International Telecommunication Union

ITU-T

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STANDARDIZATION SECTOR
OF ITU

T.800

Amendment 7

(10/2014)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

Still-image compression – JPEG 2000

Information technology – JPEG 2000 image coding system: Core coding system

Amendment 7: Profiles for an interoperable master format (IMF)

Recommendation ITU-T T.800 (2002) – Amendment 7

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INTERNATIONAL STANDARD ISO/IEC 15444-1
RECOMMENDATION ITU-T T.800

Information technology – JPEG 2000 image coding system: Core coding system

Amendment 7

Profiles for an interoperable master format (IMF)

Summary

Recommendation ITU-T T.800 "Information technology – JPEG 2000 image coding system: Core coding system" specifies the image coding format known as JPEG 2000.

Amendment 7 to ITU-T T.800 | ISO/IEC 15444-1 specifies profiles for an interoperable master format for program interchange for such applications as content contribution and editing for broadcast video interchange and digital cinema applications.

Recommendation ITU-T T.800 was developed jointly with ISO/IEC JTC 1/SC 29/WG 1 (JPEG) and corresponds as common text with ISO/IEC 15444-1.

History

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1.11	ITU-T T.800 (2002) Amd. 7	2014-10-14	16	11.1002/1000/12300

* 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.

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.

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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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Profiles for an interoperable master format (IMF)

1) Table A.10

Replace Table A.10 with the following table:

Table A.10 – Capability Rsiz parameter

Value (bits) MSB LSB	Capability
0000 0000 0000 0000	Any capabilities specified in this Recommendation | International Standard
0000 0000 0000 0001	Codestream restricted as described for Profile 0 from Table A.45
0000 0000 0000 0010	Codestream restricted as described for Profile 1 from Table A.45
0000 0000 0000 0011	2k Digital Cinema Profile as specified in Table A.46
0000 0000 0000 0100	4k Digital Cinema Profile as specified in Table A.46
0000 0000 0000 0101	Scalable 2k Digital Cinema Profile as specified in Table A.46
0000 0000 0000 0110	Scalable 4k Digital Cinema Profile as specified in Table A.46
0000 0000 0000 0111	Long-term storage Profile as specified in Table A.46
0000 0001 0000 xxxx	Broadcast Contribution Single Tile Profile as specified in Table A.48, lower 8Bits identify Mainlevel as described in Table A.49
0000 0010 0000 xxxx	Broadcast Contribution Multi-tile Profile as specified in Table A.48, lower 8Bits identify Mainlevel as described in Table A.49
0000 0011 0000 0110	Broadcast Contribution Multi-tile Reversible Profile as specified in Table A.48, Mainlevel 6 as described in Table A.50
0000 0011 0000 0111	Broadcast Contribution Multi-tile Reversible Profile as specified in Table A.48, Mainlevel 7 as described in Table A.50
0000 0100 yyyy xxxx	2k IMF Single Tile Lossy Profile as specified in Table A.51, lower 8 Bits identify Sublevel and Mainlevel as specified in Table A.53 and A.54
0000 0101 yyyy xxxx	4k IMF Single Tile Lossy Profile as specified in Table A.51, lower 8 Bits identify Sublevel and Mainlevel as specified in Table A.53 and A.54
0000 0110 yyyy xxxx	8k IMF Single Tile Lossy Profile as specified in Table A.51, lower 8 Bits identify Sublevel and Mainlevel as specified in Table A.53 and A.54
0000 0111 yyyy xxxx	2k IMF Single/Multi Tile Reversible Profile as specified in Table A.52, lower 8 Bits identify Sublevel and Mainlevel as specified in Table A.53 and A.54
0000 1000 yyyy xxxx	4k IMF Single/Multi Tile Reversible Profile as specified in Table A.52, lower 8 Bits identify Sublevel and Mainlevel as specified in Table A.53 and A.54
0000 1001 yyyy xxxx	8k IMF Single/Multi Tile Reversible Profile as specified in Table A.52, lower 8 Bits identify Sublevel and Mainlevel as specified in Table A.53 and A.54
zzzz yyyy xxxx	All other values reserved for future use by ITU-T | ISO/IEC
zzzz describe Profile, yyyy describe Sublevel, xxxx describe Mainlevel.	

2) Table A.49 and additional Tables A.50-A.54

Replace Table A.49 and add additional Tables A.50-A.54.

Table A.49 – Operating levels for the broadcast contribution single tile and multi-tile profiles

Sampling Rate = (Average Components / Pixel) × (pixels / line) × (total lines / frame) × (frames / sec)

Where Average Components is two for 4:2:2, three for 4:4:4 or 4:2:2:4, and four for 4:4:4:4

Levels	Max. Components Sampling Rate (MSamples/sec)	Max. compressed Bit Rate # (Mbits/sec)
Mainlevel 0	Unspecified	Unspecified
Mainlevel 1	65	200
Mainlevel 2	130	200
Mainlevel 3	195	200
Mainlevel 4	260	400
Mainlevel 5	520	800
Mainlevel 6	1200	1600
Mainlevel 7	2400	3200
Mainlevel 8	4800	6400
Mainlevel 9	9600	12800
Mainlevel 10	19200	25600
Mainlevel 11	38400	51200
# Max. compressed bit rate = Max. instantaneous bit rate Mega (M), in the context of this Specification, is 10^6		

Table A.50 – Operating levels for broadcast contribution multi-tile reversible profile

Sampling rate = (Average components / pixel) × (pixels / line) × (total lines / frame) × (frames / sec)

Where Average components is two for 4:2:2, three for 4:4:4 or 4:2:2:4, and four for 4:4:4:4

Levels	Max. components sampling rate (MSamples/sec)	Max. compressed bit rate# (Mbits/sec)
Mainlevel 6	520	1600
Mainlevel 7	520	Unspecified
# Max. compressed Bit Rate = Max. instantaneous Bit Rate Mega (M), in the context of this Specification, is 10^6		

Table A.51 – Codestream restrictions for interoperable master format (IMF) single tile profiles

	2k IMF single tile lossy profile	4k IMF single tile lossy profile	8k IMF single tile lossy profile
SIZ marker segment			
Profile indication	**See Table A.10**	**See Table A.10**	**See Table A.10**
Image size	Xsiz <= 2048, Ysiz <= 1556	Xsiz <= 4096, Ysiz <= 3112	Xsiz <= 8192, Ysiz <= 6224
Tiles	One tile for the whole image: YTsiz + YTOsiz >= Ysiz XTsiz + XTOsiz >= Xsiz	Same	Same
Image and tile origin	XOsiz = YOsiz = XTOsiz = YTOsiz = 0	Same	Same
Sub-sampling	($XRsiz^i$ = 1 for all components) or ($XRsiz^1$ = 1, $XRsiz^i$ = 2 for remaining components).	Same	Same

Table A.51 – Codestream restrictions for interoperable master format (IMF) single tile profiles

	2k IMF single tile lossy profile	4k IMF single tile lossy profile	8k IMF single tile lossy profile
	$YRsiz^i = 1$		
Number of components	$Csiz \leq 3$	Same	Same
Bitdepth	$7 \leq Ssiz^i \leq 15$ (8-16 bits unsigned)	Same	Same
RGN marker segment	Disallowed, i.e., no region of interest	Same	Same
Marker locations			
Packed headers (PPM, PPT)	Disallowed	Same	Same
COD, COC, QCD, QCC	Main header only	Same	Same
COD/COC marker segments			
Number of decomposition levels	$1 <= N_L <= 5$ Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.	$1 <= N_L <= 6$ Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.	$1 <= N_L <= 7$ Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.
Number of layers	Shall be exactly 1	Same	Same
Code-block size	xcb=ycb=5 The corresponding values shall be set accordingly in all deployed COD and COC markers.	Same	Same
Code-block style	SPcod, SPcoc = 0000 0000	Same	Same
Transformation	9-7 Irreversible Transform	9-7 Irreversible Transform	9-7 Irreversible Transform
Precinct size	PPx = PPy = 7 for *NL*LL band, else 8. The corresponding values shall be set accordingly in all COD and COC markers.	Same	Same
Progression order	CPRL, POC marker disallowed	Same	Same
Tile-parts	≤ 3; One for each component	Same	Same
Tile-part lengths	TLM marker segments are required in each image	Same	Same
Application specific restrictions			
Max. components sampling rate	See Table A.53	Same	Same
Max. compressed bit rate	See Tables A.53 and A.54 The maximum codestream size is the Max. compressed bit rate divided by the frame rate.	Same	Same

Table A.52 – Codestream restrictions for interoperable master format (IMF) single tile/multi-tile reversible profiles

	2k IMF single/multi-tile reversible profile	4k IMF single/multi-tile reversible profile	8k IMF single/multi-tile reversible profile
SIZ marker segment			
Profile Indication	**See Table A.10**	**See Table A.10**	**See Table A.10**
Image size	Xsiz <= 2048, Ysiz <= 1556	Xsiz <= 4096, Ysiz <= 3112	Xsiz <= 8192, Ysiz <= 6224
Tiles	One single tile for the whole image: YTsiz + YTOsiz >= Ysiz XTsiz + XTOsiz >= Xsiz or multiple tiles with tile sizes: XTsiz=YTSiz=1024	One single tile for the whole image: YTsiz + YTOsiz >= Ysiz XTsiz + XTOsiz >= Xsiz or multiple tiles with tile sizes: XTsiz=YTSiz=1024 or XTsiz=YTSiz=2048	One single tile for the whole image: YTsiz + YTOsiz >= Ysiz XTsiz + XTOsiz >= Xsiz or multiple tiles with tile sizes: XTsiz=YTSiz=1024 or XTsiz=YTSiz=2048 or XTsiz=YTSiz=4096
Image and tile origin	XOsiz = YOsiz = XTOsiz = YTOsiz = 0	Same	Same
Sub-sampling	($XRsiz^i$ = 1 for all components) or ($XRsiz^1$ = 1, $XRsiz^i$ = 2 for remaining components). $YRsiz^i$ = 1	Same	Same
Number of components	Csiz ≤ 3	Same	Same
Bitdepth	7 ≤ $Ssiz^i$ ≤ 15 (8-16 bits unsigned)	Same	Same
RGN marker segment	Disallowed, i.e., no region of interest	Same	Same
Marker locations			
Packed headers (PPM, PPT)	Disallowed	Same	Same
COD, COC, QCD, QCC	Main header only	Same	Same
COD/COC marker segments			
Number of decomposition levels	1 <= N_L <= 4 for XTsiz >= 1024 or 1 <= N_L <= 5 for XTsiz >= 2048 Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.	1 <= N_L <= 4 for XTsiz >= 1024 or 1 <= N_L <= 5 for XTsiz >= 2048 or 1 <= N_L <= 6 for XTsiz >= 4096 Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.	1 <= N_L <= 4 for XTsiz >= 1024 or 1 <= N_L <= 5 for XTsiz >= 2048 or 1 <= N_L <= 6 for XTsiz >= 4096 or 1 <= N_L <= 7 for XTsiz >= 8192 Every component of every image of a codestream shall have the same number of wavelet transform levels. The number of deployed decomposition levels shall be set accordingly in all COD and COC markers.
Number of layers	Shall be exactly 1	Same	Same
Code-block size	xcb=ycb=5 The corresponding values shall be set accordingly in all deployed COD and COC markers.	Same	Same
Code-block style	SPcod, SPcoc = 0000 0000	Same	Same

Table A.52 – Codestream restrictions for interoperable master format (IMF) single tile/multi-tile reversible profiles

	2k IMF single/multi-tile reversible profile	4k IMF single/multi-tile reversible profile	8k IMF single/multi-tile reversible profile
Transformation	5-3 Reversible Transform	Same	Same
Precinct size	PPx = PPy = 7 for *NL*LL band, else 8. The corresponding values shall be set accordingly in all COD and COC	Same	Same
Progression order	CPRL, POC marker disallowed	Same	Same
Tile-parts	One tile-part per each tile component	Same	Same
Tile-part lengths	TLM marker segments are required in each image	Same	Same
Application specific restrictions			
Max. components sampling rate	See Table A.53	Same	Same
Max. compressed bit rate	See Tables A.53 and A.54 The maximum codestream size is the Max. compressed Bit rate divided by the frame rate.	Same	Same

Table A.53 – Operating levels for IMF profiles

Sampling rate = (Average components / Pixel) × (pixels / line) × (total lines / frame) × (frames / sec)

Where Average components is two for 4:2:2, three for 4:4:4 or 4:2:2:4, and four for 4:4:4:4

Levels	Max. components sampling rate (MSamples/sec)	Allowed sublevels (see Table A.54)
Mainlevel 0	Unspecified	Unspecified
Mainlevel 1	65	Sublevels 0 up to 1
Mainlevel 2	130	Sublevels 0 up to 1
Mainlevel 3	195	Sublevels 0 up to 1
Mainlevel 4	260	Sublevels 0 up to 2
Mainlevel 5	520	Sublevels 0 up to 3
Mainlevel 6	1200	Sublevels 0 up to 4
Mainlevel 7	2400	Sublevels 0 up to 5
Mainlevel 8	4800	Sublevels 0 up to 6
Mainlevel 9	9600	Sublevels 0 up to 7
Mainlevel 10	19200	Sublevels 0 up to 8
Mainlevel 11	38400	Sublevels 0 up to 9

Table A.54 – Operating sublevels for IMF profiles

Sublevels	Max. compressed Bit Rate # (Mbit/s)
Sublevel 0	unspecified
Sublevel 1	200
Sublevel 2	400
Sublevel 3	800
Sublevel 4	1600
Sublevel 5	3200
Sublevel 6	6400
Sublevel 7	12800
Sublevel 8	25600
Sublevel 9	51200
# Max. compressed bit rate = Max. instantaneous bit rate Mega (M), in the context of this Specification, is 10^6	

3) Table M.1

Replace Table M.1 with the following table:

Box name	Type	Required	Comments
Elementary stream marker	'elsm' (0x656c736d)	Required if an Elementary stream is defined.	This marker precedes a series of boxes that contain header type information about the JPEG 2000 elementary stream
Frame rate box	'frat' (0x66726174)	Required	This box specifies the frame rate
Maximum bit rate box	'brat' (0x62726174)	Required	This box specifies the compressed bit rate
Field coding box	'fiel' (0x6669656c)	Optional	This box specifies interlacing
Time code box	'tcod' (0x74636f64)	Required	This box specifies time code
Broadcast colour specification box	'bcol' (0x62636f6c)	Required	This box specifies the broadcast colour specification
Mastering display metadata box	'dmon' (0x646d6f6e)	Required	This box describes the display characteristics of the mastering display

4) Clause M.4

Replace clause M.4 with the following text:

M.4 Elementary stream marker box (superbox)

This superbox specifies all parameters required to define an elementary JPEG 2000 access unit. If this superbox exists, it shall contain one frame rate coding box, one maximum bit rate box, one time code box and one broadcast colour specification box.

This superbox may contain other optional boxes. One or two contiguous codestreams must immediately follow the elsm superbox as defined by the coding boxes contained in the elsm superbox.

The type of an elementary stream marker box shall be 'elsm' (0x656c 736d). The contents of the elementary stream marker box are as in Figure M.1.

frat: Frame rate coding box. This box specifies the frame rate in frames per second. The format of this box is specified in M.4.1.

brat: Maximum bit rate box. This box specifies the maximum bit rate of the elementary stream in bits per second. The format of this box is specified in M.4.2.

fiel: Field coding box. This box specifies the field order if the access unit contains two fields. The format of this box is specified in M.4.3. This box is optional.

tcod: Time code box. This box specifies the time code of the access unit in the elementary stream marker superbox. The format of this box is specified in M.4.4.

bcol: Broadcast colour specification box. This box specifies the colour space of the access unit. The format of this box is specified in M.4.5.

dmon: Mastering display metadata description box. This box specifies the characteristics of the content mastering display. The format of this box is specified in M.4.6.

5) Table M.2

Replace Table M.2 with the following table.

Table M.2 – Code for identifying colour specification

Code	Colour specification
0x00	Unspecified
0x01	IEC 61966-2-1:1999
0x02	Rec. ITU-R BT.601-6
0x03	Rec. ITU-R BT.709-5
0x04	See Tables M.3, M.4 and M.5
0x05	ISO 26428-1 (X'Y'Z')
0x06	Rec. ITU-R BT.2020
0x07	SMPTE ST 2084
0x08-0xFF	Reserved

6) Clause M.4.6

Add clause M.4.6 after Table M.5.

M.4.6 Mastering display metadata box (required)

This box specifies the characteristics of the mastering display metadata. The type of the mastering display metadata box shall be 'dmon' (0x646d6f6e) and contents of the box shall have the format as in Figure M.7:

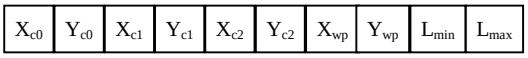

Figure M.7 – Mastering display metadata

$\mathbf{X}_c$ and $\mathbf{Y}_c$ are 2-byte unsigned integers that specify the normalized x and y chromaticity coordinates, respectively, of the colour primary component c 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 c equal to 0 should correspond to the green primary, c equal to 1 should correspond to the blue primary, and c equal to 2 should correspond to the red colour primary. The values of X_c and Y_c shall be in the range of 0 to 50 000, inclusive.

$\mathbf{X}_{wp}$ and $\mathbf{Y}_{wp}$ are 2-byte unsigned integers that specify the normalized x and y chromaticity coordinates, respectively, 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.

$\mathbf{L}_{min}$ and $\mathbf{L}_{max}$ are 4-byte unsigned integers that 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.

Default values

If the mastering display is unknown, the default values should be taken from Rec. ITU-R BT.709-5.

Table M.6 – Default values for mastering display parameters

Parameter	Default value
X_{c0}	0x3A98
Y_{c0}	0x7530
X_{c1}	0x1D4C
Y_{c1}	0x0BB8
X_{c2}	0x0C80
Y_{c2}	0x4074
X_{wp}	0x3D13
Y_{wp}	0x4042
L_{min}	0x00000367
L_{max}	0x000F4240

7) References

Add the following references to clause 2.2.

- Recommendation ITU-R BT.601 (2011), *Studio encoding parameters of digital television for standard 4:3 and wide screen 16:9 aspect ratios*.
- Recommendation ITU-R BT.2020 (2014), *Parameter values for ultra-high definition television systems for production and international programme exchange*.
- ISO 26428-1:2008, *Digital cinema (D-cinema) distribution master – Part 1: Image characteristics*.

8) Bibliography (clause K)

Add the following references to clause K.8:

- CIE S 015/E:2005, *Lighting of Outdoor Workplaces.*
- ISO 11664-3:2012 (CIE S014-3/E:2011), *Colorimetry – Part 3: CIE tristimulus values.*
- SMPTE ST 2084:2014, *High Dynamic Range Electro-Optical Transfer Function of Mastering Reference Displays*.

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