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ISO/IEC 14496-2

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2004-06-01

AMENDMENT 3
2007-07-01

Information technology — Coding of audio-visual objects —

Part 2: **Visual**

AMENDMENT 3: Support for colour spaces

Technologies de l'information — Codage des objets audiovisuels —

Partie 2: Codage visuel

AMENDEMENT 3: Support pour espaces de couleur

Reference number
ISO/IEC 14496-2:2004/Amd.3:2007(E)

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Foreword

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Amendment 3 to ISO/IEC 14496-2:2004 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

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Information technology — Coding of audio-visual objects —

Part 2:
Visual

AMENDMENT 3: Support for colour spaces

At the end of subclause 4.1, add the following:

Floor() the largest integer less than or equal to the argument

Round() Sign(*x*) * Floor(Abs(*x*) + 0,5), for an argument *x*

In 6.3.2, replace Table 6-8 with the following:

Table 6-8 — Colour Primaries

Value	Primaries			Informative Remarks
0	Forbidden			
1	primary green blue red white D65	x 0,300 0,150 0,640 0,3127	y 0,600 0,060 0,330 0,3290	ITU-R Recommendation BT.709-5 ITU-R Recommendation BT.1361 conventional colour gamut system or extended colour gamut system IEC 61966-2-4 Society of Motion Picture and Television Engineers RP 177 Annex B
2	Unspecified			Image characteristics are unknown or are determined by the application
3	Reserved			For future use by ISO/IEC
4	primary green blue red white C	x 0,21 0,14 0,67 0,310	y 0,71 0,08 0,33 0,316	ITU-R Recommendation BT.470-6 System M (historical) United States National Television System Committee 1953 Recommendation for transmission standards for color television United States Federal Communications Commission Title 47 Code of Federal Regulations (2004) 73.682 (a) (20)
5	primary green blue red white D65	x 0,29 0,15 0,64 0,3127	y 0,60 0,06 0,33 0,3290	ITU-R Recommendation BT.1700 625 PAL or 625 SECAM ITU-R Recommendation BT.1358 625 ITU-R Recommendation BT.470-6 System B, G (historical) ITU-R Recommendation BT.601-6 625

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6	primary	x	y	ITU-R Recommendation BT.1700 NTSC ITU-R Recommendation BT.1358 525 ITU-R Recommendation BT.601-6 525 Society of Motion Picture and Television Engineers 170M (functionally the same as the value 7)
	green	0,310	0,595	
	blue	0,155	0,070	
	red	0,630	0,340	
	white D65	0,3127	0,3290	
7	primary	x	y	Society of Motion Picture and Television Engineers 240M (functionally the same as the value 6)
	green	0,310	0,595	
	blue	0,155	0,070	
	red	0,630	0,340	
	white D65	0,3127	0,3290	
8	primary	x	y	Generic film (colour filters using Illuminant C)
	green	0,243	0,692 (Wratten 58)	
	blue	0,145	0,049 (Wratten 47)	
	red	0,681	0,319 (Wratten 25)	
	white C	0.310	0.316	
9-255	Reserved			For future use by ISO/IEC

In 6.3.2, replace Table 6-9 with the following:

Table 6-9 — Transfer Characteristics

Value	Transfer Characteristic	Informative Remarks
0	Forbidden	
1	$V = 1{,}099\ L_C^{0{,}45} - 0{,}099$ for $1 \geq L_C \geq 0{,}018$ $V = 4{,}500\ L_C$ for $0{,}018 > L_C \geq 0$	ITU-R Recommendation BT.709-5 ITU-R Recommendation BT.1361 conventional colour gamut system (functionally the same as the value 6)
2	Unspecified	Image characteristics are unknown or are determined by the application.
3	Reserved	For future use by ISO/IEC
4	Assumed display gamma 2,2	ITU-R Recommendation BT.470-6 System M (historical) United States National Television System Committee 1953 Recommendation for transmission standards for color television ITU-R Recommendation BT.1700 (2007 revision) 625 PAL or 625 SECAM United States Federal Communications Commission Title 47 Code of Federal Regulations (2004) 73.682 (a) (20)
5	Assumed display gamma 2,8	ITU-R Recommendation BT.470-6 System B, G (historical)
6	$V = 1{,}099\ L_C^{0{,}45} - 0{,}099$ for $1 \geq L_C \geq 0{,}018$ $V = 4{,}500\ L_C$ for $0{,}018 > L_C \geq 0$	ITU-R Recommendation BT.1700 NTSC ITU-R Recommendation BT.1358 525 or 625 ITU-R Recommendation BT.601-6 525 or 625 Society of Motion Picture and Television Engineers 170M (functionally the same as the value 1)

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7	$V = 1{,}1115\ L_C^{0{,}45} - 0{,}1115$ for $L_C \geq 0{,}0228$ $V = 4{,}0\ L_C$ for $0{,}0228 > L_C$	Society of Motion Picture and Television Engineers 240M
8	$V = L_C$	Linear transfer characteristics
9	$V = 1{,}0\text{-}\mathrm{Log}_{10}(L_C) \div 2$ for $1 \geq L_C \geq 0{,}01$ $V = 0{,}0$ for $0{,}01 > L_C$	Logarithmic transfer characteristic (100:1 range)
10	$V = 1{,}0 - \mathrm{Log}_{10}(L_C) \div 2.5$ for $1 \geq L_C \geq 0{,}0031622777$ $V = 0{,}0$ for $0{,}0031622777 > L_C$	Logarithmic transfer characteristic (316,22777:1 range)
11	$V = 1{,}099\ L_C^{0{,}45} - 0{,}099$ for $L_C \geq 0{,}018$ $V = 4{,}500\ L_C$ for $0{,}018 > L_C > -0{,}018$ $V = -(1{,}099\ (-L_C)^{0{,}45} - 0{,}099)$ for $-0{,}018 \geq L_C$	IEC 61966-2-4
12	$V = 1{,}099\ L_C^{0{,}45} - 0{,}099$ for $1{,}33 > L_C \geq 0{,}018$ $V = 4{,}500\ L_C$ for $0{,}018 > L_C \geq -0{,}0045$ $V = -(1{,}099\ (-4 * L_C)^{0{,}45} - 0{,}099) \div 4$ for $-0{,}0045 > L_C \geq -0{,}25$	ITU-R Recommendation BT.1361 extended colour gamut system
13-255	Reserved	For future use by ISO/IEC

In 6.3.2, replace the semantics of matrix_coefficients and Table 6-10 with the following:

matrix_coefficients: This 8-bit integer describes the matrix coefficients used in deriving luminance and chrominance signals from the green, blue, and red primaries, and is defined in Table 6-10.

In this table, the following applies:

When transfer_characteristics is not equal to 11 or 12, E'_R, E'_G and E'_B are analog with values between 0 and 1.

When transfer_characteristics is equal to 11 (IEC 61966-2-4) or 12 (ITU-R BT.1361 extended colour gamut system), E'_R, E'_G and E'_B are analog with a larger range not specified in this International Standard.

Nominal black is considered to have the property $E'_R = 0$, $E'_G = 0$ and $E'_B = 0$

Nominal white is considered to have the property $E'_R = 1$, $E'_G = 1$ and $E'_B = 1$.

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If matrix_coefficients is not equal to 8, the following applies.

E'_Y is analog with the value 0 associated with nominal black and the value 1 associated with nominal white.

E'_{PB} and E'_{PR} are analog with the value 0 associated with both nominal black and nominal white.

When transfer_characteristics is not equal to 11 or 12, E'_Y is analog with values between 0 and 1 and E'_{PB} and E'_{PR} are analog with values between -0,5 and 0,5.

When transfer_characteristics is equal to 11 (IEC 61966-2-4) or 12 (ITU-R BT.1361 extended colour gamut system), E'_Y, E'_{PB} and E'_{PR} are analog with a larger range not specified in this International Standard.

Y, Cb and Cr are related to E'_Y, E'_{PB} and E'_{PR} by the following formulae:

if **video_range** is equal to 0:

$$Y = \max[0, \min[(2^n -1), \text{Round}(219 * 2^{n-8} * E'_Y) + 2^{n-4}]]$$
$$Cb = \max[0, \min[(2^n -1), \text{Round}(224 * 2^{n-8} * E'_{PB}) + 2^{n-1}]]$$
$$Cr = \max[0, \min[(2^n -1), \text{Round}(224 * 2^{n-8} * E'_{PR}) + 2^{n-1}]]$$

if **video_range** is equal to 1:

$$Y = \max[0, \min[(2^n -1), \text{Round}((2^n -1) * E'_Y)]]$$
$$Cb = \max[0, \min[(2^n -1), \text{Round}((2^n -1) * E'_{PB}) + 2^{n-1}]]$$
$$Cr = \max[0, \min[(2^n -1), \text{Round}((2^n -1) * E'_{PR}) + 2^{n-1}]]$$

for n bit video.

For example, for 8 bit video,

When transfer_characteristics is not equal to 11 or 12, video_range equal to 0 gives a nominal black-to-white range of Y from 16 to 235, and a nominal range of Cb and Cr from 16 to 240;

When transfer_characteristics is not equal to 11 or 12, video_range equal to 1 gives a nominal black-to-white range of Y from 0 to 255, and a nominal range of Cb and Cr from 0 to 255.

If matrix_coefficients is equal to 8 (YCgCo), the following applies.

if **video_range** is equal to 0:

$$R = \max[0, \min[(2^n – 1), 2^{n-8} * (219* E'_R + 16)]]$$
$$G = \max[0, \min[(2^n – 1), 2^{n-8} * (219* E'_G + 16)]]$$
$$B = \max[0, \min[(2^n – 1), 2^{n-8} * (219* E'_B + 16)]]$$

if **video_range** is equal to 1:

$$R = \max[0, \min[(2^n – 1), (2^n – 1)* E'_R]]$$
$$G = \max[0, \min[(2^n – 1), (2^n – 1)* E'_G]]$$
$$B = \max[0, \min[(2^n – 1), (2^n – 1)* E'_B]]$$

for n bit video.

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Y, Cb and Cr are related to R, G and B by the following formulae:

$$Y = \text{Round}(0.5 * G + 0.25 * (R + B))$$
$$Cb = \text{Round}(0.5 * G - 0.25 * (R + B)) + 2^{(n-1)}$$
$$Cr = \text{Round}(0.5 * (R - B)) + 2^{(n-1)}$$

NOTE – For purposes of the YCgCo nomenclature used in Table 6-10, Cb and Cr of the above equations may be referred to as Cg and Co, respectively. The inverse conversion for the above three equations should be computed as:

$$t = Y - (Cb - 2^{(n-1)})$$
$$G = \max[0, \min[(2^n - 1), Y + (Cb - 2^{(n-1)})]]$$
$$B = \max[0, \min[(2^n - 1), t - (Cr - 2^{(n-1)})]]$$
$$R = \max[0, \min[(2^n - 1), t + (Cr - 2^{(n-1)})]]$$

Table 6-10 — Matrix Coefficients

Value	Matrix	Informative Remarks
0	Forbidden	
1	$E'_Y = 0{,}7152\ E'_G + 0{,}0722\ E'_B + 0{,}2126\ E'_R$ $E'_{PB} = -0{,}3854\ E'_G + 0{,}5000\ E'_B - 0{,}1146\ E'_R$ $E'_{PR} = -0{,}4542\ E'_G - 0{,}0458\ E'_B + 0{,}5000\ E'_R$	ITU-R Recommendation BT.709-5 ITU-R Recommendation BT.1361 conventional colour gamut system and extended colour gamut system IEC 61966-2-4 $xvYCC_{709}$ Society of Motion Picture and Television Engineers RP 177 Annex B
2	Unspecified	Image characteristics are unknown or are determined by the application
3	Reserved	For future use by ISO/IEC
4	$E'_Y = 0{,}59\ E'_G + 0{,}11\ E'_B + 0{,}30\ E'_R$ $E'_{PB} = -0{,}331\ E'_G + 0{,}500\ E'_B - 0{,}169\ E'_R$ $E'_{PR} = -0{,}421\ E'_G - 0{,}079\ E'_B + 0{,}500\ E'_R$	United States National Television System Committee 1953 Recommendation for transmission standards for color television United States Federal Communications Commission Title 47 Code of Federal Regulations (2004) 73.682 (a) (20)
5	$E'_Y = 0{,}5870\ E'_G + 0{,}1140\ E'_B + 0{,}2990\ E'_R$ $E'_{PB} = -0{,}3313\ E'_G + 0{,}5000\ E'_B - 0{,}1687\ E'_R$ $E'_{PR} = -0{,}4187\ E'_G - 0{,}0813\ E'_B + 0{,}5000\ E'_R$	ITU-R Recommendation BT.1700 625 PAL or 625 SECAM ITU-R Recommendation BT.1358 625 IEC 61966-2-4 $xvYCC_{601}$ ITU-R Recommendation BT.470-6 System B, G (historical) ITU-R Recommendation BT.601-6 625 (functionally the same as the value 6)

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6	$E'_Y = 0{,}5870\ E'_G + 0{,}1140\ E'_B + 0{,}2990\ E'_R$ $E'_{PB} = -0{,}3313\ E'_G + 0{,}5000\ E'_B - 0{,}1687\ E'_R$ $E'_{PR} = -0{,}4187\ E'_G - 0{,}0813\ E'_B + 0{,}5000\ E'_R$	ITU-R Recommendation BT.1700 NTSC ITU-R Recommendation BT.1358 525 ITU-R Recommendation BT.601-6 525 Society of Motion Picture and Television Engineers 170M IEC 61966-2-4 $xvYCC_{601}$ (functionally the same as the value 5)
7	$E'_Y = 0{,}701\ E'_G + 0{,}087\ E'_B + 0{,}212\ E'_R$ $E'_{PB} = -0{,}384\ E'_G + 0{,}500\ E'_B - 0{,}116\ E'_R$ $E'_{PR} = -0{,}445\ E'_G - 0{,}055\ E'_B + 0{,}500\ E'_R$	Society of Motion Picture and Television Engineers 240M
8	YCgCo	Defined as specified above
9-255	Reserved	For future use by ISO/IEC

In the case that video_signal_type() is not present in the bitstream or colour_description is zero the matrix coefficients are assumed to be those corresponding to matrix_coefficients having the value 1.

In the case that video_signal_type() is not present in the bitstream, video_range is assumed to have the value 0 (a range of Y from 16 to 235 for 8-bit video).

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