CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding
(Rapporteur's Group on Part of Q.3/XV)

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SOURCE: CHAIRMAN OF THE EXPERTS GROUP FOR ATM VIDEO CODING
TITLE : REPORT OF THE TENTH MEETING IN TORINO AND ROMA (21-29 January 1993) - PART III
Purpose : Report

Part III Joint Sessions with MPEG

Contents

1. Introduction

The joint sessions with MPEG were held at the Ministero P.T. Building in Roma during 25-29 January 1993 at the kind invitation of the Ministry of Posts and Telecommunications. The Experts Group appreciated the support and hospitality of the hosting organization.

A list of documents considered during the joint sessions is attached to this report as Annex 1.

2. REQUIREMENTS sub-group (S. Okubo)

The REQUIREMENTS sub-group met every day during the week (January 25-29) under chairmanship of Sakae Okubo. In addition to our own sessions, we had joint sessions with other sub-groups as follows;

- with VIDEO and IMPLEMENTATION, 16:30 - 17:15 on Wednesday to solve outstanding issues related to the Main Profile definition
- with SYSTEMS, 9:00 - 10:20 on Thursday to finalize the "Guide for Systems Work" document.

2.1 Information on requirements

2.1.1 Relevant documents

047	NTV	Requirements for applying extended definition progressive scanning images
100	Nasse	Proposal for MPEG-2 verification tests
128	EBU G5	Replies from members of Subgroup G5 to MPEG documents
133	CCIR TG11/4	Report of the first meeting of TG11/4
179	Koster	Proposal for and discussion on the syntax to exploit the correlation between similar video signals over a pair of video codecs
216	CCIR	Draft new Recommendation: Reference model for data broadcasting
226	SMPTE	Contribution to MPEG on SMPTE File Format for Digital Picture Exchange

2.1.2 Agreements

- To include progressive/interlaced indication in Picture Layer (MPEG93/047,179).

- To include 720x480x1x59.94 format as another example of progressive format in the requirements listing document (MPEG93/047).

- To recognize the necessity of a mechanism to indicate relationship between two correlated video signals in the video and/or system layer (MPEG93/179). Reflection on the syntax is left to the decision of other sub-groups.

- To consider the SMPTE document (MPEG93/226) in the study of presentation related indications which facilitate bitstream interchange across applications.

- To return a liaison response to the EBU comments (MPEG93/128) including general statement describing current status of our study and Integrated Requirements Listing revised in London (MPEG92/674a).

2.1.3 Items needing guidance of WG11

- There has been recognized necessity of including source related indications such as colorimetry, color matrix in the syntax to make consistency with SMPTE "Digital Picture Exchange" (MPEG93/226). We need a guideline on what application dependent indications are to be in the video syntax.

- At the plenary on Wednesday, Dr. Gill provided a proposal for our further study that VIDEO and AUDIO subgroups define their own extensible structures and parameters to accommodate presentation related parameters. Considerations were that we want to put them in video and audio bitstreams, not in user data, and that we can not define all of them now.

2.2 Definition of Profiles

2.2.1 Relevant documents

N02 62	Convenor	Report of London meeting
045	JNB	Comments for Rome meeting
046	JNB	Profile proposal for MPEG-2 profiles
059	Reader	Report of ad-hoc group on draft core profile and additional profiles
071	Fautier	Extended DC precision in the MPEG-2 core profile
082	CCITT/J	Core profile based on communication applications consideration
097	Reader	Classification of MPEG-2 algorithm techniques into profiles
117	Kogure	Consideration on core profile
141	Fautier	Proposal for CORE buffer size information
154	ETSI NA5/VCM	Clarification and suggestion on profiles
156	Yamada	A consideration for core profile
168	Sugiyama	Proposal of limitation in core profile
196	CCIR SG11	Progress report of the activities of SRG-UR1
215	DIN	Comments on the resolutions of the 20th WG11 meeting
237	REQ group	Definition of Profiles and the Main Profile
238	Lippman	Suggestion for a revised set of profiles

2.2.2 Agreements

- To adopt the descriptive text (MPEG93/237, contained in this report as Annex 2) generated during this meeting for definition of profile and Main Profile based on the London agreements.

- To adopt the specifications for Main Profile at Main Level in terms of syntactic elements and their associated values if relevant, which were worked out during this meeting (MPEG93/237). It should be noted that some items still need consultation with VIDEO and IMPLEMENTATION sub-groups.

- To use a new name in substitution of "Core" because it sometimes convey wrong messages to the outside society, giving impression that there would be no profiles smaller than this. After some discussion, we reached a conclusion to use "Main Profile" and "Main Level", leaving "Main Level" subject to further discussion.

- To seek advice of CCIR whether coding format of 480 lines, instead of 486 lines, for 525 line television signals are acceptable for purpose of distribution to end users with our explanation of why 480 lines are considered appropriate.

2.2.3 Discussion on profiles/levels other than Main

- One view was that hierarchically structured three profiles (onion ring structure) may be sufficient as discussed in MPEG93/238.

- Another view was that it may practically be required to structure some profile(s) other than Main Profile in a non-hierarchical manner (crossing onion rings).

- There was some discussion that a codec product may implement specifications outside Profile X but inside Profile Y (>X) and what conformance this product can claim. A solution seems to be to claim decoder conformance as Profile X and encoder conformance as Profile Y.

- There was also a question whether a software decoder which may discard B pictures data and not display them can claim conformance with the standard. There was another question to what extent regional variants of the international standard are allowed.

2.2.4 Items to be further discussed

- Levels other than Main Level in Main Profile.
- Profiles other than Main Profile.
- Whether 4:2:2 be in other level of Main Profile or in other Profile.
- Profile and Level indicator

2.3 Structure of standard

2.3.1 Relevant documents

057	Kogure	Report of ad-hoc group to process comments on the WD
091	WD Ed. gr.	MPEG-2 Working Draft (Video part)
092	Kogure	Presenting structures of profiles in WD
195	JTC1/SC21	Proposal for a new work item: SQL multimedia and application packages (SQL/MM)

2.3.2 Discussion

Due to the urgent work for the Main Profile, this topic could not be handled during this week. Inputs are requested toward the Sydney meeting.

2.4 Verification

2.4.1 Relevant documents

100	Nasse	Proposal for MPEG-2 verification tests

2.4.2 Discussion

This verification process is intended to make sure all the requirements are supported by the draft standard.

- In MPEG93/100, necessity of clarifying specifications of the profiles has been pointed out. Interest in scalable coding, such as HDTV/CTV compatibility, has also been expressed.

- What quality is obtained at particular bit rates is one of the most concerned characteristics for customers of the standard.

- Due to lack of time at this meeting, this topic will be discussed further in Sydney focusing on methodologies to verify items addressing functionalities such as scalability, in addition to picture quality.

2.5 Guide for Systems work

2.5.1 Relevant documents

92/770	REQ group	Guide for Systems Work, London Revision
239	REQ group	Guide for Systems Work, Rome Revision

2.5.2 Agreements

- To adopt the revised text as in MPEG93/239.

2.6 Very low bit rate audiovisual coding

2.6.1 Relevant documents

213	CCITT WPXV/1	Terms of reference for Special Rapporteur for very low bitrate visual telephony

2.6.2 Discussion

We had a short free discussion on what would be the first activities, possible work methods and possibility of generic coding at very low bit rates. It was a common feeling that we need technical breakthroughs to make this new standard. As to the possibility of "generic coding", two solutions were mentioned; downloadable algorithm and heterogeneous standards.

2.6.3 Action

- To recommend starting activities at the Sydney meeting by reviewing the state of the arts with demonstration and having a brain storming session.

3. VIDEO sub-group (G. Bjøntegaard)

Unlike previous meetings, the video group this time stayed together as one group. The group dealt with some 130 documents! The bulk of the documents reported results from core experiments. A major part of the video work was therefore to review these results and reach conclusions. The video group also had joint meetings with requirements and implementation. In addition there was a joint meeting with CMTT/2 on digital broadcast matters.

Joint meeting with CMTT/2.

> CMTT/2 is dealing with digital TV coding. The group wants to cooperate with MPEG on video coding matters. The group presented its present work items. It was decided to keep the contact and that members of CMTT/2 could cooperate with MPEG on the ad. hoc. group level.

Joint meeting with requirements and implementation.

> The status of the different subgroups were presented. There is at the moment a good co-operation between the subgroups. This is helpful to the convergence process. Video had put many questions concerning complexity to the implementation group. The responses are reflected in the decisions on different coding items reported below.

Short reports on the main outcomes concerning different items are given below.

Prediction.

Many documents reported results from the core experiments L.13, L.14 and L.15. The main conclusions were:

- Special prediction mode (in particular Dual+) is accepted due to its performance for M=1.
- 8x8 and 16x8 frame prediction was not accepted. Further tests will be made until next meeting.
- Reverse order prediction was not accepted. (Further tests will be made until next meeting?)

Quantization.

- Use of 8x1 DCT and NTC did not show good enough results to overcome problems with noise around edges. (Further tests will be made until next meeting?)
- Use of adaptive VLCs for coefficient coding showed promising results. Further tests will be made until next meeting.

Error resilience.

- Bitstream partitioning was accepted as a useful way of using different priorities to different parts of the bitstream. This was accepted.
- Leaky prediction was not accepted because there are other ways (I slices, I pictures) to solve the same problem. (Further tests will be made until next meeting?)
- Motion vectors for I pictures will be tested further until the next meeting.
- Structured packing was not accepted.

Scalability.

- In spatial scalability progress was made in defining filters for Interlace -Interlace conversion.
- Work is done towards single loop solutions in frequency scalability.
- Effort is being made to define a combined syntax for both spatial and frequency scalability.

Good progress was made in the video group concerning convergence on coding issues. It seems realistic that the remaining issues needed for the "March freezing" will be solved by the next meeting.

4. IMPLEMENTATION STUDIES sub-group (G. Morrison)

4.1 Sessions

The sessions were sole, joint with Video and Requirements and joint with Video

4.2 Participants

The following people took part for the vast majority of the sole sessions. There were a few other participants for short times during the sole sessions.

Geoff Morrison	BT Labs (chair)
Adrian Wise	Pioneer
Richard Bramley	Thomson
Mark Veltman	Sony
Hironori Yamauchi	NTT
Chadd Fogg	Cascade Design Automation
Sam Narashiman	Singapore Microelectronics Institute
Barth Canfield	Thomson
Fathy Yassan	Thomson

Marco Gandini CSELT
Thierry Fautier Philips LEP

4.3 Topics discussed

The topics discussed were all related to the video algorithm. The majority were raised by the Video Subgroup. The remainder were prompted by the Requirements Subgroup, MPEG documents to the meeting or by the participants.

MBA stuffing

This had been the topic of an ad-hoc group established at the London meeting but a decision had not been reached. After reviewing the inputs to the ad-hoc the options were to recommend:

1. no change
2. removal of MBA stuffing
3. the introduction of a per frame limit
4. the introduction of a per macroblock limit.

It was evident that there was no single choice which was optimum for all encoders and decoders. However, after ascertaining that zero bit stuffing before start codes constituted a viable alternative for encoders, we agreed to recommend the removal of the MBA stuffing codeword from the MPEG-2 syntax.

Universal VLC

We had studied the MUVLC at the Brazil and London meetings and recommended that it not be incorporated into MPEG-2. Mr. Descamps presented document MPEG 93/12 in an attempt to change our minds. The ensuing discussion confirmed our earlier views that this VLC method has serious disadvantages (number of gates and memory size/bandwidth) compared to that already in the MPEG-2 Test Model.

Prediction modes

We noted that the Dual Prime prediction method has the highest memory bandwidth, being essentially equivalent to reading for B pictures plus a write back (which is not required for B pictures). However, we were aware that the method gives significant coding performance benefit in applications which are delay sensitive and thus did not wish to reject it.

Our initial conclusions were that reverse order prediction increased delay, complicated memory management, had an implementation dependent effect on memory size and we did not support it. After making these known in a joint session we were requested to revisit the issue by Dimitris Anastassiou. Further examination revealed that the extra delay and extra memory are only required when M=1. Ironically it also is in this case that the performance gains come.

Document MPEG 93/33 showed the increases in memory bandwidth incurred by 8 by 8 prediction modes. We recommended that 8 by 8 and 16 by 8 frame modes not be included in the main profile.

Adaptive coefficient VLCs

There was some initial concern that switching between VLC sets based on the previous coefficient might have latency implications in some implementations giving timing problems if switching frequently between short codewords. However, switching would be taking place because the codeword used was longer than it could be. Thus frequent switching and short codes would not be encountered together.

Of more concern was the possible increase in table size but this was thought to be still acceptable provided they could be in ROM. It was pointed out that start code emulation should be checked for any new VLC proposals.

Spatial-temporal weighting

This refers to the prediction in the upper layer(s) of the spatial scalability/compatibility algorithm. We agreed that the simple mixing of the upsampled lower layer and the motion compensated current layer is trivial from the computational requirements.

We reported to the Video Subgroup that they might wish to consider reverting to a switch between (rather than a mix of) the two sources to reduce implementation costs. The savings would be two-fold. First, only either the lower or current layer would need to be extracted from memory thus reducing memory bandwidth. Secondly, the operations of half pel interpolation on the current layer and upsampling of the lower layer are very similar, so that if they were not both required for a macroblock, hardware could be shared between these two functions.

Intra motion vectors

We had no reason to change our recommendation at the London meeting concerning the provision of motion vectors for intra macroblocks to aid error concealment at decoders.

4:2:0/4:2:2/4:4:4 compatibility

We had sympathy with the proposal in document MPEG 93/29 to provide compatibility between the colour formats by spatial scalability. The reasons were that it retains an 8 by 8 IDCT in all cases and has very little impact on a 4:2:0 decoder (which is perceived as being the dominant type, at least initially). We did have some concern that a more general descriptor was required to cover a wider range of scalability possibilities (not just colour differences) than considered in the above contribution.

We were not in favour of an alternative proposal, effectively a 2 band subband approach which required a 4:2:0 decoder to parse 4:2:2 encoded video.

We considered a proposal to have a flag indicating intra or inter field vertical downsampling of colour components, not to be an issue of any importance to us.

Non-transform coding

We did not support the scheme in document MPEG 93/181 as it introduced complex flow control and although the computations are easy the process is register intensive requiring on-chip cache. In reply to a suggestion that the DCT transpose memory could be used, it was agreed that the latter is highly optimised and not suitable.

Support for fast forward and fast reverse

Document MPEG 93/31 (Revision 22 Jan 93) proposed a broadcast profile which enables random access and fast forward/reverse play mode with storage media. Pointers are inserted in slice headers to intra coded macroblocks. We did not favour this for two reasons. Firstly, the technique complicates encoders because the pointer value cannot be known at slice header construction time and must therefore be filled in later. Secondly, equivalent functionality can be achieved on any bitstream by adding a small (and potentially low cost) amount of MPEG decoding to the storage media player.

Data partitioning and frequency scalability

We were joined by Eric Viscito, Gunter Schamel and Thomas Sikora to consider implementation aspects of frequency scalability. They outlined two schemes:

1. Data partitioning, in which coded transform coefficients were separated into two or more sets, the break point being signalled in the slice header.
2. Coefficient refinement. Some coefficients appear twice being first quantised with a coarser quantiser and then the error quantised more finely.

A potential difficulty with layered schemes was pointed out by some VLSI implementers. The assumption that the variable length decoding of two streams was no more demanding that the variable length decoding of one of the same total bit rate was challenged. The issue relates to the on-chip caches required between the external coded data buffer and the variable length decoder to handle the very high peak rates which can arise. The sum of the peak rates of multiple streams may exceed the peak rate of a single one, thus increasing the cache sizes. Because the coded data buffer is in the same physical memory as the frame buffers the caches for these must be larger too. Thus there is likely to be a significant impact on the design of the total memory interface. This is already one of the most challenging areas in MPEG-2 implementations.

Because of the above we recommended that if video data partitioning becomes a part of MPEG-2, main profile decoders be permitted to decode only the first partition and that the partitions be multiplexed at a system level. The latter relieves a decoder from parsing the entire video data to extract just some of it.

We noted that the coefficient refinement algorithm incurs the above plus increased inverse quantisation processing.

Flexibility of picture size

We agreed with the MPEG-1 concept that flexibility of picture size up to some maximum caused minimal and acceptable additional decoder complexity. (This comment applies only to the decoding. Handling the display of flexible picture sizes is another matter.)

Leaky prediction

We were not so concerned about the multiplication (which could be a shift and subtract) to introduce the leak as the fixes for the limit cycle problem. As this did not seem to have been resolved by the Video subgroup we deferred further consideration.

Coded data buffer size

We recommended that the Video Subgroup investigate video buffer sizes and provide figures with evidence that they are the minimum acceptable.

Maximum bit rate

A figure of 15 Mbit/s was thought reasonable on processing speed grounds but the buffer size may also be linked to the coded bit rate. There is a desire to keep memory size down, especially for main profile decoders. Therefore we reserved our position until the Video Subgroup has studied buffer sizes.

Coded Block Pattern

Document 93/189 made a proposal to extend the Code Block Pattern to cover 4:2:2 and 4:4:4. While this was acceptable to us in itself, the overall approach does not give the downward compatibility of MPEG 93/29.

Document MPEG 93/11 pointed out the inconsistency between MPEG block numbering (for 4:2:2 and 4:4:4) and JPEG's MDU and urged that MPEG change. This prompted other participants to defend the MPEG numbering with other valid implementation arguments. We decided not to request a change.

Motion vector range

We recommended that the range of vertical motion vectors in the main profile be restricted to about +/-128 pels (with half pel resolution). No restriction in the horizontal direction is necessary as there is no implementation advantage.

Motion vector coding

We agreed to recommend changes to the coding of motion vectors

- use of intra DC VLC
- removal of 'f' codes
- removal of half pel flags
- addition at sequence layer of indications of maximum horizontal and vertical motion vectors

Variable bit rate operation

We did not perceive variable bit rate operation to introduce any additional processing difficulties provided the peak bit rate is consistent with the constant bit rate case. However, we were not certain that decoder synchronisation, buffer management, etc were adequately investigated and specified by the Video and System Subgroups to support variable bit rate.

5. SYSTEMS sub-group (B.G. Haskell, C.J. McGrath)

The MPEG 2 Systems group met each day during the interval 25 January to 29 January, 1993 as part of the 21st meeting of ISO/IEC JTC1/SC29/WG11 in Rome Italy. Systems group chair Alexander (Sandy) MacInnis presided at each session. A listing of MPEG delegates who attended one or more of the sessions is attached. Mr. MacInnis noted at the first meeting that the systems group had increased notably in size over recent MPEG 2 systems meetings and welcomed the new participants.

Over the course of the week, the following documents were identified to be directed to Systems group issues and were discussed both singly and in various combinations.

MPEG 93/ 58, 64, 75, 87, 88, 102, 110, 142, 147, 165, 170, 171, 172, 173, 175, 180, 187, 188, 208, 223, 226

During the meetings, document MPEG 92/770, "Guide for Systems Work, London Revision" was also used to provide guidance to the proposal evaluation process. It should be noted that the contents of 92/770 were review and updated in a joint Systems/Requirements meeting and subsequent drafting session held on 27 January and entered as document MPEG 93/[t.b.d.]

Meetings during the week focussed on gaining a broad understanding of the systems proposals included in the above documents. Several longer term members of the MPEG systems group gave brief tutorials on the application of and philosophy behind MPEG 1 systems, particularly as the information applied to the current task.

The Systems group status at 0800 Friday, 29 January is best summarized in the three attached sheets, "Agreements of Systems Committee (With proposed Revisions Thurs Eve)", "MPEG 2 Systems - Transport Packet Format", and "MPEG 2 Systems - MULTIPLEX HIERARCH MODEL", all of which are to be considered informal working documents at this time.

Following consideration of a liason statement from CCITT WP XV/1, MPEG 93/147, the following summary of the discussion was generated:

The Systems committee thanks CCITT WP XV/1 for the liaison statement (COMXV-TD) which was considered during the Rome January 1993 meeting.

WG11 Systems welcomes the willingness of WP XV/1 to adopt as far as possible the "core" of the system multiplex specification now under development, rather than developing an independent system multiplex. WG11 is eager to work with WP XV/1 on specific and detailed issues to enable the same specification to be adopted by CCITT.

WG11 Systems believes that many of the matters of concern expressed in the liaison statement are already being addressed by the Systems committee. The Systems committee is aware of and appreciates the importance of telecommunications applications of multimedia and audio-video data streams.

Some of the specific concerns raised in the referenced liaison statement are addressed as follows:

Systems does not understand the intent of the requirement to assign an alternative Pack header for CCITT purposes. Systems can reserve stream IDs for use by CCITT.

MPEG Systems time stamps can be used to indicate time relationships between different streams in CCITT systems.

Provisions are being made to provide error resiliency, including the flexibility to apply the packet structures in manners which are optimized to specific applications. Techniques such as selecting packet lengths to suit data links, packet continuity counters, marking of defective packets, structured packing, and separate priorities for pckets containing different coding layers are under consideration.

Data stream conditional access, with provisions for selective scrambling (encryption) and transmision of information providing for encrypted keys, is part of the current development effort.

Other topics may be of interest to CCITT. We warmly welcome further collaboration to ensure that the MPEG2 Systems specification fullly addresses all of the concerns of CCITT WP XV/1.

Two ad-hoc groups have been established up to this time, one concerned with the harmonization of the various proposals (chair Philippe Decotignie) and one concerned with continuing the editorial work on the working draft (chair Sandy MacInnis) between Rome and Sydney.

Systems will meet at the Sydney meeting during all available hours.

Tentative

Agreements of Systems Committee (With proposed Revisions Thurs Eve)

1. Define both Transport Stream and Program Stream in an integrated syntax and semantics definition.

2. Above to be defined such that the conversion between them is reasonably easy and inexpensive to implement.

3. Time stamps (PTSand/or DTS [or equivalent]) including SCRs (or equivalent) with correct values in terms of STD will be included. The STD model (or equivalent) applies to both the transport and program streams.

4. A transport stream consists of fixed length packets. Lengths, dynamics of length change, T.B.D.

5. Each transport packet has a packet identifier.

6. Transport packets can have different priorities. The means of indicating priority is TBD.

7. Transport packets have continuity counters.

8. Each transport packet contains data from at most one elementary stream.

9. Each transport packet identifier is associated with at most one elementary stream.

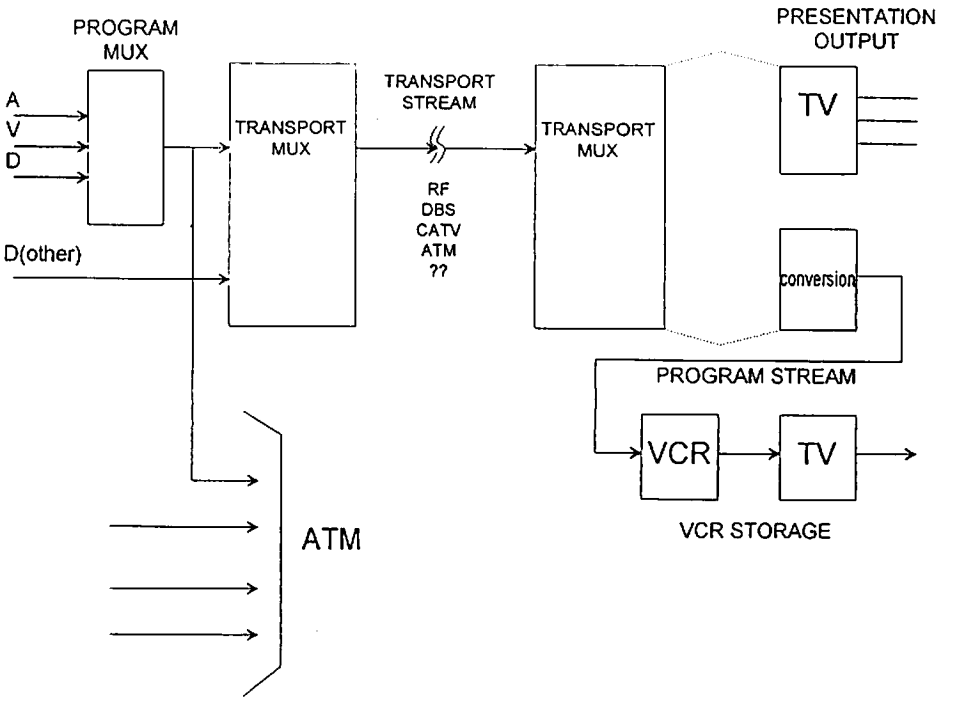
10. Each transport packet carries some indication concerning encryption status.

Additions Proposed Thursday Evening:

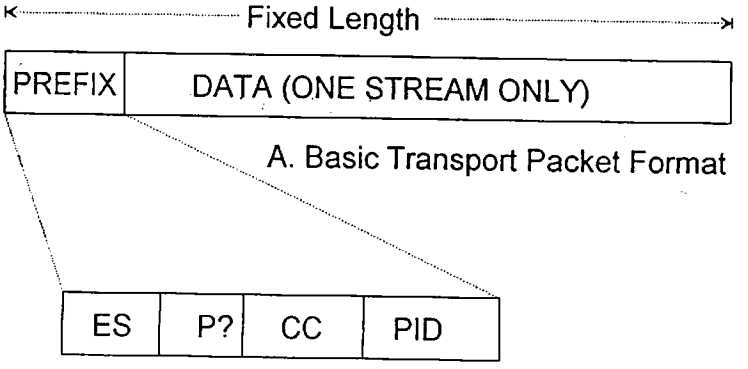
Purpose of item 6 :
Indicate to downstream processors relative priority of this packet.

Additions to item 10 :
. Examples of encrytion status are unencrypted, odd key, even key.

MPEG 2 Systems
MULTIPLEX HIERARCHY MODEL



MPEG 2 Systems - Transport Packet Format



B. Transport Packet PREFIX

PID = Packet ID
CC = Continuity Counter
ES = Encryption Status
P ? = Priority Indicator
(?->may not be in header)

Lengths and ordering are TBD

PTS, DTS and SCR (or equivalents) with correct values are included in Transport Packets , as needed

MPEG SYSTEMS Participant List — ISO/IEC JTC1/SC29/WG11 Rome

27-Jan-93

Last Name	First Name	Company	Telephone	FAX	Internet Email
Curet	Dominique	CCETT	+ 33-99-12-4005	+ 33-99-12-4098	
DeClerck	Christophe	MATRA Communications	+ 33-13-460-8083	+ 33-13-460-8492	
Decotignie	Philippe	Laboratoires d'Electronique Philips	+ 33-14-510-6779	+ 33-14-510-6960	deco@lep.lep-philips.fr
Deiss	Michael S	Thomson CE	+ 1-317-267-6834	+ 1-317-267-6923	deissm@tcemail.indy.tce.com
Dobson	Louise	SES/ASTRA	+ 352-71-7251	+ 352-71-725-416	
Ferbrache	Rex	Tektronix	+ 1-503-627-4355	+ 1-503-627-4486	rexf@tv.tv.tek.com
Gardner	DelRae	Compression Labs Inc.	+ 1-408-922-4658	+ 1-408-922-4608	delrae@cygnusx1.portal.com
Gold	Martin	National TransCommunications, Ltd	+ 44-962-822304	+ 44-962-822409	martin@ntlrd.demon.co.uk
Guglielmo	Mario	CSELT	+ 39-11-228-6115	+ 39-11-228-6190	
Ho	Yo-Sung	Philips Labs	+ 1-914-945-6227	+ 1-914-945-6500	ysh@philabs.philips.com
Lafon	Philippe	EURODEC	+ 33 1 34 24 6090	+ 33 1 34 24 8658	
Lhuillier	JJ	Philips USA	+ 1-914-945-6358	+ 1-914-945-6500	jjx@philabs.philips.com
Logston	Gary	Scientific Atlanta	+ 1-404-903-5110	+ 1-404-903-5080	gary_logston@technet.sa.com
MacInnis	Sandy	Kaleida	+ 1-415-966-0867	+ 1-415-966-0496	macinnis@kaleida.com
Maslaney	Michael	Scientific Atlanta	+ 1-404-903-5811	+ 1-404-903-5080	
McGrath	Carl	AT&T	+ 1-508-960-6269	+ 1-508-960-1477	jm@mvuye.att.com
Mead	Donald C	Hughes Aircraft Co.	+ 1-310-364-5909	+ 1-310-364-5321	dmead@hitchcock.dcf.scg.hac.com
Moog	Wim	Irdeto	+ 31-2503-2345	+ 31-2503-25924	wim@irdeto.nl
Moroney	Paul	General Instrument	+ 1-619-535-2446	+ 1-619-535-2486	pmoroney@gi.com
Nelson	John	TV COM International	+ 1-619-451-1500	+ 1-619-451-1505	jnelson@tieman.com
Noordam	Pieter	Philips Research	+ 31-40-742042	+ 31-40-742630	noordam@prl.philips.nl
Stampleman	Joseph	Apple Computer	+ 1-408-862-5425	+ 1-408-974-9775	jbs@apple.com
Tanton	Nick	BBC Research	+ 44-737-832361	+ 44-737-832336	nick.tanton@rd.eng.bbc.co.uk
Tayer	Marc	General Instrument	+ 1-619-535-2575	+ 1-619-535-2486	mtayer@gi.com
Tiernan	Jim	T/V COM International	+ 1-619-587-0252	+ 1-619-587-0257	jtiernan@tiernan.com
van der Meer	Jan	Philips Consumer Electronics	+ 31-40-735774	+ 31-40-737353	vdmeer@nlvv14.ce.philips.nl
Vollbrecht	Jennifer	Hughes Aircraft Co.	+ 1-310-416-8834	+ 1-310-364-9875	jennifer@unagi.scg.hac.com
Wallace	Greg	The 3DO Company	+ 1-415-572-5273	+ 1-415-493-9107	gwallace@3do.com
Wang	Fang-Ming	C-Cube	+ 1-408-944-8122	+	fmw@c3.pla.ca.us
Wasilewski	Tony	Scientific Atlanta	+ 1-404-903-5004	+ 1-404-903-5080	tony_wasilewski@technet.sa.com
Wechselberger	Tony	T/V COM International	+ 1-619-451-1500	+ 1-619-451-1505	
Whittington	Fritz	Texas Instruments	+ 1-214-995-0397	+ 1-214-995-6194	fritz@ti.com
Zdepski	Joel	David Sarnoff Research Center	+ 1-609-734-2885	+ 1-609-734-2049	jzdepski@sarnoff.com

List of Documents (MPEG93/???)

#	Source	Title
001	Convenor	Document list ('93)
002	CCITT/GB	Demonstration of TV and Interlaced SIF compatibility
003	CCITT/GB	SNR scalable experiment with compatible syntax
004	CCITT/GB	Compatible coding
005	CCITT/GB	Demonstration of compatibility with H.261
006	Morris et al	Proposal for compatible syntax
007	Juhola	Results for core experiment no. 14 Special prediction mode
008	ANSI	Resolutions for MPEG meeting in Rome
009	Paik et al.	Results of core experiment L.13 Adaptive 8x8 intra and 8x8 motion vectors
010	Sezan et al	Results of core experiment on reverse-order-P prediction scheme
011	Wise	Block numbering
012	Descamps	Implementation of an MUVLC-MUVLD
013	Marchisio et al	A prototype distributed multimedia retrieval system
014	CCITT/J	Demonstration of HDTV coding by D1 VCR
015	CCITT/J	Simulation results on compatibility
016	Biggar et al	Proposed framework for error resilience informative text in MPEG2/H.26X
017	Sikora	Error resilience and frequency scalable coding
018	Leditschke	Spatial localisation for cell loss resilience
019	Leditschke	A hybrid AAL packing scheme
020	Australia	HDTV facilities (in Canberra) for Sydney MPEG meeting
021	Toshiba	Simulation results on special prediction modes and its hardware evaluation
022	Boon et al.	Interlace-interlace Conversion : Experiment Results and Proposal
023	Boon et al.	Result Interlace-interlace Coding for Frame-pictures
024	Sony	Classification and Syntax for Frame/Field Structure
025	Sony	Result of Core experiment L.13: 8x8 motion vector and 8x8 Inter/Intra Decision
026	Sony	10bit Input Signal System
027	Sony	Result of Core experiment Q.4 and 5: NTC vs 8x1 DCT
028	Sony	Result of Core experiment Q.6(3): Alternative VLC vs ATT's proposal
029	Sony	Spatial scalable coding between chroma 4:2:2 and 4:2:0 format - Backward compatibility of chroma
030	Sony	Result of Core experiment G.2(c): Interlace-interlace scalable coding for Frame-pictures
031	Sony	Syntax for Fast Forward/Reverse at Strage Media
032	Sony	MB Stuffing Problem
033	Veltman	Implementation evaluation for motion compensation method
034	Sony	Restriction for 4:2:0 format
035	KDD	Results of prediction core experiment L-14 Special Prediction mode
036	Waseda Un.	Results on Core Experiment I.12 Single Loop Decoder Structure on F-Scalability
037	TI Japan	Results of Core Experiments on Interlace-progressive Compatible Coding for Frame-pictures
038	GCT	Results of Quantization Experiments
039	GCT	An MC Filtering Technique for Drift Correction in Frequency Scalability
040	GCT	Core Experiment Results on I.12
041	GCT	Solutions for Some Still Remaining Issues on Frequency Scalability
042	GCT	Core Experiment Results on L.14
043	Sharp	Results of Core Experiments on Interlace-interlace Compatible Coding for Frame-pictures
044	NHK/Ikegami	Subjective assessment of HDTV picture quality
045	JNB	Comments for Rome Meeting
046	JNB	Profile Proposal for MPEG-2 Profiles
047	NTV	Requirement for applying Extended Definition Progressive Scanning Images
048	Koster	Adding compatible prediction to even fields
049	Koster	Interlace to interlace conversion
050	Koster	Report of ad-hoc group on Technical Report on MPEG 1 Video compression
051	Koster	Report of ad-hoc group on syntax matters and maintenance of the test model TM3
052	Watanabe	Report of ad_hoc group on experiments on prediction modes
053	Wells	Report of ad_hoc group on experiments on quantization and entropy coding
054	Viscito	Report of ad-hoc group on experiments relative to the scalability requirements
055	Puri	Report of ad-hoc group on experiments relative to the compatibility requirements
056	Biggar	Report of ad_hoc group on ATM cell loss and error resilience.

057	Kogure	Report of ad-hoc group to process comments on the Working Draft.
058	Maslaney	Report of ad-hoc group on Multiplexing of Multiple Programs
059	Reader	Report of ad-hoc group on draft Core Profile and additional profiles
060	Morrison	Report of ad-hoc group on real time decoding of MPEG Video bit streams.
061	Reader	Report of editorial group on DIS 11172
062	Wong	Results on scan and VLC core experiments (Q.1.2 and Q.6.3)
063	Wong	Results on compatibility core experiment (G.1.b)
064	Siracusa et	A proposal for general MPEG transport syntax and structure
065	Savatier	Some video issues
066	Savatier et al	Concealment motion vectors associated with intra MBs
067	Savatier	Simulation results on Non-Transform Coding (NTC)
068	Savatier	Simulation results on special prediction modes (L-14)
069	Savatier	Self-adaptive VLC selection for coefficient coding
070	Savatier	Simulation results on alternative zigzag scan and adaptive VLC
071	Fautier et al	Extended DC precision in the MPEG-2 core profile
072	Corset et al	Results of core experiment G3 on SNR_scalability
073	Nocture et al.	Syntactic requirements of the SNR scalable approach based on a two layer quantisation structure
074	Tranchard	Results of experiment 2(b) on Interlaced/Interlaced compatible coding
075	Decotignie	Quality hierarchy and transmission priority levels
076	Telia AB	Leaky prediction
077	Telia AB	Cell loss experiments on one layer coding
078	Telia AB	Spatial scalability, interlaced to interlaced frame based
079	CCITT/J	Comparison between short-slice method and structured packing
080	CCITT/J	Fix for the noisy background problem in leaky prediction
081	CCITT/J	Cascade coding of H.26x and H.261
082	CCITT/J	Core profile based on communication applications considerations
083	CCITT/J	Results of Non 8x8 DCT core experiments (Q.5) in low delay mode
084	CCITT/J	Clarification of low delay descriptions
085	Brandis et al	Comparison of frequency scalable coders employing frame and field extraction
086	Borgwardt	Some results on prediction core experiment L.14
087	Hopper	Comparison on methods of critical data delivery in high error-rate environments
088	Montreuil	Performance of digital coded modulation for the delivery of MPEG-2 stream compared to analog FM modulation
089	Zdepsky	Display related data for the MPEG-2 video picture layer
090	Chair/Test	MPEG-2 verification test
091	WD Ed. gr.	MPEG-2 Working draft (Video part)
092	Kogure et al	Presenting structures of profiles in working draft
093	Kogure et al	Simulation results for alternative fixed scan and alternate intra VLC table
094	Kogure et al	Simulation results for NTC (Q.4) and Non 8x8 DCT (Q.5)
095	Kogure et al	A posteriori decision method for prediction mode
096	Chair/DSM	New Work Item Proposal for Digital Storage Media (DSM)
097	Reader	Classification of MPEG-2 algorithm techniques into profiles
098	Reader	MPEG 2 slice position syntax
099	Reader	Procedure to revise MPEG-2 video syntax
100	Nasse	Proposal for MPEG-2 verification tests
101	Madec	Core experiment G.3 SNR scalability with quantisation structure
102	van d. Meer	Proposed enhancements to part 4 of CD 11172, compliance
103	Erdem et al.	10-bit extension for MPEG-2
104	DIN	Resolutions of the German National Body (DIN) to the ISO/IEC JTC1/SC29/WG11 meeting in Rome
105	Hammer et al	Simulation results of core experiment Q.6.1 (Frequency scanning)
106	CNET	Experiment on spatio-temporal weighted H.261/MPEG2 compatibility with base layer at 128/384 kbit/s
107	Uz et al.	Experiment on structured packing with error concealement
108	Joseph et al	Experiments on coefficient scanning (F.5)
109	Puri	Thresholding for 16x8 frame prediction
110	Noordam et al	Proposal of an MPEG-2 program multiplexer
111	VADIS	Cleanup of the Test Model
112	Wong	Results of experiment combining scan, VLC, and 16x8 frame prediction features
113	Wong	Results of prediction core experiment (L.15)
114	Sun et al.	Experiments on spatial scalability with error concealement
115	Uz et al.	Experiments comparing leaky-prediction and error concealement
116	Uz et al.	Experiments on increased error resilience by transmitting I-frame motion vectors
117	Kogure et al.	Consideration on core profile

118	Sikora	Scalable side information - Results for single loop decoder stucture
119	Sikora	Scalable side information with extended Mquant table
120	Sikora	Scalable coding employing block based quarter pel prediction scale_4 interpolation filters
121	Johnson et al	Drift minimisation in frequency scalability scale_4 reconstruction using block-based interpolation filters
122	Dunstan et al	Results for frequency scalable coder error resilience experiment
123	Sikora	Error resilience and frequency scalable coding
124	Aus UVC	Comparison of DCT-based interlaced-in-interlaced extraction method
125	NVS	ISO/IEC JTC1/SC29/WG11 meeting in Norway
126	AFNOR	Invitation to MPEG meeting in Paris
127	SISIR	Meeting of ISO/IEC JTC1/SC29/WG11 in Singapore in 1994
128	EBU G5	Replies from members of Subgroup G5 to MPEG documents
129	CCIR	ITU/CCIR workshops on enhanced television (New Zealand) and digital terrestrial television broadcasting (Los Angeles)
130	CCIR TG11/4	Meeting of CCIR TG 11/4 - Harmonization of HDTV standards between broadcast and non-broadcast applications
131	Hampel et al	New Work Item Proposal for Hierarchical Lossy/Lossless compression of 5-D images with 1-16 bpp
132	SISIR	Comments of CD 11172 - MPEG Part 1/2/3
133	CCIR TG11/4	Report of the first meeting of TG 11/4
134	Wallace et al	Two Draft New Work Item Proposals 1. Limited gray level enhancements to JPEG DIS 10918-1 2. Limited gray level enhancements to JBIG CD 11544
135	CMTT/2-SRG	9th meeting of the Special Rapporteur's group of CMTT/2 on secondary distribution
136	CCIR SG 11	Approval of 30 new or revised Questions
137	CCITT EG	Report of the ninth meeting in Ipswich and London
138	CMTT/2-SRG	Draft specification of the TV/HDTV compatible coding scheme
139	Bigi	Letter to SC29 Secretariat
140	HHI	A new HDTV sequence "Kiel Harbour" for MPEG tests
141	Fautier et al	Proposal for core buffer size definition
142	Holborow et al	Transport multiplex proposal for MPEG-2 Systems
143	Puri et al.	Simplified interlace-interlace conversion
144	Yu et al.	Results of core experiment allowing reverse ordering of fields in field structure
145	Chaing et al	Demonstration of interlace to interlace HDTV/Standard TV coding using motion compensated up/down sampling
146	Mokry et al.	Results of core experiment using efficient frequency scalability
147	CCITT SG XV	Liaison statement to MPEG concerning system aspects
148	CMTT/2 SRG	Secondary distribution of TV and HDTV pyramidal DCT proposal
149	CMTT/2 SRG	Advances in the pyramidal coding scheme for the secondary distribution of TV and HDTV signals New simulation results
150	CMTT/2 SRG	Draft specification of the TV/HDTV compatible coding scheme by pyramidal DCT
151	Ed. Group	Modified L-14 (Special Prediction Modes)
152	Fogg	Complexity statistics in picture header
153	Herpel et al	Drawback of 3-field upconversion for spatial scalability
154	ETSI NA5/	Clarification and suggestions on profiles
155	Viscito et al	Frequency domain scalability
156	Yamada	A consideration for core profile
157	Yamada	Review of MPEG1 heritages and less control syntax in lower layers
158	CCITT/J	Report of AC leaky prediction
159	CCITT	Modification of the CCITT/MPEG ATM cell loss model
160	ETRI	Simulation results on DTV and HDTV compatibility
161	SC29	IS 11172 Patent situation
162	JPEG	Revised draft - New Work Item compression of images having multiple correlated components
163	SC29	Resolutions of 3rd plenary meeting of SC29
164	CCITT	Concerns about current patent policy practice of Joint ISO/CCITT standards/recommendations
165	Curet	Specification of a super-multiplex with different levels of protection
166	Sugiyama	Results of leaky prediction experiments
167	Sugiyama	Results of Non-8x8 DCT and NTC experiments
168	Sugiyama	Proposal of limitation in core-profile
169	Sugiyama	Proposal of modification on Field-Picture
170	Wasilewski	Universal Multi-program multiplex and transport for MPEG-2 Systems

171	Logston	Packet identifiers and a Multiplex Mapping Language
172	Wasilewski	Summary of current MPEG-2 Systems multiplex work
173	Wasilewski	An MPEG-2 multi-program multiplex syntax
174	Haskell et al	3:2 pulldown signalling
175	Declerck	Proposal for a multiplex structure in MPEG-2
176	Schamel	Results on MUVLC (core experiment Q.6)
177	Schamel	Results on frequency scalability (core experiment I.11)
178	AT&T	Results of experiments on leaky prediction
179	Koster et al.	Proposal for and discussion on the syntax to exploit the correlation between similar video signals over a pair of video codecs
180	Tiernan et al.	Transmission of broadcast applications of digital services, including video, audio, and data programs
181	Puri et al.	Quadtree segmented coding (QSC): A robust NTC scheme?
182	Puri et al.	Quantization issues and proposed directions for core experiments Q.2.2 and Q.3
183	Puri et al.	Results of fixed scan core experiment Q.1.2
184	Puri et al.	Results of adptive VLC core experiment Q.6.3
185	Puri et al.	Rate partitioning in efficient frequency scalability
186	Puri et al.	Result of prediction core experiment L.15 and L.7
187	Curet et al.	VADIS comments on MPEG standardisation of master-multiplex level
188	Stampleman	A directory format for MPEG-2 Systems
189	Savatier	Unified syntax for coded block pattern
190	Gonzales	Correction to test model 3 and working draft
191	CCETT	Patent statement
192	IRT	Patent statement
193	Philips	Patent statement
194	Univ. Illinois	Workshop on very low bitrate video compression
195	JTC1/SC21	Proposal for a New Work Item: SQL Multimedia and application packages (SQL/MM)
196	CCIR SG11	Progress report of the activities of SRG-UR1
197	CMTT/2 SRG	Liaison statement from CMTT/2-SRG to TG 11/3 and 11/4
198	CCITT SGXVIII	Liaison to CCITT SG XV ATM Video Coding Experts Group, CMTT/3, CCIR IWP11/9, CCIR 11B and ISO/IEC JTC1/SC29/WG11
199	ISO/IEC	Extracts from ISO/IEC Directives
200	Convenor	MPEG membership list
201	CSELT	Proposal for the structure of a video encoder source code
202	AUS NB	General information for Sydney meeting
203	Aravind	L-14 Results with M=1, SVMC-prime only
204	MHEG	Identification of additional standard multimedia components
205	ITTF	Letter to Convenor
206	SC18	WD of the TR om Multimedia and Hypermedia: Model and Framework
207	Kogure et al.	Proposal for stuffing data limitations
208	NHK	Present status of the development of signal transmission format for ISDB
209	Convenor	22nd WG11 meeting notice
210	Bertin	Information on EURESCOM project IMS-1 Integrated Multimedia Services at about 1 Mbit/s
211	Jourdan et al.	A possible mapping of MHEG actions on MPEG-DSM CC
212	CMTT/2	Comments on the report of the SR for secondary distribution of digital TV and HDTV - Future direction of work
213	CCITT WPXV/1	Terms of reference for Special Rapporteur for Very Low Bitrate Visual Telephony
214	CCCITT EG	Error resilience framework for informative text and further experimentation
215	DIN	Comments on the resolutions of the 20th WG11 meeting
216	CCIR SG 11	Draft new Recommendation: Reference model for data broadcasting
217	SC29	Management report of the ISO/IEC JTC1/SC29 third plenary meeting, Ottawa, Canada, 1992/11/09-11
218	Convenor	Letter Re: Patent statements to ISO
219	Convenor	Report on the relations between patented items in 11172 and encoded bitstreams
220	Convenor	Annex IV to Angra dos Reis meeting report
221	Convenor	Collection of patent statements
222	CMTT/2-SRG	Liaison message to MPEG
223	Lhuillier	Suggested increase in system clock frequency for MPEG-2
224	CCITT	Statement on CCITT patent policy
225	Ed. Group	Test Model 4
226	Wilson	Contribution to MPEG on SMPTE file format for digital picture exchange
227	SGS-Thomson	Simplification of vector scaling in the L-14 modes
228	SGS-Thomson	Intra code tables

229	SGS-Thomson	8*8 vectors
230	SGS-Thomson	NTC, Frequency Scanning
231	AUSCons,et al	Proposal for data partitioning syntax
232	Balletta	Intervention of the Secretary of the Italian PT Minister
233	Uz,Zdepski	System support required for data partitioning
234	AT&T,GI	Experiment on 16*8/8*8 MC for progressive sequences
235	McCann	Comments on profiles and the core profile
236	Sikora,et al	Proposal for Core Profile Data partitioning syntax
237	Req. subgroup	Definition of Profiles and the Main Profile
238	Lippman	Suggestions for a revised set of Profiles
239	Req. subgroup	Guide for Systems work. Rome revision
240	Sikora, et al	Proposal for Core experiment syntax on data partitioning
241	Borgwardt	Downloadable Y and C quantizer weighting matrices
242	Yagasaki	Modification of non-linear arrangement of stepsize

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ISO/IEC JTC1/SC29/WG11
CODING OF MOVING PICTURES AND ASSOCIATED AUDIO

ISO/IEC JTC1/SC29/WG11
MPEG 93/237
28 January 1993

Source: REQUIREMENTS Sub-group
Title: Definition of Profiles and the Main Profile

Note - Term of "Core" has been changed to "Main", and term "Main Level" is subject to further discussion.

1. Definition of Terms

MPEG-2 Syntax	The set of syntactic elements used for specifying MPEG-2 bitstreams
MPEG-2 Parameter	A variable within the MPEG-2 syntax which may take one of a large range of values. A variable which can take one of only two values is a flag and not a parameter.
Profile	A defined sub-set of the MPEG-2 syntax.
Level	A defined set of constraints on the values which may be taken by MPEG-2 parameters within a particular profile. A profile may contain one or more levels.
Main Profile	A particular profile which is intended to be suitable for use by the largest possible number of major initial applications of MPEG-2 in terms of both functionality requirements and cost constraints.
Main Level	A particular level within the Main Profile which defines a set of MPEG-2 parameter constraints which are intended to be appropriate for use by the largest possible number of major initial applications of MPEG-2 in terms of both functionality requirements and cost constraints.

2. Use of Profiles and Levels

1. Compliance tests will be carried out against a defined level of a defined profile.
2. Full compliance* to the same level of the same profile by two codecs will be a sufficient guarantee of their ability to successfully decode each other's bitstreams.
3. The number of profiles should be kept as small as practical. In particular, the development of profiles which are very similar, but not quite identical, will be discouraged.
4. Wherever practical, a new profile will be defined to be either a superset or a subset of each existing profile. Particular attention will be paid to try to make this true for the Main Profile.
5. The number of levels within a Profile should be kept small and, wherever practical, levels will be defined so that higher level conforming decoders can decode lower level bitstreams.
6. Wherever practical, the meaning of levels will be harmonised between different profiles.
7. The MPEG-2 bitstream will support the indication of the profile and level which will be required to decode the bitstream.

*) Meaning of full compliance is to be defined.

3. Specifications for Video Main Profile at Main Level

Main Profile at Main Level is specified in terms of syntactic elements and their associated values as shown in Table 1. In this table, syntactic elements are taken from the TM3 document. These elements should be updated according to the emerging specifications of the future TM/WD document.

END

Table 1 Main Profile at Main Level

Note - It was agreed at the London meeting that the Main Profile should support robustness to bit errors and cell losses. Specific syntax elements to be included in the Main Profile awaits the study of Video Group on frequency layering (coefficient scanning), leaky prediction, etc.

Notations:

x :	included in Main Profile Syntax
o :	not included in Main Profile Syntax
D (in type) :	item with level-dependent parameters
I (in type) :	item independent of levels in a profile
P (in type) :	item for postprocessing after decoding
CH:I :	to be consulted with Implementation Group
CH:V :	to be consulted with Video Group
CH:V,I :	to be consulted with Implementation Group and Video Group

Sequence layer (SEL)

General

#	Syntactic element	Status	Type	Parameter range
1	horizontal_size_value	x	D	up to 720 in multiples of 16 *1
2	vertical_size_value	x	D	up to 480/576 in multiples of 16 *1
3	pel_aspect_ratio	x	P	
4	picture_rate	x	D	23.976/24/25/29.97/30*1
5	bit_rate	x	D	up to 15Mbps
6	vbv_buffer_size	x	D	2Mb? CH:V
7	profile_and_level_ID (for bitstream)	x	D	(specific values are under stduy)
8	load_intra_quantizer_matrix	x	I	
9	load_non_intra_quantizer_ matrix	x	I	
10	chroma_format	x	?	4:2:0*2
11	extent_horizontal_size	o	-	
12	extent_vertical_size	o	-	
13	video_format	x	P	
14	intra_vlc_format	x	I	CH:V
15	tcoef_escape_format	x	I	
16	display_horizontal_ dimension	x	P	
17	display_vertical_dimension	x	P	

*1) Horizontal: up to 720, Vertical: up to 576, Frame rate: up to 30, and Horizontal x Vertical. x Frame rate: up to 10368k pels/s.

Only 5 combinations are relevant for full size pictures;
720 x 480 x 30
720 x 480 x 29.97
720 x 480 x 24
720 x 480 x 23.976
720 x 576 x 25

*2) 4:2:2 may be in another level, or in another profile.

Spatial scalability

#	Syntactic element	Status	Type	Parameter range
18	sscalable	o	-	
19	sscale_code	o	-	
20	compatible_mtype	o	-	
21	load_prediction_ weighting_matrix	o	-	

Frequency scalabilty

#	Syntactic element	Status	Type	Parameter range
22	fscalable	o	-	
23	interlaced	o	-	
24	subband	o	-	
25	linked_prediction	o	-	
26	scalable_side_information	o	-	
27	motion_refinement	o	-	
28	MUVLC_coding	o	-	
29	fscale_code	o	-	
30	motion_compensation_loop	o	-	

Spatial scalability or Frequency scalability

#	Syntactic element	Status	Type	Parameter range
31	low_resolution_prediction_ horizontal_dimension	o	-	
32	low_resolution_prediction_ vertical_dimension	o	-	

GOP layer (GL)

General

#	Syntactic element	Status	Type	Parameter range
1	time_code	x	I	
2	closed_gop	x	I	
3	broken_link	x	I	

Picture layer (PL)

General

#	Syntactic element	Status	Type	Parameter range
1	picture_coding_type	x	I	I,P,B
2	vbv_delay	x	I	
3	full_pel_forward_vector	x	I	
4	forward_f_code	x	D?	CH:V
5	full_pel_backward_vector	x	I	
6	backward_f_code	x	D?	CH:V
7	picture_structure	x	I	Fr & Fi structures
8	forward_reference_field	x	I	
9	backward_reference_field	x	I	
10	chroma_postprocessing_ type	x	P	
11	v-axis / field_sequence / sub_carrier_phase / burst_amplitude / sub_carrier_phase	x	P	
12	pan_horizontal_left_upper_ offset	x	P	
13	pan_vertical_left_upper_off set	x	P	
14	intra_dc_prediction	x	I	single value (9 or 10 bits?) CH:V
15	qscale_type	?	I	CH:V
16	leak_factor_code	?	I	CH:V,I

Spatial scalability or Frequency scalability

#	Syntactic element	Status	Type	Parameter range
17	overlap_horizontal_left_upp er_offset	o	-	
18	overlap_vertical_left_upper _offset	o	-	
19	slave_slice	o	-	

Slice layer (SLL)

General

#	Syntactic element	Status	Type	Parameter range
1	quantizer_scale	x	I	

Frequency scalability

#	Syntactic element	Status	Type	Parameter range
2	dct_size	o	-	

MB layer (ML)

General

#	Syntactic element	Status	Type	Parameter range
1	macroblock_address_increment	x	I	*3
2	macroblock_type	x	I	
3	frame_motion_type	x	I	Fr/Fi/smart prediction
4	field_motion_type	x	I	Fi/16x8/smart prediction
5	8x8/16x8 MV	o	I	
6	dct_type	?	I	Fr/Fi or zigzag/vertical, or 8x8/8x1DCT/NTC? CH:V,I
7	quantizer_scale	x	I	
8	forward_motion_vectors	x	I	
9	backward_motion_vectors	x	I	
10	coded_block_pattern	x	I	*3

*3: Included for consistancy with low delay and low bitrate operations.

Spatial Scalability

#	Syntactic element	Status	Type	Parameter range
11	compatible_type	o	-	
12	compat_macroblock_type	o	-	
13	wt_code	o	-	
14	scaled_block	o	-	

Others

#	Syntactic element	Status	Type	Parameter range
1	Maximum period for refresh	x	D	132
2	Presentation-related indications	x	P	e.g. colorimetry, color matrix, gamma
3	Decoder-related indications	x	D	e.g. interlace/progressive, 3-2 pull down
4	VBR operation	x	I	