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

Part 15: Multimedia preservation application format

AMENDMENT 1: Implementation guidelines for MP-AF

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

Partie 15: Format pour application de la conservation des multimédias

AMENDEMENT 1: Lignes directrices pour MP-AF

Reference number
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Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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 ISO documents 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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Amendment 1 to ISO/IEC 23000-15:2016 was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

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Page 57, Clause 7

Insert Clause 8 and Clause 9

8 Implementation guidelines (non-normative)

8.1 General

8.2 to 8.4 provide an overview of three concrete use cases from professional digital preservation stakeholders. Their workflows and most relevant metadata are introduced, then MP-AF XML implementations addressing preservation needs from real-world use cases are reported. Terminology from Open Archival Information System (OAIS)[4] is used, which defines information packages (IP) at the ingest (Submission IP - SIP) and delivery (Dissemination IP - DIP) side of a preservation system.

A typical format migration use case is presented in 8.2, which showcases a common necessity in digital preservation workflows. 8.3 focuses on "Audiovisual Digitization" scenario based on a concrete project that is currently under deployment at RAI Radiotelevisione Italiana (i.e. the National Italian Broadcaster). 8.4 deals with digitization of audio content of Short Play (SP) vinyl records and Master 1/2 inch tapes, a concrete activity performed at National Diet Library (NDL) of Japan. MP-AF compliant XML documents are reported entirely within source code boxes in this document and also included as separated XML files in the electronic inserts.

8.5 discusses the use of MP-AF in content archival and packaging (i.e. how to tie essences and metadata together).

8.2 Outsourcing format migration use case

8.2.1 General

This is a generic use case about basic format migration activities. Let's suppose that the organization Fred&Alice Limited conceived, commissioned and/or produced an audiovisual work, e.g. a documentary about the rivers, mountains, and sites of the region where Fred was born. The Work is titled "Fred's places" for which Fred&Alice Limited obtained an ISAN identifier, such as ISAN-XXXX-YYYY-ZZZZ. The Work is composed of two parts stored in two HD-XDCAM MXF (50 Mbits/s) files. The first part has a time length of 37 min and the second part of 23 min, representing the first and second part of the content. Fred&Alice Limited now needs another representation of the Work as DVD ISO image file for 1 hour of playback, to be later printed on DVDs and commercialized. They decided to rely on an external company, ACME Preservation for performing the format migration. Additionally, they are asking information regarding the quality control of the resulting essences and a complete documentation of media processing activities.

In the following we describe:

— the activities undertaken within the format migration process including the description of agents/tools and operators;

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— the specific preservation information created in this scenario, which can be represented by specific MP-AF preservation descriptors like Fixity, Integrity and Rights.

8.2.2 Process overview

Fred&Alice Limited send to "ACME Preservation" a digital copy of the material, including the checksums of the involved files. ACME Preservation run an ingest process, verifying the fixity and the integrity of files by checksum calculation and comparison with the provided values. Ingestion also includes a format validity check, done by using an automatic tool. ACME Preservation discover that MXF files are not strictly compliant with some parts of the relevant SMPTE standard specifications, even if they can be correctly played in practical environments.

ACME Preservation inform Fred&Alice Limited about this minor problem and propose to fix it performing a simple file trans-wrapping. Fred&Alice Limited accept this proposal and also ask for the two parts of the programme to be merged in order to have a single MXF file as output.

The following metadata documenting this first part of the process is saved:

— date and venue of the operations;

— the software tool that detected the SMPTE compliance problem;

— the software tool used for performing the merging and trans-wrapping operation;

— tool used for validating the result of the trans-wrapping;

— the location of media files that represent the input and the result of the trans-wrapping operation;

— the time required for executing the trans-wrapping operation.

Table 8 summarizes the sequence of activities carried out. The columns represent the respective responsibilities of each organization.

Table 8 — Sequence of activities

Activity	Fred&Alice Limited	ACME preservation
1	DIP creation including essences and required metadata in MP-AF format	
2		Conformance checking of the container with identification of possible violations
3		Merging files constituting multiple parts of the same programme; fixing of MXF wrapper in case of SMPTE standards violations, with logging of the operation in MP-AF format
4		Transcoding of essence to the target coding schemes with logging of the operation in MP-AF format
5		Quality control (i.e. formal check) of the resulting file with logging of the operation results in MP-AF format
6	Ingestion of the updated SIP containing the transcoded and trans-wrapped essence and the updated MP-AF metadata	

First, Fred&Alice Limited create the DIP to be delivered to ACME Preservation. It contains the following main entities:

— the essence files;

— the relevant metadata in MP-AF XML format with:

  — a *DescriptiveMetadataDescriptor* containing basic descriptive metadata at preservation object level;

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— thedescriptionoftherepresentation(XDCAMinMFX)alreadyavailablewithEssence/Components (i.e. related to the first and second part of the video programme);

— *TechnicalMetadataDescriptors* containing technical metadata at preservation object and essence/bitstream level.

In the second stage, ACME Preservation receives the DIP and performs the requested migration/transcoding including quality control activities. Most importantly, ACME Preservation updates the MP-AF XML metadata document by adding the new representation given by the ISO image of the work. The package delivered by ACME Preservation to Fred&Alice Limited includes the following:

— a *PreservationObject* with two representations:

— the old representation: two essences, each with a/v streams (no locators, as essence is not included);

— the new representation: one essence with a/v streams (includes the locator of essence);

— *TechnicalMetadataDescriptor* containing technical metadata at preservation object and essence/bitstream level;

— *DescriptiveMetadataDescriptor* containing basic descriptive metadata at preservation object level;

— *QualityMetadataDescriptor* containing quality metadata for old representations;

— process metadata (i.e. description and configurations of the tools used in the process) documenting the derivation of the new representation;

— *QualityMetadataDescriptor* containing quality metadata for the new representation being assessed by ACME Preservation.

Figure 18 shows a logical representation of the MP-AF document including the updates from ACME Preservation, reflecting the activities performed and the produced outputs. This updated MP-AF instance is delivered back to the Fred&Alice Limited's archive, together with the freshly created DVD ISO files.

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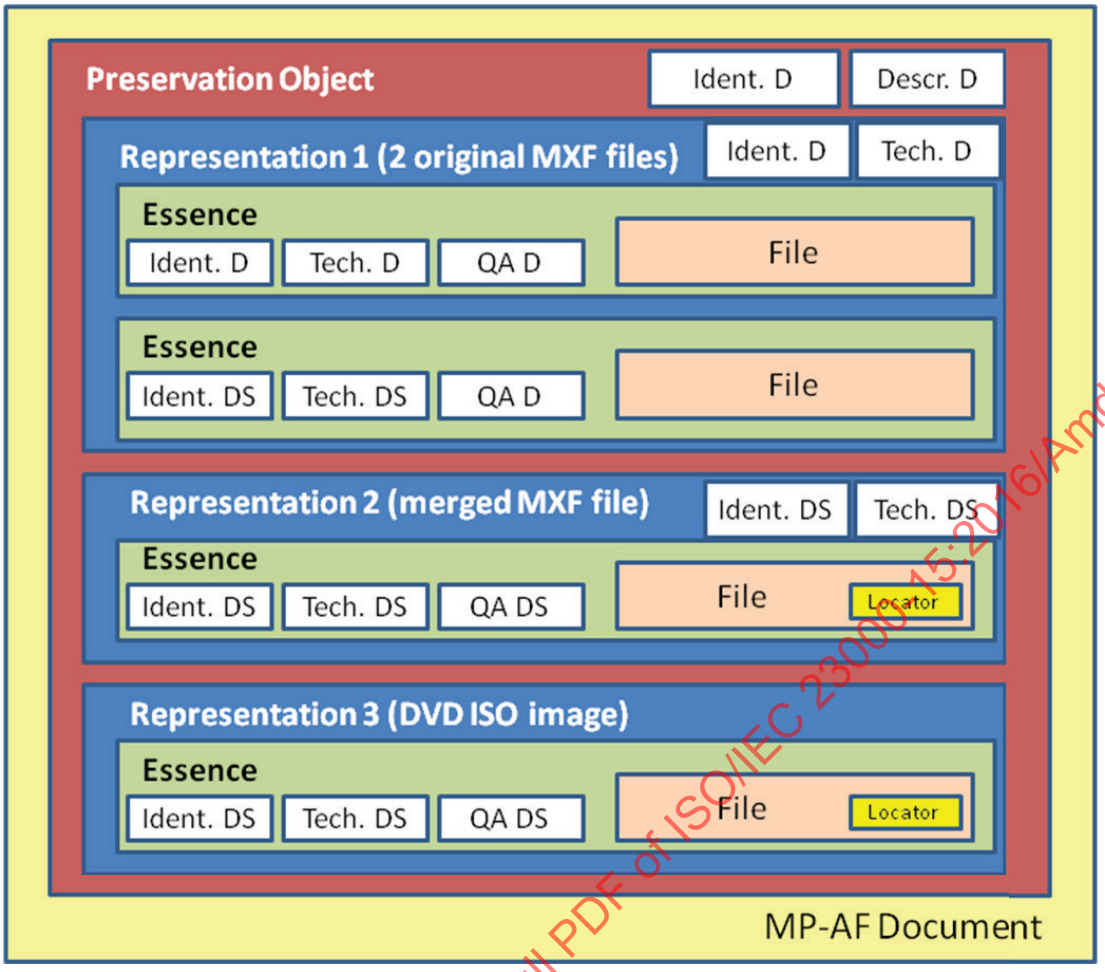

Key

D	descriptor	Ident.	identification
DS	description scheme	Descr.	descriptive metadata
QA	analysis	Tech.	technical metadata

Figure 18 — Structure of MP-AF document delivered to Fred&Alice Limited

8.2.3 Preservation Information

8.2.3.1 General

Pre-existing and newly created preservation metadata created by ACME Preservation, are stored in MP-AF making use of the following specific descriptors:

8.2.3.2 Fixity

Fred&Alice Limited originally recorded the checksum (MD5) of all three provided files, which enables the verification of their fixity, ensuring that no bit changes have occurred. For a more robust check, they decided to add an alternative checksum (SHA1). Also they decide to store distinct checksum values for each component (video and audio) and for each video segment along the timeline.

NOTE The MP-AF Fixity Descriptor supports multiple checksums representations separately for each essence/component.

8.2.3.3 Integrity

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Fred&Alice Limited is concerned about the fact that one of the two MXF files could get lost and one could be unaware that a part of the whole programme is missing (i.e. treating the file as a shorter version of the programme).

Fred&Alice Limited is tempted to concatenate the two files, but the operators are not sure about the technical quality of the result, so they keep the original parts in separate files.

NOTE MP-AF allows providing information that guarantees the integrity by means of an Integrity Descriptor, linked to specific Representations of the Preservation Object.

8.2.3.4 Rights

Fred&Alice Limited are the original producers of "Fred's places" and they hold all the rights including the exploitation. They also have

— a document with free text description of the work,

— emails exchanged with other companies having technically contributed to the production, and

— the document for the request of ISAN registration.

One year ago, they granted exclusive rights to "Mountains and Rivers Entertainment Limited" for performing any kind of communication to the public and on any public performances in the country "Italy" ["ITA", ISO country code: 380[1)]]. The material delivered to "Mountains and Rivers Entertainment Limited" were created by means of transcoding from the MXF files, but no copy of it was kept by Fred&Alice Limited.

NOTE MP-AF allows providing such information through the Rights Descriptor linked to the specific Representation.

8.2.3.5 Quality

ACME Preservation performs file format compliance checks for the produced files. This results in a report containing the checks performed and the outcome reported by the automatic quality analysis tools. The XML report includes only few recommended tests for MXF wrapper consistency, but many others can be added.

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1) ISO 3166-1 numeric.

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8.2.4 XML Serialization of MP-AF Metadata

This subclause provides a complete XML serialization of MP-AF Metadata that formally validates against the normative schema provided by the standard. Useful comments are provided inline.

```
<DIDL xmlns="urn:mpeg:maf:schema:preservation:2015" xmlns:mpaf="urn:mpeg:maf:schema:preserva-
tion:2015" xmlns:didmodel="urn:mpeg:mpeg21:2002:02-DIDMODEL-NS" xmlns:mpeg7="urn:mpeg:mpeg7:sche-
ma:2004" xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS" xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:ebucore="urn:ebu:metadata-schema:ebuCore_2014" xmlns:xsi="http://www.w3.org/2001/XMLSchema-in-
stance" xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS" xmlns:didl="urn:mpeg:mpeg21:2002:02-
DIDL-NS" xsi:schemaLocation="urn:mpeg:maf:schema:preservation:2015 mpaf.xsd urn:mpeg:mpeg21:2002:02-
DIDL-NS mpeg21/did/didl.xsd">
  <DIDLInfo>
    <ProcessEntities>
      <!-- Checksum verification -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa18" uri="a1">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://my.org/qc/tool1</Operator>
        <!-- first part of the programme -->
        <Content relationType="uses" ref="http://my.org/essence1"/>
        <!-- second part of the programme -->
        <Content relationType="uses" ref="http://my.org/essence2"/>
      </Activity>
      <!-- Repairing/Rewrapping -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa56" uri="a2">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01" operatorOnBehalfOf="http://
my.org/people/doe">http://my.org/qc/tool2</Operator>
        <Content relationType="uses" ref="http://fred_alice.org/essence1"/>
        <Content relationType="uses" ref="http://fred_alice/essence2"/>
        <!-- The joined and transrapped MXF -->
        <Content relationType="creates" ref="http://fred_alice/essence3"/>
      </Activity>
      <!-- Quality Control/File-based  made on joined-transwrapped MXF-->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa21" uri="a3">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://acme.org/qc/tool4</
Operator>
        <Content relationType="uses" ref="http://fred_alice/essence3"/>
      </Activity>
      <!-- Transcoding -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa13" uri="a4">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://acme.org/qc/tool3</
Operator>
        <Content relationType="uses" ref="http://fred_alice/essence3"/>
        <!-- The proxy quality version of the entire programme -->
        <Content relationType="creates" ref="http://fred_alice/essence4"/>
      </Activity>
      <!-- Quality Control/File-based made on generated proxy version-->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa21" uri="a5">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://acme.org/qc/tool4</
Operator>
        <Content relationType="uses" ref="http://fred_alice/essence4"/>
      </Activity>
      <!-- Metadata Extractor -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool1" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt25"/>
      <!-- MXF joiner and Trans-Wrapper -->
```

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```
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool2" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt18"/>
      <!-- Transcoder -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool3" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt35"/>
      <!-- Proxy file analyzer -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool4" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt14"/>
      <!-- Audiovisual technician -->
      <Operator xsi:type="mpaf:PersonType" uri="http://acme.org/people/doe" type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat12">
        <mpaf:Name>
          <mpeg7:GivenName>John</mpeg7:GivenName>
          <mpeg7:FamilyName>Doe</mpeg7:FamilyName>
        </mpaf:Name>
      </Operator>
    </ProcessEntities>
  </DIDLInfo>
  <!-- The programme to be transcoded, made of 2 MXF files -->
  <Item xsi:type="mpaf:PreservationObjectType" uri="http://fred_alice/pm1">
    <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
      <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
        <mpaf:Identifier type="http://smpte-ra.org/umidreg/s330mex.html">urn:smpte:umid:060A2B-
340101010501010D12130000000123456789ABCDEF0123456789ABCDEF</mpaf:Identifier>
      </Statement>
    </Descriptor>
    <Descriptor xsi:type="didl:DescriptorType">
      <didl:Statement mimeType="text/xml" xsi:type="didl:StatementType">
        <ipmpinfo:IPMPGeneralInfoDescriptor>
          <ipmpinfo:ToolList>
            <ipmpinfo:ToolDescription localID="AESEncrypt">
              <ipmpinfo:IPMPToolID>http://www.w3.org/2001/04/xmlenc#aes128</ipmpinfo:IPMPToolID>
              <ipmpinfo:Remote ref="urn:IPMPToolsServer:ToolEnc005-3485"/>
            </ipmpinfo:ToolDescription>
          </ipmpinfo:ToolList>
        </ipmpinfo:IPMPGeneralInfoDescriptor>
      </didl:Statement>
    </Descriptor>
    <!-- Original master version, composed of 2 files for first and second part respectively -->
    <Item xsi:type="mpaf:RepresentationType" uri="http://fred_alice/rep1">
      <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
        <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
          <mpaf:Identifier type="http://smpte-ra.org/umidreg/s330mex.html">urn:smpte:u-
mid:060A2B3401010 10501010D12130000000123456789ABCDEF0123456789ABCDEF</mpaf:Identifier>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
        <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
          <TechMetadata>
            <mpeg7:MediaProfile>
              <mpeg7:MediaFormat>
                <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2">
                  <mpeg7:Name>Audiovisual</mpeg7:Name>
                </mpeg7:Content>
              </mpeg7:MediaFormat>
```

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```
          </mpeg7:MediaProfile>
        </TechMetadata>
      </Statement>
    </Descriptor>
    <Item xsi:type="mpaf:EssenceType" uri="http://fred_alice.org/essence1">
      <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
        <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
           <Identifier type="http://fred_alice/archiveID">abc123</Identifier>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
        <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
          <TechMetadata>
            <mpeg7:MediaProfile>
              <mpeg7:MediaFormat>
                <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2"/>
                <mpeg7:FileFormat href="urn:mpeg:mpeg7:cs:FileFormatCS:2001:6">
                  <mpeg7:Name>Digital video format</mpeg7:Name>
                </mpeg7:FileFormat>
              </mpeg7:MediaFormat>
            </mpeg7:MediaProfile>
          </TechMetadata>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="mpaf:QualityDescriptorType">
        <Statement mimeType="text/xml" xsi:type="mpaf:QualityStatementType">
          <Description xsi:type="mpeg7:ContentEntityType">
            <mpeg7:MultimediaContent xsi:type="mpeg7:AudioVisualType">
              <mpeg7:AudioVisual/>
            </mpeg7:MultimediaContent>
          </Description>
        </Statement>
      </Descriptor>
      <Component xsi:type="mpaf:FileType" uri="http://fred_alice.org/essence1.mxf">
        <Resource mimeType="application/mxf"/>
      </Component>
    </Item>
    <Item xsi:type="mpaf:EssenceType" uri="http://fred_alice.org/essence2">
      <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
        <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
          <Identifier type="http://fred_alice.org/archiveID">abc124</Identifier>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
        <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
          <TechMetadata>
             <mpeg7:MediaProfile>
              <mpeg7:MediaFormat>
                <mpeg7:Content href=""/>
                <mpeg7:FileFormat href=""/>
              </mpeg7:MediaFormat>
            </mpeg7:MediaProfile>
          </TechMetadata>
```

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```
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="mpaf:QualityDescriptorType">
          <Statement mimeType="text/xml" xsi:type="mpaf:QualityStatementType">
            <Description xsi:type="mpeg7:ContentEntityType">
              <mpeg7:MultimediaContent xsi:type="mpeg7:AudioVisualType">
                <mpeg7:AudioVisual/>
              </mpeg7:MultimediaContent>
            </Description>
          </Statement>
        </Descriptor>
        <Component xsi:type="mpaf:FileType" uri="http://fred_alice.org/essence2.mxf">
          <Resource mimeType="application/mxf" ref="http://fred_alice.org/essence2.mxf"/>
        </Component>
      </Item>
    </Item>
    <!-- Joined and fixed master version resulting in a single  MXF file with its own wrapper compli-
ant to the latest SMPTE standard version -->
    <Item xsi:type="mpaf:RepresentationType" uri="http://fred_alice/rep2">
      <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
        <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
          <Identifier type="http://smpte-ra.org/umidreg/s330mex.html">urn:smpte:umid:060A2B3401010
10501010D12130000000123456789ABCDEF0123456789ABCDEF</Identifier>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
        <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
          <TechMetadata>
            <mpeg7:MediaProfile>
              <mpeg7:MediaFormat>
                <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2"/>
              </mpeg7:MediaFormat>
            </mpeg7:MediaProfile>
          </TechMetadata>
        </Statement>
      </Descriptor>
      <Item xsi:type="mpaf:EssenceType" uri="http://fred_alice.org/essence3">
        <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
          <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
            <Identifier type="http://fred_alice.org/archiveID">abc567</Identifier>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
          <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
            <TechMetadata>
              <mpeg7:MediaProfile>
                <mpeg7:MediaFormat>
                  <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2"/>
                </mpeg7:MediaFormat>
              </mpeg7:MediaProfile>
            </TechMetadata>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="mpaf:QualityDescriptorType">
```

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```
          <Statement mimeType="text/xml" 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/QADecomposi-
tionCS#qualitymeasures">
                    <mpeg7:Header xsi:type="mpeg7:DescriptionMetadataType">
                      <mpeg7:Comment>
                        <mpeg7:FreeTextAnnotation>Video and Audio quality annotations made automati-
cally</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">1.0</
mpeg7:RatingValue>
                                    <mpeg7:RatingScheme style="higherBetter"/>
                                </mpeg7:QualityRating>
                                <mpeg7:QCProfile>
                                    <mpeg7:Name href="http://acme.org/qc/mxfconformance"/>
                                    <!-- This is the list of QC checks automatically made by the
tool -->
                                    <mpeg7:QCItem>
                                        <!-- Operational Pattern -->
                                        <mpeg7:Name href="http://ebu.io/qc/items/0025W"/>
                                        <mpeg7:InputParameter name="OperationalPatternExpect-
ed">OP1a</mpeg7:InputParameter>
                                    </mpeg7:QCItem>
                                    <mpeg7:QCItem>
                                        <!-- KAG size  -->
                                        <mpeg7:Name href="http://ebu.io/qc/items/0151W"/>
                                        <mpeg7:InputParameter name="KAGsizeExpected">512</mpeg7:In-
putParameter>
                                    </mpeg7:QCItem>
                                    <mpeg7:QCItem>
                                        <!-- Partition Status  -->
                                        <mpeg7:Name href="http://ebu.io/qc/items/0063W"/>
                                        <mpeg7:InputParameter name="PartitionStatusHeaderExpected">-
Closed/Complete</mpeg7:InputParameter>
                                        <mpeg7:InputParameter name="PartitionStatusBodyExpected">-
Closed/Complete</mpeg7:InputParameter>
                                        <mpeg7:InputParameter name="PartitionStatusFooterExpected">-
Closed/Complete</mpeg7:InputParameter>
                                    </mpeg7:QCItem>
                                </mpeg7:QCProfile>
                                <!-- This is the result of the checks -->
                                <mpeg7:QCItemResult>
                                    <mpeg7:Name href="http://ebu.io/qc/items/0025W">
                                        <mpeg7:Name>Operational Pattern</mpeg7:Name>
                                    </mpeg7:Name>
                                    <mpeg7:Output name="CheckResult">True</mpeg7:Output>
                                    <mpeg7:ExecutionStatus>complete</mpeg7:ExecutionStatus>
                                    <mpeg7:DetectionMethod>automatic</mpeg7:DetectionMethod>
```

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```
                                </mpeg7:QCItemResult>
                                <mpeg7:QCItemResult>
                                    <mpeg7:Name href="http://ebu.io/qc/tests/0151W">
                                        <mpeg7:Name>KAG Size</mpeg7:Name>
                                    </mpeg7:Name>
                                    <mpeg7:Output name="CheckResult">True</mpeg7:Output>
                                    <mpeg7:ExecutionStatus>complete</mpeg7:ExecutionStatus>
                                    <mpeg7:DetectionMethod>automatic</mpeg7:DetectionMethod>
                                </mpeg7:QCItemResult>
                                <mpeg7:QCItemResult>
                                    <mpeg7:Name href="http://ebu.io/qc/tests/0063W">
                                        <mpeg7:Name>Partition Status</mpeg7:Name>
                                    </mpeg7:Name>
                                    <mpeg7:Output name="CheckResult">True</mpeg7:Output>
                                    <mpeg7:ExecutionStatus>complete</mpeg7:ExecutionStatus>
                                    <mpeg7:DetectionMethod>automatic</mpeg7:DetectionMethod>
                                </mpeg7:QCItemResult>
                            </mpeg7:MediaQuality>
                        </mpeg7:MediaProfile>
                    </mpeg7:MediaInformation>
                </mpeg7:AudioVisualSegment>
            </mpeg7:TemporalDecomposition>
        </mpeg7:AudioVisual>
    </mpeg7:MultimediaContent>
  </Description>
 </Statement>
</Descriptor>
<Component xsi:type="mpaf:FileType" uri="http://fred_alice.org/essence3.mxf">
 <Resource mimeType="application/mxf"/>
</Component>
</Item>
</Item>
<!-- Proxy version for CD ISO creation -->
<Item xsi:type="mpaf:RepresentationType" uri="http://fred_alice/rep3">
 <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
  <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
   <Identifier type="http://smpte-ra.org/umidreg/s330mex.html">urn:smpte:umid:060A2B3401010
10501010D12130000000123456789ABCDEF0123456789ABCDEF</Identifier>
  </Statement>
 </Descriptor>
 <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
  <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
   <TechMetadata>
    <mpeg7:MediaProfile>
     <mpeg7:MediaFormat>
     <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2"/>
     </mpeg7:MediaFormat>
    </mpeg7:MediaProfile>
   </TechMetadata>
  </Statement>
 </Descriptor>
 <Item xsi:type="mpaf:EssenceType" uri="http://fred_alice.org/essence4">
  <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
   <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
```

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```
            <Identifier type="http://fred_alice.org/archiveID">abc567</Identifier>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
          <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
            <TechMetadata>
              <mpeg7:MediaProfile>
                <mpeg7:MediaFormat>
                  <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2"/>
                </mpeg7:MediaFormat>
              </mpeg7:MediaProfile>
            </TechMetadata>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="mpaf:QualityDescriptorType">
          <Statement mimeType="text/xml" xsi:type="mpaf:QualityStatementType">
            <Description xsi:type="mpeg7:ContentEntityType">
              <mpeg7:MultimediaContent xsi:type="mpeg7:AudioVisualType">
                <mpeg7:AudioVisual/>
              </mpeg7:MultimediaContent>
            </Description>
          </Statement>
        </Descriptor>
        <Component xsi:type="mpaf:FileType" uri="http://fred_alice.org/essence4.iso">
          <Resource mimeType="application/octet-stream"/>
        </Component>
      </Item>
    </Item>
  </Item>
</DIDL>
```

Figure 19 — MP-AF XML representation of format migration example

8.3 Audiovisual Digitization Use Case

8.3.1 General

At the date of writing, RAI is undertaking a strategic internal project with the aim of digitizing its whole historical archive. This operation is done by moving the audio-visual content from old media carriers (e.g. Betacam tapes and 16 mm films) to master high quality files. Besides the essence, metadata have to be preserved with a special attention to technical and process metadata. This document does not dig into the details of the whole processing workflow or the technical aspects of the employed software tools. It focuses on describing the main metadata output that RAI intends to preserve and their collocation inside the MP-AF standard. The related MP-AF XML serialization included in this document is not to be understood as a final and complete version in use at RAI.

8.3.2 Process overview

Content migration is a complex process that includes a wide set of interdependent activities operated either automatically by specific software and devices or manually by specialized technicians and operators. Figure 20 shows briefly the main activities involved in a simplified version of the workflow adopted in RAI, in this picture the temporal sequence of actions is represented from left to right. Each activity is summarized in 8.3.3, with specific focus on generated metadata and their representation in MP-AF.

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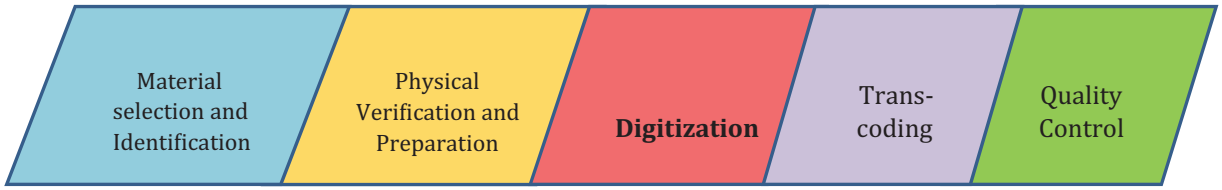

Figure 20 — Simplified migration workflow

8.3.3 Preservation metadata along the processing chain

8.3.3.1 General

Making reference to Figure 20, the following subclauses briefly describe each activity and related produced metadata to be represented and preserved inside MP-AF.

8.3.3.2 Material selection and identification

In this phase, the analogue material is selected taking into account given priorities, numbers of copies and kind of original media available, rights, etc. The Selection and Identification is typically performed relying on the available information in legacy databases, collected metadata are related mostly to the identification of the editorial items stored on the media and their rights.

The MP-AF descriptors used for representing this information are

— *IdentificationDescriptor* for unique identification,

— *ContextDescriptor* for the description of the context (the RAI archives digitization project), and

— *ExploitationRightsDescriptor* for describing existing rights.

8.3.3.3 Physical verification and preparation

In this phase, a human operator (agent) checks the physical condition of the media and prepares it for the digitization (i.e. applying a barcode to a cassette needed for the following automation processes or repairing the splices in a film).

This phase is tracked in terms of recording who made the operation and/or the tools used (e.g. a Betacam cleaner). Additionally, some technical metadata are verified/completed here like the size and duration of the cassette if these are not available from the previous processing step.

Technical metadata is placed in *TechnicalMetadataDescriptor,* while the report from the cleaner is referenced as an external file. It is supposed that in this phase, the operator also checks the authenticity of the content, the result of this evaluation is stored within the *AuthenticityDescriptor.*

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8.3.3.4 Digitization

8.3.3.4.1 General

Within this activity, the analogue audio-visual signals are translated into digital form and recorded on a master file in a predefined format. The digitization is at the core of the entire process and is very important to ensure the usage of high quality tools in order to guarantee the maintenance of original audio and video quality. Betacam cassettes are digitized using proper VTRs, in this case the monitoring of radio frequency (RF) levels is a key activity for verifying if the magnetic heads read the original tape correctly. In case of problems, the tape can be reworked for example using a different VTR, cleaning the heads or even by performing a physical restoration of the tape. The collected RF signal information is of a large size. Basically, a value for luminance and for chrominance per each video field/frame is recorded; therefore this is not suitable to be serialized directly in the XML report, being stored in an external text file, referenced inside MP-AF *QualityDescriptor.* Other useful metadata represented inside this example include the date and the location of digitization, the identification of the robotic line performing the digitization and the specific VTR being used for playing the tape. The relation between the produced master file and the original media is described within the *ProvenanceDescriptor.* The master file is checksummed globally and for each frame. This information is preserved using a *FixityDescriptor.*

8.3.3.4.2 Transcoding

In this phase, a transcoder tool (e.g. the open source tool *ffmpeg*[2)]) derives from the master file a proxy representation with lower bitrate to be used by following activities for indexing and previewing. The name and version of the transcoding tool is preserved together with all the parameters used for the operation (e.g. the configuration of audio channels, the target bitrate and resolution, etc.). The proxy itself is matter of preservation and constitutes a further MP-AF *Representation*.

8.3.3.4.3 Assisted quality control

In this activity, audio and video technicians check the quality of the content from the master file, helped by automatic measures gathered in previous phases like the VTR RF signals. More precisely operators are requested to check the correctness of the aspect ratio, the global video and audio quality, and to annotate video and audio defects along the timeline.

The quality control checklist (i.e. what to check and how) can be specified following the formal definition of QCItems provided by the EBU Quality Control[3)] group.

To complete check of all the programmes is time consuming, therefore RAI decided to reduce it to specific intervals covering a percentage of the duration. The results and annotations are preserved inside the MP-AF *QualityDescriptor* that makes use of ISO/IEC 15938-5:2003/Amd 5:2015 and the *ExtendedMediaQualityType* definition.

In this phase, the user additionally checks the completeness of the content, the result of this assessment is stated and preserved inside a descriptor of type *IntegrityDescriptorType.*

8.3.4 MP-AF XML serialization

This subclause reports a complete (yet not exhaustive) XML serialization of MP-AF metadata that formally validates against the last version of the normative schema provided by the standard. Useful comments are provided inline.

The *mpaf:DIDLInfo* element contains all the process-related information including the list of Operators (i.e. Agents and Tools) and the relevant Activities (i.e. as described in previous clauses). Each activity reports what is used as input and what is produced as output. For example, the Digitization activity uses the Betacam tape and creates the master MXF file and the plain text metadata file with the VTR RF measures. The top-most *mpaf:Item* element describes the object of preservation (i.e. the

2) http://ffmpeg.org/

3) http://www.ebu.io/qc/item

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editorial entity or programme having attribute type="PreservationObjectType"). This aggregates the three Representations: the original media (i.e. in this case a Betacam cassette), the master quality MXF-D10 file resulting from digitization and the MPEG-4 AVC proxy file derived from the master. The *ContextDescriptor, AuthenticityDescriptor* and *ExploitationRightsDescriptor* are also attached to the *Preservationobject.* The representation of the original cassette contains an *IntegrityDescriptor,* while for the master file three descriptors are attached (i.e. an *IntegrityDescriptor*, a *FixityDescriptor* and a *QualityDescriptor).*

Figure 21 shows the logical representation of the MP-AF document with the above mentioned structure, the XML serialization follows immediately after.

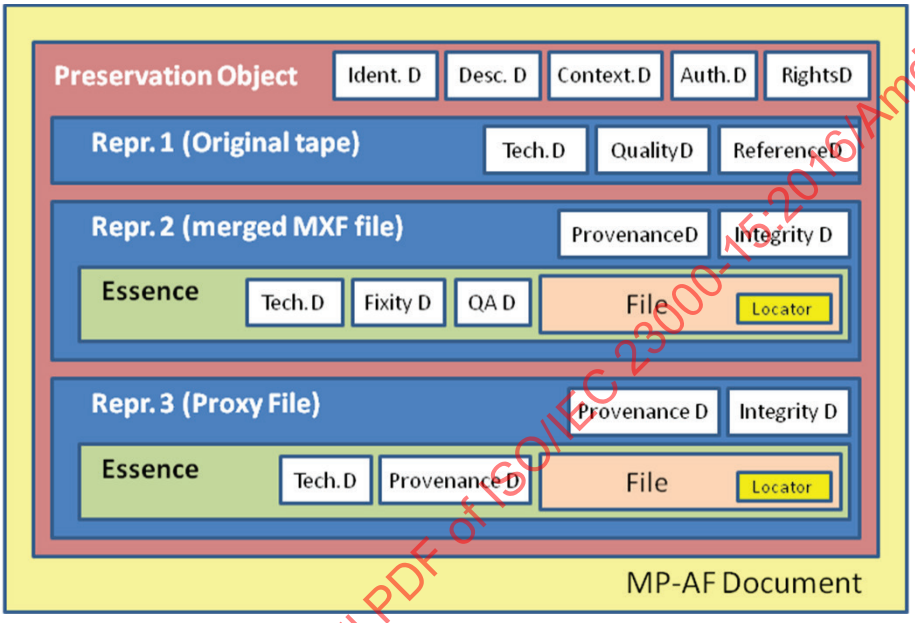

Figure 21 — Structure of MP-AF document used by RAI

```
<!--  MP-AF XML instance describing the metadata preserved by RAI when migrating from legacy media
to Master quality files -->
<!-- Note: This is a non exaustive nor fully stable example  -->
<DIDL xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:maf:schema:preserva-
tion:2015" xmlns:mpaf="urn:mpeg:maf:schema:preservation:2015" xmlns:dc="http://purl.org/dc/ele-
ments/1.1/" xmlns:ebucore="urn:ebu:metadata-schema:ebuCore_2015" xmlns:mpeg7="urn:mpeg:mpeg7:sche-
ma:2004" xsi:schemaLocation="urn:mpeg:maf:schema:preservation:2015 mpaf.xsd">
  <!-- This part contains all the process related information, including operators and activities -->
  <DIDLInfo>
    <ProcessEntities>
      <!-- List of Tools involved -->
      <Operator xsi:type="ToolType" type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt07"
uri="http://identifiers.rai.it/digimaster/line1/taperecorder1">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="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="ToolType" type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt38"
uri="http://identifiers.rai.it/digimaster/line1/cleaner1">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
```

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```
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>Preparation tools/Cleaner</dc:description>
          </Statement>
        </Descriptor>
        <Name>TC-matic</Name>
        <Manufacturer href="http://www.indelt.it/"/>
      </Operator>
      <Operator xsi:type="ToolType" type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt35"
uri="http://identifiers.rai.it/digimaster/line1/proxy_encoder">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>Coding, wrapping/transcoding ffmpeg, used for proxy generation from the
master file </dc:description>
          </Statement>
        </Descriptor>
        <Name>ffmpeg</Name>
        <Manufacturer href="https://www.ffmpeg.org/"/>
        <Version>2.5.3 "Bohr"</Version>
        <Parameters>
          <!-- This is the command line used for transcoding from MXF-D10 to MPEG-4 AVC -->
          <Param type="commandline"> ffmpeg -i 01+IDTECA+NUMSUPP.mxf  -c:v libx264  -flags +il-
me+ildct -b:v 2M -map 0:0 -c:a libfdk_aac -cutoff 18000 -b:a 64k   -map 0:1 -map_channel 0.1.0:0.1
-map 0:1 -map_channel 0.1.1:0.2  -map 0:1 -map_channel 0.1.2:0.3  -map 0:1 -map_channel 0.1.3:0.4 -f
mp4 01+IDTECA+NUMSUPP.mp4</Param>
        </Parameters>
      </Operator>
      <Operator xsi:type="ToolType" type="urn:mpeg:maf:cs:preservation:ToolCS:2015:pt14"
uri="http://identifiers.rai.it/digimaster/QCworkstation/DigiMasterQC">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>Quality Control Tool
                        DigiMaster Quality Control tool - Used for QC defect annotations</dc:de-
scription>
          </Statement>
        </Descriptor>
        <Name>DigiMasterQC</Name>
        <Manufacturer href="https://www.crit.rai.it/"/>
        <Version>1.0</Version>
        <Parameters>
          <!-- This configuration specifies a specific taxonomy for audio and video defects -->
            <Param type="configuration">digimaster.xml</Param>
        </Parameters>
      </Operator>
      <!-- List of Agents (persons) -->
      <!-- This is the person responsible for the monitoring of the migration macro-activity (in-
cludes cleaning, digitization and transcoding)-->
      <Operator xsi:type="PersonType" uri="http://identifiers.rai.it/digimaster/humanresources/
p12345" type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat06">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
              <dc:description>Systems Operator</dc:description>
          </Statement>
        </Descriptor>
        <Name>
            <mpeg7:FamilyName>Mario</mpeg7:FamilyName>
            <mpeg7:GivenName>Rossi</mpeg7:GivenName>
```

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```
        </Name>
      </Operator>
      <!-- This is the person who checks and prepares the physical media before actual digitization-->
      <Operator xsi:type="PersonType" uri="http://identifiers.rai.it/digimaster/humanresources/p6789"
type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat10">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="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>
      <!-- This is the person who makes the Quality Control on the master MXF file -->
      <Operator xsi:type="PersonType" uri="http://identifiers.rai.it/digimaster/humanresources/p1111"
type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat12">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>AudioVisual Technician</dc:description>
          </Statement>
        </Descriptor>
        <Name>
          <mpeg7:FamilyName>Guido</mpeg7:FamilyName>
          <mpeg7:GivenName>Bianchi</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="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>
            CARRIER ASSESSMENT AND PREPARATION
            This activity checks the physical conditions of the media and prepares it for the fol-
lowing steps.
            </dc:description>
          </Statement>
        </Descriptor>
        <!-- Points to the operator previously defined, role is Execution-->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://identifiers.rai.it/
digimaster/humanresources/p6789</Operator>
      </Activity>
      <!-- A macro activity of type migration includes 3 activities: cleaning of the tape, digitiza-
tion of the tape, transcoding of the master file to a proxy file -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa05" uri="http://identifiers.rai.
it/digimaster/activites/a2" start="2014-07-01T09:30:00" end="2014-07-01T09:06:00" executed="true">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>
              OVERALL MIGRATION PROCESS
              This activity is made up of several sub-activities as described in the following
              The Agent is the system operator that supervises the robotic and its digitisation lines
            </dc:description>
          </Statement>
```

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```
        </Descriptor>
        <!-- This activity is automatic, then no Agents are directly involved-->
        <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa14" uri="http://identifiers.
rai.it/digimaster/activites/a2.1" start="2014-07-01T09:30:00" end="2014-07-01T09:06:00" execut-
ed="true">
          <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
            <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
              <dc:description>
              CLEANING
              This activity consists in cleaning the tape using a dedicated Cleaner machine
              </dc:description>
            </Statement>
          </Descriptor>
          <!-- Points to the operator previously defined -->
          <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://identifiers.rai.it/
digimaster/line1/cleaner1</Operator>
          <!-- Pointer to the original tape (ref is used in a Item of type RepresentationType
below)-->
          <Content relationType="uses" ref="http://archive.rai.it/rome/technicalversions/
tapes/01+IDTECA+NUMSUPP"/>
          <!-- Pointer to the cleaning report that is an external file  (ref is used in a Reference-
Descriptor below)-->
          <Content relationType="creates" ref="http://identifiers.rai.it/archive/cleaningRe-
ports/01+IDTECA+NUMSUPP"/>
        </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" execut-
ed="true">
          <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
            <Statement xsi:type="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://archive.rai.it/rome/technicalversions/
tapes/01+IDTECA+NUMSUPP"/>
          <!-- pointer to the master file coming out from digitization (ref is used in an Item of Es-
senceType below)-->
          <Content relationType="creates" ref="http://archive.rai.it/rome/technicalversions/master-
files/01+IDTECA+NUMSUPP.MXF"/>
          <!-- pointer to the external file containing the RF measures of chrominance and luminance
envelopes  (ref is used in a ReferenceDescriptor below)-->
          <Content relationType="creates" ref="http://identifiers.rai.it/archive/RFmeasures/01+IDTE-
CA+NUMSUPP"/>
        </Activity>
        <!-- This activity is automatic, then no Agents are directly involved-->
        <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa13" uri="http://identifiers.
rai.it/digimaster/activites/a2.3" start="2014-07-01T11:12:00" end="2014-07-01T11:17:00" execut-
ed="true">
          <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
            <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
              <dc:description>
```

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```
                PROXY CREATION
                This activity consists in the generation of MPEG-4 AVC proxy from MXF-D10 master file
(transcoding)
              </dc:description>
            </Statement>
          </Descriptor>
          <!-- Points to the operator previously defined -->
          <Operator>http://identifiers.rai.it/digimaster/line1/proxy_encoder</Operator>
          <!-- Pointer to the original tape (ref is used in a Item of type RepresentationType
below)-->
          <Content relationType="uses" ref="http://archive.rai.it/rome/technicalversions/master-
files/01+IDTECA+NUMSUPP.MXF"/>
          <!-- pointer to the proxy file coming out from transcoding (ref is used in an Item of Rep-
resentationType below)-->
          <Content relationType="creates" ref="http://archive.rai.it/rome/technicalversions/proxy-
files/01+IDTECA+NUMSUPP.mp4"/>
        </Activity>
        <!-- This is the Agent of the migration macro-activity, role is Supervisor -->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr02">http://identifiers.rai.it/
digimaster/humanresources/p12345</Operator>
        <!-- Location where the digitization farm is located -->
        <Location xsi:type="mpeg7:PlaceType">
         <mpeg7:Name>Central Archive Rome</mpeg7:Name>
         <mpeg7:StructuredPostalAddress>
           <mpeg7:StreetNumber>1041</mpeg7:StreetNumber>
           <mpeg7:StreetName>Via Salaria</mpeg7:StreetName>
           <mpeg7:City>Roma</mpeg7:City>
           <mpeg7:PostingIdentifier>00100</mpeg7:PostingIdentifier>
         </mpeg7:StructuredPostalAddress>
        </Location>
      </Activity>
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa77" uri="http://identifiers.rai.
it/digimaster/activites/a3" start="2014-07-02T09:02:00" end="2014-07-02T09:28:00" executed="true">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>
              QUALITY CONTROL/HUMAN
              This activity consists in the manual checking of the audio and video content from the
master MXF file
            </dc:description>
          </Statement>
        </Descriptor>
        <!-- This is the pointer to the QC Technician previously defined in this doc that made the QC
activity on the master file, role is Execution -->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://identifiers.rai.it/
digimaster/humanresources/p1111</Operator>
        <!-- This is the pointer to the software tool (previously defined) used for doing the QC de-
fects annotations -->
        <!-- Agent p6789 used the tool AVAT for QC annotations -->
        <Operator operatorOnBehalfOf="http://identifiers.rai.it/digimaster/humanresources/
p1111">http://identifiers.rai.it/digimaster/QCworkstation1/DigiMasterQC</Operator>
        <!-- The master file of the entire tape-->
        <Content relationType="uses" ref="http://archive.rai.it/rome/technicalversions/master-
files/01+IDTECA+NUMSUPP.MXF"/>
        <!-- RF measures are used to help the technician doing the QC check-->
        <Content relationType="uses" ref="http://identifiers.rai.it/archive/RFmeasures/01+IDTECA+-
NUMSUPP"/>
```

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```
        <!-- QC report is inside a QualityDescriptor (that uses Mpeg7) included in this doc and with
uri="qcreport"-->
        <Content relationType="creates" ref="#qcreport"/>
      </Activity>
    </ProcessEntities>
  </DIDLInfo>
  <!-- ****** This is the programme to preserve (a specific editorial version) ****** -->
  <Item xsi:type="PreservationObjectType" uri="http://archive.rai.it/rome/editorialversions/IDTECA">
    <Descriptor xsi:type="IdentificationDescriptorType">
      <Statement mimeType="text/xml">
        <Identifier type="UMID">00000800.46b1.e8f1.d81d1300.36700580</Identifier>
      </Statement>
    </Descriptor>
    <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
      <Statement xsi:type="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:subject>fiction</dc:subject>
        <dc:description>Rai internal production</dc:description>
      </Statement>
    </Descriptor>
    <Descriptor xsi:type="ContextDescriptorType">
      <Statement mimeType="text/xml">
        <Reference>
          <!-- RelationshipType  rs02 is Project -->
          <Relation relationshipType="urn:mpeg:maf:cs:preservation:RelationshipCS:2015:rs02">http://
identifiers.rai.it/projects/DigiMaster</Relation>
          <Description xsi:type="mpeg7:TextualType">The overall context is the RAI DigiMaster pro-
ject dealing with the migration of media carriers to master high quality MXF files</Description>
        </Reference>
      </Statement>
    </Descriptor>
    <!-- authenticity statement for the tape being digitised -->
    <Descriptor xsi:type="AuthenticityDescriptorType">
      <Statement mimeType="text/xml" xsi:type="AuthenticityStatementType">
        <CheckList>
          <Entity ref="http://archive.rai.it/rome/technicalversions/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 who performed the Authenticity check, role is Execution -->
          <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://identifiers.rai.it/
digimaster/humanresources/p6789</Operator>
          <Timestamp>2014-07-01T08:15:00</Timestamp>
        </CheckList>
      </Statement>
    </Descriptor>
    <!-- Rights expressed using MCO, in this simple case RAI holds the IPR -->
    <Descriptor xsi:type="ExploitationRightsDescriptorType">
```

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```
      <Statement xsi:type="MCORightsStatementType" mimeType="application/owl+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">
          <owl:Import>urn:mpeg:mpeg21:mco:ipre:2012</owl:Import>
          <owl:Declaration>
            <owl:NamedIndividual IRI="#x554"/>
          </owl:Declaration>
          <owl:Declaration>
            <owl:NamedIndividual IRI="#x555"/>
          </owl:Declaration>
          <owl:Declaration>
            <owl:NamedIndividual IRI="#x556"/>
          </owl:Declaration>
          <owl:Declaration>
            <owl:NamedIndividual IRI="#rai.it"/>
          </owl:Declaration>
          <owl:ClassAssertion>
            <owl:Class IRI="http://purl.oclc.org/NET/mvco.owl#IPEntity"/>
            <owl:NamedIndividual IRI="#x554"/>
          </owl:ClassAssertion>
          <owl:ClassAssertion>
            <owl:Class IRI="http://purl.oclc.org/NET/mvco.owl#Permission"/>
            <owl:NamedIndividual IRI="#x555"/>
          </owl:ClassAssertion>
          <owl:ClassAssertion>
            <owl:Class IRI="urn:mpeg:mpeg21:mco:ipre:2012#ExploitIPRights"/>
            <owl:NamedIndividual IRI="#x556"/>
          </owl:ClassAssertion>
          <owl:ClassAssertion>
            <owl:Class IRI="urn:mpeg:mpeg21:mco:core:2012#Organization"/>
            <owl:NamedIndividual IRI="#rai.it"/>
          </owl:ClassAssertion>
          <owl:ObjectPropertyAssertion>
            <owl:ObjectProperty IRI="http://purl.oclc.org/NET/mvco.owl#permitsAction"/>
            <owl:NamedIndividual IRI="#x555"/>
            <owl:NamedIndividual IRI="#x556"/>
          </owl:ObjectPropertyAssertion>
          <owl:ObjectPropertyAssertion>
            <owl:ObjectProperty IRI="http://purl.oclc.org/NET/mvco.owl#actedOver"/>
            <owl:NamedIndividual IRI="#x556"/>
            <owl:NamedIndividual IRI="#x554"/>
          </owl:ObjectPropertyAssertion>
          <owl:ObjectPropertyAssertion>
            <owl:ObjectProperty IRI="http://purl.oclc.org/NET/mvco.owl#actedBy"/>
            <owl:NamedIndividual IRI="#x556"/>
            <owl:NamedIndividual IRI="#rai.it"/>
          </owl:ObjectPropertyAssertion>
          <owl:DataPropertyAssertion>
            <owl:DataProperty IRI="urn:mpeg:mpeg21:2002:01-DII-NS#Identifier"/>
          <owl:NamedIndividual IRI="#x554"/>
          <owl:Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#string">00000800.46b1.e8f1.
d81d1300.36700580</owl:Literal>
          </owl:DataPropertyAssertion>
```

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```
          <owl:DataPropertyAssertion>
            <owl:DataProperty IRI="urn:mpeg:mpeg21:mco:ipre:2012#isExclusive"/>
            <owl:NamedIndividual IRI="#x555"/>
            <owl:Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#boolean">true</owl:Literal>
          </owl:DataPropertyAssertion>
          <owl:AnnotationAssertion>
            <owl:AnnotationProperty IRI="http://purl.org/dc/elements/1.1/identifier"/>
            <owl:IRI>#x554</owl:IRI>
            <owl:Literal datatypeIRI=" http://www.w3.org/2001/XMLSchema#string">00000800.46b1.e8f1.
d81d1300.36700580</owl:Literal>
          </owl:AnnotationAssertion>
          <owl:AnnotationAssertion>
            <owl:AnnotationProperty IRI="http://purl.org/dc/elements/1.1/title"/>
            <owl:IRI>#rai.it</owl:IRI>
            <owl:Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#string">RAI – Radiotelevi-
sione Italiana S.p.A.</owl:Literal>
          </owl:AnnotationAssertion>
          <owl:AnnotationAssertion>
            <owl:AnnotationProperty IRI="http://purl.org/dc/elements/1.1/identifier"/>
            <owl:IRI>#rai.it</owl:IRI>
            <owl:Literal datatypeIRI="http://www.w3.org/2001/XMLSchema#string">VATIN:06382641006</
owl:Literal>
          </owl:AnnotationAssertion>
        </owl:Ontology>
      </Statement>
    </Descriptor>
    <!-- This is the original master Betacam Tape representation -->
    <Item xsi:type="RepresentationType" uri="http://archive.rai.it/rome/technicalversions/
tapes/01+IDTECA+NUMSUPP">
      <Descriptor xsi:type="TechnicalMetadataDescriptorType">
        <Statement xsi:type="EBUCoreTMStatementType" mimeType="text/xml">
          <TechMetadata>
            <ebucore:medium mediumId="01+IDTECA+NUMSUPP" typeLabel="BetacamSPLarge"/>
            <ebucore:duration>
              <ebucore:normalPlayTime>PT01H</ebucore:normalPlayTime>
            </ebucore:duration>
          </TechMetadata>
        </Statement>
      </Descriptor>
      <!-- This is the reference to an external file created by the cleaner as a report  -->
      <Descriptor xsi:type="ReferenceDescriptorType" uri="http://identifiers.rai.it/archive/cleanin-
gReports/01+IDTECA+NUMSUPP">
        <Statement xsi:type="RelationStatementType" mimeType="text/xml" xmlns:-
dii="urn:mpeg:mpeg21:2002:01-DII-NS">
          <dii:RelatedIdentifier>01+IDTECA+NUMSUPP.cleanreport.xml</dii:RelatedIdentifier>
        </Statement>
      </Descriptor>
      <Descriptor xmlns:mpaf="urn:mpeg:maf:schema:preservation:2015" xsi:type="QualityDescriptor-
Type" uri="http://identifiers.rai.it/archive/RFmeasures/01+IDTECA+NUMSUPP">
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement xsi:type="DublinCoreDMStatementType" mimeType="text/xml">
            <dc:description>This is the reference to an external file created by the RF analyzer dur-
ing the digitization</dc:description>
          </Statement>
        </Descriptor>
```

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```
        <!-- the representation attribute points to a useful resource indicating the dislocationa
and meaning of the information inside the RFmeasure.txt files -->
        <Statement mimeType="text/plain" xsi:type="QualityStatementType" ref="01+IDTECA+NUMSUPP.RF-
measures.txt" representation="http://archive.rai.it/representations/VTR_RF.txt"/>
      </Descriptor>
    </Item>
    <!-- This is the Master quality representation -->
    <Item xsi:type="RepresentationType" uri="http://archive.rai.it/rome/technicalversions/master-
files/01+IDTECA+NUMSUPP">
      <!-- Here we state the fact that this representation comes from the digitisation of a specific
tape -->
      <Descriptor xsi:type="ProvenanceDescriptorType">
        <Statement mimeType="text/xml" xsi:type="ProvenanceStatementType">
          <!-- This is the link to the activity of tape digitization that from the tape produces the
master file, this activity is defined under DIDLinfo at the beginning of this xml -->
          <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa07" uri="http://identifiers.
rai.it/digimaster/activites/a2.2"/>
        </Statement>
      </Descriptor>
      <!-- integrity of the representation -->
      <Descriptor xsi:type="IntegrityDescriptorType">
        <Statement mimeType="text/xml" xsi:type="IntegrityStatementType">
          <CheckList>
            <!-- list all entities that must be present to consider the representation complete -->
             <Entity>http://archive.rai.it/rome/technicalversions/masterfiles/01+IDTECA+NUMSUPP.
MXF</Entity>
          </CheckList>
          <!-- Link to the source tape, RelationshipType  rs17 is "Media Carrier"  -->
          <ExternalDependency relationshipType="urn:mpeg:maf:cs:preservation:Relation-
shipCS:2015:rs17">http://archive.rai.it/rome/technicalversions/tapes/01+IDTECA+NUMSUPP</ExternalDe-
pendency>
        </Statement>
      </Descriptor>
      <!-- This is the actual master MXF file -->
      <Item xsi:type="EssenceType" uri="http://archive.rai.it/rome/technicalversions/master-
files/01+IDTECA+NUMSUPP.MXF">
        <Component xsi:type="FileType">
          <Descriptor xsi:type="TechnicalMetadataDescriptorType">
            <Statement xsi:type="EBUCoreTMStatementType" mimeType="text/xml">
              <TechMetadata>
                <ebucore:videoFormat>
                  <ebucore:width unit="pixels">1920</ebucore:width>
                  <ebucore:lines>1080</ebucore:lines>
                  <ebucore:frameRate>25</ebucore:frameRate>
                  <ebucore:aspectRatio>
                    <ebucore:factorNumerator>16</ebucore:factorNumerator>
                    <ebucore:factorDenominator>9</ebucore:factorDenominator>
                  </ebucore:aspectRatio>
                  <ebucore:videoEncoding typeLabel="D10"/>
                  <ebucore:codec>
                    <!-- This is the eVTR extension mounted inside the VTR -->
                    <ebucore:name>BKMW-3000</ebucore:name>
                    <ebucore:vendor>Sony</ebucore:vendor>
                  </ebucore:codec>
                  <ebucore:scanningFormat>interlaced</ebucore:scanningFormat>
                  <ebucore:scanningOrder>top</ebucore:scanningOrder>
```

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```
                    <ebucore:technicalAttributeInteger typeLabel="bit depth">8</ebucore:technicalAt-
tributeInteger>
                    <!-- 4:2:2 subsampling is given with horizontal subsampling=2 and vertical subsam-
pling=1 according to MXF SMPTE 377-1 -->
                    <ebucore:technicalAttributeInteger typeLabel="horizontal subsampling">2</ebucor-
e:technicalAttributeInteger>
                    <ebucore:technicalAttributeInteger typeLabel="vertical subsampling">1</ebucor-
e:technicalAttributeInteger>
                  </ebucore:videoFormat>
                  <ebucore:audioFormat>
                    <ebucore:audioEncoding typeLabel="PCM"/>
                    <ebucore:samplingRate>48000</ebucore:samplingRate>
                    <ebucore:sampleSize>16</ebucore:sampleSize>
                    <ebucore:channels>8</ebucore:channels>
                  </ebucore:audioFormat>
                  <ebucore:containerFormat>
                    <ebucore:containerEncoding formatLabel="MXF"/>
                  </ebucore:containerFormat>
                  <ebucore:duration>
                    <ebucore:normalPlayTime>PT1H</ebucore:normalPlayTime>
                  </ebucore:duration>
                  <ebucore:fileSize>2000406004</ebucore:fileSize>
                  <ebucore:fileName>01+IDTECA+NUMSUPP.MXF</ebucore:fileName>
                </TechMetadata>
              </Statement>
            </Descriptor>
            <!-- Here the information about QC, made using  mpeg7 -->
            <!-- the uri attribute is used here and in the QC Activity for referencing -->
            <Descriptor xsi:type="QualityDescriptorType" uri="qcreport">
              <Statement mimeType="" xsi:type="QualityStatementType">
                <Description xsi:type="mpeg7:ContentEntityType">
                  <mpeg7:MultimediaContent xsi:type="mpeg7:AudioVisualType">
                    <mpeg7:AudioVisual>
                      <mpeg7:TemporalDecomposition criteria="http://mpeg7.joanneum.at/cs/QADecomposi-
tionCS#qualitymeasures">
                        <mpeg7:Header xsi:type="mpeg7:DescriptionMetadataType">
                          <mpeg7:Comment>
                            <mpeg7:FreeTextAnnotation>Video and Audio quality annotations made manual-
ly</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>
                                    <!-- General Image Quality -->
                                    <mpeg7:Name href="http://ebu.io/qc/tests/0087B"/>
```

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```
                                </mpeg7:QCItem>
                                <mpeg7:QCItem>
                                  <!-- Image Shape, could happen that the master files comes as 4:3
while it is 16:9 -->
                                  <mpeg7:Name href="http://ebu.io/qc/tests/0121B"/>
                                </mpeg7:QCItem>
                              </mpeg7:QCProfile>
                              <!-- This is the result of the quality analyses, mpeg7:Name/@href
just below is used to reference the QCItem-->
                              <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:SegmentOutput>
                                  <mpeg7:Output name="PictureQualityGeneral">2</mpeg7:Output>
                                  <mpeg7:MediaTime>
                                    <mpeg7:MediaTimePoint>T00:05:01</mpeg7:MediaTimePoint>
                                    <mpeg7:MediaDuration>PT11S</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: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/0125B">
                                  <mpeg7:Name>General Audio Quality</mpeg7:Name>
                                </mpeg7:Name>
                                <mpeg7:SegmentOutput>
                                  <mpeg7:Output name="AudioQualityGeneral">2</mpeg7:Output>
                                  <mpeg7:MediaTime>
                                    <mpeg7:MediaTimePoint>T00:01:03</mpeg7:MediaTimePoint>
```

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```
                                    <mpeg7:MediaDuration>PT5S</mpeg7:MediaDuration>
                                  </mpeg7:MediaTime>
                                </mpeg7:SegmentOutput>
                                <mpeg7:SegmentOutput>
                                  <mpeg7:Output name="AudioQualityGeneral">2</mpeg7:Output>
                                  <mpeg7:MediaTime>
                                    <mpeg7:MediaTimePoint>T00:05:01</mpeg7:MediaTimePoint>
                                    <mpeg7:MediaDuration>PT11S</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>
          <Descriptor xsi:type="FixityDescriptorType">
            <!-- Here the checksums ... global and frame based  -->
            <Statement mimeType="text/xml" xsi:type="FixityStatementType">
              <!-- global checksum -->
              <Check xsi:type="FixityCheckType" type="MD5">5a6efbbaea4271f3d57a750fab91d1db</Check>
              <!-- segment checksums, entire edit unit -->
              <!-- only the first 2 edit units are reported for  brevity -->
              <Check xsi:type="SegmentFixityCheckType" type="MD5" start="1" span="1" unit="editu-
nit">5a6efbbaea4271f3d57a750fab91d1db</Check>
              <Check xsi:type="SegmentFixityCheckType" type="MD5" start="2" span="1" unit="editu-
nit">54bb3861ba0aaed2b546d1cdff381efe</Check>
              <!-- segment checksums, audio part-->
              <!-- only the first 2 edit units are reported for  brevity -->
              <Check xsi:type="SegmentFixityCheckType" type="MD5" start="1" span="1" unit="editunit"
stream="audiotrack1">d2fa305ef3f187aba19046ed0077b603</Check>
              <Check xsi:type="SegmentFixityCheckType" type="MD5" start="2" span="1" unit="editunit"
stream="audiotrack1">72a46379779bf69aa08b4a000ce6dbb3</Check>
              <!-- segment checksums, video  part -->
              <!-- only the first 2 edit units are reported for  brevity -->
              <Check xsi:type="SegmentFixityCheckType" type="MD5" start="1" span="1" unit="editunit"
stream="audiotrack2">edba27bb51d4ea3b35c41e9373edf75c</Check>
              <Check xsi:type="SegmentFixityCheckType" type="MD5" start="2" span="1" unit="editunit"
stream="audiotrack2">1bcf25e81a023b89959ee46a5f3684ca</Check>
            </Statement>
          </Descriptor>
          <Resource mimeType="video/mxf" ref="01+IDTECA+NUMSUPP.MXF"/>
        </Component>
      </Item>
    </Item>
```

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```
    <!-- This is the Proxy quality representation -->
    <Item xsi:type="RepresentationType" uri="http://archive.rai.it/rome/technicalversions/proxy-
files/01+IDTECA+NUMSUPP">
      <Item xsi:type="EssenceType" uri="http://archive.rai.it/rome/technicalversions/proxy-
files/01+IDTECA+NUMSUPP.mp4">
        <Component xsi:type="FileType">
          <Descriptor xsi:type="ProvenanceDescriptorType">
            <Statement mimeType="text/xml" xsi:type="ProvenanceStatementType">
              <!-- This is the link to the activity of file transcoding that from the master file pro-
duces the proxy file, this activity is defined under DIDLinfo at the beginning of this xml -->
              <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa13" uri="http://identi-
fiers.rai.it/digimaster/activites/a2.3"/>
            </Statement>
          </Descriptor>
          <Descriptor xsi:type="TechnicalMetadataDescriptorType">
            <Statement xsi:type="MPEG7TMStatementType" mimeType="text/xml">
              <TechMetadata>
                <mpeg7:MediaProfile>
                  <mpeg7:MediaFormat>
                    <mpeg7:Content href="urn:mpeg:mpeg7:cs:ContentCS:2001:2">
                      <mpeg7:Name>Audiovisual</mpeg7:Name>
                    </mpeg7:Content>
                    <mpeg7:FileFormat href="urn:mpeg:mpeg7:cs:FileFormatCS:2001:5">
                      <mpeg7:Name>mp4</mpeg7:Name>
                    </mpeg7:FileFormat>
                    <mpeg7:FileSize>200050801</mpeg7:FileSize>
                    <mpeg7:BitRate variable="1">2000000</mpeg7:BitRate>
                    <mpeg7:VisualCoding>
                      <mpeg7:Format href="urn:mpeg:mpeg7:cs:VisualCodingFormatCS:2001:3.7">
                        <mpeg7:Name>MPEG-4 Visual Main Profile</mpeg7:Name>
                      </mpeg7:Format>
                      <mpeg7:Pixel bitsPer="8"/>
                      <mpeg7:Frame rate="25" aspectRatio="1.778" height="1080" width="1920" struc-
ture="progressive"/>
                    </mpeg7:VisualCoding>
                    <mpeg7:AudioCoding>
                      <!-- look for mpeg7 CS -->
                      <mpeg7:Format href="urn:mpeg:mpeg7:cs:AudioCodingFormatCS:2001:4.3">
                        <mpeg7:Name>MPEG-2 Audio AAC</mpeg7:Name>
                      </mpeg7:Format>
                      <mpeg7:AudioChannels>8</mpeg7:AudioChannels>
                      <mpeg7:Sample bitsPer="16" rate="48000"/>
                    </mpeg7:AudioCoding>
                  </mpeg7:MediaFormat>
                </mpeg7:MediaProfile>
              </TechMetadata>
            </Statement>
          </Descriptor>
          <Resource mimeType="video/mp4" ref="01+IDTECA+NUMSUPP.mp4"/>
        </Component>
      </Item>
    </Item>
  </Item>
</DIDL>
```

Figure 22 — MP-AF XML representation of audiovisual digitization example

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8.4 Audio Digitization Use Case

8.4.1 General

National Diet Library (NDL) in Japan has been digitizing Short Play (SP) gramophone records and audio tapes (4 track 1/2 inch) because of their obsolescence and fragility and the difficulty to ensure proper playback through of really old devices. Nowadays, such players are no more present on the shelf and many manufacturers have disbanded their construction. Figure 23 shows an overview of the digitization process carried out at NDL.

8.4.2 SP gramophone records

The SP gramophone records are digitized to audio files that are stored mostly on DVD-R, even if sometimes also hard disks are used.

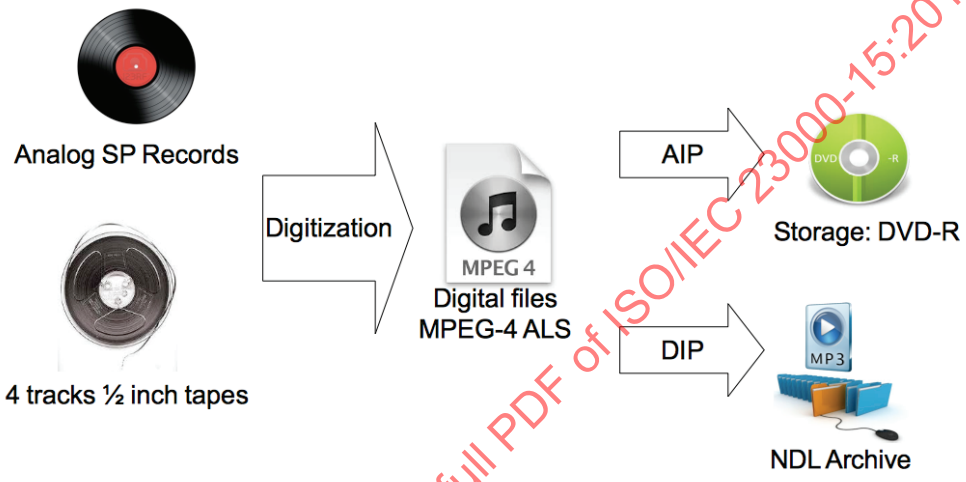

Figure 23 — Overview of digitization process carried out at NDL

The digitization process creates master files with high quality encoding using a lossless compression, (i.e. the MPEG-4 ALS - Audio Lossless Coding). For better access to the audio content, a more compact copy, in a lower quality, is created. The MP3 format has been selected for this purpose.

For a good preservation and management of the newly created digital files, the following metadata is collected:

— Metadata of original SP records available from NDL archive (i.e. registry information):
  — Bibliographic ID of the record;
  — Bibliographic descriptive information: title, author, performer, publisher, publication date, etc.;
  — Type of media (i.e. SP record type).

During the digitization, information about the process itself is gathered such as:

— Process information:
  — Date and venue of digitization;

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  - Agents and tools used for digitization:
    - Brand and model of the analogue to digital (A/D) converters devices being used for playback;
    - Technicians involved;
  - Auxiliary information such as cleaning method, noise reduction, etc.
- Output File Information (one for each side of the tape):
  - Name and ID;
  - Format and codec (i.e. using MPEG-4 ALS);
  - Sampling rate;
  - Bit depth;
  - Size in bytes;
  - Fixity information (i.e. using MD5 checksum).

From the process of browsing quality (proxy) creation the following metadata are gathered:

- Acting Agents and Tools:
  - Software (converters and transcoders);
  - Technicians involved;
- Browsing quality file Information:
  - Name and ID;
  - Format and codec (MP3);
  - Sampling rate;
  - Bit depth;
  - Size in bytes;
  - Fixity information (MD5 checksum).

The NDL's staff archives the digitized files and metadata for dissemination in an internal media management system, following a separate flow than the master quality files.

Concerning the Rights, the NDL staff clears the rights information before dissemination and stores them as well. If copyright protection period is expired, the dissemination file is provided under public access licence though the internet. In case of still valid copyright protection period, the dissemination file is restricted to be accessed only from NDL institution by NDL personnel.

8.4.3 Tapes (4 tracks 1/2 inch)

Analogue tapes 4 tracks 1/2 inch are digitized to MPEG-4 ALS lossless audio file format, the same used for SP records. The digitization process follows the same workflow as presented in Figure 3. The metadata gathered are slightly different, because of the different source format.

One difference is that 1/2 inch tapes usually contain more songs on the same media while gramophone records always contain one per side. One file is created for each song and the original order inside the tape is kept as additional metadata (i.e. songs 1 to N).

Table 9 reports the most relevant metadata created during the digitization process.

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Table 9 — Most relevant metadata gathered during the NDL workflow

DESCRIPTIVE	Example
ALBUM	
Album title	春の海/宮城道雄<I>
Album title transcription	ハルノウミ/ミヤギミチオ<1> HARU-NO-UMI/Miyagi Michio <1>
Album ID	#13106
Album structure description	LP, Side A , Side B
Publisher (label)	ビクター Japan Victor
Date of issue (Year-Month-Date)	1993-12-01
Date of creation (Year-Month-Date)	1930-01-01
Subject	箏曲(生田流) Ikutaryu-School Style Koto music
Collection information	歴史的音源 Historical music recordings
SIDE A	
Title (song or other)	春の海(一)- Spring see 1
Title transcription (song or other)	ハルノウミ(1) - HARU-NO-UMI(1)
ID (song or other)	Side-A-001
Creator (composer)	宮城　道雄[作曲] Michio Miyagi
Creator (composer) transcription	ミヤギ ミチオ Michio Miyagi
Audio playback time (duration as hh:mm:ss)	03:07:00
Description of the original recordings (Item number, etc.)	商品番号: 13106 Side-A #13106 Side-A
ID of the original material	VI001555
SIDE B	
…	
TECHNICAL DIGITIZATION	
Digitization ID (song or other)	Info:ndljp/pid/1319027
Digitization ID attributor	NDL japan
Contributor (Digitizer)	ビクターエンタテインメント(株) Victor Entertainment Inc.
Date of digitization	2009-02-28
Provider of digitised content (note asks Victor to digitise content on behalf on NDL and then HiRAC gives digitised content to NDL)	HiRAC(歴史的音盤アーカイブ) HiRAC: Historical Records Archive Promotion Conference
Sampling rate	44,1 kHz
Bit depth	24 bit
AD converter for digitization	ONKYO SE-U33GXV2
Noise reduction type	No noise reduction applied
Digitization compression scheme	Lossless (No compression applied)
File format type	WAV
File format version	n.a.
Digitised filename	File123456789.wav
Digitised file ID	12345678
FIXITY	

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Table 9 *(continued)*

DESCRIPTIVE	Example
Message digest algorithm	MD5
Message digest value	Xxxx
Message digest originator	Software name and version
STORAGE	
Medium	DVD-R
Media ID	13452445
ACCESS	
File format for dissemination	FLV
URI (root location for dissemination)	http://dl.ndl.go.jp/info:ndljp/pid/1319027/
Filename	File123456789.flv
File ID	78792798327
Date of conversion	2011-02-28
Operator of conversion (contributor)	NDL
Sampling rate	44,1 kHz
Bit depth	16 bit
RIGHTS	
Creator (composer)	宮城　道雄[作曲] Michio Miyagi [composer]
Publisher	ビクター Japan Victor
Access restriction (Internet access available or NDL internal only)	Internet access available
Copyright	Public domain
EVENT HISTORY INFORMATION	
Event identifier	Xxxyyy
Event type	Migration
Event date time	2013-01-01
Agent type identifier	NDL member
Agent identifier name	岡本
Agent identifier name transcription	オカモト Okamoto

8.4.4 XML serialization of MP-AF metadata

This subclause reports a complete XML serialization of MP-AF metadata recorded during the digitization of a SP with two sides. The XML formally validates against the normative schema provided by the standard. Useful comments are provided inline.

The *mpaf:DIDLInfo* element contains the process related information including the list of Operators (Agents and Tools) and the relevant Activities described in previous chapters. Each activity reports what is used as input and what is produced as output. For example, the Digitization activity uses the master quality file and creates the proxy file.

The top-most *mpaf:Item* element describes the preservation object (i.e. the entire SP disk, attribute type= “PreservationObjectType”). This object includes two other preservation objects which are side A and side B of the disk. This is modelled in this way because each side has its own value as different preservation entity. Inside side A and side B objects find place two distinct Representations: the master quality WAV file resulting from digitization, which is stored on DVD and the MP3 proxy file derived from the master.

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Both at *PreservationObject* and *Representation* levels the *Identification Descriptor*, *DescriptiveMetadata Descriptor* and *TechnicalMetadata Descriptor* are used in order to include additional relevant information. Figure 24 shows a schematic representation of the MP-AF document with the above mentioned structure, the XML serialization follows immediately after.

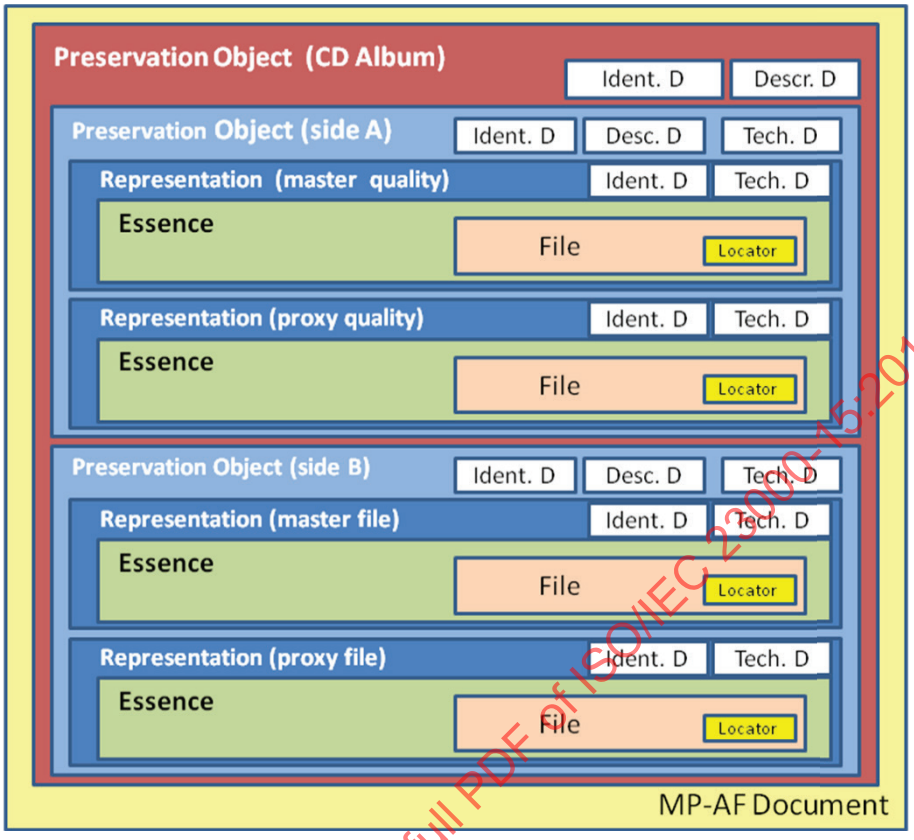

Figure 24 — Logical structure of the MP-AF Document as used by NDL

```
<DIDL xmlns="urn:mpeg:maf:schema:preservation:2015" xmlns:mpaf="urn:mpeg:maf:schema:preserva-
tion:2015" xmlns:didmodel="urn:mpeg:mpeg21:2002:02-DIDMODEL-NS" xmlns:mpeg7="urn:mpeg:mpeg7:sche-
ma:2004" xmlns:mp7amd5="urn:x-mpeg:mpeg7:amd5:2014" xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS"
xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:ebucore="urn:ebu:metadata-schema:ebuCore_2015"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMP-
INFO-NS" xmlns:didl="urn:mpeg:mpeg21:2002:02-DIDL-NS" xsi:schemaLocation="urn:mpeg:maf:schema:pres-
ervation:2015 mpaf.xsd">
  <DIDLInfo>
    <ProcessEntities>
      <!-- Digitisation activity, operated by Okamoto -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa07" uri="Info:ndljp/
pid/1319027" start="2009-02-28T00:00:00" executed="true">
        <!-- role is execution -->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://www.ndl.co.jp/users/Oka-
moto</Operator>
        <Content ref="http://www.ndl.go.jp/fileID/78792798327" relationType="creates"/>
      </Activity>
      <!-- Transcoding activity, done by Victor Entertainment Inc. and supervised by HiRAC -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa13" uri="http://www.ndl.go.jp/
fileID/78792798327/creation" start="2011-02-28T00:00:00" executed="true">
        <!-- role is execution -->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://www.jvcmusic.co.jp</Operator>
        <!-- role is supervision-->
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr02">http://hirac.jp</Operator>
```

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```
        <Content ref="http://dl.ndl.go.jp/info:ndljp/pid/1319027/" relationType="creates"/>
      </Activity>
      <Operator type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat06" uri="http://www.ndl.
co.jp/users/Okamoto" xsi:type="PersonType">
        <Name xml:lang="jp">
          <mpeg7:FamilyName>岡本</mpeg7:FamilyName>
        </Name>
        <Name xml:lang="en">
          <mpeg7:FamilyName>Okamoto</mpeg7:FamilyName>
        </Name>
        <Name xml:lang="jp">
          <mpeg7:FamilyName>オカモト</mpeg7:FamilyName>
        </Name>
        <Affiliation>
          <Organization>
            <mpeg7:Name>NDL</mpeg7:Name>
          </Organization>
        </Affiliation>
      </Operator>
      <Operator type="urn:mpeg:maf:cs:preservation:AgentTypeCS:2015:pat07" uri="http://www.jvcmusic.
co.jp" xsi:type="OrganizationType">
        <Name xml:lang="jp">ビクターエンタテインメント(株)</Name>
        <Name xml:lang="en">Victor Entertainment Inc.</Name>
      </Operator>
      <Operator type="http://www.ndl.go.jp/roles/contentprovider" uri="http://hirac.jp" xsi:-
type="OrganizationType">
        <Name xml:lang="jp">HiRAC(歴史的音盤アーカイブ)</Name>
        <Name xml:lang="en">HiRAC: Historical Records Archive Promotion Conference</Name>
      </Operator>
    </ProcessEntities>
  </DIDLInfo>
  <!-- ****** This is the Album to preserve ****** -->
  <Item xsi:type="mpaf:PreservationObjectType" uri="http://www.ndl.go.jp/id/12345">
    <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
      <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
        <mpaf:Identifier type="http://www.ndl.go.jp/albumid">#13106</mpaf:Identifier>
      </Statement>
    </Descriptor>
    <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
      <Statement mimeType="text/xml" xsi:type="EBUCoreXMLDMStatementType">
        <ebuCoreMain>
          <ebucore:coreMetadata>
            <ebucore:title typeLabel="album title">
              <dc:title xml:lang="jp">春の海/宮城道雄 - 1</dc:title>
            </ebucore:title>
            <ebucore:title typeLabel="album title transcription">
              <dc:title xml:lang="jp">ハルノウミ/ミヤギミチオ - 1</dc:title>
            </ebucore:title>
            <ebucore:title typeLabel="album title transcription">
              <dc:title xml:lang="jp">HARU-NO-UMI/Miyagi Michio - 1</dc:title>
            </ebucore:title>
            <ebucore:subject>
              <dc:subject xml:lang="jp">箏曲(生田流)</dc:subject>
              <dc:subject xml:lang="jp">Ikutaryu-School Style Koto music</dc:subject>
```

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```
            </ebucore:subject>
            <ebucore:description typeLabel="album structure">
              <dc:description xml:lang="en">LP, Side A, Side B</dc:description>
            </ebucore:description>
            <ebucore:description typeLabel="collection">
              <dc:description xml:lang="en">歴史的音源</dc:description>
              <dc:description xml:lang="en">Historical music recordings</dc:description>
            </ebucore:description>
            <ebucore:publisher>
              <ebucore:organisationDetails>
                <ebucore:organisationName xml:lang="jp">ビクター</ebucore:organisationName>
                <ebucore:organisationName typeLabel="transcription" xml:lang="en">Japan Victor</ebu-
core:organisationName>
              </ebucore:organisationDetails>
            </ebucore:publisher>
            <ebucore:date>
              <ebucore:created startDate="1930-01-01"/>
              <ebucore:issued startDate="1993-12-01"/>
            </ebucore:date>
            <ebucore:type>
              <ebucore:genre typeLanguage="jp" typeLabel="箏曲(生田流)"/>
              <ebucore:genre typeLanguage="en" typeLabel="Ikutaryu-School Style Koto music"/>
              <ebucore:objectType typeLabel="LP"/>
            </ebucore:type>
            <ebucore:identifier typeLabel="album ID">
              <dc:identifier>#13106</dc:identifier>
            </ebucore:identifier>
          </ebucore:coreMetadata>
        </ebuCoreMain>
      </Statement>
    </Descriptor>
    <!-- Side A -->
    <Item xsi:type="mpaf:PreservationObjectType">
      <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
        <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
          <mpaf:Identifier type="http://www.ndl.go.jp/sideId">#13106-Side-A-001</mpaf:Identifier>
          <mpaf:Identifier type="http://www.ndl.go.jp/originalContentID">VI001555</mpaf:Identifier>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="TechnicalMetadataDescriptorType">
        <Statement mimeType="text/xml" xsi:type="EBUCoreTMStatementType">
          <TechMetadata>
            <ebucore:duration>
              <ebucore:normalPlayTime>PT0H3M7S</ebucore:normalPlayTime>
            </ebucore:duration>
          </TechMetadata>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
        <Statement mimeType="text/xml" xsi:type="EBUCoreXMLDMStatementType">
          <ebuCoreMain>
            <ebucore:coreMetadata>
              <ebucore:title>
```

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```
                <dc:title xml:lang="jp">春の海(一)</dc:title>
                <dc:title xml:lang="en">Spring see (1)</dc:title>
                <dc:title xml:lang="jp">ハルノウミ(1)</dc:title>
                <dc:title xml:lang="jp">HARU-NO-UMI(1)</dc:title>
              </ebucore:title>
              <ebucore:creator>
                <ebucore:contactDetails>
                  <ebucore:name xml:lang="jp">宮城　道雄[作曲] Michio Miyagi</ebucore:name>
                  <ebucore:name xml:lang="en">Michio Miyagi</ebucore:name>
                  <ebucore:name xml:lang="jp">ミヤギ ミチオ</ebucore:name>
                </ebucore:contactDetails>
                <ebucore:role typeLabel="composer"/>
              </ebucore:creator>
              <ebucore:description typeLabel="original recordings">
                <dc:description>商品番号: 13106 Side-A
                            #13106 Side-A</dc:description>
              </ebucore:description>
              <ebucore:rights>
                <dc:rights>Internet access available</dc:rights>
                <ebucore:rightsHolder>
                  <ebucore:organisationDetails>
                    <ebucore:organisationName xml:lang="jp">ビクター</ebucore:organisationName>
                    <ebucore:organisationName typeLabel="transcription" xml:lang="en">Japan Victor</
ebucore:organisationName>
                  </ebucore:organisationDetails>
                  <ebucore:role typeLabel="publisher"/>
                </ebucore:rightsHolder>
                <ebucore:rightsHolder>
                  <ebucore:contactDetails>
                    <ebucore:name xml:lang="jp">宮城　道雄[作曲]</ebucore:name>
                    <ebucore:name xml:lang="en">Michio Miyagi</ebucore:name>
                    <ebucore:name xml:lang="jp">ミヤギ ミチオ</ebucore:name>
                  </ebucore:contactDetails>
                  <ebucore:role typeLabel="composer"/>
                </ebucore:rightsHolder>
                <ebucore:copyrightStatement>public domain</ebucore:copyrightStatement>
              </ebucore:rights>
            </ebucore:coreMetadata>
          </ebuCoreMain>
        </Statement>
      </Descriptor>
      <Item xsi:type="RepresentationType" uri="http://www.ndl.go.jp/fileID/78792798327">
        <!-- digital master representation -->
        <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
          <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
            <mpaf:Identifier type="http://www.ndl.go.jp/fileID">78792798327</mpaf:Identifier>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="TechnicalMetadataDescriptorType">
          <Statement mimeType="text/xml" xsi:type="EBUCoreTMStatementType">
            <TechMetadata>
              <ebucore:medium typeLabel="DVD-R" mediumId="13452445"/>
              <ebucore:audioFormat>
```

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```
                <ebucore:codec>
                  <ebucore:name>ONKYO SE-U33GXV2</ebucore:name>
                </ebucore:codec>
                <ebucore:samplingRate>44100</ebucore:samplingRate>
                <ebucore:sampleSize>24</ebucore:sampleSize>
                <ebucore:technicalAttributeString typeLabel="file format">WAV</ebucore:technicalAttributeString>
                <ebucore:technicalAttributeString typeLabel="noise reduction type">no noise reduction applied</ebucore:technicalAttributeString>
                <ebucore:technicalAttributeString typeLabel="digitisation compression type">lossless TRUE</ebucore:technicalAttributeString>
                <ebucore:technicalAttributeString typeLabel="fixity message digest algorithm">MD5</ebucore:technicalAttributeString>
                <ebucore:technicalAttributeString typeLabel="fixity message digest value">8916074482beee884f94eaa4cf7ee1d7</ebucore:technicalAttributeString>
                <ebucore:technicalAttributeString typeLabel="fixity message digest originator">software name and version</ebucore:technicalAttributeString>
              </ebucore:audioFormat>
            </TechMetadata>
          </Statement>
        </Descriptor>
        <Item xsi:type="EssenceType">
          <Component xsi:type="FileType">
            <Resource mimeType="audio/wav" ref="File123456789.wav"/>
          </Component>
        </Item>
      </Item>
      <Item xsi:type="RepresentationType" uri="http://dl.ndl.go.jp/info:ndljp/pid/1319027">
        <!-- dissemination representation -->
        <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
          <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
            <mpaf:Identifier type="http://www.ndl.go.jp/fileID">78792798327</mpaf:Identifier>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="DescriptiveMetadataDescriptorType">
          <Statement mimeType="text/xml" xsi:type="EBUCoreXMLDMStatementType">
            <ebuCoreMain>
              <ebucore:coreMetadata>
                <ebucore:format formatName="dissemination format">
                  <ebucore:audioFormat>
                    <ebucore:samplingRate>44100</ebucore:samplingRate>
                    <ebucore:sampleSize>16</ebucore:sampleSize>
                    <ebucore:technicalAttributeString typeLabel="file format">FLV</ebucore:technicalAttributeString>
                  </ebucore:audioFormat>
                  <ebucore:fileName>File123456789.flv</ebucore:fileName>
                <ebucore:locator>http://dl.ndl.go.jp/info:ndljp/pid/1319027/</ebucore:locator>
                </ebucore:format>
              </ebucore:coreMetadata>
            </ebuCoreMain>
          </Statement>
        </Descriptor>
        <Descriptor xsi:type="TechnicalMetadataDescriptorType">
          <Statement mimeType="text/xml" xsi:type="EBUCoreTMStatementType">
            <TechMetadata>
              <ebucore:audioFormat>
```

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```
                <ebucore:samplingRate>44100</ebucore:samplingRate>
                <ebucore:sampleSize>16</ebucore:sampleSize>
                <ebucore:technicalAttributeString typeLabel="file format">FLV</ebucore:technicalAttributeString>
              </ebucore:audioFormat>
            </TechMetadata>
          </Statement>
        </Descriptor>
        <Item xsi:type="EssenceType">
          <Component xsi:type="FileType">
            <Resource mimeType="video/x-flv" ref="File123456789.flv"/>
          </Component>
        </Item>
      </Item>
    </Item>
    <!-- side B -->
    <Item xsi:type="mpaf:PreservationObjectType">
      <!-- Side B, Information not reported, structure equivalent to Side A-->
    </Item>
  </Item>
</DIDL>
```

Figure 25 — MP-AF XML representation of audio digitization example

8.5 MP-AF and packaging

8.5.1 General

There are basically two ways of using MP-AF: embedding metadata with the content and referencing content from the metadata. Sometimes, a mixed approach may be used. MP-AF supports both options without interoperability conflicts. For enhanced interoperability, different types of containers providing means for embedding metadata (e.g. PA-AF, MXF, AXF, IMF) are supported, but it is out of scope of the normative specification to define the mechanism for embedding. There is no interoperability conflict with the existing PA-AF specification when MP-AF is combined with PA-AF.

8.5.2 Embedding in container formats

8.5.2.1 General

This subclause describes possible options for embedding MP-AF in media formats. Possible choices are MPEG PA-AF, SMPTE MXF, SMPTE AXF, LoC METS among others. In the following, the embedding mechanisms for MPEG PA-AF, SMPTE AXF and SMPTE MXF are described.

8.5.2.2 Professional Archive Application Format (PA-AF)

PA-AF (ISO/IEC 23000-6:2012) specifies the following:

— a metadata format to describe the original structure of digital files archived in a PA-AF file;

— a metadata format to describe context information related to a PA-AF file and digital files archived in it;

— a metadata format to describe necessary information to reverse the pre-processing processes applied to digital files prior to archiving them in a PA-AF file;

— a file format for carriage of the metadata formats and digital files.

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The master metadata document in a PA-AF container conforms to MPEG-21 DIDL. An MP-AF document can take this role. The following small precautions are necessary to allow validation against the schema of PA-AF, while allowing the inclusion of all constructs of MP-AF:

— change default namespace to DIDL;

— Replace `urn:mpeg:maf:schema:preservation:2015 mpaf.xsd` with `urn:mpeg:maf:schema:preservation:DIDL:2015 mpafdidl.xsd`;

— Make sure to use the MPAF namespace prefix in `xsi:type` attributes (e.g. `Operator xsi:type="mpaf:ToolType"`).

Example DIDL document containing MP-AF extensions (same document as described in 8.1.3):

```
<DIDL xmlns="urn:mpeg:mpeg21:2002:02-DIDL-NS" xmlns:mpaf="urn:mpeg:maf:schema:preservation:
DIDL:2015" xmlns:didmodel="urn:mpeg:mpeg21:2002:02-DIDMODEL-NS" xmlns:mpeg7="urn:mpeg:mpeg7:sche-
ma:2004" xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS" xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:ebucore="urn:ebu:metadata-schema:ebuCore_2014" xmlns:xsi="http://www.w3.org/2001/XMLSchema-in-
stance" xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS" xmlns:didl="urn:mpeg:mpeg21:2002:02-
DIDL-NS" xsi:schemaLocation="urn:mpeg:maf:schema:preservation:DIDL:2015 mpafdidl.xsd
urn:mpeg:mpeg21:2002:02-DIDL-NS mpeg21/did/didl.xsd">
  <DIDLInfo>
    <ProcessEntities>
      <!-- Checksum verification -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa18" uri="a1">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://my.org/qc/tool1</Operator>
        <!-- first part of the programme -->
        <Content relationType="uses" ref="http://my.org/essence1"/>
        <!-- second part of the programme -->
        <Content relationType="uses" ref="http://my.org/essence2"/>
      </Activity>
      <!-- Repairing/Rewrapping -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa56" uri="a2">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01" operatorOnBehalfOf="http://
my.org/people/doe">http://my.org/qc/tool2</Operator>
        <Content relationType="uses" ref="http://fred_alice.org/essence1"/>
        <Content relationType="uses" ref="http://fred_alice/essence2"/>
        <!-- The joined and transwrapped MXF -->
        <Content relationType="creates" ref="http://fred_alice/essence3"/>
      </Activity>
      <!-- Quality Control/File-based made on joined-transwrapped MXF-->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa21" uri="a3">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://acme.org/qc/tool4</
Operator>
        <Content relationType="uses" ref="http://fred_alice/essence3"/>
      </Activity>
      <!-- Transcoding -->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa13" uri="a4">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://acme.org/qc/tool3</
Operator>
        <Content relationType="uses" ref="http://fred_alice/essence3"/>
        <!-- The proxy quality version of the entire programme -->
        <Content relationType="creates" ref="http://fred_alice/essence4"/>
      </Activity>
      <!-- Quality Control/File-based made on generated proxy version-->
      <Activity type="urn:mpeg:maf:cs:preservation:ActivityCS:2015:pa21" uri="a5">
        <Operator role="urn:mpeg:maf:cs:preservation:RoleCS:2015:pr01">http://acme.org/qc/tool4</
Operator>
```

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        <Content relationType="uses" ref="http://fred_alice/essence4"/>
      </Activity>
      <!-- Metadata Extractor -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool1" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt25"/>
      <!-- MXF joiner and Trans-Wrapper -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool2" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt18"/>
      <!-- Transcoder -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool3" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt35"/>
      <!-- Proxy file analyzer -->
      <Operator xsi:type="mpaf:ToolType" uri="http://acme.org/qc/tool4" type="urn:mpeg:maf:cs:pres-
ervation:ToolCS:2015:pt14"/>
      <!-- Audiovisual technician -->
      <Operator xsi:type="mpaf:PersonType" uri="http://acme.org/people/doe" type="urn:mpeg:ma-
f:cs:preservation:AgentTypeCS:2015:pat12">
        <mpaf:Name>
          <mpeg7:GivenName>John</mpeg7:GivenName>
          <mpeg7:FamilyName>Doe</mpeg7:FamilyName>
        </mpaf:Name>
      </Operator>
    </ProcessEntities>
  </DIDLInfo>
  <!-- The programme to be transcoded, made of 2 MXF files -->
  <Item xsi:type="mpaf:PreservationObjectType" uri="http://fred_alice/pm1">
    <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
      <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
        <mpaf:Identifier type="http://smpte-ra.org/umidreg/s330mex.html">urn:smpte:umid:060A2B-
340101010501010D12130000000123456789ABCDEF0123456789ABCDEF</mpaf:Identifier>
      </Statement>
    </Descriptor>
    <Descriptor xsi:type="didl:DescriptorType">
      <didl:Statement mimeType="text/xml" xsi:type="didl:StatementType">
        <ipmpinfo:IPMPGeneralInfoDescriptor>
          <ipmpinfo:ToolList>
            <ipmpinfo:ToolDescription localID="AESEncrypt">
              <ipmpinfo:IPMPToolID>http://www.w3.org/2001/04/xmlenc#aes128</ipmpinfo:IPMPToolID>
              <ipmpinfo:Remote ref="urn:IPMPToolsServer:ToolEnc005-3485"/>
            </ipmpinfo:ToolDescription>
          </ipmpinfo:ToolList>
        </ipmpinfo:IPMPGeneralInfoDescriptor>
      </didl:Statement>
    </Descriptor>
    <!-- Original master version, composed of 2 files for first and second part respectively -->
    <Item xsi:type="mpaf:RepresentationType" uri="http://fred_alice/rep1">
      <Descriptor xsi:type="mpaf:IdentificationDescriptorType">
        <Statement xsi:type="mpaf:IdentificationStatementType" mimeType="text/xml">
          <mpaf:Identifier type="http://smpte-ra.org/umidreg/s330mex.html">urn:smpte:u-
mid:060A2B3401010 10501010D12130000000123456789ABCDEF0123456789ABCDEF</mpaf:Identifier>
        </Statement>
      </Descriptor>
      <Descriptor xsi:type="mpaf:TechnicalMetadataDescriptorType">
        <Statement xsi:type="mpaf:MPEG7TMStatementType" mimeType="text/xml">
          <TechMetadata>
            <mpeg7:MediaProfile>
```

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