SMPTE REGISTERED DISCLOSURE DOCUMENT

Material Exchange Format — Mapping ARRICORE Bitstreams into the MXF Generic Container

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This document is intended to support the development of applications that read and process ARRICORE essence. It is not intended to support the development of hardware or software applications that create MXF Files containing ARRICORE essence 'from scratch,' that is, MXF Files containing ARRICORE essence that did not originate in an ARRI camera. Creation of such MXF Files is reserved to individuals and organizations that have entered into agreements with the proponent identified below for such file creation.

All other inquiries in respect of this document, including inquiries as to intellectual property requirements that may be attached to use of the disclosed technology, should be addressed to the proponent identified below.

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Introduction

This clause is entirely informative and does not form an integral part of this Registered Disclosure Document.

ARRI cameras can generate sequences of frames containing captured image essence as image data in a partially processed form, metadata, and, optionally, audio and/or data essence. This document describes how sequences of frames of this partially processed form of image essence, termed ARRICORE essence, are mapped into the MXF Constrained Generic Container. It also describes certain metadata present in the container that carry information required for correct transformation of the partially processed image essence to fully-processed image essence.

1 Scope

This Registered Disclosure Document (RDD) specifies the mapping of ARRICORE essence as a Picture Essence track of the MXF Constrained Generic Container in frame-wrapped form. It defines the ARRICORE bitstream, the KLV coding, essence container label values, essence coding labels, and SubDescriptor values describing the mapping, as well as the composition of the content package. It also states the layout of MXF Files containing ARRICORE essence, and constraints on applications producing such files.

2 Conformance Notation

This RDD uses the conformance notation specified in SMPTE ST 377-1.

3 Normative References

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

SMPTE RDD 55:2022, Material Exchange Format (MXF) — Carriage of ARRI Camera System Metadata. https://doi.org/10.5594/SMPTE.RDD55.2022

SMPTE ST 377-1:2019, Material Exchange Format (MXF) — File Format Specification. https://doi.org/10.5594/SMPTE.ST377-1.2019

SMPTE ST 378:2004, Material Exchange Format (MXF) — Operational Pattern 1a. https://doi.org/10.5594/SMPTE.ST378.2004

SMPTE ST 379-2:2010, Material Exchange Format (MXF) — MXF Constrained Generic Container. https://doi.org/10.5594/SMPTE.ST379-2.2010

SMPTE ST 382:2007, Material Exchange Format (MXF) — Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container. https://doi.org/10.5594/SMPTE.ST382.2023

4 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

4.1
ARRICORE MXF File

file conforming to the provisions of this Registered Disclosure Document, containing ARRICORE Picture Essence and associated metadata, and, optionally, audio and/or data essence

4.2
ARRICORE Picture Essence

partially processed image data as a BLOB comprised of 8-bit bytes

4.3
binary large object
BLOB

large sequence of data, the elements of which are always of the same data type, and the structure of which is opaque at a documented level of abstraction

5 ARRICORE Essence

5.1 Introduction (informative)

ARRICORE Essence contains partially processed image data produced by an ARRI digital camera.

The processing applied to the image data varies according to the ARRICORE Picture Essence Coding Label carried in the ARRICORE Picture Essence Processing SubDescriptor. Definitions of the processing of the image data to form the ARRICORE essence or of the processing of the ARRICORE essence to form a fully-processed image are outside the scope of this document.

5.2 ARRICORE Picture Essence encoding

ARRICORE Picture Essence shall represent images produced by an ARRI digital camera as a BLOB comprised of 8-bit bytes.

6 ARRICORE Essence Container

6.1 ARRICORE Picture Element KLV Coding

6.1.1 Element Key

ARRICORE Picture Essence shall be Frame-Wrapped, and shall be identified with the ARRICORE Picture Element Key as specified in Table 1. Bytes 1 to 13 of the label are defined in SMPTE ST 379-2.

Table 1 — ARRICORE Picture Element Keys

Item Name	Symbol	Kind	Item UL
ARRICORE Picture Element	`ARRICOREPictureElement`	LEAF	`060e2b34.01020101.0d010301.15kk20nn` where: kk = Count of Picture Elements in the Picture Item nn = Number (used as an Index) of this Picture Element in the Picture Item

NOTE The wildcard bytes (14 and 16) in the UL for `ARRICOREPictureElement`, “kk” and “nn”, are replaced with the hexadecimal value 0x7f in an essence keys register, as outlined in SMPTE Metadata Registers > Register (Essence Element Keys) > UL suffix (see Bibliography).

6.1.2 Element Length

The BER length field of the KLV triple for ARRICORE Picture Essence shall be 8 bytes long.

6.1.3 Element Value

The KLV value is an encoding of a single frame of ARRICORE Picture Essence, prepended by some amount of Pre-Picture Essence Padding. This padding is shown in Figure 1, with O_s representing the ImageStartOffset.

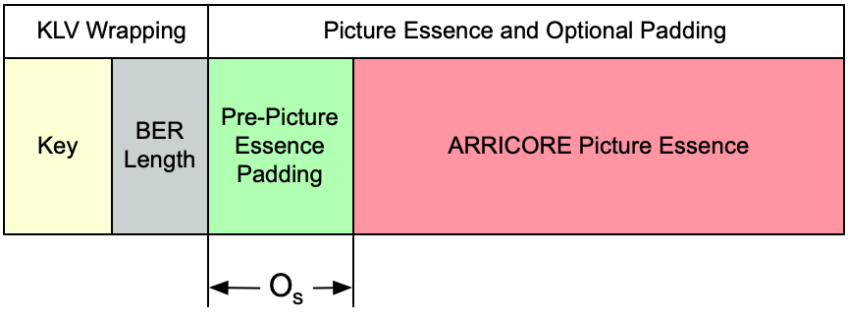

Figure 1 — ARRICORE Picture Essence Element Layout

NOTE Valid values of O_s in an ARRICORE MXF File are constrained as described in 7.1.1.

6.2 ARRICORE Essence Container Labels

The ARRICORE Essence Container Labels shall be as specified in Table 2. Bytes 1 to 13 of the labels are defined in SMPTE ST 379-2.

Table 2 — ARRICORE Essence Container Labels

Item Name	Symbol	Kind	Item UL
ARRICORE Frame-Wrapped CBE Essence Container	MXFGCARRICOREFrameWrappedCBE	LEAF	060e2b34.0401010d.0d010301.02270101
ARRICORE Frame-Wrapped VBE Essence Container	MXFGCARRICOREFrameWrappedVBE	LEAF	060e2b34.0401010d.0d010301.02270201

6.3 ARRICORE Picture Essence Coding Labels

The ARRICORE Picture Essence Coding Labels shall be as specified in Table 3.

Table 3 — ARRICORE Picture Essence Coding Label

Item Name	Symbol	Kind	Item UL
ARRICORE CBE Standard Profile	ARRICORECBEStandardProfile	LEAF	060e2b34.0401010d.04010202.030a0101
ARRICORE VBE Standard Profile	ARRICOREVBEStandardProfile	LEAF	060e2b34.0401010d.04010202.030a0201

6.4 Metadata

6.4.1 General

Storage of metadata applicable to all frames in the ARRICORE MXF File (static metadata) generic to both ARRICORE Picture Essence and other essence created by ARRI camera systems shall be as specified in SMPTE RDD 55.

Static metadata specific to the processing and interpretation of ARRICORE Picture Essence and other picture essence captured by ARRI camera systems shall be stored in the ARRICORE Picture Essence Processing SubDescriptor as specified in 6.4.2.

Metadata that potentially can change from frame to frame (dynamic metadata) shall be stored in the System Item and in the Supplemental Data Essence Container elements as specified in SMPTE RDD 55.

6.4.2 ARRICORE Picture Essence Processing

6.4.2.1 ARRICORE-specific Picture Essence Processing SubDescriptor

Metadata concerning processing of the picture essence in ways specific to ARRICORE shall be carried by an ARRICORE Picture Essence Processing SubDescriptor, a subclass of the Picture Essence Processing SubDescriptor that is defined in SMPTE RDD 55.

6.4.2.2 Constraints on PictureEssenceProcessingSubDescriptor

In an ARRICORE MXF File, the following Boolean item of PictureEssenceProcessingSubDescriptor shall always have the value TRUE:

- WhiteBalanceApplied

In an ARRICORE MXF File, the following Boolean item of PictureEssenceProcessingSubDescriptor shall always have the value FALSE:

- ColorLookApplied

6.4.2.3 Constraints on TextureProcessingSubDescriptor

In an ARRICORE MXF File, the following Boolean item of TextureProcessingSubDescriptor, defined in SMPTE RDD 55, shall always have the value FALSE:

- TextureApplied

6.4.2.4 ARRICORE Picture Essence Processing SubDescriptor ULs

The ULs of the ARRICORE Picture Essence Processing SubDescriptor Key and of the ARRICORE Picture Essence Processing items shall be as specified in Table 4.

Table 4 — ARRICORE Picture Essence Processing SubDescriptor ULs

Item Name	Symbol	Kind	Item UL
ARRICORE Picture Essence Processing SubDescriptor	`ARRICOREPictureEssenceProcessingSubDescriptor`	LEAF	`060e2b34.027f0101.0e170103.01000000`
ARRICORE Unit Calibration Data	`ARRICOREUnitCalibrationData`	LEAF	`060e2b34.0101010e.0e170103.01010000`

6.4.2.5 ARRICORE Picture Essence Processing SubDescriptor

The ARRICORE Picture Essence Processing SubDescriptor shall be as specified in Table 5.

Table 5 — ARRICORE Picture Essence Processing SubDescriptor

Symbol	Type	Len	Req?	Meaning
`ARRICOREPictureEssenceProcessingSubDescriptor`	Set Key	16	Req	Defines image processing parameters specific to ARRICORE camera system images.
`Length`	BER Length	4	Req	Set Length.
All items in PictureEssenceProcessingSubDescriptor except the Key or Group UL and the Length, if present				
`ARRICOREUnitCalibrationData`	DataValue	var	Opt	Per-camera-sensor radiometric calibration data.

7 Application Considerations

7.1 Partition Structure

7.1.1 General Constraints

An ARRICORE MXF File shall not contain a Run-In.

An ARRICORE MXF File shall include a Header Partition, zero or more triads of Body Partitions, a Footer Partition, and a Random Index Pack (RIP).

The Header Partition shall not contain an Index Table segment, nor shall the Header Partition contain ARRICORE Picture Essence.

The Footer Partition shall contain Header Metadata and an Index Table.

Every edit unit shall be indexed.

The partition structure shall be as specified in Clauses 7.1.2 and 7.1.3 for the ARRICORE Frame-Wrapped CBE Essence Container and for the ARRICORE Frame-Wrapped VBE Essence Container, respectively.

When the size of ARRICORE Picture Essence is constant, and the size of any sound essence and/or data essence is constant or can be readily made so by padding, the ARRICORE Frame-Wrapped CBE Essence Container should be used.

When the size of ARRICORE Picture Essence is constant, and the size of any sound essence is constant or can be readily made so by padding, but the data essence byte count is non-uniformly distributed throughout the timeline, or the maximum size of such data essence cannot be established before the start of MXF File creation, the ARRICORE Frame-Wrapped VBE Essence Container may be used.

NOTE 1 The above implies that readers of constant-size ARRICORE Picture Essence ought to be prepared to process such essence carried in an ARRICORE Frame-Wrapped VBE Essence Container as well as in an ARRICORE Frame-Wrapped CBE Essence Container.

NOTE 2 As SMPTE RDD 61 builds on SMPTE RDD 55, in accordance with the partition structure specified in SMPTE RDD 55, the value of the HeaderByteCount item in the Header Partition Pack shall be at least 16,777,216 (2^{24}) bytes.

7.1.2 Partition Structure for the ARRICORE Frame-Wrapped CBE Essence Container

The arrangement of Header Partition, triads of Body Partitions, Footer Partition and Random Index Pack shall be as shown in Figure 2, and the order of Body Partitions in a triad shall be first the Index Table, second the edit units, and third the Header Metadata.

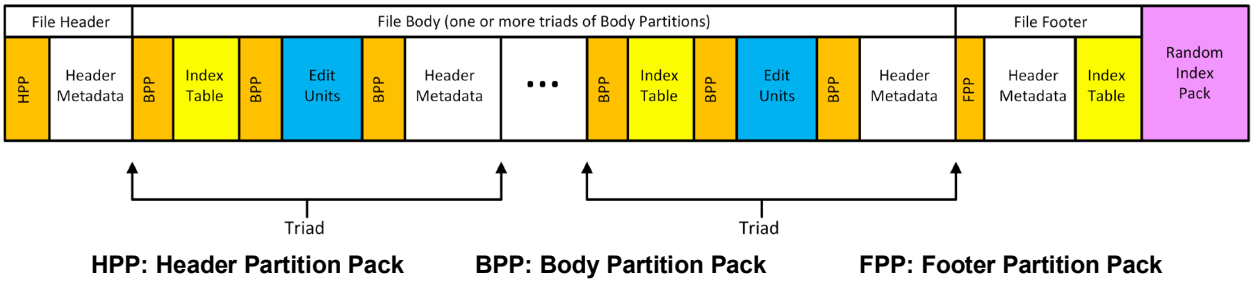

Figure 2 — ARRICORE MXF File Partition Structure for ARRICORE Frame-Wrapped CBE Essence Container

7.1.3 Partition Structure for the ARRICORE Frame-Wrapped VBE Essence Container

The arrangement of Header Partition, triads of Body Partitions, Footer Partition and Random Index Pack shall be as shown in Figure 3, and the order of Body Partitions in a triad shall be first the edit units, second the Index Table, and third the Header Metadata.

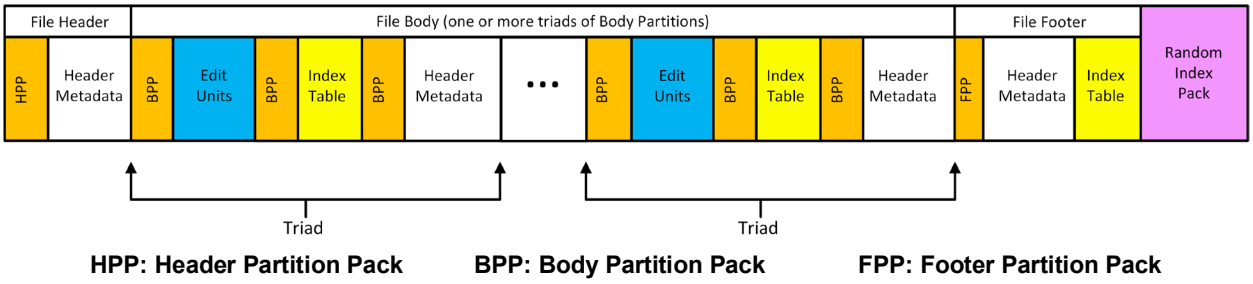

Figure 3 — ARRICORE MXF File Partition Structure for ARRICORE Frame-Wrapped VBE Essence Container

7.2 Partition Duration

The duration of all Body Partitions containing ARRICORE Picture Essence shall be constant (measured in time or edit units), with the possible exception of the final Body Partition containing ARRICORE Picture Essence. The duration should be approximately 10 seconds, and all Body Partitions containing ARRICORE Picture Essence shall be less than or equal to 10.01 seconds in duration.

7.3 Operational Pattern

The Preface shall indicate the use of Operational Pattern 1a as described in SMPTE ST 378.

7.4 Mapping Track Numbers to Generic Container Elements

Each Track Number for a Picture Essence Element (and, if present, a Sound Essence Element) shall be derived as described in SMPTE ST 379-2. There may be zero or more Data Tracks in an ARRICORE MXF File.

7.5 Essence Container Constraints

7.5.1 General Constraints

ARRICORE Picture Essence shall be mapped into the Constrained Generic Container using Frame Wrapping.

An ARRICORE MXF File shall use internal essence only.

Content Packages found in an ARRICORE Frame-Wrapped CBE Essence Container or in an ARRICORE Frame-Wrapped VBE Essence Container shall contain a System Item, a Picture Item, and a Data Item. If an ARRICORE MXF File includes Sound Essence, the Content Package shall also contain a Sound Item immediately after the Picture Item. The Data Item shall follow immediately after the Sound Item; if no Sound Item is present, the Data Item shall follow immediately after the Picture Item.

The layout of a Content Package from an ARRICORE Frame-Wrapped CBE Essence Container or an ARRICORE Frame-wrapped VBE Essence Container, corresponding to camera operation when sound essence is also stored, shall be as shown in Figure 4.

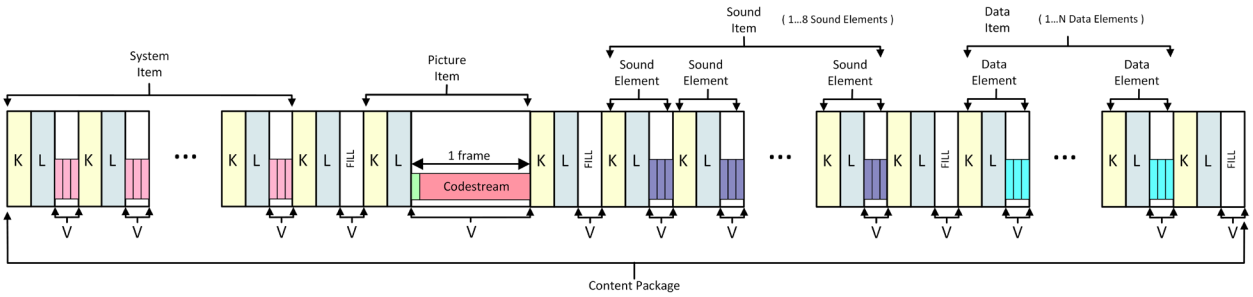

Figure 4 — ARRICORE Content Package Layout

7.5.2 Picture Item

The ARRICORE Picture Element Key shall be used to indicate the presence of ARRICORE Picture Essence.

The Picture Item shall contain a single Picture Element.

The ImageStartOffset in the Generic Picture Essence Descriptor shall be a value such that the offset from the first byte of the Content Package to the first byte of ARRICORE Picture Essence is an integral multiple of 64.

7.5.3 Sound Item

Sound essence, if present, shall be mapped into single-channel SMPTE ST 382 Sound Essence Elements. The Sound Item may contain between 1 to 8 (inclusive) Sound Essence Elements.

7.5.4 Data Item

The Container shall contain a Supplemental Data Element that carries the time-varying metadata specified in SMPTE RDD 55.

There may be additional Data Elements in the Container.

7.5.5 KLV Alignment Grid (KAG)

The KAG size for an ARRICORE MXF File shall be 512.

Bibliography

SMPTE Metadata Registers > Register (Essence Element Keys) > UL suffix.
https://registry.smpte-ra.org/view/draft/docs/Register%20(Essence%20Element%20Keys)/UL%20suffix/