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Information technology — Generic coding of moving pictures and associated audio information —

Part 1: Systems

AMENDMENT 1: Carriage of JPEG XS in MPEG-2 TS

Technologies de l'information — Codage générique des images animées et du son associé —

Partie 1: Systèmes

AMENDEMENT 1: Transfert de JPEG XS en MPEG-2 TS

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

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

Amendment 1

Carriage of JPEG XS in MPEG-2 TS

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1) Clause 1.2.3

In clause 1.2.3, Additional References, add the following references:

- ISO/IEC 21122-1:2019, *JPEG XS low-latency lightweight image coding system – Part 1: Core coding system*.
- ISO/IEC 21122-2:2019, *JPEG XS low-latency lightweight image coding system – Part 2: Profiles and buffer models*.
- ISO/IEC 21122-3:2019, *JPEG XS low-latency lightweight image coding system – Part 3: Transport and container formats*.
- ISO/IEC 23091-2:2019, *Coding-independent code points – Part 2: Video*.

2) Clauses 2.1.77bis to 2.1.77sexies

After clause 2.1.77, add the following clauses 2.1.77bis to 2.1.77sexies:

2.1.77bis JPEG XS elementary stream header (jxes header): All parameters required to decode a JPEG XS video access unit and display the decoded data.

2.1.77ter JPEG XS still picture (system): JPEG XS video access unit as defined in 2.1.77quater with constraints as specified in W.2.

2.1.77quater JPEG XS video access unit: The JPEG XS codestream or multiple JPEG XS codestreams, as defined in ISO/IEC 21122-1, comprising a decodable and randomly accessible image, preceded by a JPEG XS elementary stream header.

2.1.77quinquies JPEG XS video elementary stream: Video elementary stream consisting of a succession of JPEG XS video access units.

2.1.77sexies JPEG XS video sequence: JPEG XS video elementary stream where all the access units have the same profile, level and sublevel (as defined in ISO/IEC 21122-2), JPEG XS video access unit coding parameters, and video parameters.

3) Clause 2.4.2.15

After clause 2.4.2.14, add the following clause 2.4.2.15:

2.4.2.15 T-STD extensions for carriage of JPEG XS video elementary streams

The interpretation, extensions, use and constraints for syntax elements in the adaptation header (2.4.3.4 and 2.4.3.5) for JPEG XS Part-1 video are defined in W.5.

The interpretation, extensions, use and constraints for syntax elements in the PES header (2.4.3.6 and 2.4.3.7) for JPEG XS Part-1 video are defined in W.5.

To define the decoding of JPEG XS video elementary streams carried in a Transport Stream, the T-STD model needs to be extended. The T-STD extensions and T-STD parameters for decoding of JPEG XS video elementary streams conforming to one or more profiles defined in ISO/IEC 21122-2 are defined in W.6.

NOTE – No extensions are specified for P-STD model, as carriage of JPEG XS video elementary streams in program streams is not supported.

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4) Clause 2.4.3.7

In clause 2.4.3.7, replace Table 2-22 with the following:

Table 2-22 – Stream_id assignments

Stream_id	Note	stream coding
'1011 1100'	1	program_stream_map
'1011 1101'	2,9,10,11	private_stream_1
'1011 1110'		padding_stream
'1011 1111'	3	private_stream_2
'110x xxxx'		ISO/IEC 13818-3 or ISO/IEC 11172-3 or ISO/IEC 13818-7 or ISO/IEC 14496-3 or ISO/IEC 23008-3 audio stream number 'x xxxx'
'1110 xxxx'		Rec. ITU-T H.262 | ISO/IEC 13818-2, ISO/IEC 11172-2, ISO/IEC 14496-2, Rec. ITU-T H.264 | ISO/IEC 14496-10 or Rec. ITU-T H.265 | ISO/IEC 23008-2 video stream number 'xxxx'
'1111 0000'	3	ECM_stream
'1111 0001'	3	EMM_stream
'1111 0010'	5	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 Annex A or ISO/IEC 13818-6_DSMCC_stream
'1111 0011'	2	ISO/IEC_13522_stream
'1111 0100'	6	Rec. ITU-T H.222.1 type A
'1111 0101'	6	Rec. ITU-T H.222.1 type B
'1111 0110'	6	Rec. ITU-T H.222.1 type C
'1111 0111'	6	Rec. ITU-T H.222.1 type D
'1111 1000'	6	Rec. ITU-T H.222.1 type E
'1111 1001'	7	ancillary_stream
'1111 1010'		ISO/IEC 14496-1_SL-packetized_stream
'1111 1011'		ISO/IEC 14496-1_FlexMux_stream
'1111 1100'		metadata stream
'1111 1101'	8	extended_stream_id
'1111 1110'		reserved data stream
'1111 1111'	4	program_stream_directory

The notation x means that the values '0' or '1' are both permitted and results in the same stream type. The stream number is given by the values taken by the x's.

NOTE 1 – PES packets of type program_stream_map have unique syntax specified in 2.5.4.1.

NOTE 2 – PES packets of type private_stream_1 and ISO/IEC_13552_stream follow the same PES packet syntax as those for Rec. ITU-T H.262 | ISO/IEC 13818-2 video and ISO/IEC 13818-3 audio streams.

NOTE 3 – PES packets of type private_stream_2, ECM_stream and EMM_stream are similar to private_stream_1 except that no syntax is specified after PES_packet_length field.

NOTE 4 – PES packets of type program_stream_directory have a unique syntax specified in 2.5.5.

NOTE 5 – PES packets of type DSM-CC_stream have a unique syntax specified in ISO/IEC 13818-6.

NOTE 6 – This stream_id is associated with stream_type 0x09 in Table 2-34.

NOTE 7 – This stream_id is only used in PES packets, which carry data from a program stream or an ISO/IEC 11172-1 System Stream, in a transport stream (refer to 2.4.3.8).

NOTE 8 – The use of stream_id 0xFD (extended_stream_id) identifies that this PES packet employs an extended syntax to permit additional stream types to be identified.

NOTE 9 – JPEG 2000 video streams (stream_type = 0x21) are carried using the same PES packet syntax as private_stream_1.

NOTE 10 – Timeline and External Media Information streams (stream_type = 0x27) are carried using the same PES packet syntax as private_stream_1.

NOTE 11 – JPEG XS video streams (stream_type = 0x32) are carried using the same PES packet syntax as private_stream_1.

5) Clause 2.4.4.10, Table 2-34

In clause 2.4.4.10, Semantic definition of fields in Transport Stream program map section, replace Table 2-34 with the following:

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Table 2-34 – Stream type assignments

Value	Description
0x00	ITU-T | ISO/IEC Reserved
0x01	ISO/IEC 11172-2 Video
0x02	Rec. ITU-T H.262 | ISO/IEC 13818-2 Video or ISO/IEC 11172-2 constrained parameter video stream (see Note 2)
0x03	ISO/IEC 11172-3 Audio
0x04	ISO/IEC 13818-3 Audio
0x05	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 private_sections
0x06	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 PES packets containing private data
0x07	ISO/IEC 13522 MHEG
0x08	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 Annex A DSM-CC
0x09	Rec. ITU-T H.222.1
0x0A	ISO/IEC 13818-6 type A
0x0B	ISO/IEC 13818-6 type B
0x0C	ISO/IEC 13818-6 type C
0x0D	ISO/IEC 13818-6 type D
0x0E	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 auxiliary
0x0F	ISO/IEC 13818-7 Audio with ADTS transport syntax
0x10	ISO/IEC 14496-2 Visual
0x11	ISO/IEC 14496-3 Audio with the LATM transport syntax as defined in ISO/IEC 14496-3
0x12	ISO/IEC 14496-1 SL-packetized stream or FlexMux stream carried in PES packets
0x13	ISO/IEC 14496-1 SL-packetized stream or FlexMux stream carried in ISO/IEC 14496_sections
0x14	ISO/IEC 13818-6 Synchronized Download Protocol
0x15	Metadata carried in PES packets
0x16	Metadata carried in metadata_sections
0x17	Metadata carried in ISO/IEC 13818-6 Data Carousel
0x18	Metadata carried in ISO/IEC 13818-6 Object Carousel
0x19	Metadata carried in ISO/IEC 13818-6 Synchronized Download Protocol
0x1A	IPMP stream (defined in ISO/IEC 13818-11, MPEG-2 IPMP)
0x1B	AVC video stream conforming to one or more profiles defined in Annex A of Rec. ITU-T H.264 | ISO/IEC 14496-10 or AVC video sub-bitstream of SVC as defined in 2.1.10 or MVC base view sub-bitstream, as defined in 2.1.89, or AVC video sub-bitstream of MVC, as defined in 2.1.8 or MVCD base view sub-bitstream, as defined in 2.1.94, or AVC video sub-bitstream of MVCD, as defined in 2.1.9, or AVC base layer of an HEVC video stream conforming to one or more profiles defined in Annex G or Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x1C	ISO/IEC 14496-3 Audio, without using any additional transport syntax, such as DST, ALS and SLS
0x1D	ISO/IEC 14496-17 Text
0x1E	Auxiliary video stream as defined in ISO/IEC 23002-3
0x1F	SVC video sub-bitstream of an AVC video stream conforming to one or more profiles defined in Annex G of Rec. ITU-T H.264 | ISO/IEC 14496-10
0x20	MVC video sub-bitstream of an AVC video stream conforming to one or more profiles defined in Annex H of Rec. ITU-T H.264 | ISO/IEC 14496-10
0x21	Video stream conforming to one or more profiles as defined in Rec. ITU-T T.800 | ISO/IEC 15444-1
0x22	Additional view Rec. ITU-T H.262 | ISO/IEC 13818-2 video stream for service-compatible stereoscopic 3D services (see Notes 3 and 4)
0x23	Additional view Rec. ITU-T H.264 | ISO/IEC 14496-10 video stream conforming to one or more profiles defined in Annex A for service-compatible stereoscopic 3D services (see Notes 3 and 4)
0x24	Rec. ITU-T H.265 | ISO/IEC 23008-2 video stream or an HEVC temporal video sub-bitstream (see Note 5)
0x25	HEVC temporal video subset of an HEVC video stream conforming to one or more profiles defined in Annex A of Rec. ITU-T H.265 | ISO/IEC 23008-2

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Table 2-34 – Stream type assignments

Value	Description
0x26	MVCD video sub-bitstream of an AVC video stream conforming to one or more profiles defined in Annex I of Rec. ITU-T H.264 | ISO/IEC 14496-10
0x27	Timeline and External Media Information Stream (see Annex U)
0x28	HEVC enhancement sub-partition which includes TemporalId 0 of an HEVC video stream where all NALs units contained in the stream conform to one or more profiles defined in Annex G of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x29	HEVC temporal enhancement sub-partition of an HEVC video stream where all NAL units contained in the stream conform to one or more profiles defined in Annex G of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x2A	HEVC enhancement sub-partition which includes TemporalId 0 of an HEVC video stream where all NAL units contained in the stream conform to one or more profiles defined in Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x2B	HEVC temporal enhancement sub-partition of an HEVC video stream where all NAL units contained in the stream conform to one or more profiles defined in Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x2C	Green access units carried in MPEG-2 sections
0x2D	ISO/IEC 23008-3 Audio with MHAS transport syntax – main stream
0x2E	ISO/IEC 23008-3 Audio with MHAS transport syntax – auxiliary stream
0x2F	Quality access units carried in sections
0x30	Media Orchestration Access Units carried in sections
0x31	Substream of a Rec. ITU-T H.265 | ISO/IEC 23008-2 video stream that contains a Motion Constrained Tile Set, parameter sets, slice headers or a combination thereof. See 2.17.5.1.
0x32	JPEG XS video stream conforming to one or more profiles as defined in ISO/IEC 21122-2
0x33 .. 0x7E	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 reserved
0x7F	IPMP stream
0x80 .. 0xFF	User Private

6) Clause 2.6.90, Table 2-107

In clause 2.6.90, Extension descriptor, replace Table 2-107 with:

Table 2-107 – Extension descriptor

Syntax	No. of bits	Mnemonic
Extension_descriptor () {		
descriptor_tag	**8**	**uimsbf**
descriptor_length	**8**	**uimsbf**
extension_descriptor_tag	**8**	**uimsbf**
if (extension_descriptor_tag == 0x02) {		
ObjectDescriptorUpdate()		
}		
else if (extension_descriptor_tag == 0x03) {		
HEVC_timing_and_HRD_descriptor()		
}		
else if (extension_descriptor_tag == 0x04) {		
af_extensions_descriptor ()		
}		
else if (extension_descriptor_tag == 0x05) {		
HEVC_operation_point_descriptor( )		
}		
else if (extension_descriptor_tag == 0x06) {		

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Table 2-107 – Extension descriptor

Syntax	No. of bits	Mnemonic
HEVC_hierarchy_extension_descriptor( )		
}		
else if (extension_descriptor_tag == 0x07) {		
Green_extension_descriptor ()		
}		
else if (extension_descriptor_tag == 0x08) {		
MPEG-H_3dAudio_descriptor()		
}		
else if (extension_descriptor_tag == 0x09) {		
MPEG-H_3dAudio_config_descriptor()		
}		
else if (extension_descriptor_tag == 0x0A) {		
MPEG-H_3dAudio_scene_descriptor()		
}		
else if (extension_descriptor_tag == 0x0B) {		
MPEG-H_3dAudio_text_label_descriptor()		
}		
else if (extension_descriptor_tag == 0x0C) {		
MPEG-H_3dAudio_multi-stream_descriptor()		
}		
else if (extension_descriptor_tag == 0x0D) {		
MPEG-H_3dAudio_drc_loudness_descriptor()		
}		
else if (extension_descriptor_tag == 0x0E) {		
MPEG-H_3dAudio_command_descriptor()		
}		
else if (extension_descriptor_tag == 0x0F) {		
Quality_extension_descriptor ()		
}		
else if (extension_descriptor_tag == 0x10) {		
Virtual_segmentation_descriptor ()		
}		
else if (extension_descriptor_tag == 0x11) {		
timed_metadata_extension_descriptor()		
}		
else if (extension_descriptor_tag == 0x12) {		
HEVC_tile_substream_descriptor()		
}		
else if (extension_descriptor_tag == 0x13) {		
HEVC_subregion_descriptor()		
}		
else if (extension_descriptor_tag == 0x14) {		
JXS_video_descriptor()		
}		
else {		
for (i=0; i<N; i++) {		
reserved	**8**	**bslbf**
}		
}		
}		

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7) Clause 2.6.91

7.1) New field

In clause 2.6.91, Semantic definition of fields in the extension descriptor, add the following field after the description of field "HEVC_subregion_descriptor()":

JXS_video_descriptor() – This structure is defined in 2.6.127 and 2.6.128.

7.2) Table 2-108

In clause 2.6.91, Semantic definition of fields in the extension descriptor, replace Table 2-108 with:

Table 2-108 – Extension descriptor tag values

Extension_descriptor_tag	TS	PS	Identification
0	n/a	n/a	Reserved
1	n/a	X	Forbidden
2	X	X	ODUpdate_descriptor
3	X	n/a	HEVC_timing_and_HRD_descriptor()
4	X	n/a	af_extensions_descriptor()
5	X	n/a	HEVC_operation_point_descriptor( )
6	X	n/a	HEVC_hierarchy_extension_descriptor( )
7	X	n/a	Green_extension_descriptor()
8	X	n/a	MPEG-H_3dAudio_descriptor()
9	X	n/a	MPEG-H_3dAudio_config_descriptor()
0x0A	X	n/a	MPEG-H_3dAudio_scene_descriptor()
0x0B	X	n/a	MPEG-H_3dAudio_text_label_descriptor()
0x0C	X	n/a	MPEG-H_3dAudio_multi-stream_descriptor()
0x0D	X	n/a	MPEG-H_3dAudio_drc_loudness_descriptor()
0x0E	X	n/a	MPEG-H_3dAudio_command_descriptor()
0x0F	X	n/a	Quality_extension_descriptor()
0x10	X	n/a	Virtual_segmentation_descriptor()
0x11	X	n/a	timed_metadata_extension_descriptor()
0x12	X	n/a	HEVC_tile_substream_descriptor()
0x13	X	n/a	HEVC_subregion_descriptor()
0x14	X	n/a	JXS_video_descriptor()
0x15 .. 0xFF	n/a	n/a	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 Reserved

8) Clauses 2.6.127 and 2.6.128

After clause 2.6.126, add clauses 2.6.127 and 2.6.128

2.6.127 JPEG XS video descriptor

For JPEG XS video elementary streams conforming to ISO/IEC 21122-1 and to one or more profiles defined in ISO/IEC 21122-2, the JPEG XS video descriptor (see Table 2-130) provides information that may be present in each JPEG XS access unit as well as for the JPEG XS video sequence. In addition, it provides information to signal JPEG XS still pictures. This descriptor shall be included for each JPEG XS video elementary stream component in the PMT with stream_type equal to 0x32.

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Table 2-130 – JPEG XS video descriptor

Syntax	No. of bits	Mnemonic
JXS_video_descriptor() {		
descriptor_tag	**8**	**uimsbf**
descriptor_length	**8**	**uimsbf**
descriptor_version	**8**	**uimsbf**
horizontal_size	**16**	**uimsbf**
vertical_size	**16**	**uimsbf**
brat	**32**	**uimsbf**
frat	**32**	**bslbf**
schar	**16**	**bslbf**
Ppih	**16**	**bslbf**
Plev	**16**	**bslbf**
max_buffer_size	**32**	**uimsbf**
buffer_model_type	**8**	**uimsbf**
colour_primaries	**8**	**uimsbf**
transfer_characteristics	**8**	**uimsbf**
matrix_coefficients	**8**	**uimsbf**
video_full_range_flag	**1**	**bslbf**
reserved	**7**	**bslbf**
still_mode	**1**	**bslbf**
mdm_flag	**1**	**bslbf**
zero_bits	**6**	**bslbf**
if (mdm_flag == '1') {		
X_c0, Y_c0, X_c1, Y_c1, X_c2, Y_c2	**16x6**	**uimsbf**
X_wp	**16**	**uimsbf**
Y_wp	**16**	**uimsbf**
L_max	**32**	**uimsbf**
L_min	**32**	**uimsbf**
MaxCLL	**16**	**uimsbf**
MaxFALL	**16**	**uimsbf**
}		
for (i=0; i<N; i++) {		
private_data_byte	**8**	**bslbf**
}		
}		

2.6.128 Semantics of fields in JPEG XS video descriptor

descriptor_version – This 8-bit field specifies the version of the JPEG XS video descriptor in case additional capabilities are added in the future. Value of this field shall be '0000 0000' and all other values are reserved for future use.

horizontal_size – This field shall be coded the same as W_f parameter found in the JPEG XS codestream picture header, as defined in ISO/IEC 21122-1.

vertical_size – This field shall be coded the same as H_f parameter found in the JPEG XS codestream picture header, as defined in ISO/IEC 21122-1.

brat – This parameter specifies the maximum bitrate of the elementary stream in Mbit per second. A detailed definition can be found in ISO/IEC 21122-3.

frat – This parameter specifies the frame rate of the elementary stream and also contains a flag indicating if the stream is interlaced or progressive. A detailed definition can be found in ISO/IEC 21122-3.

schar – This parameter specifies the image sample characteristics and the sampling structure. A detailed definition can be found in ISO/IEC 21122-3.

Ppih – This field specifies the Profile of the elementary stream. It shall be coded the same as the Ppih parameter defined in ISO/IEC 21122-1 using the values defined in ISO/IEC 21122-2.

Plev – This field specifies the level and sublevel of the elementary stream. It shall be coded the same as the Plev parameter defined in ISO/IEC 21122-1 using the values defined in ISO/IEC 21122-2.

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max_buffer_size – This 32-bit field specifies the size of the elementary stream buffer (EB in Figure W.2) required to ensure decoding without overflow nor underflow. This value, expressed in Mbytes, shall not exceed (max_rate/160), where max_rate corresponds to the maximum encoded rate allowed by the combination of the selected level and sublevel, as defined in ISO/IEC 21122-2, expressed in Mbits/s. When level or sublevel is unrestricted, max_buffer_size shall not exceed (brat/160).

buffer_model_type – This 8-bit field specifies the smoothing buffer model type to which the carried video stream is conforming to. Currently, only value 2 is allowed, other values are reserved for future ISO/IEC use.

NOTE – Streams generated with buffer model type 1 are also compliant with type 2 and can therefore be signalled with this field set to '2'.

colour_primaries, transfer_characteristics, matrix_coefficients, video_full_range_flag – These four fields (three 1-byte integers and one 1-bit flag) shall be coded according to the semantics with the same name defined in ISO/IEC 23091-2.

still_mode – This 1-bit field, when set to '1', indicates that the JPEG XS video stream may include JPEG XS still pictures, as described in W.2. When set to '0', then the associated JPEG XS video stream shall not contain JPEG XS still pictures.

mdm_flag – When set to '1', this 1-bit field indicates that the JPEG XS video descriptor contains the characteristics of the Mastering Display Metadata, as described in ISO/IEC 21122-3 (see below corresponding fields). When set to '0', then the JPEG-XS video descriptor shall not contain the characteristics of the Mastering Display Metadata.

zero_bits – These 6 bits shall be all set to '0' and are reserved for future use.

The following fields X_c0, Y_c0, X_c1, Y_c1, X_c2, Y_c2, X_wp, Y_wp, L_max and L_min correspond to the fields defined in SMPTE ST2086:2014 "Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images". The fields MaxFALL and MaxCLL correspond to the fields defined in ANSI/CTA 861-G:2016 "A DTV Profile for Uncompressed High Speed Digital Interfaces". If these 12 fields have unknown values at the time of generating the stream, they shall not be included in the descriptor and the mdm_flag shall be set to '0'.

X_c0, Y_c0, **X_c1, Y_c1, X_c2, Y_c2** – These 16-bit fields are included only if the mdm_flag is set to '1'. They specify the normalized x and y chromaticity coordinates of the colour primary components of the mastering display in increments of 0.00002, according to the CIE 1931 definition of x and y as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15). For describing mastering displays that use red, green, and blue colour primaries, it is suggested that index value c0 should correspond to the green primary, c1 should correspond to the blue primary, and c2 should correspond to the red colour primary. The values of these 6 fields shall be in the range of 0 to 50 000, inclusive.

X_wp and **Y_wp** – These 16-bit fields are included only if the mdm_flag is set to '1'. They specify the normalized x and y chromaticity coordinates of the white point of the mastering display in normalized increments of 0.00002, according to the CIE 1931 definition of x and y as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15). The values of X_wp and Y_wp shall be in the range of 0 to 50 000.

L_max and **L_min** – These 32-bit fields are included only if the mdm_flag is set to '1'. They specify the nominal maximum and minimum display luminance, respectively, of the mastering display. The minimum luminance of the mastering display is computed by L_min×0.0001 cd/m^2, the maximum luminance by L_max×0.0001 cd/m^2. L_min shall be less than L_max. At minimum luminance, the mastering display is considered to have the same nominal chromaticity as the white point.

MaxCLL – This 16-bit field is included only if the mdm_flag is set to '1'. It specifies the Maximum Content Light Level and corresponds to the brightest pixel in the entire stream, in units of 1 cd/m2, where 0x0001 represents 1 cd/m2 and 0xFFFF represents 65535 cd/m2. It shall be calculated according to Annex P Calculation of MaxCLL and MaxFALL section P.1 in ANSI/CTA 861-G:2016 A DTV Profile for Uncompressed High Speed Digital Interfaces.

MaxFALL – This 16-bit field is included only if the mdm_flag is set to '1'. It specifies the Maximum Frame Average Light Level and corresponds to the highest frame average brightness per frame in the entire stream, in units of 1 cd/m2, where 0x0001 represents 1 cd/m2 and 0xFFFF represents 65535 cd/m2. It shall be calculated according to Annex P Calculation of MaxCLL and MaxFALL section P.2 in ANSI/CTA 861-G:2016 "A DTV Profile for Uncompressed High Speed Digital Interfaces".

If for some reason the MaxCLL and/or MaxFALL values are unknown, the value 0x0000 shall be used.

9) Annex W

Add the following Annex W after Annex V.

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Annex W

Carriage of JPEG XS part 1 video over MPEG-2 Transport Streams

(This annex forms an integral part of this Recommendation | International Standard.)

W.1 Introduction

This annex specifies normative constraints for the carriage of JPEG XS video in an MPEG-2 transport stream. The parameters specified include mapping of JPEG XS video streams into MPEG-2 transport packets, signalling of JPEG XS video streams as well as T-STD parameters depending on selected profile, level and sublevel. Transport of JPEG XS video shall be limited to transport stream only. Program stream support may be added in the future based on application requirements.

W.2 JPEG XS video access unit, JPEG XS video elementary stream, JPEG XS video sequence and JPEG XS still picture

The JPEG XS video access unit contains the elementary stream (jxes) header created as defined in W.3 concatenated with self-contained ISO/IEC 21122-1 codestream(s). The (jxes) header contains all video-related parameters necessary to display the decoded codestream(s). Two codestreams may comprise an access unit when the access unit is an interlaced frame.

The JPEG XS video elementary stream is a progression of JPEG XS access units and the JPEG XS video sequence is a subset of JPEG XS video elementary stream where all the JPEG XS access units have the same parameters in the (jxes) header.

The JPEG XS still picture (system) consists of a JPEG XS video sequence which contains exactly one JPEG XS access unit. This still picture has an associated PTS and the presentation time of succeeding pictures, if any, is later than that of the still picture by at least two picture periods. The JPEG XS still picture (system) mode is used to support transmission of JPEG XS video access units at a rate much lower than the display frame rate (determined by the difference in PTS values between successive JPEG XS access units). JPEG XS still picture can be used in applications such as 'slide show' and 'stills with Music'.

W.3 Elementary stream header (jxes) and mapping to PES packets

Each JPEG XS access unit from a JPEG XS video elementary stream shall start with an elementary stream header (jxes header) as detailed in Table W.1.

Table W.1 – JPEG XS Access unit elementary stream header (jxes header)

Syntax	No. of bits	Mnemonic
jxes_header() {		
jxes_length	**32**	**uimsbf**
jxes_box_code '0x6a786573'	**32**	**bslbf**
brat	**32**	**uimsbf**
frat	**16**	**uimsbf**
schar	**16**	**uimsbf**
Ppih	**16**	**bslbf**
Plev	**16**	**bslbf**
color_primaries	**8**	**uimsbf**
transfer_characteristics	**8**	**uimsbf**
matrix_coefficients	**8**	**uimsbf**
video_full_range_flag	**1**	**uimsbf**
reserved	**7**	**uimsbf**
tcod	**32**	**uimsbf**
}		

Semantics

Except for the **tcod** field, all fields from the jxes header are also found in the JXS video descriptor defined in 2.6.127 and 2.6.128. This is done in purpose to allow for a greater flexibility of the implementations, at a cost of a negligible overhead. Values found in the JXS video descriptor and in the jxes headers shall be consistent. If inconsistent values are found, values from the jxes header shall take precedence.

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brat – The brat parameter specifies the maximum bitrate of the elementary stream in Mbit per second. A detailed definition can be found in ISO/IEC 21122-3.

frat – The frat parameter specifies the frame rate of the elementary stream and also contains a flag indicating if the stream is interlaced or progressive. A detailed definition can be found in ISO/IEC 21122-3.

schar – The schar parameter specifies the image sample characteristics and the sampling structure. A detailed definition can be found in ISO/IEC 21122-3.

Ppih – This field specifies the Profile of the elementary stream. It shall be coded the same as the Ppih parameter defined in ISO/IEC 21122-1 using the values defined in ISO/IEC 21122-2.

Plev – This field specifies the Level and Sublevel of the elementary stream. It shall be coded the same as the Plev parameter defined in ISO/IEC 21122-1 using the values defined in ISO/IEC 21122-2.

color_primaries, transfer_characteristics, matrix_coefficients, video_full_range_flag – These four fields (three 1-byte integers and one 1-bit flag) shall be coded according to the semantics with the same name defined in ISO/IEC 23091-2.

tcod – The tcod parameter specifies the timecode of an access unit. A detailed definition can be found in ISO/IEC 21122-3.

Figure W.1 shows the structure and mapping of JPEG XS video access unit into PES packets. JPEG XS represents each frame as one or two JPEG XS codestreams (depending if the stream is interlaced or not), as defined in ISO/IEC 21122-1. The Codestream_Header(), included within each codestream, contains all information to decode its image, including the image size and the profile, level and sublevel indicators, as defined in ISO/IEC 21122-1 and ISO/IEC 21122-2. Preceding the codestreams, a JPEG XS elementary stream (jxes) header containing video-related information, as shown in Table W.1, shall be present. Each PES packet shall contain one single JPEG XS video access unit.

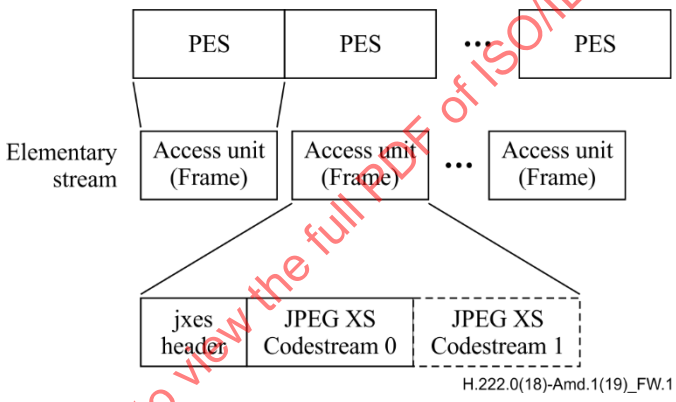

Figure W.1 – Structure and order of JPEG XS access units

W.4 JPEG XS transport constraints

When a JPEG XS video elementary stream conforming to one or more profiles as defined in ISO/IEC 21122-1 and ISO/IEC 21122-2 is transported using MPEG-2 systems, the following constraints apply:

1. Each JPEG XS video access unit shall contain an elementary stream header (jxes header) defined in Table W.1 followed by one or two ISO/IEC 21122-1 codestream(s).
2. Each JPEG XS codestream shall contain a picture header with Ppih and Plev fields equating to corresponding values found in the JXS video descriptor detailed in 2.6.127 and in the JPEG XS elementary stream (jxes) header detailed in W.3.
3. The JPEG XS video access units shall be ordered in the JPEG XS video elementary stream in a monotonic display order.
4. Each PES packet shall contain exactly one JPEG XS video access unit.
5. Each PES packet shall include a PES header with PTS.
6. For successive JPEG XS video access units, the increments to PTS shall be consistent with increments to corresponding tcod parameters in the jxes header.
7. The following constraints apply to the coding of syntax elements in the adaptation header for transport of JPEG XS video elementary stream:
    a. Both random_access_indicator and elementary_stream_priority_indicator flags may be set to '1' for each JPEG XS video access unit contained in the transport packet. Applications may limit the

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