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AMENDMENT 1
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Information technology — Generic coding of moving pictures and associated audio information —

Part 1:
Systems

AMENDMENT 1: Ultra-low latency and 4k and higher resolution support for transport of JPEG 2000 video

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

Partie 1: Systèmes

AMENDEMENT 1: Support de résolution 4k et supérieure et latence ultrafaible pour le transfert de vidéos JPEG 2000

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted.

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This document was prepared by ITU-T as Rec. ITU-T H.220.0 (03/2017) and drafted in accordance with its editorial rules. It was adopted under the JTC1 PSDO procedure by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*, in collaboration with ITU-T.

A list of all parts in the ISO/IEC 13818 series can be found on the ISO website.

INTERNATIONAL STANDARD ISO/IEC 13818-1
RECOMMENDATION ITU-T H.222.0

Information technology – Generic coding of moving pictures and associated audio information – Part 1: Systems

Amendment 1

Ultra-low latency and 4K and higher resolution support for transport of JPEG 2000 video

Summary

Amendment 1 to ITU-T H.222.0 (2017) | ISO/IEC 13818-1:2017 fixes interoperability issues in the transport of JPEG 2000 Part 1 (Rec. ITU-T T.800 | ISO/IEC 15444-1) by removing references to Rec. ITU-T T.800 | ISO/IEC 15444-1 Annex M and updating the definition of the elementary stream header to make it self-contained in ISO/IEC 13818-1 Annex S. It further adds support for JPEG 2000 Ultra-Low Latency (ULL) encoding and transport of professional video, audio and data over Internet Protocol networks, by specifying the use of horizontal, independent JPEG 2000 stripes. Finally, it supports higher resolutions (4K or higher) of JPEG 2000 video images by adding a new block mode. This new mode allows implementers to divide a given frame into blocks.

History

Edition	Recommendation	Approval	Study Group	Unique ID[*]
1.0	ITU-T H.222.0	1995-07-10	15	11.1002/1000/1071
1.1	ITU-T H.222.0 (1995) Amd. 1	1996-11-11	16	11.1002/1000/3834
1.2	ITU-T H.222.0 (1995) Amd. 2	1996-11-11	16	11.1002/1000/4096
1.3	ITU-T H.222.0 (1995) Technical Cor. 1	1998-02-06	16	11.1002/1000/4532
1.4	ITU-T H.222.0 (1995) Amd. 3	1998-02-06	16	11.1002/1000/4228
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1.6	ITU-T H.222.0 (1995) Amd. 5	1999-05-27	16	11.1002/1000/4498
1.7	ITU-T H.222.0 (1995) Amd. 6	1999-05-27	16	11.1002/1000/4671
2.0	ITU-T H.222.0	2000-02-17	16	11.1002/1000/5142
2.1	ITU-T H.222.0 (2000) Technical Cor. 1	2001-03-01	16	11.1002/1000/5419
2.2	ITU-T H.222.0 (2000) Technical Cor. 2	2002-03-29	16	11.1002/1000/5675
2.3	ITU-T H.222.0 (2000) Amd. 1	2002-12-14	16	11.1002/1000/6190
2.4	ITU-T H.222.0 (2000) Amd. 1/Cor. 1	2003-06-29	16	11.1002/1000/6449
2.5	ITU-T H.222.0 (2000) Amd. 2	2003-06-29	16	11.1002/1000/6363
2.6	ITU-T H.222.0 (2000) Amd. 3	2004-03-15	16	11.1002/1000/7208
2.7	ITU-T H.222.0 (2000) Technical Cor. 3	2005-01-08	16	11.1002/1000/7435
2.8	ITU-T H.222.0 (2000) Amd. 4	2005-01-08	16	11.1002/1000/7436
2.9	ITU-T H.222.0 (2000) Amd. 5	2005-01-08	16	11.1002/1000/7437
2.10	ITU-T H.222.0 (2000) Technical Cor. 4	2005-09-13	16	11.1002/1000/8560
3.0	ITU-T H.222.0	2006-05-29	16	11.1002/1000/8802
3.1	ITU-T H.222.0 (2006) Amd. 1	2007-01-13	16	11.1002/1000/9024
3.2	ITU-T H.222.0 (2006) Amd. 2	2007-08-29	16	11.1002/1000/9214

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[*] To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

3.3	ITU-T H.222.0 (2006) Cor. 1	2008-06-13	16	11.1002/1000/9471
3.4	ITU-T H.222.0 (2006) Cor. 2	2009-03-16	16	11.1002/1000/9692
3.5	ITU-T H.222.0 (2006) Amd. 3	2009-03-16	16	11.1002/1000/9691
3.6	ITU-T H.222.0 (2006) Cor. 3	2009-12-14	16	11.1002/1000/10621
3.7	ITU-T H.222.0 (2006) Cor. 4	2009-12-14	16	11.1002/1000/10622
3.8	ITU-T H.222.0 (2006) Amd. 4	2009-12-14	16	11.1002/1000/10623
3.9	ITU-T H.222.0 (2006) Amd. 5	2011-05-14	16	11.1002/1000/11287
3.10	ITU-T H.222.0 (2006) Amd. 6	2011-05-14	16	11.1002/1000/11288
4.0	ITU-T H.222.0	2012-06-29	16	11.1002/1000/11655
4.1	ITU-T H.222.0 (2012) Amd. 1	2014-01-13	16	11.1002/1000/12054
4.2	ITU-T H.222.0 (2012) Amd. 2	2014-01-13	16	11.1002/1000/12055
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4.5	ITU-T H.222.0 (2012) Amd. 5	2014-10-14	16	11.1002/1000/12306
5.0	ITU-T H.222.0	2014-10-14	16	11.1002/1000/12359
5.1	ITU-T H.222.0 (2014) Amd. 1	2015-04-29	16	11.1002/1000/12452
5.2	ITU-T H.222.0 (2014) Amd. 1 Cor. 1	2015-11-29	16	11.1002/1000/12625
5.3	ITU-T H.222.0 (2014) Amd. 2	2015-12-14	16	11.1002/1000/12632
5.4	ITU-T H.222.0 (2014) Amd. 3	2015-12-14	16	11.1002/1000/12633
5.5	ITU-T H.222.0 (2014) Amd. 1 Cor. 2	2016-07-14	16	11.1002/1000/12899
5.5	ITU-T H.222.0 (2014) Cor. 1	2016-07-14	16	11.1002/1000/12903
5.7	ITU-T H.222.0 (2014) Amd. 4	2016-07-14	16	11.1002/1000/12900
5.8	ITU-T H.222.0 (2014) Amd. 5	2016-07-14	16	11.1002/1000/12901
5.9	ITU-T H.222.0 (2014) Amd. 6	2016-07-14	16	11.1002/1000/12902
5.10	ITU-T H.222.0 (2014) Amd. 3 Cor. 1	2017-03-01	16	11.1002/1000/13184
5.10	ITU-T H.222.0 (2014) Cor. 2	2017-03-01	16	11.1002/1000/13188
5.12	ITU-T H.222.0 (2014) Amd. 7	2017-03-01	16	11.1002/1000/13186
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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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.

NOTE

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

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Generic coding of moving pictures and associated audio information – Part 1: Systems

Amendment 1

Ultra-low latency and 4K and higher resolution support for transport of JPEG 2000 video

1) Clause 2.1.69

Replace 2.1.69 with the following:

2.1.69   JPEG 2000 (J2K) video access unit: The JPEG 2000 codestream or codestreams comprising a decodable and randomly accessible (portion of) image, preceded by all the parameters required to decode the access unit and display the decoded data.

2) New clauses 2.1.70, 2.1.71, 2.1.73, 2.1.74

Add new 2.1.70, 2.1.71, 2.1.73, 2.1.74 and update other subclause numbering accordingly:

2.1.70   J2K block: The JPEG 2000 codestream or codestreams corresponding to a rectangular portion of a video frame, as detailed in S.3.

> NOTE – Usage of J2K blocks requires J2K block mode (defined in 2.1.71) to be enabled in the J2K video descriptor. Such usage facilitates the support of 4k and higher resolutions.

2.1.71   J2K block mode: Optional mode defined in S.3, dividing each frame of a J2K video stream in a certain amount of rectangular blocks, each encoded as an independent J2K block (defined in 2.1.70).

2.1.73   J2K stripe: The JPEG 2000 codestream or codestreams comprising a decodable horizontally divided portion of an image, as detailed in S.4.

> NOTE – Usage of J2K stripes requires J2K stripe mode (defined in 2.1.74) to be enabled in the J2K video descriptor. Such usage enables transport of a J2K video stream with a low end-to-end latency.

2.1.74   J2K stripe mode: Optional mode defined in S.4, dividing the (portion of) image transported in a J2K video access unit in a succession of horizontal stripes, each encoded as an independent J2K stripe (defined in 2.1.73).

3) Clause 2.6.80

Replace Table 2-99 with the following:

Table 2-99 – J2K video descriptor

Syntax	No. of bits	Mnemonic
J2K_video_descriptor() {		
descriptor_tag	**8**	**uimsbf**
descriptor_length	**8**	**uimsbf**
extended_capability_flag	**1**	**bslbf**
profile_and_level	**15**	**bslbf**
horizontal_size	**32**	**uimsbf**
vertical_size	**32**	**uimsbf**
max_bit_rate	**32**	**uimsbf**
max_buffer_size	**32**	**uimsbf**
DEN_frame_rate	**16**	**bslbf**
NUM_frame_rate	**16**	**bslbf**
if (extended_capability_flag == '1') {		

Table 2-99 – J2K video descriptor

Syntax	No. of bits	Mnemonic
stripe_flag	1	bslbf
block_flag	1	bslbf
mdm_flag	1	bslbf
reserved (all bits to be set to '0')	5	bslbf
} else {		
color_specification	8	bslbf
}		
still_mode	1	bslbf
interlaced_video	1	bslbf
reserved	6	bslbf
if (extended_capability_flag == '1') {		
colour_primaries	8	uimsbf
transfer_characteristics	8	uimsbf
matrix_coefficients	8	uimsbf
video_full_range_flag	1	bslbf
reserved	7	bslbf
if (stripe_flag == '1') {		
strp_max_idx	8	uimsbf
strp_height	16	uimsbf
}		
if (block_flag == '1') {		
full_horizontal_size	32	uimsbf
full_vertical_size	32	uimsbf
blk_width	16	uimsbf
blk_height	16	uimsbf
max_blk_idx_h	8	uimsbf
max_blk_idx_v	8	uimsbf
blk_idx_h	8	uimsbf
blk_idx_v	8	uimsbf
}		
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
}		
}		

4)   Clause 2.6.81

Replace 2.6.81 with the following:

2.6.81   Semantics of fields in J2K video descriptor

extended_capability_flag – This 1-bit field indicates that the J2K video stream uses extended color specification (through three bytes defining the chromaticity parameters, as described below), and that it might have one or several of the following capabilities enabled: stripes (through the J2K stripe mode), blocks (through the J2K block mode), or inclusion of mastering display metadata. The exact list of enabled capabilities is set through subsequent flags in the video descriptor (see below).

profile_and_level – This 15-bit field shall correspond to the 15 least significant bits of the 2-bytes Rsiz value included in all J2K codestream main headers of this J2K video stream. Rsiz values that are defined in Table A.10 of Rec. ITU-T T.800 | ISO/IEC 15444-1 and do set to '0' their most significant bit are allowed.

> NOTE – the combination of the extend_capability_flag and the profile_and_level field ensures backward and forward compatibility with legacy devices conforming to previous versions of this Recommendation | International Standard. Having the extended_capability_flag set to '1' leads indeed to a 16-bit value outside the range accepted by previous versions of this Recommendation | International Standard. This way, J2K video streams with extended capabilities can be unequivocally identified by both legacy and new devices.

horizontal_size – This 32-bit field indicates the horizontal size of the frame (for progressive) or field (for interlaced) comprised in each J2K access unit. If J2K block mode is enabled, this frame or field corresponds to a spatial rectangular block of the entire video frame or field. It shall be coded the same as the Xsiz parameter found in all J2K codestream main headers of this J2K video stream, as defined in Annex A of Rec. ITU-T T.800 | ISO/IEC 15444-1.

vertical_size – This 32-bit field indicates the vertical size of the frame (for progressive) or field (for interlaced) comprised in each J2K access unit. If J2K block mode is enabled, this frame or field corresponds to a spatial rectangular block of the entire video frame or field. If J2K stripe mode is disabled, it shall be coded the same as the Ysiz parameter found in all J2K codestream main headers of this J2K video stream. If J2K stripe mode is enabled, it shall be coded as the sum of the Ysiz parameters found in all J2K codestreams composing the frame (for progressive) or a field (for interlaced) comprised in each J2K access unit. Ysiz parameters are defined in Annex A of Rec. ITU-T T.800 | ISO/IEC 15444-1.

max_bit_rate – This field may be coded the same as the *brat_max_br* field specified in Table S.1 and shall not exceed the maximum compressed bit rate value for the profile and level specified in Table S.2. This field shall be set appropriately and signalled when profile_and_level = '000 0011 0000 0111', where no maximum bit rate is specified.

max_buffer_size – This field shall not exceed the Maximum buffer size value for the profile and level specified in Table S.2. When profile_and_level = '000 0011 0000 0111', the max_buffer_size shall be set appropriately and shall not exceed (max_bit_rate/1.60E5), where max_bit_rate is expressed in bit/s.

DEN_frame_rate – This field shall be coded the same as frat_denominator field specified in Table S.1 (see Annex S).

NUM_frame_rate – This field shall be coded the same as frat_numerator field specified in Table S.1 (see Annex S).

> NOTE – J2K frame rate is derived from the DEN_frame_rate and NUM_frame_rate values. Table 2-100 lists examples of typical broadcast frame rates with associated values of DEN_frame_rate and NUM_frame_rate.

Table 2-100 – Example frame rates based on DEN_frame_rate and NUM_frame_rate values

DEN_frame_rate	NUM_frame_rate	Frame rate ratio (decimal representation)	Frame rate
0000 0000 0000 0000			Forbidden
0000 0011 1110 1001	0101 1101 1100 0000	24 000 / 1001	23.976
0000 0000 0000 0001	0000 0000 0001 1000	24 / 1	24.0
0000 0000 0000 0001	0000 0000 0001 1001	25 / 1	25.0
0000 0011 1110 1001	0111 0101 0011 0000	30 000 / 1001	29.97
0000 0000 0000 0001	0000 0000 0001 1110	30 / 1	30.0
0000 0000 0000 0001	0000 0000 0011 0010	50 / 1	50.0
0000 0011 1110 1001	1110 1010 0110 0000	60 000 / 1001	59.94
0000 0000 0000 0001	0000 0000 0011 1100	60 / 1	60.00

stripe_flag – This 1-bit field is included only if the extended_capability_flag is set to '1'. It indicates whether the J2K video stream has J2K stripe mode enabled. When this flag is set to '1' the J2K access unit elementary stream header (see Table S.1) shall not include the syntax element j2k_tcod, shall include the syntax element j2k_strp, and the corresponding J2K access unit shall be made of a succession of J2K stripes. When this flag is set to '0', the J2K access unit elementary stream header shall include the syntax element j2k_tcod, shall not include the syntax element j2k_strp, and the corresponding J2K access unit shall be made of one J2K codestream in case of progressive content and two J2K codestreams in case of interlaced content.

block_flag – This 1-bit field is included only if the extended_capability_flag is set to '1'. When set to '1', it indicates that the J2K video stream has J2K block mode enabled, meaning that this J2K video stream actually corresponds to a spatial rectangular block of the full video stream. Subdivision of each frame into rectangular independent blocks is further defined in Section S.3. When set to '0', then the associated J2K video stream shall not have J2K block mode enabled.

mdm_flag – This 1-bit field is included only if the extended_capability_flag is set to '1'. When set to '1', it indicates that the J2K video descriptor contains the characteristics of the Mastering Display Metadata, as described in SMPTE ST 2086:2014 (see below corresponding fields). When set to '0', then the J2K video descriptor shall not contain the characteristics of the Mastering Display Metadata.

color_specification – This 8-bit field is included only if the extended_capability_flag is set to '0' and corresponds to the legacy color specification method. It shall be coded the same as the bcol_colcr 8-bit field of the j2k_bcol box as specified in Table S.1 (see Annex S).

still_mode – This 1-bit field, when set to '1', indicates that the J2K video stream may include J2K still pictures. When set to '0', then the associated J2K video stream shall not contain J2K still pictures.

interlaced_video – This 1-bit field indicates whether the J2K video stream contains interlaced video. When this flag is set to '1' the J2K access unit elementary stream header (see Table S.1) shall include the syntax elements brat_aut2, fiel_box_code, fiel_fic and fiel_fio. When this flag is set to '0', these syntax elements shall not be present in the J2K access unit elementary stream header.

color_primaries, transfer_characteristics, matrix_coefficients, video_full_range_flag – These four fields (three 8-bit fields and one 1-bit field) are included only if the extended_capability_flag is set to '1' and correspond to a color specification method allowing a broader set of color code points than the legacy method (see color_specification field above). These fields shall be coded according to the semantics with the same name defined in Rec. ITU-T H.273 | ISO/IEC 23001-8.

strp_max_idx – This 8-bit field is included only if J2K stripe mode is enabled. It shall be in the range 0x01-0xff and indicates the maximum value of the stripe index. It corresponds to the number of stripes in the block/field/frame, minus one. Value 0x00 is forbidden as a minimum of 2 stripes is required (otherwise J2K stripe mode shall be disabled).

strp_height – This 16-bit field is included only if J2K stripe mode is enabled. It indicates the default vertical size of a stripe. Depending on the vertical_size field value, the last stripe might have a different height, as detailed in S.4.

full_horizontal_size – This 32-bit field is included only if J2K block mode is enabled. It indicates the horizontal size of the entire video frame of this J2K video stream.

full_vertical_size – This 32-bit field is included only if J2K block mode is enabled. It indicates the vertical size of the entire video frame of this J2K video stream.

blk_width – This 16-bit field is included only if J2K block mode is enabled. It indicates the default width of a J2K block. Depending on the full_horizontal_size field value, the last block of a row might have a different width, as detailed in S.3.

blk_height – This 16-bit field is included only if J2K block mode is enabled. It indicates the default height of a J2K block. Depending on the full_vertical_size field value, the last block of a column might have a different height, as detailed in S.3.

max_blk_idx_h – This 8-bit field is included only if J2K block mode is enabled and indicates the maximum value of the horizontal block index for this video frame. It corresponds to the total number of blocks in the horizontal direction, minus one.

max_blk_idx_v – This 8-bit field is included only if J2K block mode is enabled and indicates the maximum value of the vertical block index for this video frame. It corresponds to the total number of blocks in the vertical direction, minus one.

blk_idx_h – This 8-bit field is included only if J2K block mode is enabled and indicates the horizontal block index of the current block.

blk_idx_v – This 8-bit field is included only if J2K block mode is enabled and indicates the vertical block index of the current block.

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 in units of 0.0001 candelas per square metre. 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.

5)   Annex S, clause S.2

Replace S.2 with the following:

S.2   J2K video access unit, J2K video elementary stream, J2K video sequence and J2K still picture

The J2K video access unit contains the elementary stream (elsm) header created as defined in S.3 concatenated with self-contained Rec. ITU-T T.800 | ISO/IEC 15444-1 codestream(s). The (elsm) header contains all video-related parameters necessary to display the decoded codestream(s). Multiple codestreams may comprise an access unit in the two following situations:

1.   When the access unit is an interlaced (portion of) frame.
2.   When the J2K stripe mode is enabled, as defined in S.4.

The J2K video elementary stream is a progression of J2K access units and the J2K video sequence is a subset of J2K video elementary stream where all the J2K access units have the same parameters in the (elsm) header.

The J2K still picture (system) consists of a J2K video sequence which contains exactly one J2K 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 J2K still picture (system) mode is used to support transmission of J2K video access units at a rate much lower than the display frame rate (determined by the difference in PTS values between successive J2K access units). J2K still picture can be used in applications such as 'slide show' and 'stills with Music'.

6)   Annex S, new clauses S.3 and S.4

After S.2, add new subclauses S.3 and S.4 and update subsequent subclause numbering accordingly.

S.3   Optional J2K block mode for high resolution support

By default, each video frame is encoded into one self-contained Rec. ITU-T T.800 | ISO/IEC 15444-1 codestream for progressive content, and into two such codestreams for interlaced content (one per field). The codestream(s) are then encapsulated in a J2K access unit, which therefore always contains an entire video frame.

For 4k resolution (3840x2160) and beyond, the J2K block mode can be used. This mode allows to divide each video frame horizontally and vertically in the spatial domain, into multiple video blocks, each block being processed the same way entire frames were processed in the default mode. The main use case for this mechanism is to be able to stream different quadrants or blocks of a video separately. As an example, a 3840x2160p/59.94 video can be divided into four 1920x1080p/59.94 video blocks.

For this mode to be correctly enabled, the video descriptor shall have *extended_capability_flag* and *block_flag* both set to '1' and shall contain the block dimensions (stored in *horizontal_size* and *vertical_size* fields), the frame dimensions (stored in *full_horizontal_size* and *full_vertical_size* fields), the maximum values of the horizontal and vertical block index (*max_blk_idx_h*, *max_blk_idx_v*), and the horizontal and vertical index value for the block being processed by the video descriptor (*blk_idx_h*, *blk_idx_v*). See Table 2-99 for further details on the J2K video descriptor. The blocks shall be constructed so that they have the same horizontal and vertical size, with the exception of the ones located on the last row and the ones located on the last column, which may have a different size. The following method shall be used to derive the width and height of a block:

> if (blk_idx_h == max_blk_idx_h):
>   width = full_horizontal_size – (horizontal_size * max_blk_idx_h)
> otherwise:
>   width = horizontal_size
>
> if (blk_idx_v == max_blk_idx_v):
>   height = full_vertical_size – (vertical_size * max_blk_idx_v)
> otherwise:
>   height = vertical_size

When this mode is enabled, each J2K video access unit contains the Rec. ITU-T T.800 | ISO/IEC 15444-1 codestream(s) related to a specific video block only. Corresponding J2K video blocks across video frames compose an independent J2K video elementary stream (with its own J2K video descriptor) that shall have its own PID.

S.4 Optional J2K stripe mode for Ultra-Low Latency

The J2K stripe mode has been defined to allow carriage of JPEG 2000 video in an MPEG-2 transport stream with a sub-frame end-to-end latency. This mode is implemented through an horizontal striping mechanism: the picture embedded in a J2K access unit (whether it be an entire progressive video frame, the two fields of an interlaced video frame, a progressive video block or the two fields of an interlaced video block as defined in S.3) is divided horizontally into an integer number of stripes, each stripe being encoded as a self-contained Rec. ITU-T T.800 | ISO/IEC 15444-1 codestream.

To produce a compliant Ultra-Low Latency (ULL) J2K video stream, the J2K video descriptor (see Table 2-99) shall have the following information set accordingly

- The *extended_capability_flag* and the *stripe_flag* both set to '1'.
- The fields *strp_max_idx* and *strp_height* respectively indicating the number of stripes per frame minus one, and the stripe height.

In the JPEG 2000 Elementary Stream header, they shall ensure the Stripe Coding box (*j2k_strp*) is present, and they shall ensure the Time Coding box (*j2k_tcod*) is not present. Stripes shall be included in raster order, from top to bottom. All stripes shall have the same size, with the exception of the very last (bottom) one, which may have a different height. The stripe height is given by the following formula:

> if last stripe in the frame/field/block:
>   *height = vertical_size – (strp_height * strp_max_idx)*
> otherwise:
>   *height = strp_height*

When this mode is enabled, each J2K access unit contains *N* Rec. ITU-T T.800 | ISO/IEC 15444-1 codestreams where:

> *N* = (*strp_max_idx* + 1) for progressive content
> *N* = 2*(*strp_max_idx* + 1) for interlaced content

7) Annex S, new clause S.5

Replace old clause S.3 with the following:

S.5 Elementary stream header (elsm) and mapping to PES packets

Each J2K access unit from a J2K video elementary stream shall start with an elementary stream header (elsm header) as detailed in Table S.1.

Table S.1 – J2K Access unit elementary stream header

Syntax	No. of bits	Mnemonic
J2K_elsm_header() {		
elsm_box_code '0x656c 736d'	32	bslbf
// j2k_frat		
frat_box_code '0x6672 6174'	32	bslbf
frat_denominator	16	uimsbf
frat_numerator	16	uimsbf
// j2k_brat		
brat_box_code '0x6272 6174'	32	bslbf
brat_max_br	32	uimsbf
brat_auf1	32	uimsbf
If (interlaced_video == 1) {		
brat_auf2	32	uimsbf
}		
// j2k_fiel		
If (interlaced_video == 1) {		
fiel_box_code '0x6669 656c'	32	bslbf
fiel_fic	8	uimsbf
fiel_fio	8	uimsbf
}		
If (extended_capability_flag == 0 || stripe_flag == 0) {		
// j2k_tcod		
tcod_box_code '0x7463 6f64'	32	bslbf
tcod_hh (0-23)	8	uimsbf
tcod_mm (0-59)	8	uimsbf
tcod_ss (0-59)	8	uimsbf
tcod_ff (1-60)	8	uimsbf
} else { // extended_capability_flag == 1 && stripe_flag == 1		
// j2k_strp		
strp_box_code '0x7374 7270'	32	bslbf
strp_max_idx	8	uimsbf
frame_vertical_size	16	uimsbf
reserved	8	bsfbf
}		
// j2k_bcol		
If (extended_capability_flag == 0) {		
bcol_box_code '0x6263 6f6c'	32	bslbf
bcol_colcr	8	uimsbf
reserved	8	bsfbf
} else { // extended_capability_flag == 1		
color_primaries	8	uimsbf
transfer_characteristics	8	uimsbf
matrix_coefficients	8	uimsbf
video_full_range_flag	1	bsfbf
reserved	23	bsfbf
}		
}		

Semantics

j2k_frat – The two fields *frat_denominator* and *frat_numerator* are used to derive the frame rate in frames per second. If either is zero, the frame rate is variable or undefined. Otherwise, the frame rate is expressed by a rational number of the form numerator/denominator. If the frame rate is an integer, the denominator shall be equal to 1. In case of interlaced content (two fields per frame), then the field rate is twice the frame rate.

    frat_denominator – This field is defined as a 2-byte big-endian unsigned integer. It specifies the denominator used to calculate the frame rate.

    frat_numerator – The field is defined as a 2-byte big-endian unsigned integer. It specifies the numerator used to calculate the frame rate.

j2k_brat – The three fields *brat_max_br, brat_auf1* and *brat_auf2* specify the maximum bit rate of the elementary stream and the actual access unit size.

> **brat_max_br** – This field is defined as a 4-byte big-endian unsigned integer which specifies a maximum instantaneous bit rate that is not to be exceeded, expressed in bits per second for the elementary stream at the frame rate specified by *j2k_frat* fields. The maximum bit rate shall not exceed the bit rate specified for a given profile and level.

> **brat_auf1** – This field is defined as a 4-byte big-endian unsigned integer which specifies the size of the contiguous codestream corresponding to the frame in case of progressive content and to the first field in case of interlaced content. This field shall be set to zero if J2K stripe mode is enabled (*stripe_flag* == 1).

> **brat_auf2** – This field is defined as a 4-byte big-endian unsigned integer which specifies the size of the contiguous codestream corresponding to the second field in case of interlaced content. This field shall be omitted in case of progressive content. This field shall be set to zero in case of interlaced content and J2K stripe mode enabled.

j2k_fiel – The fields *fiel_fic* and *fiel_fio* specify the field order in case of interlaced content. These two fields, together with the field *fiel_box_code* shall only be present in case of interlaced content (*interlaced_video* flag in the *j2k_video_descriptor* set to '1').

> **fiel_fic** – This field is defined as a 1-byte unsigned integer which specifies the number of fields in the access unit. As this field is only present in case of interlaced content, it shall always be set to 2, and is only present for backward compatibility reasons.

> **fiel_fio** – This field is defined as a 1-byte unsigned integer which describes the order of the two fields:

>> 0 field coding unknown;

>> 1 field with the topmost line is stored first in the access unit; fields are in temporal order;

>> 6 field with the topmost line is stored second in the access unit; fields are in temporal order.

j2k_tcod – The fields *tcod_hh*, *tcod_mm*, *tcod_ss*, and *tcod_ff* specify the time code of the access unit. These fields, together with *tcod_box_code* shall only be present if the J2K stripe mode is disabled (*stripe_flag* in the *j2k_video_descriptor* set to '0').

> **tcod_hh** – This field is a 1-byte unsigned integer which specifies the hour. The value ranges from 0 to 23, inclusively.

> **tcod_mm** – This field is a 1-byte unsigned integer which specifies the minutes. The value ranges from 0 to 59, inclusively.

> **tcod_ss** – This field is a 1-byte unsigned integer which specifies the seconds. The value ranges from 0 to 59, inclusively.

> **tcod_ff** – This field is a 1-byte unsigned integer which specifies the frame count. The value ranges from 1 to 60, inclusively.

j2k_strp – The fields *strp_max_idx* and *frame_vertical_size* specify the settings for the striping mechanism. These fields, together with *strp_box_code* and the *reserved* field shall only be present if the J2K stripe mode is enabled (*extended_capability_flag* and *stripe_flag* in the *j2k_video_descriptor* both set to '1').

> **strp_max_idx** – This field is a 1-byte unsigned integer which specifies the number of J2K stripes per frame (for progressive content) or per field (for interlaced content) in this access unit, minus one. This value shall be equal to the *strp_max_idx* value found in the *j2k_video_descriptor*.

> **frame_vertical_size** – This field is a 2-byte unsigned integer which specifies the vertical size of the frame (for progressive) or field (for interlaced) comprised in this J2K access unit. This value shall be equal to the *vertical_size* value found in the *j2k_video_descriptor*.

j2k_bcol – The j2k_bcol fields described hereunder specify the color parameters of the access unit. They define one method by which an application can interpret the colourspace of the decompressed access unit. This colour specification is to be applied to the access unit after it has been decompressed and after any reverse decorrelating component transform has been applied to the image data.

> **bcol_colcr** – This field is a 1-byte integer which specifies the corresponding colour standard as defined in Table M.2 of Rec. ITU-T T.800 | ISO/IEC 15444-1. It shall only be present if, in the J2K video descriptor, *extended_capability_flag* is set to '0'.