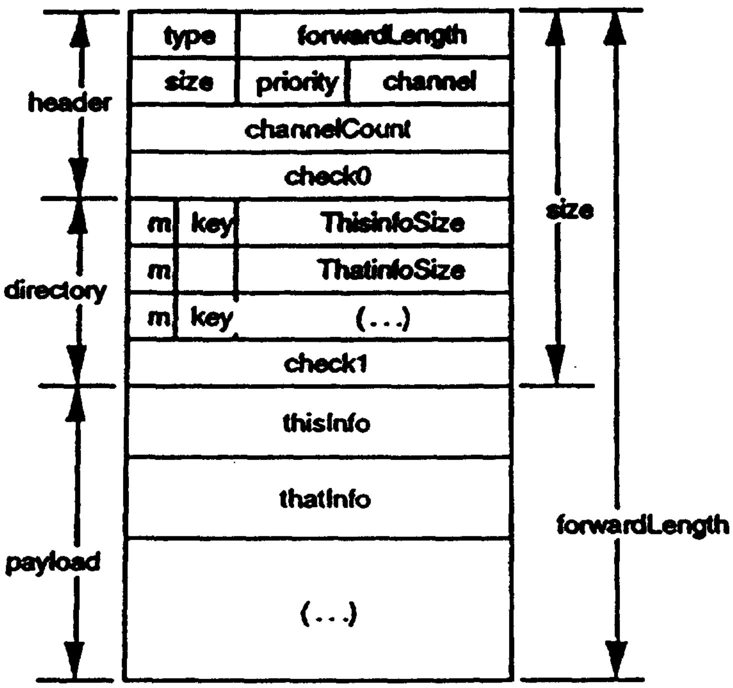


Sample UniPack Packet Format: Complete Packet

UniPack & MPEG2

The issue that we would like to explore is how SMPTE header structures might be usefully included in compliant MPEG-2 streams.

Why?

Such a stream could be playable both by a dedicated MPEG-2 player, and by a SMPTE-savvy system. An MPEG player would perform as it would with other MPEG streams since it would just ignore the SMPTE header. However, players that understand the SMPTE header would have 2 main advantages.

The *first* advantage is the variety of data structures it can carry. This would permit the use of any number of registered error correction mechanisms, timing specifications, titling formats, copyright information, etc...

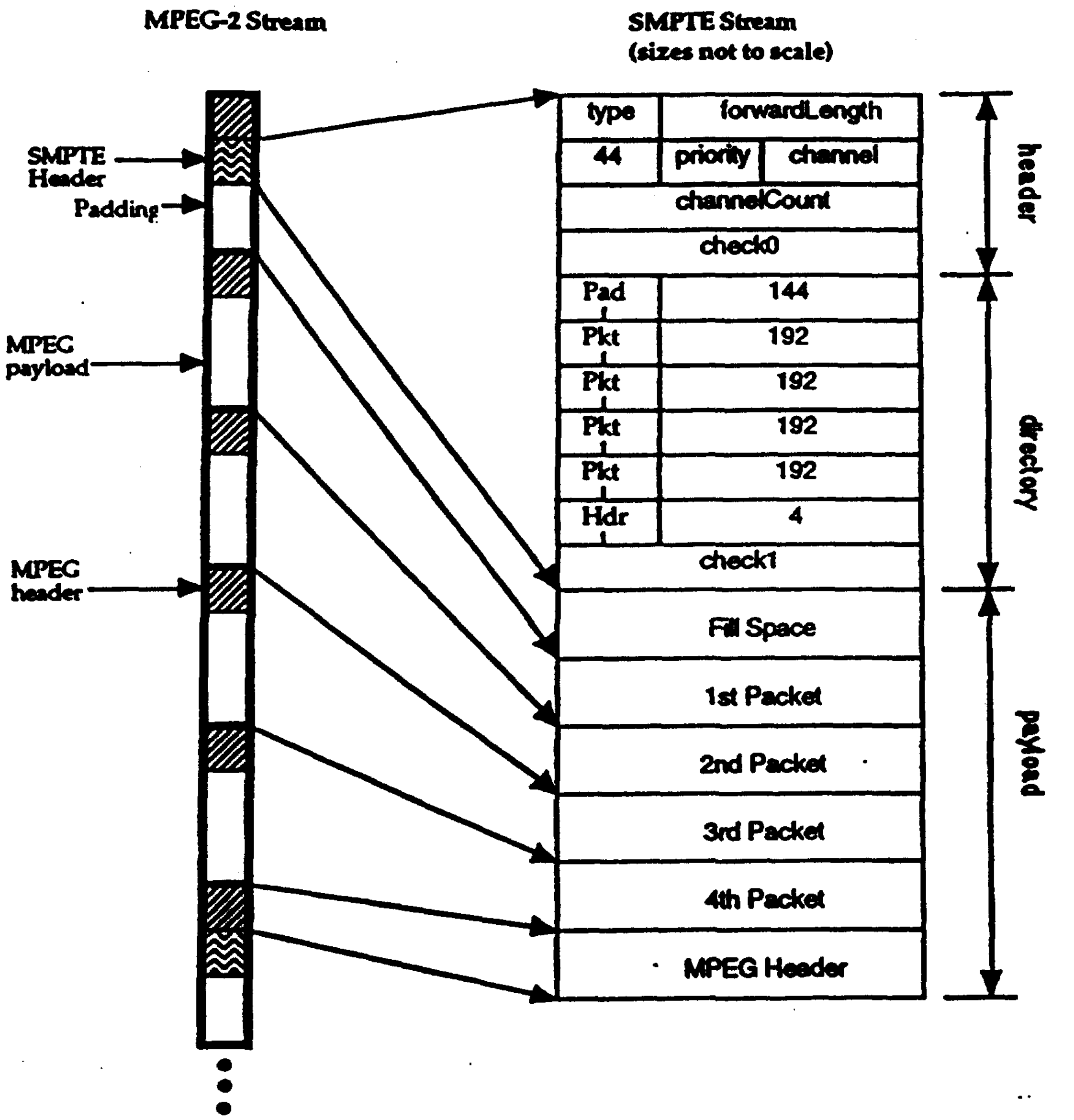
The other main advantage is that the SMPTE header includes information that allows a stream to identify the standard that was used to produce it. This makes it possible for a player to recognize and decode a wide variety of standards. As long as a standard has been registered with a recognized standards body, it will have a unique identifier that will enable it to be unambiguously identified.

Example

One way in which a SMPTE header might be included in an MPEG stream would be to include 2 bits in the MPEG header that would indicate that the packet's payload is universal header information for the identified channel as opposed to coded data. Two bits would be used to distinguish between the first header-carrying transport packet and subsequent ones. Please see the diagram on next page.

Another way of including a universal header might be to include the header using a mechanism similar to the manner in which private data is included in the current working draft.

Another method might be to put the header in the as-yet-undefined PID0 packets.



Example MPEG-2 transport stream with imbedded SMPTE header

Both diagrams are different views of the same bitstream. The one on the left shows an MPEG-2 bitstream that has a packet containing a SMPTE header referencing several MPEG packets. The diagram on the right shows a SMPTE packet whose payload consists of padding (for alignment purposes), packets, and the MPEG header data that precedes the next SMPTE header.

MPEG-2 suggestions

We strongly urge that MPEG-2 make specific provisions for including SMPTE universal headers in all of the system syntax specifications. We also urge that the current byte-alignment between header data and payload data be maintained, and further suggest that quadword alignment be considered if possible.

We believe that the universal header should be identified by using a mechanism OTHER THAN private data. We urge that the mechanism by which this is done entail as little overhead as possible.

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ISO/IEC JTC1/SC29/WG11
MPEG93 / ___
September 1993

Source: Apple Computer - Gary Demos, David Singer, Joseph Stampleman
Title: MPEG-2 Transport Stream Mapping and Adaptation Layer Fields for ATM
Committite: Systems

Introduction

The choice of the AAL that is used to carry MPEG-2 data will greatly impact the quality of the delivered services. It is not anticipated that there will necessarily be discussions on this topic at the Brussels meeting. This document is intended to present some ideas on this topic so that whatever discussions do take place and then carry over to the appropriate forums might consider these proposals.

This document supports an AAL similar to that proposed by Sandy Macinnis & Randy Sharp (5 bits sequence & 3 bits checksum in each ATM packet). The only suggested change would be to reduce the number of bits in the sequence counter to 4 and add a bit that would be used to signal packets carrying optional extra Reed-Solomon information.

Sequence Counters & Checksums

The 188 byte size of the transport stream packets is meant to allow 4 bytes to be used with 4 ATM cells of 48 bytes each. It appears that no existing Adaptation Layers of ATM (AAL 1,3/4,&5) are optimal for this purpose. The mapping of the 188 bytes of MPEG-2 transport packets onto the 192 bytes of 4 ATM cells should be considered carefully in order to provide tools for appropriate reconstruction of MPEG-2 data in the presence of the kinds of losses which may occur on an ATM connection.

The kinds of losses which might be expected on an ATM connection are as follows:

1) If one or more bits are dropped in an ATM header (five bytes preceding the 48 byte cell payload), then the ATM 48-byte cell will not be received at the destination. The cell will be missing.

2) Congestion can also result in missing cells.

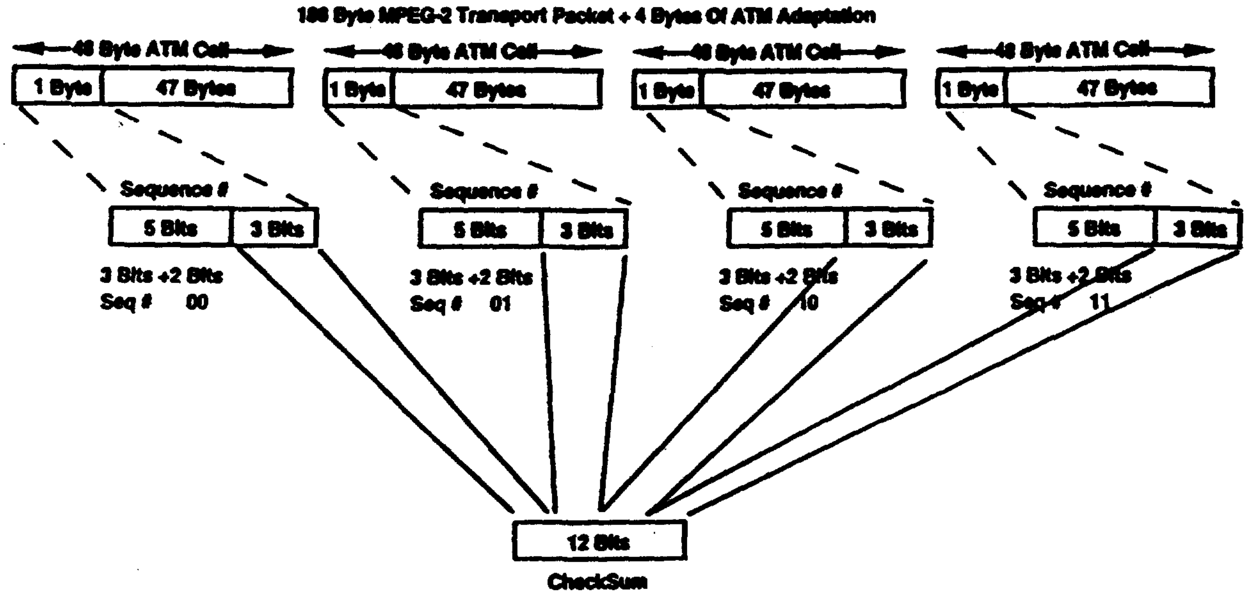
3) If one or more bits are dropped in the ATM 48-byte payload, the cell will be delivered, but its contents will be damaged.

There are two features which we feel are necessary in the Adaptation Layer Fields in order to assist in adapting to these likely error types.

1 - A sequence number is needed in each ATM cell in order to indicate which cells have not been delivered (if any).

2 - A checksum is needed in order to determine whether the data is valid in the four 48-byte cells making up the MPEG-2 188-byte cell.

It was proposed by Alexander (Sandy) Macinnis of Kalieda and Randy Sharpe of BBT in the July meeting that the following configuration be used for the ATM adaptation layer for MPEG-2 transport:



MPEG-2 ATM Adaptation Layer

The exact placement of the bits in each cell may not be accurate to their proposal, but for the purposes of discussion, the size of the fields is the main issue.

In this configuration, the four byte difference between 192 bytes (four 48-byte ATM cells) and 188 bytes (MPEG-2 packet) is applied as one byte in each of the four cells. Each byte is split into a sequence number field and a checksum field. Their proposal was to use 5 bits of sequence number and 3 bits of checksum. The 5 bits of sequence number will support counting up to 32 cells, and can therefore detect cell losses up to 31 in a row. The 5 bits is further naturally split into 2 bits of MPEG-2 cell position, and 3 bits of MPEG-2 cell sequence number. This allows the framing of the first, second, third, and fourth ATM cells in the MPEG-2 transport packet to be defined by the low 2 bits. Eight MPEG-2 transport packets can be sequenced.

The 3 bits of checksum can be combined over the 4 ATM cells to create a 12 bit checksum for the MPEG-2 transport packet. This supports bit checking accuracy to roughly one part in 4k, which is significantly more robust than a one byte checksum, which is only one in 256 in robustness.

It is certainly possible to adjust the allocations of these relative numbers of bits. It appears that 4 bits of sequence number and 4 bits of checksum would be workable, providing a 16 cycle sequence count, and a 16-bit checksum. The use of 6 bits of sequence number and 2 bits of checksum has the weakness that only a single byte would be available for the checksum. The use of 4 bits of sequence number and 3 bits of checksum provide adequate sequence counting and checksum.

By providing sequence numbers and a checksum, the location of errors and missing packets would be provided. This can be used with Reed-Solomon codes or other error correct codes to provide correction for lost or damaged ATM cells. Reed-Solomon codes, and other codes, can correct with twice the effectiveness if they can be informed of which cells are errored or missing, which can then be treated as "erasures".

If the checksum is incorrect, and it identifies a given packet as correct when it is flawed, then the Reed-Solomon (or other) code will still correct the packet, but with half the effectiveness. That is, it can be corrected, but only half as many cells can be corrected in this case with a given number of extra Reed-Solomon (or other) cells. The robustness of the checksum must be taken into account when designing the number of extra error correcting cells.

We therefore believe that the effectiveness of the adaptation layer is maximized by being able to provide sequence numbers and checksum validity information. Since a simple form of checksum would cover 4 ATM cells, the location of the error may not be identified to the cell, but rather to the group of 4 cells. However, with an appropriate checksum construction, it appears to be possible to identify which of the four ATM cells have error(s). Some care should be taken in the design of the checksum to ensure this cell identification capability. This capability does not appear feasible with a single byte checksum. Since the Reed-Solomon code, or other error correction code, will probably be arranged to correct entire lost cells, having a knowledge of which cells contain errors, to the individual cell, is the optimal goal.

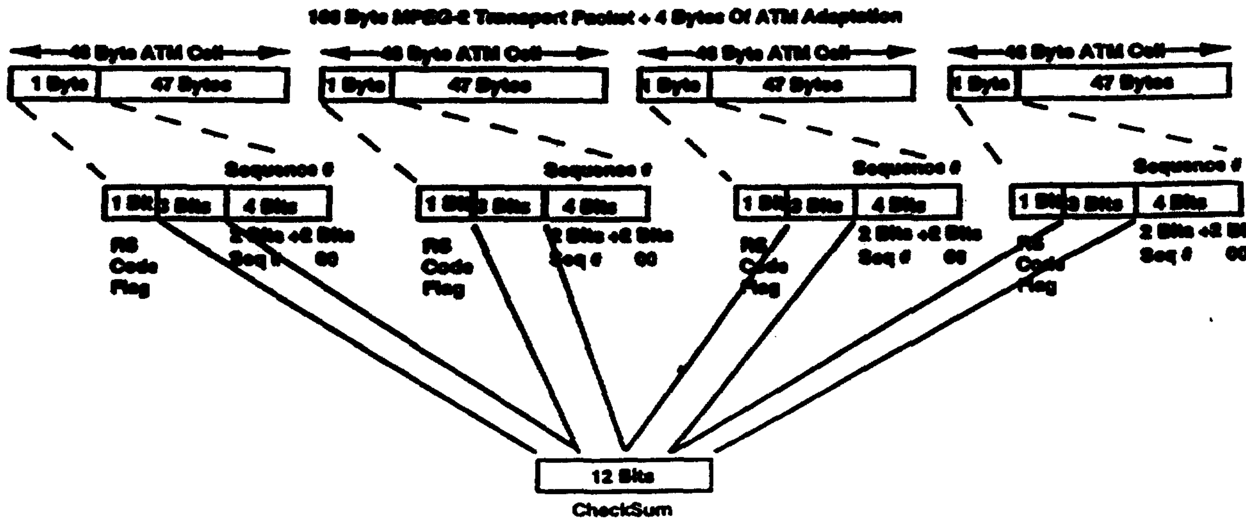
Alteration To Include RS Code Flag

Packet retry models, as are used in TCP/IP, and ATM Adaptation Layer 5 (AAL 5), may not be suitable for MPEG-2 transmission. The only viable alternatives to packet-retry, in the presence of errored or lost cells, are to attempt to suppress the bad data, or to attempt to correct the data. The use of an error correcting code is often more desirable.

When using Reed-Solomon error correction codes, or other error correction techniques, it would be desirable to be able to identify which cells contain the error correction codes, and which cells contain the MPEG-2 transport data. Assuming that an "in the clear" form of Reed-Solomon (or other error correcting code) is being used, it would be desirable to be able to identify and differentiate the clear cells from the error correcting cells. In this way, a lower cost decoder could ignore the error correcting cells, and thus avoid any need to decode the Reed-Solomon (or other error correcting) code. A more capable decoder which contains a Reed-Solomon (or other error correction) decoder would be able to correct for lost or errored cells up to the limits of the code being used.

It appears that the appropriate place to identify which cells are involved in error correcting codes is in the MPEG-2 transport adaptation to ATM. Thus, it may be appropriate to consider modifying the proposal by Alexander (Sandy) MacInnis of Kalieda and Randy Sharpe of BBT to add a bit for an error correction code flag. This bit would indicate whether the particular ATM 48-byte cell contains a quarter of an MPEG-2 transport packet, or whether it contains 47 bytes of Reed-Solomon (or other error correcting) code.

The following modification to the above proposal adds this RS Code flag, and reduces the number of bits in the sequence counter from 5 to 4:



Possible MPEG-2 ATM Adaptation Layer Including RS-Code Flag

The inclusion of the RS-Code flag in the high bit allows easy byte sign detection of the presence of absence of RS-Code data in each ATM cell. Maintaining 4 bits of sequence number and 3 bits (for 12 bits) of CheckSum still provides adequate ranges.

It may be desirable to establish a relationship between the sequence numbers and the positions of Reed-Solomon (or other) error correcting code blocks. For example, it may be desirable to continue incrementing the sequence number at the transition from the data cells to the error correction cells. However, it may be useful to set the sequence number of the next data cell following the last error correction cell to be the same sequence number as the first error correction cell. In this way, for decoders which cannot process the Reed-Solomon (or other) error correction codes, the sequence number of the MPEG-2 transport data will continuously increase without gaps.

For example:

Cell Type:	MPEG-2 data	MPEG-2 data	RS-Code	RS-Code	MPEG-2 data	MPEG-2 data
Sequence #	11	12	13	14	13	14

Since the RS-Code cells have the RS Code Flag set (=1), they can be identified and used by RS-capable decoders, and they can be ignored by decoders not capable of decoding the RS-Code.

For those cells involved in the RS-Code (or other code), the checksum will come in 3-bit increments. Thus, if two 48-byte cells are used for RS-Code (or other code), there will be 6-bits of checksum. If four bytes are used, there will be 12-bits, and if eight bytes are used, there will be 24 bits available for checksum. The checksum helps validate the sequence counter and the RS-Code bit, as well as the RS-Code (or other code) data. However, it is obvious that a 6-bit checksum is not robust. Thus, the use of the checksum field may need to be tailored to the particular RS-Code parameters and the particular use. For RS-Codes involving 4-cells or more of additional RS-data, a minimum of 12-bits of Checksum will be available.

Reed-Solomon Groups

In order to correct lost or errored cells, a typical configuration of Reed-Solomon code would be to add two, four, or eight extra cells to a cell group. Depending upon error conditions, up to two, four, or eight cells can be corrected, with one, three, and seven being correctable under other conditions. A cell group size might be 32, 48, 64, 96, 128, or 192 cells, depending upon the particular requirements. Smaller groups provide smaller latency, but start-up overheads in Reed-Solomon code pipelines suggest longer groups for effiency.
The following table indicates the resulting group sizes:

Group Size In Cells	Group Size In Bytes
32 + 2 = 34	34 * 48 = 1,632
32 + 4 = 36	36 * 48 = 1,728
48 + 2 = 50	50 * 48 = 2,400
48 + 4 = 52	52 * 48 = 2,496
48 + 8 = 56	56 * 48 = 2,688
64 + 2 = 66	66 * 48 = 3,168
64 + 4 = 72	68 * 48 = 3,264
64 + 8 = 72	72 * 48 = 3,456
96 + 8 = 104	104 * 48 = 4,992
128 + 8 = 136	136 * 48 = 6,528
192 + 8 = 200	200 * 48 = 9,600

These group sizes can be considered in relation to various typical network packet sizes:

Ethernet/IP	1.5k Bytes
FDDI	up to 4k Bytes
Fibre Channel	up to 2.1k Bytes

Since network packet sizes are related to potential uses of MPEG-2 transport on computer networks, it is relevant to consider the relationship of these ATM group sizes to network packet sizes. It should also be noted that ATM systems will often wish to carry network packets having these sizes, such as IP packets. Often such transport will use ATM Adaptation Layer 5 (AAL 5). However, a packet-retry model, such as AAL-5, may not be suitable for real-time media transport, such as MPEG-2. Thus, a model of transport wherein lost or errored cells are corrected may be more suitable.

It is thus suggested that the relationship of ATM, MPEG-2 transport, and computer networks be considered together. The inter-relationship of these transport issues suggests that a set of interoperability relationships may be suggested for how to group and transport MPEG-2 using ATM and computer networks.

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MPEG93 / ___
September 1993

Source: Apple Computer - Gary Demos, David Singer, Joseph Stampleman
Title: Use of adaption_field_control reserved code
Committee: Systems

Introduction

A goal of MPEG systems from the outset of the design of the transport bitstream has been extensibility. This document raises two questions related to this issue.

One question is the exact mechanism by which extensibility can be achieved. For example, when the adaption_field_control is coded with the reserved value, some currently defined values cease to have meaning. Could a packet using the reserved code use these fields? This and related questions need to be resolved.

Another question is the procedure by which reserved values can be "unreserved". What procedures need to be followed in order for MPEG to discuss, reach agreement on, and incorporate extensions?

Clarifications needed from members of the MPEG-2 Systems Committee:

1) How many of the fields other than the PID will be checked or needed in the transport_packet when the 2 bits of adaptation_field_control are set to the reserved code of 0? The draft document is unclear on this point. The document reads: " In current MPEG-2 decodes, a transport packet with the adaptation_field_control set to '00' shall be discarded." If this is true, we desire clarification of the requirements on other fields in this packet under this condition:

a) Is the sync byte required, or is this field available for other uses?
b) Is the transport_packet_error_indicator field available for use?
c) Can the PES_packet_start_indicator bit be given a different meaning?
d) Is transport priority needed or used in this context? Is it available?
e) Can any of these bits be used to extend the number of bits of the PID?
f) Is the transport_scrambling_control field available for use?

2) When the 2 bits of adaptation_field_control are set to the reserved code of 0, is it acceptable to make use of the PES_packet_start_indicator bit for purposes other than the start of a PES packet? For example, could this bit be used to indicate that this transport_packet contains a UniPack header when using the reserved code?

3) Would it be acceptable to use the PES_packet_start_indicator being 0 to indicate that this transport_packet contains payload for a previous UniPack header on this PID? Since the adaptation_field_control is set to the reserved code of 0, the data would not be MPEG-2 data in this context, since the packet would be discarded by MPEG-2 (only) decoders.

4) Is the transport_scrambling_control field available for other uses when the adaptation_field_control is set to the reserved code of 0? For example, could this 2 bit field be used as a continuity counter for UniPack payload packets when using the reseved code?

5) The sync_byte does not seem to be defined. Is it possible to specify the sync byte as being a CRC_8 over the subsequent 3 bytes? This would provide a more robust sync than a defined static sync code value, since the continuity_counter would yield a varying value. Such a varying value would ensure that

repetitive computer data would not perpetuate the static value within the data. If a static sync code value is required or already specified, what is this value? Could common values such as 0, 1, and 255 be avoided?

Depending upon the resolution and clarification of these issues, various UniPack universal packet header mappings onto MPEG-2 are possible. If we make the following set of assumptions concerning the clarifications, we can provide an example UniPack mapping onto MPEG-2 transport. These assumptions for this example, using the adaptation_field_control reserved code of 0, are:

*) The sync_byte must be present
*) The PID cannot be extended
*) The transport_packet_error_indicator must retain its meaning
*) The PES_packet_start_indicator is available as a UniPack header start
*) transport_priority retains its meaning
*) transport_scrambling_control is available as a UniPack continuity counter
*) The adaptation_field_control is set to the reserved code of 0
*) The continuity counter is not available, and obeys the behavior specified in the draft document which reads: "The continuity_counter shall not be incremented when the adaptation_field_control of the packet equals '00'".

Under these assumptions, the example intended mapping of UniPack onto MPEG-2 transport would be as follows. The existing MPEG-2 transport packet layer is shown first. Then an example UniPack header packet is shown, using the "complete packet" as the example. Next is shown a UniPack payload packet, where the PID is used to associate the data with a previous UniPack header packet on the same PID. The next drawing shows how a common data stream can contain data which is readable by both MPEG-2 readers as well as UniPack-savvy readers. For the UniPack-capable reader, extra information can be provided about the MPEG-2 packets on the same PID. Also, ECC and other support and check information can be interspersed using UniPack payload packets.

MPEG-2 Transport Packet Layer (from MPEG-2 Systems working draft):

Syntax	No. of bits	Identifier
transport_packet(){		
sync_byte	8	bslbf
transport_packet_error_indicator	1	bslbf
PES_packet_start_indicator	1	bslbf
transport_priority	1	bslbf
PID	13	uimsbf
transport_scrambling_control	2	bslbf
adaptation_field_control (i=0)	2	bslbf
continuity_counter	4	uimsbf
if(adaptation_field_flag=='10' || adaptation_field_flag=='11') {		
adaptation_field()		
}		
else adaptation_field_length = 0		
if(adaptation_field_flag=='01' || adaptation_field_flag=='11') {		
N = 188 - adaptation_field_length - 4		
for (i=0;i<N;i++){		
data_byte	8	bslbf
}		
}		
}		

The above table shows the unmodified MPEG-2 transport packet. The following section from the draft document describes the use of the fields:

Semantic Constraints

1. Packet_data_bytes consists of contiguous segments of Packetized Elementary Stream (PES) packets.

2. If a PES packet starts within a Transport Packet, the PES packet's Packet Start Code Prefix occurs immediately following the continuity_counter, or the adaption_field() if one is present.

3. The PID values 0 and 1 are reserved for Program Association Table and Conditional Access Table respectively.

4. PID value 1FFF is reserved for null packets.

5. PID values 2 to 7 and 1FF8 to 1FFE will be reserved for future use.

Transport_error_indicator: The transport_error_indicator is a 1 bit flag. When set to '1' it indicates that at least one uncorrectable bit error exists in the associated transport packet. This bit may be changed by entities external to the transport layer.

PES_packet_start_indicator: The PES_packet_start_indicator is a one bit flag. A '1' indicates that the payload of this transport packet will commence with a PES packet header. A '0' indicates there is no PES header in the transport packet payload.

transport_priority: The transport_priority is a one bit indicator. When set to '1' it indicates that the associated packet is of greater priority than packets within the same PID stream which do not have the bit set to '1'.

PID: The PID is a 13 bit field, indicating the type of the data stored in the packet payload. PID value 0x0000 is reserved for transport table (refer to ...). PID value 0x0001 is reserved for conditional access table (refer to ...). PID values 0x0002-0x0007 are reserved. PID values 0x1FF8-0x1FFE are reserved. PID value 0x1FFF is reserved for null packets.

scrambling_control: The 2 bit scrambling_control indicate the scrambling of the transport packetpayload.

00	not scrambled
01	user defined
10	user defined
11	user defined

adaptation_field_control: This 2 bit field indicates whether this transport packet header is followed by an adaptation field and/or payload.

00	reserved
01	no adaptation_field, payload only
10	adaptation_field only, no payload
11	adaptation_field followed by payload

In current MPEG-2 decoders, a transport packet with the adaptation_field_control set to '00' shall be discarded.

continuity_counter: The continuity_counter is a 4 bit field incrementing with each transport packet with the same PID. The continuity_counter wraps around to 0 after its maximum value. The continuity_counter shall not be incremented when the adaptation_field_control of the packet equals '00' or '10'. If two consecutive transport packets of the same PID have the same continuity_counter value and the adaptation_field_control equals '01' or '11', the two transport packets shall be considered duplicate.

Proposed Future UniPack Transport Packet Layer, Complete Packet Example:

Syntax	No. of bits	Identifier
transport_packet(){		
sync_byte	8	bslbf
transport_packet_error_indicator	1	bslbf
PES_packet_start_indicator (==1, UniPack Header)	1	bslbf
transport_priority	1	bslbf
PID	13	uimsbf
UniPack_continuity_counter (==0)	2	bslbf
adaptation_field_control (==0, indicating UniPack)	2	bslbf
continuity_counter (frozen)	4	uimsbf
Additional UniPack Header:		
UniPack_c	2	bslbf
UniPack_header_type *(this example = complete packet)*	6	bslbf
total_packet_length (= total_data_length+header_length)	24	uimsbf
header_length (start of transport_packet to data_bytes)	8	uimsbf
priority_byte	8	uimsbf
channel_number (= MPEG-2 program number)	16	uimsbf
channel_running_byte_count	32	uimsbf
CRC_32 (over first 16 bytes of header)	32	bslbf
Optional Directory (Depending on UniPack_header_type):		
N = (header_length - 24)/4		
for (i=0;i<N;i++){		
UniPack_f	2	bslbf
UniPack_key	6	bslbf
directory_item_packet_length	24	uimsbf
}		
CRC_32 (over directory)	32	bslbf
N = 188 - header_length - 4		
for (i=0;i<N;i++){		
data_bytes	8	bslbf
}		
}		

The above table shows the UniPack mapping onto the MPEG-2 transport_packet layer. See the UniPack document for details on the meaning of the UniPack fields. Note that the first CRC_32 has been extended to cover the first 4 bytes of the transport_packet header, in addition to the additional 12-bytes of the UniPack first header block. This augments other checks on the PID and other key fields in the transport_packet header to ensure validity. CRC_32 should be sufficiently robust for all data uses of a universal header.

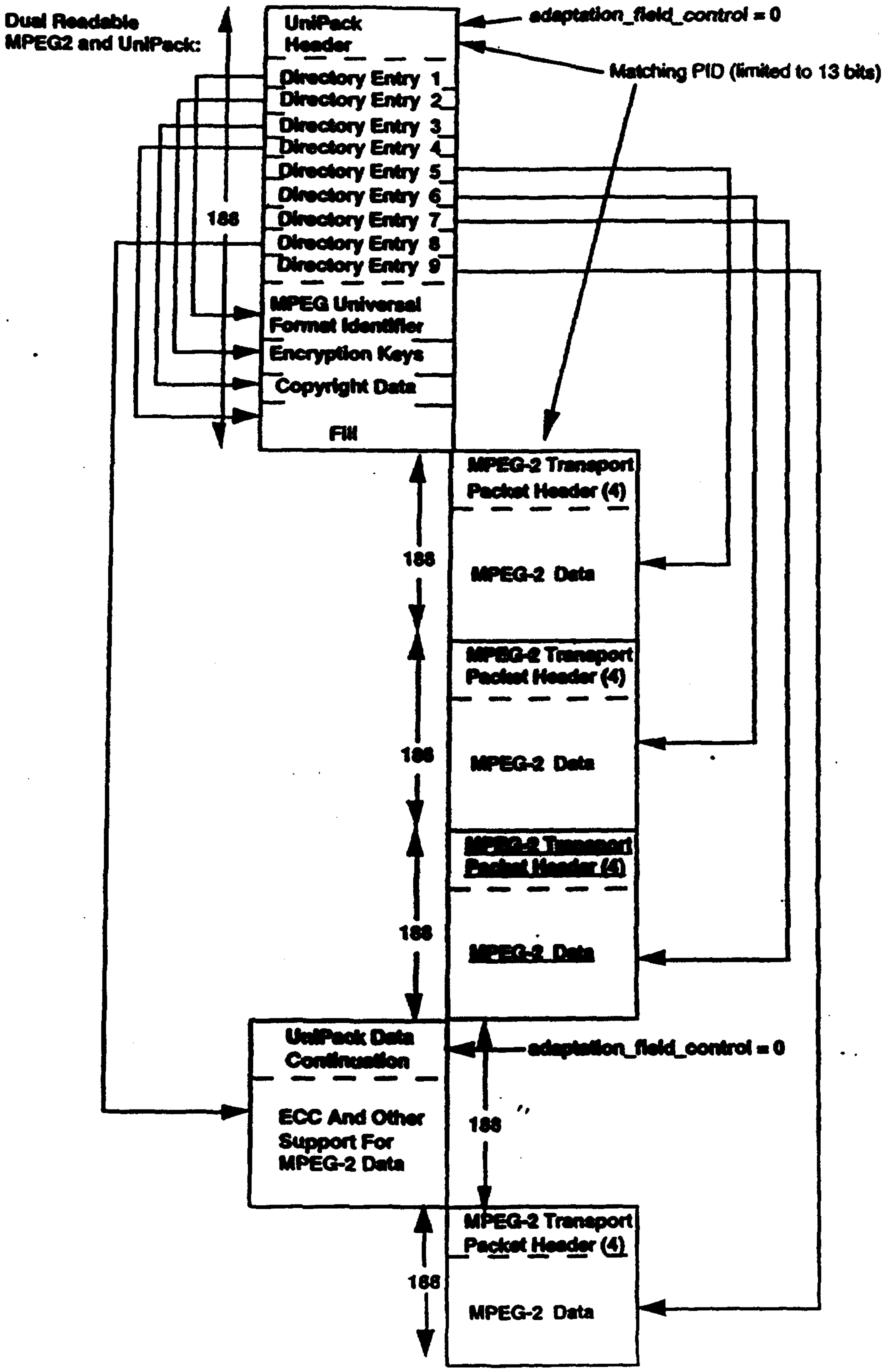
The remainder of the transport_packet following the CRC_32 after the optional directory contains data as described by the UniPack header (and its optional directory).

Proposed UniPack Transport Packet Layer, Continuation of UniPack Data:

Syntax	No. of bits	Identifier
transport_packet(){		
sync_byte	8	bslbf
transport_packet_error_indicator	1	bslbf
PES_packet_start_indicator (==0, UniPack Payload))	1	bslbf
transport_priority	1	bslbf
PID	13	uimsbf
UniPack_continuity_counter (increments each pkt)	2	bslbf
adaptation_field_control (==0, indicating UniPack)	2	bslbf
continuity_counter (frozen)	4	uimsbf
N = 188 - header_length - 4		
for (i=0;i<N;i++){		
data_bytes	8	bslbf
}		
}		

The above table shows a continuation packet for payload for the UniPack header which was issued previously on the same PID. The data_bytes may contain other information such as larger continuity counters, a 16 bit channel number (program number), and other information, as described in the UniPack header's initial directory.

On the following page, the combination of UniPack and MPEG-2 is shown, with the data stream readable from both MPEG-2 and UniPack. The directory entries describe each MPEG-2 packet individually. It is also possible to have a single identifier, descriptor, or directory entry for a collection of MPEG-2 transport_packets.


Dual Readable
MPEG2 and UniPack:
UniPack
Header
adaptation_field_control = 0
Matching PID (limited to 13 bits)
Directory Entry 1
Directory Entry 2
Directory Entry 3
Directory Entry 4
Directory Entry 5
Directory Entry 6
Directory Entry 7
Directory Entry 8
Directory Entry 9
188
MPEG Universal
Format Identifier
Encryption Keys
Copyright Data
Fill
MPEG-2 Transport
Packet Header (4)
188
MPEG-2 Data
MPEG-2 Transport
Packet Header (4)
188
MPEG-2 Data
MPEG-2 Transport
Packet Header (4)
188
MPEG-2 Data
UniPack Data
Continuation
adaptation_field_control = 0
ECC And Other
Support For
MPEG-2 Data
188
MPEG-2 Transport
Packet Header (4)
188
MPEG-2 Data

Received: from Kodak.COM (kodakr.kodak.com) by mailroom.itc.kodak.com with SMTP id AA08708
(5.65c/IDA-1.4.4); Fri, 15 Oct 1993 14:52:43 -0400
Received: from FARNSWORTH.MIT.EDU by Kodak.COM (5.61+/2.1-Eastman Kodak)
id AA11600; Fri, 15 Oct 93 14:53:30 -0400
Received: by farnsworth.mit.edu (5.57/Ultrix3.0-C)
id AA01281; Fri, 15 Oct 93 14:48:42 -0400
Received: by media.mit.edu (5.57/DA1.0.4.amt)
id AA26088; Fri, 15 Oct 93 14:47:49 -0400
Date: Fri, 15 Oct 93 14:47:49 -0400
From: Gary Demos <garyd@media.mit.edu>
Message-Id: <9310151847.AA26088@media.mit.edu>
To: com@media.mit.edu, gerovac@rdvax.enet.dec.com,
hierarchy@farnsworth.mit.edu, mnl%apple@kodakr.kodak.com,
roberts@itc.kodak.com
Subject: Serious flaws in interoperability in the GA proposal
Status: R

To: Robert Sanderson, Kodak, Chair of FCC ATV Interoperability Review Board
& Mike Liebhold, Apple Computer, Vice Chair
cc: Branko Gerovac, Digital Equipment, Secretary

As you know, I am a member of the interoperability review board, which met on 6&7 October 1993. I am very concerned that many of my technical concerns and objections have not been addressed. It is inappropriate for the United States to move forward with an advanced television system when so many crucial technical issues are unresolved or outright faulty.

At the present, the Grand Alliance proposal for U.S. advanced television is highly flawed. It contains the following design errors:

1) It proposes an interim interlaced format. Interlace is an obsolete analog technique which is totally unsuitable for use by the National Information Infrastructure, the computer industry, and the Hollywood film production community. There also cannot be an interim interlaced standard, since interlace cannot be replaced once it is introduced. The majority of the review board members object to interim interlace or any interlace format being part of advanced television for the United States. I urge you to clearly indicate in the summary of the interoperability review meeting that the majority of the review board oppose the use of interlace.

2) There should be sufficient technical preparation for U.S. advanced television so that the standard introduced will last for at least ten years, and hopefully for fifty years. The current proposal is not thorough, and is unlikely to last even five years, and is therefore inappropriate for adoption or approval until substantial further technical refinement.

3) The Grand Alliance has an incorrect concept of interoperability. They represent that they can support many formats to accomodate the needs of many industries. This concept is totally in error. The formats which they propose to support are mutually incompatible, and therefore cannot interoperate with each other. Further, they propose for every receiver to be required to decode each format, some of which are incompatible. This adds cost and degrades quality for every receiver. This design notion is substantially below optimal.

4) Many objections which I raised were not addressed in the meeting, due to lack of time. These objections include problems with the use of 59.94 and 60.0 Hz when display rates greater than 70 Hz are required for computer display applications. It is inappropriate to consider that the interoperability review has taken place when many crucial issues, such as this one, have not been resolved.

5) Many issues raised by the review board were accepted for action. These issues include the development of overlay planes as part of the ATV system architecture, and the ability to support compositing. A period of technical work will be required in order to specify the operation of such key technical components of an advanced television system. The advanced television system should not be accepted until such technical work is completed and accepted.

6) The concept of a National Information Infrastructure "Reference Frame" was accepted by the review board. The primary benefit of advanced television for the United States is the ability to support interactive text, maps, and graphics, which cannot now be supported by our current NTSC television system. There was debate as to the level of resolution appropriate for this reference. I recommend that the N.I.I. Reference be the proposed 1280 x 720 progressive scan format, which is one of the formats being proposed by the Grand Alliance. There was debate over this proposed resolution, since it precludes the use of the interlaced formats being proposed, since they are substantially inferior to this resolution for presentation of interactive literature. I urge that this reference must be established before any advanced television proposal can be accepted. It is essential that those preparing material for the N.I.I. be able to have a reference for how much text can be presented on the screen, and for what level of detail can be used with maps and graphics. I further urge that the N.I.I. reference must exceed the capabilities of MPEG-2 and other forms of digital NTSC, since advanced television would be unnecessary with a reference of such low resolution as could already be provided by existing MPEG-2 systems in development.

7) The transport systems, using MPEG-2 type of transport, have not been evaluated in the context of interoperability, and indeed the design is incomplete. I proposed several methods to adjust and augment the design of the advanced television transport system. Until there is a response to the challenges of incomplete specification, it is inappropriate to accept the advanced television system for the United States. Too much is at stake to allow acceptance of partially completed work, which may ultimately prove to have design errors when implemented.

I urge the chairs of the interoperability review to not hide the serious nature of the errors in the advanced television proposal by the Grand Alliance. I further urge that the serious disputes concerning key technical issues within the proposal be reflected in any representation of the activities of the interoperability review board. Indeed, the majority of the review board was convinced that the proposal, as currently presented, is inappropriate for the United States.

Sincerely,

Gary Demos
President/CEO
DemoGraFX

Dr. Thomas A. DeFanti
Chair, ACM SIGGRAPH Committee on ATV
tom@siggraph.org

Position:

Progressive scan must be available on EVERY future television receiver so that the National Information Infrastructure can be built on the merger of digital television and digital computing.

Interlace does not give sufficient vertical resolution for NII usage. Hard-edge graphics and text need full vertical resolution with a flicker-free display. Interlace broadcast will result in unacceptable flicker on low-end receivers because progressive scan will not be mandated in these receivers.

Literacy and math skills are at stake. The NII is the key to the educational and life-long learning systems of the 21st century. We have unsuccessfuly struggled with bringing computers and television together for over 20 years, largely because of interlaced NTSC standards.

We are in a post-literate age. Without progressive scan as the lowest common denominator, it will be an illiterate age as well.

ACM SIGGRAPH

Special Interest Group on Computer Graphics

October 18, 1993

Robert Sanderson
Chairman, Joint Experts Group on Interoperability
Eastman Kodak Co.
Bldg 5, 4th Floor
1447 St. Paul St.
Rochester, NY 14653-7102

Dear Mr. Sanderson:

As you know, I represented ACM SIGGRAPH at last week's ACATS Interoperability Review in Washington D.C. I found the meeting to be extremely informative.

The ACM SIGGRAPH committee on ATV is adamantly opposed to any form of interlace digital HDTV output on consumer-level devices. We believe that progressive scan devices are the only feasible displays for information coming from the National Information Infrastructure (NII) and other computer-based services. We do not believe that interlace sets can be used in this context because one would either have to view a display with horrible interlace flicker (which is enough to make one turn one's head away) or halve the vertical resolution, yielding an impractical 32x9 aspect ratio for text and computer-generated image use. Furthermore, we believe that an interim standard allowing interlace would greatly impair the access to the NII by the segment of Americans who cannot afford both a computer display and a digital HDTV set. Thus, we are firmly against any interlace standard for even an interim period.

The Grand Alliance does not directly address the NII compatibility issue other than to point to the optional other progressive standards it is embracing. Allowing any interlace option is tantamount to eliminating the other options for our lifetimes, since a cheaper, non-compatible standard is embraced and produced first. The computer community I represent has spent the past 20 years suffering with the incompatibility of interlace television and computers. Now is the time to fuse computing and television by adopting progressive scan as the one acceptable method of display.

Requiring progressive scan on a consumer set does not, however, necessitate progressive scan cameras or broadcast. The consumer set will have enough memory inside it to scan out video in any way from signals received in any order. The consumer set simply has to display in progressive format so that it doesn't flicker unacceptably with NII-type information. Virtually all computers put out progressive scan and, eventually, cameras and broadcast equipment will follow. Consumer video cassette recorders (VCRs) could similarly feed a variety of compression techniques (including interlace) into progressive scan consumer sets, although interlace would destroy or cause any NII-type information to flicker.

We believe that achieving consensus on progressive scan and NII compatibility is so critical that any additional time spent debating the issue is well worth it. We urge you to continue the debate in good faith and examine all the issues, including new ones brought up last week. This is not a time for haste.

Sincerely,

Thomas A. DeFanti
Chair, ACM SIGGRAPH Committee on ATV
Professor and Director
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cc: Richard Wiley
Wiley, Rein & Fielding
1776 K Street NW, Washington, DC

Congressman Edward J. Markey
2133 Rayburn House Office Bldg.
Washington, DC 20515

Mary Whitton
Chair, ACM SIGGRAPH

Rob Hummel
V.P. Animation Technology
Walt Disney Motion Pictures and Television

Some Comments based on the Grand Alliance Proposal:

1. First of all, I'm concerned there aren't more representatives of the film production community here, since they represent the only worldwide production standard. It was pointed out there exits a plethora of video formats around the world, yet the only constant is that all areas of the world produce film product at 24fps.

2. On page 29, 16x9 is listed as film production aspect ratio - - It has *never* been a production aspect ratio.

3. Page 4, you would be hard pressed to find a Director, Cinematographer, Editor, or Producer that doesn't feel Panning compromise artistic content.

4. Page 29 states that film maintains its progressive nature even during NTSC Transmission. This is not true. Film transfers are always having to be compromised in order to minimize interlace artifacts that get introduced by NTSC.

5. Why 1000 line ~~progressive~~ interlace??

   NHK's own research concluded that an interlace display of given number of lines is equal to a progressive display consisting of 40% fewer lines.

   Therefore, 1000 line interlace is equal to 600 line progressive in resolution. So why bother?

   I feel if we do 1000 lines, it should be progressive or not even bothered with. If 1000 line interlace is less resolution than 720 Progressive, then we should just stay with 720 until 1000 progressive becomes practical.

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Walt Disney Television

Post-It™ brand fax transmittal memo 7671	# of pages ▸ 2
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Rob Hummel
Vice President
Animation Technology

October 15, 1993

Congressman Edward J. Markey
2133 Rayburn House Office Building
Washington, D.C. 20515

Dear Congressman Markey,

I am concerned that although there has been expressed serious disagreement over the current Grand Alliance proposal for a High Definition Television standard, the proposal appears to be approaching adoption by the FCC.

It appears that the very narrow interests of broadcasters and equipment manufacturers are being placed before the broader interests of:

- Those that create the vast majority programming for television.
- Those that maintain the only library of television and wide screen film materials that can take advantage of advanced television.
- Future capabilities of distributing information, graphics, and education through any National Information Infrastructure (NII) or electronic publishing.
- The consumers that may be faced with purchasing multiple pieces of display hardware through the years in order to keep step with technology instead of one display that will have potential for being future proof.

We in the Hollywood production community are baffled by broadcasters and equipment manufacturers that present Advanced Television as something that is urgently needed in the marketplace now. Clearly, the public is not complaining about the resolution of what is currently displayed on their sets. The only driving force we can see behind the urgency of Advanced Television is hardware manufacturers that may want to see a faster return on years of investment in old technology, and broadcasters hoping advanced television will slow the fragmenting of the television audience.

One must question the motivation of manufacturers with the recent introduction of a new form of presenting movies to the consumer on a Compact Disc at lower than VHS video resolution. This new format is supported by Phillips, JVC, Sony, and Matsushta with data they say indicates the consumer doesn't find the lower quality image unacceptable. Yet these are the same manufacturers that say there is a demand for higher definition images on television.

This illustrates what imperative drives the hardware manufacturers, which I don't fault them for. I just feel it certainly begs one to be careful when listening to those same manufacturers when establishing a standard that should be in the public's and country's best long term interests.

It can not be overstated how important future education for the general public will rely on distribution of text and information being presented on electronic displays in the home. We must be careful that a standard adopted does not result in displays incapable of resolving detailed text information, thus possibly excluding a large segment of the population not able to afford separate displays for information and entertainment.

George Gilder underscores this point very eloquently in his article in the current issue of *ASAP* (published by *FORBES*), where he says, "...scripture declares that in the beginning was the word. There was no mention of image." His point being that dissemination of information via text will still be the most efficient way to convey information, not with images. Therefore, the Grand Alliance proposal should be concerned with the greater need of displaying text information than the relatively easy ways to display images.

If there's anything you can do to ensure the Grand Alliance standard is given full consideration in its impact upon all those it will effect, I hope you will take action. It would be foolish for our country to capitulate to false deadlines in the establishment of this standard when the only urgency is that we adopt a standard that will not betray the interests of the many for the interests of the few.

Yours truly,

Rob Hummel

Rob Hummel
Vice President, Animation Technology

cc: Vice President Albert Gore
Honorable James H. Quello
Robert Sanderson, Chairman ACATS Joint Experts Group on Interoperability ✓
Richard Wiley, Chairman ACATS

AMERICAN SOCIETY OF CINEMATOGRAPHERS

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(213) 969-4333 • FAX (213) 882-6391

October 5, 1993

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.

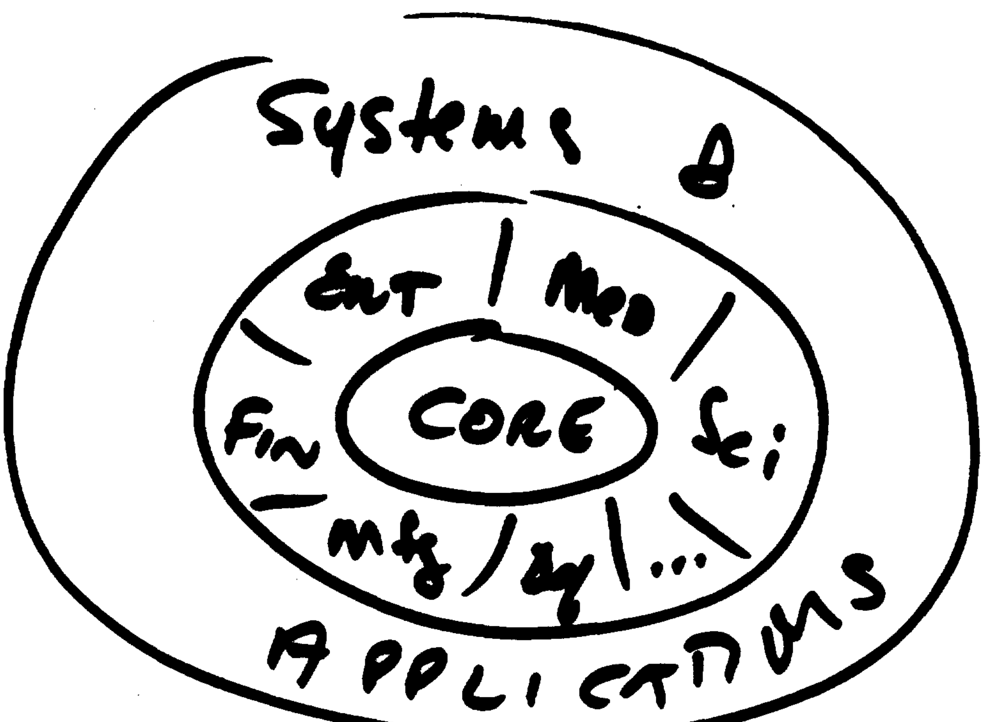
Yours truly,

Victor J. Kemper, ASC
President
American Society of Cinematographers

Remarks on NII

- CORE - Generic Portion
- MANTLE - Domain Specific Portion

Systems & Applications form the outermost shell



Comment by: R. Kahn