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Information technology — Multimedia application format (MPEG-A) —

Part 15: Multimedia preservation application format

Technologies de l'information — Format pour application multimédia (MPEG-A) —

Partie 15: Format pour application de la conservation des multimédias

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23000 consists of the following parts, under the general title *Information technology — Multimedia application format (MPEG-A)*:

— *Part 1: Purpose for multimedia application formats*

— *Part 2: MPEG music player application format*

— *Part 3: MPEG photo player application format*

— *Part 4: Musical slide show application format*

— *Part 5: Media streaming application format*

— *Part 6: Professional archival application format*

— *Part 7: Open access application format*

— *Part 8: Portable video application format*

— *Part 9: Digital multimedia broadcasting application format*

— *Part 10: Surveillance application format*

— *Part 11: Stereoscopic video application format*

— *Part 12: Interactive music application format*

— *Part 13: Augmented reality application format*

— *Part 15: Multimedia preservation application format*

— *Part 16: Publish/subscribe application format*

— *Part 18: Media linking application format*

The following part is under preparation:

— *Part 17: Multiple sensorial media application format*

Introduction

ISO/IEC 23000 (also known as "MPEG-A") is an MPEG standard that supports a fast track to standardization by selecting readily tested and verified tools taken from the MPEG body of standards and combining them to form a MAF (Multimedia Application Format). If a needed piece of technology is not provided within MPEG, then additional technologies originating from other organizations can be included by reference in order to facilitate the envisioned MAF.

The Multimedia Preservation Application Format (MP-AF ISO/IEC 23000-15) defines the Multimedia Preservation Description Information (MPDI). MPDI extends the concept of Preservation Description Information (PDI),[4] providing metadata addressing the specific requirements for preserving multimedia content.[13] MP-AF defines a metadata format that enables users to effectively exchange information (metadata) related to multimedia preservation operations and their outcomes. Typical examples include the description of integrity checking and related results, content migration from one system to another, replication of subparts or entire contents, content quality evaluation and related quality report, relationships between the source and output of any transformation process, etc. At the core of MP-AF is its data model definition provided through UML diagrams and formal descriptions and a normative XML-Schema implementation. The model has been harmonized with MPEG-21 Digital Item Declaration and the schema reuses considerable parts of existing MPEG technologies, most notably MPEG-21 and MPEG-7.

ISO/IEC 23000 also provides the industry with a coherent and consistent approach to manage multimedia preservation metadata supporting a variety of application scenarios, such a digitization, format migration, content restoration, etc. This includes various applications, hardware/software systems and processing methods used in different digital media administrative domains and being independent of technological changes.

ISO/IEC 23000 defines a data model for preservation metadata and its serialization in XML. It thus serves as an interoperable metadata format at the external interfaces of a digital preservation system. The most widely known and adopted reference model for digital preservation is the Open Archival Information System (OAIS),[4] a framework for understanding and applying concepts necessary for long-term preservation of digital information. In the following, the OAIS terminology is adopted for describing the several preservation notions addressed by MP-AF.

OAIS defines information packages (IP) at the ingest (submission – SIP) and delivery (dissemination – DIP) side of a preservation system. These packages enfold the object of digital preservation that is made up of the content items (one or more) and associated resources and metadata. Different packaging formats can serve as an implementation for the IP and the same type of wrapper could be used for submission, dissemination, as well as internal (archive) IPs. According to the OAIS guidelines, the Professional Archival Application Format (ISO/IEC 23000-6:2012, PA-AF), which has been designed to provide a standardized packaging format for digital files, fulfils the needs for a packaging format within MPEG technologies.

The basic objective of digital preservation is to enable the seamless communication of information over time and free from loss or corruption. Traditionally, this has been achieved by the conservation of physical media on which the information is inscribed and materially associated. If the physical object persists without alteration, the information remains unchanged and is being communicated to any person or system capable of receiving it.

Even if some physical change occurs, the essential characteristics of the information it carries may remain intact. For example, the ink in a textual document may have faded, but the text can remain fully readable. However, the persistence of digital information is complicated by several factors, mainly technological change. Obsolescence may make digital storage media unreadable and digital encodings indecipherable. Progress may make it desirable to use new software to process old data, but entails the risk that the output is not faithful to the source. For multimedia, the complexity is increased by the variety of formats used and the complexity introduced by the use of compression, codecs and wrappers.

For any use over time where the integrity of the data or fidelity to original properties are important, controls that are independent of the technologies used to store and process the data need to be imposed.

The foundation for such controls is Preservation Description Information (PDI[4]). PDI is metadata and contextual information that identifies what is being preserved, defines its essential properties, describes requirements for processing it, and identifies processes which generated, used or modified Digital Items as well as their results.

Many organizations collecting multimedia content, such as archives, libraries, museums, etc. already have digital preservation systems in place. These organizations have sometimes the need to exchange multimedia assets and related metadata, for example

— to exchange assets between preservation systems/repositories within the organization or with related organizations,

— to change/upgrade their preservation systems,

— to exchange content with service providers, and

— to provide preservation services for other organizations.

These exchanges need to include preservation description information that enables the receiving organization both to assess the integrity and fidelity of the assets it receives and to establish a baseline for curation and use of the assets. The description may include metadata about content, structure and quality, as well as technical, historical and editorial information, and information about property and use rights and conditions.

The following are the purposes of the MP-AF in brief:

— to enable the exchange of multimedia assets (multimedia resources plus associated metadata) between different repositories by providing interoperable preservation description information;

— to enable archive management to react to specific events and determine when preservation actions, such as migration, are needed to maintain the accessibility of preserved multimedia content;

— to enable automatic assessment of preservation strategies and their execution;

— to enable archive management to avoid corruption or loss of multimedia assets when changes are made in the hardware, software or storage media used by the archive by providing standardized descriptors to characterize multimedia assets and to describe preservation actions and outcomes for long term preservation;

— to enable producers (originators of assets to be preserved) to provide the archive with sufficient descriptive information to assess, plan for, and carry out preservation processes that maintain the integrity and fidelity of the content;

— to enable consumers who need comprehensive and interoperable preservation description information (e.g. other archives and consumers who wish to use preserved assets in the production of new ones) to receive standard preservation description information together with multimedia assets.

Information technology — Multimedia application format (MPEG-A) —

Part 15: Multimedia preservation application format

1 Scope

This part of ISO/IEC 23000 specifies the standard representation of the multimedia description information (MPDI) generated and used by an organization in the process of preserving a multimedia asset for the purpose of facilitating the exchange of multimedia content between archives or other stakeholders (e.g. publishers, broadcasters, service providers and the like), as well as subsequent preservation and use.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 15938-4:2002/Amd 1, *Audio extensions*

ISO/IEC 15938-5, *Information technology — Multimedia content description interface — Part 5: Multimedia description schemes*

ISO/IEC 15938-5:2003/Amd 5, *Quality metadata, multiple text encodings, extended classification metadata*

ISO/IEC 21000-2, *Information technology — Multimedia framework (MPEG-21) — Part 2: Digital Item Declaration*

ISO/IEC 21000-3:2003, *Information technology — Multimedia framework (MPEG-21) — Part 3: Digital Item Identification*

ISO/IEC 21000-3:2003/Amd 1, *Related identifier types*

ISO/IEC 21000-3:2003/Amd 2, *Digital item semantic relationships*

ISO/IEC 21000-5, *Information technology — Multimedia framework (MPEG-21) — Part 5: Rights Expression Language*

ISO/IEC 21000-20, *Information technology — Multimedia framework (MPEG-21) — Part 20: Contract Expression Language*

ISO/IEC 21000-21, *Information technology — Multimedia framework (MPEG-21) — Part 21: Media Contract Ontology*

ISO 15924, *Information and documentation — Codes for the representation of names of scripts*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

IEC Electropedia: available at http://www.electropedia.org/

ISO Online browsing platform: available at http://www.iso.org/obp

For the terms used in this document and not defined in this clause, please refer to the normative references.

3.1 MPEG-21 terminology

MP-AF terminology is consistent with the terminology adopted in MPEG-21. As the reader of the MP-AF specification may not be familiar with terminology from ISO/IEC 21000-2 MPEG-21 Digital Item Declaration (DID), the definitions of the following terms needed for the definition of MP-AF are included in 3.1.

3.1.1
Digital Item Identification
DII
standard (ISO/IEC 21000-3) used by MPEG-21 for identification of Digital Item and their components

3.1.2
Resource
individually identifiable asset such as a video or audio clip, an image, or a textual asset

Note 1 to entry: A resource may also potentially be a physical object (e.g. a video tape).

Note 2 to entry: All resources shall be locatable via an unambiguous address.

Note 3 to entry: The term asset in the definition has a different meaning than the MP-AF term Asset defined in 3.2.3.

3.1.3
Container
structure that allows Items and/or Containers to be grouped

Note 1 to entry: A Container itself is not an Item; containers are groupings of Items and/or Containers. *Descriptors* (3.1.6) allow for the "labelling" of Containers with information appropriate for the purpose of the grouping.

3.1.4
Item
grouping of sub-items and/or *components* (3.1.5) that are bound to relevant *Descriptors* (3.1.6)

Note 1 to entry: These descriptors contain information about the Item. An Item that contains no sub-items can be considered a whole. An Item that does contain sub-items can be considered a compilation. Items may also contain annotations to their sub-parts.

Note 2 to entry: The term Item from MPEG-21 DID is used synonymously with Digital Item in this part of ISO/IEC 23000.

3.1.5
Component
binding of a *Resource* (3.1.2) to a set of *Descriptors* (3.1.6)

Note 1 to entry: These descriptors are information concerning all or part of the specific resource instance. A Component itself is not an *Item* (3.1.4); Components are building blocks of Items. Components may be conditional (see MPEG-21 DID for details).

3.1.6
Descriptor
associates information with the enclosing entity

Note 1 to entry: This information may be a *component* (3.1.5) (such as a thumbnail of an image or a text component) or a textual statement. Descriptors may be conditional (see MPEG-21 DID for details).

3.2 MP-AF Structure terminology

3.2 introduces the terms of the relevant entities in the MP-AF data model. While 3.2 provides definitions of the terms, the entities of the model are described in 5.2 (including visualization in Figure 1).

3.2.1
Work
creation that retains intellectual or descriptive attributes independently of its manifestations

Note 1 to entry: This concept is also referred to as creation or intellectual entity in other contexts.

3.2.2
Preservation Object
combines information describing the intellectual and artistic attributes of a *Work* (3.2.1) together with Digital *Items* (3.1.4) that encode the Work

Note 1 to entry: It includes technical, descriptive and preservation metadata and any other information needed to ensure consistent and reliable access to the Digital Item(s) over time. A Preservation Object may contain Digital Items pertaining to one or more particular *Representation(s)* (3.2.5) together with information and metadata specific to that Representation. It may also contain metadata common to all Representations. A Preservation Object may contain other Preservation Objects.

3.2.3
Asset
special type of *Preservation Object* (3.2.2) describing a *Work* (3.2.1) and the associated exploitation rights belonging to a known owner

Note 1 to entry: The entity holding the rights on the digital copies may be different from the one holding the rights on the Work itself.

3.2.4
Group
logical aggregation of related Preservation Objects

Note 1 to entry: It may represent a physical or virtual collection, a bunch of *Items* (3.1.4), a shipment, etc.

Note 2 to entry: The data model supports Preservation Objects to be composed of other Preservation Objects. A Group is an aggregation of Preservation Objects, but is not a Preservation Object itself.

3.2.5
Representation
specific and complete manifestation of the *Work* (3.2.1)

Note 1 to entry: Representations may differ in terms of technical or descriptive properties while sharing the same intellectual and/or descriptive attributes of the Work (e.g. different performances of the same Work, low vs. high definition representations of a movie).

Note 2 to entry: A Representation aggregates the whole set of *Essences* (3.2.6) plus any additional metadata needed for a complete presentation of a Work.

3.2.6
Essence
manifestation of a *Work* (3.2.1) or part of a Work; refers to the metadata needed for correctly rendering media content including all associated *Components* (3.2.7)

3.2.7
Component
entity holding specific technical metadata supporting the handling of the media resource referenced by a *Media Locator* (3.2.10)

Note 1 to entry: A Component can be a File or *Bitstream* (3.2.9). It manages a (virtual/internal) file structure, multimedia resources and (optionally) referenced metadata (e.g. controlled vocabularies, taxonomies, original content or metadata files).

3.2.8
File
Component (3.2.7) materialized as a unit recognized by a computer system, subsystem, or application

3.2.9
Bitstream
Component (3.2.7) recorded as contiguous or non-contiguous data within a File

Note 1 to entry: If metadata are specific to streams or tracks (e.g. audio and video tracks of a file), Bitstream shall be used and descriptors shall be added on Bitstream level.

3.2.10
Media Locator
reference or identifier of a storage media volume, Item or part of an Item containing at least one *Component* (3.2.7)

3.3 MP-AF Description terminology

3.3.1
Common Core Metadata Set
contains basic technical and descriptive attributes, which can be easily mapped to different metadata formats in use (also outside the preservation domain)

3.3.2
Core Descriptive Metadata
basic set of editorial properties describing the Digital Item

EXAMPLE Title or subject.

3.3.3
Core Technical metadata
basic set of technical properties of the Digital Item or Component

EXAMPLE Video resolution or audio sampling rate.

3.3.4
Media
"multimedia" such as audio, video, medical imagery and the like

Note 1 to entry: When referring to the units of physical materials on which digital data are recorded, the terms "storage media" or "physical media" are used.

3.4 Multimedia Preservation Description Information (MPDI) terminology

The preservation description information (PDI) applies to multimedia assets being preserved. MPDI adapts and extends the concept of preservation description information from OAIS in order to better address the long term accessibility of multimedia assets. MPDI consists of metadata for Provenance, Context, Reference, Quality, Fixity, Integrity, Authenticity, and Rights. The requirements for MPDI are detailed in Reference [13].

3.4.1
Provenance
documents the chronology of events regarding the creation, modification, ownership and custody of a resource, such as who produced it and who has had custody since its origination; it provides information on the history of the multimedia content (including processing history).

3.4.2
Context
circumstances that resulted in the production of the resource and how the preserved resource relates to other resources

EXAMPLE It may describe why and how the resource was created, it may indicate from which resources the current one has been derived, or it may specify the relationship to other resources.

3.4.3
Reference
information that is used for identifying the multimedia resources

Note 1 to entry: It provides one or more identifiers, or systems of identifiers, by which the resources may be uniquely and persistently identified. Reference information supports the linkage of identical or related resources that might be stored in separate repositories. These repositories may use different mechanisms for identifying resources (e.g. using different standards for representing local identifiers).

3.4.4
Quality
information related to the description of the technical condition of Digital Items and resources

Note 1 to entry: This information can at least partly be automatically extracted from content with specialized tools but often requires manual revision and validation. This manual work causes considerable costs, which is an additional reason for preserving it. Quality information includes audio and visual defects and characteristics, their collocation in time and space and their severity. Additionally, structural information and technical metadata of resources in relation to relevant standards are considered. This latter kind of information is contained in media container and bitstream metadata rather than in the multimedia content itself. Finally, it is also necessary to preserve the description of the hardware devices, tools and agents used for extracting and reviewing that quality information.

3.4.5
Fixity
encompasses the information ensuring that resources (as described by their properties) are not altered in an undocumented manner

Note 1 to entry: This information is also used to verify the integrity of Digital Items. Thus, if the fixity information for an Item changes over time, the Item has changed.

3.4.6
Integrity
state of a Digital Item indicating the fact of being complete and unaltered

Note 1 to entry: It can be proven by verifying the presence of all required parts in an unaltered (i.e. not modified) state.

3.4.7
Authenticity
information to enable an Agent to verify that an object is correctly identified and free from (intentional or accidental) corruption (i.e. capable of delivering its original message)

Note 1 to entry: The Agents that issue statements about authenticity should also be correctly identified. Authenticity encompasses identity and integrity. Identity comprises all those attributes necessary to determine what a thing is (e.g. the original recording of a Work). Integrity asserts that none of those essential attributes have changed, i.e. there are no significant differences neither in the same resource over time nor between two resources thought to be copies of the same asset. While identical copies are authentic, authenticity does not require complete equivalence. Thus, a digital version of an analog original may be an authentic copy of the Work if it can be shown that the differences between the two versions are not significant, e.g. all of the content is present and is structured the same way, and all important elements or attributes, such as title, creator, performer, remain the same.

3.4.8
Rights
information concerning legal, regulatory or contractual provisions that affect ownership, control, access or use of resources insofar as they impact the long term preservation

EXAMPLE Intellectual property, copyrights, privacy, etc.

Note 1 to entry: Actions or events in the preservation of resources need to respect such rights.

3.5 MP-AF Process terminology

3.5.1
Activity
preservation action performed on at least one Digital Item or Component

Note 1 to entry: The activity is carried out by one or more *Operators* (3.5.2) known to the preservation system.

3.5.2
Operator
Agent (3.5.3) or a *Tool* (3.5.4) contributing to the execution of an *Activity* (3.5.1) by performing (part of) it or being used to perform it

3.5.3
Agent
person or legal entity (organization) involved in one or more Activities dealing with the processing of Digital Items or Components

3.5.4
Tool
device, system or software used for executing Activities dealing with the processing of Digital Items or Components

4 Abbreviated terms

AVDP	MPEG-7, Audiovisual Description Profile (ISO/IEC 15938-9:2005/Amd 1:2012)
CCDM	EBU, Conceptual Class Description Model
DID	ISO/IEC 21000-2 MPEG-21, Digital Item Declaration
DIDL	ISO/IEC 21000-2 MPEG-21, Digital Item Declaration Language
DII	ISO/IEC 21000-3 MPEG-21, Digital Item Identification
DIP	OAIS, Dissemination Information Package
EIDR	Entertainment Identifier Registry Association
EBU	European Broadcasting Union
ISAN	International Standard Audiovisual Number
MPDI	Multimedia Preservation Description Information
MP-AF	Multimedia Preservation Application Format (subject of this part of ISO/IEC 23000)
MPEG-A	ISO/IEC 23000, Application Formats
OAIS	Open Archival Information System

PA-AF	MPEG-A, Professional Archival Application Format
PDI	OAIS, Preservation Description Information
PREMIS	Preservation Metadata Maintenance Activity
PRONOM	The National Archives' technical registry (UK)
PUID	PRONOM, Persistent Unique identifier
SIP	OAIS, Submission Information Package
SMPTE	Society of Motion Picture and Television Engineers
UMID	SMPTE 330M, Unique Media Identifier
W3C	World Wide Web Consortium

5 MP-AF data model

5.1 General

The MP-AF data model allows to effectively represent all the relevant metadata for the preservation of digital objects, with specific attention to, but not limited to, multimedia, including images, graphics, video, animation, sound and text, and any combinations of those.

Clause 5 is split into the description of the logical data model (5.2) that makes use of UML diagrams and the description of MPDI descriptors (5.3). XML Schema is used to define the normative serialization of the model.

5.2 Logical data model

5.2 introduces the main entities of the MP-AF logical data model.

The definition of the elements/classes of the MP-AF data model follows the goal of maximizing interoperability and maintaining logical compatibility with existing preservation data models. This should facilitate the adoption of the MP-AF model among organizations that already use compatible models, at least for data exchange purposes, such as the migration between preservation systems (for software or hardware upgrade, for example) or for exchange between repositories.

The MP-AF data model is defined for representing the Multimedia Preservation Description Information (MPDI) needed for discovering, preserving, accessing and delivering multimedia resources. An overview of the logical data model is shown in Figure 1 represented in UML language. It is made up of entities with a <<Metadata>> stereotype, which correspond to the metadata types specified in 5.3.3.

The following subclauses describe the MP-AF Digital Item Entities (5.2.1), the MP-AF Process Entities (5.2.2), their relations to MPEG-21 DID Entities (5.2.3) and the mechanism for defining specializations of Activities and Operators (5.2.4). In each subclause, the involved part of the implementation schema are reported in specific text boxes and explained.

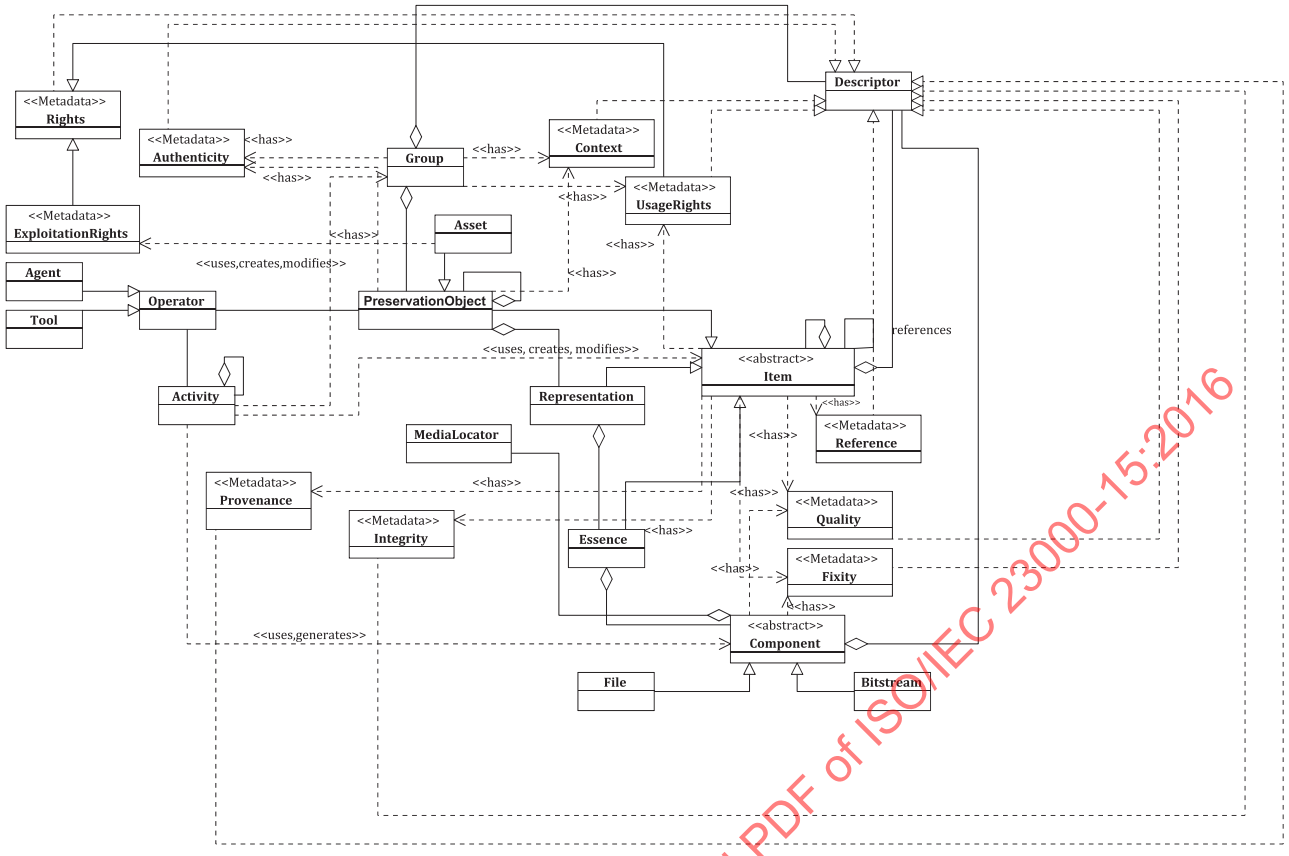

Figure 1 — UML diagram of the MP-AF data model.

5.2.1 MP-AF Digital Item Entities

The central entities in the model are those describing multimedia content. All of them are Digital Items representing the following three levels of aggregation:

— preservation object and asset;

— representation;

— essence.

Some of the entities described in 5.2.1 are based on entities defined in MPEG-21 DID. Their relation to the MPEG-21 DID entities is detailed in 5.2.3.

5.2.1.1 Digital Item

An intellectual/editorial entity to be preserved, a representation of such an entity or an essence. See 4.1.4. This entity is abstract, only its specializations may be instantiated.

5.2.1.1.1 ItemBaseType

Base type for Items described in place or references to Items. This type establishes the inheritance from MPEG-21 DID model ItemType, and serves as a common ancestor for Items described in place or being referenced. This enables Items and references to Items to be treated in the same way, thus supporting splitting the structure definition within a document or over multiple documents in order to simplify parsing the structure.

```
<complexType name="ItemBaseType" abstract="true">
  <complexContent>
   <extension base="didmodel:ItemType" />
  </complexContent>
</complexType>
```

5.2.1.1.2 ItemType

Base type for Items described in place. It is the common ancestor of all types representing content.

```
<complexType name="ItemType" abstract="true">
  <complexContent>
   <extension base="mpaf:ItemBaseType">
    <attribute name="uri" type="anyURI">
    </attribute>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
uri	URI identifying the Item. URI may be abbreviated as relative URIs, if they have the document URI as base URI.

5.2.1.1.3 ItemRefBaseType

Base type for reference to an Item.

```
<complexType name="ItemRefBaseType" abstract="true">
  <complexContent>
   <extension base="mpaf:ItemBaseType">
    <sequence />
   </extension>
  </complexContent>
</complexType>
```

5.2.1.1.4 ItemRefType

Reference to an Item. Items and references to Items can be treated in the same way, thus supporting splitting the structure definition within a document or over multiple documents in order to simplify parsing the structure.

```
<complexType name="ItemRefType">
  <complexContent>
   <extension base="mpaf:ItemRefBaseType">
    <attribute name="ref" type="anyURI">
    </attribute>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
ref	This shall reference an element in the same preservation metadata document (a relative URL may be used) or an element in another document (using an absolute URL).

5.2.1.2 Preservation Object

See 4.2.2.

Relations

— Preservation Object aggregates 0..n Preservation Objects: Preservation Objects may be recursively nested in order to express the natural structure of various types of multimedia content. In this particular case, it can be treated also as a single object (e.g. an entire audio CD vs. the tracks it contains).

— Preservation Object aggregates 0..n Representations

5.2.1.2.1 PreservationObjectType

A Preservation Object.

```
<complexType name="PreservationObjectType">
  <complexContent>
   <extension base="mpaf:ItemType">
    <sequence>
     <element name="Condition" type="didmodel:ConditionType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Choice" type="didmodel:ChoiceType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Item" type="mpaf:ItemType" minOccurs="0" maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Condition	Condition as defined by MPEG-21 DID.
Descriptor	The Descriptor(s) of the PreservationObject. See 5.2.1.11 for permitted descriptor types.
Choice	Choice as defined by MPEG-21 DID.
Item	Item may be of type PreservationObject or Representation only.

5.2.1.3 Asset

Asset is a specialization of Preservation Object, characterized by a mandatory descriptor for ExploitationRights (cf. SMPTE definition of Asset). A PreservationObject having ExploitationRights has to be represented as an Asset. See 4.2.3.

Relations

— Asset has 1..n ExploitationRights descriptors.

5.2.1.3.1 AssetType

A Preservation Object with associated exploitation rights.

```
<complexType name="AssetType">
  <complexContent>
   <restriction base="mpaf:PreservationObjectType">
    <sequence>
     <element name="Condition" type="didmodel:ConditionType" minOccurs="0"
maxOccurs="unbounded">
     </element>
```



```
      <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="1"
maxOccurs="unbounded">
      </element>
      <element name="Choice" type="didmodel:ChoiceType" minOccurs="0"
maxOccurs="unbounded">
      </element>
      <element name="Item" type="mpaf:ItemType" minOccurs="0" maxOccurs="unbounded">
      </element>
     </sequence>
     <attribute name="uri" type="anyURI">
     </attribute>
    </restriction>
  </complexContent>
</complexType>
```

Name	Definition
Condition	Condition as defined by MPEG-21 DID.
Descriptor	The Descriptor(s) of the PreservationObject. See 5.2.1.11 for permitted descriptor types. At least one ExploitationRightsDescriptor should be present.
Choice	Choice as defined by MPEG-21 DID.
Item	Item may be of type PreservationObject or Representation only.
uri	URI identifying the Asset. URI may be abbreviated as relative URIs, if they have the document URI as base URI.

5.2.1.4 Representation

See 4.2.5.

Relations

— Representation aggregates 0..n Essences

5.2.1.4.1 RepresentationType

A Representation of a Preservation Object.

```
<complexType name="RepresentationType">
  <complexContent>
   <extension base="mpaf:ItemType">
    <sequence>
     <element name="Condition" type="didmodel:ConditionType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Choice" type="didmodel:ChoiceType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Item" type="mpaf:EssenceType" minOccurs="0" maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Condition	Condition as defined by MPEG-21 DID.
Descriptor	The Descriptor(s) of the PreservationObject. See 5.2.1.11 for permitted descriptor types.
Choice	Choice as defined by MPEG-21 DID.
Item	Item shall be of type Essence.

5.2.1.5 Essence

See 4.2.6.

Relations

— Essence aggregates 0..n Components

5.2.1.5.1 EssenceType

```
<complexType name="EssenceType">
  <complexContent>
   <extension base="mpaf:ItemType">
    <sequence>
     <element name="Condition" type="didmodel:ConditionType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Choice" type="didmodel:ChoiceType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Component" type="mpaf:ComponentType" minOccurs="0"
maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Condition	Condition as defined by MPEG-21 DID.
Descriptor	The Descriptor(s) of the Essence. See 5.2.1.11 for permitted descriptor types.
Choice	Choice as defined by MPEG-21 DID.
Component	The Component(s) of the Essence.

5.2.1.6 Component

A component is the binding of a resource to a set of metadata. A component itself is not an Item; components are building blocks of Items. See 4.1.5.

This entity is abstract, only its specializations may be instantiated. File and Bitstream are specializations of Components containing Media Locators that point to digital resources or analog sources.

Relations

— Component aggregates 1..n Resources

5.2.1.6.1 ComponentType

Base type for Components.

```
<complexType name="ComponentType" abstract="true">
  <complexContent>
   <extension base="didmodel:ComponentType">
    <sequence>
     <element name="Condition" type="didmodel:ConditionType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Resource" type="mpaf:MediaLocatorType" minOccurs="1"
maxOccurs="unbounded">
```



```
      </element>
     </sequence>
     <attributeGroup ref="mpaf:ID_ATTRS" />
     <attribute name="uri" type="anyURI">
     </attribute>
    </extension>
   </complexContent>
</complexType>
```

Name	Definition
Condition	Condition as defined by MPEG-21 DID.
Descriptor	The Descriptor(s) of the Component. See 5.2.1.11 for permitted descriptor types.
Resource	The MediaLocator(s) of the component.
Uri	URI identifying the Commponent. URI may be abbreviated as relative URIs, if they have the document URI as base URI.
ID_ATTRS	

5.2.1.7 File

See 4.2.8.

5.2.1.7.1 FileType

A Component of type File.

```
<complexType name="FileType">
  <complexContent>
   <extension base="mpaf:ComponentType" />
  </complexContent>
</complexType>
```

5.2.1.8 Bitstream

See 4.2.9.

5.2.1.8.1 BitstreamType

A Component of type Bitstream.

```
<complexType name="BitstreamType">
  <complexContent>
   <extension base="mpaf:ComponentType" />
  </complexContent>
</complexType>
```

5.2.1.9 Media Locator

A reference to a (physical/digital) Resource (see 4.1.2). See 4.2.10.

5.2.1.9.1 MediaLocatorType

A Media Locator of a Component.

```
<complexType name="MediaLocatorType">
  <complexContent>
   <extension base="mpaf:ResourceBaseType" />
  </complexContent>
</complexType>
```

5.2.1.10 Group

A Container (see 4.1.3) of Preservation Objects. See 4.2.4.

5.2.1.10.1 GroupType

A group of Preservation Objects. Grouping may be nested. It adds a URI identifier to the DID model type.

```
<complexType name="GroupType">
  <complexContent>
   <extension base="didmodel:ContainerType">
    <sequence>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <choice minOccurs="1" maxOccurs="unbounded">
      <element name="Container" type="mpaf:GroupType" />
      <element name="Item" type="mpaf:PreservationObjectType" />
     </choice>
    </sequence>
    <attribute name="uri" type="anyURI">
    </attribute>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Descriptor	The Descriptor(s) of the Component. See 5.2.1.11 for permitted descriptor types.
uri	URI identifying the Group. URI may be abbreviated as relative URIs, if they have the document URI as base URI.

5.2.1.11 Descriptor

See 4.1.6.

Table 1 provides an overview indicating to which content entities each preservation metadata descriptor can apply. Descriptors not supported on an entity shall be added to the parent entity (the columns in the table are ordered from parent to child from left to right).

Descriptors are not supported on entities, when the properties being described cannot be different than for the parent entity. The Context is the same for all the constituent parts of a Preservation Object, a specific Representation or Essence cannot exist outside the context of the object. Verifying Authenticity requires at least a complete Representation, thus describing it below this level is not useful. On the level of a single File or Bitstream only Identification, Quality and Fixity may be specific; other properties are shared on Essence level. In addition, Annotations can be made on arbitrary level.

Table 1 — Usage of preservation metadata descriptors in different Digital Item and Component Entities

	Digital Item			Component
	Preservation Object	Representation	Preservation Object	Representation
Identification	+	+	+	+
Provenance	+	+	+	-
Context	+	-	-	-
Reference	+	+	+	-
Quality	+	+	+	+
Integrity	+	+	+	-
Authenticity	+	+	-	-
Fixity	+	+	+	+
Rights	+	+	+	-
Annotation	+	+	+	+

5.2.1.11.1 DescriptorBaseType

Base type for MP-AF Descriptors. This is the common ancestor of the generic MP-AF Descriptor (see below) and the specialized Descriptor types defined in 5.3.3, which constrain the Statement element to the appropriate types for each of the Descriptors.

```
<complexType name="DescriptorBaseType" abstract="true">
  <complexContent>
   <extension base="didmodel:DescriptorType">
    <sequence>
     <element name="Condition" type="didmodel:ConditionType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
    </sequence>
    <attributeGroup ref="mpaf:ID_ATTRS" />
    <attribute name="uri" type="anyURI" use="optional">
    </attribute>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Condition	Condition as defined by MPEG-21 DID.
Descriptor	Nesting of descriptors in only allowed for specific types as described in 5.3.5.
uri	URI identifying the Descriptor. URI may be abbreviated as relative URIs, if they have the document URI as base URI.
ID_ATTRS	Generic ID attribute. For compatibility with MPEG-21 DID. The use of the uri attribute to provide URIs as identifier for entities is strongly recommended.

5.2.1.11.2 DescriptorType

Type for generic MP-AF Descriptor, containing a generic MP-AF Statement. This type serves as an extension point for additional preservation descriptors not defined in this part of ISO/IEC 23000.

```
<complexType name="DescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:StatementType" minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	The DID statement containing/referencing the payload of the descriptor.

5.2.1.11.3 StatementType

Statement holding contents of a descriptor. If the descriptor is contained inline, it shall conform to the XML representation defined in this part of ISO/IEC 23000. Referenced descriptors should conform to this representation. If they use a different representation, the representation attribute shall be present. Inline descriptors and referencing are mutually exclusive, i.e. if the descriptor content is present, the ref attribute shall not be used and vice versa.

```
<complexType name="StatementType" mixed="false">
  <complexContent>
   <extension base="didmodel:StatementType">
    <attribute name="mimeType" type="string" use="required">
    </attribute>
    <attribute name="ref" type="anyURI
```

```
    </attribute>
    <attribute name="encoding" type="string">
    </attribute>
    <attribute name="contentEncoding" type="NMTOKENS">
    </attribute>
    <attribute name="representation" type="string">
    </attribute>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
mimeType	Specifies the data type of the statement as a concatenation of MIME media-type, sub-type, and parameters, as defined in IETF RFC 2045.
ref	This shall reference an element in the same preservation metadata document (a relative URL may be used) or an element in another document (using an absolute URL).
encoding	Specifies the encoding format of the statement. If the statement contains base64 encoded data, the encoding attribute shall be present and its value shall be set to base64. If the encoding attribute is not present, the data shall be unencoded.
contentEncoding	Specifies the content-encoding(s) as defined in IETF RFC 2616. A content-encoding value is used as a modifier to the MIME media-type. When present, its value indicates what additional content-encodings have been applied to the Statement.
representation	Representation of the metadata (e.g. XML schema, other documentation) of an external statement, if different from the XML format of an inline descriptor.

5.2.2 MP-AF Process Entities

Apart from the content hierarchy, the MP-AF data model provides entities for representing preservation activities. Activity represents a preservation action applied by Operators to Preservation Objects, Components or Groups. Activities may be nested and therefore, they are able to model processes, subprocesses and simple tasks as well.

Operators are persons, organizations or systems that can be instantiated as Agents (persons, organizations) or Tools (hardware devices, software applications). They are involved in a certain Activity with a specific role. Operators can have relations between them.

5.2.2.1 Activity

An action in the lifecycle of the content Item. See 4.5.1.

Relations

— Activity contains 0..n Activities, i.e. may be composed of other, more fine-grained Activities

— Activity is related to 0..n Digital Items or Components (i.e. the content or part of its metadata). At least one Digital Item or Component should be referenced by an Activity. If the Activity is modelled as a hierarchy of subactivities, the reference to Digital Items or components may be done on any level. This reference is further distinguished into the following:

  — uses: A Digital Item or Component (i.e. content or metadata) is an input to this Activity;

  — creates: A Digital Item or Component (i.e. content or metadata) is a result of this Activity;

  — modifies: A Digital Item or Component (i.e. content or metadata) is changed or amended as result of this Activity.

In the context of an Activity, a referenced Operator is further qualified by the following:

— Operator operatorOnBehalfOf 0..1 other Operators;

— Operator hasPermissions in this activity (reference to a rights statement).

5.2.2.1.1 ActivityType

An Activity in the Preservation process.

```
<complexType name="ActivityType">
  <complexContent>
   <extension base="mpaf:MPAFBaseType">
    <sequence>
     <element name="Descriptor" type="didmodel:DescriptorType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Parameters" minOccurs="0">
      <complexType>
       <sequence>
        <element name="Param" minOccurs="1" maxOccurs="unbounded">
         <complexType>
          <simpleContent>
           <extension base="string">
            <attribute name="type" type="anyURI" />
           </extension>
          </simpleContent>
         </complexType>
        </element>
       </sequence>
      </complexType>
     </element>
     <element name="Activity" type="mpaf:ActivityType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Operator" type="mpaf:OperatorRefType" minOccurs="0"
maxOccurs="unbounded">
     </element>
     <element name="Content" minOccurs="0" maxOccurs="unbounded">
      <complexType>
       <sequence>
        <choice minOccurs="0" maxOccurs="unbounded">
         <element name="Added" type="anyURI">
         </element>
         <element name="Modified" type="anyURI">
         </element>
         <element name="Removed" type="anyURI">
         </element>
        </choice>
       </sequence>
       <attribute name="ref" type="anyURI" use="required">
       </attribute>
       <attribute name="relationType" use="required">
        <simpleType>
         <restriction base="string">
          <enumeration value="uses">
          </enumeration>
          <enumeration value="creates">
          </enumeration>
          <enumeration value="modifies">
          </enumeration>
         </restriction>
        </simpleType>
       </attribute>
      </complexType>
     </element>
     <element name="Location" type="mpeg7:PlaceType" minOccurs="0">
     </element>
    </sequence>
    <attribute name="start" type="dateTime" use="optional">
    </attribute>
    <attribute name="end" type="dateTime" use="optional">
    </attribute>
    <attribute name="type" type="anyURI" use="required">
    </attribute>
    <attribute name="executed" type="boolean" default="true" use="optional">
    </attribute>
```

```
   </extension>
  </complexContent>
</complexType>
```

NOTE As other types introduced by MP-AF, `ActivityType` is derived from the base class `MPAFBaseType`, which is explained in 5.3.2.

Name	Definition
`Descriptor`	The descriptor(s) of the Activity, providing an entry point for custom extensions.
`Parameters`	Container of a name/value list of parameters of the Activity.
`Param`	Parameter containing a type and a value.
`type`	Type of the parameter shall be a reference to a term in a controlled vocabulary. Preferably use the recommended taxonomy indicated in Annex C.
`Activity`	List of Sub-Activities of the Activity.
`Operator`	Reference to Operators involved in completing the Activity.
`Content`	Reference the modified, added or removed items, components or descriptors.
`Added`	Item, Component or Descriptor being added as a result of the Activity.
`Modified`	Item, Component or Descriptor being modified as a result of the Activity.
`Removed`	Item, Component or Descriptor being removed as a result of the Activity.
`ref`	Reference to the Item or Component to which the Activity is applied. This shall reference an element in the same preservation metadata document (a relative URL may be used), or an element in another document (using an absolute URL).
`relationType`	Type of relation between the Item or Component and the Activity.
`Location`	Location where the Activity is performed.
`start`	Start date/time of the Activity.
`end`	End date/time of the Activity.
`type`	Reference to a unique identifier of the type of Activity.
`executed`	Whether the Activity has actually been executed (in contrast to only planned).

5.2.2.2 Operator

An entity contributing to the completion of an Activity by performing (part of) it or being used to perform it. See 4.5.2. This entity is abstract, only its specializations may be instantiated.

Relations

— Operator performs 0..n Activities, the type of involvement is further specified by the Operator's role attribute.

5.2.2.2.1 OperatorType

Base type of Operator.

```
<complexType name="OperatorType" abstract="true">
  <complexContent>
   <extension base="mpaf:MPAFBaseType">
    <sequence>
     <element name="Descriptor" type="didmodel:DescriptorType"
      minOccurs="0" maxOccurs="unbounded">
     </element>
    </sequence>
    <attribute name="type" type="anyURI" use="required">
    </attribute>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Descriptor	The descriptor(s) of the Operator, providing an entry point for custom extensions.
type	A reference to a unique identifier of the type of the operator. Preferably use the recommended taxonomy indicated in Annex C.

5.2.2.2.2 OperatorRefType

Reference to an Operator specifying its role in the context of the relation being described.

```
<complexType name="OperatorRefType">
  <simpleContent>
   <extension base="anyURI">
    <attribute name="role" type="anyURI" use="optional">
    </attribute>
    <attribute name="operatorOnBehalfOf" type="anyURI" use="optional">
    </attribute>
    <attribute name="hasPermission" type="anyURI" use="optional">
    </attribute>
   </extension>
  </simpleContent>
</complexType>
```

Name	Definition
role	The role of the Operator in the context of the relation being described. Preferably use the recommended taxonomy indicated in Annex C.
operatorOnBehalfOf	Reference to another Operator, which controls, invokes or uses the Operator being described.
hasPermission	Reference to a rights statement describing rights of the Agent in the context of the preservation Activity.

5.2.2.3 Agent

A person or organization involved in performing an activity, a specialization of Operator. See 4.5.3.

5.2.2.3.1 AgentType

Compatible with MPEG-7 AgentType, defined as specialization of Operator.

```
<complexType name="AgentType" abstract="true">
  <complexContent>
   <extension base="mpaf:OperatorType" />
  </complexContent>
</complexType>
```

5.2.2.3.2 PersonType

Compatible to MPEG-7 PersonType.

```
<complexType name="PersonType">
  <complexContent>
   <extension base="mpaf:AgentType">
    <sequence>
     <choice maxOccurs="unbounded">
      <element name="Name" type="mpeg7:PersonNameType" />
      <element name="NameTerm" type="mpeg7:ControlledTermUseType" />
     </choice>
     <element name="Affiliation" minOccurs="0" maxOccurs="unbounded">
      <complexType>
       <choice>
        <element name="Organization" type="mpeg7:OrganizationType" />
        <element name="PersonGroup" type="mpeg7:PersonGroupType" />
       </choice>
      </complexType>
     </element>
     <element name="Citizenship" type="mpeg7:countryCode" minOccurs="0"
```

```
        maxOccurs="unbounded" />
     <element name="Address" type="mpeg7:PlaceType" minOccurs="0" />
     <element name="ElectronicAddress" type="mpeg7:ElectronicAddressType"
minOccurs="0"maxOccurs="unbounded" />
     <element name="PersonDescription" type="mpeg7:TextualType"
        minOccurs="0" />
     <element name="Nationality" type="mpeg7:countryCode"
        minOccurs="0" />
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

5.2.2.3.3 PersonGroupType

Compatible to MPEG-7 PersonGroupType.

```
<complexType name="PersonGroupType">
  <complexContent>
   <extension base="mpaf:AgentType">
    <sequence>
      <element name="Name" minOccurs="0" maxOccurs="unbounded">
       <complexType>
        <simpleContent>
         <extension base="mpeg7:TextualType">
          <attribute name="type" use="optional">
           <simpleType>
            <restriction base="NMTOKEN">
             <enumeration value="former" />
             <enumeration value="variant" />
             <enumeration value="main" />
            </restriction>
        </simpleType>
          </attribute>
         </extension>
        </simpleContent>
       </complexType>
      </element>
      <element name="NameTerm" minOccurs="0" maxOccurs="unbounded">
       <complexType>
        <complexContent>
         <extension base="mpeg7:ControlledTermUseType">
          <attribute name="type" use="optional">
           <simpleType>
            <restriction base="NMTOKEN">
             <enumeration value="former" />
             <enumeration value="variant" />
             <enumeration value="main" />
            </restriction>
           </simpleType>
          </attribute>
         </extension>
        </complexContent>
       </complexType>
      </element>
      <element name="Kind" type="mpeg7:TermUseType" minOccurs="0" />
      <element name="Member" type="mpeg7:PersonType" minOccurs="0"
maxOccurs="unbounded" />
      <element name="Address" type="mpeg7:PlaceType" minOccurs="0" />
      <element name="ElectronicAddress" type="mpeg7:ElectronicAddressType"
minOccurs="0" />
     </sequence>
    </extension>
   </complexContent>
</complexType>
```

5.2.2.3.4 OrganizationType

Compatible to MPEG-7 OrganisationType.

```
<complexType name="OrganizationType">
  <complexContent>
   <extension base="mpaf:AgentType">
    <sequence>
     <element name="Name" minOccurs="0" maxOccurs="unbounded">
      <complexType>
       <simpleContent>
        <extension base="mpeg7:TextualType">
         <attribute name="type" use="optional">
          <simpleType>
           <restriction base="NMTOKEN">
            <enumeration value="former" />
            <enumeration value="variant" />
            <enumeration value="main" />
           </restriction>
          </simpleType>
         </attribute>
        </extension>
       </simpleContent>
      </complexType>
     </element>
     <element name="NameTerm" minOccurs="0" maxOccurs="unbounded">
      <complexType>
       <complexContent>
        <extension base="mpeg7:ControlledTermUseType">
         <attribute name="type" use="optional">
          <simpleType>
           <restriction base="NMTOKEN">
            <enumeration value="former" />
            <enumeration value="variant" />
            <enumeration value="main" />
           </restriction>
          </simpleType>
         </attribute>
        </extension>
       </complexContent>
      </complexType>
     </element>
     <element name="Kind" type="mpeg7:TermUseType" minOccurs="0" />
     <element name="Contact" type="mpeg7:AgentType" minOccurs="0"
        maxOccurs="unbounded" />
     <element name="Address" type="mpeg7:PlaceType" minOccurs="0" />
     <element name="ElectronicAddress" type="mpeg7:
        ElectronicAddressType" minOccurs="0" />
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

5.2.2.4 Tool

A device or software involved in performing an activity, a specialization of Operator. See 4.5.4.

5.2.2.4.1 ToolType

A Tool and its parameters.

```
<complexType name="ToolType">
  <complexContent>
   <extension base="mpaf:OperatorType">
    <sequence>
     <element name="Name" type="mpeg7:TextualType" minOccurs="0" maxOccurs="unbounded">
     </element>
     <element name="Manufacturer" type="mpeg7:ControlledTermUseType"
minOccurs="0"maxOccurs="unbounded">
     </element>
     <element name="Version" type="string" minOccurs="0">
     </element>
     <element name="Parameters" minOccurs="0">
      <complexType>
```

```
        <sequence>
         <element name="Param" minOccurs="1" maxOccurs="unbounded">
          <complexType>
           <simpleContent>
            <extension base="string">
             <attribute name="type" type="anyURI" />
            </extension>
           </simpleContent>
          </complexType>
         </element>
        </sequence>
       </complexType>
      </element>
     </sequence>
     <attribute name="information" type="anyURI" use="optional" />
     <attribute name="license" type="anyURI" use="optional" />
    </extension>
   </complexContent>
</complexType>
```

Name	Definition
Name	The name of the Tool.
Manufacturer	The manufacturer of the Tool, providing a reference to a unique identifier.
Version	The version identifier of the Tool.
Parameters	A container of a name/value list of parameters of the Tool.
Param	A parameter containing a type and a value.
type	The type of the parameter shall be a reference to a term in a controlled vocabulary. Preferably use the recommended taxonomy indicated in Annex C.
information	A reference to a source of additional information about the tool.
license	A reference to a source describing the license of the tool.

5.2.3 Relation to MPEG-21 DID Entities

The MP-AF data model is represented based on the MPEG-21 Digital Item Declaration (DID) Model.

Table 2 lists the MP-AF entities that are defined as specializations of corresponding entities of the DID data model.

Table 2 — Specialization relation between MP-AF and MPEG-21 DID Model entities

MP-AF Model Entity	DID Model Entity
Container	Container
Item	Item
Component	Component
Descriptor	Descriptor
Media Locator (via ResourceType and ResourceBaseType)	Resource
Statement	Statement

In addition, the Condition entity defined in the DID data model is included in MP-AF for compatibility reasons and no specializations are defined.

Figure 2 shows the relation of the MPEG-21 entities (highlighted) with some of the core entities of the MP-AF model. The Descriptors contain a Statement element according to MPEG-21 DID, which holds the actual metadata content or references it. Statements are not shown in the diagram.

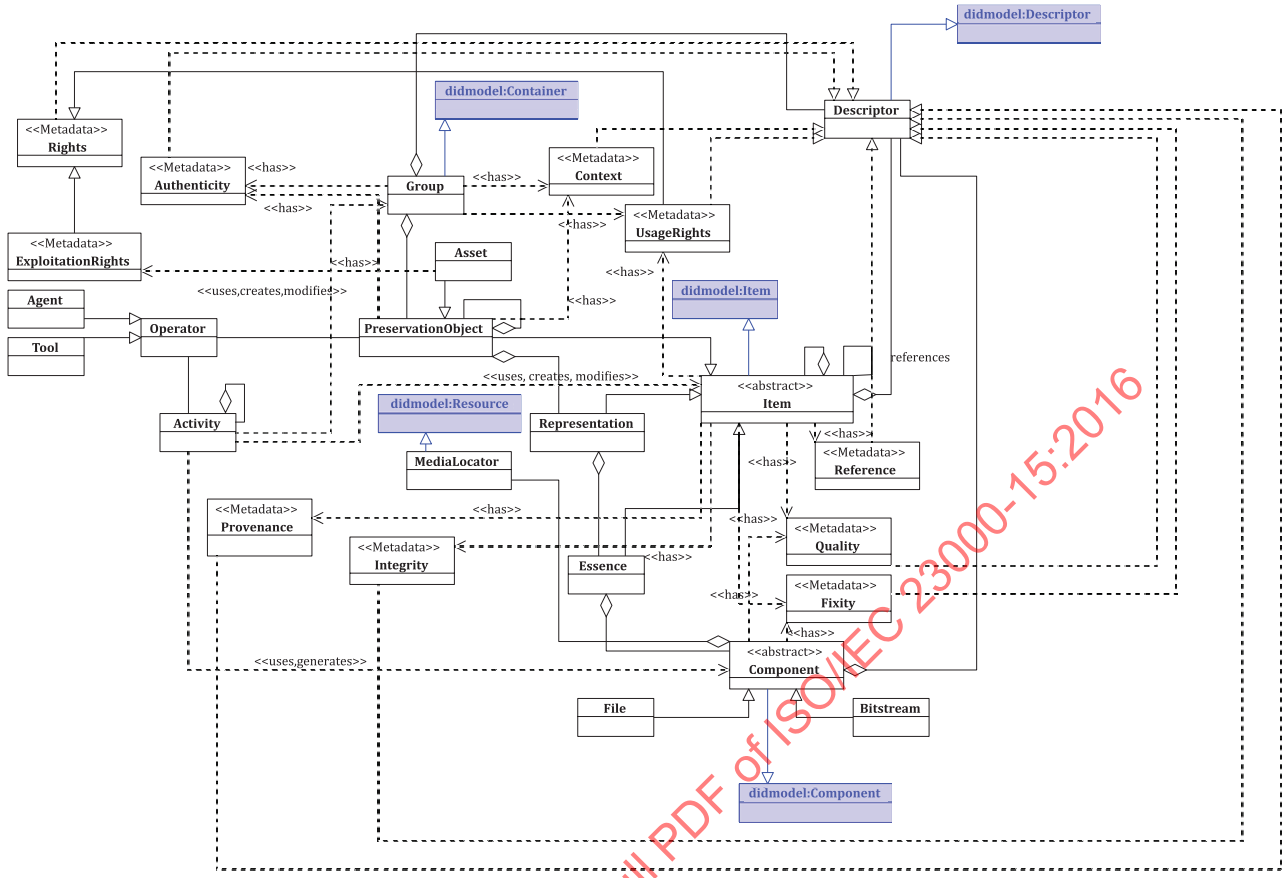

Figure 2 — The MP-AF data model and relations to MPEG-21 elements (highlighted).

The relationships between the entities of MP-AF data model and other metadata models (PREMIS, EBU CCDM MPEG-21 MVCO, and W3C Provenance) are shown in Annex B.

5.2.4 Specific subclasses of Activity and Operator

5.2.4 defines the mechanism to define subclasses of the Activity and Operator entities of the MP-AF data model.

Rather than adding further specializations as classes to the model, Activities and Operators have a type attribute that points to a controlled vocabulary of subclasses of this entity. The controlled vocabulary should be hierarchical. The hierarchy ensures that in the case when an unknown activity type occurs, this can be logically assigned to an upper level of the hierarchy.

The controlled vocabularies should be represented in a standard format such as MPEG-7 Classification Schemes or in W3C Simple Knowledge Organization Scheme (SKOS).[11] Recommended controlled vocabularies are defined in Annex C.

The properties of Activity and Operator entities are specified in 6.2.2 where three examples involving the activities of videotape migration to file, automatic and assisted quality control are provided. In the following, a simplified example that shows the use of the type attribute to specialize activities is provided.

```
<Activity id="a1"
type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa09"
   start="2014-07-01T10:05:00" end="2014-07-01T11:10:00" executed="true">
      <.../>
</Activity>
<Operator xsi:type="mpaf:ToolType"
      type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt07"
      uri="http://myvocabulary.org/qcfarm/taperecorder1">
      <.../>
</Operator>
```

Figure 3 — XML snippet showing the use of type attribute to specialize activity

5.3 Implementation of the MP-AF data model

5.3 describes in detail the implementation of the MP-AF data model through XML schema technology.

Some of the metadata are already covered by the entities of the MP-AF data model in 5.2, while MPDI specific descriptors are described in 5.3.3.

5.3.1 Implementation of structure

The MP-AF data model is represented using the XML schema defined in Annex A. The schema makes use of the core entities of the MPEG-21 DID model and the content hierarchy of the MP-AF model is represented by the hierarchy of the MPEG-21 Digital Items. Non-content classes and specializations of Digital Item are defined as types in the MP-AF schema.

This approach provides compatibility with the DID model structure, e.g. used in PA-AF. The conformance of MP-AF document instances to MPEG-21 DID is described in 7.4.

5.3.2 Top-level elements

The root element is `DIDL`, compatible with the MPEG-21 DIDL root element. It shall contain a single Container or Item element (or their respective specializations).

In addition, the root element may contain a `DIDLInfo` element, which holds a list of process entities, i.e. Activities and Operators. It is recommended to use this element to contain process entities related to multiple Digital Items in the document. Activities and Operators related to individual entities should be represented or referenced in a `ProvenanceDescriptor` (see 5.3.3.1.5).

5.3.2.1 MPAFBaseType

Abstract base type for types introduced in MP-AF that have no base type from the MPEG-21 DID model. It carries identifier attributes.

```
<complexType name="MPAFBaseType" abstract="true">
  <attributeGroup ref="mpaf:ID_ATTRS" />
  <attribute name="uri" type="anyURI" use="required">
  </attribute>
</complexType>
```

Name	Definition
`uri`	A URI identifying the MP-AF entity. URI may be abbreviated as relative URIs, if they have the document URI as base URI.
`ID_ATTRS`	Generic ID attribute. For compatibility with MPEG-21 DID. The use of the uri attribute to provide URIs as identifier for entities is strongly recommended instead of using ID_ATTRS.

5.3.2.2 PreservationMetadataType

Root element type of an MP-AF document. It shall contain one Item or Group.

```
<complexType name="PreservationMetadataType">
  <sequence>
   <element name="DIDLInfo">
    <complexType>
     <sequence>
      <element name="ProcessEntities">
       <complexType>
        <choice minOccurs="0" maxOccurs="unbounded">
         <element name="Operator" type="mpaf:OperatorType" />
         <element name="Activity" type="mpaf:ActivityType" />
        </choice>
       </complexType>
      </element>
     </sequence>
    </complexType>
   </element>
   <choice minOccurs="1">
    <element name="Container" type="mpaf:GroupType">
    </element>
    <element name="Item" type="mpaf:ItemType">
    </element>
   </choice>
  </sequence>
</complexType>
```

Name	Definition
DIDLInfo	Global process entity definitions. The element is named DIDLInfo for compatibility with MPEG-21 DIDL.
ProcessEntities	Process entities (Operators, Activities) not specific to one Item in the description.
Operator	
Activity	
Container	A container holding the Items being described.
Item	The root Item being described.

```
<DIDLInfo>
  <ProcessEntities>
    <!-- List of Tools and Devices involved) -->
    <Operator xsi:type="mpaf:ToolType" type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt07"
uri="http://identifiers.rai.it/digimaster/line1/taperecorder1">
      <Descriptor xsi:type="mpaf:DescriptiveMetadataDescriptorType">
        <Statement xsi:type="mpaf:DublinCoreDMStatementType" mimeType="text/xml">
          <dc:description>The model of video recorder (with eVTR extension), used for digitization
</dc:description>
        </Statement>
      </Descriptor>
      <Name>Sony MSW-A2000</Name>
      <Manufacturer href="http://www.sony.it/"/>
    </Operator>
    <Operator xsi:type="mpaf:ToolType" type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt09"
uri="http://identifiers.rai.it/digimaster/line1/cleaner1">
      <Descriptor xsi:type="mpaf:DescriptiveMetadataDescriptorType">
        <Statement xsi:type="mpaf:DublinCoreDMStatementType" mimeType="text/xml">
          <dc:description>Cleaner for Betacam tapes, manufactured by Indelt</dc:description>
        </Statement>
      </Descriptor>
      <Name>TC-matic</Name>
      <Manufacturer href="http://www.indelt.it/"/>
    </Operator>
    <!-- List of Agents involved (persons)  -->
        <!-- This is the person responsible for checking and preparing the physical media before actual
digitization-->
    <Operator xsi:type="mpaf:PersonType" uri="http://identifiers.rai.it/digimaster/humanresources/p6789"
type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat10">
      <Descriptor xsi:type="mpaf:DescriptiveMetadataDescriptorType">
        <Statement xsi:type="mpaf:DublinCoreDMStatementType" mimeType="text/xml">
          <dc:description>Media Preparation Expert</dc:description>
        </Statement>
      </Descriptor>
      <Name>
        <mpeg7:FamilyName>Gennaro</mpeg7:FamilyName>
        <mpeg7:GivenName>Verdi</mpeg7:GivenName>
      </Name>
    </Operator>
    <!-- List of Activities in the process -->
    <Activity type=" urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa78"
uri="http://identifiers.rai.it/digimaster/activites/a1" start="2014-07-01T08:03:00" end="2014-07-
01T08:15:00" executed="true">
      <Descriptor xsi:type="mpaf:DescriptiveMetadataDescriptorType">
        <Statement xsi:type="mpaf:DublinCoreDMStatementType" mimeType="text/xml">
          <dc:description>
             Carrier Assessment and Preparation
             Checks the physical conditions of the media and prepares it for the following steps.
             </dc:description>
        </Statement>
      </Descriptor>
      <!-- Points to the operator previously defined, role is simply Execution-->
      <Operator
role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://identifiers.rai.it/digimaster/humanresources/p6
789</Operator>
    </Activity>
    <!-- This activity is automatic, then no Agents are directly involved-->
    <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa07"
uri="http://identifiers.rai.it/digimaster/activites/a2.2" start="2014-07-01T10:05:00" end="2014-07-
01T11:10:00" executed="true">
      <Descriptor xsi:type="mpaf:DescriptiveMetadataDescriptorType">
        <Statement xsi:type="mpaf:DublinCoreDMStatementType" mimeType="text/xml">
          <dc:description>
                 DIGITIZATION
                 This activity consists in the migration of content from the tape to a master MXF-D10 file
            </dc:description>
        </Statement>
      </Descriptor>
      <!-- Points to the operator previously defined-->
      <Operator>http://identifiers.rai.it/digimaster/line1/taperecorder1
</Operator>
    <!-- Pointer to the original tape (ref is used in a Item of type RepresentationType  below)-->
      <Content relationType="uses" ref="http://identifiers.rai.it/archive/rome/tapes/01+IDTECA+NUMSUPP"/>
      <!-- pointer to the master file coming out from digitization -->
      <Content relationType="creates" ref="http://identifiers.rai.it/archive/masterfile/01+IDTECA+NUMSUPP"/>
      <!-- pointer to the external file containing the RF measures of chrominance and luminance envelopes-->
      <Content relationType="creates" ref="http://identifiers.rai.it/archive/RFmeasures/01+IDTECA+NUMSUPP"/>
    </Activity>
  </ProcessEntities>

</DIDLInfo>
```


Figure 4 — XML snippet showing the use of DIDLInfo, containing Operators and Activities

5.3.3 Implementation of Specific Descriptor Types of Preservation Metadata

5.3.3 describes how MPDI metadata are modelled through dedicated Descriptors. Those Descriptors follow the MPEG-21 DID standard as they contain a Statement holding the metadata in a specified representation. The metadata can be inline or contained in an external file.

Some Descriptors support different metadata representations (e.g. MPEG-7, DublinCore or EBUCore, MPEG-21 CEL or MPEG-21 MCO). In this case, multiple types of Statements for the Descriptor are defined, which can be used alternatively.

Descriptors and contained Statements are modelled as specializations of MPEG-21 DID Descriptors and Statements. Thus, the `mimeType` attribute of Statements is mandatory and the Statement shall either contain the content of the description or provide a reference to the content of the description using the `ref` attribute. If the content of the description is inline for the descriptors specified below, the value of `mimeType` shall be one of `application/xml`, `text/xml`, `application/rdf+xml`, `application/owl+xml`, `application/json`.

Figure 5 shows an example of DescriptiveMetadataDescriptor making use of DubiInCoreDMStatementType and reporting basic descriptive metadata about a Digital Items like title, creator, publisher, etc. Descriptors created by Activities can be referred from the Activity using the `uri` attribute of the Descriptor. Within the Activity, the descriptor is referenced using a Content element with a correspondent `ref` attribute.

```
<Descriptor xsi:type="mpaf:DescriptiveMetadataDescriptorType">
      <Statement xsi:type="mpaf:DublinCoreDMStatementType "
mimeType="text/xml">
            <dc:title xml:lang="IT">ProgrammeA</dc:title>
            <dc:language>IT</dc:language>
            <dc:creator>Rai</dc:creator>
            <dc:publisher>Rai</dc:publisher>
            <dc:type>fiction</dc:type>
            <dc:description>Rai internal production</dc:description>
      </Statement>
</Descriptor>
```

Figure 5 — Snippet of an XML instance showing a descriptive metadata Descriptor making use of DublinCore

5.3.3.1 Provenance

Provenance metadata consists of identification, relationship and process metadata. These aspects are covered by the Descriptors defined in this Clause. The Provenance Descriptor serves as a container for defining Operators and Activities, which can then be cross-linked with Digital Items.

5.3.3.1.1 Identification and description

A specific Identification Descriptor is defined in MP-AF, holding an identifier with a specification of the type of identification system used. In addition, Item identification and description are supported by elements from MPEG-21 DII and can be included in descriptors. An informative list of organizations/registries for identifiers is given in Annex C.

5.3.3.1.2 IdentificationDescriptorType

Descriptor holding an Identifier.

```
<complexType name="IdentificationDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
```

```
      <element name="Statement" type="mpaf:IdentificationStatementType"
        minOccurs="1">
      </element>
     </sequence>
    </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	The DID statement containing/referencing the payload of the descriptor.

5.3.3.1.3 IdentificationStatementType

Statement holding an Identifier.

```
<complexType name="IdentificationStatementType">
  <complexContent>
   <extension base="mpaf:StatementType">
    <sequence>
     <element name="Identifier" type="mpaf:IdentifierType" minOccurs="0"
       maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Identifier	One or more identifiers of the entity being described.

```
<Descriptor xsi:type="mpaf:IdentificationDescriptorType">
       <Statement mimeType="text/xml">
              <Identifier type="UMID">00000800.46b1.e8f1.d81d1300.36700580</Identifier>
       </Statement>
</Descriptor>
```

Figure 6 — XML snippet showing identification metadata

5.3.3.1.4 Relationships

Basic support for structural relationships between the Items is provided by the Digital Item structure.

MP-AF adopts ISO/IEC 21000-3:2003/Amd 1 for expressing relations between Digital Items. The MPEG-21 Digital Item Semantic Relationships (ISO/IEC 21000-3:2003/Amd 2) provides a basic set of relationships between Digital Items. A further controlled vocabulary is described in Annex C.

Specializations of relationships are derivation relationships, expressing relations where Digital Items are derived from other Digital Items (e.g. by creating proxies).

```
<Descriptor xsi:type="mpaf:ContextDescriptorType">
       <Statement mimeType="text/xml">
              <Reference>
                <Relation relationshipType=" urn:mpeg:maf:cs:preservation:RelationshipCS:2015:rs02"/>
                     <Description xsi:type="mpeg7:TextualType">The overall context is the RAI
DigiMaster project dealing with the migration of media carriers to master high quality MXF
files</Description>
              </Reference>
       </Statement>
</Descriptor>
```

Figure 7 — Snippet of an XML instance showing a Relation used within a Context Descriptor

5.3.3.1.5 Processes

For the representation of preservation processes applied to Digital Items, Components and Groups, the Activity and Operator entities are defined as part of the core MP-AF data model. These entities are defined to ensure maximum compatibility with the corresponding entities in PREMIS, EBU CCDM, W3C PROV and BPMN.[6]

As part of the preservation metadata of a multimedia asset, the history of creation and processing steps applied, as well as their parameters, are described. This representation thus differs from process model representations including branching and options. The processing log describes what actually happened with a Digital Item, i.e. it is a linear sequence of activities, with the option to add a hierarchy for grouping activities. The descriptions of activities in the model uses a set of specific types (e.g. digitization, with possible further specialization film scanning), in order to improve interoperability between preservation systems. In a similar way, types of tools/devices being operators in these activities are identified. In addition, parameters of tools/devices are represented in a key/value structure, with a set of defined keys for the most important properties are specified.

The description of planned activities, or activities that were planned, but not executed, is supported.

The description of environments related to the execution of processes can be implemented by context descriptors referencing external environment metadata.

Provenance can be described using identification (and description), relationships and processes. Hence, the MP-AF `ProvenanceDescriptor` supports these elements represented by Activities and Operators.

A `ProvenanceDescriptor` contains one `ProvenanceStatement`, which holds a list of zero or more Activities and Operators. Provenance can be described by linking these entities appropriately with content entities.

It is recommended to use this descriptor for Activities and Operators related only to the Digital Item being described. Otherwise, the list of process entities contained in the `DIDLInfo` element should be used.

Possible taxonomies for activities, tools and parameters are described in Annex C.

5.3.3.1.6 ProvenanceDescriptorType

Descriptor for provenance metadata. This descriptor is used to hold the Activities and Operators needed for describing the processes applied to the Digital Item. Note that it is not used to describe the parts or components of the Digital Item, this is done by the hierarchy of Digital Items. In addition, the Integrity Description (see 5.3.3.5) can be used to list the resources to be considered during integrity checking.

```
<complexType name="ProvenanceDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:ProvenanceStatementType"
      minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
`Statement`	The DID statement holding/referencing the payload of the descriptor. The DID statement carrying the provenance information (either in embedded form or by using referencing mechanism).

5.3.3.1.7 ProvenanceStatementType

Description statement for provenance metadata. Holds activities and operators that are only used in the context of the Item being described.

```
<complexType name="ProvenanceStatementType">
  <complexContent>
   <extension base="mpaf:StatementType">
    <sequence>
     <element name="Operator" type="mpaf:OperatorType" minOccurs="0"
       maxOccurs="unbounded">
     </element>
     <element name="Activity" type="mpaf:ActivityType" minOccurs="0"
       maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Operator	A list of Operators working on the Item being described.
Activity	A list of Activities applied to the Item being described.

5.3.3.2 Reference

The structure based on MPEG-21 provides sufficient capabilities for Item identification, supporting multiple identifiers, qualified by type.

In order to support the description of linked resources, a ReferenceDescriptor is defined. It connects elements and their aggregations to other resources, either local or distributed. The ReferenceDescriptor is based on MPEG-21 DII, which supports Item identification by qualified types.

The MP-AF ReferenceDescriptor contains one RelationStatement with one RelatedIdentifier element from ISO/IEC 21000-3:2003/Amd 1.

5.3.3.2.1 ReferenceDescriptorType

Descriptor for reference metadata.

```
<complexType name="ReferenceDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:RelationStatementType"
       minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	A DID statement holding/referencing the payload of the descriptor.

5.3.3.2.2 RelationStatementType

Description for relation metadata, holding identifiers of related entities.

```
<complexType name="RelationStatementType" mixed="false">
  <complexContent mixed="false">
   <extension base="mpaf:StatementType">
    <sequence>
     <element ref="dii:RelatedIdentifier" minOccurs="0">
     </element>
    </sequence>
```

```
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Related Identifier	The identifier of the related entity.

5.3.3.2.3 DerivationRelationStatementType

Description for describing derivation relations between Items (e.g. migration). It contains the identifier of the Item from which the one described has been derived.

```
<complexType name="DerivationRelationStatementType" mixed="false">
  <complexContent mixed="false">
   <extension base="mpaf:RelationStatementType" />
  </complexContent>
</complexType>
```

```
<Descriptor xsi:type="mpaf:ReferenceDescriptorType"
       uri="http://identifiers.rai.it/archive/cleaningReports/01+IDTECA+NUMSUPP">
              <Statement xsi:type="mpaf:RelationStatementType" mimeType="text/xml"
              xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS">
                   <dii:RelatedIdentifier>01+IDTECA+NUMSUPP.cleanreport.xml
                   </dii:RelatedIdentifier>
              </Statement>
</Descriptor>
```

Figure 8 — XML snippet showing a Reference to an external file created during the process by a Betacam tape cleaning device

5.3.3.3 Context

Context represents information about the purpose of preservation (e.g. project and preservation program). Relationships represent relations between different Digital Items, while Context includes relations to any type of related resource.

As ISO/IEC 21000-3/Amd 1 and ISO/IEC 21000-3/Amd 2 only specify relations between Digital Items, thus they are not applicable for referring to external documents. The MP-AF model thus adds an element to refer to external resources. The type of relationship is defined by using controlled vocabularies (e.g. using URI identifying items in a taxonomy, see also Annex C).

Context information describes the purpose of preservation and provides the relationships between the current preservation object and every related resource. MP-AF supports references to related Items and textual information about their context.

This mechanism can also be used to reference playback/edit environment descriptions in external formats, e.g. PREMIS. For example, a PREMIS document may be part of the preservation package, and the respective elements of the description can be referenced using a context descriptor.

The context descriptor can also be used to reference process models (e.g. BPMN models) of the preservation processes applied.

A `ContextDescriptor` contains one `ContextStatement`, which holds at least one `Reference` element. Each `Reference` is specified by the following:

— a relation, with a URI as target and a URI from a controlled vocabulary specifying the relation type (compatible to `RelatedIdentifier` from ISO/IEC 21000-3/Amd 1); a recommended controlled vocabularies for relations is described in Annex C;

— zero or more labels (free text);

— zero or more descriptions (free text).

5.3.3.3.1 ContextDescriptorType

Descriptor for context metadata.

```
<complexType name="ContextDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:ContextStatementType" minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	The DID statement holding/referencing the payload of the descriptor.

5.3.3.3.2 RelatedEntityType

Compatible to DII RelatedIdentifier, but with more general semantics (i.e. referring to any type of entity, not just Items). The content holds the target of the reference.

```
<complexType name="RelatedEntityType">
  <simpleContent>
   <extension base="anyURI">
    <attribute name="relationshipType" type="anyURI">
    </attribute>
   </extension>
  </simpleContent>
</complexType>
```

Name	Definition
relationshipType	An identifier for the type of relationship. See Annex C for a recommended controlled vocabulary.

5.3.3.3.3 ContextStatementType

Description statement for context metadata.

```
<complexType name="ContextStatementType">
  <complexContent>
   <extension base="mpaf:StatementType">
    <sequence>
     <element name="Reference" minOccurs="0" maxOccurs="unbounded">
      <complexType>
       <sequence>
        <element name="Label" type="mpeg7:TextualType" minOccurs="0"
         maxOccurs="unbounded">
        </element>
        <element name="Relation" type="mpaf:RelatedEntityType"
         minOccurs="1" maxOccurs="unbounded">
        </element>
        <element name="Description" type="mpeg7:TextualType"
         minOccurs="0" maxOccurs="unbounded">
        </element>
       </sequence>
      </complexType>
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Reference	One or more references to contextual entities. One such reference should group relations of the same context.
Label	One or more labels of the context reference.
Relation	One of more relations to resources of the context.
Description	One or more descriptions of the context reference.

An XML snippet is provided in Figure 7.

5.3.3.4 Fixity

Component and fragment level checksums are supported.

The fixity descriptor provides either a single checksum or a list of fixity checks for segments. The fixity descriptor describes

— checksum type, identified by a URI referencing a controlled vocabulary (see Annex C), and

— checksum value

The fixity description for a segment contains a specification of the fragment by one or more of the following means:

— byte range, specified by the following:

  — byte offset;

  — number of bytes;

  — chunk semantics (e.g. stream, edit unit, audio unit);

— start and span, and the respective unit (e.g. time, pages, tiles, lines, XPath);

— stream/track identification.

A FixityDescriptor contains one FixityStatement that specifies one or more fixity checks. A basic fixity check holds a string with the result of the check and a type attribute (URI) that points to a controlled vocabulary specifying the type of check.

A SegmentFixityCheck extends the basic fixity check with segment addressing attributes.

5.3.3.4.1 FixityDescriptorType

Descriptor for fixity metadata.

```
<complexType name="FixityDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:FixityStatementType"
      minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	A DID statement holding/referencing the payload of the descriptor.

5.3.3.4.2 FixityStatementType

Description statement holding results of fixity checks.

```
<complexType name="FixityStatementType">
  <complexContent>
   <extension base="mpaf:StatementType">
    <sequence>
     <element name="Check" type="mpaf:FixityCheckType" minOccurs="0"
      maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Check	The description of the result(s) of one or more fixity checks (global or fragment-based).

5.3.3.4.3 FixityCheckType

Global fixity check. The content holds the extracted checksum.

```
<complexType name="FixityCheckType">
  <simpleContent>
   <extension base="string">
    <attribute name="type" type="anyURI" use="required">
    </attribute>
   </extension>
  </simpleContent>
</complexType>
```

Name	Definition
Type	An identifier of the type/algorithm of fixity checks that has been applied. See Annex C for a recommended controlled vocabulary.

5.3.3.4.4 SegmentFixityCheckType

Segment-based fixity check, specifying type and result of the check, as well as the fragment on which the check has been performed. The content holds the extracted checksum.

```
<complexType name="SegmentFixityCheckType">
  <simpleContent>
   <extension base="mpaf:FixityCheckType">
    <attributeGroup ref="mpaf:byteAddress">
    </attributeGroup>
    <attributeGroup ref="mpaf:rangeAddress">
    </attributeGroup>
    <attribute name="chunkUnit" type="anyURI" use="optional">
    </attribute>
    <attribute name="stream" type="string" use="optional">
    </attribute>
   </extension>
  </simpleContent>
</complexType>
```

Name	Definition
chunkUnit	The unit of a chunk being checked (e.g. a group of pictures).
Stream	The identification of the stream being checked, either as a numeric index of the stream or as a textual identifier of the stream.
byteAddress	The segment being checked, expressed by as a byte range of the Resource.
rangeAddress	The segment being checked, expressed as an arbitrary type of range with start and span, and an identification of the unit.

```
<Descriptor xsi:type="mpaf:FixityDescriptorType">
       <!-- Here the checksums ... global and frame based  -->
       <Statement mimeType="text/xml" xsi:type="mpaf:FixityStatementType">
       <!-- global checksum -->
       <Check xsi:type="mpaf:FixityCheckType" type="MD5">5a6efbbaea4271f3d57a750fab91d1db
       </Check>
       <!-- segment checksums, entire edit unit -->
       <!-- only the first 2 edit units are reported for  brevity -->
       <Check xsi:type="mpaf:SegmentFixityCheckType" type="urn:tva:metadata-
cs:ChecksumAlgorithmCS:md5" start="1" span="1"
unit="editunit">5a6efbbaea4271f3d57a750fab91d1db</Check>
       <Check xsi:type="mpaf:SegmentFixityCheckType" type="urn:tva:metadata-
cs:ChecksumAlgorithmCS:md5" start="2" span="1"
unit="editunit">54bb3861ba0aaed2b546d1cdff381efe</Check>
      </Statement>
</Descriptor>
```

Figure 9 — XML snippet showing the use of Fixity Descriptor with MD5

5.3.3.5 Integrity

Integrity metadata comprises the following elements:

— index of content Items (structure);

— optionally, a list of identifiers of Digital Items to be validated during integrity checking;

— dependency on other packages (e.g. collection and packages of individual episodes);

— component-level checksums on original and packaged content (in order to compare);

— optionally checksums on metadata documents/fragments.

Format validation results can be represented using the quality descriptors.

Integrity is based on top of fixity and is made up of several other information among the preserved object, such as its structure (identifiers, checksums, etc.) and its dependency to other resources. An `IntegrityDescriptor` contains one `IntegrityStatement`, which holds the following.

a) A list with zero or more entities (referenced by URIs) to be checked for existence. The list of entities may contain deprecated entities, if they are no longer accessible or are scheduled to become inaccessible. The date until when the content was/is planned to be accessible and a description can be added.

b) A list of zero or more external dependencies (wrt. the preservation information package), with a URI as target and a URI from a controlled vocabulary specifying the relation type (compatible to `RelatedIdentifier` from ISO/IEC 21000-3/Amd 1).

An example showing the use of the Integrity Descriptor can be found in Figure 10.

5.3.3.5.1 IntegrityDescriptorType

Descriptor for integrity metadata.

```
<complexType name="IntegrityDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:IntegrityStatementType"
      minOccurs="1">
     </element>
```

```
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	The DID statement holding/referencing the payload of the descriptor.

5.3.3.5.2 IntegrityStatementType

Description statement for integrity metadata.

```
<complexType name="IntegrityStatementType">
  <complexContent>
   <extension base="mpaf:StatementType">
    <sequence>
     <element name="CheckList" minOccurs="0" maxOccurs="1">
      <complexType>
       <sequence>
        <element name="Entity" type="anyURI" minOccurs="0" maxOccurs="unbounded">
        </element>
        <element name="DeprecatedEntity" minOccurs="0" maxOccurs="unbounded">
         <complexType>
          <simpleContent>
           <extension base="anyURI">
            <attribute name="accessibleUntil" type="dateTime">
            </attribute>
            <attribute name="description" type="string" />
           </extension>
          </simpleContent>
         </complexType>
        </element>
       </sequence>
      </complexType>
     </element>
     <element name="ExternalDependency" type="mpaf:RelatedEntityType" minOccurs="0"
maxOccurs="unbounded">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
CheckList	List of entities to be checked for presence and completeness.
Entity	An entity to be checked. This shall reference an element in the same preservation metadata document (a relative URL may be used) or an element in another document (using an absolute URL).
DeprecatedEntity	An entity to be only checked until the accessibility date. This shall reference an element in the same preservation metadata document (a relative URL may be used) or an element in another document (using an absolute URL).
accessibleUntil	The accessibility date of the entity. The date may be used for automated preservation planning purposes.
description	A description of the entity.
ExternalDependency	List of dependencies external to the current preservation package that shall be checked.

```
<Descriptor xsi:type="mpaf:IntegrityDescriptorType" uri="integrity_id" >
        <Statement mimeType="text/xml" xsi:type="mpaf:IntegrityStatementType">
                <CheckList>
                        <!-- list all entities that must be present to consider the representation complete -->
                        <Entity>http://identifiers.rai.it/archive/masterfile/01+IDTECA+NUMSUPP</Entity>
                </CheckList>
                <!-- dependency external to the source tape  -->
                <ExternalDependency relationshipType="urn:mpeg:maf: cs:preservation:RelationshipCS:2015:rs17">
http://identifiers.rai.it/archive/rome/tapes/01+IDTECA+NUMSUPP</ExternalDependency>
        </Statement>
</Descriptor>
```

Figure 10 — XML snippet showing the use of Integrity Descriptor stating that the resource is complete and unaltered. *integrity_id* is linked from the activity that assessed the Integrity

5.3.3.6 Authenticity

MP-AF can include metadata to support checking of authenticity but cannot ensure itself the authenticity of the Preservation Object. MP-AF supports the following information for checking authenticity:

a) information provided by the submitter of the object to the archive (descriptive, rights and provenance metadata);

b) a complete log of the activities related to the preservation object, including technical, organizational and legal activities (based on the process description model);

c) metadata for comparing representations of the Preservation Object, e.g. fingerprints;

d) log of checking integrity (including fixity) and identity (including provenance) of Preservation Objects, Representations and their parts, and the result of this assessment. The timestamp and the Operator performing the authenticity assessment of the Preservation Object or Representation are also recorded.

The first three points are input to the authenticity assessment and this information is represented in different descriptors of MP-AF (in provenance descriptors and activities, rights descriptors, technical and reference metadata, integrity and fixity metadata). The fourth point covers the result of authenticity assessment and is covered by the Authenticity descriptor.

The `AuthentictyDecriptor` contains one `AuthenticityStatement` describing the following

— a list with one or more entities (referenced by URIs) that were checked for integrity and identity, providing

  — a confidence score about authenticity; optionally, further qualified scores can be added, e.g. to express the confidence about provenance separately, and

  — a textual annotation of the assessment result

— timestamp of the assessment;

— operator performing the assessment.

An example showing the use of the Authenticity Descriptor can be found in Figure 11.

5.3.3.6.1 AuthenticityDescriptorType

Descriptor for documenting authenticity assessments.

```
<complexType name="AuthenticityDescriptorType">
 <complexContent>
 <extension base="mpaf:DescriptorBaseType">
 <sequence>
 <element name="Statement" type="mpaf:AuthenticityStatementType" minOccurs="1">
 </element>
 </sequence>
```

```
 </extension>
 </complexContent>
</complexType>
```

Name	Definition
Statement	The DID statement holding/referencing the payload of the descriptor.

5.3.3.6.2 AuthenticityStatementType

Description statement for documenting authenticity assessments.

```
<complexType name="AuthenticityStatementType">
  <complexContent mixed="false">
   <extension base="mpaf:StatementType">
    <sequence>
     <element name="CheckList" minOccurs="0">
      <complexType>
       <sequence>
        <element name="Entity" minOccurs="0" maxOccurs="unbounded">
         <complexType>
          <sequence>
           <element name="Confidence">
            <complexType>
             <simpleContent>
              <extension base="mpeg7:zeroToOneType">
               <attribute name="type" type="string">
               </attribute>
              </extension>
             </simpleContent>
            </complexType>
           </element>
           <element name="Annotation" type="mpeg7:TextAnnotationType">
           </element>
          </sequence>
          <attribute name="ref" type="anyURI">
          </attribute>
         </complexType>
        </element>
        <element name="Operator" type="mpaf:OperatorRefType"
          maxOccurs="unbounded">
        </element>
        <element name="Timestamp" type="dateTime">
        </element>
       </sequence>
      </complexType>
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
CheckList	List of items that have been checked for integrity (including fixity) and identity (including provenance).
Entity	An entity that has been checked.
Confidence	The confidence in the result of the check.
type	The type of check the confidence refers to.
Annotation	Textual annotation giving details about the performed check and/or the results/observations.
Ref	Reference to an entity being checked. This shall reference an element in the same preservation metadata document (a relative URL may be used) or an element in another document (using an absolute URL).
Operator	Details about the operator(s) performing the check.
Timestamp	Date and time at which the result of the check valid.

```
<Descriptor xsi:type="mpaf:AuthenticityDescriptorType">
  <Statement mimeType="text/xml" xsi:type="mpaf:AuthenticityStatementType">
   <CheckList>
    <Entity ref="http://identifiers.rai.it/archive/rome/tapes/01+IDTECA+NUMSUPP">
      <Confidence type="identity">1.0</Confidence>
       <Annotation>
         <mpeg7:FreeTextAnnotation>This is the original programme broadcast back in
           1970.</mpeg7:FreeTextAnnotation>
          </Annotation>
         </Entity>
     <!-- the person assessing the authenticity (Preservation Manager)-->
   <Operator role=" urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat01">
    http://identifiers.rai.it/digimaster/humanresources/p98765</Operator>
   <Timestamp>2014-10-30T10:00:00</Timestamp>
  </CheckList>
 </Statement>
```

Figure 11 — XML snippet showing the use of Authenticity Descriptor

5.3.3.7 Quality

MP-AF provides means to represent metadata related to (semi-)automatic quality control of multimedia data. The quality metadata description framework specified in ISO/IEC 15938-5/Amd 5 is used for this purpose.

The description is compatible with the data model defined by the EBU QC group. It is recommended that the metadata refers to the taxonomy of quality control items defined in Reference [12].

Quality metadata describes results of assessing the properties, condition and possible impairments of content, on levels ranging from file containers down to audiovisual baseband.

A `QualityDescriptor` contains one `QualityStatement` with quality description according to ISO/IEC 15938-4/Amd 1 or ISO/IEC 15938-5/Amd 5. The statement may contain a complete description or only the description for a segment, represented using MPEG-7 `DescriptionUnit DS`.

If a complete description is used, it is recommended that the content of the statement conforms to the MPEG-7 Audiovisual Description Profile (AVDP, ISO/IEC 15938-9:2012/Amd 1).

An example showing the use of the Quality Descriptor can be found in Figure 12.

5.3.3.7.1 QualityDescriptorType

Descriptor holding quality metadata.

```
<complexType name="QualityDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:QualityStatementType" minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
`Statement`	The DID statement containing/referencing the payload of the descriptor.

5.3.3.7.2 QualityStatementType

Description statement holding quality metadata as defined in MPEG-7 (including MDS AMD 5).

```
<complexType name="QualityStatementType">
  <complexContent>
   <extension base="mpaf:StatementType">
    <choice minOccurs="0" maxOccurs="unbounded">
     <element name="DescriptionUnit" type="mpeg7:Mpeg7BaseType">
     </element>
     <element name="Description" type="mpeg7:CompleteDescriptionType">
     </element>
    </choice>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
DescriptionUnit	A description unit holding a single Segment or MediaQualityType element.
Description	A complete MPEG-7 content description, including quality descriptors.

```
<Descriptor xsi:type="mpaf:QualityDescriptorType" id="qcreport">
  <Statement mimeType="" xsi:type="mpaf:QualityStatementType">
    <Description xsi:type="mpeg7:ContentEntityType">
      <mpeg7:MultimediaContent xsi:type="mpeg7:AudioVisualType">
        <mpeg7:AudioVisual>
          <mpeg7:TemporalDecomposition
criteria="http://mpeg7.joanneum.at/cs/QADecompositionCS#qualitymeasures">
            <mpeg7:Header xsi:type="mpeg7:DescriptionMetadataType">
              <mpeg7:Comment>
                <mpeg7:FreeTextAnnotation>Video and Audio quality annotations made
manually</mpeg7:FreeTextAnnotation>
              </mpeg7:Comment>
            </mpeg7:Header>
            <mpeg7:AudioVisualSegment>
              <mpeg7:MediaInformation>
                <mpeg7:MediaProfile>
                  <mpeg7:MediaQuality xsi:type="mpeg7:ExtendedMediaQualityType">
                    <mpeg7:QualityRating type="objective">
                      <mpeg7:RatingValue xsi:type="mpeg7:zeroToOneType">0.8</mpeg7:RatingValue>
                      <mpeg7:RatingScheme style="higherBetter"/>
                    </mpeg7:QualityRating>
                    <mpeg7:QCProfile>
                      <mpeg7:Name href="http://www.rai.it/DigiMaster/BetacamProfile"/>
                      <!-- This is the list of QC checks that technicians are asked to do -->
                      <mpeg7:QCItem>
                        <!-- Image Shape, master files could come as 4:3 while they are 16:9 -->
                        <mpeg7:Name href="http://ebu.io/qc/tests/0121B"/>
                      </mpeg7:QCItem>
                      <mpeg7:QCItem>
                        <!-- General Image Quality -->
                        <mpeg7:Name href="http://ebu.io/qc/tests/0087B"/>
                      </mpeg7:QCItem>
                    </mpeg7:QCProfile>
                    <mpeg7:QCItemResult>
                      <mpeg7:Name href="http://ebu.io/qc/tests/0121B">
                        <mpeg7:Name>Image Shape</mpeg7:Name>
                      </mpeg7:Name>
                      <mpeg7:Output name="ImageShapeNotValid">False</mpeg7:Output>
                      <mpeg7:ExecutionStatus>complete</mpeg7:ExecutionStatus>
                    </mpeg7:QCItemResult>
                    <mpeg7:QCItemResult>
                      <mpeg7:Header xsi:type="mpeg7:DescriptionMetadataType">
                        <mpeg7:LastUpdate>2014-07-02T09:28:00</mpeg7:LastUpdate>
                      </mpeg7:Header>
                      <mpeg7:Name href="http://ebu.io/qc/tests/0087B">
                        <mpeg7:Name>General Image Quality</mpeg7:Name>
                      </mpeg7:Name>
                      <mpeg7:SegmentOutput>
                        <mpeg7:Output name="PictureQualityGeneral">3</mpeg7:Output>
                        <mpeg7:MediaTime>
                          <mpeg7:MediaTimePoint>T00:01:03</mpeg7:MediaTimePoint>
                          <mpeg7:MediaDuration>PT5S</mpeg7:MediaDuration>
                        </mpeg7:MediaTime>
                      </mpeg7:SegmentOutput>
                      <mpeg7:ExecutionStatus>complete</mpeg7:ExecutionStatus>
                      <mpeg7:ResultDescription>
                        <mpeg7:FreeTextAnnotation/>
                      </mpeg7:ResultDescription>
                      <mpeg7:DetectionMethod>assisted</mpeg7:DetectionMethod>
                    </mpeg7:QCItemResult>
                  </mpeg7:MediaQuality>
                </mpeg7:MediaProfile>
              </mpeg7:MediaInformation>
            </mpeg7:AudioVisualSegment>
          </mpeg7:TemporalDecomposition>
        </mpeg7:AudioVisual>
      </mpeg7:MultimediaContent>
    </Description>
  </Statement>
</Descriptor>
```


Figure 12 — XML snippet showing the use of Quality Descriptor, including a simple QCProfile and the assessment results

5.3.3.8 Rights

The following rights metadata representations defined in MPEG-21 are supported:

— ISO/IEC 21000-5 Rights Expression Language. REL can be used to represent usage rights;

— ISO/IEC 21000-20 Contract Expression Language. CEL can be used if media-related contracts need to be documents. CEL can also be used, when documentation of the history of the rights situation is needed;

— ISO/IEC 21000-21 Media Contract Ontology. MCO can be used if media-related contracts need to be documents. MCO can also be used, when documentation of the history of the rights situation is needed. MCO shall be serialized in RDF/XML or OWL/XML serialization.

In order to be able to perform preservation activities, all the rights shall be documented and clearly represented.

The following specific types of rights descriptors are defined:

a) `UsageRightsDescriptor`: describing rights related to the use of content, typically in a B2C scenario;

b) `ExploitationRightsDescriptor`: describing contracts about the content, that define how it can be used commercially.

A `RightsDescriptor` contains one `RightsStatement`, for which the one the following subtypes are specified:

— `RELRightsStatement`: rights description represented in Rights Expression Language, used for description of usage rights;

— `CELRightsStatement`: rights description represented in Contract Expression Language, typically used for description of exploitation rights;

— `MCORightsStatement`: rights description represented in Media Contract Ontology, typically used for description of exploitation rights.

An example showing the use of the MCO Rights Descriptor can be found in Figure 13.

5.3.3.8.1 RightsDescriptorType

Descriptor for rights metadata. Specializations of the descriptor for exploitation and usage rights are defined.

```
<complexType name="RightsDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:RightsStatementType" minOccurs="1">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
`Statement`	The DID statement holding/referencing the payload of the descriptor.

5.3.3.8.2 RightsStatementType

Description statement for rights metadata. Specializations of this statement for specific rights metadata languages are to be instantiated.

```
<complexType name="RightsStatementType" abstract="true">
  <complexContent mixed="false">
   <extension base="mpaf:StatementType" />
  </complexContent>
</complexType>
```

5.3.3.8.3 RELRightsStatementType

Description statement for rights metadata represented using MPEG-21 REL.

```
<complexType name="RELRightsStatementType">
  <complexContent>
   <extension base="mpaf:RightsStatementType">
    <sequence>
     <any namespace="urn:mpeg:mpeg21:2003:01-REL-R-NS" processContents="lax"
minOccurs="0">
     </any>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

5.3.3.8.4 CELRightsStatementType

Description statement for rights metadata represented using MPEG-21 CEL.

```
<complexType name="CELRightsStatementType">
  <complexContent>
   <extension base="mpaf:RightsStatementType">
    <sequence>
     <any namespace="urn:mpeg:mpeg21:cel:core:2012 urn:mpeg:mpeg21:cel:ipre:2012"
processContents="lax" minOccurs="0">
     </any>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

5.3.3.8.5 MCORightsStatementType

Description statement for rights metadata represented using MPEG-21 MCO.

```
<complexType name="MCORightsStatementType">
  <complexContent>
   <extension base="mpaf:RightsStatementType">
    <sequence>
     <any namespace="urn:mpeg:mpeg21:mco:core:2012 urn:mpeg:mpeg21:mco:ipre:2012 http://
purl.org/dc/elements/1.1/http://www.w3.org/2000/01/rdf-schema http://www.w3.org/2006/
vcard/ns http://www.w3.org/2002/07/owl http://www.w3.org/1999/02/22-rdf-syntax-ns
urn:mpeg:mpeg21:2002:01-DII-NS http://purl.oclc.org/NET/mvco.owl" processContents="lax"
minOccurs="0">
     </any>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

5.3.3.8.6 UsageRightsDescriptorType

Descriptor for usage rights metadata.

```
<complexType name="UsageRightsDescriptorType">
  <complexContent>
   <extension base="mpaf:RightsDescriptorType" />
  </complexContent>
</complexType>
```

5.3.3.8.7 ExploitationRightsDescriptorType

Descriptor for rights metadata.

```
<complexType name="ExploitationRightsDescriptorType">
  <complexContent>
   <extension base="mpaf:RightsDescriptorType" />
  </complexContent>
</complexType>
```

```
<Descriptor xsi:type="mpaf:ExploitationRightsDescriptorType">
       <Statement xsi:type="mpaf:MCORightsStatementType" mimeType="text/xml"
xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS">
              <owl:Ontology xmlns:owl="http://www.w3.org/2002/07/owl" ontologyIRI="urn:it.rai:mco-
rights-00000800.46b1.e8f1.d81d1300.36700580.owl">
            <!-- All the MCO stuff here  -->
              </owl:Ontology>
       </Statement>
</Descriptor>
```

Figure 13 — XML snippet showing the use of Exploitation Rights Descriptor, using MPEG Media Contract Ontology (MCO)

5.3.4 References to controlled vocabularies and other resources

MP-AF provides a referencing mechanism based on the use of controlled vocabularies for specialized types and based on URI for referencing other generic resources.

In order to represent specialized types of entities (e.g. types of Activities and Operators) and attributes (e.g. roles of Operators), MP-AF uses references to controlled vocabularies, as well as for representing the content metadata elements with a limited (but extensible) set of possible values (e.g. PRONOM[5] file format descriptions, codecs and ISBN numbers). URIs are often used to unambiguously refer to the terms in the controlled vocabularies.

The referencing mechanism includes pointing to other resources within the same information package as the referring MP-AF document, to other packages or to web resources. Resolvable URIs (e.g. URLs) to publicly accessible web resources should be preferred. When referring to web resources, even persistent URIs may not have longer lifetime than referring preservation package.

5.3.5 Nesting of descriptors

Nesting of descriptors has the function of providing metadata about the parent descriptor. Nesting of descriptors is restricted to one level and only the following type of descriptors may be annotated on other descriptors:

— FixityDescriptor;

— ProvenanceDescriptor;

— RightsDescriptor;

— AnnotationDescriptor.

6 Common core metadata set

6.1 General

The common core metadata set includes descriptive metadata by which a Digital Item can be unambiguously identified. It also includes technical metadata (e.g. describing the format) associated with one or more specific Representations, Essences or Components of the corresponding Preservation Object.

The common core metadata set is modelled with two specific Descriptor types

— `DescriptiveMetadataDescriptor` (as specified in 6.2), and

— `TechnicalMetadataDescriptor` (as specified in 6.3).

Statement types for these descriptors are defined for the different serializations of these metadata supported by MP-AF.

6.2 Core descriptive metadata

6.2.1 Content metadata

Descriptive metadata for content Items is modelled using a `DescriptiveMetadataDescriptor`. The descriptor may include the following types of statements:

— `MPEG7DMStatement`: holds MPEG-7 `CreationInformation` or `DescriptionUnit` for describing the content;

— `EBUCoreDMStatement`: holds an EBUCore document with descriptive metadata represented in XML;

— `EBUCoreRDFDMStatement`: holds an EBUCore document with descriptive metadata represented in RDF/OWL;

— `DublinCoreDMStatement`: holds the extended list of metadata terms defined by Dublin Core Metadata Initiative (dcterms) which includes the list of 15 core elements of descriptive metadata.

Table 3 lists the recommended elements that should be contained in such a descriptor and gives a reference definition for them.

Table 4 shows the mappings of these metadata elements to the formats supported. However, no element is defined as mandatory.

For all string values, multi-linguality should be supported. All formats considered support the use of the `xml:lang` attribute. According to RFC 4646, the language tag may also contain the type of script according to ISO 15924. However, for readability, the used formats may represent script as a separate optional attribute. In some cases it may also be necessary to represent strings in the metadata document in different character encodings, other than the one specified in the preamble of the XML document. Support for these extended textual types is defined in ISO/IEC 15938-5/Amd 5 and EBU Core (v1.5 or later).

Table 3 — Descriptive metadata elements

Element	Description
Title	A title is the 'main' name given to a resource, e.g. a media Item, a media object, or a sequence as specified by the associated title type. It corresponds for a series to the series title, for a program to the program title, for an Item to the Item title, etc. Titles are recorded as they appear. The title is the name by which a resource is formally known and that everyone should use to refer to or search for that particular resource. The title may be provided in several languages. If present, the date attributes indicate when the title was attributed, used and/or deprecated.[a]
AlternativeTitle	An alternative title for the main one.
Description	Free-form text or a narrative to report general notes, abstracts, or summaries about the intellectual content of a resource. The information may be in the form of a paragraph giving an individual program description, anecdotal interpretations, or brief content reviews. The description may also consist of outlines, lists, bullet points, edit decision lists, indexes, or tables of content, a reference to a graphical representation of content or even a pointer (URI, URL) to an external resource. For a radio or television program, a running order can be used as description. A description can be provided in different languages.[a]

Table 3 *(continued)*

Element	Description
Subject	The generalized topic of that represents the intellectual content of the resource. Typically, a subject is expressed by keywords, key phrases, or even specific classification codes. Controlled vocabularies, authorities, or formal classification schemes may be employed when selecting descriptive subject terms. It is possible to employ both keywords, derived from a formal classification scheme, such as Dewey or UDC, and genres/subgenres such as those produced by TV-Anytime or Escort, to cover subject(s) and genre(s) and enter as appropriate subject type below. Persons as subjects are also placed here.[a]
Date	Dates associated with events occurring during the life of the Digital Item, e.g. creation, modification, fixity check etc.
Object type	The object is used to qualify the type of work that is being described, e.g. a program, clip.
Genre	Kind, category, or sort of Work, e.g. talk show.
Target audience	The audience to which the Work is intended to. Audience can be defined by several different restrictions, including geographical region, age and any other criteria.
Coverage (temporal)	A period of time (e.g. date or date range) used for expressing when a Work has specific rights (e.g. transmission). Coverage can also be used to define a period of time associated with the work (e.g. a particular historical period in a historical documentary).
Coverage (spatial)	A spatial location (e.g. a place name or geographic coordinates) or a jurisdiction (such as a named administrative entity) used for expressing where a Work has specific rights (e.g. transmission). Coverage can also be used to define a location associated with the work (e.g. a particular area in a travel documentary).
Language	Identifies languages and their use in the intellectual content of the resource. Recommended best practice for the values of the Language element is defined by RFC 5646.[a]
Part	Editorial segments/fragments, timelines, play lists, elements of a group such as "tracks" of a record, episodes of a series or season, etc. Parts can also be used to describe timelines for dynamic metadata or as a mechanism to sort metadata in various categories (e.g. separating audio from video or data).
PublicationHistory	Information about the publication history, i.e. when, where, in which formats and under which rights conditions the resource has been distributed.[a]
Rating	Numeric rating of distributed Works by users, using a specified scale.
Version	Version of a Work, e.g. UK Version, US Version, home video version, etc.
[a] From EBUCore 1.5 definition.	

Table 4 — Mapping of descriptive metadata to supported formats

Element	MPEG-7 MDS	EBUCore	DublinCore (dcterms)
Title	Creation/Title	Title	title
attributionDate	*Header (CreationMetadata)*	*@attributiondate*	
		@typeGroup	
AlternativeTitle	Creation/Title	AlternativeTitle	alternative
type	*@type*	*@typeGroup*	
attributionDate	*Header (CreationMetadata)*	*@attributiondate*	
Description	Creation/Abstract	Description	description
type	*@type*	*@typeGroup*	
Subject	Classification/Subject	Subject	subject
type	*@type*	*@typeGroup*	
attributor	*Header (CreationMetadata)*[a]	*attributor*	
[a] Not for the specific subject but for the Classification element.			

Table 4 *(continued)*

Element	MPEG-7 MDS	EBUCore	DublinCore (dcterms)
Date ***type***	Creation/Creation Coordinates/Date	Date *@created, @issued, @modified, @digitised, @released, @copyrighted, @alternative*	date, dateAccepted, dateCopyrighted, dateSubmitted, issued, available, modified, valid
Object type	Classification/Form	Type/objectType	Type
Genre	Classification/Genre	Type/genre	Type
Target audience	Classification/Target	Type/targetAudience	Audience
Coverage (temporal) ***type***	Event/SemanticPlace	Coverage/temporal *@type*	Temporal
Coverage (spatial) ***type***	Event/SemanticTime	Coverage/spatial *@type*	spatial
Language ***type***	Classification/Language/@type, /CaptionLanguage, /SignLanguage *@type*	Language *@type*	language
Part	TemporalDecomposition/Segment	Part	hasPart
PublicationHistory	Classification/Release/Region Classification/Release/@date	PublicationHistory	—
Rating ***value, min, max, provider***	Classification/ParentalGuidance/Rating Classification/MediaReview/Rating:./RatingValue./RatingScheme	Rating *@ratingValue, @ratingScaleMaxValue, @ratingScaleMinValue, @ratingProvider*	—
Version	Version (MDS Amd5)	Version	hasVersion

[a] Not for the specific subject but for the Classification element.

The descriptive metadata descriptors may contain decomposition into parts and contain metadata for parts, in order to complement the Digital Item structure. Parts are represented in the respective format by the appropriate representation of the Part element as defined in Table 4.

6.2.1.1 DescriptiveMetadataDescriptorType

Descriptor for descriptive metadata.

```
<complexType name="DescriptiveMetadataDescriptorType">
  <complexContent>
   <extension base="mpaf:DescriptorBaseType">
    <sequence>
     <element name="Statement" type="mpaf:DescriptiveMetadataStatementType" minOccurs="0">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
Statement	The DID statement holding/referencing the payload of the descriptor.

6.2.1.2 DescriptiveMetadataStatementType

Description statement for descriptive metadata.

```
<complexType name="DescriptiveMetadataStatementType" abstract="true">
  <complexContent mixed="false">
   <extension base="mpaf:StatementType" />
  </complexContent>
</complexType>
```

6.2.1.3 MPEG7DMStatementType

Description statement for descriptive metadata represented using MPEG-7 MDS.

```
<complexType name="MPEG7DMStatementType">
  <complexContent>
   <extension base="mpaf:DescriptiveMetadataStatementType">
    <choice minOccurs="0" maxOccurs="unbounded">
     <element name="CreationInformationType" type="mpeg7:CreationInformationType">
     </element>
     <element name="DescriptionUnit" type="mpeg7:Mpeg7BaseType">
     </element>
    </choice>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
CreationInformationType	A creation information descriptor holding descriptive metadata.
DescriptionUnit	A descriptor or set of descriptors (other than creation information) holding descriptive metadata.

6.2.1.4 EBUCoreXMLDMStatementType

Description statement for descriptive metadata represented using EBU Core XML.

```
<complexType name="EBUCoreXMLDMStatementType">
  <complexContent>
   <extension base="mpaf:DescriptiveMetadataStatementType">
    <sequence>
     <element name="ebuCoreMain" type="ebucore:ebuCoreMainType" minOccurs="0">
     </element>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

Name	Definition
ebuCoreMain	A EBU Core main element holding descriptive metadata in XML.

6.2.1.5 EBUCoreRDFDMStatementType

Description statement for descriptive metadata represented using EBU Core RDF.

```
<complexType name="EBUCoreRDFDMStatementType">
  <complexContent>
   <extension base="mpaf:DescriptiveMetadataStatementType">
    <sequence>
     <any namespace="http://www.ebu.ch/metadata/ontologies
/ebucore/ebucore http://purl.org/dc/elements/1.1/
http://www.w3.org/2000/01/rdf-schema http://www.w3.org/2006/vcard/ns http://www.
w3.org/2002/07/owl http://www.w3.org/1999/02/22-rdf-syntax-ns" processContents="lax"
minOccurs="0">
     </any>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

6.2.1.6 DublinCoreDMStatementType

Description statement for descriptive metadata represented using Dublin Core.

```
<complexType name="DublinCoreDMStatementType">
  <complexContent>
   <extension base="mpaf:DescriptiveMetadataStatementType">
    <sequence>
     <group ref="dc:elementsGroup">
     </group>
    </sequence>
   </extension>
  </complexContent>
</complexType>
```

6.2.2 Descriptive Metadata for Non-Content Entities

6.2.2.1 Metadata for Activities

Activities should be linked to content objects involved and optionally to the Operators in the process. A type of the Activity shall be specified. In addition, the following properties may be specified:

— start and end time of the event;

— location of the event;

— whether the Activity has actually been executed or was only planned;

— key/value list of parameters of the activity;

— references to the involved Operators, and their role;

— references to the Digital Items involved in the Activity;

This metadata is modelled as properties of the respective entities of the data model.

An instance of an activity is described by an Activity element holding a unique identifier of the activity, identifying the type of activity using a controlled vocabulary (see Annex C) and specifying its further properties, including sub-activities.

6.2.2.2 Metadata for Operators

The type attribute of an Operator shall be present, preferably as a reference to a controlled vocabulary identifying the type of operator (see Annex C).

For all Operators referenced from an Activity, the role of the Operator in the Activity shall be provided. A recommended controlled vocabulary for roles is described in Annex C.

This metadata is modelled as properties of the respective entities of the data model. Examples of defining Operators and Activities and linking them can be found in Figure 14 and Figure 15.

```
<!-- This activity consists in a migration of content from a tape to a master file -->
<!-- Activity type and Operator type and role are expressed with provisional URIs pointing to
classification schemes not yet fully available, see annex C -->
<Activity uri="a1" type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa09"
start="2014-07-01T10:05:00" end="2014-07-01T11:10:00" executed="true">
        <!-- The operator is a VTR device doing the play and analog to digital conversion of
audiovisual content -->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">
http://myvocabulary.org/qcfarm/taperecorder1</Operator>
                <!-- tape1 is digitized -->
                <Content relationType="uses" ref="http://myvocabulary.org/archive/tape1"/>
                <!-- file1 is the master file coming out from digitization -->
                <Content relationType="creates" ref="http://myvocabulary.org/staging/file1" />
        <Location xsi:type="mpeg7:PlaceType">
                <mpeg7:Name>Place of the digitisation farm is</mpeg7:Name>
        </Location>
</Activity>
<Operator xsi:type="mpaf:ToolType"
        type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt07"
        uri="http://myvocabulary.org/qcfarm/taperecorder1">
        <Name>VTR_model</Name>
        <Manufacturer href="http://vtrbrand.com">
                <mpeg7:Name>VTR_manufacturer</mpeg7:Name>
        </Manufacturer>
</Operator>
```

Figure 14 — XML snippet describing the migration of content from tape to master file

```
<!-- This activity consists in a quality check made on a file -->
<!-- Activity type and Operator type and role are expressed with provisional URIs pointing to
classification schemes not yet fully available, see annex C -->
<Activity uri="a2" type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa21"
start="2014-07-01T11:11:00" end="2014-07-01T11:20:00" executed="true">
        <!-- The operator is a QC automatic tool provided by a QCvendorX -->
        <Operator
role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://myvocabulary.org/qc/tool1</Operator>
        <!--AQC is performed on file1 looking for blockiness -->
        <Content relationType="uses" ref="http://myvocabulary.org/file1" >
                <!--AQC produces a textual report -->
                <Added>http://myvocabulary.org/qareport1</Added>
        </Content>
</Activity>
<Operator xsi:type="mpaf:ToolType"
        type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt14"
        uri="http://myvocabulary.org/qc/tool1">
        <Name>QCtoolY</Name>
        <Manufacturer href="http://www.vendorx.com/products/qc">
                <mpeg7:Name>QCvendorX</mpeg7:Name>
        </Manufacturer>
        <Version>1.0</Version>
</Operator>
```

Figure 15 — XML snippet describing a quality check made on an audiovisual file

```
<!-- This activity consists in a manual quality validation made on a audiovisual file previously
analysed by some AQC-->
<!-- Activity type and Operator type and role are expressed with provisional URIs pointing to
classification schemes not yet fully available, see annex C -->
<Activity uri="a3" type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa23"
start="2014-07-01T14:00:00" end="2014-07-01T16:00:00" executed="true">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01"
                operatorOnBehalfOf="http://myvocabulary.org/people/doe"
>http://myvocabulary.org/people/tool2</Operator>
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01"
>http://myvocabulary.org/people/doe</Operator>
        <!--Validation is made on file1 using also metadata available in qcreport_file1-->
        <Content relationType="uses" ref="http://myvocabulary.org/file1" >
                <!--manual validations and annotations are added to qcreport_file1-->
                <Modified>http://myvocabulary.org/qareport1</Modified>
        </Content>
</Activity>
<!-- The operator is a video technician that validates the results of the AQC using a specific
annotation tool-->
<Operator xsi:type="mpaf:ToolType"
        type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt14"
        uri="http://myvocabulary.org/people/tool2">
        <Name>ZKQCcheck</Name>
        <Manufacturer href="http://www.xysoft.com"><mpeg7:Name>XYsoft</mpeg7:Name></Manufacturer>
        <Version>2.0</Version>
</Operator>
<Operator xsi:type="mpaf:PersonType" uri="http://myvocabulary.org/people/doe"
type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat12">
        <Name>
                <mpeg7:GivenName>John</mpeg7:GivenName>
                <mpeg7:FamilyName>Doe</mpeg7:FamilyName>
        </Name>
</Operator>
```

Figure 16 — XML snippet describing the manual quality validation made of an audiovisual file

6.2.2.3 Metadata for Agents

The Agent type is aligned with the MPEG-7 `AgentType`. For Agents, metadata compatible to the `Person`, `PersonGroup` and `Organization` descriptions from ISO/IEC 15938-5 Agent DS may be specified. This includes for Persons: Name, Affiliation, Address and Description; and for Organizations: Name, Kind, Contact and Address.

6.2.2.4 Metadata for Tools

The following metadata for Tools is defined in the data model:

— `information`: a URL from which further information about the Tool can be retrieved;

— `Name`: zero or more names of the tool;

— `Manufacturer`: zero or more references to a controlled vocabulary identifying a manufacturer of the tool;

— `Version`: the version of the Tool (optional);

— `Parameters`: a set of key/value pairs describing parameters of the Tool (optional). The following keys are predefined:

  — `cmdLine`: the command line arguments used to invoke a software tool.

6.3 Core technical metadata

A core set of technical metadata for different types of content entities is listed below including a short description. This set of metadata has been defined based on technical metadata in ISO/IEC 15938-5, Reference [7], Reference [8] and Reference [10].

The properties are represented in a Technical Metadata descriptor, using ISO/IEC 15938-5 `MediaInformation` DS or EBUCore `FormatType`. The mapping of the properties to the respective elements in MPEG-7 `MediaInformation` DS and EBUCore `FormatType` are defined below.

6.3.1 Properties for all content types

Table 5 — Properties for all content types

Property name	Description	MPEG-7 Media-Information DS	EBUCore FormatType	Data type	Preservation Object	Representation	Essence	Component (File/ Bitstream)
EditRate	Inverse of EditUnit i.e. the number of edit units in a second. Edit Unit is the smallest portion of an Essence stream which can be edited such as a field of a picture, a frame or an audio sample.	mediaTime PropertyGrp	videoFormat/ frameRate audioFormat/ samplingRate	unsigned Int		x	x	x
Duration	The temporal length of an audio or video essence.	MediaTime/ MediaIncr Duration	duration	unsigned Long	x	x	x	x
Lossless	Audio or video coding without any information loss.	—	technicalAttribute Boolean/with @ typeLabel= "lossless"	boolean		x	x	x
Format: (wrapper, codec)	Which kind of file wrapper and audio and video coding is used.	FileFormat	format/container Format videoFormat/ videoEncoding/ @ typeLink audioFormat/ audioEncoding/ @ typeLink	anyUri			x	x

6.3.2 Properties for image/video content

Table 6 — Properties for image/video content

Property name	Description	MPEG-7 Media-Information DS	EBUCore FormatType	Data type	Preservation Object	Representation	Essence	Component (File/ Bitstream)
Picture-Width	Number of active samples per line in a video frame.	Frame/@ width	videoFormat/ width (with @unit = "lines per frame" and "typeLabel="active") imageFormat/ width (with @unit = "lines per frame")	unsigned Int		x	x	x
Picture-Height	Number of active lines in a video frame.	Frame/@ height	videoFormat/ height (with @unit = "samples per line" and "typeLabel="active") imageFormat/ height (with @unit = "samples per line")	unsigned Int		x	x	x
Frame Layout	Identifies how the lines of a video frame are scanned, i.e. progressive or with a kind of interlacing.	Frame/@ structure	videoFormat/ scanningFormat videoFormat/ scanningOrder	string (with enumeration)		x	x	x
Component-Bit-Depth	The number of active bits per component sample.	Pixel/@ bitsPer	videoFormat/ technicalAttribute Integer with @ typeLabel="bit depth" imageFormat/ technicalAttribute Integer with @typeLabel="bit depth"	unsigned Int		x	x	x
Frame Aspect Ratio	The Aspect Ratio is the ratio of width to height of the physical representation of video frame.	Frame/@ aspectRatio	videoFormat/ technicalAttribute Double with @ typeLabel= "aspectRatio"	double		x	x	x
Picture Essence-Coding	The Essence coding/ compression scheme in use for the video.	VisualCoding/ Format	imageFormat/ videoEncoding/ @ typeLink videoFormat/ videoEncoding/@ typeLink	anyUri		x	x	x