SMPTE REGISTERED DISCLOSURE DOCUMENT

Interoperable Master Format – Application ProRes

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1 Scope

This document specifies an Application of the IMF framework specified in SMPTE ST 2067-2. The Application follows the Image Characteristics, Track File and Composition constraints specified in SMPTE ST 2067-21 whenever possible, and uses the Apple ProRes codec specified in SMPTE RDD 36.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE RDD 36:2015, Apple ProRes Bitstream Syntax and Decoding Process

SMPTE RDD 44:2017, Material Exchange Format — Mapping and Application of Apple ProRes

SMPTE ST 2067-2:2016, Interoperable Master Format – Core Constraints

SMPTE ST 2067-21:2016, Interoperable Master Format – Application #2E

4 General

All provisions of SMPTE ST 2067-2 shall apply.

5 Image Essence

5.1 Characteristics

Image frames shall conform to the combinations of characteristics allowed in Table 1. The notation a..b indicates that any value between a and b, including a and b, is allowed.

Table 1. Image Characteristics.

Image Frame Width	1..1920				1..3840		1..4096	
Image Frame Height	1..1080				1..2160		1..3112	
Frame Structure	Progressive			Interlaced	Progressive			
Stereoscopy	Monoscopic Stereoscopic			Monoscopic	Monoscopic Stereoscopic			
Frame Rate	24 24000/1001 25 30 30000/1001 50 60 60000/1001			25 30 30000/1001	24 24000/1001 25 30 30000/1001 50 60 60000/1001		24 24000/1001 25 30 30000/1001 50 60 60000/1001 120	
Sampling	4:4:4		4:2:2	4:2:2	4:2:2		4:4:4	
Quantization	QE.1	QE.2	QE.1	QE.1	QE.1		QE.1 QE.2	
Color Components	R'G'B' $Y'C'_BC'_R$	R'G'B'	$Y'C'_BC'_R$	$Y'C'_BC'_R$	$Y'C'_BC'_R$		R'G'B'	
Colorimetry	COLOR.1 COLOR.2 COLOR.3	COLOR.3	COLOR.1 COLOR.2 COLOR.3	COLOR.1 COLOR.2 COLOR.3	COLOR.3	COLOR.5 COLOR.7	COLOR.3	COLOR.5 COLOR.6 COLOR.7
Pixel Bit Depth	8 10				8 10	10 12	8 10	10 12

NOTE 1: The image characteristics parameters used in Table 1 are defined in SMPTE ST 2067-20, as referenced by SMPTE ST 2067-21, and SMPTE ST 2067-21.

NOTE 2: Progressive segmented frames, as defined in SMPTE RDD 36, are not supported in this Application.

NOTE 3: COLOR.7 corresponds to the PQ system specified in Recommendation ITU-R BT.2100.

NOTE 4: The image characteristics specified in Table 1 are those specified by ST 2067-21, with the exception of the removal of COLOR.4 and modifications to Pixel Bit Depth combinations.

5.2 Coding

5.2.1 General

Each image frame, in the case of progressive structure, or pair of fields, in the case of interlaced structure, shall consist of a single frame() structure as specified in SMPTE RDD 36.

Encoded alpha data shall not be present.

Bitstream parameters shall be set according to Table 2.

Table 2. Bitstream Parameters.

Bitstream Parameter	Image Characteristic
horizontal_size	Shall be equal to Image Width
vertical_size	Shall be equal to Image Height
chroma_format	Shall correspond to the Sampling of the Image Frame
interlace_mode	Shall be 0 if Frame Structure is Progressive, or 1 or 2 if Frame Structure is Interlaced. See also Section 6.5.2.
aspect_ratio_information	Shall be ignored by a SMPTE RDD 45 conformant bitstream reader
frame_rate_code	Shall be ignored by a SMPTE RDD 45 conformant bitstream reader
color_primaries	As specified in Section 5.2.2
transfer_characteristic	As specified in Section 5.2.2
matrix_coefficients	As specified in Section 5.2.2
alpha_channel_type	Shall be 0

NOTE 1: Aspect ratio and frame rate are signaled in the Generic Picture Essence Descriptor of the Track File.

NOTE 2: In the case of interlace structure, the first field is always the first in temporal order, as specified in SMPTE RDD 36.

5.2.2 color_primaries, transfer_characteristic and matrix_coefficients

The color_primaries, transfer_characteristic and matrix_coefficients parameter shall be set according to Table 3.

Table 3. color_primaries, transfer_characteristic and matrix_coefficients Parameters.

Colorimetry	color_primaries	transfer_characteristic	matrix_coefficients
COLOR.1	6	1	6
COLOR.2	5	1	6
COLOR.3	1	1	1
COLOR.5	9	1	9

COLOR.6	12	16	1
COLOR.7	9	16	9

6 Image Track Files

6.1 Shim Parameters

Image Track Files are associated with the shim parameter values specified in Table 4.

Table 4. Shim Parameter Values Definitions.

Shim Parameter	Value
shim_id	*Value specified in Table 6*
gc_type	379-2-gc
picture_family	RDD36
picture_bitrate	RDD45
picture_format	RDD45
picture_custom_ANC	False
picture_render_ANC	False

6.2 Essence

Image Track Files shall contain image essence that conforms to Section 5.

6.3 Wrapping

Image Track Files shall conform to Section 5 and 6 at SMPTE RDD 44.

NOTE 1: The partition segmentation and index table rules of Section 5.3.3 at SMPTE RDD 44 apply exclusively;

NOTE 2: Picture Essence Descriptor constraints are specified in Section 6.5.1.

6.4 Profiles

Image Track Files shall conform to the combination of image sampling characteristic and ProRes profiles (as specified in SMPTE RDD 44) listed in Table 5.

Table 5. Coding Profiles.

Sampling	ProRes Profiles
4:2:2	422 LT
	422
	422 HQ
4:4:4	4444
	4444 XQ

NOTE: The 422 Proxy profile is not supported by this Application.

6.5 Generic Picture Essence Descriptor

6.5.1 General

The Picture Essence Descriptor referenced by the Top-Level File Package of Image Track File shall be:

- a CDCI Picture Essence Descriptor if the decoded image uses $Y'C'_BC'_R$ color components; or
- an RGBA Picture Essence Descriptor if the decoded image essence uses R'G'B' color components.

The Picture Essence Descriptor shall conform to:

- Section 6 (excluding Section 6.1.4) of SMPTE ST 2067-21; and
- Sections 6.1.2.1 (excluding Section 6.1.2.1.8), 6.1.2.2 and 6.1.2.3 of SMPTE ST 2067-20 as referenced by SMPTE ST 2067-21.

NOTE: The Bitstream structure specified in SMPTE RDD 36 stores images using color-difference color components exclusively. The presence of a CDCI Picture Essence Descriptor or RGBA Picture Essence Descriptor indicates the color components of the decoded image.

6.5.2 DisplayF2Offset

If the image structure is interlaced, the DisplayF2Offset item shall be equal to:

- 0, if the interlace_mode parameter of the image essence is equal to 1; or
- -1, if the interlace_mode parameter of the image essence is equal to 2.

7 Composition

7.1 Application Identification

The ApplicationIdentification element, as specified in SMPTE ST 2067-2, shall include exactly one instance of the value listed in Table 6.

Table 6. Application Identification.

`tag:apple.com,2017:imf:rdd45:2017`

7.2 Main Image Virtual Track

All Image Track Files referenced by the Main Image Virtual Track shall conform to Sections 5 and 6, and shall have identical:

- image essence characteristics, as specified in Section 5.1;
- ProRes profile, as specified in Section 6.4.

7.3 MaxCLL and MaxFALL

Section 7.2 of SMPTE ST 2067-21 shall apply.

7.4 Segment Duration

Section 7.4 of SMPTE ST 2067-20, as referenced by SMPTE ST 2067-21, shall apply.

Bibliography

Recommendation ITU-R BT.2100-1, Image parameter values for high dynamic range television for use in production and international programme exchange