MXF/ProRes Metadata

Version 3.0.0.10

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1 Introduction

The following new cameras will write MXF as container format for ProRes and no longer Apple QuickTime such as in the existing ARRI cameras.

The new MXF container for ProRes uses metadata for the image and sound essence as defined in RDD 44:2017-11 and for ARRI-specific metadata the existing ARRIRAW 4K header as known from the MXF/ARRIRAW recording format.

However, additional metadata is recorded in the camera. The current specification defines parameters chosen within the range allowed by RDD 44:2017-11. Additionally, the identifiers and parameters used to store acquisition and specific colrimetric metadata are specified.

For reading MXF/ProRes metadata, ARRI provides an MXF library and technical documentation for the MXF metadata header. ARRI recommends using the MXF library for metadata extraction to ensure correct reproduction of the original camera material.

2 Scope

This document specifies the parameters chosen within the scope of RDD 44:2017-11 and mapping of additional metadata into the MXF Generic Container.

Parameters specific to ARRI cameras are defined and structure of colorimetric metadata with its parameters is detailed. This allows developers to decode and interpret MXF/ProRes files written by ARRI cameras.

3 Version History

Version	Date	Change Note	Author
	2019-06-07	Initial version	Wegner, Wolfgang

4 Conformance Notation

4.1 Normative Text

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: **"shall", "should", or "may"**.

Keyword	Description
"shall" and **"shall not"**	Indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.
"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.
"may" and **"need not"**	Indicate courses of action permissible within the limits of the document.
"reserved"	Indicates a provision that is not defined at this time, shall not be used, and may

	be defined in the future.
"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.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

4.2 Informative Text

Informative text is text that is potentially helpful to the user, but not indispensable. Informative text can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

Most of the texts in this document are normative. However, there are a few exceptions, however:

- Introduction
- Sections labeled as "Informative"
- Individual paragraphs that start with "Note:"

5 Normative References

	Note
	Some references are made to the document "Metadata for ALEXA SUP 11 / ALEXA 65 SUP 1.0 / AMIRA 2.0 – White Paper, ARRI Digital Workflow Solutions, 1 April 2015" as [1] and "ARRI Look File version 2 (ALF-2) processing for ALEXA and AMIRA cameras Color Processing and Metadata Information" as [2]. It is intended to include the relevant definitions into the final version of this specification.

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

SMPTE ST 326:2000 – SDTI Content Package Format (SDTI-CP)

SMPTE ST 331:2011 – Element and Metadata Definitions for the SDTI-CP

SMPTE ST 377-1:2011 – Material Exchange Format (MXF) – File Format Specification

SMPTE ST 378:2004 – Material Exchange Format (MXF) – Operational Pattern 1a

SMPTE ST 379-2:2010 – Material Exchange Format (MXF) – MXF Generic Container

SMPTE ST 382:2007 – Material Exchange Format (MXF) – Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container

SMPTE ST 384:2005 – Material Exchange Format (MXF) – Mapping of Uncompressed Pictures into the Generic Container

SMPTE ST 385:2004 – Material Exchange Format (MXF) – Mapping SDTI-CP Essence and Metadata into the MXF Generic Container

SMPTE ST 394:2006 – Material Exchange Format (MXF) – System Scheme 1 for the

MXF Generic Container

SMPTE ST 405:2006 – Material Exchange Format (MXF) – Elements and Individual Data Items for the MXF Generic Container System Scheme 1

SMPTE RDD 18:2010 – Acquisition Metadata Sets for Video Camera Parameters

SMPTE RP 210v13:2012 – Metadata Dictionary Registry of Metadata Element Descriptions

SMPTE RP 224v12:2011 – SMPTE Labels Register

SMPTE RP 2057:2011 – Text-Based Metadata Carriage in MXF

SMPTE EG 42:2004 Material Exchange Format (MXF) – MXF Descriptive Metadata

SMPTE RDD 44:2017-11 Material Exchange Format - Mapping and Application of Apple ProRes

6 Outline of MXF File Structure

The camera uses segmented essence with partition durations as specified in RDD 44. As required, each body partition includes an index segment indexing the previous partition and the footer partition holds a complete index repetition. The header partition status is open and incomplete, the footer partition status is closed and complete.

The ProRes picture essence uses ARRI LogC V3 color space, which implies ITU709 coding equations, ARRI AWG3 Color Primaries and ARRI LogC V3 transfer characteristics.

Supported Apple ProRes Profiles (Link to MXF/ProRes Sample Files):

- 422 HQ, 4444, 4444 XQ
- Supported Resolutions:
- HD (1920 x 1080)
- 2K (2048 x 1152)
- UHD (3840 x 2160)
- Opengate (4448 x 3096, Container: 4480 x 3096)
- 2.39:1 (4448 x 1856, Container: 4480 x 1856)

7 Content Data Mapping

All essence data is mapped into the MXF container according to RDD 44.

7.1 Acquisition Metadata Mapping

	Note
ℹ️	The meaning of the 256 Byte binary metadata block is detailed in "9.1.5 Dynamic Metadata in Proprietary ARRI Atom" of the Document in [1]. (To be moved into the appendix of this document!)

The dynamic metadata acquired during recording **shall be** mapped into the system item according to RDD 18:2010. The 256 Byte dynamic metadata block **shall be** mapped into the Lens Unit Metadata Set using the Local Tag 82.00.

8 UL Keys used for Coding

	Note
ℹ️	The actual meaning of ARRI LUT Design Data, ARRI Look 3D LUT Data, ARRI Look Video Parameters v2, ARRI Look User LUT, ARRI Look Name, ARRI Look Information is not currently contained in this specification. Please see the document "ARRI Look File version 2 (ALF-2) processing for ALEXA and AMIRA cameras Color Processing and Metadata Information" for details.

All ARRI-specific metadata sets and items within these sets use the same keys as already introduced for ARRIRAW/MXF to allow re-use of existing parsers for this data. Two new keys have been introduced to specify the transfer characteristic and color primaries in the picture essence descriptor.

Byte No.	Description	Value (hex)	Meaning
1-4	SMPTE UL Designator 06.0E.2B.34		
5-8	Category, Registry, Structure and Version as in ST 0336:2007		
9,10	0F.01 (Experimental Range, to be replaced by 0D.xx)		
11	Item Type Identifier	01h	Picture Descriptor
		02h	Label
		03h	Frame Wrapping
		04h	Metadata Set
		05h	Property
12-15	Item Identifier	01.01.01.01	Distinction within each group
16	Index	00h	Index in case of more than one item of the same type

Table 1 Structure of UL Keys for this Specification

Item Name	UL Key
ARRIRAW Binary Metadata Wrapping	06 0e 2b 34 01 01 01 vv 0f 01 04 01 01 01 01 00
ARRIRAW Color Processing Metadata Local Set	06 0e 2b 34 02 13 01 vv 0f 01 04 02 01 01 01 00
ARRI Look LUT Design Data	06 0e 2b 34 02 04 01 vv 0f 01 05 02 02 01 01 00
ARRI Look 3D LUT Data	06 0e 2b 34 02 04 01 vv 0f 01 05 02 03 01 01 xx

	xx defines the LUT type as follows: 00: Standard Log C to Rec.709 conversion 3D_LUT 01: Standard Log C to Rec.709 conversion 3D_LUT with CDL 02: Log C to DCI-P3/Rec.2020 conversion 3D_LUT 03: Log C to DCI-P3/Rec.2020 conversion 3D_LUT with CDL
ARRI Look Video Parameters v2	06 0e 2b 34 02 04 01 vv 0f 01 05 02 04 01 01 00
ARRI Look User LUT	06 0e 2b 34 01 01 01 vv 0f 01 05 02 05 01 01 00
ARRI Look Name (currently not used because of redundancy to ARRIRAW header)	06 0e 2b 34 02 04 01 vv 0f 01 05 02 06 01 01 00
ARRI Look Information	06 0e 2b 34 02 04 01 vv 0f 01 05 02 07 01 01 00
ARRIRAW Dynamic Binary Metadata Wrapping	06 0e 2b 34 01 01 01 vv 0f 01 04 03 01 01 01 00 Local Tag for use in RDD 18 Lens Metadata Block: 82 00
ARRI Transfer Characteristic LogC-V3 (value of Picture Essence Transfer Characteristic item in picture essence descriptor)	06 0e 2b 34 04 01 01 0d 0e 17 04 01 03 01 02 01
ARRI Color Primaries AWG3 (value of Picture Essence Color Primaries item in picture essence descriptor)	06 0e 2b 34 04 01 01 0d 0e 17 04 01 03 01 03 01

Table 2 UL Key Definitions for this Specification

9 Specification of Sets, Descriptors and Properties

9.1 ARRI Color Processing Metadata Set

The ARRI Color Processing Metadata Set groups all properties describing the color processing to be applied to the picture essence data. For compatibility, the property value definitions are identical to those of the equivalent Quicktime Atoms.

The Color Processing Metadata Set uses 2-byte tag and BER length coding to accomodate large items (3D LUT) that would not fit 2-byte length coding.

The Color Processing Metadata Set is not referenced from standard MXF header data.

There **may be** one or multiple instances of the Color Processing Metadata Set; in the latter case, the user **may** check the set of identifications to match This Generation UID with Generation UID of a specific Color Processing Metadata Set to select a specific generation of color processing metadata. See "Layering Color Processing Metadata" below for details.

Item Name	Type	Len	Local Tag	Item UL	Req?	Meaning or Quicktime Equivalent
ARRI Color Processing Metadata Set	Set Key	16		As defined in Table 3	Req	Defines the Picture Essence Descriptor Set
Length	BER Length	var			Req	Set Length (see ST 377-1:2011)
Instance UID as defined in ST 377-1:2011	UUID	16	3C 0A		Opt	
ARRIRAW Binary Metadata Wrapping	Data Stream	4096	dyn.		Req	As specified in "9.2.1/9.3 Extended Metadata Block" of the Document in [1] (to be incorporated into this document)
ARRI Look 3D LUT Data	Data Stream		dyn.			Depending on value of Byte 16: 00: com.arri.camera.look.lut3d 01: com.arri.camera.look.lut3d_with_cdl 02: com.arri.camera.look.lut3d.master 03: com.arri.camera.look.lut3d_with_cdl.master
ARRI Look Video Parameter with target color space	Data Stream		dyn.			com.arri.camera.look.video_param_with_target_colorspace
ARRI Look User LUT	UInt32	4	dyn.			com.arri.camera.look.user_lut
ARRI Look Name	Data Stream		dyn.			com.arri.camera.look.name
ARRI Look Information	Data Stream		dyn.			com.arri.camera.look.information
ARRI Look LUT Design Data	Data Stream		dyn.			com.arri.camera.look.lut_design_data

Table 3 Property Items to be used in ARRI Color Processing Metadata Set

9.2 Layering Color Processing Metadata

The use of metadata overlays during editing and postprocessing is encouraged and **shall be** possible without interfering with or overwriting the original metadata recorded with the clip. Especially, the metadata (static as well as dynamic) items written by the camera during recording of the clip **shall** never be overwritten but instead be overlaid if required.

The metadata valid for decoding **shall be** identified by reference via This Generation UID Property in the Identification Set at the highest entry in the Identifications Property of the Preface Set in the Header Partition according to ST 377-1:2011.

In case of layering metadata, the encoder **shall** include all metadata items from the previously active Metadata Set into the newly written Metadata Set, updating Properties as needed and copying unmodified Properties. Accordingly, a Decoder **may** rely on the Metadata Set detected as the active set to be complete.

9.3 Contact

If you have any questions, please contact us via digitalworkflow@arri.de.