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SMPTE REGISTERED DISCLOSURE DOCUMENT

Material Exchange Format — Mapping and Application of Apple ProRes

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Table of Contents Page

Introduction

This section is entirely informative and does not form an integral part of this Registered Disclosure Document (RDD).

ProRes is a picture-by-picture (intra-frame) compression scheme. This RDD specifies the mapping of ProRes bitstreams (SMPTE RDD 36) into a subset of the MXF Generic Container (SMPTE ST 379-2). This RDD also describes application considerations.

MXF file encoders (file writers) require a ProRes bitstream for each picture, each picture's bitstream length, and additional technical metadata items. This metadata can be provided by a ProRes encoder or an application that synthesizes or acquires a ProRes bitstream from another source.

The goals for this MXF specification are to be straightforward to implement, to be as constrained as possible to maximize interoperability, but to be sufficient for the needs of:

- Video camera recording.
- Use in broadcast environments, including playout servers and asset management systems.
- Use in professional video editing and preview, which require: fast file-open time, efficient file playback, and ability to edit while file is being recorded.
- Compatibility considerations for applications such as IMF and AS-11.

References to other documents have the section or table number and the section title or table caption in parentheses.

1 Scope

This Registered Disclosure Document (RDD) specifies the mapping of ProRes bitstreams into a subset of the MXF Generic Container (SMPTE ST 379-2). This document also defines application restrictions. The ProRes bitstream is documented by SMPTE RDD 36:2015. ProRes bitstreams are mapped into a Picture Essence Track of the MXF Generic Container with Frame Wrapping. This RDD defines the KLV coding, the required Keys (Universal Labels) and MXF Picture Essence Descriptor items.

2 Conformance Notation

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

3 Normative References

The following standards and related documents contain provisions that, 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 ST 377-1:2011, Material Exchange Format (MXF) — File Format Specification

Amendment 1:2012 to SMPTE ST 377-1:2011

Amendment 2:2012 to SMPTE ST 377-1:2011

SMPTE ST 379-2:2010, Television — Material Exchange Format (MXF) — MXF Constrained Generic Container

SMPTE ST 2067-5:2013, Interoperable Master Format — Essence Component

Amendment 1:2016 to SMPTE ST 2067-5:2013

4 Glossary of Acronyms, Terms and Data Types

The general glossary of acronyms, terms and data types used in the MXF specification is given in SMPTE ST 377-1 and is supplemented in SMPTE ST 379-2. These glossaries are not repeated here to avoid any divergence of meaning. In this document, terms are used as defined by SMPTE ST 377-1 in preference to any definition specific to SMPTE ST 379-2.

5 ProRes Mapping Specifications and Application Considerations

The ProRes container shall be compliant with SMPTE ST 379-2 with constraints defined in the following sections.

5.1 Essence Containers

5.1.1 Files with a Single Picture Essence Track

A Content Item is comprised of one or more Content Element(s), each of which shall contain a single picture (one full video frame) as illustrated in Figure 1.

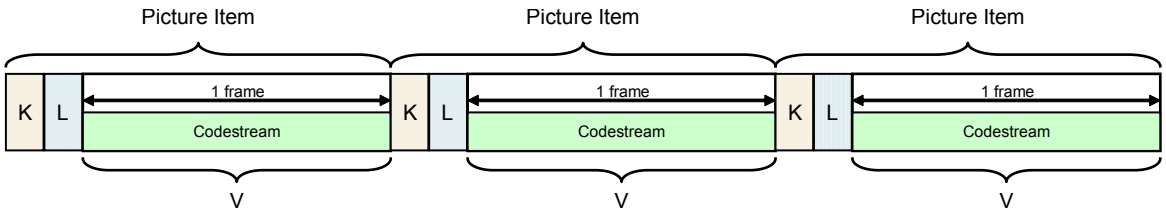

Figure 1 – Frame Wrapping of Picture Elements in the Generic Container

5.1.2 Files with Multiple Essence Tracks

The ProRes pictures may be interleaved with other essence components (Sound or Data) in the Frame Wrapped Essence Container as illustrated in Figure 2. Other essence components shall be as defined by an MXF mapping standard or a SMPTE RDD. All Essence Elements (Generic Container Content Elements) shall be Frame Wrapped. Each Picture (one full video frame) should contain essence data that is independent of adjacent pictures.

Other MXF standards may place additional requirements on the Content Element sequences in a Content Package.

Note: The term Frame Wrapping is defined by SMPTE ST 379-2 as the individual wrapping of one Content Package having a basic sample unit. This basic sample unit is defined by the ProRes bitstream and can be the result of compression of two fields from an interlaced scanned picture or one frame from a progressively scanned picture.

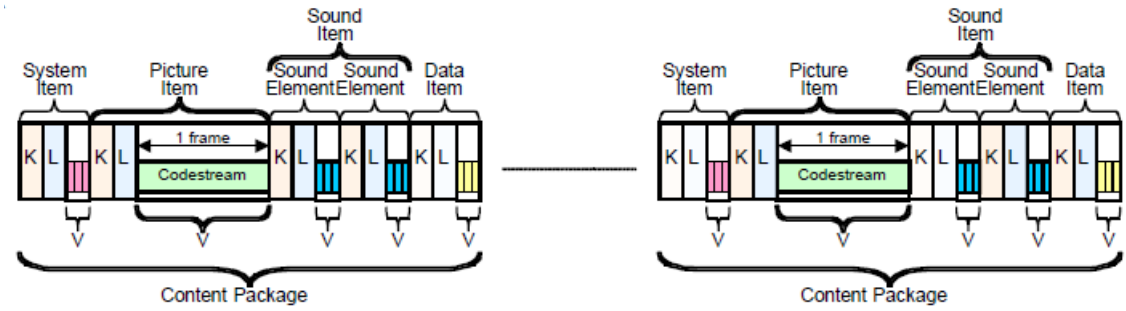

Figure 2 – Frame Wrapping of interleaved items and elements in the Generic Container

Note: Interleaving Essence Elements sometimes involve timing tolerances whose specification is beyond the scope of this RDD. However, the design of the frame based interleaved Generic Container is well established for time aligned Essence Elements within each Content Package.

5.2 Generic Container Mapping

All Content Elements shall use Frame Wrapping as defined in the Generic Container (SMPTE ST 379-2). Each Picture Element shall contain an individual KLV wrapped picture (one progressive video frame or two interlaced video fields). All pictures in a track shall have the same image characteristics described from the linked Picture Essence Descriptor.

Each Frame Wrapped Generic Container Content Package is a separate editable unit with synchronized System, Picture, Sound and Data Items.

A System Item may be included in a Content Package.

Note: SMPTE ST 379-2 Section 8.2 (Content Items and Content Elements) has additional information.

5.3 Essence Segmentation and Index Tables

Application requirements need to be considered when selecting one of the file Essence segmentation and Index Table specifications described below. One of the partition segmentation and index table rules from the following subsections of 5.3 shall be used.

5.3.1 Files That Are Not Segmented

A file that includes Essence in only one Partition (and does not break Essence into multiple Partitions) shall use a Header Partition or a Body Partition for the Essence. An Essence Container in a single Partition may be of any duration.

In such a file, all Index Tables shall be stored in the Footer Partition, the Header Partition, or both.

5.3.2 Files with Essence Segmented into Fixed Duration Partitions

The first Partition containing Essence shall be a Body Partition.

The duration of all Body Partitions, with the possible exception of the final Body Partition, should be approximately 10 seconds and all Body Partitions shall be less than or equal to 10.01 seconds in duration. The duration of the final Body Partition may be less than the other Body Partitions. The duration of all Body Partitions shall be constant (measured in time or Edit Units) with the possible exception of the final Body Partition.

Body Partition durations in Edit Units and seconds should follow the values documented in Table 1.

Table 1 – Partition Durations (Informative)

Frame Rate	Partition Duration (Edit Units)	Partition Duration (seconds)
24/1.001p	240	10.01
24p	240	10
25p and 25i	240	9.6
30/1.001p and 30/1.001i	300	10.01
50p	480	9.6
60/1.001p	600	10.01

Note: The Partition durations are chosen as a compromise between Partition size and Partition durations based on established MXF implementations to facilitate interoperability.

Each Body Partition with the exception of the first Body Partition shall include an Index Table for the previous Body Partition from the same Essence Container.

All Index Table Segments shall be repeated at the end of the file. Files with a single File Package shall repeat all Index Table Segments in the Footer Partition. Files with multiple File Packages shall repeat all Index Table Segments for all streams in the last Partition of each stream that includes Index Table Segments.

Notes:

1) Files with segmented Essence Containers can be decoded while being recorded.
2) If an application normally requires that Essence Containers be segmented, short files (less than 10 seconds), can be encoded using the rules in this section.
3) SMPTE ST 377-1 Section 5.2.2 (Partition Rules Summary) summarizes the use of partitions in MXF files.