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Categories, uses and challenges of metadata and process documentation

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Session outline

- What is metadata and how can it support digital preservation?
- Discussion
- Introduction to the PREMIS Data Dictionary and other selected initiatives
- Practical session - Using the PREMIS Data Dictionary
- Summary and concluding discussion

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Preservation metadata - an introduction

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Defining metadata (1)

- **Some definitions:**
  - **Literally, "data about data"**
    - **Defines the basic concept, but is (perhaps) not very meaningful**
    - **Refers to everything and nothing (Duff, 2004)**
  - **"Structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use or manage" information objects (NISO, 2004)**

Defining metadata (2)

- **Metadata is now typically defined by *function***
  - **For example, the popular categorisation promoted by the Library of Congress:**
    - **Descriptive metadata**
    - **Structural metadata**
    - **Administrative metadata**
  - **But note: potential overlap between categories, the need to consider extrinsic qualities like "context"**

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Defining metadata (3)

- The importance of metadata has now been realised:
  - … "is recognised as a critically important, and yet increasingly problematic and complex concept with relevance for information objects as they move through time and space" -- Gilliland-Swetland (2004)
- Metadata needs to be 'understood' by both machines and people

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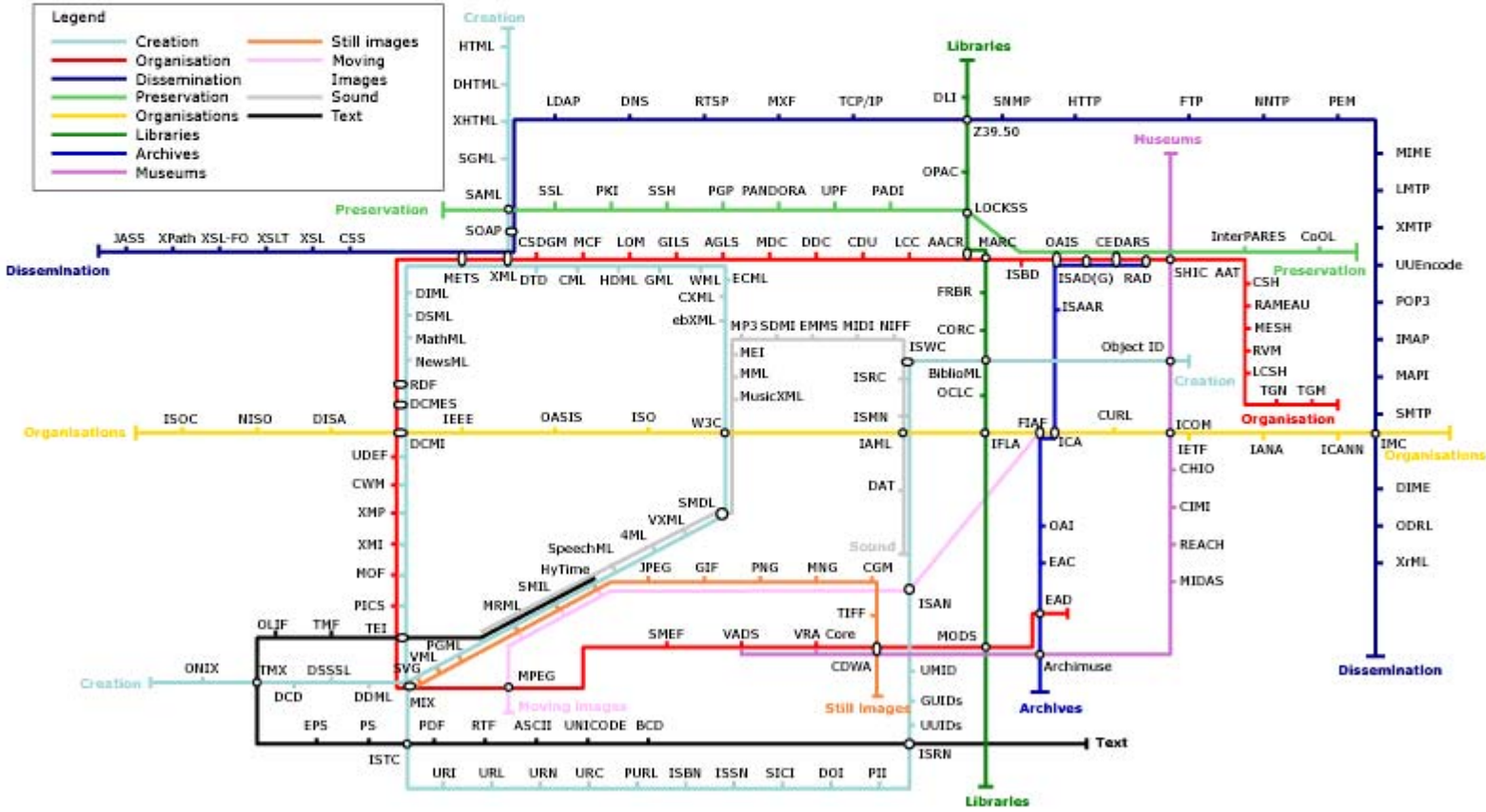
Defining metdata (4)

- **But a large (and growing) number of initiatives, formats, schemas, etc.**
  - **See James Turner's MetaMap for one attempt to visualise the metadata information space: http://mapageweb.umontreal.ca/turner/meta/english/**

MetaMap

[© 2004 James M. Turner, Véronique Moal, & Julie Desnoyers]

Position the mouse over an acronym to see what it stands for in a popup window.
Click on the acronym to see its definition and a link to its official site.



Preservation metadata (1)

- **Definitions:**
  - **All of the various types of data that allow the re-creation and interpretation of the structure and content of digital data over time (Ludäsher, Marciano and Moore, 2001)**
  - **"… the information a repository uses to support the digital preservation process" -- PREMIS working group (2005)**

Preservation metadata (2)

- ***All*** **digital preservation strategies depend, to some extent, upon the creation, capture and maintenance of appropriate metadata**
- **"Preserving the right metadata is key to preserving digital objects" -- ERPANET Briefing Paper (Duff, Hofman & Troemel, 2003)**

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Preservation metadata (3)

- **Preservation metadata fulfil a range of different roles, e.g.:**
  - **"… metadata accompanies and makes reference to each digital object and provides associated descriptive, structural, administrative, rights management, and other kinds of information" (Lynch, 1999)**
  - **Spans the categories of administrative, structural, descriptive and technical metadata**

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Preservation metadata (4)

- **Metadata is key to the understanding and reuse of digital information, e.g.:**
  - **"… it is impossible to conduct a correct analysis of a data set without knowing how the data was cleaned, calibrated, what parameters were used in the process, etc." -- Deelman, *et al*. (2004)**
  - **Growing emphasis on open access to research data (OECD working group)**
  - **The 'data deluge'**

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Preservation metadata (5)

- **Wide range of relevant initiatives:**
  - **Cultural heritage information**
    - **Supporting repository functions (e.g., PREMIS Data Dictionary, METS, …)**
    - **Digital imaging (NISO Z39.87, …)**
  - **Archives (RKMS, VERS, InterPARES, …)**
  - **Scientific data**
  - **Multimedia (MPEG-7, MPEG-21, …)**

Preservation metadata (6)

- **Current position:**
  - **Early initiatives tended to be theoretical in nature (e.g., metadata frameworks); current ones have a far more practical focus**
  - **Some consensus in cultural heritage domain on the *types* of metadata required**
    - **Influence of the Reference Model for an Open Archival Information System (OAIS)**

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The OAIS model

- ISO 14721:2003
- A reference model - establishes a common framework of terms and concepts
- Identifies the basic functions of an OAIS:
  - Ingest, Data Management, Archival Storage, Administration, Access, Preservation Planning
- Defines an information model

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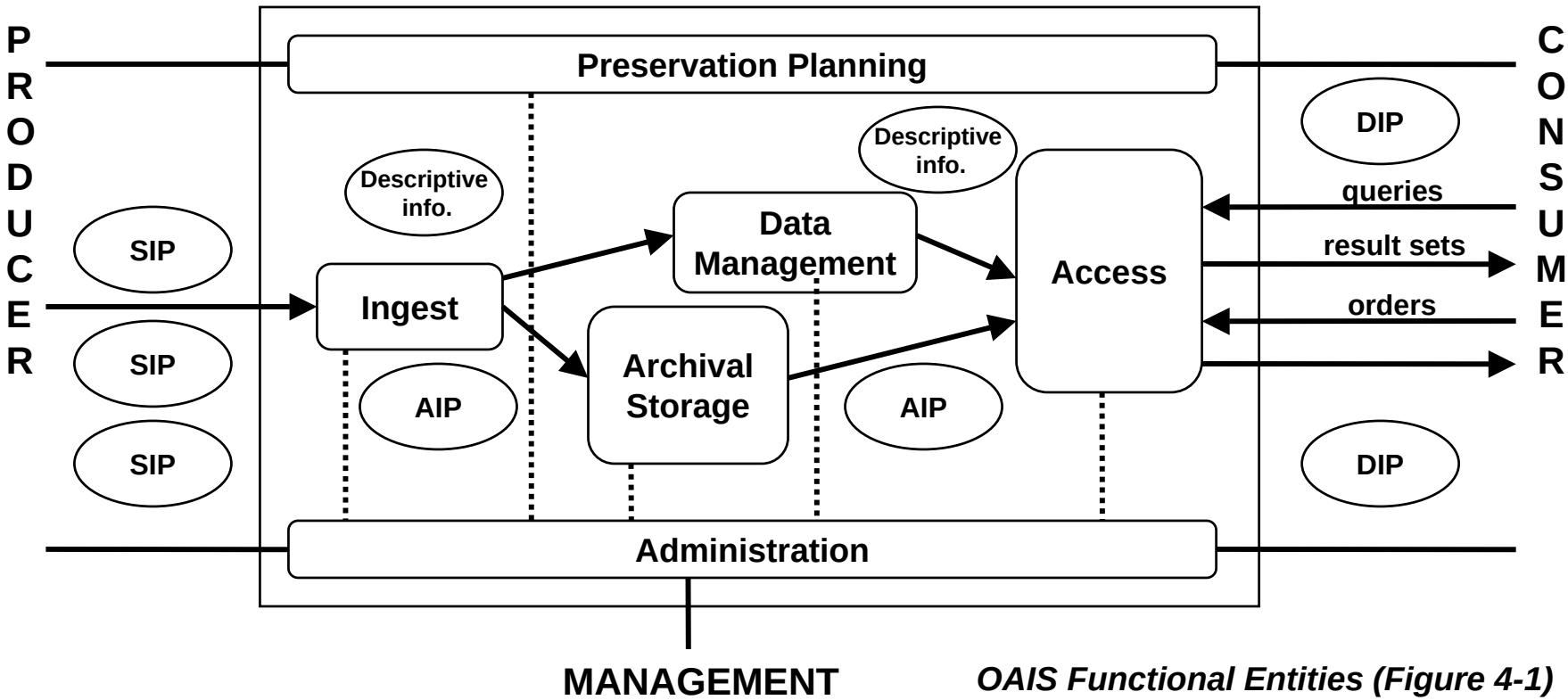
OAIS functional model



OAIS Functional Entities (Figure 4-1)

OAIS information model (1)

- **Information Object (basic concept):**
  - **Data Object (bit-stream)**
  - **Representation Information**
    - **Information that permits "the full interpretation of Data Object into meaningful information"**
    - **Technical and structural metadata**

OAIS information model (2)

- **Information Object Classes:**
  - **Content Information**
  - **Preservation Description Information (PDI)**
  - **Packaging Information**
  - **Descriptive Information**

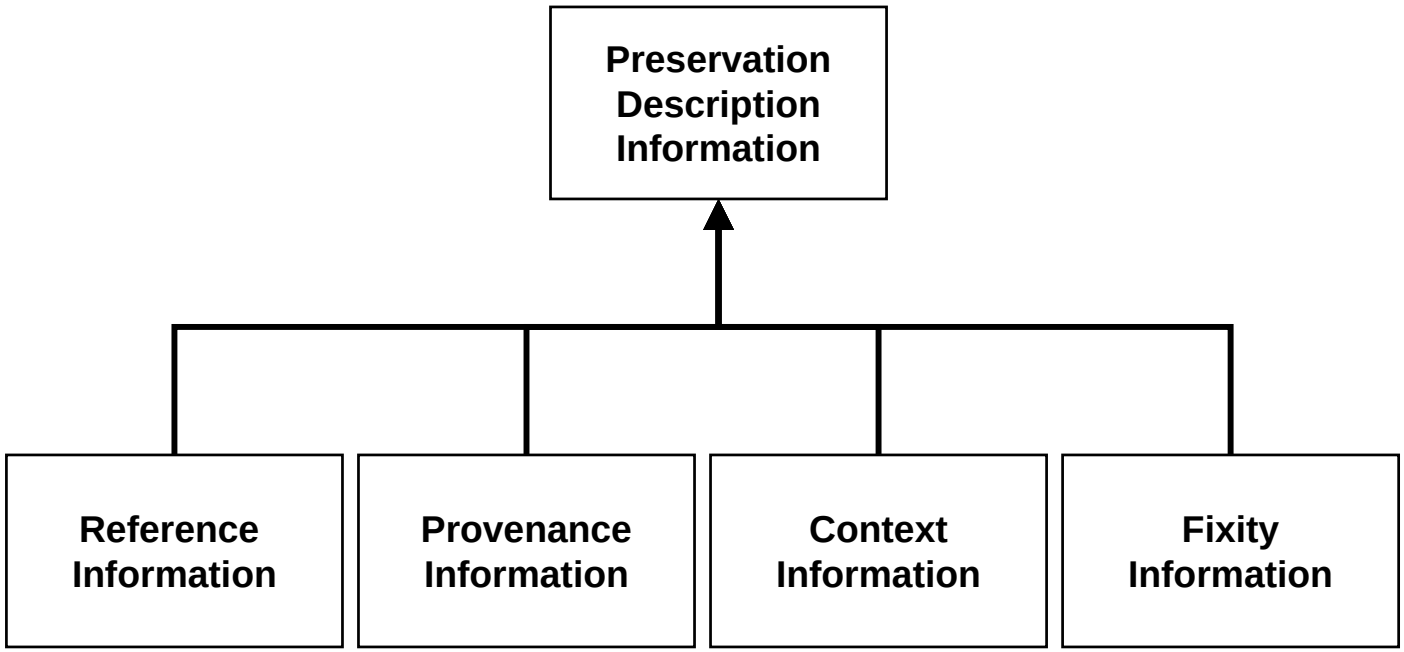
OAIS information model (3)

- **Information Package:**
  - Container that encapsulates Content Information and PDI
  - Packages for submission (SIP), archival storage (AIP) and dissemination (DIP)
  - AIP = "... a concise way of referring to a set of information that has, in principle, all of the qualities needed for permanent, or indefinite, Long Term Preservation of a designated Information Object"

OAIS information model (4)

- **Archival Information Package (AIP):**
  - **Content Information**
    - **Original target of preservation**
    - **Information Object (Data Object & Representation Information)**
  - **Preservation Description Information (PDI)**
    - **Other information (metadata) "which will allow the understanding of the Content Information over an indefinite period of time"**

OAIS information model (5)



PDI Preservation Description Information (Figure 4-16)

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Types of PDI (1)

- **Reference Information:**
  - **Reflects the need for objects to be identified and located definitively over time**
  - **A role for descriptive metadata (?)**
  - **Unique identification:**
    - **Within a repository (essential to the management of objects)**
    - **Within the wider environment (unique identifiers)**

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Types of PDI (2)

- **Provenance Information:**
  - **Context Information that documents the history of the Content Information**
  - **A key part of the *integrity* of objects is being able to trace their origin and chain of custody**
  - **A principle of archives profession**

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Types of PDI (3)

- **Context Information:**
  - **Documenting the relationships of the Content Information to its environment**
  - **Understanding of objects cannot properly be interpreted without some understanding of its wider environment, e.g.:**
    - **Technical dependencies on hardware and software**
    - **Linking scientific data to its experimental context**

Types of PDI (4)

- **Fixity Information:**
  - **Reflects the need for the users of digital resources to have confidence that they are what they claim to be and that their integrity have not been compromised**
  - **Integrity checks at the level of Content Data Objects (checksums, etc.)**
  - **Wider issue of provenance, custody, and trust**

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Discussion

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Discussion questions (1)

- What are the most important types of preservation metadata?
- What factors should repositories take into account when defining what preservation metadata they need?
- Are there any major things missing from the OAIS categories?

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Discussion questions (2)

- What tools may be needed?
- Where should metadata be stored?
- What about interoperability (e.g. object or metadata exchange)?

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An overview of some metadata initiatives related to preservation

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Archives

- **Recordkeeping metadata**
  - **Business Acceptable Communications (BAC) model developed by the Pittsburgh Project (1995)**
  - **Australian Recordkeeping Metadata Schema (RKMS)**
  - **Individual standards developed, e.g. by the UK National Archives, the National Archives of Australia, the Public Record Office Victoria, etc.**

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Digitisation initiatives

- NISO Z39.87 Technical Metadata for Digital Still Images (draft, 2001)
- Metadata Encoding & Transmission Standard (METS)
  - Maintained by the Library of Congress
  - XML container for different types of metadata: descriptive, administrative, and structural
  - Potential as OAIS Information Package

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Research libraries

- An urgent practical response to digital initiatives and the growing amount of digital content needing management:
  - National Library of Australia (1999)
  - Harvard University Library
  - National Library of New Zealand (2003)
- Research projects
  - UK Cedars project outline specification (2000)
  - NEDLIB project (2000)

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International activity

- **Metadata Framework Working Group**
  - **Sponsored by OCLC and RLG**
  - **Preservation Metadata Framework (2002)**
    - **built upon OAIS model and the work of earlier initiatives**
  - **Framework was a set of recommendations, not a specification for implementation**
- **PREMIS Working Group**

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The PREMIS Data Dictionary for Preservation Metadata

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PREMIS Working Group (1)

- **PREMIS WG = Preservation Metadata: Implementation Strategies**
  - **Sponsored by OCLC and RLG**
  - **Established 2003**
  - **International working group and advisory committee (practical focus)**
    - **Members from the US, the UK, the Netherlands, Germany, Australia and New Zealand**
  - **Chaired by Priscilla Caplan and Rebecca Guenther**

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PREMIS Working Group (2)

- **Main objectives:**
  - **A 'core' set of preservation metadata elements (Data Dictionary)**
  - **Strategies for encoding, packaging, storing, managing, and exchanging metadata**
- **Outputs:**
  - **Implementation Survey report (Sept. 2004)**
  - **PREMIS Data Dictionary (May 2005)**

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PREMIS review (1)

- **Implementing Preservation Repositories for Digital Materials**
  - **Review of current practice within cultural heritage organisations**
    - **Based on responses to questionnaire together with follow-up interviews**
    - **Questions about business plans, policies, preservation strategies, as well as metadata**

PREMIS review (2)

- **Findings:**
  - **Very little current experience of digital preservation; no knowledge whether the metadata collected will be adequate**
  - **The OAIS model has informed the implementation of many repositories**
  - **METS was the most commonly-used scheme for non-descriptive metadata**
  - **Metadata is stored *both* in databases and together with content data objects**

PREMIS review (3)

- Trends identified:
  - Redundant storage of metadata both within databases (for ease of use) and encapsulated with data objects (self-documenting)
  - METS is commonly used for the packaging of different metadata
  - OAIS is just the starting point
  - The retention of the original versions of objects to reduce risks
  - The use of multiple preservation strategies

[http://www.oclc.org/research/projects/pmwg/]

Data Dictionary for Preservation Metadata

Contents:

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PREMIS data dictionary (1)

- **Background:**
  - **OAIS remains the conceptual foundation (but some differences in terminology)**
  - **The data dictionary is a translation of the OAIS-based 2002 *Framework* into a set of implementable semantic units**
  - **Preservation metadata = "the information a repository uses to support the digital preservation process"**

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PREMIS data dictionary (2)

- Defines metadata that supports "maintaining viability, renderability, understandability, authenticity, and identity in a preservation context."
- Core metadata = "things that most working repositories are likely to need to know in order to support digital preservation."
- Recognition of the need for automatic capture of metadata

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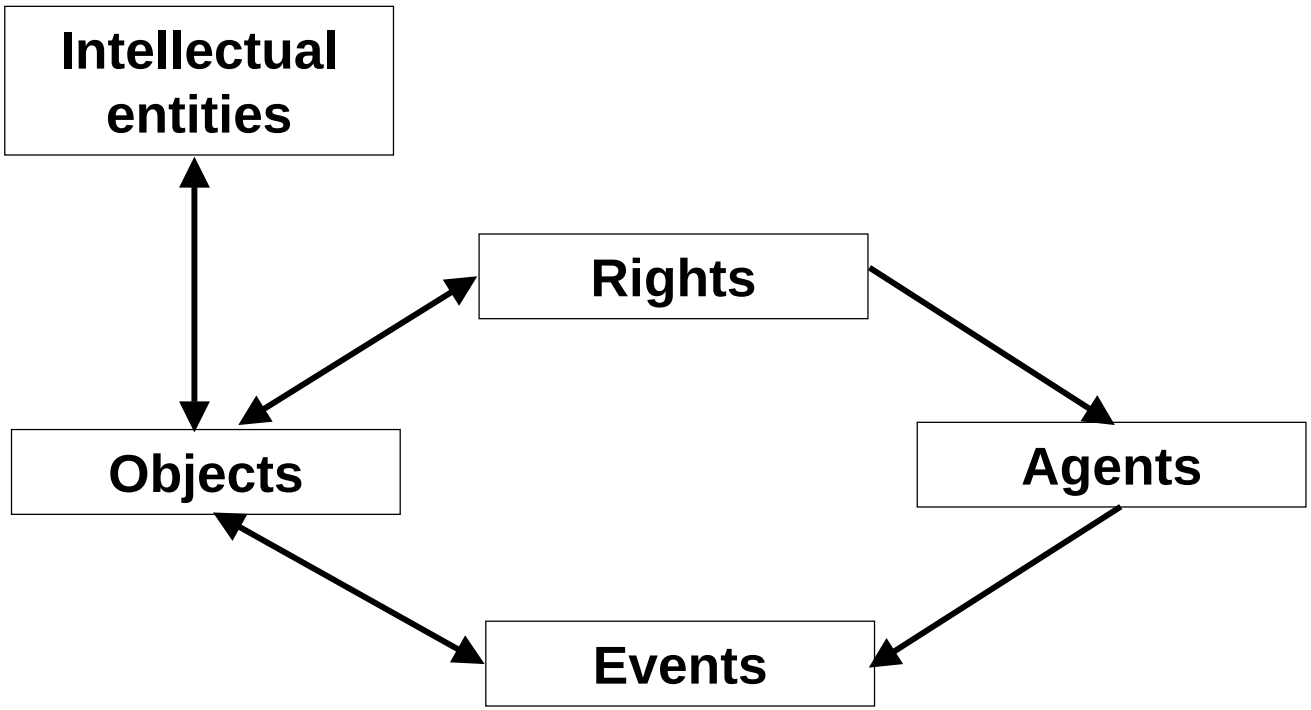
PREMIS data dictionary (3)

- The Data Dictionary is implementation independent, i.e. does not define how it should be stored
- Based on simple data model that defines five types of entities

PREMIS data model (1)



PREMIS data model (2)

- *Entities*:
  - Digital Object, Intellectual Entity, Event, Agent, & Rights
- *Relationships* are statements of association between instances of entities
- *Semantic Units* are the properties of an entity, and have values

PREMIS data model (3)

- *Digital Object* = a discrete unit of information
  - Files = named and ordered sequence of bytes known by an operating system
  - Bitstream = a set of bits embedded within a file
  - Representation = the set of files needed for a "complete and reasonable" rendering of an Intellectual Entity

PREMIS data model (4)

- *Intellectual Entity* = a coherent set of content that can be viewed as a single unit
- *Event* = an action involving at least one Object or Agent known to the repository
  - Documents actions that modify Digital Objects, records validity checks, etc.
  - Objects can be associated with any number of events

PREMIS data model (5)

- *Agent* = persons, organisations, or programs associated with preservation events
  - Not the main focus of the data dictionary
- *Rights Statements* = assertions of rights pertaining to Objects or Agents
  - WG concentrated on rights and permissions associated with preservation activities

PREMIS data model (6)

- ***Relationships:***
  - **Relationships between Objects:**
    - **Structural relationships, e.g. how files combine to make up an Intellectual Entity**
    - **Derivation relationships, e.g. resulting from format transformations or replications**
    - **Dependency relationships, e.g. when Objects depend on others, e.g. fonts, DTDs, etc.**
  - **1:1 principle**

Data Dictionary, v 1.0 (1)

- **Defines semantic units for Objects, Events, Agents and Rights**
  - **Object: objectIdentifier, preservationLevel, objectCategory, objectCharacteristics (format, significant properties, etc.), creatingApplication, storageMedium, environment (dependencies, hardware and software details, etc), relationship, …**

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Data Dictionary v 1.0 (2)

- Event: eventIdentifier, eventType (from a controlled list, e.g. ingestion, migration, normalization), eventDateTime, eventDetail, eventOutcomeInformation, linkingAgentIdentifier, …
- Agent: agentIdentifier, agentName, agentType, …
- Rights: permissionStatement, …

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Limits to scope (1)

- Does not focus on descriptive metadata
  - Domain specific and dealt with by many other schemes
- Does not define the characteristics of Agents
- Does not directly consider rights and permissions not directly associated with preservation actions, e.g. access or reuse

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Limits to scope (2)

- Does not deal with technical metadata for all different types of digital file (left to format experts)
- Does not deal with the detailed documentation of media or hardware (left to specialists)
- Does not consider in detail the business rules of a repository, e.g. roles, policies, and strategies (but this could be added to data model)

Issues (1)

- The PREMIS Data Dictionary is an important contribution to the ongoing development of preservation metadata
- It is, however, implementation independent
  - Provides definition of semantics and a suggested XML binding
- Maintenance Agency (Library of Congress):
  - http://www.loc.gov/standards/premis/schemas.html

Issues (2)

- Conformance
  - Non-PREMIS elements not conflict with or overlap with PREMIS semantic units
  - Need for more harmonisation
- The exchange of Objects
  - Mandatory metadata needs to be able to be extracted and packaged with the object
- The use of controlled vocabularies

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Using the PREMIS Data Dictionary for Preservation Metadata (practical session)

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Practical exercise (1)

- Go quickly through the semantic units for the Object Entity (pp. 2-5 - 2-53 only)
- Identify whether they are intrinsic to the object or whether the metadata content needs to be created or captured by the repository
  - Examples: preservationLevel can only be decided by the repository; the formatName is somehow directly dependent on the object itself

Practical exercise (2)

- Process: pass the Data Dictionary around the group so that you all take it in turns to lead the discussion of a semantic unit
- Not exact process, do not discuss each semantic unit for too long, do not get too bogged down in detail
- The object is to identify what PREMIS metadata *may* be able to be captured automatically by analysis of objects on ingest

Practical exercise (3)

- This should result in two lists:
  - "Intrinsic" metadata that may be able to be captured
  - Metadata that needs to be generated by the repository (or its processes)
- Quick report back at end from groups on the first list only
- Objective is to get to know the detail of the PREMIS Data Dictionary a little better
- Hopefully it will be fun!

Other issues

Costs of metadata

- **Balance risks with costs:**
  - **There is a perception that metadata creation and maintenance will be expensive**
  - **But costs associated with data recovery are not trivial**
- **Avoid imposing unnecessary costs:**
  - **Avoid large schemas**
  - **Need to identify the *right* metadata (importance of 'core metadata')**

Metadata capture

- Need to reduce amount of metadata created 'by hand'
- Capture that metadata that already exists in other forms
- Develop tools to automatically capture some metadata (e.g. technical metadata)
- Need for event metadata to be captured at creation, ingest, migration, and at other appropriate points in the object life-cycle

Interoperability

- **Interoperability is important:**
  - **To support the reuse of existing metadata**
  - **To support the exchange of digital objects between repositories**
- **A role for centralised repositories for file format information (e.g. PRONOM, GDFR) and metadata schemas?**

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Summing up

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Summing up

- Metadata is perceived to be essential for the long-term management (preservation) of digital objects - think about the metadata required in every session of this summer school
- There is now some consensus on what metadata might be required to support preservation processes (e.g., OAIS model, PREMIS Data Dictionary)
- Still little experience with the practical implementation of preservation metadata

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Key links:

- **PREMIS Data Dictionary for Preservation Metadata: http://www.oclc.org/research/projects/pmwg/**
- **ERPANET Training Seminar on "Metadata in Digital Preservation" (Marburg, 2003): http://www.erpanet.org/**
- **OAIS Reference Model: http://www.ccsds.org/documents/650x0b1.pdf**

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