NBC TECHNOLOGY

30 Rockefeller Plaza (1600W)
New York, New York 10112
Telephone: +1-212-664-7557
Telefax: +1-212-664-5219

RECEIVED

NOV 2 9 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

TO: ACATS - Joint Experts Group on Interoperability
FM: Stan Baron
DT: 04 Oct 93
RE: Interoperability Goals for Grand Alliance System

• **High quality HDTV pictures and sound:** The first concern is to [illegible] quality broadcast standard. Inclusion of features to facilitate uses other than broadcast are desirable only if they cause little or no loss in possible broadcast quality.

• **Wide service area for terrestrial broadcast:** The primacy of the broadcast service implies that the chosen standard should not sacrifice terrestrial broadcast service area in attempting to provide for features for other services.

• **Low interference to existing NTSC service:** The NTSC service will be the main source of broadcasters' revenue and TV delivery to the viewing public for many years, and therefore, the chosen standard should not sacrifice interference performance into existing NTSC services in attempting to provide for features for other services.

• **Interoperability with other HDTV delivery media, computers, and telecommunications networks:** is highly desirable. However, interoperability with other media should not imply placing the burden of conformity upon the broadcast signal, to force it to be in a form usable without change in other media. If conversion is relatively simple and inexpensive, there is no need to place an unnecessary burden on the broadcast signal itself. Interoperability can be achieved through the use of a universal standard of headers and descriptors which allow identification of different audio, video, and data services within a program service and different program services. The same headers and descriptor mechanisms can be used to identify unique service constructions which allows for conversion where necessary.

• **Cost effective solution for consumers and users:** The broadcast standard should make maximum use of international standards (*e.g. MPEG, QAM, Headers/Descriptors, etc.*) that will promote lower costs by their widespread use.

• **Data stream access and "clean-cut points":** Interoperability, consumer usage, and the ability to transport the data stream over a variety of transport media require that the system provide "clean-cut points" at regular, known intervals for the purpose of inserting differing services in the data stream, re-packetizing for alternate communications media, and for simple operations not requiring decoding and re-encoding of the audio and video data streams. Applications are switching between or inserting new data streams in an interactive environment, facilitating random access in recorded media, and local program insertion in a broadcast network feed. The MPEG proposed standard provides for such a capability.

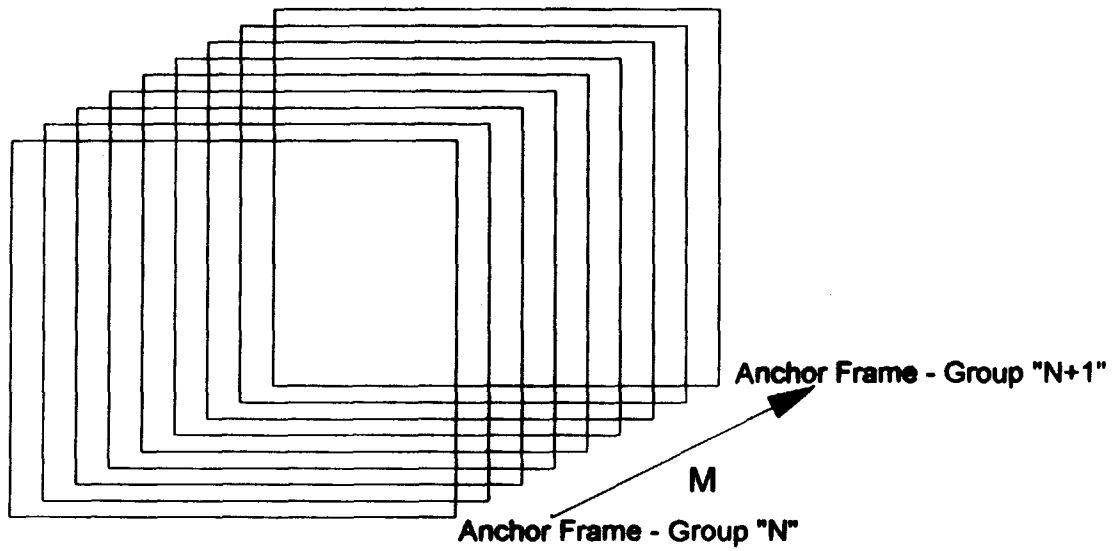
Each GOP = constant number of frames (M) = a constant amount of time (Tf = M/F) = constant amount of data (Rg = M*R/F), although amount of data representing any single frame in the group (I,P,B) may vary.

Given: F frames/sec.

R bits/sec data rate

M frames in a GOP

Then 1 GOP = M/F secs = M*R/F bits/sec



Group of Pictures (GOP)

A GOP provides the basis for a "clean-cut" point.

RECEIVED
NOV 5 2001

RECEIVED

NOV 2 9 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

CableLabs

Cable Television Laboratories, Inc.
1050 Walnut Street, Suite 500
Boulder, CO 80302

To: Robert Sanderson
Chair, Interoperability Expert Group
FCC Advisory Committee on ATV Service

From: Craig K. Tanner
Cable Television Laboratories, Inc.
Chairman, Transport Expert Group
and Member, Technical Sub-Group
FCC Advisory Committee on ATV Service

Date: October 5, 1993

Subject: Interoperability Concerns of the Cable Television Industry

The cable television industry has some vital interests in the interoperability of the advanced television system currently under development. This letter reviews these topics for the consideration of the Joint Expert Group on Interoperability which you chair.

Cable Modulation Mode

In its presentation to the Advisory Committee's Technical Sub-Group, The Grand Alliance has committed to developing an extension of the expected broadcast modulation mode that will allow the transmission of two ATV programs in a single six megahertz channel on cable television systems. Before formation of the Grand Alliance, CableLabs tested the 16-VSB transmission system designed and built by Zenith Electronics Corporation, with good results. The Grand Alliance has since indicated that it is considering an alternate QAM-based modulation technique that will achieve a similar bit rate in a 6 MHz cable channel, namely 256-QAM.

There may be some wisdom in choosing a cable modulation mode that is a natural extension of the still undetermined broadcast modulation mode, but what is most important

is that the ATV standard incorporate this cable mode and require agile digital receivers to be incorporated in all ATV receivers. In this way, all consumer receivers will automatically identify either "broadcast mode" or "cable mode" transmissions, and provide seamless reception in either case.

More than 62 percent of U.S. homes receive their television signals from cable systems. Cable systems are also planning to become providers of a wide range of broadband, interactive digital services to consumers. Inclusion of the cable modulation mode is essential to optimizing the use of cable system bandwidth and thus making bandwidth available for other information-age services.

Conditional Access System

The cable television industry is a major supplier of subscription pay and pay-per-view television services. As cable systems migrate to digital transmission and interactive network capabilities, these programming services will grow in popularity, thus improving program choice for viewers.

An essential element in the health of this supply of programming is the ability to provide access to those who are interested in paying for premium services, while denying access to those who do not wish to do so. While digital transmission provides an excellent platform for an effective conditional access system, its many elements must be carefully planned. The FCC Advisory Committee's Expert Group on Transport will be examining the Grand Alliance Proposal to be sure it allows the functionality required to implement successful conditional access sub-systems, and we urge the Interoperability Expert Group to do the same.

Viewer-Transparent Data Reallocation

Current plans for a packetized digital data transport scheme will allow great flexibility in devoting portions of the data stream to information other than the compressed video and audio data. At times, it will be desirable to convert the majority of the data capacity of the channel to this other data, if only for a short time (some number of seconds), as in software downloading, or addressing of subscribers for conditional access.

This feature will be useful for a range of services, but only if the data stream can be allocated in a "viewer-transparent" manner. In other words, the broadcaster or cable operator must be able to continue to provide meaningful picture and sound while the data transmission is taking place, thus providing continuity of service to viewers.

This will require careful specification of techniques, perhaps to be implemented largely on the receiver side, that will devote the preponderance of the data capacity to this other data, while maintaining for the viewer a display of either a still picture, or a small window with motion video surrounded by a graphic. Audio should accompany both. This simplified display will require only a fraction of the full data capacity, thus freeing most of the channel's data capacity for the transmission of the other data.

This "viewer-transparent data reallocation" capability should be a documented part of the ATV standard that is required in all ATV receivers, lest it not be able to be used for fear of disruption to receivers without the proper functionality.

Interlace vs. Progressive Scan

CableLabs supports the Technical Sub-Group's proposal for an ATV service which would launch with a 1,080-line interlaced raster format with the necessary "hooks" in the transport systems and in all receviers to allow a transition some years later to a progressively scanned image. Achieving a credible plan for such a migration will be challenging, but it offers the best scenario for highest picture performance and a proper fit with real-world economics, while positioning the North American ATV system as a central component in the coming National Information Infrastructure.

Conclusion

CableLabs and its member companies look forward to reviewing the details of these aspects of the ATV system proposed for standardization, andwill perform laboratory and field testing as required.

AMERICAN SOCIETY OF CINEMATOGRAPHERS

1782 NORTH ORANGE DRIVE • HOLLYWOOD, CALIFORNIA 90028
(213) 969-4333 • FAX (213) 882-6391

RECEIVED

NOV 29 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

October 5, 1993

OFFICERS

VICTOR J. KEMPER
PRESIDENT

WOODY OMENS
FIRST VICE PRESIDENT

HARRY WOLF
SECOND VICE PRESIDENT

HOWARD A. ANDERSON, JR.
SECRETARY

HARRY WOLF
TREASURER PRO-TEM

RICHARD GLOUNER
SERGEANT-AT-ARMS

BOARD OF GOVERNORS

HOWARD A. ANDERSON, JR.
STANLEY CORTEZ
ALLEN DAVIAU
LINWOOD DUNN
RICHARD EDLUND
RICHARD GLOUNER
RICHARD KELLEY
VICTOR KEMPER
PHILIP LATHROP
WOODY OMENS
STEVEN POSTER
LEONARD SOUTH
HASKELL WEXLER
HARRY WOLF
VILMOS ZSIGMOND

KEMP NIVER
MUSEUM CURATOR

To Whom It May Concern:

The American Society of Cinematographers has decided to publicly state its opposition to the direction being chosen for a United States transmission standard for HDTV. The ASC represents the artistic members of the Hollywood production community charged with capturing the visual aspect of the stories we tell, those best qualified to ensure that the integrity of these images is maintained.

Incorporating interlace scanning or a 16x9 aspect ratio in a transmission standard would be an avoidable artistic and financial mistake. Also, it is inconceivable that a so-called "interim" standard is even being considered when so much is at stake for the industry and the consumer.

Heretofore, Hollywood and the worldwide film production community have been excluded from the discussions leading to an HDTV standard, in spite of the fact that the Hollywood studios and production community maintain the largest library of motion picture and television images in the world. It is our concern that these images are presented in a manner which preserves the original intent of the filmmakers. The format of advanced television that is adopted should have the flexibility to present images in a manner that most closely matches their original presentation.

The problems of displaying fine detail on interlace displays are well known. Unintentional moiré patterns can distract from the telling of a story. More significant is the necessity of locking in a specific frame rate for an interlace display. A fixed, specific frame rate for display means that images not shot in that frame rate must be compromised slightly in order to be adapted to the interlace display.

The advantage of a progressive scan architecture is its ability to display in whatever frame rate is appropriate to the material being displayed. Using Header/Descriptors, the television display can be intelligent enough to interpret the correct frame rate for any given material. Motion Pictures photographed at 24fps can be displayed at 48 or 72 scans per second; those shot at other frame rates can also be displayed at their correct display rates without complex adaptations of the frame rate as required by a fixed 60HZ display.

Header/Descriptors will also enable formatting information to be carried with transmitted images. This would allow a subject to be displayed on a set in its correct original aspect ratio, if desired by the filmmaker. Since the current aspect ratio chosen for HDTV does not match any previously used format, all films will have to be adapted to fit within the confines of 16x9, often losing information in the process.

It is curious that while the only true existing library of widescreen material is available from the motion picture community, the chosen HDTV aspect ratio has no relation to any previously photographed format. There have never been any films composed for an aspect ratio of 16x9 (1.78:1).

It is clear that an interlace display standard will require compromises in how motion picture images will be displayed. A progressive standard, on the other hand, lends itself to flexibility, and can adapt to display images much closer to the way they were originally intended to be displayed.

With these facts in mind, the American Society of Cinematographers formally places its support behind a system of High Definition Television that displays images with a progressively scanned display. To adopt an interlace-based system, intermediate or otherwise, would be to adopt a lower quality display medium and most likely anchor a United States standard in old technology.

Yours truly,

Victor J. Kemper, ASC
President
American Society of Cinematographers

MARL

October 4, 1993

JEGI Doc.-033

INTEROPERABILITY ISSUES.

RECEIVED

NOV 2 9 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

1. Do we require square pixels for transmission standard?

In case the answer is yes, and we expect that the production standard [illegible] resolution horizontally than the transmission, then the production standard must have higher resolution vertically (more lines) as well to maintain square pixels.

2. Why do we insist that the horizontal resolution for the production has to be better than for the transmission, but are satisfied with vertical resolution being the same for production and transmission?

3. How many times the HDTV signal can be compressed and decompressed. This becomes an important issue for editing on lower level (for computers and many consumer applications).

4. For home VCR format, could it be considered practical and economical to drop the header and descriptors and to reorganize the packets for optimum shuttle performance. This must be an industry standard for interchangeability reasons. (Encryption etc., could be a problem). In general how flexible is the transport coding.

5. Migration to higher quality.

- *Is it realistic to consider to transmit terrestrial HDTV at regular quality, and to reserve the augmentation for satellite and cable transmissions.*
- *I see some major problems (S/N) for higher level QAM or assigning a second RF channel for enhancement data.*
- *How does the receiver identify where the enhancement channel is (channel coded into the header, or channels allocated in pairs?)*
- *How can the home VCR handle this?*

6. International interoperability.

- *Our main objective is to create a US terrestrial transmission standard. 18 Mbps in a 6 MHz channel.*
- *The 625 line countries have typically an 8 MHz terrestrial channel, with different frame rate and a different compression requirement. This, in case any of the transmissions will be terrestrial, the plan has been to transmit HDTV via satellite with possibly even wider bandwidth.*
- *We have already a new proposal from Europe for a 1152 x 1440 standard, which is not related to any of the present format proposals.*
- *The best way toward international standardization might be to create a US standard as soon as possible, with maximum flexibility (interoperability) and a system that is easy to convert to other standards.*

Jukka Hamalainen

JEGI Doc.-034
RECEIVED
NOV 2 9 1993
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

INTEROPERABILITY WITH FILM

The assets of a film studio are its library titles: whether feature films or television programing produced on film. The revenues generated by a film studio are maximized by distributing its assets in as wide a variety of markets as possible. Distribution by electronic means is a major source of revenue at present, and is expected to increase in share in the future. This is the case for both the domestic and international markets. It is for these reasons that the film production community cannot accept a trade of spatial resolution for higher picture repetition rates.

The Technology Council of the Motion Picture-Television Industry has issued a document calling for a digital mastering format for film: progressively scanned, 24 frames per second with a vertical resolution of greater than 1000 lines. This would serve the international market as it can now be seen to be developing. Europe will almost certainly adopt a standard greater than 1000 lines, Japan has already done so. Feature films for the Japanese market are in preparation for laser disc release now.

It should be noted that the export market for entertainment programing is an important one for Hollywood, even though it represents only 40% of its gross entertainment product. It is second only to aircraft in manufactured product for the United States, with a net positive balance of trade estimated at nearly two billion dollars per year.

The Technology Council is in the process of preparing a comprehensive list of user requirements but it has been recognized that a digital mastering format for film will have to be supported by a recording system with all the features currently in daily use at television studios, such as editors, time code generators et al. Such ancillary equipment will be necessary for the preparation of the digital masters themselves as well as derivative sub-masters as may be needed for electronic distribution.

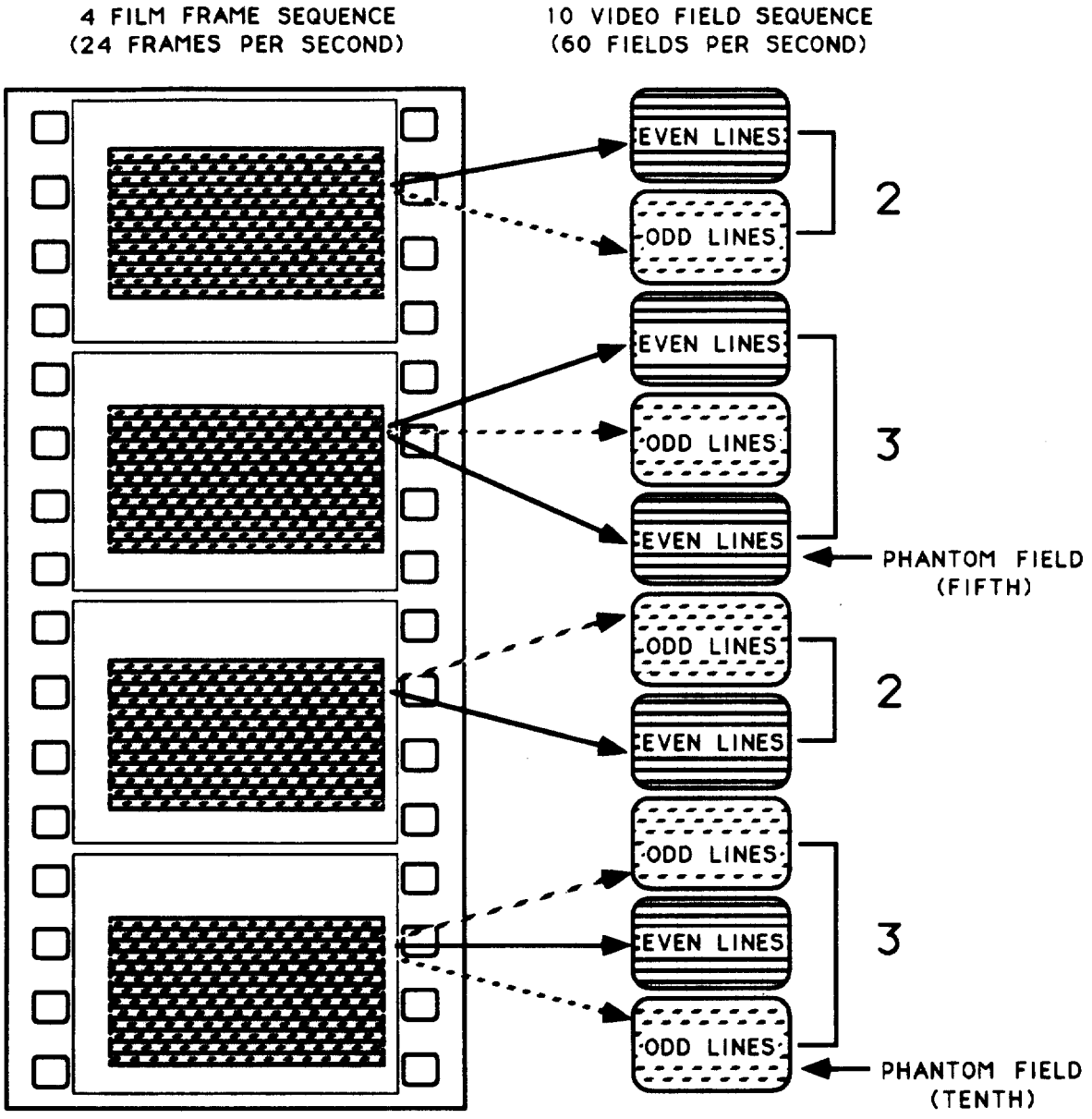
Sony Pictures Studios wishes to lend its support to the format with the highest spatial resolution under consideration, namely

1920X1080; and, in so doing to add its voice to the unanimity of the ACATS Technical Subgroup chaired by Dr. Flaherty and Dr. Dorros. We call upon television broadcasters to converge as well on this format to help reduce the cost of program preparation equipment which does not enjoy the economies of scale of the consumer marketplace.

The technical merits and cost benefits of an interlace, high spatial resolution system for film is detailed in the accompanying diagram. As can be seen, a progressively scanned, 24 frame, digital master is inherent in the digital record. Moreover it should be noted that a clear migration path to a 60 frame per second, progressively scanned image of greater than 1000 lines is also inherent in this approach. In fact, should a receiver manufacturer wish to implement such a display for a film program , it could be delivered to the home by the Grand Alliance proposal and displayed even now.

William G. Connolly
Sony Pictures High Definition Center

TELECINE 3/2 PULLDOWN SEQUENCE



- THERE IS <u>NO TEMPORAL CHANGE</u> BETWEEN FIELDS WHEN SCANNING A FILM FRAME
- CURRENTLY, LINES CONSTITUTING THE FILM FRAME ARE CLOCKED OUT ALTERNATELY
- THIS RESULTS IN AN IMAGE IDENTICAL TO A PROGRESSIVELY SCANNED IMAGE

NOTE: BY DROPPING EACH FIFTH PHANTOM VIDEO FIELD A 24 F.P.S. VIDEO SEQUENCE RESULTS

RECEIVED
NOV 2 9 1993
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

ARPA HDS COMMENTS & CONCERNS

- DoD is an interested party to HDTV proceedings only as it impacts issues such as the capture, transmission, switching, analysis and display of high quality text (e.g. manuals), maps and intelligence imagery. DoD's perspective is that of a user.

- Military competitiveness means "winning the information war". Being on the leading edge of the information integration revolution is a necessary part of winning the information war. If HDTV standards can accelerate the information revolution in the United States, DoD is a very interested party. (And in such a case, is one of very many such parties.)

- DoD must be able to win the information war "any time, anywhere." US leadership in HDTV standards setting, if done right and soon, can plausibly lead to one worldwide standard. From a social good perspective, economies of scale will help disadvantaged people in the US and around the world become part of the information age.

- From a military perspective, a single progressively scanned HDTV standard adopted worldwide will make the information technology components of the "any time, anywhere" force more affordable, simplify logistics for US forces in other countries, and increase the ability of US forces to the use the infrastructure of host countries

- One of the key advances in information technology that will be occurring over the next decade is the convergence of video, computing and telecommunications

- The choice of forward-looking US HDTV standards can hurry the day of this oft-predicted convergence, helping maintain the US edge in information technology

- While there are many detailed technical considerations, the central technical <u>requirement</u> for DoD interest in HDTV is:

Interoperability with computer systems

Which requires:
- Digital
- Progressive scan-square pixels
- Header/Descriptors

While progressive scan-square pixels are included in the GA proposal, as we understand them to date, there is included in there an interlace-round pixel option as an "interim" standard for transmission. Our concerns are:

1. Interlace may not be "interim" but it is intermediate. i.e. it does not seem to bring us closer to the sort of system that would meet our needs.
2. We understand the path from interlace to proscan for cameras and TVs, but do not understand this for the transmission channel. We have a suspicion that an "interim" solution would delay the right solution.

- Given DoD's needs in this area, and if HDTV is more than an entertainment delivery system, DoD is willing to partake in some testing of HDTV systems with respect to their performance on maps, manuals, and images. These applications were completely outside the scope of the test cases used to date.
- If involved in testing, DoD would look for cost sharing arrangements with other interested parties with similar requirements, such as the computer and information industries.

JEGI Doc.-036

Jack Fuhrer
Hitachi America, Ltd.
HDTV Receiver and VCR Manufacturer

RECEIVED
NOV 2 9 1993
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Grand Alliance and MPEG2

The Grand Alliance proposal is moving towards a position of incompatibility with the MPEG2 standard. Currently the GA proposal for transport is a constrained set of the MPEG2 systems layer. These constraints exist partly as a limit of parameters to make MPEG2 systems an implementable design and partly to identify those features of the systems layer which are not needed by the Grand Alliance. Thus it will be possible to construct a system decoder for GA HDTV which will not necessarily recognize all the functionality of the MPEG2 systems layer, however, any GA bit stream should be compliant to MPEG2 systems standard and thus be processed by any MPEG2 systems decoder.

In video coding the GA proposal has syntax features which where deemed unnecessary by the MPEG video group (AC leak). Thus any GA video bit stream is potentially undecodable by a standard MPEG2 main profile decoder. It is reasonable and logical to constrain the GA proposal to be a valid subset of MPEG2. This will insure that any GA bit streams are decodable on any MPEG2 main profile high level equipment. This will lead to interoperability between GA bit streams and any future equipment which makes use of the international standard. The current roadblock to this interoperability is the AC leak syntax.

RECEIVED

NOV 29 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Comments From Gary Demos
FCC ATV Interoperability Review Board Member
6 October 1993

Attachments: *8 Page List of Questions for G.A.*
Cooperation Between SMPTE and MPEG Systems (UniPack/MPEG-2 summary)
MPEG-2 Transport Stream Mapping and Adaptation Layer Fields for ATM
Use of adaptation_field_control reserved code (UniPack/MPEG-2 mapping)

My Major Concerns:

Interlace is not interoperable.

59.94 and 60.0 Hz are problematic, when 70+ Hz is required.

I don't believe the assertion that 59.94/60 Hz on 72/75/76 Hz display is acceptable.

We need a reference resolution for creation of N.I.I. content. I suggest 1280 x 720 prog.

Low latency is critical for N.I.I. interactive use. Only the AC leak can provide this.

Other Concerns:

Should an overlay plane definition be part of the ATV system?
Should an open text and graphics language (like SGML) be specified as part of ATV?
Multiscan is an unacceptable requirement for all receivers. Should only be premium units.
Interaction of the transport stream, universal header, encryption, and ATM needs testing

Suggestions:

The G.A. system should be made flexible in aspect ratio for movies (1.33, 1.85, 2.35).

By locking down 1280 and 1920 as horizontal resolutions, a variety of vertical resolutions, using square pixels, can be used to support a variet of aspect ratios.

1440 x 1080 should be replaced with 1280 x 1080 for compatibility with 1280 x 720.
- If non square pixels are going to be used, maintaining 1280 horizontal is preferrable

1920 x 1080 at 24 Hz is apparenly feasible now with the G.A. system.

Use residuals to enhance from 1280 x 720 to 1920 x 1080.
- minimizing 1280 x 720 decoding costs.
- allowing 1280 x 720 displays to receive all ATV pictures.
- ensuring N.I.I. compatible progressive scan capability, compliant with reference.
- residuals can enhance picture further for 40 Mbit/sec cable systems.
- residuals can enhance picture for DVTR release using 50Mbits/second.

A high resolution still image mode (like Photo-CD) should be created and tested.

Conditional replenishment, is association with alpha blending should be part of ATV.

The G.A. should evaluate UniPack as a universal packet header candidate, since its definition is mostly worked out in the context of the the G.A./ MPEG-2 transport

Synchronize nationally to the 8kHz ATM/Sonet clock

Questions From Gary Demos
FCC ATV Interoperability Review Board Member

FCC ATV Interoperability Review, October 6,7 1993

Questions For The Grand Alliance

Computer Screen Text And Graphics Display

1. *How would you propose to handle non-band-limited image data? Such data is typically presented on computer screens as text, window borders, and graphics. Such data is typically raster-aligned and is usually created from a source format such as run-length coding, Adobe Postscript (tm), Apple Macintosh quickdraw (tm), X-Windows (for Unix), or Microsoft Windows (tm) (for PC DOS). Would you use overlay planes in the receiving device? If so, how many bit planes should be specified(2 or 4)? If no overlay planes are specified as part of the system, would you put this image data of text and graphics through your compression algorithm?*

2. *If overlay planes are selected as the preferred mode of sending text and graphics overlays, how would you propose that WP-2 test this capability?*

3. *Are the data areas in your system sufficiently robust, or could they be augmented with further error correction such they might contain graphics screen data as described above (in 1)? Postscript and other screen or printer formatting data types are extremely intolerant to errors. How could errors during screen display be handled if they were to occur? How should WP-2 test the sending of such graphic and text representational formats in the presence of anticipated impairments and errors?*

4. *What mechanism should be used to decide what screen presentation language formats should be supported by advanced television systems? Should the FCC decide using one or more non-proprietary data representations, or should proprietary and non-proprietary display data representations be supported? Example choices might be open standards such as Standard Generalized Markup Language (SGML) using Clear Text (ASCII) encoding (or Binary encoding), or alternatively Open Document Architecture (ODA). A Document Type Descriptor (DTD) for SGML could be easily defined for ATV use. What complexity would be associated with supporting more than one such format for interpretation to everydisplay? What graphics language and syntax should be used to support maps and other graphics?*

5. *Would you expect to see numerous fonts supported in every receiver? What would be the additional receiver display system complexity associated with a large number of fonts vs a few simple fonts? Should the fonts be standardized for every receiver? If so, should WP-2 test the set of fonts selected? Should WP-2 test graphics and text language compliance and functionality?*

6. *Jim Clark, the founder and Chairman of the Board of Silicon Graphics, says that we should plan for 3-D computer graphics in the receiving display. How do you think such 3-D graphics would be integrated with the advanced television picture? How would you expect to support 3-D graphics, and what data formats would you expect to use? Is the data area appropriate and sufficient for this purpose?*

7. *If 3-D graphics were to be used for a backgrounds, and advanced television were to be used for foregrounds, a transparency (or alpha) channel would be required in order to provide anti-aliased matte edges. How would you anticipate sending a partial image together with a transparency channel for such a 3-D and advanced television hybrid moving image? Could there be a mechanism for supporting multiple optional overlays using this technique (e.g. for maps). If such an image compositing capability is feasible with the G.A. system, how should WP-2 go about testing this capability?*

Flexibility Of System

1. *Is the G.A. system somewhat independent of scanning parameters, within limits? What do you estimate the range of such flexibility in scanning parameters might be?*

2. *Should WP-2 test the limits of flexibility of resolution and frame rate for the G.A. system? How should WP-2 go about performing such tests?*

Reference System

1. *Should there be a reference display that could be used to compose text, graphics, and other image material?*

2. *Should the reference display have the resolution of 1280 x 720? Would this be sufficient and suitable as the reference for all National Information Infrastructure (N.I.I.) uses? (Such uses might include education, medicine, collaborative work, library reference, scientific research, etc.)*

3. *If 1280 x 720 is used as the progressive scan and square pixel reference display for composing image material, would not the "1000" line format need to be at least as good in displaying these images as the reference? Would not the "1000" line format therefore need to be progressive scan, since interlace at this resolution would be unnacceptably inferior to the 1280 x 720 reference?*

4. *How would WP-2 test compliance with the display quality of the reference used to compose images, text, and graphics for interoperable uses?*

Receivers

1. *What is the concept of the G.A. concerning formats accepted by receivers? Is it anticipated that receivers will all need to be multi-scan-rate? Doesn't this cause a cost burden on every receiver, and preclude providing low cost receivers?*

2. *If 1280 x 720 progressive were to be the "reference system", would it be the intention of the G.A. to support all formats for direct and optimal display on 1280 x 720 single-scan-rate receivers? How could cost be optimized for any format conversions required in order for all G.A. transmitted formats to be optimally presented on 1280 x 720?*

3. *Would data rates and memory sizes be optimal if a 1280 x 720 signal were always present in the ATV signal, such that it could always be decoded directly?*

4. *For presentation of ATV images created using a reference 1280 x 720 system, do you anticipate that 480 line NTSC would have to zoom a factor of 3/2 using progressive scan NTSC (ITV), and a factor of 3 using normal interlaced NTSC, in order to read the text and graphics acceptably?*

Resolution Scalability

1. *Could your system be expanded to include resolution scalability in the compressed format?*

2. *It appears that receiver cost would be optimized at 1280 x 720 if the 1280 x 720 ATV signal were to be decoded directly (without conversion from higher resolution formats). Would this not be optimized if any higher resolution formats, such as 1920 x 1080, were coded as*

a residual on top of 1280 x 720? Would not the optimal quality and lowest cost be provided for a 1280 x 720-only display if the ATV signal is always present at this resolution, and the residual for 1920 x 1080 (or other higher resolution) could be ignored.

3. *Will the proposed G.A. system have a higher priority portion of the transmission, like the former ATRC and AT&T/Zenith proposals)? Could a reduced resolution format be decoded from the higher priority?*

4. *The G.A. has indicated that they are interested in being compatible to some degree with MPEG-2 transport and compression. How will this affect the desire by some to use MPEG-2 for multiple NTSC channels in one 6MHz band? Will it be possible to share a 6 MHz band between both MPEG-2 and ATV in the same modulation? What would be the proportional bit rates for such a shared channel? Would 5 Mbits/second be used for MPEG-2 and 15 Mbits/second be used for ATV, with 20 Mbits/second as rate of the 6 MHz modulation (after ECC)? Would it be more efficient to code wide-screen progressive-scan NTSC at 864 x 486 as part of a layered ATV signal, with residuals for 1280 x 720 and 1920 x 1080 resolution enhancements?*

5. *What is your estimate of the cost of a receiver for each year during the next decade for your full advanced television format?*

6. *Zenith has demonstrated 40 Mbits/second over a 6MHz channel on cable. If this doubled data rate were to be allocated for augmentation of the advanced television picture, could your system be expanded to offer higher resolution beyond the first 20 Mbit/sec advanced television format? Should WP-2 test the ability of the G.A. system to offer higher resolution using 40 Mbits/sec? Would the resolution best be enhanced by using a resolution-enhancing residual?*

7. *How important do you think square pixels and progressive scanning may be in creating resolution scalability?*

8. *How could your system be used to send a color still image to a color printer? Could the data area be used in conjunction with the main picture stream to provide this capability? What higher resolution could be achieved? What should WP-2 do to test high resolution still image transport using the G.A. system?*

Temporal Rate

1. *It is my understanding that the proposed G.A. system can provide a 24 frame per second image stream from motion pictures, such that a 72 Hz refresh display could be used. Is this correct?*

2. *Computer displays require a refresh rate which exceeds 70 Hz. How can your system be used or modified to allow presentation of advanced television on computer displays in the home or office? Would there be motion artifacts in such a presentation, and if so, how problematic is their appearance? How would you propose testing this for acceptability in the interoperability testing which will be performed under WP-2?*

3. *If both 59.94 and 60.0 Hz are found to be unworkable for these reasons, could your system be adapted to 72 or 75 Hz? How big of a modification would be required and what would be the expected performance?*

4. *If temporal rate compatibility with computer displays is deemed to be critical, can these temporal rate issues be tested with your system? How much time and effort might such testing take? Can we plan for operating the G.A. system at 72 /75 Hz in the WP-2 testing process in order to verify operation at these refresh rates.*

5. *It appears that there is a cost advantage from having the display rate be an integral multiple of the image update rate. For example, if the display rate is 72 Hz, then the image update rates of 72, 36, and 24 images per second are integral multiples (or 75, 37.5, 25). Use of integral rates allows double buffering. Use of non-integral rates, such as 24 frames per second for movies and 60 Hz for display, requires triple buffers to adjust for the non-integral rate relationship. Similarly, artifacts are minimized by integral relationships. Would there be a cost and performance advantage by restricting the ATV rates to 24, 36, and 72, or 25, 37.5 and 75?*

6. *The strong pressure to have ATV operate at 59.94 Hz and 60.0 Hz is coming primarily from those who favor entertainment-only and passive television-only uses. These have primarily been broadcasters, although others have also endorsed these numbers. Since NTSC, which is the source of this rate, is a low resolution medium, why is it being used to set the ATV rate? Isn't motion picture film, which operates at 24 frames per second, the more dominant force in selecting an appropriate ATV frame rate, since film represents our vast resource of existing high resolution materials. Is it proper that the broadcasters and other interests who are pressuring for 59.94 and/or 60.0 Hz carry so much weight that they are precluding an objective consideration of 72 or 75 Hz as the appropriate rate for ATV?*

7. *Zenith demonstrated 40 Mbits/second in a 6MHz band on cable. How best should the extra 20 Mbits/second be used? Zenith demonstrated a pair of 20Mbits/second ATV channels. Would some combination of enhanced resolution and improved temporal rate be another appropriate use of the factor of two increase in data rate available on Cable? Would this best be done by using a temporal rate enhancing residual as well as a resolution enhancing residual?*

Temporal Rate Scalability

1. *Could the use of motion vectors and compressed corrections, which is the G.A. proposal, be used to create a hierarchy of temporal decoding rates? For example, could 24, 36, and 72 Hz image update rates all be decoded directly from the same scalably compressed format? When is it estimated that motion vector technology will be useful for temporal rate conversion? Are estimates correct that this is at least ten years away?*

2. *Can your system be modified or adapted to update different regions of the image at different temporal rates? If your system already does this in a hidden fashion, is it possible to provide this "conditional replenishment" update capability more explicitly to more fully optimize image presentation?*

3. *Should conditional replenishment or variable screen update capabilities be tested by WP-2?*

4. *Can your system be adapted to provide higher resolution at 24 frames per second than for higher frame rates? In your opinion, would such higher resolution at 24 frames per second provide an enhanced viewing experience of movies over using the same resolution for 24 frame per second material as for the higher rates?*

5. *What should WP-2 be testing with respect to 24 frame per second material? The previous round of testing did not test this directly, but rather only tested 3/2 pulldown embedded in the signal. Should enhanced resolution at 24 frames per second be tested in WP-2?*

Channel Capacity Scalability

1. *During the next ten to twenty years, fiber communication will provide bandwidth to homes and offices in the hundreds or thousands of megabits. The proposed advanced television formats use approximately 20 Mbits/second. How should capacity of hundreds or thousands of megabits be best used? Can your system easily scale to use 40 or 80 Mbits/second? What format parameters would you improve? Examples include wider gamut colorimetry and dynamic range (more bits per pixel), wide screen aspect ratios, higher resolution,*

more sound channels, higher temporal rate, stereoscopic display, multiple screens, parallel information channels, etc.

2. *If greatly increased digital capacity were to be available in the future, could you adjust your system to use variable data rate in order to provide more constant image quality?*

3. *What should be tested in WP-2 with regard to the G.A. system's capability for utilizing 40 Mbits/sec or for using variable data rates between 20 and 40 Mbits/second?*

Channel Interoperability

1. *In the G.A. proposal, 188byte packets are used with a 184 byte payload. How would such packet schemes be related to such protocols as ATM which uses 53 byte packets with a 48 byte payload? How would packet priority be used with ATM or other such systems? How would packet dropping or errors be handled?*

2. *What does the G.A. think of the proposal to use one byte in each ATM cell which is divided into 4 bits of sequence number, 3 bits to form a 12 bit checksum with the three other cells, and 1 bit for an ECC code block flag? The sequence number identifies dropped packets, the checksum identifiers errored packets, and the ECC code flag allows low cost decoders to ignore error correction blocks.*

3. *What should be tested in WP-2 with respect to ATM transport of the G.A. data stream?*

Clock Synchronization

1. *A variety of applications will require synchomization of multiple ATV images, including collaborative work, video conferencing, and multiple ATV windows on the screen. How is this best achieved?*

2. *The ATM/Sonet network will have a nation-wide 8kHz reference clock. Would it be a reasonable plan to lock all ATV sources to the nationwide 8kHz clock reference?*

3. *If no synchronization is provided, how much cost and quality degradation do you estimate for the picture and for the audio due to the required resampling?*

4. *Should WP-2 test synchronization of multiple ATV signals in a collaborative work simulation?*

5. *MPEG-2 and CCIR-601/656 have selected a 27 MHz data clock for use with a 13.5 MHz pixel clock. The 27 MHz clock is biased toward non-square pixel formats using 720 pixels in CCIR 601. This is highly problematic for interoperable computer applications which require square pixels and progressive scan. What is the plan for ATV clock rates?*

Data Encryption

1. *It may be desirable to encrypt the advanced television data in order to protect the image and sound from unauthorized viewing. Although the advanced television proposed systems are being tested in the presence of data errors, they are possibly not being tested in an encrypted form. What encryption algorithm for your system's data do you favor? How sensitive is such an algorithm to errors in the data? How would data errors affect the picture quality since the data errors occur in the encrypted data stream? How would networks such as ATM networks with potential packet reordering or dropping affect encrypted data?*

2. *What should be tested in WP-2 with respect to encryption and data errors?*

Latency

1. *Many applications of ATV will require interactive use. The most critical factor in interactive use of ATV will be the end-to-end delay. In the first G.A. presentation, it was indicated that the AC-Leak can achieve an end-to-end delay of 1/10 of a second, whereas the use of I-frames (as in MPEG and MPEG-2) results in an end-to-end delay of 1/2 second. Are these delay times, as presented previously by the G.A., correct?*

2. *Isn't this a crucial issue for ATV system architecture for such applications as video conferencing, collaborative work, interactive server-based games, and navigation of services? If so, isn't the need for the AC Leak a critical requirement?*

3. *Since the use of I-frames, in the style of MPEG-2, is said to cause a 1/2 second end-to-end delay, how much more delay is added by the use of B-frames? Aren't B-frames only useful for coding 24-frame per second movies?*

Interactive Two-Way Communication

1. *Current television delivery via terrestrial broadcast, satellite, and cable is predominantly one-way broadcast. When fiber systems come into existence, two way interactive communication will become feasible. How would you best make use of this two way or interactive communication capability with your advanced television system?*

2. *What is your estimate of the cost of an originating workstation for teleconferencing in your advanced television format over each of the next ten years?*

Storage Media

1. *How would you propose to format advanced television on video tape and video disk type devices? What would be the likely affect of media errors? How might fast forward and fast reverse be implemented?*

2. *Is it feasible to have scalable quality levels for media such as video tape and video disk? Could useful advanced television be presented at 5, 10, 25, 40, 50, or 80 Mbits/second to provide various cost/quality and play length levels? Would a layered residual compression format be optimal for providing this flexibility?*

Compression Efficiency Extensibility

1. *Digital image compression technology, upon which all of the digital HDTV proposals are based, is a rapidly advancing field. Technical developments in just the last two years have seen major new developments and improvements in compression quality and efficiency. This trend is likely to continue for many years. How can your use of data compression take into account rapid major advancements in compression techniques? Can you devise a method to extend your system by upgrading to new more efficient compression while not resulting in immediate obsolescence for those receiving displays using the currently proposed compression technique?*

2. *Do you anticipate that decompression chips in receiving displays will be programmable to some degree? How would you take advantage of such programmability?*

Use Of Header/Descriptor

1. *In the proposed advanced television system, the packet and error protection structure is such that these are placed at the outer most layer. One goal of the header/descriptor is to help identify unknown data streams. For this purpose, it was originally conceived that the header/descriptor would be the outer-most layer. How could your system accommodate the header/descriptor as an outer-most layer? If you intend for the header/descriptor to be an inner layer, how would you propose that it serve its universal identification function for data streams?*

2. *The proposed advanced television system allows acceptable transmission of picture data in the presence of data errors. Audio data and data within the data area may need to be almost error-free. The header/descriptor must also be interpreted without errors in order to function properly. Redundant transmission, error-correction-interleaving, and a separate transport header are possible mechanisms. How might your system expect to support the error-free header interpretation requirement?*

3. *In some of the proposals, data is grouped into packets which are prioritized. In all proposals, the data contains the separate elements of audio, picture brightness, color, motion vectors, data areas, etc. How would you propose to use the header/descriptor to identify each such data sub-area?*

4. *The UniPack universal header proposal to SMPTE from Apple has been developed to work within the MPEG-2 transport layer. The MPEG-2 transport layer is being considered for use by the G.A. Would the UniPack universal packet header proposal therefore be suitable for the header/descriptor needs of the G.A. system?*

Resolution Hierarchy

1. *The format of 1280 x 720 will use a production format of perhaps 1312 x 738 to allow extra border for image processing. A resolution hierarchy for the lower resolution image of 864 x 486 and 648 x 486 would be based upon the scaling fraction 2/3. Most scalable image resolution hierarchies have been based upon 1/2. Do you feel it is feasible to build a scalable resolution compression hierarchy based upon a 2/3 scaling relationship?*

2. *If a 2/3 relationship is created, 1280 x 720 would be stepped up to the next higher resolution of 1920 x 1080. Are there advantages to using this 3/2 relationship over using a 4/3 relationship to 1706 x 960?*

3. *It appears that 1920 x 1080 is desired by some, but difficult to achieve at high frame rates. Some have proposed a compromise to the horizontal resolution down to 1440. The use of 1440 does not appear to interoperate well with 1280 horizontal in the 1280 x 720 format. Would it be appropriate to consider 1280 x 1080 as an alternative to 1440 x 1080? Would 1280 x 1080 result in reduced cost for receivers which operate at both the 720 and 1080 line formats?*

4. *There are many who feel that horizontal resolutions such as 4096, 3072, 2048, 1536, 1024, 1280, and 640 are most desirable for digital display systems due to the match between these resolutions and digital chips and circuits. There is therefore some sentiment that television systems based upon the CCIR 601 horizontal resolution of 720, which include 1408, 1440, and 1920, are not appropriate for many industries. Could your system's use of 1440 or 1408 be adjusted to either of the nearby values of 2048,1536, or 1280? Square pixels would yield 2048 x 1152 and1536 x 864 as well as the familiar 1280 x 720.*

5. *There have been groups considering production formats for the ATV distribution formats of 1920 x 1080 and 1280 x 720. Can you explain the inconsistency between production formats under consideration for 1280 x 720, which provide extra room for processing (perhaps 1312 x 738), and production formats for 1920 x 1080, which do not appear to have any extra room for processing?*

Resolution For Movies

1. *Movies operate at 24 frames per second. Can the highest resolution under present consideration, 1920 x 1080, be supported at this frame rate using the G.A. system?*

2. *Since the largest overall refenue factor in television is the presentation of film material, shouldn't the greatest attention in the selection of ATV be focused on performance and*

resolution at 24 frames per second? It appears that only sports coverage requires the higher frame rates.

3. *Using a rate of 24 frames per second, Jae Lim has indicated that his formerly proposed system can convey information at resolutions up to 2560 x 1440. Will the G.A. system retain this capability?*

4. *How much resolution and format aspect ratio flexibility is available for 24 frame per second movie material? Could the G.A. system support 2048 x 870 (2.35:1 aspect ratio), 2048 x 1108 (1.85:1), and/or 2048 x 1536 (1.33 :1)?*

16:9 Aspect Ratio

1. *There have been many who have pointed out problems created by the choice of a 16:9 aspect ratio. These problems include the absence of use in existing film production of this aspect ratio, as well as difficulties in constructing digital display circuits which fall more naturally on factor of two boundaries. Would your system easily accommodate a change to a 2:1 aspect ratio?*

2. *If a 2:1 aspect ratio were alternatively selected for ATV, what resolutions would you favor? Are 1280 x 640, 1440 x 720, 1536 x 768, 1920 x 960, or 2048 x 1024 among the possible choices?*

3. *Would it be desirable to send original material in its original aspect ratio, and require that the receiving device handling the blanking of the border areas? For example, 1.33,1.85, and 2.35 material would be sent at these original aspect ratios. Would it then be possible to have a variety of receiver displays in the market which support a variety of aspect ratios, as chosen by the consumer?*

4. *If multiple aspect ratios in the transmitted /distributed image format were to be used,,would it be better to fix the horizontal values or the vertical values of the material? For example, should 1.33, 1.85, and 2.35 aspect ratios all have a common horizontal resolution (perhaps 1280, 1920, or 2048), or should they have a common vertical value (perhaps 720, or 1024)? Is it correct that digital circuitry is more optimal if the horizontal value is kept constant when supporting multiple aspect ratios?*

Issues With Interlace

1. *How would you present non-band-limited image data on the interlaced display? Would the image presentation be limited to text and graphics in which horizontal features span at least two or four lines? Would this be done by magnifying existing text and graphics by a factor of two?*

2. *Can interlace at 960 or 1080 lines be able to display text and graphics with quality equal to or exceeding a 1280 x 720 reference? Since this appears unlikely, should consideration of an interlaced format be abandoned?*

3. *If you had to revise the interlaced format to have square pixels and be progressively scanned, what format would you favor? Does the G.A. favor 1706 x 960 or 1920 x 1080 as eventually being feasible at high frame rates using progressive scan?*

4. *There are many who feel that horizontal resolutions such as 4096, 3072, 2048, 1536, 1024, 1280, and 640 are most desirable for digital display systems due to the match between these resolutions and digital chips and circuits. There is therefore some sentiment that television systems based upon the CCIR 601 horizontal resolution of 720, which include 1408, 1440, and 1920, are not appropriate for many industries. Could your system's use of 1440 or 1408 be adjusted to either of the nearby values of 2048,1536, or 1280? Square pixels would yield 2048 x 1152 and1536 x 864 as well as the familiar 1280 x 720.*

5. *Why is interlace being considered in the G.A. system? 1280 x 720 is both progressive scan and square pixels at high frame rates suitable for sports. Why is this not completely sufficient for coverage of sports, which is the primary need for high frame rates?*

6. *The desire for high resolution is satisfied at 1920 x 1080 (or other nearby resolution), which appears achievable at 24 frames per second. The desire for rapid frame rate coverage for sports is achieved by using 1280 x 720. What need is there for 1920 x 1080 (or other nearby resolution) using interlace, since the needs and desires of the system appear to be met without the use of an interlaced format?*

(end)

Source:	Joseph Stampleman, Apple Computer
Distribution:	MPEG Systems group
Date:	May 13, 1993
Subject:	Cooperation between SMPTE and MPEG Systems

Introduction

Apple Computer is submitting to SMPTE a universal video header format proposal called "UniPack" which is being distributed along with this document. Our goal is not to try convince MPEG-2 to adopt this video format. Our primary goal is to propose UniPack as an example of a more flexible, feature-rich data format that meets the long-term goals of the SMPTE header work. Once all of the SMPTE proposals have been reconciled, we hope that the result will indeed be a data syntax that, while being more complex, will provide a larger feature set.

However, we don't think of a SMPTE universal header format necessarily as a mutually exclusive alternative to the MPEG-2 transport layer (although it can be used in that way). Our reason for bringing this work directly to the attention to MPEG-2 is that we believe it may be possible for a universal header to coexist with an MPEG-2 transport. Such a stream would therefore be readable by both a dedicated MPEG player and by a SMPTE-savvy one. MPEG-2 stream would benefit by being able to use the SMPTE headers. The purpose of this document is to describe how the two formats might coexist, and to suggest how MPEG-2 might best provide hooks for use of such a header.

We welcome comments on both UniPack and on how a SMPTE universal header might coexist with the MPEG2 transport layer.

UniPack Summary

A UniPack stream is a group of successive packets. There are several different types of packets. All packets include a length field. All packets contain a header that identifies the packet type, information that accompanies all headers of that type, and a checksum. Some packets contain a "directory" (see below) that precedes a payload. Most packets contain a payload. All of these data structures (header, directories, payloads) are quadword aligned.

The nature of all data items in UniPack is identified by a 64-bit identifier that denotes the standard that's being used. For example, the identifier might declare that the operative standards body is ISO, and within that, MPEG, and then within that, MPEG-2 video. Similarly, the identifier might declare ANSI, and within that, Apple, and then within that, any format that Apple chooses to support. These 64-bit identifiers do not need to be transmitted repeatedly- they can be "defaulted" - or inferred - from previous declarations within that channel. UniPack channels correspond roughly to MPEG programs. In this way, the meaning of identifiers within UniPack can be tailored to support a wide variety of uses, and can be so defined by registered users of the standard.

Some packets contain directories. These define a map of what sorts of data are contained in the packet's payload. This mapping then permits the stream to