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Digital cinema (D-cinema) packaging —

Part 4: MXF JPEG 2000 application

Emballage du cinéma numérique (cinéma D) —

Partie 4: Application MXF JPEG 2000

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 26429-4 was prepared by the Society of Motion Picture and Television Engineers (as SMPTE 429-4-2006) and was adopted, under a special “fast-track procedure”, by Technical Committee ISO/TC 36, *Cinematography*, in parallel with its approval by the ISO member bodies.

ISO 26429 consists of the following parts, under the general title *Digital cinema (D-cinema) packaging*:

— *Part 3: Sound and picture track file*

— *Part 4: MXF JPEG 2000 application*

— *Part 6: MXF track file essence encryption*

— *Part 7: Composition playlist*

SMPTE 429-4-2006

SMPTE STANDARD

D-Cinema Packaging — MXF JPEG 2000 Application

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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

This SMPTE document was prepared by the Technology Committee DC28 on Digital Cinema Technology in coordination with the Technology Committee W25 on Metadata and Wrappers.

Introduction

SMPTE 422M defines the mapping of any compliant JPEG2000 codestream into the MXF generic container and defines Keys, ULs and Essence Descriptor definitions. This document further defines the MXF mapping for Digital Cinema application.

1 Scope

SMPTE 422M defines the mapping of any compliant JPEG 2000 codestream into the MXF generic container and provides Keys, ULs and essence descriptor definitions. This standard further defines the MXF mapping details and constraints for application within D-Cinema.

2 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 377M-2004, Television — Material Exchange Format (MXF) — File Format Specification

SMPTE 422M-2006, Material Exchange Format (MXF) — Mapping JPEG 2000 Codestreams into the MXF Generic Container

SMPTE 428-1-2006, D-Cinema Distribution Master — Image Characteristics

SMPTE 429-3-2006, D-Cinema Packaging — Sound and Picture Track File

ISO/IEC 15444-1:2004, Information Technology — JPEG 2000 Image Coding System: Core Coding System

ISO/IEC 15444-1:2004/Amd 1:2006, Profiles for Digital Cinema Applications

3 Introduction

The MXF Generic Container (GC) is fully described in SMPTE 379M. SMPTE 422M specifies the mapping of JPEG 2000 codestreams as a Picture Element that may be used in the Picture Item of the MXF Generic Container. ISO-IEC 15444-1 Amd 1 specifies the JPEG 2000 profiles for use in D-Cinema applications.

This standard specifies the mapping of D-Cinema profiles of JPEG 2000 coded pictures into the MXF Generic Container.

Glossaries of acronyms, terms and data types used by the Material Exchange Format (MXF) are defined in SMPTE 377M and SMPTE 379M.

Glossaries of definitions, abbreviations and symbols used by JPEG 2000 are defined in ISO-IEC 15444-1.

3.1 Acronyms (Informative)

Some of the acronyms used in this document are listed here for information:

- DCDM: Digital Cinema Digital Master
- KAG: KLV Alignment Grid
- KLV: Key Length Value
- UL: Universal Label

4 Sampling Constraints

The source picture sampling shall comply with SMPTE 428-1.

5 JPEG 2000 Codestream Restrictions

The JPEG 2000 codestreams shall be restricted according to ISO-IEC 15444-1 Amd 1. This amendment defines two profiles for D-Cinema usage referred to in this standard as 2K and 4K.

6 MXF Mapping Constraints

The D-Cinema application shall use only frame-based wrapping as defined in SMPTE 422M. There shall only be one picture essence track in the MXF file as defined in SMPTE 429-3.

6.1 KLV Coding Constraints

The KLV coding structure is defined in SMPTE 422M section 5. This section defines specific values for the D-Cinema application.

6.1.1 Essence Element Key

The Essence Element Key is defined in SMPTE 422M Table 1. The specific values for the D-Cinema application shall be as defined in Table 1 below.

Table 1 – Specification of the D-Cinema Constrained JPEG 2000 Picture Element Key Value

Byte No.	Description	Value (hex)	Meaning
1~13	See SMPTE 422M	See SMPTE 422M	As defined in SMPTE 422M
14	Essence Element Count	01h	Count of Picture Elements in the Picture item
15	Essence Element Type	08h	JPEG 2000 Frame-wrapped Picture Element
16	Essence Element Number	01h	The Number (used as an Index) of this Picture Element in the Picture Item

6.2 UL Constraints

6.2.1 Essence Container UL

The Essence Container UL is defined in SMPTE 422M Table 2. The specific values for the D-Cinema application shall be as defined in Table 2.

Table 2 – Specification of the Essence Container Label

Byte No.	Description	Value (hex)	Meaning
1-14	See SMPTE 422M	See SMPTE 422M	As defined in SMPTE 422M
15	Content Kind	01h	Frame-wrapped Picture Element
16	Reserved	00h	

6.2.2 Picture Essence Compression UL

The Picture Essence Compression UL is defined in SMPTE 422M Table 3. The specific values for the D-Cinema application shall be as defined in Table 3.

Table 3 – Specification of the Picture Essence Compression Label

Byte No.	Description	Value (hex)	Meaning
1-15	See SMPTE 422M	See SMPTE 422M	As defined in SMPTE 422M
16	JPEG 2000 Codestream Restrictions	03h	Identifies codestream restrictions for the 2K D-Cinema profile.
		04h	Identifies codestream restrictions for the 4K D-Cinema profile

6.3 Application Issues

SMPTE 429-3 defines the Operational Pattern and the use of the KAG, the KLV Fill and Index Tables for D-Cinema applications.

6.4 Essence Descriptors

This section gives guidance in the use of MXF descriptors for use with this application specification.

MXF files conforming to this specification shall use the RGBA Picture Essence Descriptor defined in SMPTE 377M together with the JPEG 2000 Picture Sub Descriptor defined in SMPTE 422M.

The identification of the picture components is provided through the values of the PixelLayout Item of the RGBA Picture Essence Descriptor as defined in SMPTE 377M Annex E2.46. The DCDM color components *X*, *Y* and *Z* shall be coded respectively using the hexadecimal code values D8h, D9h and DAh.

NOTE – These values represent the ISO 7-bit character codes for the letters: '*X*', '*Y*' and '*Z*' with the most significant bit of each byte set to '1'. This distinguishes the DCDM color components from the '*X*', '*Y*' and '*Z*' character values already defined in SMPTE 377M Annex E 2.46.

Other picture essence sub-descriptors may be added to provide additional description of D-Cinema pictures.

6.4.1 RGBA Picture Essence Descriptor (Informative)

Table 4 below illustrates the RGBA Picture Essence Descriptor fields that should be used in D-Cinema applications. For simplicity and readability, not all columns defined in SMPTE 377M are shown in the table. Designers should note that the values given here are for guidance only and should not be used verbatim.

NOTE – The RGBA Picture Essence Descriptor includes all the properties from the File Descriptor, the Generic Picture Essence Descriptor and the RGBA Picture Essence Descriptor as defined in SMPTE 377M. Those properties that are for MXF management or are optional are not shown in table 4 below except where useful benefit is gained. In particular, Table 4 does not define the set Key value nor its Length field, as these are defined in SMPTE 377M. For clarity, not all columns of the descriptor are shown in Table 4, particularly the 'Local Tag', 'UL Designator', 'Req' and 'Meaning' columns. Please refer to SMPTE 377M Annex D for these values.

Table 4 – Specification of Values for the D-Cinema application RGBA Picture Essence Descriptor

Item Name	Type	Len	2K Values	4K Values
Linked Track ID	UInt32	4		
Sample Rate	Rational	8	{24,1} {48,1}	
Essence Container	UL	16	See Table 2	
Picture Essence Coding	UL	16	See Table 3	
Frame layout	UInt8	1	0	
Stored Width	UInt32	4	2048. Lower values may be used where permitted by the appropriate DCDM operational level	4096. Lower values may be used where permitted by the appropriate DCDM operational level
Stored Height	UInt32	4	1080. Lower values may be used where permitted by the appropriate DCDM operational level	2160. Lower values may be used where permitted by the appropriate DCDM operational level
Aspect Ratio	Rational	8	{256,135} by default. Other values are used where the pixel array does not fully occupy the DCDM operational level.	
Video Line Map	Array of Int32	16	2, 4, 0, 0 (each value is Int32)	
Gamma	UL	16	See SMPTE RP 224 (D-Cinema specific value)	
Component Max Ref	UInt32	4	4095	
Component Min Ref	UInt32	4	0	
Pixel Layout	8-byte array	8	'D8.0C.D9.0C.DA.0C.00.00' in hexadecimal code	
Sub Descriptors	8+16n	24	1, 16, UID (JPEG 2000 Picture Sub Descriptor Instance UID Value).	

6.4.2 JPEG 2000 Picture Sub Descriptor (Informative)

Table 5 provides additional guidance for the values of the required individual properties used in the JPEG2000 Picture Sub Descriptor. Designers should note that the values given here are for guidance only and should not be used verbatim. For simplicity and readability, not all columns defined in SMPTE 422M are shown in Table 5. Neither are the rows that define the Key and Length shown. Please refer to SMPTE 422M for the full description of this table.

Table 5 – Specification of Values for the D-Cinema application JPEG 2000 Picture Sub Descriptor

Element Name	Type	Len	2K Values	4K Values
Rsiz	UInt16	2	03h (2K D-Cinema application)	04h (4K D-Cinema application)
Xsiz	UInt32	4	2048. Lower values may be used where permitted by the appropriate DCDM operational level	4096. Lower values may be used where permitted by the appropriate DCDM operational level.
Ysiz	UInt32	4	1080. Lower values may be used where permitted by the appropriate DCDM operational level	2160. Lower values may be used where permitted by the appropriate DCDM operational level.
XOsiz	UInt32	4	0	
YOsiz	UInt32	4	0	
XTsiz	UInt32	4	2048 or less	4096 or less
YTsiz	UInt32	4	1080 or less	2160 or less
XTOsiz	UInt32	4	0	
YTOsiz	UInt32	4	0	
Csiz	UInt32	4	3	
Picture Component Sizing	J2K Component SizingArray	8+3n	3,3,{11,1,1},{11,1,1},{11,1,1}	

NOTE – The use of the letters "*X*" and "*Y*" in the table above refer to the horizontal and vertical image size parameters and have no relationship with the use of the same letter values used for the *X'Y'Z'* color space.