to play within these industries, and broadcasting must fit within the overall framework of ATV's total development.

IV. THE STUDIO ORIGINATION STANDARD

The issue of a uniform studio origination standard may not, at first glance, appear to relate to the many other complex issues surrounding ATV terrestrial transmission that are of more direct concern to the Commission. Sony believes, however, that the transmission issues cannot be addressed effectively until an ATV studio origination signal format is clearly defined, universally adopted, and, perhaps most importantly, actually implemented. An ATV transmission format cannot be implemented until cost-effective equipment is widely available from many manufacturers.

The issue of where we start or what the studio origination standard should be has recently generated spirited debate within the broadcast industry. This debate seeks to examine the optimum relationship between production and transmission of ATV. Recently, a possible new United States HDTV production standard was proposed that is "most friendly"

to the current NTSC system and to some proposed Enhanced Definition Television ("EDTV") and HDTV transmission systems developed in the United States. Sony is alarmed by the recent trend among broadcasters to move away from considerations of world-wide importance in future television production and to focus, perhaps understandably, on the perplexing issues of terrestrial broadcasting of ATV. Sony believes that the industry simply does not have the luxury to exclusively tailor a studio production HDTV standard to any one of a variety of different proposed terrestrial transmission systems. Such a narrow focus would dismiss the larger viewpoint to which we repeatedly refer. Such a narrow focus would also minimize the superb accomplishments of the SMPTE and ATSC, which for the past four years have examined these issues from the broader perspective urged here, and would disregard the realities of current developments in advanced electronic imaging technologies. We therefore focus on this primary issue of the studio origination standard in the hope of clearly demonstrating that terrestrial broadcasting is only one facet of the master HDTV signal.

A. The Studio Production Standard as It Relates to Terrestrial Transmission

All future ATV transmission schemes must take their video feeds from an HDTV studio or picture origination source (e.g., video tape recorder). The function of the HDTV

production studio is to originate a very high quality master signal. By all definitions to date, this master signal will be in the form of wideband component video, specifically three video signals (R, G, B or Y, CR, CB). The ATV transmission must begin with some form of encoding of these studio signals, the task being to formulate these into (ideally) a single composite video suitable for transmission. It may also be encoded into a dual signal format for two-channel transmission (as proposed by some). How this encoding is accomplished will vary depending upon the methodology of a particular system. In each case, some form of specialized bandwidth reduction scheme is also envisioned. In all systems proposed to date, the encoding and the bandwidth compression are quite complex processes, and a very profound transformation of the original studio origination signal is necessary. This transformation goes far beyond mere considerations of TV line standards conversion.

What is of primary significance, however, is that all ATV encoding systems start with the acceptance of a feed of three wideband video signals. These signals emanate from an HDTV origination studio, a studio involving HDTV cameras, switchers, special effects, distribution, and recording. It is to this studio that we urge the most careful attention. Without taking this studio into consideration, ATV terrestrial transmission simply cannot be examined.

Of necessity, the HDTV studio will be considerably more complex and considerably more expensive than today's 525-line NTSC television studio. Because Sony currently manufactures and sells both types of equipment, we are well aware of both the greater cost and complexity of the HDTV studio equipment. As a general rule of thumb, the HDTV 1125/60 studio equipment today costs approximately three times as much as the equivalent 525 NTSC equipment. This is measured, of course, at a time when the production volume of such HDTV equipment is at a much lower level than its 525 NTSC counterparts. However, our own careful analysis indicates that dramatic cost reductions will not necessarily be forthcoming as manufacturing volume increases because of the need to employ costly advanced technologies in the manufacture of all HDTV equipment.

This brings us to the key point. There are only a few measures that, if implemented, will ensure that such equipment ultimately reaches an acceptable cost level for the end user:

1. Dramatically increasing the overall manufacturing volume;
2. Stimulating vigorous competition among numerous manufacturers;
3. Speedily amortizing high research and development costs among many manufacturers; and

4. Employing electronic technologies whose costs are guaranteed to lower with time, most notably digital.

Sony believes that if all of these measures are implemented simultaneously, real progress is ensured. The single most effective means of ensuring that these measures will be implemented is to establish a uniform studio production standard. Adoption of a uniform standard will:

1. Encourage wider participation by both manufacturers and end users;
2. Optimize economies of scale within a given manufacturing organization; and
3. More sharply focus competition, and thus enhance global economies of scale.

If the studio origination standard is pragmatically and carefully selected, it will:

1. Embrace all TV industries seeking high quality imaging, thereby boosting economies of scale; and
2. Carefully embrace digital implementation of the standard, which will encourage the development of cost effective digital HDTV equipment, ultimately lowering costs.

The continuing dramatic evolution of digital large scale integration ("LSI") semiconductor systems will continue to lower the costs of electronics. Implementation of digital HDTV equipment in the future will capitalize on these cost

savings. Therefore, Sony urges the Commission to adopt a uniform HDTV studio standard that carefully embraces digital considerations. We are already very involved in the production of a variety of 1125/60 HDTV digital equipment, and we urgently need a unified standard to fully realize the possible manufacturing cost enhancements.

B. The Production Standard as It Relates to Film

1. Transfer from HDTV to 35mm Film

Sony has never embraced the concept of developing a new advanced television system that would render motion picture production and distribution obsolete. To the contrary, from the very outset, Sony believed that HDTV would serve as an important new adjunct to motion picture production. Specifically, we enthusiastically embraced the technical criteria outlined by the NHK in their development of the 1125/60 HDTV system insofar as it specifically sought an electronic image quality compatible with projected 35mm film. We foresaw an important new relationship between HDTV production techniques and those that exist today within the film production community. This would bring a new production flexibility to all program producers.

Accordingly, a very early Sony HDTV project focused on the development of a high quality means to trans-

fer HDTV tape material to 35mm color film. We chose the electron beam recording ("EBR") technique (well known to the industry) and embarked on a major development program to produce an HDTV version of such a machine. This has now been brought to fruition. The first full time service of HDTV-to-film transfer was inaugurated in October 1986 at the Sony-PCL production house in Tokyo utilizing the EBR developed by Sony. Important experiments have been conducted in HDTV production with subsequent transfer to film over the past three years, working in concert with international film communities. Within the past year, two motion picture films for general cinema release (one produced in Italy and the second in New York) have been originated using the 1125/60 HDTV production system.

An alternative transfer technique for HDTV to film, based upon laser technology, has also been brought to a final stage of refinement. It, too, is now servicing the international community currently engaged in motion picture production by HDTV techniques.

Meanwhile, other experiments continue and other productions are in the final stages of preparation. So, a considerable body of experience already exists today in the real working synergism of HDTV and film.

2. The Role of SMPTE

Of special significance to the United States is the extensive work done by SMPTE within their working group on High Definition Electronic Production ("HDEP"). This large group of experts included a high proportion of members from the United States motion picture industry. These motion picture experts participated fully with their television colleagues in closely examining all facets of a studio production standard, and they helped to refine details of the final 1125/60 parameters now presented to the industry as a proposed United States standard for studio production.

It is very important to note that of all the countries in the world currently engaged in HDTV studies, only in the United States was an active, cooperative partnership forged between the interests of the video and the film communities. Indeed, the unanimous vote (no negative and no abstentions) of the SMPTE HDEP working group on August 11, 1987, to propose the 1125/60 (as modified by the Group) HDTV system as a United States standard for studio origination is testament to the pragmatic, realistic alliance that was developed. This work should form the foundation for all future ATV developments.

C. The Production Standard as It Relates to Standards Conversion

We live in a world today where 35mm film is the internationally recognized high quality master medium for television program origination. This single worldwide standard is readily "converted" to any television standard. It is presently done so on a wide scale. The telecine machines used to perform these disparate conversions are, in the general sense, standards converters; that is, they convert down from a film standard to different television standards.

We will face a world tomorrow where HDTV will offer an alternate master -- an all-electronic master. There will exist for many decades to come a need to convert these master origination signals to the existing television systems of the world, both 525/60 and 625/50. This conversion will, of course, be all-electronic. The equipment that accomplishes this is known as TV standards converters or down converters, which convert down from a picture containing substantial picture information to the present day TV systems having considerably less information.

The technical parameters of the HDTV studio origination were chosen early with this dynamic in mind. The 1125/60 parameters were specifically chosen to better facil-

itate the downconversion to both 525 and 625 line systems. The frame conversion, of course, continues as a technical dilemma. Striking progress has been demonstrated, however, during the past two years in the technically challenging area of downconversion from 1125/60 to 625/50, particularly as it relates to the difficulties of this particular frame rate conversion. International experts generally concede that modern technology has indeed mastered this formerly daunting problem. The cost effective implementation of this downconversion is confidently expected to yield measurably to the power of modern LSI. Downconversion, after all, is an all-digital electronic process. This latter point is another key reason for urging close adherence to the technical parameters proposed by SMPTE/ATSC regarding the digital implementation of the 1125/60 system.

It has been simplistically suggested recently that downconversion to 525 NTSC within the United States would be better facilitated by employment of a 1050 line production standard rather than the 1125 line proposal. We strongly urge caution here and remind the Commission once again of the broader perspective. United States program producers seek a HDTV production standard that will convert to all of the world's present and future 525 and 625 line television systems, including downconversion to 525 NTSC Composite; downconversion to 525 Digital 4:2:2 Component; downconversion to 525 Analog Studio Component (as proposed by SMPTE); down-

conversion to 525 Analog Small Format Component; downconversion to 625/50 Digital 4:2:2 Components; downconversion to 625/50 PAL Composite; downconversion to 625/50 SECAM Composite; and downconversion to 625/50 Analog Small Format Components.

Of particular importance is the downconversion to the digital component standards now firmly established worldwide according to CCIR Recommendation 601. These digital components (and their analog counterparts) are the core of much that is currently planned for the studios envisioned to produce some of the enhanced 525 and 625 systems. Consequently, it is necessary to examine not only the line numbers, but also the digital relationships (specifically the number of active digital samples per horizontal TV line). Here, the digital parameters under study within the 1125/60 system exhibit a particular elegance. They relate directly and simply to the digital samples of both the 525 and the 625 digital 4:2:2 systems. They were designed to do so.

V. THE TRANSMISSION BANDWIDTH ISSUE: HDTV OR EDTV?

While Sony is not directly engaged in the manufacture of terrestrial transmission equipment, we are very familiar with the encoding specifications of all of the world's current transmission signal formats. We manufacture a wide range of broadcast equipment to these specifications. In the area of HDTV, we are currently quite active in the develop-