FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

OFFICE OF COMMISSIONER
JAMES H. QUELLO

October 26, 1987

William F. Schreiber
Professor of Electrical Engineering
Director, Advanced Television
Research Program
Massachusetts Institute of Technology
Room E15-387
Cambridge, Massachusetts 02139

Dear Professor Schreiber,

Your letter to the FCC Commissioners and your oral testimony before Subcommittee Chairman Ed Markey on HDTV were right on target!

Thank you for this timely and expert contribution toward a practical, compatible, resolution of the HDTV proposals.

I believe Chairman Markey and Chairman Dingell, who are strong "jobs for Americans" advocates, will be intrigued with your statement that "there is no reason to accept inferior standards (Japanese) that effectively exclude American industry from participation in future TV manufacturing." Also, I was impressed with your estimate of more than 100 billion dollars to replace all existing receivers and VCRs by the next century. That vitally affects employment and manufacturing for the American public as well as better defined TV picture quality.

I'm taking the liberty of sending a copy of your letter with my reply to Dick Wiley, former FCC Chairman, who is chairman of the advisory committee and also to MST, a responsible engineer-oriented broadcast group.

When the opportunity arises, I would like to place your letter in the FCC record of the HDTV proceedings.

Sincerely,

James H. Quello

James H. Quello

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Copy: Dick Wiley
Tom Paro, MST
Margita White

bcc: John Dingell
Ed Markey
Al Swift
Mark McCarthy
Wally Jorgenson
Eddie Fritts
John Summers

ADVANCED TELEVISION RESEARCH PROGRAM

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ROOM E15-387, CAMBRIDGE, MASSACHUSETTS 02139

Oct. 20, 1987

Mr. Dennis R. Patrick, Chairman
Federal Communications Commission
Washington, DC 20554

Dear Chairman Patrick:

I am Director of MIT's four-year-old Advanced Television Research Program (ATRP), at present the only TV research program jointly funded within the American TV industry. I am writing to express my concern regarding the composition and the mandate, or terms of reference, of the Advisory Committee on Advanced Television recently constituted by the Commission. Specifically, it appears that the failure to include any persons on the committee other than those having a direct industry involvement is in violation of both the letter and the spirit of the Federal Advisory Committee Act of 1972, under which the Committee is being chartered. Accordingly, I request that you consider naming additional members from outside the industry at this time.

The members of the Committee and chairmen of the subcommittees, albeit distinguished and certainly honorable, are almost all committed, by policies of their companies, to particular scenarios for the development of ATV in the US. Some are well known for having tirelessly advocated the implementation of one particular system, developed in Japan.

For good or bad, television plays a very large role in American life, both social and economic. The Commission's Inquiry will have a profound effect, not only on the kind of television service provided to the American public, but also on the nature of the national telecommunication network, the consumer-electronics and professional-equipment industries, and on the public, well into the next century. For example, replacement of all the receivers and vcr's in the hands of the latter may well cost more than 100 billion dollars.

For these reasons, ATV is not primarily about beautiful pictures - it is about entr· ·eneurial activities, jobs, trade, and network architectures. These are significant c· esdions of the larger public interest that go well beyond the particular interests of the existing TV industry. To address these issues adequately, members are needed from the academic community (engineering, economics, law), labor, public-interest groups, other industries, and government. Some members with specific expertise in international competitiveness would be highly desirable.

With respect to the terms of reference, they appear to be inconsistent with the NOI. The latter, in my opinion, is an excellent document. It puts on the table a comprehensive

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set of issues and goes to considerable lengths to discuss the implications of various conceivable decisions. It even leaves open the possibility of a complete realignment of spectrum allocation and transmission standards, including the eventual abandonment of NTSC. The terms of reference of the Advisory Committee, on the other hand, call for an initial report within six months containing recommendations for fundamental parameters and spectrum requirements. Such an early report can only be an endorsement of the NHK system in some form. If that is to be the outcome of the Inquiry, no Inquiry is required; we can assure that result simply by doing nothing.

Attached is my recent testimony before the Subcommittee on Telecommunications and Finance on some of these matters.

Respectfully,

William F. Schreiber

William F. Schreiber
Professor of Electrical Engineering
Director, Advanced Television Research Program

Cc: Commissioner Patricia Dennis
Commissioner James Quello ✓
Ms. Diane Killory, FCC General Counsel
Congressman Edward J. Markey

Summary of Oral and Written Testimony
before the Markey Committee, October 8, 1987

William F. Schreiber
Professor of Electrical Engineering
Director, Advanced Television Research Program
Massachusetts Institute of Technology

(The opinions herein are those of the author only)

Advanced Television Systems

This testimony discusses the various ways in which the benefits of advanced television technology can be brought to the public, both from a public policy point of view and from the standpoint of technology. The effects on the TV distribution system and on domestic industry are also considered. The principal points made are as follows:

1. The Japanese have developed a high-definition TV system called "NHK" that has about twice the vertical and horizontal resolution and a wider picture than the "NTSC" system used in the US. It requires the equivalent of 5 normal TV channels, but is not seriously proposed as a *transmission* standard.

2. The governments of Japan and the US, alone among major countries, have proposed the adoption of the NHK system as a *production* and *program interchange* standard by the international community.

3. Europeans have refused to adopt this standard, and have embarked on the large and well funded *Eureka* project to develop their own system.

4. A bandwidth-compressed version of NHK, called "Muse," of somewhat lower quality, has been demonstrated for transmission. It takes 1 1/2 to 2 channels and is noncompatible with existing receivers.

5. Use of the NHK or Muse systems poses serious hazards for the US TV distribution system. There are also many technological objections. Their adoption would probably exclude American manufacturers from both the professional equipment and TV receiver markets.

6. Many superior alternatives exist or have been proposed: 1- or 2-channel compatible systems with improved quality on special receivers, noncompatible systems in one channel, and flexible systems that can continue to be improved over time. It is agreed among American interests that service to existing receivers must be continued.

7. There is no urgency to adopt any system at the present time, especially when so much progress is being made in developing systems that are more efficient than NHK and Muse, and more suited to American requirements.

Oral Testimony before the Markey Committee, October 8, 1987

William F. Schreiber
Professor of Electrical Engineering
Massachusetts Institute of Technology

(Speaking for himself only)

My name is William F. Schreiber. For 40 years, my main professional interest has been imaging systems. For 28 years, I have been a faculty member at MIT, where I am professor of electrical engineering. For the past 4 years, I have been Director of MIT's Advanced Television Research Program, the only TV research and development program jointly sponsored within the American TV industry. Our basic mission is to find out how to make better television systems. Since it is impossible to summarize in 5 minutes what we have learned in 4 years, I shall have to make a series of unqualified statements. I have submitted additional material and shall be glad to provide the committee any further information it desires. The opinions I shall express are mine only.

We are talking today about money - and jobs. Although the direct social value of TV depends on programming, it is a large industry with important economic effects. High definition is the next milestone. The technological choices we make will have a profound impact on all companies delivering TV to consumers. These choices will also determine whether the billions of dollars of professional and consumer equipment will *surely* come from abroad or *may* come, in part, from US manufacturers. The US consumer electronics market is about $24 billion, with 85% in foreign hands. The governments of the United States and Japan, alone among major nations, favor the adoption of the Japanese-developed "NHK" system. There are many technological objections to this system; its adoption will assure that virtually no HDTV equipment will be American. If "Muse," the compressed version of NHK, is used for cassettes or for transmission, the broadcast and cable industries may be seriously and adversely affected.

There are many possible paths to HDTV. All of them *must* continue to serve the 120 million or so receivers in the hands of the public. Terrestrial broadcasters favor a receiver-compatible HDTV system using no more channels than today's standard "NTSC" system. Cable companies are not so restricted, but would still prefer to use no more than one channel for any new system.

At present, we do not know how to provide true HDTV imagery within a single channel in a manner fully compatible with today's receivers. HDTV thus requires the use of extra channels, at least for an interim period during which NTSC service is maintained. The NHK system, for example, requires five standard channels. By making certain compromises, this has been compressed to one and one-half or two channels in the Muse system. Thus this method, including existing service, would require 2 1/2 or 3 channels.

Other proposals call for combining one NTSC channel with an "augmentation" channel, producing high-definition images on special receivers that use both channels. Such systems can surely be made to work. However, they tie up the extra channels permanently, in the same way as Muse.

Written Extension of Oral Testimony
before the Markey Committee, October 8, 1987

William F. Schreiber
Professor of Electrical Engineering
Director, Advanced Television Research Program
Massachusetts Institute of Technology

(The opinions herein are those of the author only)

Advanced Television Systems

We are now witnessing, within the American television industry, a curious phenomenon. A substantial number of TV professionals, primarily through SMPTE and ATSC, are working diligently to iron out all the details so that the NHK system will become the worldwide *de jure (or de facto)* standard for TV production and program interchange. Although Muse, the bandwidth-reduced version of NHK that has been proposed for transmission, is officially not on the agenda of these bodies, NHK and Muse are cousins, in my opinion. The adoption of the former makes the use of the latter inevitable. If NHK is adopted, then, in all probability, the Muse system will become the worldwide high-definition distribution standard.

The members of these committees are ostensibly working on specific details, such as signal descriptions, sampling frequencies, "square pixels," colorimetry etc. Much of the work is of excellent quality and would be relevant to any HDTV system. However, the principal effect of these efforts is to help propagate a particular system that the world community, through its authorized agency, the CCIR, refused to accept in 1986, and whose adoption would be detrimental to the interests of many of the participants and their employers.

Engineers' and scientists' identification with their work is very common; in fact, it is usually a necessary ingredient for success, and accounts for the enormous amount of time and energy we are willing to spend to get something to work right in spite of obstacles. Thus we often tend to lose sight of the overall objective. People who have spent their entire professional lives making beautiful pictures want them for their own sake. The spectacular images we have seen from the NHK system inspired many of us to work very hard to get them into every living room. The Japanese deserve a lot of credit for their foresightedness and, particularly, their willingness to spend a considerable amount of money, beginning in 1970, to show that better television pictures can be ours if we want them.

It behooves us to remember, however, that the quest for high definition and the resulting controversy about which system, if any, should be adopted, is an aspect of a vigorous commercial competition. In this competition, we have already lost most of our consumer electronics industry and a large part of the professional TV equipment market. If Muse is established in this country via VCR's, it poses a significant threat to both the broadcast and cable TV industries. If Muse or the wide-band NHK system is adopted for either terrestrial broadcasting or satellite transmission,

we could clean up our analog broadcasting and cable channels to make them good enough for Muse, we would get much higher quality on NTSC, as seen on home receivers, without any changes at all in system design.

Receiver-Compatible Systems .

Terrestrial broadcasters, who see a major threat to their audience share from HDTV delivered to the home via high-definition VCR's and special receivers that can also display NTSC, hope for the development of a one-channel *receiver-compatible* system. In such a system, the transmitted signal would be modified in such a way that existing receivers would display pictures no worse than at present and special receivers would show "high-definition" images. This is intended to permit the broadcasters to continue to serve their present viewers as they move into improved systems, and to compete with HD cassettes.

Research to improve NTSC within the 6-MHz channel, usually called EDTV (extended-definition TV), has been carried out in a number of places, such as Hitachi and Matsushita. Proposals and demonstrations have been made by others, including Faroudja and Iredale in the US, and significant work has been done in Europe. NBC has just announced a system developed at the David Sarnoff Research Laboratories, the former laboratory of RCA.[1]

Our own MIT laboratory has such a system under consideration. Many of these schemes result in worthwhile quality improvements, even if not up to the level represented by the wideband NHK system.

It is perfectly clear that the present audience must continue to be served via NTSC transmissions to existing receivers for many years to come. That being the case, extra channels must be used if "true" high-definition broadcasting is to be introduced. One way to do this is to use an NTSC channel, for compatibility, together with an augmentation signal occupying an additional channel, or perhaps only one-half a channel, that would be combined in special receivers with the NTSC transmission, to display high-definition images. Such systems have been proposed by Glenn and by North American Philips and certainly could be developed. A second way to accomplish this is to use a completely independent high-definition transmission in the second channel, in which case the same or different programs could be transmitted through the NTSC and the high-definition channels, at the option of the broadcaster. The most prominent contender for such service is Muse, which itself will require at least one and one-half, and in all likelihood, two channels. Even with this extra bandwidth, Muse suffers at present from the multipath problem mentioned above. The experimental Muse transmissions earlier this year in Washington confirmed this difficulty.

None of these three possible routes to the TV system of the future has clear sailing. The one-channel receiver-compatible method may well be the most practical interim solution. However, it probably will not have good enough performance to serve as the very high quality system that we would all like ultimately to see. The two-channel compatible scheme, while it can achieve adequate quality, at least doubles the bandwidth consumption forever. The noncompatible approach has even higher bandwidth consumption and is potentially very disruptive of existing

[1]The NBC/Sarnoff system was demonstrated for the first time at the HDTV Symposium in Ottawa this week. The pictures were very good and the demonstration evoked a great deal of interest.

We shall shortly embark on a project to demonstrate whether 1-channel HDTV can be made to work. If successful, it is the intention of MIT and the sponsors to offer this system to any and all users with at most nominal royalties.

The Open-Architecture Smart Receiver

The design of an entirely new system at the present time can take advantage of television receiver capabilities made possible by the enormous progress in integrated circuits of the past two decades. For about the same price as the first color receivers, a highly flexible unit could be designed, not only capable of squeezing maximum quality from whatever signal is transmitted, but one that could adapt itself, under the control of a small amount of digital information transmitted along with the picture signal, to the signal format. The latter, in turn, could be adapted to the characteristics of the particular program material. For example, fast-moving sports scenes could be shot at high frame rates for optimum motion rendition, while slowly moving images that emphasize fine detail could be rendered at lower frame rates. In both cases, the display, as distinct from the transmission, would operate at both high resolution and high frame rate, for flicker-free reproduction without visible line structure.

A programmable receiver of this nature could, at little additional cost, receive signals in a variety of formats, including, of course, NTSC. (Some multistandard receivers are already available in Europe.) This means that, as our knowledge increases, improvements could be introduced at the transmitter without making receivers obsolete.

Another valuable feature of a truly modern receiver is that it could be organized in much the same way as a personal computer. This means that it would be possible to plug in hardware and software modules designed and produced by third parties for enhancing and/or adding capabilities. Easy interfacing to computers, cable, VCR's, video games, various proposed interactive services, and, perhaps most important of all, electronic still photographic equipment, could readily be provided.

Conclusion

From all this, it is obvious that we are in the midst of a true renaissance in visual communications systems. With the knowledge now available and with the hardware we now know how to build, there are many alternative ways to provide the American people with a vastly improved television system. This can be done without placing at risk the elaborate existing structure for delivering programs to the public. The hope for a worldwide standard based on the NHK system has been dashed by the European decision to follow a separate path.

The original NHK system was devised more than ten years ago, and it is now widely considered to be impractical and wasteful as a broadcast standard. Muse modifies the original system and does improve its efficiency, but with what we know today, we can do much better than either of these systems in terms of image quality for a given channel capacity.

From a technical standpoint, I can see no reason to accept these standards when there are substantially better alternatives available. From an economic standpoint, there is no reason to accept inferior standards that effectively exclude American industry from participation in future TV manufacturing. I therefore suggest that the adoption of the NHK production system or the Muse transmission system at this time as any kind of standard, *de jure* or *de facto,* is against the