



2020 3D Media Spatial Sound and Vision

D3.5 Metadata Representation for 3D Cinema Production

Project ref. no.	ICT-FP7-215475
Project acronym	2020 3D Media
Start date of project (dur.)	1 March, 2008 (48 months)
Document due Date :	Feb. 28, 2010
Actual date of delivery	Feb. 23, 2010
Leader of this deliverable	JRS
Reply to	Werner Bailer (werner.bailer@joanneum.at)
Document status	Final

Version	Date	Description
0.01	2009-02-05	Document setup
0.10	2009-10-23	Outline
0.20	2010-01-20	First draft
0.30	2010-02-05	Added definition of metadata keys, updated some sections
0.40	2010-02-08	Completed audio metadata and RP210 extensions
0.50	2010-02-10	Added description of XML format for distribution
0.90	2010-02-12	Final draft sent to internal review
1.00	2010-02-23	Final, addressing comments from internal review

Deliverable Identification Sheet

Project ref. no.	ICT-FP7-215475
Project acronym	2020 3D Media
Project full title	2020 3D Media Spatial Sound and Vision
Document name	2020_3D_Media_D3.5_20100228
Security (distribution level)	Public (PU)
Contractual date of delivery	M24, Feb. 28, 2010
Actual date of delivery	Feb. 23, 2010
Deliverable number	D3.5
Deliverable name	Metadata Representation for 3D Cinema Production
Type	Report
Status & version	Final 1.0
Number of pages	31
WP / Task responsible	JRS / JRS
Other contributors	UoH, DTS, Fraunhofer, GVN, DTO, Datasat, UoR
Author(s)	Werner Bailer (JRS), Philippe Bekaert (UoH), Klaas Jan Damstra (GVN), Jan van Rooy (GVN), Stephen Field (DTS), Dave Stringer (Datasat), David Fuschi (UoR)
EC Project Officer	Jorge Santos
Abstract	This document summarises the metadata specification throughout the workflows covered by 2020 3D Media, their mapping to formats and embedding into containers, where applicable.
Keywords	Metadata, SMPTE RP210, MPEG-7, KLV, MXF
Sent to peer reviewer	Feb. 12, 2010
Peer review completed	Feb. 22, 2010
Circulated to partners	Via plone
Read by partners	Yes
Mgt. Board approval	To be approved by SB

Table of contents

- 1 Public Executive Summary 4
- 2 Introduction 5
- 3 Acquisition 6
 - 3.1 Camera and lens metadata 6
 - 3.2 Audio Metadata 6
 - 3.3 Calibration metadata 8
 - 3.4 Online content analysis results..... 10
 - 3.5 Embedding 10
- 4 Post-production..... 11
 - 4.1 Offline content analysis 11
 - 4.2 Segmentation for 2D/3D conversion 11
 - 4.3 Audio 11
 - 4.4 Editing information..... 12
 - 4.5 Embedding 12
- 5 Distribution 13
 - 5.1 Metadata for automating versioning 13
 - 5.2 Metadata distributed with content..... 13
 - 5.2.1 Required Properties..... 13
 - 5.2.2 Support in Standards..... 14
 - 5.2.3 Options for Embedding..... 15
 - 5.2.4 Adopted Solution 16
 - 5.2.5 Format of the Metadata Document..... 16
 - 5.3 Archiving..... 17
- 6 Conclusion 18
- 7 Annex A: Camera calibration parameters – towards an exchange format proposal 19
- 8 Annex B: Definition of additional SMPTE RP210 elements 23
- 9 Annex C: SMPTE 434M extensions 25
 - 9.1 XML representation of metadata elements 25
 - 9.2 XML representation of set for additional distribution metadata 28
- 10 References 31

1 Public Executive Summary

This document defines the metadata representations that are used throughout the entire workflow. It considers for each of the workflow steps the relevant subset of metadata properties as collected in D3.1 “Support for multi-view content in metadata standards and formats”. The metadata formats (based on existing standards as far as possible) used in acquisition, post-production and distribution are detailed. Whenever appropriate, embedding of metadata into containers is considered.

The annexes of the document specify SMPTE 335M compliant representations of properties not included in SMPTE RP210, as well as needed extensions to SMPTE 434M for the representation of distribution metadata. The conclusion summarises possible future contributions to standards, which can be considered, once the specifications in this document are implemented and tested.

2 Introduction

This document defines the metadata representations that are used throughout the entire workflow. It considers for each of the workflow steps the relevant subset of metadata properties as collected in D3.1 “Support for multi-view content in metadata standards and formats”. This document specifies the properties used and their representation, building on existing standards when possible, and outlining possible extensions to standards. Whenever appropriate, embedding of metadata into containers is considered.

The scope of this document is clearly limited to sparse technical and descriptive metadata. Any densely sampled information that reaches comparable bandwidth to essence, such as depth maps or ambisonics audio samples are out of scope of this document. Representation of such data is discussed in D3.6 “Extensions of MPEG-C Part 3, MVC and MXF for advanced depth and 3D audio representation”. In cases where other documents specify the metadata formats to be used, this document references them.

This deliverable is structured as follows. Sections 3 through 5 specify the metadata representation for acquisition, post-production and distribution respectively. Section 6 then concludes and discusses open issues in standardisation.

3 Acquisition

This section describes the representation of metadata captured by devices or estimated by algorithms online/just after capture.

3.1 Camera and lens metadata

In accordance with the specifications in D4.3 “Protocols and standards for data capture”, we assume that from a metadata point of view, the same representation is used for both main and satellite cameras. The actual metadata items supported by the satellite cameras depend on the selection of the camera model and are a subset of the metadata items listed in D3.1.

Static camera and lens metadata items are represented using SMPTE RP210 [RP210]. If this is not possible for lens metadata properties, properties from Lens Serial Interface Rev1.01 will be used.

If a tracker is available the same solution for capturing the tracker metadata as specified in IP-RACINE is used. However, the proprietary binary block of tracker metadata is converted to a standard representation in order to use the same format for tracking information recorded on set and estimated in post-production. The representations for camera position and orientation information are the SMPTE RP 210 properties described in the specification of calibration information in Section 3.3.

3.2 Audio Metadata

Besides standard metadata already used referring to the captured audio (name of audio track, time and date, etc.), there are a few additional metadata that are needed when using the technology developed in this project. A metadata property specifying whether the recording is in 3D or not needs to be added. If this property has the value true, further metadata properties described in the table below are needed, otherwise standard audio properties are sufficient.

Annex B defines experimental keys in order to represent the additional properties in SMPTE RP210 compliant format.

Property	Description	Data type	RP210 representation (key, name)	
3D audio recording	Whether this is a 3D audio recording or not.	Boolean		
Microphone model	Type of microphone use, values are <i>Soundfield STXXX</i> or <i>Tetramic VXXX</i>	String	06.0E.2B.34.01.01.01.01 01.01.20.03.00.00.00.00	Device model
Output type	Output type for audio format (implicit in the model, but useful to specify explicitly), values are <i>A-format</i> , <i>B-format</i> , or <i>custom</i> (with an additional identifier for the format)	String	06.0E.2B.34.01.01.01.05 04.09.01.00.00.00.00.00	Recorded Format
Acoustics captured	Whether the recording was aimed at capturing the acoustics of a place or not. If this value is true, the properties below are required.	Boolean		
Excitation signal	The signal used to capture the acoustic impulse response, values are <i>sine sweep</i> or <i>MLS</i> (maximal length sequences).	String		
Excitation signal parameters	The parameters of the excitation signal: the duration in seconds, further parameters specific to the type, e.g. for sine sweep: starting and ending frequency in Hz, type of sine sweep (logarithmic, linear).	Name-value set		
Loudspeaker model	Type of loudspeaker used to generate excitation signal. The model defines the technical properties.	String	06.0E.2B.34.01.01.01.01 01.01.20.03.00.00.00.00	Device model
Deconvolution method	One of the following values: <i>none</i> (i.e. left for postproduction), <i>MLS standard</i> , <i>sine sweep inversion without harmonic distortion treatment</i> , <i>sine sweep inversion with harmonic distortion deleted</i>	String		
Microphone position	Microphone position in 3D space (w.r.t. a local absolute reference point)	Float (degrees, [0°;360°)); Float (degrees, (-90°,90°)); Float (degrees, (-180°,180°))	06.0E.2B.34.01.01.01.07 07.01.10.01.06.00.00.00; 06.0E.2B.34.01.01.01.07 07.01.10.01.04.00.00.00; 06.0E.2B.34.01.01.01.07 07.01.10.01.05.00.00.00	Platform Heading Platform Pitch Platform Roll
Microphone orientation	Microphone orientation in 3D space (given as pan/tilt/roll angles and convention for specifying the angles)	Float (metres) Float (metres) Float (metres)	06.0E.2B.34.01.01.01.01 07.01.02.02.02.02.00.00; 06.0E.2B.34.01.01.01.01 07.01.02.02.02.03.00.00; 06.0E.2B.34.01.01.01.01 07.01.02.02.02.04.00.00	Device Relative Position X; Device Relative Position Y; Device Relative Position Z

3.3 Calibration metadata

This section proposes a representation of the camera calibration metadata summarised by WP5 (see Annex A). The representation is based on existing standards as far as possible and suggests extensions for other properties. The following table lists the metadata properties considered relevant and lists mappings to relevant standards (mainly SMPTE RP210 [RP210]) as documented in D3.1.

Annex B defines experimental keys in order to represent the additional properties in SMPTE RP210 compliant format.

Property	Description	Standard	Property name	Property reference ¹	Data type (unit)
Frame height	Height of the frame in pixels	RP210	Active Lines per Frame	06.0E.2B.34.01.01.01.01 04.01.03.02.02.00.00.00	UInt16 (pixels)
Frame width	Width of the frame in pixels	RP210	Active Samples per Line	06.0E.2B.34.01.01.01.01 04.01.05.01.02.00.00.00	UInt16 (pixels)
Pixel height	Height of a pixel	n/a			Float (µm)
Pixel width	Width of a pixel	n/a			Float (µm)
Pixel aspect ratio	The aspect ratio, expressed as width/(height*cos(skew))	n/a			Float (1)
Camera orientation	Camera orientation in 3D space (given as pan/tilt/roll angles and convention for specifying the angles)	RP210	Platform Heading Platform Pitch Platform Roll	06.0E.2B.34.01.01.01.07 07.01.10.01.06.00.00.00; 06.0E.2B.34.01.01.01.07 07.01.10.01.04.00.00.00; 06.0E.2B.34.01.01.01.07 07.01.10.01.05.00.00.00	Float (degrees, [0°;360°)); Float (degrees, (-90°,90°)); Float (degrees, (-180°,180°))
Camera position	Camera position in 3D space (w.r.t. a local absolute reference point)	RP210	Device Relative Position X; Device Relative Position Y; Device Relative Position Z	06.0E.2B.34.01.01.01.01 07.01.02.02.02.02.00.00; 06.0E.2B.34.01.01.01.01 07.01.02.02.02.03.00.00; 06.0E.2B.34.01.01.01.01 07.01.02.02.02.04.00.00	Float (metres) Float (metres) Float (metres)
FlipZ	Indicates whether additional flipping of z-axis is required	n/a			bool
Focal length	Focal length	RP210	Focal Length	06.0E.2B.34.01.01.01.03 04.20.02.01.01.04.01.00	Integer (mm)
Principal point	Principal point (x and y coordinate in the image coordinate system)	RP210	Source image center x;	06.0E.2B.34.01.01.01.01 07.01.02.03.03.00.00.00;	Int16 (pixels)

¹ SMPTE designator for items defined in RP210.

Property	Description	Standard	Property name	Property reference ¹	Data type (unit)
			Source image center y	06.0E.2B.34.01.01.01.01 07.01.02.03.04.00.00.00	Int16 (pixels)
Skew	Angle between x and y axis of the image coordinate system (often a skew parameter is given, which is cos or -tan of this angle), Note: even if rectangular pixel grids are assumed, nonzero effective skew can result from calibration algorithms.	n/a			Float (degrees)
Lens model type	Models relation between image coordinates and ray directions.	n/a			Enumeration
Radial lens distortion	Expressed as division of 2 polynomials, 3 nominator , 4 denominator coefficients	n/a			7x float (cm^[2,3,4,6])
Tangential distortion	2 coefficients	n/a			2x float (cm^2)
Center of distortion	In image coordinates, often coincides with principal point, but might be different	n/a			2* float (normalised image coordinates)
Inverted distortion representation	Whether given parameters undistort	n/a			bool

3.4 Online content analysis results

Apart from estimation of calibration metadata, tracking of feature point and subsequent segmentation of the trajectories, estimation of camera trajectories and of object bounding boxes and trajectories can be used as online analysis step (see D5.9 for a description of these algorithms). The output is time-dependent dynamic metadata in the form of point and object trajectories. As such information is typically used in 3D modelling tools, the format needs to be well suited for import in such tools.

In order to avoid product specific file formats, the open formats X3D [X3D] and COLLADA [COLL] have been considered. Both are XML based representations. Although it is appealing that X3D is an ISO standard, investigation showed it is rather used as a distribution format. Thus many 3D modelling tools have X3D export capabilities, while the functionality of importers is quite limited. Thus COLLADA will be used, which is rather designed as an exchange format.

3.5 Embedding

The essence format used in the acquisition stage is MXF. For technical metadata, it is advantageous to embed them into the essence container. Typically metadata will be transmitted as a binary blob from the camera to the recording system, and is embedded into the MXF structures there.

The metadata properties covered by SMPTE RP210 can be natively embedded into the MXF header structures.

For the properties defined by Lens Serial Interface, KLV representations are available.

It is not planned to embed the metadata represented in COLLADA into the MXF container, as is will be used separately from the essence.

4 Post-production

This section describes metadata representation resulting from content analysis or annotations in post-production. In contrast to acquisition and distribution, some of the prototypes are in an earlier stage, thus the definitions are on a coarser level than for the other stages of the workflow.

4.1 Offline content analysis

Offline content analysis tools provide a wide range of rich and possibly fine grained metadata. Based on the experiences from IP-RACINE and the tools developed there it has been decided to use MPEG-7 [MPEG7] for representing this metadata. The XML representation (textual format, TeM) of MPEG-7 will be used, as there are more tools available for processing and the size of a description document is not critical.

The main description capabilities of MPEG-7 that are relevant for representing the results of the offline content analysis tools are:

- Creation (production) metadata (e.g. title, production place/date, rating, classification, keywords), similar scope as MXF DMS-1 Production Framework.
- Decomposition into temporal segments, which may be organized hierarchically (e.g. video, scene, shot). The decomposition can be done by any criteria.
- Decomposition into objects, i.e. spatial or spatiotemporal segments of the content.
- Description of low-level visual and audio features of a segment, such as dominant colours, dominant spectral components.
- Text annotations: Both free text annotation and structured annotations (e.g. lists of keywords, who/what/when/where) are supported. All descriptors that involve text are designed to be multilingual. Structured text annotations allow the use of controlled vocabularies (thesauri, ontologies).
- Semantics: Allows describing objects, agents, events, concepts and their relations.

For the MPEG-7 documents the Detailed Audiovisual Profile (DAVP) defined in [BS06] is used. This MPEG-7 profile is currently considered as candidate for an MPEG-7 profile to be defined by the EBU P/SCAIE working group. As has been analysed in D3.1, it is possible to represent the metadata of multiview content in an MPEG-7 compliant way, however, the semantics of the segments representing the views are not explicit. The following conventions are used:

- According to the DAVP specification, the root segment of the content is first decomposed into its modalities before applying temporal or spatiotemporal decomposition. Thus this decomposition contains several VideoSegments that represent the different views.
- In addition, a VideoSegment containing metadata valid across all views (e.g. synchronous key frame time points, motion activity of the overall scene) is added to this decomposition.
- The camera ID is stored in the creation tool parameters of each of these video segments.
- In order to fulfil the requirement of unique identifiers within an XML document, all segment identifiers are prefixed with the view ID.

4.2 Segmentation for 2D/3D conversion

The algorithms used for this purpose need to create a dense segmentation for each frame of the input 2D sequence. This information is thus treated like a still image sequence containing essence. The formats used for representation are described in D5.2 "Improved algorithms for 2D-3D image conversion".

4.3 Audio

The azimuth-elevation metadata, as well as other metadata describing the source spatial properties, is quite dense, it will thus be embedded into the audio essence container described in D3.6 "Extensions of MPEG-C Part3, MVC and MXF for advanced depth and 3D audio representation".

4.4 Editing information

For editing information, both EDL and AAF will be used. Both formats are also supported for exporting result sets from the browsing tools.

When tools generate representations for edit decisions, the edits can be replicated for the different views. Thus no specific needs for extending existing formats have been identified.

4.5 Embedding

In the post-production steps essence is handled as still image sequences. As essence is manipulated with a number of tools which might not fully handle all embedded metadata, all metadata that has not been embedded during acquisition will be stored separately.

5 Distribution

This section describes metadata needed for automating the creation of different versions and metadata that actually needs to be distributed with the content.

5.1 Metadata for automating versioning

The metadata needed for the automation of versioning in the distribution system is basically the same set described in Section 5.2 below. However, the system needs to keep track of the possibly different values of the metadata elements for the different versions. For example, there might be different release dates for different markets, that could apply to the same (language, age) version. The distribution system holds this information, while only the relevant release data is included in the DCP. In contrast, if the DCP holds different versions (language, age), the metadata need to be included and associated with the respective CPL.

5.2 Metadata distributed with content

5.2.1 Required Properties

The following table lists the elements that should be distributed together with the content. As in D3.1, the letters in the “Ctx” column denote the context of the element:

- P...production: the entire set audiovisual content related to one movie production
- A...asset: a single piece of audiovisual essence
- S...segment: a (spatio)temporal part of audiovisual essence

In a first version the implementation will probably mostly the items on the production level (esp. in cases where several contexts are possible), except when explicitly required (e.g. in the CPL metadata).

The “S” column specifies specific elements for certain distribution packages:

- D...DCI compliant content only
- N...Non-DCI compliant content only
- L...live content only

The “DCI” column specifies whether an element is included (or even required) by parts of the DCI specification:

- C...in CPL
- P...in PKL
- N...in file naming convention
- T...in track file
- K...in KDM

		Ctx	S	DCI
Visual				
Active lines per Frame	Specifies the total number of lines (rows) in the active portion of a frame in the video pixel matrix.	PA		T
Active samples per Line	Total number of samples (columns) in the active portion of a line in the video pixel matrix.	PA		T
Color space	Name of the color profile (ITU-R701, XYZ, ...)	PA	N	
Color space definition	Definition of color space if not standard one	PA	N	
Eye order / dominance	For stereo content stored in an interleaved format: left/right eye first. Note: DCI compliant content is always left first.	PA	N	
Frame aspect ratio	Frame aspect ratio	PA		TC
Frame rate	The video frame rate.	PA		T
Audio				
Audio sample rate	The audio sample rate.	PA		T
Audio sample type	The audio sample type.	PA		T
Sound channels	Number of audio channels	PA		T

Sound coding	Audio coding format	PA	Y	NC
Descriptive - General				
Asset/clip duration	Duration of each asset	A		T
Checksum	Checksum of each asset	A		P
Size	Size in bytes of each asset	A		P
Total runtime/duration	Duration of the complete content (e.g. of a CPL)	P		
Descriptive - Identification				
Feature Title	Name of Film	P		NC
UUID/UMID	Unique identifier of each media asset.	PA		TCP
Version	Cine, Airplane, iPod, Mobile, HD, SD, Home	PA		C
Descriptive - Production				
Actors	List of 5 main Actors	P		
Audio language	The primary Audio Language	PAS		N
Country of Origin	Country to which Feature is accredited	P		C
Director	Directors of Feature	P		
Distributor	Company having the distribution rights for the territory, there could be a several distributors for one version of the movie for several countries	P		
Languages	List of languages (ISO language identifiers) for which this asset is appropriate	PAS		C
Locations	List of up to 5 main locations	P		
Owner	Who is the owner of this version of the feature.	P		N
Subtitle language		PAS		N
Video language		PAS		
Year or release	The Main year in which the Feature was released	P		
Descriptive - Rights				
Copyright		PAS		
Descriptive – Publication/Distribution				
Certifications	Countries in which it is approved to be shown	PA		NC
Exclusions	Details of locations, areas or companies to which the Feature should not be distributed.	P		K
Invalid from	Dates after which the feature should not be shown.	P		K
Live Coding Arrangements	set of metadata properties describing FEC, modulation, data rate, ...	P	L	
Live only	Flag indicating whether live content may be stored	P	L	
Number of plays	Number of times the content may be played	P	L	
Valid from	Date from which the feature is allowed to be shown.	P		K
Descriptive – Process				
DCP Creator	Company that produced the DCP	P	D	
Reel number	Reel number for each asset in a DCP	A		C
Descriptive – Content				
Genre	The name of the genre.	PAS		
Tag Line	A short statement used for marketing	P		

5.2.2 Support in Standards

	SMPTE RP210	MPEG-7	EBU P/Meta
Visual			
Active lines per Frame	x	x	x
Active samples per Line	x	x	x
Color space	x	x	x
Color space definition	x		

Eye order / dominance			
Frame aspect ratio	x	x	x
Frame rate	x	x	x
Audio			
Audio sample rate	x	x	x
Audio sample type	x	x	x
Sound channels	x	x	x
Sound coding	x	x	x
Descriptive - General			
Asset/clip duration	x	x	x
Checksum			
Size		x	x
Total runtime/duration	x	x	x
Descriptive - Identification			
Feature Title	x	x	x
UUID/UMID	x	x	x
Version		x	
Descriptive - Production			
Actors	x	x	x
Audio language	x	x	x
Country of Origin	x	x	x
Director	x	x	x
Distributor	x	x	x
Languages	x	x	x
Locations	x	x	x
Owner	x	x	x
Subtitle language	x	x	(x)
Video language	x	x	x
Year or release	x	x	x
Descriptive - Rights			
Copyright	x	x	x
Descriptive – Publication/Distribution			
Certifications	x		x
Exclusions			x
Invalid from	x	x	x
Live Coding Arrangements			
Live only			x
Number of plays	x		x
Valid from	x	x	x
Descriptive – Process			
DCP Creator			
Reel number	x	x	
Descriptive – Content			
Genre	x	x	x
Tag Line		x	

5.2.3 Options for Embedding

The following options for distribution of metadata elements have been identified:

- embed in each MXF/BWF asset

- some metadata already there (due to MXF and DCI requirements)
- seamlessly integrated in security and supplementary package mechanisms
- no central access point for metadata at playout, need to look up in assets
- metadata referring to whole production must be repeated in each asset
- metadata needs to be available during DCDM creation (directly at MXF wrapping or at least injected before packaging)
- in the non DCI compliant case (e.g. live content), another container than MXF might be used
- separate XML file (metadata format to be defined) per package holding metadata about the assets included
 - no change of MXF wrapping required
 - easy to handle, central access point
 - same representation independent of content representation
 - if used together with DCP, some elements are redundant
 - could it be included in DCP?
 - what if supplementary packages are necessary: repeat metadata or require access to original package (issues with security?)
 - outside DCP
 - it depends on the TMS to retrieve and use the file – might get lost
 - should it go over same distribution channel as content, or e.g. web service from where it could be retrieved (database of content metadata)

5.2.4 Adopted Solution

It has been decided to include a separate XML document into the DCP and reference it in the PKL. In a DCP package, the PKL was designed to include additive files, those files being not referenced in the CPL. DCI and SMPTE allow this, there is no base restriction.

It is better to stay at XML format because it is already widely used in the DCP package (PKL, CPL, KDM, etc. are XML files) so tools are existing to process this type of files.

The advantages of this solution is that there is a central access point for accessing metadata, without the need to look into MXF files of individual assets. It is also in line with the approach of the iMP² project. The only drawback is that metadata properties which are mandatory in one of the components of the DCP are duplicated. However, having one complete metadata document is seen as advantageous even if some properties are duplicated.

5.2.5 Format of the Metadata Document

All of the metadata formats considered lack some of the required properties. As the DCI specification is a SMPTE standard, the use of SMPTE RP210 seems to be the best choice. As other documents in the DCP are XML documents, an XML representation according to [MXFXML] is used.

The additional XML file mirrors the structure of the DCP using the following rules:

- The XML file contains one source package, one or more material packages and optional global metadata (picture and sound descriptor, descriptive metadata according to DMS-1 production framework)
- Each playable asset in the asset map is represented by a segment of a timeline track in the source package. The InstanceID of the track segment coincides with the UUID of the asset.

² <http://imp-project.eu/>

- Each CPL is mapped to a material package. The InstanceID attribute of the material package coincides with the UUID of the CPL.
- Each sound and picture asset of the CPL is mapped to a segment in a timeline track of the material package. In case of several reels, there are several track segments on each/some of the timelines.
- Each of the source packages can contain picture and sound descriptors containing the technical properties of the assets. As defined by SMPTE 434M, these descriptors are linked to the timelines in the source by the descriptor's LinkedTrackID attribute.
- Each of the material packages can contain a static track with descriptive metadata according to the DMS-1 production framework.
- In case there are properties that are valid for all CPLs, they can be added as global picture/sound descriptor or descriptive metadata.
- Metadata not covered by the picture/sound descriptors or DMS-1 production framework is included in the production framework metadata using the extension metadata group defined in Annex D.
- In order to allow for multiple classifications of one CPL, classifications will be described as a list of name/value pairs of issuer and rating.

5.3 Archiving

The EDCine project [EDC] has worked extensively on the definition of a OAIS compliant archiving process for digital cinema content, including the definition of a master archive format. The format is metadata agnostic, and relevant metadata is assumed to be embedded into the respective MXF files.

For metadata that is not specific to a certain essence, the approach described above for the distribution scenario could be used. A file conforming to the same specification could be included in the archive master DCP.

6 Conclusion

This document describes the metadata formats used in the different stages of the workflow. In the acquisition and distribution stage most metadata is represented using SMPTE RP210, which can be easily embedded into MXF containers. In the distribution stage also the XML representation is used in order to include metadata valid across several assets as a separate document into the DCP. The post-production stage deals with more diverse and richer metadata, thus formats such as MPEG-7 are used. As there is an overlapping set of properties in the different formats, mappings will be necessary at the interfaces of the respective workflow stages. This mapping can be achieved with the technology developed in WP3T1.

As partly anticipated in D3.1, the following gaps in existing standards exist:

- There is limited support for calibration and lens metadata. Extensions of SMPTE RP210 would be appropriate to cover these areas.
- While multiple views can be described in comprehensive formats such as MPEG-7, however, the semantics are not well-defined. The definition of a profile that defines the notion of views could solve this issue. A possible option is the profile currently being defined by the EBU P/SCAIE working group.
- Some of the technical and descriptive properties needed in distribution are not available in SMPTE RP210.

Inputs to standards bodies will be made once tested implementations for the proposed extensions are available.

7 Annex A: Camera calibration parameters – towards an exchange format proposal

Author: Philippe Bekaert (UHasselt)

Design principle: parameters as human friendly as possible, can be displayed and manipulated on user interface e.g. without conversions.

Image dimension:

- Image width and height in pixels
- Pixel width and height in micrometers. Restriction to rectangular pixel grids (zero skew).
Note: Nonzero effective skew can result from calibration algorithms and can be represented as intrinsic camera parameter below.

Lens model: enumeration: models how image coordinates are related with ray directions.

Restriction to central cameras.

```

RECTILINEAR      // r = f * tan(theta)      - rectilinear lens
ORTHOGRAPHIC     // r = f * sin(theta)     - orthographic projection of
a sphere
EQUIDISTANT      // r = f * theta          - equidistant fish eye lens,
e.g. fujinon FE series
STEREOGRAPHIC   // r = 2*f*tan(theta/2) - less marginal object
distortion, ideal for printing
EQUISOLIDANGLE  // r = 2*f*sin(theta/2) - equisolid angle fish eye
lens / mirror image on a ball
EQUIRECTANGULAR // u = longitude -180...180 deg, v = latitude (range
depending on image width and height and pixel aspect ratio)
CYLINDRICAL      // u = longitude -180...180 deg, v = f*tan(latitude)
- projection onto cylinder with radius f

```

Of these models, only rectilinear, equidistant and equisolid angle correspond with physical lenses. The others models are encountered in the context of imagery preprocessed on a computer. Theta = angle w.r.t. direction “straight ahead” from camera. f, r : see below.

Intrinsic camera parameters:

```

float fc;                // focal length in mm, meaning depends on
lens model = parameter f in the lens model formulae above
vec2 pc;                // principal point (image coordinates).
Image distance r in formulae above is measured w.r.t. this point.
float skew;             // effective skew angle, in degrees. Nonzero
values are usually an artifact of the calibration.
float aspect;          // effective aspect ratio (dimensionless),
allowed to differ from pixel height / (pixel width x cos(skew))

```

Image coordinates: Bottom left image coordinate is (0,0), top-right is (width, height).

OpenGL camera axis frame: X=right, Y=up, Z=reversed viewing direction.

Alternative To Be Discussed: (0,0) is top left corner, center of top left pixel, center of bottom left pixel + Y points down, Z is view direction.

Extrinsic camera parameters:

```

vec3 angles;           // camera orientation Euler angles in
degrees
vec3 center;          // center of projection

```

The Euler angles are measured counter clockwise around the X, Y and Z axis. Rotation around X is applied first, then around Y, and finally around Z. 'angles' describes the mapping from the camera frame to the world frame.

Alternatives To Be Discussed: compose Z,Y,X order, angle measured clockwise, camera orientation maps world frame to camera frame.

```
bool flipz;
```

Flag indicating whether an additional flipping of camera Z axis is necessary. False for calibrations generated according to the conventions outlined here, but may be true for calibrations generated according to other conventions.

This flag is strictly spoken redundant. The same effect could be modeled by allowing a negative aspect ratio with skew having sign reversed accordingly, and camera orientation including an additional 180 degrees rotation around the X axis.

Lens distortion: models aberration from the ideal lens models above. Parameters

```
vec2 cod; // center of distortion (image coordinates),
often equal to principal point, but may differ.
float k1, k2, k3; // radial distortion numerator. Units:
1/cm^2, 1/cm^4, 1/cm^6.
float l1, l2, l3, l4; // radial distortion denominator. Units:
1/cm, 1/cm^2, 1/cm^3, 1/cm^4
float p1, p2; // tangential (decentering) distortion.
Units: 1/cm^2
bool invertDistortion; // false: formula undistorts (default),
true: formula distorts (Heikkila, Zhang, matlab - see note below)
```

Formula:

$$(x_u, y_u) = (x, y) * \text{radial}(r) + \text{decentering}(x, y)$$

With

```
(x_u, y_u) the undistorted coordinates (would be observed with ideal
lens) relative to center of distortion
(x, y) the distorted (observed) image coordinates, w.r.t. center of
distortion
r = sqrt(x^2 + y^2) distorted image coordinate distance to center
of distortion
radial(r) = (1 + k1*r^2 + k2*r^4 + k3*r^6) / (1 + l1*r + l2*r^2 +
l3*r^3 + l4*r^4)
decentering(x, y) = (p1*B(x, y) + p2*D(x, y) , p2*C(x, y) + p1*D(x, y))
B(x, y) = 3x^2 + y^2
C(x, y) = x^2 + 3y^2
D(x, y) = 2xy
```

See note on lens distortion below.

Conversion of parameters to intrinsic and extrinsic camera matrix:

```
const mat3 toIntrinsicMatrix(float pixwidth, float fc, float aspect,
float skew, const vec2& pc, int flipz)
{
float f = fc/pixwidth*1e3; // focal length in u pixels (fc is
in mm, pixwidth in micrometers per u pixel)
float s = -tan(skew * M_PI/180.); // dimensionless geometric skew
```

```

float a = aspect; // dimensionless v : u aspect
ratio (pixheight / (pixwidth * cos(skew))
return mat3(f, f*s, flipz ? -pc[0] : pc[0],
            0, f*a, flipz ? -pc[1] : pc[1],
            0, 0, flipz ? -1.0 : 1.0);
}
const mat4 toExtrinsicMatrix(const mat3& R, const vec3& C)
{
const mat3 Rt(R.transposed());
return mat4(Rt, -(Rt*C));
}

```

Note on lens distortion:

The radial distortion numerator and decentering distortion terms are the "plumb Bob" model from

D.C. Brown, "Decentering Distortion of Lenses, Photometric Engineering", pages 444-462, Vol. 32, No. 3, 1966.

D.C. Brown, "Photogrammetric Engineering", pages 855-866, Vol. 37, No. 8, 1971.

http://www.vision.caltech.edu/bouguetj/calib_doc/papers/Brown71.pdf

The radial distortion denominator is the division model used by Scaramuzza in his omnidirectional camera calibration toolbox, which is based on Micusiks CVPR03 paper, and which is a generalisation of the single term division model introduced by Fitzgibbon:

A.W. Fitzgibbon, "Simultaneous linear estimation of multiple view geometry and lens distortion", CVPR 2001

B. Micusik, T. Pajdla. "Estimation of Omnidirectional Camera Model from Epipolar Geometry". CVPR 2003

D. Scaramuzza, A. Martinelli, R. Siegwart, "A Flexible Technique for Accurate Omnidirectional Camera Calibration and Structure from Motion", Proceedings of IEEE International Conference of Vision Systems (ICVS'06), 2006.

The formula above is applied to camera sensor plane coordinates, measured in centimeter. For cameras with rectangular pixel grid, image coordinates u' are transformed to metric sensor coordinates u'' by multiplying with pixel width and height (in cm). (u'' and u' relative to the center of distortion). In general (non-zero skew): $u'' = Au'$, with

$$A = \begin{bmatrix} w & w*s \\ 0 & w*a \end{bmatrix}$$

w = pixel width in cm, s = $-\tan(\text{skew})$, a = aspect ratio: pixel width/(pixel height * $\cos(\text{skew})$).

Measuring in centimeters, rather than millimeters or meters, yields typical distortion coefficients k and l around 0.1 ... 1.

Differences w.r.t. the often used intrinsic camera model from

J. Heikkila, O. Silven, "A Four-step Camera Calibration Procedure with Implicit Image Correction", CVPR 1997

- p_1 and p_2 are swapped

- the formula above expresses undistorted coordinates as a function of distorted ones. In the paper, the same formula is used to express distorted coefficients as a function of undistorted ones. The latter convention is also used in

Z. Zhang, A Flexible New Technique for Camera Calibration, ICCV 1999, PAMI 2000, MSR-TR-98-71

and can be traced back to:

C. C. Slama, editor. Manual of Photogrammetry. American Society of Photogrammetry, fourth edition, 1980.

The flag 'invertDistortion' indicates whether the distortion formula maps distorted points to undistorted ones (false) or undistorted to distorted ones (true).

Additional difference w.r.t. the matlab camera calibration toolbox of Bouquet, and derivatives, e.g. Svoboda's multi-camera self-calibration toolbox

http://www.vision.caltech.edu/bouquet/calib_doc/htmls/parameters.html

- in the toolbox, the formula above is applied to normalized coordinates $x_n = (1/Z) [X \ Y]^T$ of a 3D point $[X \ Y \ Z]^T$ in camera frame (projection onto $Z=1$ plane) instead of coordinates $(f/Z) [X \ Y]$ in the camera sensor plane at $Z=f$ (focal length). The units of k_1 , k_2 , k_3 , p_1 , and p_2 in matlab are f^2/mm^2 , f^4/mm^4 , f^6/mm^6 , f^2/mm^2 and f^2/mm^2 resp. If $f=10\text{mm}$ (1cm), ours and matlab's would be identical. Our convention allows to fit lens distortion parameters, or to undistort images, when not (yet) knowing focal length.

Knowledge of focal length is not always required to fit distortion parameters. We assume the size of a pixel to be known, instead.

Most often, principal point pc and center of distortion cod are taken equal, but they do not need to coincide, see for instance:

R.G. Willson and S.A. Shafer, "What is the center of the image?", CVPR 1993.

R. Hartley and S.B. Kang, "Parameter-Free Radial Distortion Correction with Center of Distortion Estimation", PAMI Vol 29 nr 8 Aug 2007, pp 1309 – 1321

8 Annex B: Definition of additional SMPTE RP210 elements

The properties from the calibration and distribution metadata sets, that are not covered by SMPTE RP210 elements are defined here as experimental elements (class 15 according to [MDict]).

Property	SMPTE Designator	Description
Calibration metadata		
Pixel height	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.01	Height of a pixel in μm
Pixel width	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.02	Width of a pixel in μm
Pixel aspect ratio	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.03	The aspect ratio, expressed as $\text{width}/(\text{height} \cdot \cos(\text{skew}))$
FlipZ	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.04	Indicates whether additional flipping of z-axis is required (bool)
Skew	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.05	Angle in degrees between x and y axis of the image coordinate system (often a skew parameter is given, which is \cos or $-\tan$ of this angle), Note: even if rectangular pixel grids are assumed, nonzero effective skew can result from calibration algorithms.
Lens model type	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.06	Models relation between image coordinates and ray directions: values:
Radial lens distortion	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.07	Expressed as division of 2 polynomials, 3 nominator , 4 denominator coefficients (7 floating point values ($\text{cm}^{[2,3,4,6]}$))
Tangential distortion	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.08	2 coefficients (floating point in cm^2)
Center of distortion	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.09	In normalised image coordinates [0;1], often coincides with principal point, but might be different
Inverted distortion representation	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.01.00.0A	Whether given parameters undistort
Distribution metadata		
Visual		
Eye order / dominance	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.01.00	For stereo content stored in an interleaved format: left/right eye first. Note: DCI compliant content is always left first.
Descriptive – General		
Checksum	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.02.00	Checksum of each asset
Size	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.02.01	Size in bytes of each asset
Descriptive - Identification		
Version	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.03.00	Cine, Airplane, iPod, Mobile, HD, SD, Home
Descriptive – Publication/Distribution		
Exclusions	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.04.00	Details of locations, areas or companies to which the Feature should not be distributed.
Live Coding Arrangements	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.04.01	Set of metadata properties describing FEC, modulation, data rate, ...
Live only	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.04.02	Flag indicating whether live content may be stored
Descriptive – Process		

Property	SMPTE Designator	Description
DCP Creator	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.05.00	Company that produced the DCP
Descriptive – Content		
Tag Line	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.02.06.00	A short statement used for marketing
Audio metadata		
3D audio recording	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.03.00.00	Whether this is a 3D audio recording or not.
Acoustics captured	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.03.01.00	Whether the recording was aimed at capturing the acoustics of a place or not. If this value is true, the properties below are required.
Excitation signal	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.03.01.01	The signal used to capture the acoustic impulse response, values are <i>sine sweep</i> or <i>MLS</i> (maximal length sequences).
Excitation signal parameters	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.03.01.02	The parameters of the excitation signal: the duration in seconds, further parameters specific to the type, e.g. for sine sweep: starting and ending frequency in Hz, type of sine sweep (logarithmic, linear).
Deconvolution method	06.0E.2B.34.01.01.01.01 0F.00.00.00.00.03.01.03	One of the following values: <i>none</i> (i.e. left for postproduction), <i>MLS standard</i> , <i>Sine sweep inversion without harmonic distortion treatment</i> , <i>Sine sweep inversion with harmonic distortion deleted</i>

9 Annex C: SMPTE 434M extensions

This section contains the extensions to the XML schema definitions needed to cover additional metadata elements in conformance with Annex C of SMPTE 434M [MXFXML].

These extensions are:

- XML representations of existing RP210 elements that are not already included in SMPTE 434M
- XML representations of the additional metadata elements defined in Annex B
- XML representation of the metadata set that holds the elements not included in the sets PictureDescriptor, SoundDescriptor or ProductionFramework

9.1 XML representation of metadata elements

This schema defines XML representations of existing RP210 elements that have not been included in SMPTE 434M as well as XML representations of the additional elements defined in Annex B.

```
<?xml version="1.0" encoding="utf-8"?>
<!-- -->
<!--2020 3D Media Extensions-->
<!--(c) 2010 JOANNEUM RESEARCH, http://www.joanneum.at/en/iis-->
<!-- -->
<!-- - -->
<!-- - -->
<xs:schema xmlns="http://www.20203dmedia.eu/xml/smp434/2010/dictionary"
  xmlns:extElements2020="http://www.20203dmedia.eu/xml/smp434/2010/dictionary"
  xmlns:s377mTypes="http://www.smpte-ra.org/schemas/434/2006/types/S377M/2004"
  xmlns:s377mGroups="http://www.smpte-ra.org/schemas/434/2006/groups/S377M/2004"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.20203dmedia.eu/xml/smp434/2010/dictionary"
  elementFormDefault="qualified" attributeFormDefault="qualified">
  <!-- - -->
  <!-- - -->
  <xs:import namespace="http://www.smpte-ra.org/schemas/434/2006/types/S377M/2004"
    schemaLocation="../../dataTypes/s377m_types.xsd" />
  <!-- - -->
  <!-- - -->
  <xs:import namespace="http://www.smpte-ra.org/schemas/434/2006/groups/S377M/2004"
    schemaLocation="../../groups/s377m_metadata.xsd" />
  <!-- - -->
  <!--Properties already existing in RP210-->
  <xs:element name="ActiveLinesPerFrame" type="s377mTypes:UInt16">
    <xs:annotation>
      <xs:documentation>Specifies the total number of lines (rows) in the active portion
        of a frame in the video pixel matrix. </xs:documentation>
      <xs:appinfo source="http://www.smpte-
        ra.org/schemas/434/Dictionary/ElementName">Active Lines per Frame</xs:appinfo>
      <xs:appinfo source="http://www.smpte-
        ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.03.02.0
        2.00.00.00</xs:appinfo>
    </xs:annotation>
  </xs:element>
  <xs:element name="ActiveSamplesPerLine" type="s377mTypes:UInt16">
    <xs:annotation>
      <xs:documentation>Total number of samples (columns) in the active portion of a
        line in the video pixel matrix.</xs:documentation>
      <xs:appinfo source="http://www.smpte-
        ra.org/schemas/434/Dictionary/ElementName">Active Samples per
        Line</xs:appinfo>
      <xs:appinfo source="http://www.smpte-
        ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.05.01.0
        2.00.00.00</xs:appinfo>
    </xs:annotation>
  </xs:element>
  <xs:element name="SignalFormCode" type="s377mTypes:ISO7bitCharString">
    <xs:annotation>
```

```

<xs:documentation>Code specifies the component sequence for the video pixel matrix
  (eg RGB, YUV etc).</xs:documentation>
<xs:appinfo source="http://www.smpte-
  ra.org/schemas/434/Dictionary/ElementName">Signal Form Code</xs:appinfo>
<xs:appinfo source="http://www.smpte-
  ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.02.01.0
  1.04.00.00</xs:appinfo>
</xs:annotation>
</xs:element>
<xs:element name="ColorimetryCode" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>The fundamental color coding that relates the scene CIE tri-
      stimulus values (X, Y, Z) to the linear video levels (R, G,
      B).</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Colorimetry Code</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.02.01.0
      1.03.00.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="CaptureAspectRatio" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>Specifies the horizontal to vertical aspect ratio of the image
      captured at the sensor - hence after the (possibly anamorphic) lens.
    </xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Capture Aspect Ratio</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.01.01.0
      2.00.00.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="FrameRate" type="s377mTypes:UInt16">
  <xs:annotation>
    <xs:documentation>The rate that video images are captured, expressed in frames per
      second.</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Frame Rate</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.03.01.0
      3.00.00.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="BitsPerSample" type="s377mTypes:UInt8">
  <xs:annotation>
    <xs:documentation>The maximum number of significant bits for the value without
      compression.</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Bits Per Sample</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.02.03.03.0
      1.00.00.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="AudioCodingSchemeName" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>Specifies the audio coding or compression scheme used as a
      name</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Audio Coding Scheme
      Name</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.03.04.02.04.02.0
      2.00.00.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="VideoClipDuration" type="s377mTypes:UInt32">
  <xs:annotation>
    <xs:documentation>The amount of time elapsed between the start of capture and the
      end of capture of the video clip.</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Video Clip Duration</xs:appinfo>

```

```

<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.07.07.02.02.01.0
2.05.00.00</xs:appinfo>
</xs:annotation>
</xs:element>
<xs:element name="ReelOrRollNumber" type="s377mTypes:ISO7bitCharString">
<xs:annotation>
<xs:documentation>An organisationally given number for a film reel or
roll.</xs:documentation>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementName">Reel or Roll Number</xs:appinfo>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.01.03.02.01.0
1.00.00.00</xs:appinfo>
</xs:annotation>
</xs:element>
<xs:element name="Genre" type="s377mTypes:ISO7bitCharString">
<xs:annotation>
<xs:documentation>Programme genre (e.g., entertainment, current affairs magazine,
Italo Western, ...)</xs:documentation>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementName">Genre</xs:appinfo>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.03.02.01.01.0
3.00.00.00</xs:appinfo>
</xs:annotation>
</xs:element>

<!--Extension properties (note: these properties have experimental KLV keys)-->
<xs:element name="EyeDominance" type="s377mTypes:UInt8">
<xs:annotation>
<xs:documentation>For stereo content stored in an interleaved format: left/right
eye first. Note: DCI compliant content is always left
first.</xs:documentation>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementName">Eye Dominance</xs:appinfo>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
0.02.01.00</xs:appinfo>
</xs:annotation>
</xs:element>
<xs:element name="Checksum" type="s377mTypes:UInt64">
<xs:annotation>
<xs:documentation>Checksum of an asset</xs:documentation>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementName">Checksum</xs:appinfo>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
0.02.02.00
</xs:appinfo>
</xs:annotation>
</xs:element>
<xs:element name="Size" type="s377mTypes:UInt64">
<xs:annotation>
<xs:documentation>Size in bytes of an asset</xs:documentation>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementName">Size</xs:appinfo>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
0.02.02.01</xs:appinfo>
</xs:annotation>
</xs:element>
<xs:element name="Version" type="s377mTypes:ISO7bitCharString">
<xs:annotation>
<xs:documentation>Cine, Airplane, iPod, Mobile, HD, SD, Home</xs:documentation>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementName">Version</xs:appinfo>
<xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
0.02.03.00</xs:appinfo>
</xs:annotation>

```

```

</xs:element>
<xs:element name="Exclusions" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>Details of locations, areas or companies to which the feature
      should not be distributed.</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Exclusions</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
      0.02.04.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="LiveCodingArrangements" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>set of metadata properties describing FEC, modulation, data
      rate, ...</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Live Coding
      Arrangements</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
      0.02.04.01</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="LiveOnly" type="s377mTypes:Boolean">
  <xs:annotation>
    <xs:documentation>Flag indicating whether live content may be
      stored</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Live Only</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.04.01.02.01.0
      1.03.00.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="DCPCreator" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>Company that produced the DCP</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">DCP Creator</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
      0.02.05.00</xs:appinfo>
  </xs:annotation>
</xs:element>
<xs:element name="TagLine" type="s377mTypes:ISO7bitCharString">
  <xs:annotation>
    <xs:documentation>A short statement used for marketing</xs:documentation>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementName">Tag Line</xs:appinfo>
    <xs:appinfo source="http://www.smpte-
      ra.org/schemas/434/Dictionary/ElementUL">06.0E.2B.34.01.01.01.01.0F.00.00.00.0
      0.02.06.00</xs:appinfo>
  </xs:annotation>
</xs:element>
</xs:schema>

```

9.2 XML representation of set for additional distribution metadata

This schema defines a metadata set to be plugged into DMS-1 production framework that holds required metadata not yet included in PictureDescriptor, SoundDescriptor or DMS-1 descriptive metadata.

```

<?xml version="1.0" encoding="utf-8"?>
<!-- -->
<!--2020 3D Media Extensions-->
<!--(c) 2010 JOANNEUM RESEARCH, http://www.joanneum.at/en/iis-->
<!-- -->
<!-- - -->
<!-- - -->

```

```

<xs:schema xmlns:extGroups2020="http://www.20203dmedia.eu/xml/smp434/2010/groups"
  xmlns="http://www.20203dmedia.eu/xml/smp434/2010/groups"
  xmlns:s335mElements="http://www.smpte-
ra.org/schemas/434/2006/properties/S335M" xmlns:s377mTypes="http://www.smpte-
ra.org/schemas/434/2006/types/S377M/2004" xmlns:s377mGroups="http://www.smpte-
ra.org/schemas/434/2006/groups/S377M/2004"
  xmlns:extElements2020="http://www.20203dmedia.eu/xml/smp434/2010/dictionary"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.20203dmedia.eu/xml/smp434/2010/groups"
  elementFormDefault="qualified" attributeFormDefault="qualified">
  <!-- - -->
  <!-- - -->
  <xs:import namespace="http://www.smpte-ra.org/schemas/434/2006/types/S377M/2004"
    schemaLocation="../dataTypes/s377m_types.xsd" />
  <!-- - -->
  <!-- - -->
  <xs:import namespace="http://www.smpte-ra.org/schemas/434/2006/properties/S335M"
    schemaLocation="../dictionary/rp210.xsd" />
  <!-- - -->
  <!-- - -->
  <xs:import namespace="http://www.smpte-ra.org/schemas/434/2006/groups/S377M/2004"
    schemaLocation="./s377m_metadata.xsd" />
  <!-- - -->
  <!-- - -->
  <xs:import namespace="http://www.20203dmedia.eu/xml/smp434/2010/dictionary"
    schemaLocation="../dictionary/dict_ext.xsd" />
  <!-- - -->
  <!-- - -->
  <!-- -->
  <!-- - -->
  <!-- - -->
  <!-- - -->
  <!-- -->
  <!-- -->
  <xs:element name="TheatreDistribution" type="extGroups2020:TheatreDistributionType">
    <xs:annotation>
      <xs:documentation>Metadata set additionally added to the DCP</xs:documentation>
      <xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Groups/Name">TheatreDistribution</xs:appinfo>
      <xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Groups/Key">06.0E.2b.34.02.53.00.00.00.00.00.00.00.0A
</xs:appinfo>
    </xs:annotation>
  </xs:element>
  <!-- -->
  <xs:complexType name="TheatreDistributionType">
    <xs:complexContent>
      <xs:extension base="s377mGroups:AbstractSetType">
        <xs:sequence>
          <!--Visual-->
          <xs:element ref="extElements2020:SignalFormCode" minOccurs="0">
            <xs:annotation>
              <xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
            </xs:annotation>
          </xs:element>
          <xs:element ref="extElements2020:ColorimetryCode" minOccurs="0">
            <xs:annotation>
              <xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
            </xs:annotation>
          </xs:element>
          <xs:element ref="extElements2020:EyeDominance" minOccurs="0">
            <xs:annotation>
              <xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
            </xs:annotation>
          </xs:element>
          <!--Descriptive-->
          <xs:element ref="extElements2020:Checksum" minOccurs="0">
            <xs:annotation>
              <xs:appinfo source="http://www.smpte-
ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>

```

```

        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:Size" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:Version" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="s335mElements:Country" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:Exclusions" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:LiveCodingArrangements" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:LiveOnly" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:DCPCreator" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:ReelOrRollNumber" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:Genre" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
    <xs:element ref="extElements2020:TagLine" minOccurs="0">
        <xs:annotation>
            <xs:appinfo source="http://www.smpte-
                ra.org/schemas/434/Groups/PropertyRequiredStatus">Opt</xs:appinfo>
        </xs:annotation>
    </xs:element>
</xs:sequence>
</xs:extension>
</xs:complexContent>
</xs:complexType>
</xs:schema>

```

10 References

- [BS06] Werner Bailer and Peter Schallauer, "The Detailed Audiovisual Profile: Enabling Interoperability between MPEG-7 Based Systems," Proceedings of 12th International Multi-Media Modeling Conference, Beijing, 2006.
- [COLL] Mark Barnes and Ellen Levy Finch (eds.), COLLADA – Digital Asset Schema Specification, Release 1.5.0, April 2008.
- [DCI] Digital Cinema Initiatives, Digital Cinema System Specification, Version 1.2, March 2008.
- [DMS1] Material Exchange Format (MXF) — Descriptive Metadata Scheme-1, SMPTE 380M-2004.
- [DPX] File Format for Digital Moving-Picture Exchange (DPX), Version 2.0, SMPTE 268M-2003.
- [EDC] EDCine Project. <http://www.edcine.org/>
- [MDict] Metadata Dictionary Structure, SMPTE 335M-2001.
- [MPEG7] Information Technology - Multimedia Content Description Interface (MPEG-7). ISO/IEC 15938:2001, International Organization for Standardization (ISO), 2001.
- [MXF] Material Exchange Format (MXF) — File Format Specification, SMPTE 377M-2004.
- [MXFGC] Material Exchange Format (MXF) — MXF Generic Container, SMPTE 379M-2004.
- [MXFXML] Material Exchange Format — XML Encoding for Metadata and File Structure Information, SMPTE 434-2006.
- [RP210] Metadata Dictionary Registry of Metadata Element Descriptions. SMPTE RP210.11, 2008.
- [X3D] Extensible 3D (X3D), ISO/IEC 19775:2004.