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Before The
Federal Communications Commission
Washington, D.C.

In the Matter of

Advanced Television Systems
and Their Impact on the Existing
Television Broadcast Service

MM Docket Number 87-268

Reply Comments
of
The Del Rey Group

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This document represents the reply comments by the Del Rey Group regarding the recent Notice of Inquiry into Advanced Television Systems, docket number 87-268. This response is divided into two sections; the first section outlines general comments, and the second, those comments regarding a specific document submitted under the November 18th deadline. Attached to this document is a copy of our recent press release describing the first simulations of the HD-NTSC™ protocol.

General Comments

The Del Rey Group is delighted to note that the large majority of comments by industry reflect the philosophy held by ourselves and represented by our HD-NTSC system proposal, namely:

(a) The ATV system adopted for use in this country must be compatible with the existing universe of NTSC receivers in the sense that the ATV signal can be decoded by said equipment to produce an acceptable image to consumers without the need for any converters or other adaptors on the input connection.

(b) The ATV system should be as efficient with spectrum as possible, ideally a single channel format.

(c) Image quality delivered by such an ATV system must be competitive with the quality delivered via non-broadcast or non-cablecast media such as videodisc and videocassette.

These specifications lead one to the following parameters for the ideal ATV solution:

--large and obvious increase in horizontal and vertical resolution
--elimination of luminance/chrominance interaction defects
--elimination of interlace scan defects
--increase in aspect ratio to 5:3
--digital audio performance comparable to Compact Disc™
--single 6Mhz channel operation
--ATV signal acceptable to conventional NTSC receivers.

These parameters are exactly the ones behind the design of the Del Rey Group's HD-NTSC protocol, which also appears to offer the following additional features to those listed above:

--compatibility with existing studio equipment, such as Video Tape Recorders, Editing Equipment, and Transmitters
--single-channel compatibility with existing satellite transponders and terrestrial microwave links

--ability to easily increase system static resolution performance to very high levels in the future without the need for additional spectrum and without the need for yet another NTSC system overhaul such as the one occuring presently.

It is believed by the Del Rey Group that these last three features are very desirable benefits and furthermore are unique to the HD-NTSC protocol.

It must, however, be noted that while first simulations of HD-NTSC look promising, much work lies ahead, and funding is badly needed to accelerate the development cycle. Recent events, however, point to the possibility of a consortium, or partnership, that would be created specifically for this purpose. This consortium would be comprised of various organizations such as broadcasters, cablecasters, manufacturers, and venture capital companies.

Every ATV system proposal before the FCC today represents a mixture of features and compromises, and HD-NTSC is no exception. We believe that our proposal or a derivative of it will be found to be the protocol most acceptable to industry and the viewing public. HD-NTSC in present form requires a single broadcast or cable channel. We suspect that reasonable appeals for scarce spectrum from a half-dozen directions (including, no doubt, spectrum uses not even conceived of at present) will make it most difficult to allocate additional spectrum unless it becomes quite clear that there is simply no other way to broadcast HDTV. The Del Rey Group hopes that *all* proposed ATV systems find funding so that accurate evaluations can take place.

Finally, the Del Rey Group urges the Commission to keep in mind that there is a wide disparity in financial resources and, perhaps, political influence between those organizations advocating specific system proposals at this time. We are appreciative of the interest the Commission and others have shown towards our HD-NTSC protocol, and wish only that the best technology is chosen for the task at hand.

Specific Comments

Regarding NHK Response:

The Del Rey Group regards NHK technology as strictly first-rate. There are some, however, who believe the only shortcoming of the 1125 line system is simply that it represents the prevailing environment of the 1970's, when the basic system parameters were first formulated. For example, it would perhaps make sense in a production standard to employ a progressive scanning technique, not interlace, which has traditionally been used to eliminate the flicker associated with a 30 Hz scan.

Today, frame stores in monitors can accomplish the same result, but it would have been difficult in 1970 to predict the remarkable price/performance progress in microelectronics about to take place. A progressive scan would provide for greater vertical resolution (certainly a desirable result given the archival nature of the production environment) and would also make transcoding into a transmission standard such as HD-NTSC much simpler.

We are disturbed by the notion of an NHK Master Plan which outlines in significant detail the implementation scenario for 1125 line HDTV/Muse in Japan and, by implication, the United States. We find it illogical that significant effort be expended on a new, incompatible, and "brute force" format when so much can be done with NTSC. Brilliant engineers at NHK and elsewhere have laid the foundations of psychophysical data, upon which can now be built the framework of a new, greatly improved, yet *compatible* television protocol. The large investment in hardware made by Japanese firms will not be wasted, since the new television equipment will have many similarities to their current pre-production prototypes. Technology continues to evolve, and it is time to set aside master plans struck in the past in order to reconsider whether a particular path chosen for us is really the one we truly wish to follow.

1. *Summary, page ii: "NHK...has spent 17 years in the development of high definition television..."*
This should not be interpreted to suggest that it would take another 17 years to develop a comparable yet compatible system, since new knowledge builds upon old. Some have suggested a compatible HDTV system based on the principles of The Del Rey Group, NHK, and others could be up and running within 3 years, given a sufficient funding level.

2. *Summary, page ii: "The Muse-HDTV system has no competitors. It is the only true high definition television system available."*
We disagree, though it is clear that Muse is furthest along the development path compared to alternative systems in this country and in Europe. Even so, Muse receivers are still years away from being available at the local video dealer.

We are not sure what "true" high definition is, and recall reading that 525 line NTSC was often referred to as High Definition back in the late 1930's.

3. *Page 3: "NHK has been most cooperative in sharing its knowledge with others"*
The writer's own observation is that NHK is most cooperative in assisting others performing demonstrations of Muse, not with sharing particulars of circuit design. NHK clearly protects that technology it considers proprietary.

4. *Page 3: "Picture quality is of greatest importance"*
While important, picture quality must be balanced with the other two important criteria: bandwidth efficiency and compatibility.

As an aside, many in this country feel that conventional NTSC can display remarkable image quality if more attention is paid to delivery. The fact that a typical NTSC picture in the home is generally not very good does not imply that NTSC should be discarded.

5. *Page 5: "There should be no doubt that consumer demand exists for a system vastly superior to NTSC."*
This statement is left unsupported by solid data. How much demand, especially if the new system won't fit gracefully into the current video environment? And at what price?

6. *Page 5: "In January of this year, NHK performed a terrestrial broadcast experiment in Washington, D.C. ... The joint effort gave notice that HDTV has entered an era of practical application in broadcasting."*
We take exception to the use of the word *practical.* The Washington demonstration was anything but practical. What the experiment showed was that one could take a transmission protocol originally optimized for FM satellite use and send it a distance of a few miles as a vestigial sideband AM signal by way of a powerful horn antenna aimed squarely at a dish antenna on Capitol Hill. Even then, a multipath problem ("ghost") surfaced which required the hasty construction of a manually-adjusted ghost-cancelling circuit back at the studio. We do not wish to demean the value of the tests, only to remove a sugar coating that seems to have been recently applied. The Muse experiment in Washington was just that, an experiment.

6. *Page 6: "...a lesser enhanced definition television (EDTV)...will be used in Japanese terrestrial broadcasts..."*
We do not understand why Japanese industry is taking the time to improve NTSC along certain lines such as (a) ghost cancelling, (b) progressive scanning, and (c) horizontal resolution improvement without also adding further enhancements such as (d) wide aspect ratio, (e) vertical/horizontal subsampling, (f) chroma/luma prefiltering, and (g) digital audio. Why go only part way?

7. *Page 6: "This [1125 line] standard has been established through cooperation between Japan, the U.S. and Canada..."*

That is correct, but it appears to us that support for the 1125 system in both the United States and Canada is waning as other alternatives such as HD-NTSC become more fully fleshed out. The recent ATSC vote to support the 1125 line standard was very close, while if the same vote had been taken a year ago, it most surely would have passed with a solid majority. If the ATSC were to vote again on the same topic six months from now, it is likely to reject the 1125 line standard.

8. *Page 8: "The HDTV studio standard has already found acceptance in the U. S. film and software production industry."*

We don't think the making of one or two feature films in HDTV compared to the thousands made on 35mm film stock this year constitutes "acceptance". HDTV offers unique advantages to the filmmaker, and suffers unique drawbacks. A totally electronic imaging system will one day replace film, but it is not at all clear whether 1125 line HDTV is the format that will do so, or whether the change takes place next year or a decade from now. Since 35mm film is a truly universal high definition production medium *now*, filmmakers generally are playing it safe and are sitting this one out.

9. *Page 10: "The picture quality of a 26-inch NTSC television is not as good as a MUSE picture on a 120-inch screen."*

Taken at face value, that statement appears to be incorrect. A 120 inch screen with a 5:3 aspect ratio has a vertical dimension of about 61 inches, compared to about 16 inches for the NTSC screen. This is an increase of nearly 4 times, yet Muse vertical resolution is only about twice as good as NTSC. To an observer seated a few feet away from both screens, the NTSC image would appear far sharper.

10. *Page 10: "Once in production, the MUSE 40-inch television will cost less than today's price for a 35-inch 'large screen' NTSC television."*

We believe that will be true, but of course by that time the 35 inch NTSC television will be far less expensive than it is today, and also far less in cost than the 40 inch Muse set.

11. *Pages 12-13: "NTSC-MUSE-6"*

Muse-6 is a single channel, compatible derivative of Muse. NHK states that image quality is not much better than NTSC. We believe this is perhaps because the signal not only must conform to the NTSC environment but it also has to be derived from the Muse environment, a herculean task for any systems designer. The Del Rey Group's HD-NTSC protocol employs a quite different subsampling technique and suffers no compatibility constraint with Muse, which perhaps explains the substantial

difference between our observations of HD-NTSC images on the VAX simulation system and the Muse-6 results reported by NHK.

12. *Page 19: "The converter, costing less than $50.00,..."*
There are many including ourselves who believe NHK is underestimating the complexity and cost of a translation unit that takes in 1125/60/2:1/16:9/digital audio HDTV and delivers 525/59.94/ 2:1/4:3/MTS audio out the other end. Such a box will have to determine when to drop unwanted frames in order to match the slightly different frame rates, and employ some sort of pan-and-scan in order to keep wide-screen action centered. We do not doubt such a unit can be constructed, since the technology is known, but we believe the price would be significantly higher.

One of the Del Rey Group benchmarks in creating its HD-NTSC signal format was that no black box converters of any kind would be allowed. We believe this is important for rapid and total integration of HDTV into the existing broadcast and cablecast environments.

13. *Page 19: "...brightness and color separation of the NTSC system is fundamentally flawed, limiting picture quality improvement..."*
It was originally thought that the presence of cross-luminance (dot crawl) and cross-color (rainbow effects on tweed jackets) were an inherent part of NTSC color encoding, but numerous researchers have now demonstrated how to cleanly separate the luminance and chrominance signals through a technique called prefiltering. The Del Rey Group HD-NTSC proposal will rely on this technique to deliver RGB-like color quality over an NTSC channel.

14. *Page 21: "...excessive reliance on bandwidth compression will double receiver costs..."*
Clearly, any sophisticated signal processing in the receiver will add to the cost of the unit, but we hasten to point out that a Muse decoder is an equally complex circuit design. Both Muse and HD-NTSC will rely on the continued remarkable cost reductions in microelectronics to deliver a sophisticated circuit at an affordable price in the future.

Regarding David Sarnoff Research Center Response:
The ACTV proposal offered jointly by The David Sarnoff Research Center (DSRC) and NBC offers an interesting combination of technologies. DSRC recommends a two-phase approach to high definition television. The first phase involves a signal that is carried in compatible fashion over a single NTSC channel and delivers an enhanced resolution wide-screen image. Phase Two builds upon that signal by using an augmentation channel to carry additional detail information and digital

audio. As such, full implementation requires the use of additional spectrum. In addition, the ACTV approach probably requires additional investment in the studio for dual channel video tape recorders and editing systems, since the Helper Signal is not placed in quadrature on the main signal until transmission.

There are similarities between ACTV and our HD-NTSC proposal. Both systems are based on a philosophy of receiver compatibility. Both HD-NTSC and the Phase I version of ACTV can be delivered over a single broadcast or cable channel. Both systems incorporate a display memory in the new receivers in order to provide a progressive display scan. Both systems employ luminance/chrominance prefiltering to remove cross-luminance and cross-color artifacts. Both systems deliver a 5:3 aspect ratio.

In other ways the two proposals are significantly different. HD-NTSC offers significantly higher spatial resolution, while ACTV delivers high temporal resolution. In addition, the two systems differ greatly in the mechanism for carrying a wider aspect ratio to viewers. Finally, HD-NTSC offers digital audio in addition to conventional MTS stereo, and the ability to deliver even higher spatial resolution in the future without additional spectrum.

1. *Page 3: "Additional spectrum will be needed for a future 'one picture height' system."*
NHK research suggests that there may never be a need for significant improvements over their 1125 line (3 picture height) system quality, since their audience tests indicate that viewers tend to sit about 3 picture-heights away from images displaying motion, an effect we have all felt as children trying out the first row of a movie theater.

2. Page 9: *"Display brightness and contrast less than that delivered by today's home receivers will not be acceptable. There is no known technology today for achieving a large HDTV direct view display with acceptable consumer brightness."*
We believe that the current generation of both direct-view and projection HDTV displays offer remarkable performance. We do not think the projected costs at time of introduction (1990-1992) or the somewhat reduced brightness level will prevent the successful introduction of HDTV to the marketplace.

Summary

We are pleased to see much serious thought finally being given to an overhaul of the NTSC delivery system after 40 years of faithful monochrome service and 35 years of color service. In those three

decades we have witnessed remarkable advances in microelectronics and digital technology, and the timing is perfect for the incorporation of new technology into television delivery. We most emphatically do *not* believe, however, that we must start from scratch, because there is nothing inherently wrong with NTSC. There is no need here to re-invent the television process. All that is needed is to apply the knowledge we have accumulated over the years to the rugged and universal signal protocol we already know well.

The 1953 NTSC color system was not an RCA system, nor a Hazeltine sytem, nor an NHK system. It was a system resulting from the collaborative effort of many individuals and organizations. As creators of the HD-NTSC signal protocol, the Del Rey Group stands ready to work with the industry in accomplishing our common objectives.

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Second Milestone Passed With Compatible HDTV System

Wednesday, 9 December 1987
--Marina del Rey, California--

A television technology offering movie-like quality over a single broadcast or cable channel is another step closer to reality this month, according to Richard J. Iredale, founder of The Del Rey Group and a leading advocate of single-channel high definition television (HDTV). According to Mr. Iredale, researchers performing a simulation of the Del Rey Group's encoding system known as HD-NTSC™ have succeeded in applying the technology for the first time to color images.

Mr. Iredale explains: "The heart of our HD-NTSC transmission system is a subsampling technique called TriScan™ which takes a high definition monochrome (black and white) signal and compresses it down to the NTSC format. This compressed HD-NTSC signal behaves just like regular NTSC--it can be stored on an NTSC recorder, edited in an NTSC studio, and transmitted over a single NTSC channel. The great part is that this new signal can be received by conventional television sets to give a conventional picture, while at the same time a new receiver using the HD-NTSC decoding process will be able to build an image with nearly twice the vertical and horizontal resolution of regular NTSC. Plus, the new sets will deliver a wide-screen artifact-free picture and digital stereo--taken together, a tremendous improvement over conventional television."

Mr. Iredale continues, "This whole concept was first introduced in a paper we delivered at a SMPTE Conference about a year ago. Shortly afterward we had discussions with the Canadian Broadcasting Corporation (CBC) and with the INRS, a prestigious research center located in Montreal, about running simulations of the HD-NTSC protocol on the center's VAX 8600 system.

"Those first tests were performed last summer, using monochrome images. The results of those tests showed great promise, as reported in a press release issued at the time, and the decision was made to begin working with color images. I am delighted to report that several weeks ago the Montreal researchers succeeded in encoding a high definition color image into composite HD-NTSC and back again."

When asked about alternative systems under development both in this country and in Japan, Mr. Iredale smiled and responded, "There are many intelligent people working on a variety of systems, but to us the situation is quite clear. First, we believe a single 6MHz channel could be all we're going to get to play with--it's likely there's just too much demand for spectrum from a half-dozen directions to consider adoption of 1 1/2 or 2 channel systems. Secondly, many industry voices are emphatic that the signal coming down that single 6MHz channel had better be directly watchable on the 150 million receivers already in use. Thirdly, the transmission system needs to produce a really terrific picture,

because it has to compete against wideband videocassettes someday. Add it all up and we think it says HD-NTSC.

"The recent FCC Notice of Inquiry listed our proposal as only one of several under development. One organization has recently announced a subsampling system that is also single-channel and compatible, but they themselves state that picture quality is not much better than regular NTSC. Another team has shown simulations of a single-channel system quite different from our approach, and while offering promise, it is felt by some to fall short of the benchmark established by 1,125 line HDTV."

According to Mr. Iredale, the Montreal simulations exposed an unexpected feature--the ability of HD-NTSC to allow broadcasters to gradually increase resolution to very high levels over time while remaining within the bounds of a single NTSC channel. "HD-NTSC is capable of delivering outstanding resolution, but it would make sense to operate at somewhat reduced levels for a while as older receivers are gradually retired from service. It's like buying a new car with a powerful turbo engine and taking it on the highway. In order to be fully compatible with older sedans, you drive at their speed, but as more and more drivers trade up to turbocharged cars, your speed can be safely increased." He claims the simulations demonstrate both vertical and horizontal resolutions about equal to HDTV, or about 700 lines per picture height (l/ph), far superior to conventional NTSC resolution of 330 l/ph. Patents have been applied for on various aspects of the HD-NTSC signal.

Recently, several members of the American television industry flew to Montreal to join Mr. Iredale in viewing the latest simulation results. When asked what he needed most from industry at this point in time, Mr. Iredale immediately responded: "Funding. Funding is critical for us to get this program into high gear. If broadcasters and cablecasters don't get involved and vote with their pocketbooks, then it's quite possible that a technology hostile to their environment could be chosen instead. To borrow from an old joke, these first simulation results are like seeing light at the end of the tunnel, and at this point we're fairly certain that the light we're seeing is not the headlamp of an oncoming train. But much work remains to be done, and everything revolves around money. We don't need funding next year. We need it now."

Mr. Iredale was recently invited to testify before the House Subcommittee on Telecommunications and Finance in Washington regarding High Definition Television. His papers on the HD-NTSC proposal have appeared in the *IEEE Transactions on Consumer Electronics* , the *SMPTE Journal*, and most recently in the *IEEE Transactions on Broadcast Technology*. He graduated from the Massachusetts Institute of Technology with a BSEE degree in 1977, holds an MBA degree from the University of Southern California, and is a member of both The Society of Motion Picture and Television Engineers and the National Association of Broadcasters.

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