INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

H.262
Amendment 2
(11/96)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Coding of moving video

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Information technology – Generic coding of moving pictures and associated audio information: Video

Amendment 2: 4:2:2 Profile

ITU-T Recommendation H.262 – Amendment 2

(Previously CCITT Recommendation)

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For further details, please refer to ITU-T List of Recommendations.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. Some 179 member countries, 84 telecom operating entities, 145 scientific and industrial organizations and 38 international organizations participate in ITU-T which is the body which sets world telecommunications standards (Recommendations).

The approval of Recommendations by the Members of ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, 1993). In addition, the World Telecommunication Standardization Conference (WTSC), which meets every four years, approves Recommendations submitted to it and establishes the study programme for the following period.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC. The text of ITU-T Recommendation H.262, Amendment 2, was approved on 8th of November 1996. The identical text is also published as ISO/IEC International Standard 13818-2.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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INTERNATIONAL STANDARD

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INFORMATION TECHNOLOGY – GENERIC CODING OF MOVING PICTURES AND ASSOCIATED AUDIO INFORMATION: VIDEO

AMENDMENT 2
4:2:2 Profile

1) Clause 8

Replace Table 8-4 by:

Table 8-4 – Escape profile_and_level_indication identification

profile_and_level_indication	Name
10000110 to 11111111	(Reserved)
10000101	4:2:2 profile @ Main level
10000000 to 10000100	(Reserved)

Add the following text as a Note after Table 8-4:

NOTE – On 4:2:2 Profile: The ITU-T Rec. H.262 | ISO/IEC 13818-2 compression algorithm exploits temporal redundancy, spatial redundancy, and human psycho-visual properties and is not a lossless algorithm. For sequences with substantial spatial and temporal redundancies, or without many sharp lines/edges, the quality of the sequences obtained after decompression will be higher than that obtained for sequences with lower redundancy, or with a large number of sharp lines/edges.

The 4:2:2 profile can provide higher video quality, better chroma resolution and allows a higher bit rate (at Main level, up to 50 Mbit/s) than MP@ML. It also provides the capability to encode all active lines of video.

Although it is not part of the hierarchy of profiles and levels, the 4:2:2 profile @ Main level decoder is required to decode all the bit streams decodable by MP@ML decoders.

The 4:2:2 profile does not support scalability. This allows implementation architectures to be similar to those of MP@ML.

This profile can be used for applications requiring multiple generations of encoding and decoding. In the case of multiple generations without picture manipulation or change in picture coding type between generations, the quality remains nearly constant after the first generation. Use of picture manipulation or change in picture coding type between generations causes some degradation in quality. Nevertheless, the resulting quality is acceptable for a broad range of applications.

The 4:2:2 profile permits all I-picture encoding. This enables fast recovery from transmission errors and can simplify editing applications. This profile allows the high bit rates required to maintain high quality while using only I-picture coding. The 4:2:2 profile also allows the use of P- and B-picture coding types which can further improve quality or reduce bit rate for the same quality.

See Annex J for more information on the picture quality of the 4:2:2 profile.

2) Subclause 8.2

Replace Table 8-5 by:

Table 8-5 – Syntactic constraints of profiles

Syntactic Element	Profile					
	Simple	Main	SNR	Spatial	High	4:2:2
chroma_format	4:2:0	4:2:0	4:2:0	4:2:0	4:2:2 or 4:2:0	4:2:2 or 4:2:0
frame_rate_extension_n	0	0	0	0	0	0
frame_rate_extension_d	0	0	0	0	0	0
aspect_ratio_information	0001, 0010, 0011	0001, 0010, 0011	0001, 0010, 0011	0001, 0010, 0011	0001, 0010, 0011	0001, 0010, 0011
picture_coding_type	I, P	I, P, B	I, P, B	I, P, B	I, P, B	I,P, B
repeat_first_field	Constrained		Unconstrained			Constrained
sequence_scalable_extension()	No	No	Yes	Yes	Yes	No
scalable_mode	–	–	SNR	SNR or Spatial	SNR or Spatial	–
picture_spatial_scalable_extension()	No	No	No	Yes	Yes	No
intra_dc_precision	8, 9, 10	8, 9, 10	8, 9, 10	8, 9, 10	8, 9, 10, 11	8, 9, 10, 11
Slice structure	Restricted 6.1.2.2					

Replace Table 8-6 by:

Table 8-6 – Maximum number of bits in a macroblock

chroma_format	Maximum number of bits
4:2:0	4608
4:2:2	6144
4:2:2 (in 4:2:2 Profile)	Unconstrained
4:4:4	9216

3) Subclause 8.2.1

After the following bullet in 8.2.1:

- if vertical_size > 480 lines frame_rate shall be “25Hz”

add the following text:

Additionally, the following constraints exist for 4:2:2 profile @ Main level only:

- if vertical_size > 512 lines,

  then if picture_coding_type=011 (i.e. B-picture), repeat_first_field shall be 0;

- if vertical_size > 512 lines frame_rate shall be “25Hz”.

4) Subclause 8.5

Replace Table 8-11 by:

Table 8-11 – Upper bounds for sampling density

Level	Spatial resolution layer		Profile					
			Simple	Main	SNR	Spatial	High	4:2:2
High	Enhancement	Samples/line		1920			1920	
		Lines/frame		1152			1152	
		Frames/sec		60			60	
	Lower	Samples/line					960	
		Lines/frame		–			576	
		Frames/sec					30	
High-1440	Enhancement	Samples/line		1440		1440	1440	
		Lines/frame		1152		1152	1152	
		Frames/sec		60		60	60	
	Lower	Samples/line				720	720	
		Lines/frame		–		576	576	
		Frames/sec				30	30	
Main	Enhancement	Samples/line	720	720	720		720	720
		Lines/frame	576	576	576		576	608[a)]
		Frames/sec	30	30	30		30	30
	Lower	Samples/line					352	
		Lines/frame	–	–	–		288	–
		Frames/sec					30	
Low	Enhancement	Samples/line		352	352			
		Lines/frame		288	288			
		Frames/sec		30	30			
	Lower	Samples/line						
		Lines/frame		–	–			
		Frames/sec						

a) 512 lines/frame for 525/60, 608 lines/frame for 625/50

NOTE – In the case of single layer or SNR scaled coding, the limits specified by “Enhancement layer” apply.

Replace Table 8-12 by:

Table 8-12 – Upper bounds for luminance sample rate (samples/sec)

Level	Spatial resolution layer	Profile					
		Simple	Main	SNR	Spatial	High	4:2:2
High	Enhancement		62 668 800			62 668 800 (4:2:2) 83 558 400 (4:2:0)	
	Lower		–			14 745 600 (4:2:2) 19 660 800 (4:2:0)	
High-1440	Enhancement		47 001 600		47 001 600	47 001 600 (4:2:2) 62 668 800 (4:2:0)	
	Lower		–		10 368 000	11 059 200 (4:2:2) 14 745 600 (4:2:0)	
Main	Enhancement	10 368 000	10 368 000	10 368 000		11 059 200 (4:2:2) 14 745 600 (4:2:0)	11 059 200
	Lower	–	–	–		– 3 041 280 (4:2:0)	–
Low	Enhancement		3 041 280	3 041 280			
	Lower		–	–			
NOTE – In the case of single layer or SNR scaled coding, the limits specified by "Enhancement layer" apply.							

Replace Table 8-13 by:

Table 8-13 – Upper bounds for bit rates (Mbit/s)

Level	Profile					
	Simple	Main	SNR	Spatial	High	4:2:2
High		80			100 all layers 80 middle + base layer 25 base layer	
High-1440		60		60 all layers 40 middle + base layers 15 base layer	80 all layers 60 middle + base layers 20 base layer	
Main	15	15	– 15 both layers 10 base layer		20 all layers 15 middle + base layer 4 base layer	50
Low		4	– 4 both layers 3 base layer			

Replace Table 8-14 by:

Table 8-14 – VBV buffer size requirements (bits)

Level	Layer	Profile					
		Simple	Main	SNR	Spatial	High	4:2:2
High	Enhancement 2 Enhancement 1 Base		 9 781 248			12 222 464 9 781 248 3 047 424	
High-1440	Enhancement 2 Enhancement 1 Base		 7 340 032		7 340 032 4 882 432 1 835 008	9 781 248 7 340 032 2 441 216	
Main	Enhancement 2 Enhancement 1 Base	 1 835 008	 1 835 008	– 1 835 008 1 212 416		2 441 216 1 835 008 475 136	 9 437 184
Low	Enhancement 2 Enhancement 1 Base		 475 136	– 475 136 360 448			

Replace Table 8-15 by:

Table 8-15 – Forward compatibility between different profiles and levels

Profile and Level indication in bitstream	Decoder											
	HP @ HL	HP @ H-14	HP @ ML	Spatial @ H-14	SNR @ ML	SNR @ LL	MP @ HL	MP @ H-14	MP @ ML	MP @ LL	SP @ ML	4:2:2 @ ML
HP@HL	X											
HP@H-14	X	X										
HP@ML	X	X	X									
Spatial@H-14	X	X		X								
SNR@ML	X	X	X	X	X							
SNR@LL	X	X	X	X	X	X						
MP@HL	X						X					
MP@H-14	X	X		X			X	X				
MP@ML	X	X	X	X	X		X	X	X			X[b)]
MP@LL	X	X	X	X	X	X	X	X	X	X	X[a)]	X[b)]
SP@ML	X	X	X	X	X		X	X	X		X	X[b)]
ISO/IEC 11172	X	X	X	X	X	X	X	X	X	X	X	X[b)]
4:2:2@ML												X

X Indicates that the decoder shall be able to decode the bit stream including all relevant lower layers.

a) SP@ML decoders are required to decode MP@LL bitstreams.

b) A 4:2:2 profile@Main level decoder shall be able to decode Main profile@Main level, Main profile@Low level and Simple profile@Main level bit streams, as well as ISO/IEC 11172-2 constrained system parameter bit streams.

5) Annex E

Replace Table E.2 by:

Table E.2 – Sequence header

#	Syntactic elements	Status: SIMPLE	Status: MAIN	Status: SNR	Status: SPATIAL	Status: HIGH	Status: 4:2:2	Type	Comments
01	**horizontal_size_value**	x	x	x	x	x	x	D	Table 8-11
02	**vertical_size_value**	x	x	x	x	x	x	D	Table 8-11
03	**aspect_ratio_information**	x	x	x	x	x	x	P	
04	**frame_rate_code**	x	x	x	x	x	x	D	Table 8-11
05	(pel rate) NOTE – This is not a syntactic element.							D	Table 8-12; pel rate is a product of pels/line, lines/frame and frames/sec
06	**bit_rate_value**	x	x	x	x	x	x	D	Table 8-13
07	**vbv_buffer_size_value**	x	x	x	x	x	x	D	Table 8-14
08	**constrained_parameters_flag**	x	x	x	x	x	x	I	Set to "1" if ISO/IEC 11172-2 constrained, Set to "0" if ITU-T Rec. H.262 | ISO/IEC 13818-2
09	**load_intra_quantiser_matrix**	x	x	x	x	x	x	I	
10	**intra_quantiser_matrix[64]**	x	x	x	x	x	x	I	
11	**load_non_intra_quantiser_matrix**	x	x	x	x	x	x	I	
12	**non_intra_quantiser_matrix[64]**	x	x	x	x	x	x	I	
13	sequence_extension()	x	x	x	x	x	x	I	Always present if ITU-T Rec. H.262 | ISO/IEC 13818-2
14	sequence_display_extension()	x	x	x	x	x	x	P	
15	sequence_scalable_extension()	o	o	x	x	x	o	I	Table 8-9 for maximum number of scalable layers
16	user_data()	x	x	x	x	x	x	I	Decoder may skip this data

Replace Table E.3 by:

Table E.3 – Sequence extension

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**profile_and_level_indication**	x	x	x	x	x	x	D	Profile: one of 8 values Level: one of 16 values Escape bit: one of 2 values
02	**progressive_sequence**	x	x	x	x	x	x	I	
03	**chroma_format**	x	x	x	x	x	x	I	Table 8-5
04	**horizontal_size_extension**	x	x	x	x	x	x	D	Input picture size related
05	**vertical_size_extension**	x	x	x	x	x	x	D	Input picture size related
06	**bit_rate_extension**	x	x	x	x	x	x	D	Input picture size related
07	**vbv_buffer_size_extension**	x	x	x	x	x	x	D	Input picture size related
08	**low_delay**	x	x	x	x	x	x	I	
09	**frame_rate_extension_n**	x	x	x	x	x	x	I	Set to “0” for all defined profiles
10	**frame_rate_extension_d**	x	x	x	x	x	x	I	Set to “0” for all defined profiles

Replace Table E.4 by:

Table E.4 – Sequence display extension elements

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**video_format**	x	x	x	x	x	x	P	
02	**colour_description**	x	x	x	x	x	x	P	Input format related
03	**colour_primaries**	x	x	x	x	x	x	P	
04	**transfer_characteristics**	x	x	x	x	x	x	P	
05	**matrix_coefficients**	x	x	x	x	x	x	P	
06	**display_horizontal_size**	x	x	x	x	x	x	P	Input format related
07	**display_vertical_size**	x	x	x	x	x	x	P	Input format related

Replace Table E.5 by:

Table E.5 – Sequence scalable extension

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
		Status							
01	**scalable_mode**	o	o	x	x	x	o	I	SNR Profile: SNR Scalability Spatial and High Profile: SNR or Spatial Scalability
02	**layer_id**	o	o	x	x	x	o	I	
	if (spatial scalable)								
03	**lower_layer_prediction_ horizontal_size**	o	o	o	x	x	o	D	Table 8-12 for luminance sampling density
04	**lower_layer_prediction_ vertical_size**	o	o	o	x	x	o	D	Table 8-12 for luminance sampling density
05	**horizontal_subsampling_ factor_m**	o	o	o	x	x	o	I	
06	**horizontal_subsampling_ factor_n**	o	o	o	x	x	o	I	
07	**vertical_subsampling_ factor_m**	o	o	o	x	x	o	I	
08	**vertical_subsampling_ factor_n**	o	o	o	x	x	o	I	
	if (temporal scalable)								
09	**picture_mux_enable**	o	o	o	o	o	o	I	
10	**mux_to_progressive_ sequence**	o	o	o	o	o	o	I	
11	**picture_mux_order**	o	o	o	o	o	o	I	
12	**picture_mux_factor**	o	o	o	o	o	o	I	

Replace Table E.6 by:

Table E.6 – Group of pictures header

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**time_code**	x	x	x	x	x	x	I	Decoder may skip this data
02	**closed_gop**	x	x	x	x	x	x	I	
03	**broken_link**	x	x	x	x	x	x	I	

Replace Table E.7 by:

Table E.7 – Picture header

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**temporal_reference**	x	x	x	x	x	x	I	
02	**picture_coding_type**	x	x	x	x	x	x	I	Simple Profile: I, P at Main level, I, P, B at Low level Main, SNR, Spatial and High Profile: I, P, B
03	**vbv_delay**	x	x	x	x	x	x	I	
04	**full_pel_forward_vector**	x	x	x	x	x	x	I	Set to "0" for ITU-T Rec. H.262 | ISO/IEC 13818-2
05	**forward_f_code**	x	x	x	x	x	x	I	Set to "111" for ITU-T Rec. H.262 | ISO/IEC 13818-2
06	**full_pel_backward_vector**	x	x	x	x	x	x	I	Set to "0" for ITU-T Rec. H.262 | ISO/IEC 13818-2
07	**backward_f_code**	x	x	x	x	x	x	I	Set to "111" for ITU-T Rec. H.262 | ISO/IEC 13818-2
08	**extra_information_picture**	x	x	x	x	x	x	I	
09	picture_coding_extension()	x	x	x	x	x	x	I	
10	quant_matrix_extension()	x	x	x	x	x	x	I	
11	picture_display_extension()	x	x	x	x	x	x	P	
12	picture_spatial_scalable_extension()	o	o	o	x	x	o	I	
13	picture_temporal_scalable_extension()	o	o	o	o	o	x	I	

Replace Table E.8 by:

Table E.8 – Picture coding extension

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**f_code[0][0] (forward horizontal)**	x	x	x	x	x	x	D	Low Level [1:7] Main Level [1:8] High-1440 and High Level [1:9]
02	**f_code[0][1] (forward vertical)**	x	x	x	x	x	x	D	Low Level [1:4] Main, High-1440 and High Level [1:5]
03	**f_code[1][0] (backward horizontal)**	x	x	x	x	x	x	D	Low Level [1:7] Main Level [1:8] High-1440 and High Level [1:9]
04	**f_code[1][1] (backward vertical)**	x	x	x	x	x	x	D	Low level [1:4] Main, H-14 and High Level [1:5]
05	**intra_dc_precision**	x	x	x	x	x	x	I	Simple, Main, SNR and Spatial Profile: [8:10] High Profile: [8:11] 4:2:2 Profile: [8:11]
06	**picture_structure**	x	x	x	x	x	x	I	
07	**top_field_first**	x	x	x	x	x	x	I	
08	**frame_pred_frame_dct**	x	x	x	x	x	x	I	
09	**concealment_motion_vectors**	x	x	x	x	x	x	I	
10	**q_scale_type**	x	x	x	x	x	x	I	
11	**intra_vlc_format**	x	x	x	x	x	x	I	
12	**alternate_scan**	x	x	x	x	x	x	I	
13	**repeat_first_field**	x	x	x	x	x	x	I	
14	**chroma_420_type**	x	x	x	x	x	x	P	
15	**progressive_frame**	x	x	x	x	x	x	P	
16	**composite_display_flag**	x	x	x	x	x	x	P	
17	**v_axis**	x	x	x	x	x	x	P	
18	**field_sequence**	x	x	x	x	x	x	P	
19	**sub_carrier**	x	x	x	x	x	x	P	
20	**burst_amplitude**	x	x	x	x	x	x	P	
21	**sub_carrier_phase**	x	x	x	x	x	x	P	

Replace Table E.9 by:

Table E.9 – Quant matrix extension

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**load_intra_quantiser_matrix**	x	x	x	x	x	x	I	
02	**intra_quantiser_matrix[64]**	x	x	x	x	x	x	I	
03	**load_non_intra_quantiser_matrix**	x	x	x	x	x	x	I	
04	**non_intra_quantiser_matrix[64]**	x	x	x	x	x	x	I	
05	**load_chroma_intra_quantiser_matrix**	o	o	o	o	x	x	I	
06	**chroma_intra_quantiser_matrix[64]**	o	o	o	o	x	x	I	
07	**load_chroma_non_intra_quantiser_matrix**	o	o	o	o	x	x	I	
08	**chroma_non_intra_quantiser_matrix[64]**	o	o	o	o	x	x	I	

Replace Table E.10 by:

Table E.10 – Picture display extension

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**frame_centre_horizontal_offset**	x	x	x	x	x	x	P	Input format related
02	**frame_centre_vertical_offset**	x	x	x	x	x	x	P	Input format related

Replace Table E.11 by:

Table E.11 – Picture temporal scalable extension

#	Syntactic elements	Status: SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**reference_select_code**	o	o	o	o	o	o	I	
02	**forward_temporal_reference**	o	o	o	o	o	o	I	
03	**backward_temporal_reference**	o	o	o	o	o	o	I	

Replace Table E.12 by:

Table E.12 – Picture spatial scalable extension

#	Syntactic elements	Status: SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**lower_layer_temporal_reference**	o	o	o	x	x	o	I	
02	**lower_layer_horizontal_offset**	o	o	o	x	x	o	D	Input format related
03	**lower_layer_vertical_offset**	o	o	o	x	x	o	D	Input format related
04	**spatial_temporal_weight_code_ table_index**	o	o	o	x	x	o	I	
05	**lower_layer_progressive_frame**	o	o	o	x	x	o	I	
06	**lower_layer_deinterlaced_field_ select**	o	o	o	x	x	o	I	

Replace Table E.13 by:

Table E.13 – Slice layer

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**slice_vertical_position_extension**	x	x	x	x	x	x	D	Input format related
02	**priority_breakpoint**	o	o	o	o	o	o	I	Only required for data partitioning
03	**quantiser_scale_code**	x	x	x	x	x	x	I	
04	**slice_extension_flag**	x	x	x	x	x	x	I	
05	**intra_slice**	x	x	x	x	x	x	I	Decoder may skip this data
06	**slice_picture_id_enable**	x	x	x	x	x	x	I	Decoder may skip this data
07	**slice_picture_id**	x	x	x	x	x	x	I	Decoder may skip this data
08	**extra_bit_slice**	x	x	x	x	x	x	I	Decoder may skip this data
09	macroblock()	x	x	x	x	x	x	I	

Replace Table E.14 by:

Table E.14 – Macroblock layer

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**macroblock_escape**	x	x	x	x	x	x	I	
02	**macroblock_address_increment**	x	x	x	x	x	x	I	
03	macroblock_modes()	x	x	x	x	x	x	I	
04	**quantiser_scale_code**	x	x	x	x	x	x	I	
05	motion_vectors(0)	x	x	x	x	x	x	I	Forward motion vector
06	motion_vectors(1)	o	x	x	x	x	x	I	Backward motion vector
07	coded_block_pattern()	x	x	x	x	x	x	I	
08	block(i)	x	x	x	x	x	x	I	

Replace Table E.15 by:

Table E.15 – Macroblock modes

#	Syntactic elements	Status: SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**macroblock_type**	x	x	x	x	x	x	I	
02	**spatial_temporal_weight_code**	o	o	o	x	x	o	I	
03	**frame_motion_type**	x	x	x	x	x	x	I	01: Field-based prediction 10: Frame-based prediction 11: Dual-prime
04	**field_motion_type**	x	x	x	x	x	x	I	01: Field-based prediction 10: 16 x 8 MC 11: Dual-prime
05	**dct_type**	x	x	x	x	x	x	I	

Replace Table E.16 by:

Table E.16 – Motion vectors

#	Syntactic elements	Status: SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**motion_vertical_field_select**	x	x	x	x	x	x	I	
02	motion_vector()	x	x	x	x	x	x	I	

Replace Table E.17 by:

Table E.17 – Motion vector

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**motion_horizontal_code**	x	x	x	x	x	x	I	
02	**motion_horizontal_r**	x	x	x	x	x	x	I	
03	**dmv_horizontal**	x	x	x	x	x	x	I	
04	**motion_vertical_code**	x	x	x	x	x	x	I	
05	**motion_vertical_r**	x	x	x	x	x	x	I	
06	**dmv_vertical**	x	x	x	x	x	x	I	

Replace Table E.18 by:

Table E.18 – Coded block pattern

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	**coded_block_pattern_420**	x	x	x	x	x	x	I	
02	**coded_block_pattern_1**	o	o	o	o	x	x	I	4:2:2
03	**coded_block_pattern_2**	o	o	o	o	o	o	I	4:4:4

Replace Table E.19 by:

Table E.19 – Block layer

#	Syntactic elements	SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2	Type	Comments
01	DCT coefficients	x	x	x	x	x	x	I	
02	End of block	x	x	x	x	x	x	I	

6) New annex

Add the following Annex J:

Annex J

4:2:2 Profile test results

(This annex does not form an integral part of this Recommendation | International Standard)

J.1 Introduction

This annex provides guidance to users regarding the applicability of the 4:2:2 Profile at Main Level to applications which may require:

- higher quality than Main Profile at Main Level;
- better chroma resolution than Main Profile at Main Level;
- post processing after compression and decompression;
- multiple generations of compression and decompression;
- short Group of Pictures (GOP) for editability;
- capability to pass all active video;
- capability to pass vertical blanking interval information.

It should be noted that application of this Profile is an area of ongoing progress. Results presented here reflect varying degrees of algorithm refinement, so further improvement can be expected.

J.1.1 Test sequences

The test sequences were generated using computer simulation of the ITU-T Rec. H.262 | ISO/IEC 13818-2 compression and decompression. For 525/60, the test material included:

- Gwen;
- Trailblazers;
- Mobile and Calendar;
- Dissolve.

For 625/50, the test material included:

- Balls of Wool;
- Cactus and Comb;
- Basketball;
- Wall;
- Renata and Butterfly;
- Mobile and Calendar.

“Gwen” is a chroma key test sequence with a woman in the foreground keyed over a forest scene in the background. “Gwen” is a difficult sequence to chroma key but an easy sequence to compress. Both “Cactus and Comb” and “Balls of Wool” are chroma key sequences which were used with a coloured background. “Trailblazers” is a rapid motion basketball sequence shot with an unshuttered CCD camera. “Basketball” is also a rapid motion sports sequence. Both are typical program material and moderately difficult to compress. “Wall” consists of a woman standing in front of a wall made of many small stones. “Renata” consists of a woman in front of a complex background with a dissolve to a complex image of butterflies. "Mobile and Calendar" is a particularly difficult compression test sequence with saturated colours and complex motion. "Dissolve" consists of two segments of "Mobile and Calendar" with a one second fade between the two segments and is also difficult to compress.

Test sequences were supplied by:

- ITU-R;
- Portland Trailblazers;
- SMPTE;
- Tektronix.

J.1.2 Test procedures

MPEG has conducted experiments to verify the performance of the 4:2:2 Profile. The results of those experiments are presented here. There are separate tests for 525/60 and 625/50. The 525/60 tests explore a broad range of data rates and GOP structures, while the 625/50 tests include more variety of test material but less combinations of data rate, GOP structure, and number of generations. The parameters chosen for the experiments are for example only, and do not cover the entire range of allowed parameter values. The examples are not intended as specific recommendations. Each application should use the combination of parameters that is most appropriate, depending on its requirements for quality, editability, and cost.

The tests include both a single generation and eight generations of cascaded compression and decompression. For the eight generation tests, separate tests were done with no shifts, with two spatial shifts, and with two temporal shifts. Spatial shifting means that the picture was shifted horizontally and vertically by two pixels and two spatial lines between the first and second generations and then back between the fifth and sixth generations. Spatial shifting represents the effects of picture repositioning which might occur in a DVE. Temporal shifting means that the GOP structure was shifted one frame between the first and second generations and again between the fifth and sixth generations. Temporal shifting represents the effect of multiple generations which have different GOP alignment.

Chroma key experiments were done by processing the foreground with blue screen through compression and decompression. After decompression the component digital signal was chroma keyed to add the background. The background image was not compressed.

Mixed environment tests for 525/60 used ITU-T Rec. H.262 | ISO/IEC 13818-2 4:2:2 compression and decompression cascaded with a compressed digital VTR using 2:1 intra-field compression. The tests used a total of eight generations of compression. The four odd number generations were MPEG and the four even number generations were compressed digital VTR. There were no shifts between generations.

Mixed environment tests for 625/50 used only MPEG compression. The tests used a total of three generations of compression. The first and third generations were ITU-T Rec. H.262 | ISO/IEC 13818-2 4:2:2 compression with IBBP-GOP structure at 20 Mbits/s, while the second generation was ITU-T Rec. H.262 | ISO/IEC 13818-2 4:2:2 compression with I-only GOP structure at 50 Mbits/s. A temporal shift of one frame was included between the second and third generations.

Compression and decompression processing were contributed by:

- CCETT;
- FTZ;
- IRT;
- JVC;
- Sony;
- Technical University of Braunschweig/BTS;
- Tektronix.

Editing and duplication of test tapes were contributed by:

- RAI;
- Tektronix.

J.1.3 Subjective assessment

The subjective assessment used the DSCQS method described in ITU-R Rec. BT.500-6. Both expert and non-expert viewing sessions were conducted at a number of sites around the world. All of the expert viewing results were combined, and all of the non-expert viewing results were combined. Both expert and non-expert results are presented here. Only subjective test results are presented, as signal to noise ratio is not regarded as a reliable measure of picture quality in these cases.

Expert subjective assessment viewing sessions were conducted by:

- NHK;
- SMPTE.

Non-expert subjective assessment viewing sessions were conducted by:

- CCETT;
- JVC/MPT/NHK/NTV;
- RAI;
- Technical University of Braunschweig/BTS.

J.1.4 Test results

Test results are presented in the following order (see Tables J.1 and J.2):

- 525/60 Homogeneous Environment;
- 525/60 Non-Homogeneous Environment;
- 625/50 Homogeneous Environment;
- 625/50 Non-Homogeneous Environment.

The tables of test results are organized with higher data rates presented first and lower data rates presented last. Within a given bit rate, results are organized by GOP structure, number of generations, and type of shifting. The mean and confidence interval are given for each test sequence.

These tests used the continuous quality scale specified in ITU-R Rec. BT.500-6. The subjective assessments were done on a continuous 0 to 100 scale. The mean differences between original and compressed sequence ratings were calculated, on a 0 to 100 scale, with differences inferior or equal to 0 representing no degradation through compression and 100 being the worst possible rating.

Hereinafter the average of the differences between original and compressed sequence ratings, calculated over the subjects, will be referred to as diff-grade.

The results presented here are based on the following quality definitions:

- **transparency**: diff-grade for all test sequences does not exceed 12% of the scale;
- **near transparency**: the diff-grade of the 25% of the test sequences is between 12% and 18%, while all the other diff-grades do not exceed 12% of the scale;
- **good quality in most of the material**: the mean diff-grades calculated over the test sequences do not exceed 18%, while the diff-grades of 25% of the test sequences exceed 18% of the scale;
- **difficulties in some materials**: all other cases.

Table J.1 – Subjective test results for the 525/60 system

Compression parameters		Viewer ratings	
525/60 50 Mbits/s		**Expert viewers**	**Non-expert viewers**
GOP = I	1 generation	Transparency	Transparency
	8 generations, No shifts	Good quality in most test materials	Transparency
	8 generations, 2 spatial shifts	Good quality in most test materials	Near-transparency
GOP = IB	1 generation	Transparency	Transparency
	8 generations, No shifts	Transparency	Transparency
	8 generations, 2 spatial shifts	Good quality in most test materials	Transparency
	8 generations, 2 temporal shifts	Transparency	Transparency
525/60 30 Mbits/s		**Expert viewers**	**Non-expert viewers**
GOP = I	1 generation	Difficulties in some materials	Good quality in most test materials
	8 generations, No shifts	Difficulties in some materials	Transparency
	8 generations, 2 spatial shifts	Difficulties in some materials	Difficulties in some materials
GOP = IB	1 generation	Good quality in most test materials	Transparency
	8 generations, No shifts	Good quality in most test materials	Transparency
	8 generations, 2 spatial shifts	Difficulties in some materials	Near-transparency
	8 generations, 2 temporal shifts	Difficulties in some materials	Good quality in most test materials
525/60 20 Mbits/s		**Expert viewers**	**Non-expert viewers**
GOP = IB	1 generation	Difficulties in some materials	Difficulties in some materials
	8 generations, No shifts	Difficulties in some materials	Transparency
	8 generations, 2 spatial shifts	Difficulties in some materials	Difficulties in some materials
	8 generations, 2 temporal shifts	Difficulties in some materials	Difficulties in some materials
GOP = IBBP	1 generation	Transparency	Transparency
	8 generations, No shifts	Difficulties in some materials	Good quality in most test materials
	8 generations, 2 spatial shifts	Difficulties in some materials	Difficulties in some materials
	8 generations, 2 temporal shifts	Difficulties in some materials	Difficulties in some materials
525/60 mixed environment		**Expert viewers**	**Non-expert viewers**
30 Mbits/s GOP = I	8 generations, No shifts	Difficulties in some materials	Good quality in most test materials
20 Mbits/s GOP = IB	8 generations, No shifts	Difficulties in some materials	Good quality in most test materials

Table J.2 – Subjective test results for the 625/50 system

Compression parameters		Viewers	
625/50 50 Mbits/s		**Expert viewers**	**Non-expert viewers**
GOP = I	1 generation	Transparency	Transparency
	8 generations, 2 spatial shifts	Transparency	Transparency
625/50 30 Mbits/s		**Expert viewers**	**Non-expert viewers**
GOP = I	1 generation	Transparency	Transparency
	8 generations, 2 spatial shifts	Good quality in most test materials	Difficulties in some materials
GOP = IB	8 generations, 2 spatial shifts	Good quality in most test materials	Near-transparency
	8 generations, 2 temporal shifts	Good quality in most test materials	Near-transparency
625/50 20 Mbits/s		**Expert viewers**	**Non-expert viewers**
GOP = IB	1 generation	Transparency	Transparency
	8 generations, 2 spatial shifts	Difficulties in some materials	Difficulties in some materials
	8 generations, 2 temporal shifts	Difficulties in some materials	Difficulties in some materials
GOP = IBBP	8 generations, 2 spatial shifts	Difficulties in some materials	Difficulties in some materials
	8 generations, 2 temporal shifts	Good quality in most test materials	Good quality in most test materials
625/50 mixed environment **Cascaded 20 Mbits/s + 50 Mbits/s + 20 Mbits/s**		**Expert viewers**	**Non-expert viewers**
GOP = IBBP + I + IBBP	3 generations, 1 temporal shift	Good quality in most test materials	Good quality in most test materials

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