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# AHDS Preservation Metadata Framework

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Recommended AHDS Preservation Metadata Schema

**Final version**

**prepared by**

Raivo Ruusalepp  
Estonian Business Archives, Ltd.

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## 1. Overview

The effective management of digital preservation requires creation, maintenance and retention of detailed metadata to facilitate the preservation process. Metadata is an important component of preservation of digital objects, as it supports the discovery, use, storage and preservation processing of these objects over time. In the context of digital objects, metadata can be divided into three functional categories:

- 1) Descriptive
- 2) Structural
- 3) Administrative

Internationally, comparatively more attention has been paid to the descriptive metadata that facilitates resource discovery and identification — several standards exist (e.g., Dublin Core, EAD, etc.), and subject-specific metadata schemas are being developed continuously (e.g., Learning Object Metadata). Structural metadata that binds together the components of complex digital objects contains information required to support the use of a resource (e.g., details of an object's content, structure, any technical dependencies, meanings of coded numbers, etc.). The administrative metadata supports the management of archived digital collections and resources, including technical preservation management metadata and administrative collections management metadata. In practice, the different types of metadata are not always kept and managed together as a single set or hierarchy.

The preservation metadata is metadata which relates to the technical and physical aspects of digital objects and which inform the way the objects have changed over time in order to ensure their longevity. The change history of a digital object must be maintained over time to guarantee its authenticity and integrity. Preservation metadata is, in essence, the information infrastructure that supports the processes associated with digital preservation. More specifically, it is the information necessary to maintain the *viability*, *renderability*, and *understandability* of digital objects over the long-term. Viability requires that the archived digital object's bit stream is intact and readable from the digital media upon which it is stored. Renderability refers to the translation of the bit stream into a form that can be viewed by human users, or processed by computers. Understandability involves providing enough information such that the rendered content can be interpreted and understood by its intended users. Preservation metadata can serve as input to preservation processes, and also record the output of these same processes.

The descriptive and structural metadata are not specified in this framework. Instead it presents the first version of a set of preservation metadata elements which the AHDS expects to use to ensure the longevity of digital resources it holds in its collections.

## 2. Basis of this framework

The wide range of functions that preservation metadata is aimed to fulfil means that defining metadata standards is not a simple task and that most of the currently published schemas are relatively complex. The situation is complicated further by the perception that different kinds of metadata will be required to support different digital preservation strategies or digital information types.

Several initiatives have addressed the issue of preservation metadata, resulting in a variety of approaches to its use. These approaches, developed often independently of one another and designed largely to meet particular institutional or project requirements, nevertheless share several common features but may also differ on a number of key points.

This preservation metadata framework draws heavily on the work of the OCLC/RLG Working Group on Preservation Metadata and the National Library of Australia, but is also based on a synthesis of work carried out in:

- the Consultative Committee for Space Data Systems
- the CEDARS project
- the Public Record Office
- the Office of the e-Envoy
- the NEDLIB project
- the California Digital Library
- the Harvard University Library.

Permission of the Public Record Office to reproduce parts of its framework are acknowledged.

Many of the elements in the framework were originally identified and defined in earlier work namely:<sup>1</sup>

- Preservation Metadata and the OAIS Information Model: A Metadata Framework to Support the Preservation of Digital Objects
- Metadata for Digital Preservation: The Cedars Outline Specification
- National Library of Australia Preservation Metadata for Digital Collections (Exposure Draft)
- Harvard Digital Library DRS Administrative Metadata for Digital Still Images.

### **3. Format of the framework**

This framework represent metadata elements numbered with a simple sequential scheme. The exception is for the elements dealing with File Description (element 4), Fixity Method (8), Software Environment (element 13) and Relations (element 17), which are viewed as containing a number of sub-elements. An element can be a single field or a multi-valued field and can itself contain other elements (sub-elements). Each element is described in one table. The tables show appropriate combinations of the following for each metadata element:

- element number and name;
- definition;
- purpose;
- OAIS reference;
- scope, examples and a statement on requirement (where appropriate) on three different levels of aggregation: collection, object, and file;
- source;
- comments.

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<sup>1</sup> for links to resources see bibliography in section 8.

The element number is for reference within this document only and has no wider significance. The definition and purpose explain the meaning and reason for recording the information entailed in the element.

The OAIS reference maps the AHDS preservation metadata element to the name of the OCLC/RLG preservation metadata element.<sup>2</sup>

Three levels of granularity have been chosen that may require metadata elements to be associated with them. These are:

- Collection, which represents all files included in an individual deposit or study acquired by the AHDS Service Provider.
- Object, which may stand for sub-divisions of collections or deposits, or represent complex digital objects that comprise of several files.
- File, which is singular unit requiring digital preservation metadata.

The collection level is suitable for linking with the AHDS-wide resource discovery metadata. The Object level may only be necessary for some resources archived by the AHDS Service Providers, but in most cases can be omitted and the file level metadata can be used instead. At present, very little file-level metadata is being created and maintained by the AHDS Service Providers. However, the significance of file-level control becomes more apparent when digital resources from all Service Providers are pooled together into a single preservation system to be managed and processed for long-term.

Scope and simple examples are provided for each level of collection elements and a recommendation is made for the obligation to record the particular metadata element. The Source indicates a suggested creator for the element and Comments provide additional information on the use of the element.

The preservation metadata framework is presented in two parts: technical preservation metadata and administrative preservation management metadata. The first of these is recording the static information about the current state of the archived digital resource, whereas the second aims to document the history of change and processing that the digital resource has been subjected to during preservation.

## 4. Limitations

Metadata schemas need to be ‘fit for purpose’ and each of them needs to meet a specific set of requirements.<sup>3</sup> Thus, the current framework represents a statement of the information that is believed to be needed to manage preservation of the AHDS digital collections; it does not present a “complete set” of preservation metadata elements.

It is recognised that there is likely to be an overlap between this framework and metadata recorded for other administrative and structural purposes, or resource discovery metadata.

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<sup>2</sup> cf. OCLC/RLG Working Group on Preservation Metadata, “Metadata and the OAIS Information Model: A Metadata Framework to Support the Preservation of Digital Objects” (June 2002)

<sup>3</sup> G. Rust, “Metadata: The Right Approach, an Integrated Model for Descriptive and Rights Metadata in e-Commerce” (July/August 1998)

Different types of digital materials and different archiving systems will need different metadata support. There may be types of material and processes that are not adequately accommodated by the proposed framework. This version of the framework caters for a limited set of data types, namely:

- text
- database
- image
- video
- audio
- executables.

Other data types can be added as necessary at a later date. Such addition will require the addition of sub-elements under the File Description (4).

Metadata requirements are expected to evolve rapidly as technology advances. For example, some newer audio compression standards require completely different metadata elements from older standards. As new standards come into use, it will be necessary to update and add to this framework.

## 5. Recommended preservation metadata elements

### I. Technical Description of the Resource

<b>Number</b>	<b>1</b>		
<b>Name</b>	<b>Persistent Identifier</b>		
<b>Definition</b>	An identifier or 'permanent name' for an object that identifies it uniquely and persistently, and enables links to different manifestations of it, to metadata about it and to other objects related to it.		
<b>Purpose</b>	Each object described must have a persistent identifier to identify it uniquely, to discriminate between different manifestations of it and to link it with its metadata record.		
<b>OAIS name</b>	Archival system identification		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Unique Identifier must be used to define collection.	Unique Identifier may be used to define object if description exists at that level. It is not necessary for an object with only one file.	Unique Identifier can be used to define file.
<b>Examples</b>	3489		
<b>Required</b>	Yes	Yes, if applicable	Yes, if applicable
<b>Source</b>	AHDS Service Provider at ingest	AHDS Service Provider at ingest and/or preservation service provider at processing	AHDS Service Provider at ingest and/or preservation service provider at processing
<b>Comments</b>	Any type of Unique Identifier should be supported, as long as it is consistent with AHDS-wide taxonomy.		

<b>Number</b>	<b>2</b>		
<b>Name</b>	<b>Structural Type</b>		
<b>Definition</b>	The type or class of the object or collection being described. The list should be extensible to accommodate new formats.		
<b>Purpose</b>	Choice of appropriate preservation strategy depends on knowing structural type.		
<b>OAIS name</b>	Structural type		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Collection Structural Type describes the collection using one of the following categories: Image, Sound, Video, Text, Database, Software, or where the	Object Structural Type describes the object using one of the following categories: Image, Sound, Video, Text, Database, Software, or where the	Not used at this level.

	documents in the collection comprise more than one form, web document, or multi-media.	object comprises more than one form, web document or multi-media.	
<b>Examples</b>	1) Two files: One Microsoft Access 97 database containing 12 tables and 6 queries. One plain text file supplied as documentation.	1) Web resource 2) Paradox database	
<b>Required</b>	Yes	Yes	
<b>Source</b>	AHDS Service Provider at ingest and/or preservation service provider at processing	AHDS Service Provider at ingest and/or preservation service provider at processing	
<b>Comments</b>	List of MIME types may serve as a useful reference for object level. Many complex resources will require multiple descriptions on file level (see 4).		

<b>Number</b>	<b>3</b>		
<b>Name</b>	<b>Technical Infrastructure of Complex Object</b>		
<b>Definition</b>	Internal structure of complex digital objects: i.e., an enumeration of the components of a complex object, along with their inter-relationships.		
<b>Purpose</b>	Managing preservation requires managing the structure of complex objects as well as their components.		
<b>OAIS name</b>	Technical infrastructure of complex object		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Not relevant at collection level.	Describe the technical aspects of a complex object. This may include format of a Web page, or a GIS resource. It will also include the total number of files and total of each type of file in the complex object. If the object comprises a single file, or a collection of files with no functional relationship beyond being described as a collection, then this field is not used.	Not relevant at file level.
<b>Examples</b>		Web page: consists of one ASCII HTML file, along with three embedded static GIF files and one embedded audio WAV file.	
<b>Required</b>		Yes	
<b>Source</b>		AHDS Service Provider at ingest and/or preservation service provider	

		at processing	
<b>Comments</b>			

<b>Number</b>	<b>4</b>		
<b>Name</b>	<b>File Description</b>		
<b>Definition</b>	Technical specifications of the file(s) comprising a Collection or Object. This metadata element is made up of numerous sub-elements, many of which are type and format specific.		
<b>Purpose</b>	Describe type-specific metadata essential for managing preservation.		
<b>OAIS name</b>	File description		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Not relevant at collection level.	Not relevant at object level.	See sub-elements.
<b>Required</b>			Yes
<b>Source</b>			AHDS Service Provider at ingest and/or preservation service provider at processing
<b>Comments</b>	This metadata should apply to file formats which are used to directly render or access content. The list of Sub-elements must be extensible.		
<b>Sub-elements</b>	4.1 Text 4.2 Database 4.3 Image 4.4 Video 4.5 Audio 4.6 Executables		

Sub-elements of the File Description (4) represent the more commonly used data types but the list is by no means exclusive or exhaustive. Both the list of data type (or file format) specific sub-elements and the collection of metadata elements recorded for each data type should be extensible. Only the sub-element that is applicable to the described data resource should be used (e.g., filled in).

## II. Data Type Specific Technical Metadata

<b>4.1 Text</b>	
<b>Sub-elements</b>	4.1.1 Text Format and Version 4.1.2 Text Character Encoding 4.1.3 Text Associated DTD 4.1.4 Text Structural Divisions

<b>Number</b>	<b>4.1.1</b>
<b>Name</b>	<b>Text Format and Version</b>
<b>Definition</b>	The file type and version.
<b>Example</b>	MS Word 97; HTML 4.0; XML 1.0

<b>Number</b>	<b>4.1.2</b>
<b>Name</b>	<b>Text Character Encoding</b>
<b>Definition</b>	The character encoding standard.
<b>Example</b>	ASCII, code page 26; Unicode; EBCDIC

<b>Number</b>	<b>4.1.3</b>
<b>Name</b>	<b>Text Associated DTD</b>
<b>Definition</b>	Name of the Document Type Definition (DTD) applied to the structured text (if applicable).
<b>Example</b>	EAD

<b>Number</b>	<b>4.1.4</b>
<b>Name</b>	<b>Text Structural Divisions</b>
<b>Definition</b>	The logical divisions in a structured text file.
<b>Example</b>	TEI element DIV <sub>n</sub> used

The element Text Structural Divisions (4.1.4) originates from the Australian National Library preservation metadata schema and the previous consultants included it in their draft of the AHDS preservation metadata framework. Not being an expert in the subject area, I do not want to comment whether this is a useful feature to measure the success of preserving a digital (marked-up) text, that needs to be recorded. I have kept it in the schema just in case.

<b>4.2 Database</b>	
<b>Sub-elements</b>	4.2.1 Database Format and Version 4.2.2 Constituent Components 4.2.3 Primary Key 4.2.4 Structure of the Relational Database 4.2.5 Datatype and Representation Category 4.2.6 Representation Form and Layout 4.2.7 Maximum size of data element values 4.2.8 Minimum size of data element values

<b>Number</b>	<b>4.2.1</b>
<b>Name</b>	<b>Database Format and Version</b>
<b>Definition</b>	The file type and version.
<b>Example</b>	MS Access 97; FileMaker PRO 6

<b>Number</b>	<b>4.2.2</b>
<b>Name</b>	<b>Constituent Components</b>
<b>Definition</b>	List of tables, queries, reports, forms and other components of a database.
<b>Example</b>	Database containing 12 tables and 6 queries

<b>Number</b>	<b>4.2.3</b>
<b>Name</b>	<b>Primary Key</b>
<b>Definition</b>	Data element that is used as the primary key for linking tables in a relational database.
<b>Example</b>	Field 'ID' in table 'County Data'

<b>Number</b>	<b>4.2.4</b>
<b>Name</b>	<b>Structure of the Relational Database</b>
<b>Definition</b>	Description of relationships created between tables in a relational database.
<b>Example</b>	SELECT Source1.County, Source2.Parish INTO NewTable FROM Source1 INNER JOIN Source2 ON Source1.[County-UID] = Source2.[County-UID];

The metadata elements 4.2.2-4.2.4 are specific to relational databases — the information stored in these elements is necessary for reconstructing the structure of a relational database from, for example, text-based preservation format where individual tables have been saved separately as tab-delimited text files. The element 4.2.3 Primary Key can be omitted if all relationships are explicitly described in 4.2.4 (cf. example in 4.2.4). Other types of databases can make use of these elements, provided the purpose of description is clearly defined.

<b>Number</b>	<b>4.2.5</b>
<b>Name</b>	<b>Datatype and Representation Category</b>
<b>Definition</b>	Type of symbol, character or other designation used to represent a data element found in a database and the type of values used to represent it. May be general description of symbols or characters found in the database, or be specific to database elements.
<b>Example</b>	1) Alphanumeric characters and a graphical image. 2) The database element known as 'xx' contains alphanumeric characters, the database element known as 'yy' contains images.

<b>Number</b>	<b>4.2.6</b>
<b>Name</b>	<b>Representation Form and Layout</b>
<b>Definition</b>	Name or description of the form of representation for the data element and the layout of the characters that represent it (if appropriate). May be general description of form of representation found in the database, or be specific to database elements.
<b>Example</b>	1) text: alphabetic; code: numeric; date: yyyy:mm:dd; etc.. 2) The database element known as 'xx' contains date: yyyy:mm:dd; the database element known as 'yy' contains a quantitative value: numeric NNNN.NN; the database element known as 'zz' contains a quantitative value: currency ££,£££.99.

<b>Number</b>	<b>4.2.7</b>
<b>Name</b>	<b>Maximum size of data element values</b>
<b>Definition</b>	The maximum number of data units (e.g., digits) of the corresponding datatype.
<b>Example</b>	The database element 'xx' ('Price') has a maximum character count of 9.

<b>Number</b>	<b>4.2.8</b>
<b>Name</b>	<b>Minimum size of data element values</b>
<b>Definition</b>	The minimum number of data units (e.g., characters) of the corresponding datatype that would be present if data has been entered.
<b>Example</b>	The database element known as 'yy' ('Date of recording') has a minimum character count of 8.

The metadata elements 4.2.5-4.2.8 represent a selection of information that can be recorded for individual fields within a database table. When deemed necessary, these (and additional) elements can be identified as sub-elements of the element 4.2.2 Constituent Components and recorded for each field of each table within the database. Other examples of such field-level metadata are: name of field, description of the field, (allowed) range of data (e.g., less than 10; 'Monday', 'Tuesday', etc. only), required field, value in field if data missing or unknown, order of data within the field, formulae, audit logs, use logs, changes made, etc.

<b>4.3 Image</b>	
<b>Sub-elements</b>	4.3.1 Image Format and Version 4.3.2 Image Resolution 4.3.3 Image Dimensions 4.3.4 Image Original Dimensions 4.3.5 Image Tonal Resolution 4.3.6 Image Colour Space 4.3.7 Image Colour Management 4.3.8 Image Colour LookUp Table (CLUT) used 4.3.9 Image CLUT encoding 4.3.10 Image CLUT size 4.3.11 Display Orientation 4.3.12 Image Compression 4.3.13 Image Positivity

<b>Number</b>	<b>4.3.1</b>
<b>Name</b>	<b>Image Format and Version</b>
<b>Definition</b>	The file type and version.
<b>Example</b>	TIFF (ver. 6.0); JPEG 2000

<b>Number</b>	<b>4.3.2</b>
<b>Name</b>	<b>Image Resolution</b>
<b>Definition</b>	The spatial resolution of the image.
<b>Example</b>	300dpi; 600dpi

<b>Number</b>	<b>4.3.3</b>
<b>Name</b>	<b>Image Dimensions</b>
<b>Definition</b>	The number of pixels along the vertical and horizontal dimensions.
<b>Example</b>	4096 x 6144 pixels

<b>Number</b>	<b>4.3.4</b>
<b>Name</b>	<b>Image Original Dimensions</b>
<b>Definition</b>	Dimensions of original document or image.
<b>Example</b>	305mm x 203mm; A4

The above element (4.3.4) is sometimes used for recording the size of the original (paper document, print, painting, etc.) that was scanned or digitised.

<b>Number</b>	<b>4.3.5</b>
<b>Name</b>	<b>Image Tonal Resolution</b>
<b>Definition</b>	Bit depth of each pixel, and whether multiple bits convey grey tones or colour.
<b>Example</b>	1-bit; 8-bit greyscale; 24-bit colour

<b>Number</b>	<b>4.3.6</b>
<b>Name</b>	<b>Image Colour Space</b>
<b>Definition</b>	The colour space used for the image.
<b>Example</b>	CMYK; RGB

<b>Number</b>	<b>4.3.7</b>
<b>Name</b>	<b>Image Colour Management</b>
<b>Definition</b>	Any system used to improve consistency of colour across capture, display and output of image.
<b>Example</b>	PhotoCD

<b>Number</b>	<b>4.3.8</b>
<b>Name</b>	<b>Image Colour LookUp Table (CLUT) used</b>
<b>Definition</b>	Whether a colour lookup table is used to map from low to high colour depth, and if yes, where it is located.
<b>Example</b>	No CLUT; File-Resident CLUT (inside image file); External Windows Standard CLUT

<b>Number</b>	<b>4.3.9</b>
<b>Name</b>	<b>Image CLUT Encoding</b>
<b>Definition</b>	Type of encoding used for CLUT.
<b>Example</b>	Base64

<b>Number</b>	<b>4.3.10</b>
<b>Name</b>	<b>Image CLUT Size</b>
<b>Definition</b>	Number of colour entries defined in CLUT.
<b>Example</b>	16 entries; 126 entries

<b>Number</b>	<b>4.3.11</b>
<b>Name</b>	<b>Image Orientation</b>
<b>Definition</b>	How scanned image is stored relative to the correct “top of the image” stored in the image file.
<b>Example</b>	000 (i.e., top of image is correctly oriented); 090 (i.e., top of image is 90 degrees clockwise from where it should be).

<b>Number</b>	<b>4.3.12</b>
<b>Name</b>	<b>Display Orientation</b>
<b>Definition</b>	Designates the orientation in which the image should be presented to a conventional monitor.
<b>Example</b>	Portrait; Landscape

<b>Number</b>	<b>4.3.13</b>
<b>Name</b>	<b>Image Compression</b>
<b>Definition</b>	The type and level of compression used within the image object, and any compression parameter.
<b>Example</b>	ITU Group 4; uncompressed; native to GIF

<b>Number</b>	<b>4.3.14</b>
<b>Name</b>	<b>Image Positivity</b>
<b>Definition</b>	Whether the image should be displayed as a negative version of the stored image (e.g., with some images scanned from microforms).
<b>Example</b>	Display as negative

Note: The NISO Z39.87 / AIIM 20-2002 image metadata standard includes a comprehensive list of metadata elements for image creation (in Chapter 7) which have not been listed here.

<b>4.4 Video</b>	
<b>Sub-elements</b>	4.4.1 Video Format and Version 4.4.2 Video Codec Structure 4.4.3 Video Frame Dimensions 4.4.4 Video Duration 4.4.5 Video Frame Rate 4.4.6 Video Encoding Structure 4.4.7 Video Sound Format

<b>Number</b>	<b>4.4.1</b>
<b>Name</b>	<b>Video Format and Version</b>
<b>Definition</b>	The file type and version.
<b>Example</b>	Quicktime (ver. 1.1); AVI

<b>Number</b>	<b>4.4.2</b>
<b>Name</b>	<b>Video Codec Structure</b>
<b>Definition</b>	Codec type and version.
<b>Example</b>	MPEG; Intel Indeo ver. 3.2

<b>Number</b>	<b>4.4.3</b>
<b>Name</b>	<b>Video Frame Dimensions</b>
<b>Definition</b>	The size of a single still frame.
<b>Example</b>	640 pixels x 480 pixels

<b>Number</b>	<b>4.4.4</b>
<b>Name</b>	<b>Video Duration</b>
<b>Definition</b>	The length of the video recording.
<b>Example</b>	67 minutes 12 seconds

<b>Number</b>	<b>4.4.5</b>
<b>Name</b>	<b>Video Frame Rate</b>
<b>Definition</b>	The frame rate of the video material (frame rate per second).
<b>Example</b>	25 fps

<b>Number</b>	<b>4.4.6</b>
<b>Name</b>	<b>Video Encoding Structure</b>
<b>Definition</b>	The type of encoding structure and version.
<b>Example</b>	MPEG-3

In addition to Video Encoding Structure (4.4.6) the type and level of video compression is recorded as a separate metadata element (e.g., MPEG-3) that identifies the level of loss in video information caused by compression.

<b>Number</b>	<b>4.4.7</b>
<b>Name</b>	<b>Video Sound Format</b>
<b>Definition</b>	The sound parameters where they are incorporated into a single video file structure. May include all fields specified in audio.
<b>Example</b>	<i>see Audio</i>

<b>4.5 Audio</b>	
<b>Sub-elements</b>	4.5.1 Audio Format and Version 4.5.2 Audio Sampling Frequency 4.5.3 Audio Duration 4.5.4 Audio Sample Word Size 4.5.5 Audio Bit Rate 4.5.6 Audio Compression 4.5.7 Audio Channel Number and Type 4.5.8 Audio Sample Format 4.5.9 Audio Encapsulation

<b>Number</b>	<b>4.5.1</b>
<b>Name</b>	<b>Audio Format and Version</b>
<b>Definition</b>	The file type and version.
<b>Example</b>	AIFF interleaved; .wav; MIDI Format 0

<b>Number</b>	<b>4.5.2</b>
<b>Name</b>	<b>Audio Sampling Frequency</b>
<b>Definition</b>	The sampling frequency in kHz.
<b>Example</b>	44.1 kHz; 96 kHz

<b>Number</b>	<b>4.5.3</b>
<b>Name</b>	<b>Audio Duration</b>
<b>Definition</b>	The length of the audio recording.
<b>Example</b>	67 minutes 12 seconds

<b>Number</b>	<b>4.5.4</b>
<b>Name</b>	<b>Audio Sample Word Size</b>
<b>Definition</b>	Word length used to encode the audio (i.e., an indication of dynamic range).
<b>Example</b>	16 bit; 24 bit

<b>Number</b>	<b>4.5.5</b>
<b>Name</b>	<b>Audio Bit Rate</b>
<b>Definition</b>	Number of bits per second in audio stream.
<b>Example</b>	705.6 kbps; 2.304 Mbps

<b>Number</b>	<b>4.5.6</b>
<b>Name</b>	<b>Audio Compression</b>
<b>Definition</b>	The type and level of compression in the object.
<b>Example</b>	MPEG-3

<b>Number</b>	<b>4.5.7</b>
<b>Name</b>	<b>Audio Channel Number and Type</b>
<b>Definition</b>	The number of channels and how they are related to each other.
<b>Example</b>	Two track stereo; Single track; Five channel surround

<b>Number</b>	<b>4.5.8</b>
<b>Name</b>	<b>Audio Sample Format</b>
<b>Definition</b>	The type of encoding used in the samples.
<b>Example</b>	Linear integer; Logarithmic floating-point

<b>Number</b>	<b>4.5.9</b>
<b>Name</b>	<b>Audio Encapsulation</b>
<b>Definition</b>	The delivery format and version.
<b>Example</b>	Real Audio II

Note: if this element (4.5.9) is identical with the original file format (4.5.1) then this element can be omitted.

<b>4.6 Executables</b>	
<b>Sub-elements</b>	4.6.1 Code Type and Version

<b>Number</b>	<b>4.6.1</b>
<b>Name</b>	<b>Code Type and Version</b>
<b>Definition</b>	The code type used to compile the executable and version.
<b>Example</b>	1) Compiled using Intel code executable for Windows 95 environment 2) Compiled using Perl script 3) Java version 1.2

### III. Collection Management Metadata Elements (A Selection)

<b>Number</b>	<b>5</b>		
<b>Name</b>	<b>Date of Creation</b>		
<b>Definition</b>	Date expressed in a standardised form that the resource came into being.		
<b>Purpose</b>	The date, in combination with other metadata elements, provides evidence of an resource's authenticity and provenance.		
<b>OAIS name</b>	-		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If applicable, date that this instance of a collection came into being.	Date that this manifestation of the object came into being.	Date that this manifestation of the file came into being.
<b>Examples</b>	1998-02-20	1998-02-20	1998-02-20
<b>Required</b>	Yes	Yes	Yes
<b>Source</b>	Depositor or AHDS Service Provider at ingest.	Depositor or AHDS Service Provider at ingest or preservation service provider at processing.	AHDS Service Provider at ingest or preservation service provider at processing.
<b>Comments</b>	May be a start date or a range of dates. Other dates will be recorded under appropriate elements.		

<b>Number</b>	<b>6</b>		
<b>Name</b>	<b>Storage Information</b>		
<b>Definition</b>	Storage capacity for objects and details of the storage system, including physical format.		
<b>Purpose</b>	May help in planning preservation action relevant to particular media and storage systems. Necessary for managing the object within the archive system. For example, migration of storage media from tape to CD-ROM might require this information, since standard CD-ROMs have a maximum capacity of 650 Mb. Also important for dissemination purposes: some versions of MS Windows cannot accept files greater than 2 Gb.		
<b>OAIS name</b>	Size		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Storage size and system/carrier for entire collection.	Storage size and system/carrier for object.	Storage size and system/carrier for file.
<b>Examples</b>	3.8 Gb on server A	1.3 Mb on a CD-ROM	500 kb on exabyte tape
<b>Required</b>	Recommended	Recommended	Recommended

<b>Source</b>	AHDS Service Provider at ingest.	AHDS Service Provider at ingest or preservation service provider at processing.	AHDS Service Provider at ingest or preservation service provider at processing.
<b>Comments</b>	Provided the unique identifiers are handled systematically, storage size could be recorded only on file level and the aggregated levels could be calculated on the basis of this information.		

File compression is not a recommended practice for long-term preservation, but if some collections have been stored using compression, it may be useful to break down the Storage Information (6) element into sub-elements which record uncompressed size and various compressed sizes (based on a set of compression algorithms supported by the archive, cf. 7).

<b>Number</b>	<b>7</b>		
<b>Name</b>	<b>Compression Used</b>		
<b>Definition</b>	The type and level of compression.		
<b>Purpose</b>	Facilitates converting the compressed archived byte stream into the correct components (such as files and directories) to render the resource.		
<b>OAIS name</b>	Underlying abstract form description		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Description of the compression used on the files that comprise the collection and where the compression tool can be found.	Description of the compression used on the files that comprise the collection and where the compression tool can be found.	Description of the compression used on the files that comprise the collection and where the compression tool can be found.
<b>Examples</b>	.tar file, tar on server A	.zip, WinZip (ver. 8) in /archived/ tools/binary/zip	.zip, WinZip (ver. 8) in /archived/ tools/binary/zip
<b>Required</b>	Recommended	Recommended	Recommended
<b>Source</b>	Preservation service provider at processing	Preservation service provider at processing	Preservation service provider at processing
<b>Comments</b>	Compression is not recommended as good archival practice, but can be used for archiving some parts or copies of the archived resources (e.g., documentation).		

<b>Number</b>	<b>8</b>		
<b>Name</b>	<b>Fixity Method</b>		
<b>Definition</b>	Type of authenticity error detection technique used, e.g., a checksum or digital signature, and location of the software tools.		
<b>Purpose</b>	This information enables the checking of the integrity of an archived resource.		

<b>OAIS name</b>	Authentication type		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>			The technique used to authenticate the archived resource.
<b>Examples</b>			Digital signature consisting of a 128-bit hash computed using the MD5 one-way hash function, encrypted with a private key. Located at //tools/binary/MD5
<b>Required</b>	Optional	Optional	Recommended
<b>Source</b>	Automatically updated whenever new fixity information is generated	Automatically updated whenever new fixity information is generated	Automatically updated whenever new fixity information is generated
<b>Comments</b>	This element could include a pointer to a relevant source describing the authentication technique, for example, a persistent URL to a copy of RFC1321, the official specification of the MD5 algorithm.		

<b>Number</b>	<b>8.1</b>		
<b>Name</b>	<b>Authentication Date</b>		
<b>Definition</b>	Date of most recent archival use of this Authentication Type.		
<b>Purpose</b>	Periodic checking of preserved resources in a digital archive requires a temporal benchmark against which later manifestations/versions/copies of the data resource can be compared.		
<b>OAIS name</b>	Authentication date		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>			Date of the fixity method used to authenticate the resource.
<b>Examples</b>			2002-9-25
<b>Required</b>	Optional	Optional	Recommended
<b>Source</b>	Automatically updated whenever the fixity method is applied	Automatically updated whenever the fixity method is applied	Automatically updated whenever the fixity method is applied
<b>Comments</b>	Authentication Date sub-element is for collections management purposes, particularly if this date is different from Date of Creation (5).		

<b>Number</b>	<b>9</b>		
<b>Name</b>	<b>Fixity Information</b>		
<b>Definition</b>	This element will be used to prove the integrity of an archived resource, for example, by use of a checksum or a digital signature.		
<b>Purpose</b>	Fixity information provides the data integrity checks or verification keys used to ensure that the particular data resource has not been altered in an undocumented manner.		
<b>OAIS name</b>	Object authentication; Authentication result		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>			Value of the fixity method used to authenticate the resource.
<b>Examples</b>			file1.txt: bf4fe6e5e5c0519cf82710ddf66f2481
<b>Required</b>	Optional	Optional	Recommended
<b>Source</b>	Automatically updated whenever the fixity information changes	Automatically updated whenever the fixity information changes	Automatically updated whenever the fixity information changes
<b>Comments</b>			

The OAIS reference model treats the fixity information as a separate category of administrative metadata for preservation management. It has been included here on the same level with other metadata elements that pertain to technical preservation management, but in practice the Fixity Method (8) and Authentication Date (8.1) could be treated as equal sub-elements of Fixity Information (9).

## IV. System Level Metadata

<b>Number</b>	<b>10</b>		
<b>Name</b>	<b>Installation Requirements</b>		
<b>Definition</b>	Any specialised procedures needed to install the resource.		
<b>Purpose</b>	To enable access to objects with special installation requirements.		
<b>OAIS name</b>	Installation requirements		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Record any additional specific instructions on passwords, how to start the program, etc.	May be described at this level, e.g., an executable file in an object.
<b>Examples</b>	Use password [xxxxxxx]	Object is in the form of a ZIP file, which must be unpacked and stored on local hard drive in a specified directory tree prior to use; computer must be re-booted after installation.	This file needs to be copied into a separate directory
<b>Required</b>	Recommended	Recommended	Recommended
<b>Source</b>	AHDS Service Provider at ingest or processing	AHDS Service Provider at ingest or processing	AHDS Service Provider at ingest or processing
<b>Comments</b>	This information will be particularly useful when undertaking future migrations.		

<b>Number</b>	<b>11</b>		
<b>Name</b>	<b>Known System Requirements</b>		
<b>Definition</b>	The hardware, operating system, or software needed to render the object. May describe the range of systems on which the object will operate, or the earliest version if the object continues to be compatible with newer version. May also describe system requirements or plug-ins for operation, or memory requirements for an uncompressed file. Should state whether the requirements are preferred or mandatory.		
<b>Purpose</b>	Needed to manage requirements for accessing and operating digital resources.		
<b>OAIS name</b>	(Transformation process)		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the system or software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.

<b>Examples</b>	As for Object	1) PC, Windows 3.1 to Windows 98 2) Windows 95 Netscape Navigator ver. 4.0 with WinZip and 'x' plug-ins 3) Java Virtual Machine. Real Audio G2 or better	As for Object
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing
<b>Comments</b>	Some of the detailed information in this element is replicated in software and hardware environment elements below.		

#### IV.1 Software Environment Metadata

<b>Number</b>	<b>12</b>		
<b>Name</b>	<b>Application Software Requirements</b>		
<b>Definition</b>	Identification of a software program capable of displaying the resource, or accessing its intellectual content.		
<b>Purpose</b>	Necessary for translating the archived byte stream into human-readable content.		
<b>OAIS name</b>	Display/Access Application		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.
<b>Examples</b>		Internet Explorer 6.0; Adobe Acrobat Reader 4.0	
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor and AHDS Service Provider at ingest and processing	Depositor and AHDS Service Provider at ingest and processing	Depositor and AHDS Service Provider at ingest and processing
<b>Comments</b>			

The CEDARDS project and the OCLC/RLG preservation metadata schemas recommend the following sub-elements for Application Software Requirements (12): Input Format (the format that the Application works on), Output Format (output format to be expected from the Application), Location (location of the Application), Documentation (supporting documentation for using the Application).

## IV.2 Operating System Environment Metadata

<b>Number</b>	<b>13</b>		
<b>Name</b>	<b>Operating System Name</b>		
<b>Definition</b>	Name/designation of the software platform upon which Application Software programs operate.		
<b>Purpose</b>	Identify operating environment used by the Application Software programs of the resource.		
<b>OAIS name</b>	OS name		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.
<b>Examples</b>		Windows; Solaris; Linux	
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing
<b>Comments</b>			

<b>Number</b>	<b>13.1</b>		
<b>Name</b>	<b>Operating System Version</b>		
<b>Definition</b>	Version of the Operating System identified in Operating System Name (13).		
<b>Purpose</b>	Distinguish between different versions of an operating environment, which could potentially impact the ability to run Application Software programs, and by extension, the ability to access the archived resource.		
<b>OAIS name</b>	OS version		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.
<b>Examples</b>		Windows 98; Solaris 5.1.1	
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing

<b>Comments</b>	
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Further sub-elements, like Location and Documentation have been suggested for these elements (13 and 13.1).

### IV.3 Hardware Environment Metadata

<b>Number</b>	<b>14</b>		
<b>Name</b>	<b>Microprocessor Requirements</b>		
<b>Definition</b>	Description of microprocessor specifications necessary to operate the archived resource's Software Environment.		
<b>Purpose</b>	Ensures that users' obtain sufficient processing power to run the software necessary to render/display the resource.		
<b>OAIS name</b>	Microprocessor requirements		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.
<b>Examples</b>		Could be a general specification (e.g., 333 MHz), or a particular microprocessor (e.g., Intel Pentium II, 333 MHz)	
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor and AHDS Service Provider at ingest and processing	Depositor and AHDS Service Provider at ingest and processing	Depositor and AHDS Service Provider at ingest and processing
<b>Comments</b>			

<b>Number</b>	<b>15</b>		
<b>Name</b>	<b>Memory Requirements</b>		
<b>Definition</b>	Description of memory resources necessary to operate the archived resource's Software Environment.		
<b>Purpose</b>	Ensures that users' obtain sufficient memory to run the software necessary to render/display the resource.		
<b>OAIS name</b>	Memory requirements		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.

<b>Examples</b>		Could be a general specification (e.g., 333 MHz), or a particular microprocessor (e.g., Intel Pentium II, 333 MHz)	
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing
<b>Comments</b>			

<b>Number</b>	<b>16</b>		
<b>Name</b>	<b>Peripheral Requirements</b>		
<b>Definition</b>	Description of additional equipment needed to render/display the resource.		
<b>Purpose</b>	Describes the complete set of physical resources necessary to access the resource's content.		
<b>OAIS name</b>	Peripheral requirements		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the software necessary to access the information in the object or to use it.	If appropriate, may be described at this level.
<b>Examples</b>		Sound card, speakers; a monitor with a particular resolution; CD-ROM drive	
<b>Required</b>	Optional	Yes	Yes, if applicable
<b>Source</b>	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing	Depositor, AHDS Service Provider at ingest and processing
<b>Comments</b>			

Also the Hardware Environment Metadata elements can be supplanted with further elements that document the Location of the physical devices needed to process the resource and the location of the supporting Documentation useful for operation of the hardware devices.

## V. Relationships

<b>Number</b>	<b>17</b>		
<b>Name</b>	<b>Relationships</b>		
<b>Definition</b>	Links to other objects which are related to this object.		
<b>Purpose</b>	Document relationships that are necessary for preservation management. To enable an object to be linked to its metadata, to earlier or later manifestations of it, other forms of it, and other objects, including finding aids.		
<b>OAIS name</b>	Relationships		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	See sub-elements	See sub-elements	See sub-elements
<b>Examples</b>			
<b>Required</b>	Yes	Yes	Yes
<b>Source</b>	Preservation service provider at ingest or processing	Preservation service provider at ingest or processing	Preservation service provider at ingest or processing
<b>Comments</b>	This element is made up of numerous sub-elements, which are listed below. <sup>4</sup>		

There are different interpretations what the Relationships metadata element should be used for in the consulted metadata schemas:

- some of the metadata schemas from digital library community propose to record the whole Change History of an archived resource by linking the different transformations and manifestations of the original through this element;
- some suggest to use the Relationships for linking the technical administrative metadata with the resource discovery metadata and other references, e.g., bibliographic references to published material relating to the current resource;
- a third interpretation is to use the Relationships element for recording the composition of complex objects that are archived.

Following the discussion with AHDS Service Providers who indicated a need for somehow identifying uniquely each deposit regardless into how many collections and objects it will eventually be split, it is the this third interpretation of the Relationships metadata element that has been followed below. Thus, each file that is part of a complex object can be linked to its parent object and to its collection (*resp.* study) or deposit; and, *vice versa*, each collection and complex object has links to its constituent files. Optionally, links to other versions of the same object are provided, but the use and purpose of these elements will ultimately depend on the chosen (technical) solution for preservation metadata management.

<sup>4</sup> cf. also OCLC/RLG Working Group on Preservation Metadata, "Metadata and the OAIS Information Model: A Metadata Framework to Support the Preservation of Digital Objects", ch. V.2.

<b>Number</b>	<b>17.1</b>
<b>Name</b>	<b>Is Part Of</b>
<b>Definition</b>	The persistent identifier(s) of object(s) which this object forms a part of.

<b>Number</b>	<b>17.2</b>
<b>Name</b>	<b>Has Part</b>
<b>Definition</b>	The persistent identifiers of objects which form a part of this object.

<b>Number</b>	<b>17.3</b>
<b>Name</b>	<b>Is Version Of</b>
<b>Definition</b>	The persistent identifier of the object of which this object is a version.

<b>Number</b>	<b>17.4</b>
<b>Name</b>	<b>Has Version</b>
<b>Definition</b>	The persistent identifier of the object(s) which are a version of this object.

<b>Number</b>	<b>17.5</b>
<b>Name</b>	<b>Is Variant Of</b>
<b>Definition</b>	The persistent identifier of the object of which this object is a variant.

<b>Number</b>	<b>17.6</b>
<b>Name</b>	<b>Has Variant</b>
<b>Definition</b>	The persistent identifier of the object(s) which are a variant of this object.

<b>Number</b>	<b>17.7</b>
<b>Name</b>	<b>Refers To</b>
<b>Definition</b>	The persistent identifier of the object(s) which the contents of this object refer to. For example, an appendix or annex to a report.

<b>Number</b>	<b>17.8</b>
<b>Name</b>	<b>Is Referred To By</b>
<b>Definition</b>	The persistent identifier of the object(s) the contents of which refer to this object.

## VI. Other Functionalities

<b>Number</b>	<b>18</b>		
<b>Name</b>	<b>Access Inhibitors</b>		
<b>Definition</b>	Any method used to inhibit access, which would impact on preservation procedures (e.g., encryption or watermarking).		
<b>Purpose</b>	Without this information, the object may not be able to be accessed, copied or migrated.		
<b>OAIS name</b>	Access inhibitors		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	If useful, may be summarised at this level.	Describes access inhibitors.
<b>Examples</b>	Use password [xxxxxxx]	ZIP file password protected	1) Watermark by Digimarc Professional 2) Watermark by Invisible Ink for Images, embedded before ingest.
<b>Required</b>	Recommended	Recommended	Recommended
<b>Source</b>	AHDS Service Provider at ingest	AHDS Service Provider at ingest	AHDS Service Provider at ingest
<b>Comments</b>	Some of the features recorded in this element may also be described under Known System Requirements (11).		

Current AHDS Service Provider preservation practices do not in most cases require this element (18) to be recorded.

<b>Number</b>	<b>19</b>		
<b>Name</b>	<b>Access Facilitators</b>		
<b>Definition</b>	Description of any system or method used to enhance access to information within the resource, which need to be maintained in successive generations.		
<b>Purpose</b>	Enables the aids and facilitators to be taken into account in any preservation process.		
<b>OAIS name</b>	Access facilitators		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes systems or methods at object level.	Not described at this level.
<b>Examples</b>		1) Video and text time code linked. 2) Navigational links in hypertext file.	
<b>Required</b>		Recommended	

<b>Source</b>		AHDS Service Provider at ingest	
<b>Comments</b>			

<b>Number</b>	<b>20</b>		
<b>Name</b>	<b>Significant Properties</b>		
<b>Definition</b>	Properties of the resource's content which must be preserved or maintained during successive cycles of the preservation processes. The significant properties are characteristics that may, if not taken into account, result in a loss or distortion of content when the object is rendered.		
<b>Purpose</b>	Essential for decision-making related to level and method of access, the richness of preservation metadata required, and the type of preservation processes that will be implemented.		
<b>OAIS name</b>	Significant properties		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes significant properties at object level.	Describes significant properties at file level.
<b>Examples</b>		MS Access database: it is determined that the significant property of the database is the intellectual content of the tables, but not the screen forms used for data entry and data viewing.	PDF Document: it is determined that the significant property of the document is the intellectual content of the text, its 'look and feel' (colour scheme, embedded images, page layout, internal hyperlinks) are not considered essential and may be not preserved.
<b>Required</b>		Recommended	Recommended
<b>Source</b>		Depositor or AHDS Service Provider at ingest	Depositor or AHDS Service Provider at ingest
<b>Comments</b>	May describe exceptional characteristics or may provide links to their descriptions. Should include any relevant dates.		

Significant Properties (20) metadata is neither intrinsic to the resource itself, nor time-invariant. Rather, it constitutes the properties that are significant to the user community of the AHDS Service Provider or archived data resource. Another factor that has influence on the choice of significant properties that should/can be successfully preserved is the funds available for preservation. It is quite possible that the priorities of the designated user community and/or the funding resources of the AHDS Service Provider will change over time: as these change, so will the preserved object's significant properties.

<b>Number</b>	<b>21</b>		
<b>Name</b>	<b>Functionality</b>		
<b>Definition</b>	Description of any functional or 'look and feel' attributes of the rendered resource, in regard to its current manifestation in the archival store.		
<b>Purpose</b>	Enumerates the set of functional properties of the resource relative to the current stage of the preservation cycle.		
<b>OAIS name</b>	Functionality		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes significant functionality at object level.	If useful, may be summarised at this level.
<b>Examples</b>		Web page: contains an interactive JavaScript application and embedded animations.	
<b>Required</b>		Recommended	
<b>Source</b>		Depositor or AHDS Service Provider at ingest	
<b>Comments</b>	cf. Quirks (22)		

<b>Number</b>	<b>22</b>		
<b>Name</b>	<b>Quirks</b>		
<b>Definition</b>	Any characteristic that may appear as a loss in functionality or change in the look and feel of a collection, object or file. May describe quirks or provide links to quirks. Includes only descriptions of quirks that are relevant to the use of the current instance.		
<b>Purpose</b>	To assist preservation managers to assess the success or otherwise of preservation strategies and should prevent time being spent on trying to solve problems that were inherent in the object at the time the strategy was applied. This element documents changes that occur as a result of digitisation, duplication or migration, as well as those that might be inherent in the deposited resource.		
<b>OAIS name</b>	Quirks		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, quirks at the object or file levels may be summarised at collection level.	Describes quirks at the object level.	Describes quirks at the file level.

<b>Examples</b>	For all Web documents in the collection produced prior to HTML 4, the text format tag is no longer supported.	1) The Shockwave files could not be captured from the source document. 2) Web page: has been migrated from HTML to PDF. As a result, hyperlinks are broken; embedded JavaScript application no longer functional.	1) The text format tag is no longer supported by many browsers due to changes in HTML 4. 2) In the transfer from the previous format, the functionality of the mpeg video was impaired. 3) The original printed item contains high levels of bleed through, which degrades the image quality.
<b>Required</b>	Recommended	Recommended	Recommended
<b>Source</b>	Depositor or AHDS Service Provider at ingest	Depositor or AHDS Service Provider at ingest	Depositor or AHDS Service Provider at ingest
<b>Comments</b>	cf. Functionality (21). Should include any relevant dates.		

Quirks can be interpreted in two ways: any loss in functionality of the original deposited data resource from the time of its creation (and prior to its ingest by the AHDS Service Provider), or any loss of functionality sustained by the archived object, relative to its state when ingested, as a result of the AHDS Service Provider's preservation processes. National Library of Australia (from whom this element originated) follows the first interpretation.

To understand the relationship between Functionality (21) and Quirks (22), it is best to think of one as the 'negative' of the other. For example, given an archived data resource, one should be able to draw up a list of functional and 'look and feel' attributes of the resource's rendered content. The Functionality metadata (21) records all of these attributes which still exist in the current instance of the data resource that is in the archival store. Conversely, the Quirks metadata (22) lists all of these attributes which no longer exist as part of the data resource's current instance. Therefore, the sum of the attributes recorded in Functionality and Quirks should equal the original list of all attributes.

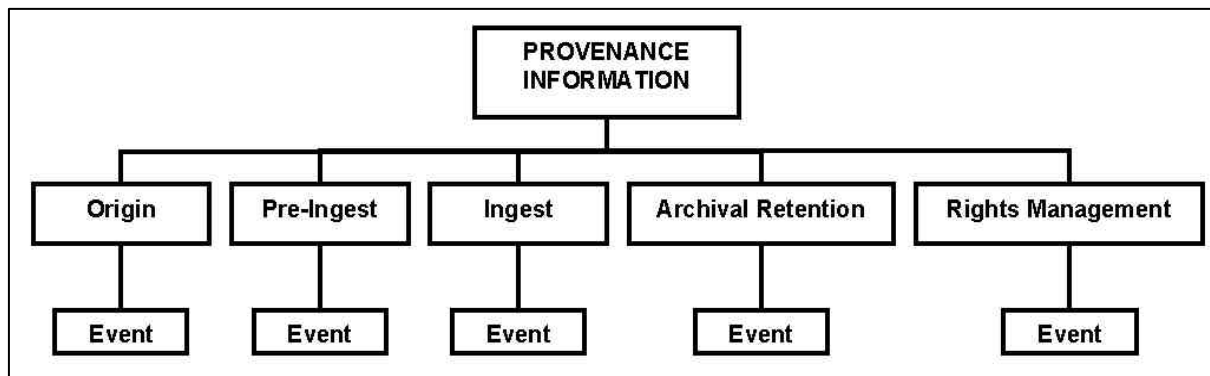
## VII. Administrative Preservation Metadata

The technical preservation metadata framework described above records an information snapshot picture or static information about an archived object as it currently stands. Throughout the course of the life-cycle of the object (e.g., a data resource), this information is prone to change: changes in format, documentation and technical environment requirements may have changed before its acquisition by the AHDS Service Provider and most definitely will change during the course of processing and preservation. Capturing these temporal aspects of the data resource's requirements is the purpose of the administrative preservation metadata.

The OAIS reference model calls this type of metadata Preservation Description Information (PDI) and extends it from data object's creation, to its ingest into the digital archive, to its retention in the archival store. The OAIS has defined Preservation Description Information as "information that is necessary to adequately preserve the particular Content Information with which it is associated. It is specifically focused on describing the past and present states of the Content Information, ensuring it is uniquely identifiable, and ensuring that it has not been unknowingly altered".<sup>5</sup>

Based on chronology of the life-cycle of a digital object, the temporal metadata can be considered to be 'event-based'. Thus, the evolutionary process associated with the archived data object is driven by the occurrence of important 'events', such as the data object's creation, a transfer in ownership, its ingest into the archive, or the migration of the data object from one format to another. Recording the particulars of these events, and their impact on the data object, is the key function of the administrative preservation metadata.

The OAIS model has selected key stages of a data object's life-cycle and included them in Preservation Description Information as Provenance Information (cf. Figure 1).



**Figure 1.** Structure of the OAIS Provenance Information

A similar approach has been adopted by some of the AHDS Service Providers. Other solutions for recording changes in technical environment of an archived data resource exist that treat the object life-cycle stages as events, too; or, that list the available types of preservation processes (e.g., copy, conversion, migration, etc.) and record a specific set of metadata sub-elements for each process. It is then possible to create process-specific 'profiles' (e.g., Conversion Profile) and manage the metadata according to these preservation processes, rather than link it to the archived data resources.<sup>6</sup>

<sup>5</sup> CCSDS 650.0-B-1, Ch. 4.2.1.4.2, p. 4-27

<sup>6</sup> cf. Ch. Dollar, "Authentic Electronic Records: Strategies for Long-Term Access", 1999, Appendix 7

Whichever solution will be chosen for the practical implementation of administrative preservation metadata, it is vital that it records the changes and processes that have been carried out on the original data resource deposited with the AHDS Service Provider. A minimum set of useful metadata elements (or sub-elements) for each 'event' or 'process' that has been undertaken by the AHDS Service Provider would include the following.

<b>Number</b>	<b>23</b>		
<b>Name</b>	<b>Name or Type of the Process</b>		
<b>Definition</b>	Name of the process applied.		
<b>Purpose</b>	To record what process was applied.		
<b>OAIS name</b>	Designation		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Describes the process applied.	Describes the process applied.
<b>Examples</b>	Move from Solaris to Linux platform	Copy from floppy disk to CD-R	Conversion of .wav to .aiff
<b>Required</b>	Yes	Yes	Yes
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>			

<b>Number</b>	<b>24</b>		
<b>Name</b>	<b>Responsible Agency</b>		
<b>Definition</b>	The name of the entity responsible for the process.		
<b>Purpose</b>	Track responsibility for changes to the collection, object or file.		
<b>OAIS name</b>	Responsible agency		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Records the name of the entity responsible for the process applied.	Records the name of the entity responsible for the process applied.
<b>Examples</b>	Migration Unlimited (commercial firm to whom, e.g., migration has been outsourced)	Archival System technical staff (Xxx Yyy)	Archival System technical staff (Xxx Yyy)
<b>Required</b>	Yes, if applicable	Yes	Yes
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>	It is good practice to identify the person or post who was responsible for carrying out the preservation process.		

<b>Number</b>	<b>25</b>		
<b>Name</b>	<b>Date and Time</b>		
<b>Definition</b>	Date and time of process.		
<b>Purpose</b>	To identify sequence of processes and provide a record of dates significant to the history of the collection, object or file.		
<b>OAIS name</b>	Date		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Records the date, or range of dates and time, if relevant, of process being carried out.	Records the date, or range of dates and time, if relevant, of process being carried out.
<b>Examples</b>		2002-09-19, 14:27	2002-09-19 - 2002-09-24
<b>Required</b>	Yes, if applicable	Yes	Yes
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>			

<b>Number</b>	<b>26</b>		
<b>Name</b>	<b>Critical Hardware</b>		
<b>Definition</b>	Itemisation of critical hardware used in the process.		
<b>Purpose</b>	Track equipment used to make changes to collection, object or file.		
<b>OAIS name</b>	-		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Records the critical hardware used in the applied process.	Records the critical hardware used in the applied process.
<b>Examples</b>		Particular brand and model of digital camera	Particular brand and model of digital camera
<b>Required</b>	Yes, if applicable	Yes, if applicable	Yes, if applicable
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>	cf. Critical Software (27)		

<b>Number</b>	<b>27</b>		
<b>Name</b>	<b>Critical Software</b>		
<b>Definition</b>	Itemisation of critical software used in the process.		
<b>Purpose</b>	Track software used to make changes to collection, object and file.		
<b>OAIS name</b>	-		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Records the critical software used in the applied process.	Records the critical software used in the applied process.
<b>Examples</b>		Gathered using Harvest version 2.2	File save, using Netscape
<b>Required</b>	Yes, if applicable	Yes, if applicable	Yes, if applicable
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>	cf. Critical Hardware (26)		

<b>Number</b>	<b>28</b>		
<b>Name</b>	<b>Process Description</b>		
<b>Definition</b>	Description of significant steps involved in the process.		
<b>Purpose</b>	To understand the details of the process.		
<b>OAIS name</b>	Procedure		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Records how the process was carried out.	Records how the process was carried out.
<b>Examples</b>		The relevant files were identified and batch scanned with the OCR option turned off.	Scanned in accordance with xyz scanning specifications.
<b>Required</b>	Yes	Yes	Yes
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>			

<b>Number</b>	<b>29</b>		
<b>Name</b>	<b>Process Result</b>		
<b>Definition</b>	Notes success or otherwise of the process. The changes that were made to the collection, object or file by the process and statement on the quality of the		

	process.		
<b>Purpose</b>	To record the outcome of quality control assessment and the changes for the preservation history of the collection.		
<b>OAIS name</b>	Outcome		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	If useful, may be summarised at this level.	Records results of the process.	Records results of the process.
<b>Examples</b>	All files converted, however, data was lost from title header.	File names were modified to display through web-presentation program. Success of the outcome checked by using <i>x</i> software.	Successfully migrated from MS Word 97 to PDF 5.0. Visual checks carried out.
<b>Required</b>	Yes	Yes	Yes
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>			

If a process results in a change in the archived data resource, it may have an impact on the information recorded in the Functionality (21) and Quirks (22) elements. The Process Result (29) must therefore be cross-linked with the Quirks element to avoid redundancy. It is also possible to break the Process Result down further into the various types of changes to the data resource that could result from the occurrence of a process.

## VIII. Other

<b>Number</b>	<b>30</b>		
<b>Name</b>	<b>Other Comments</b>		
<b>Definition</b>	Any other information relevant to the preservaticn of the collection, object or file.		
<b>Purpose</b>	To cover anything that may not fit into other elements.		
<b>OAIS name</b>	-		
<b>LEVEL</b>	<b>COLLECTION</b>	<b>OBJECT</b>	<b>FILE</b>
<b>Scope</b>	Records any relevant information about collection	Records any relevant information about object	Records any relevant information about file
<b>Examples</b>			
<b>Required</b>	Undesirable	Undesirable	Undesirable
<b>Source</b>	Preservation Service Provider	Preservation Service Provider	Preservation Service Provider
<b>Comments</b>			

Other elements like Relevant Documentation, Related Materials, Next Date of Process, Preservation Process Permission, etc. may be recorded under this heading as necessary.

## 6. Afterthoughts

The primary purpose of preservation metadata is to document the information necessary to:

- facilitate decision-making on the part of preservation managers, and
- maintain access to the content of archived digital objects.

A vast amount of information about the objects in any digital collection could be recorded. It is impossible to determine unequivocally what we will need to know in order to manage digital preservation in the future, so the framework of metadata elements necessarily reflects assumptions about our future requirements.<sup>7</sup>

It is important to balance metadata requirements against the real cost of creating and managing the metadata information and also against the practicalities of implementing a metadata storage system. The cost of creating and maintaining a sophisticated, multifaceted digital resource with rich layers of description can be balanced to some degree if it can be shown to meet user requirements. In the case of preservation metadata these user requirements are set by the need to maintain access to the resource over long-term.

The AHDS preservation metadata framework is described as a data output model, not a data input model. It indicates the information that must be retrievable from a metadata system, not necessarily what data should be entered and how it should be entered, nor does it prescribe how the preservation metadata should be associated with resources that it is describing. It is hoped that this model will be applicable to many different implementations.

### 6.1 Granularity

It is difficult to determine the appropriate level of specificity for describing all types of digital resources. Minimalist metadata schemas gloss over variations, while more detailed schemas highlight and reinforce differences. Different user communities may expect information specified at different levels of detail — the required depth of detail will depend upon the context of metadata use.

The AHDS preservation metadata framework has proposed elements and made recommendations about their applicability on three levels of descriptive granularity: collection, object and file. The model sometimes assumes that the digital object is the primary focus of management and description. This does not preclude the option of developing further specific elements for specific descriptive levels. It is likely that some degree of redundancy and overlap between the levels of aggregation will occur in implementation of the framework in practice.

The metadata framework suggested at the beginning that the collection level metadata could be associated with a single deposit or study acquired by the AHDS Service Provider. The connection of these two levels may, however, not be as practical as the association of collection level metadata with each of the three versions of the acquired collection (the original deposit, the preservation version and the dissemination version). The focus of preservation activities will naturally be the preservation version of each data resource, but it may be found useful to formally describe the other versions as well.

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<sup>7</sup> H. Berthon, C. Webb, “The Moving Frontier: Archiving, Preservation and Tomorrow’s Digital Heritage” (2000)

## 6.2 Implementation

Preservation metadata requires an implementation for storing, packaging and delivering the metadata. Implementation issues arise on two levels. The first deals with the appropriate container for preservation metadata (e.g., HTML, XML, or database). The second level concerns the manner in which the metadata is bound to its associated digital object. Possible strategies for this include:<sup>8</sup>

- 1) embedding the metadata within the digital object itself;
- 2) creating and maintaining a distinct metadata record, which is then encapsulated with the object in a single archival package; or
- 3) maintaining the metadata in a separate repository database, binding it to its associated digital object logically rather than physically.

Implementation could also take the form of a combination of these possibilities, rather than a single approach. Some AHDS Service Providers have already created collection management databases that combine all three levels of aggregation (collection, object and file) and provide a link to the stored digital resources via file locations.

The AHDS preservation metadata framework has made recommendations about the time of creation and creator of each metadata element. The execution in practice of this framework could investigate whether some of the listed metadata elements could be created and recorded automatically, or semi-automatically, and stored in the chosen implementation.

## 6.3 Vocabulary control

Digital preservation interests a range of different communities, each with a distinct vocabulary and local definitions for key terms. It will be important to understand the meaning of a number of terms within the context of preservation metadata and instead of using random keywords and terms to populate the metadata elements of the framework, more control can be established through the use of a controlled vocabulary or thesaurus. A thesaurus is a structured list of terms which establishes conventions for assigning and presenting subject headings and defines the relationships between them. A thesaurus permits related terms to be grouped into a hierarchy and cross-referenced to other groups of related terms. Using a thesaurus overcomes the problems of multiple spelling variations, different terminology, etc.

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<sup>8</sup> cf. OCLC/RLG, "Preservation Metadata for Digital Objects: A Review of the State of the Art" (January 2001)

## 7. Comparison with the OCLC/RLG preservation metadata

The work of the OCLC/RLG Working Group on Preservation Metadata on developing a preservation metadata framework resulted in a report “Metadata and the OAIS Information Model: A Metadata Framework to Support the Preservation of Digital Objects”, published in June 2002. The Working Group based their framework on the OAIS information model and a synthesis of four existing preservation metadata schemes: CEDARS, National Library of Australia, NEDLIB and the OCLC. The synthesis was further refined, elaborated and new elements were added. The mapping of the conglomerate of metadata elements from these four projects to the OAIS information model resulted in a preservation metadata framework. This OCLC/RLG framework is used for referencing the AHDS preservation metadata elements to the OAIS model. A brief description of the OAIS information model and metadata associated with it follows.

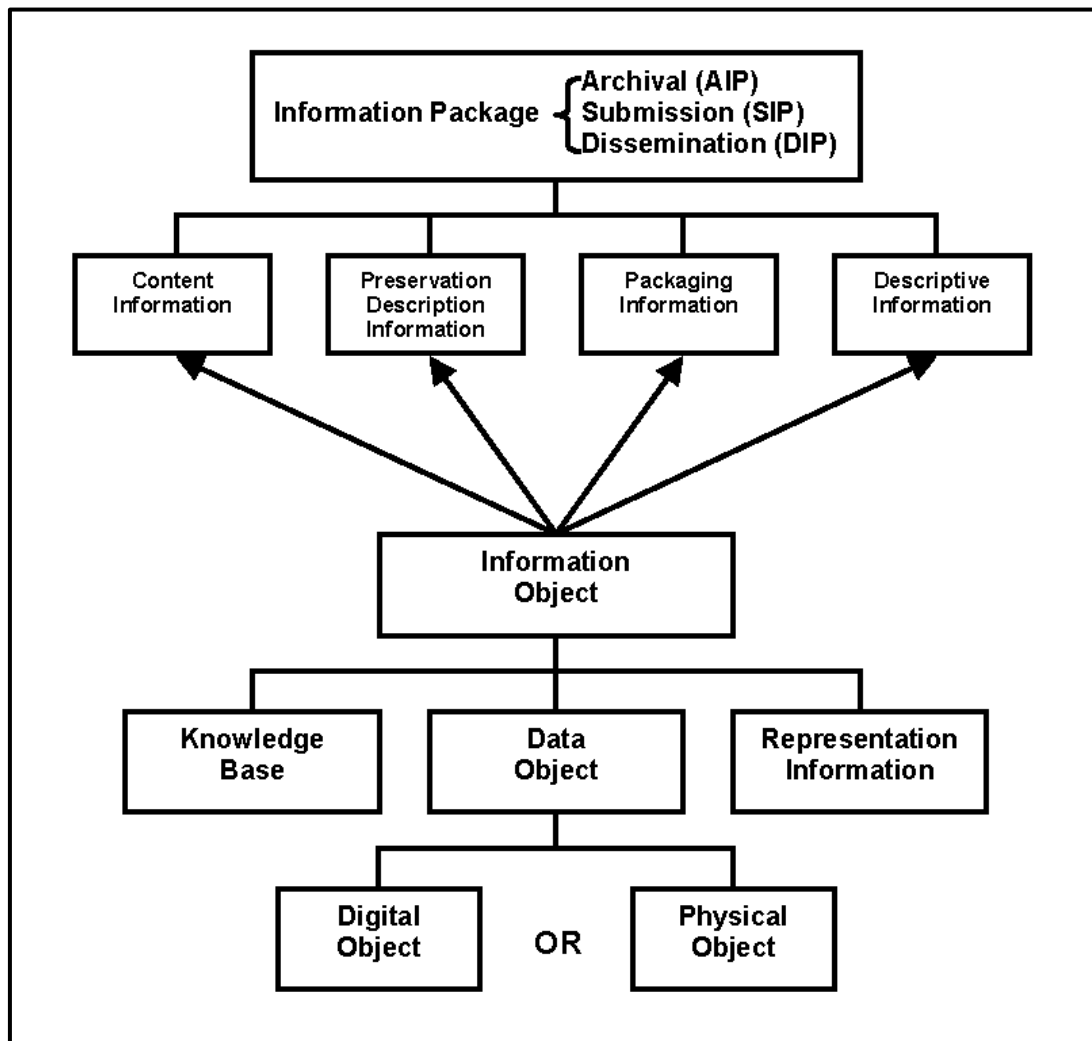
### 7.1 The OAIS Information Model

The portion of the OAIS reference model<sup>9</sup> that is of direct relevance to the issue of preservation metadata is the information model embedded within the OAIS framework. The OAIS information model broadly describes the metadata requirements associated with retaining a digital object over the long-term. The information model is particularly useful because it was developed in conjunction with a *functional* model of a digital archiving system – in other words, an articulation of the primary processes, or functional components, of an OAIS-type archive. In this sense, the information model is consistent with a comprehensive, structured view of the archiving system it supports.

The OAIS information model is illustrated in Figure 2. In the context of the OAIS, information can exist in two forms: either as a physical object (e.g., a paper document), or as a digital object (e.g., a PDF file, a TIFF file). These two types - physical and digital - are collectively known as the Content Data Object. A Content Data Object can take several forms: in particular, either the material that is the primary focus of preservation, or the metadata associated with an archived digital object.

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<sup>9</sup> “Reference Model for an Open Archival Information System (OAIS)”, CCSDS 650.0-B-1 (January 2002)



**Figure 2.** The OAIS Information Model.

An *information object* is in OAIS defined as a Data Object combined with its Representation Information. In a digital environment, this implies a sequence of bits, combined with all data necessary to make the bit stream viewable and understandable. There are four classes of information objects: Content Information, Preservation Description Information, Packaging Information, and Descriptive Information. Only the first two are relevant in the context of preservation metadata.

### **Content Information (CI)**

Consists of the Content Data Object (i.e., the information that the archive is entrusted to preserve), along with its associated Representation Information.

### **Preservation Description Information (PDI)**

Contains information necessary to manage the preservation of the Content Information with which it is associated. The OAIS reference model identifies four types of PDI:

- *Reference Information*: enumerates and describes identifiers assigned to the Content Information such that it can be referred to unambiguously, both internally and externally to the archive (e.g., UID, URN);
- *Provenance Information*: documents the history of the Content Information (e.g., its origins, chain of custody, preservation actions and effects);

- *Context Information*: documents the relationships of the Content Information to its environment (e.g., why it was created, relationships to other Content Information);
- *Fixity Information*: documents authentication mechanisms used to ensure that the Content Information has not been altered in an undocumented manner (e.g., checksum, digital signature).

## 7.2 The Content Information Framework

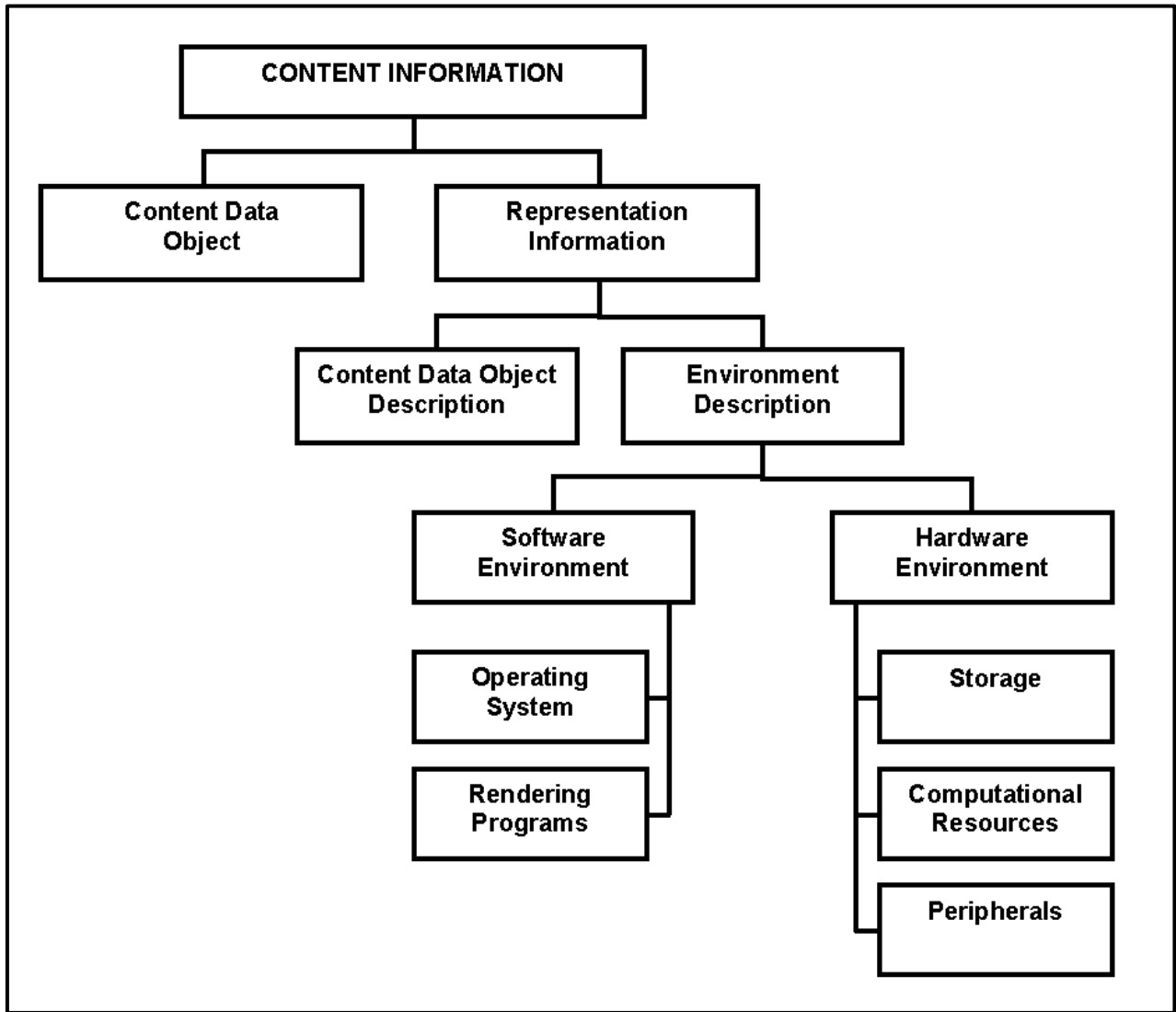
The OAIS reference model defines Content Information as “the set of information that is the original target of preservation. It is an Information Object comprised of the Content Data Object and its Representation Information”. In a digital archive, the Content Data Object is the bit sequence or set of bit sequences toward which the preservation action is primarily directed. Representation Information is information necessary to render/display, understand, and interpret the Content Data Object. To summarise:

- *Content Data Object*: a bit stream or set of bit streams;
- *Representation Information*: metadata that translates the bit stream(s) of the Content Data Object into accessible, meaningful knowledge.

Thus, Content Information is the digital content being preserved (Content Data Object), along with sufficient information to ensure that the object is both renderable and meaningful to current and future users (Representation Information).

For preservation metadata purposes it is useful to subdivide the Representation Information into two components: Content Data Object Description and Environment Description. The first component represents information detailing the characteristics and features of the Content Data Object itself that are necessary to render and understand its content. The second component describes a hardware/software environment capable of rendering or displaying the Content Data Object in the form in which it currently exists in the archival store.

The complete structure of the Content Information can be represented with a diagram (see Figure 3 below).



**Figure 3.** The structure of the OAIS Content Information framework.

### 7.3 The Preservation Description Framework

The OAIS reference model defines Preservation Description Information as “information that is necessary to adequately preserve the particular Content Information with which it is associated. It is specifically focused on describing the past and present states of the Content Information, ensuring it is uniquely identifiable, and ensuring that it has not been unknowingly altered”.

Preservation Description Information constitutes the second major component of preservation metadata. The first – Content Information – includes both the Content Data Object that is the focus of preservation, and the information necessary to render and understand the object’s content, as it currently exists in the archive. Preservation Description Information, on the other hand, focuses on information that is necessary to manage the perpetuation of the object and its content over time. Taken together, Content Information and Preservation Description Information support the two major functional components of a digital archive: access and preservation, respectively.

The OAIS information model divides Preservation Description Information into four categories:

#### **Reference**

Describes identification systems, and the mechanisms for providing assigned identifiers, used to unambiguously identify the Content Information both internally and externally to the archive in which it resides.

#### **Context**

Documents relationships of the Content Information with its environment, including the reasons for its creation and relationships to other Content Information objects.

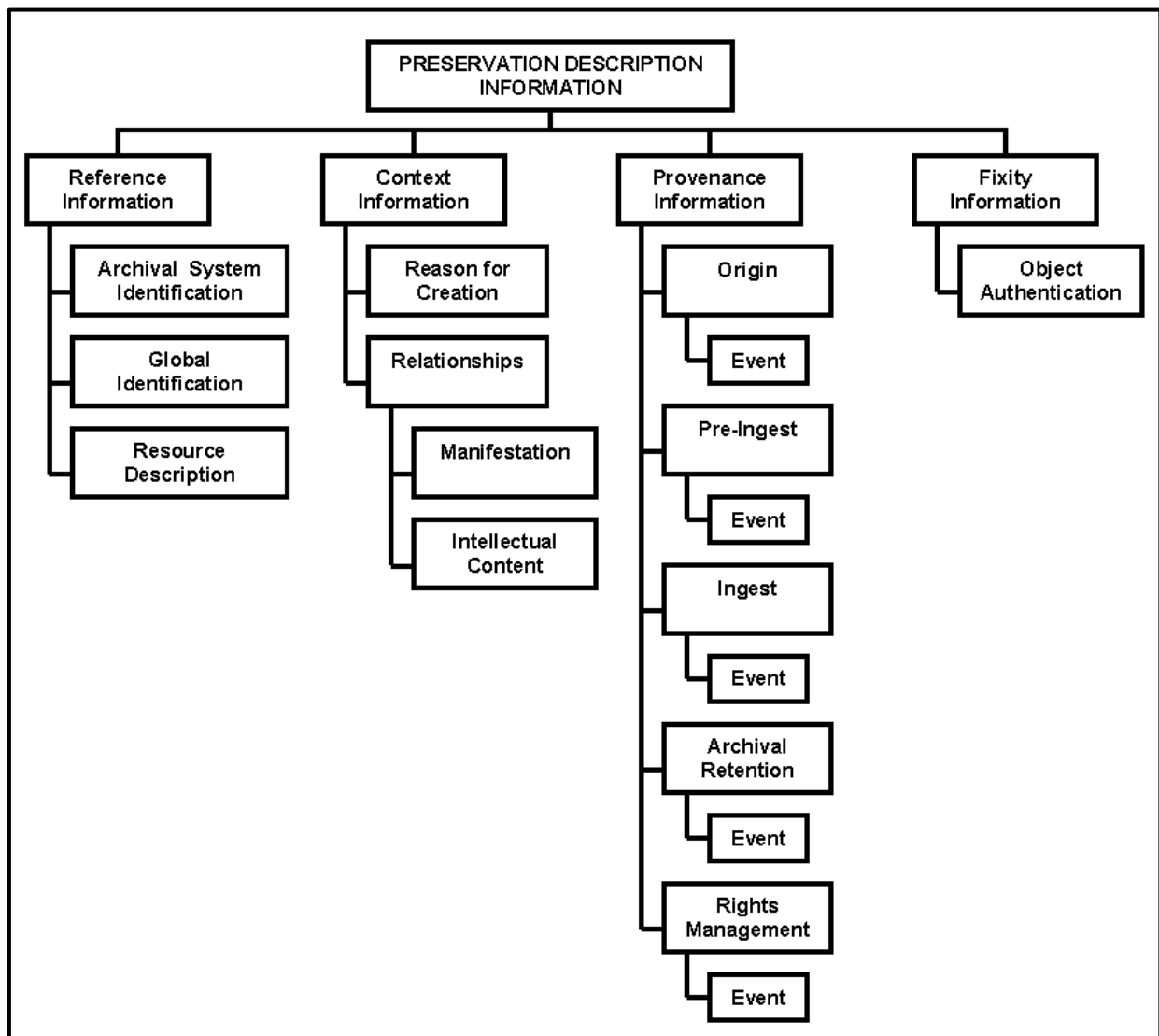
#### **Provenance**

Documents the history of the Content Information, including its origin, changes to the object or its content over time, and its chain of custody.

#### **Fixity**

Provides the Data Integrity checks or Validation/Verification keys used to ensure that the particular Content Information object has not been altered in an undocumented manner.

To summarise, Preservation Description Information records the identity, relationships, history, and integrity of the archived Content Data Object. The full structure of Preservation Description Information is illustrated in Figure 4.



**Figure 4.** The structure of the OAIS Preservation Description Information.

### 7.5 The AHDS Preservation Metadata Framework model

The preservation metadata framework specified above can be presented as an hierarchical model as follows:

## TECHNICAL DESCRIPTION OF THE RESOURCE

### 1. Persistent Identifier

### 2. Structural Type

### 3. Technical Infrastructure of Complex Object

### 4. File Description

#### 4.1 Text

4.1.1 Text Format and Version

4.1.2 Text Character Encoding

4.1.3 Text Associated DTD

4.1.4 Text Structural Divisions

#### 4.2 Database

4.2.1 Database Format and Version

4.2.2 Constituent Components

4.2.3 Primary Key

4.2.4 Structure of the Relational Database

4.2.5 Datatype and Representation Category

4.2.6 Representation Form and Layout

4.2.7 Maximum size of data element values

4.2.8 Minimum size of data element values

#### 4.3 Image

4.3.1 Image Format and Version

4.3.2 Image Resolution

4.3.3 Image Dimensions

4.3.4 Image Original Dimensions

4.3.5 Image Tonal Resolution

4.3.6 Image Colour Space

4.3.7 Image Colour Management

4.3.8 Image Colour LookUp Table (CLUT) used

4.3.9 Image CLUT encoding

4.3.10 Image CLUT size

4.3.11 Display Orientation

4.3.12 Image Compression

4.3.13 Image Positivity

#### 4.4 Video

4.4.1 Video Format and Version

4.4.2 Video Codec Structure

4.4.3 Video Frame Dimensions

4.4.4 Video Duration

4.4.5 Video Frame Rate

4.4.6 Video Encoding Structure

4.4.7 Video Sound Format

#### 4.5 Audio

4.5.1 Audio Format and Version

4.5.2 Audio Sampling Frequency

4.5.3 Audio Duration

4.5.4 Audio Sample Word Size

4.5.5 Audio Bit Rate

4.5.6 Audio Compression

4.5.7 Audio Channel Number and Type

4.5.8 Audio Sample Format

4.5.9 Audio Encapsulation

#### 4.6 Executables

4.6.1 Code Type and Version

## COLLECTION MANAGEMENT METADATA

5. Date of Creation
6. Storage Information
7. Compression Used
8. Fixity Method
9. Fixity Information

## SYSTEM LEVEL METADATA

10. Installation Requirements
11. Known System Requirements

### Software Environment Metadata

12. Application Software Requirements
13. Operating System Name
  - 13.1 Operating System Version

### Hardware Environment Metadata

14. Microprocessor Requirements
15. Memory Requirements
16. Peripheral Requirements

## RELATIONSHIPS

17. Relationships
  - 17.1 Is Part Of
  - 17.2 Has Part
  - 17.3 Is Version Of
  - 17.4 Has Version
  - 17.5 Is Variant Of
  - 17.6 Has Variant
  - 17.7 Refers To
  - 17.8 Is Referred To By

## OTHER FUNCTIONALITIES

18. Access Inhibitors
19. Access Facilitators
20. Significant Properties
21. Functionality
22. Quirks

## ADMINISTRATIVE PRESERVATION METADATA

23. Name or Type of the Process
24. Responsible Agency
25. Date and Time
26. Critical Hardware
27. Critical Software
28. Process Description
29. Process Result

## OTHER

30. Other Comments

7.6 The comparison of the above hierarchy with the OCLC/RLG recommended OAIS-compliant metadata model would be the following:

OAIS Name	AHDS No.
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**CONTENT INFORMATION**

**CONTENT DATA OBJECT**

**REPRESENTATION INFORMATION**

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