Long-Term Preservation Services

A description of LTP services in a Digital Library environment.

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The British Library

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Deutsche Nationalbibliothek – German National Library

Nasjonalbiblioteket – National library of Norway

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1   Introduction

National libraries have a significant role as memory institutions in their respective countries. They give access to the content collected over centuries as well as present-day knowledge. The technological environments for producing, storing and disseminating information have changed radically during the last two decades, which forces these institutions to develop and change.

Digital collections are growing fast through mass digitisation and deposit of born-digital information, and there are new challenges on traditional areas as acquisition, preservation and dissemination. The institutions are building large-scale technical solutions to meet the new challenges, and are also changing themselves.

The institutions vary broadly both in terms of size and variety, and in terms of the types of information in their collections. Nevertheless, they have a common set of service areas in the domain of digital library systems. This document sets out a framework allowing the libraries to seek information about products relevant for these service areas. It offers a high level description of digital library and long-term preservation (LTP) services that can be used as a starting point for development. Libraries can use this service description to define the systems they need, and suppliers can use this to understand what libraries need and connect these needs to specific systems on offer. The service description is not definitive, but reflects consensus between four European national libraries on what we need today.

The main focus of this document is long-term preservation, but considered as an integral part of the overall digital library capability within a library and the corresponding workflows. We therefore seek information about long-term preservation within this broader context. Principles and implementation may vary greatly, and we are open to alternative approaches.

The document starts with an overview of all the types of services involved in LTP, and shows how different institutions might draw the boundaries between the LTP and a wider digital library capability. We then take the three core functions of an LTP system (to ingest, retain, and provide access to digital content) and show how the services work together to fulfil each function. Finally, we give a detailed description of each type of service.

We have used OAIS as a high level conceptual framework while seeking to identify sets of focused practical services that can be used as the basis for a modular implementation.

1.1   About the authors

This document has been written by members of a working group on Long-Term Preservation. The authors represent four national libraries:

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This working group acted as a follow-up of a bigger working group with representatives from the national libraries of Spain, Portugal, Switzerland, the Czech Republic, United Kingdom, Norway, Germany and the Netherlands. The description of Long-Term Preservation services is inspired by their work on LTP architectures.

2 Definitions

2.1 Acronyms

Term	Definition
LTP	Long-Term Preservation
DL	Digital Library
OAIS	Open Archival Information System
SIP	Submission Information Package
AIP	Archival Information Package
DIP	Dissemination Information Package
OCR	Optical Character Recognition

2.2 Terminology

We use standard terms where possible, particularly from the vocabularies defined in [OAIS] and [PREMIS]. In some cases, a standard definition is not quite appropriate for our purpose – in these cases we explain why we feel a new term is necessary.

2.2.1 Systems

- A *digital library* (DL) is the collection of services and the collection of information objects that support users in dealing with information objects, and the organization and presentation of those objects available directly or indirectly via electronic/digital means.[1] A digital library is part of a wider library environment that includes physical content.

- A *long-term preservation* (LTP) system is the subset of services within a digital library that an institution deems is most closely associated with the storage of information objects. The purpose of this new term is to name the system that is defined and described within this paper.

2.2.2 Processes

Each LTP system can be broken down into three processes:

- *Ingest* is the process of accepting SIPs from producers and preparing AIPs for storage.

- *Retention* is the process of storing and preserving AIPs. We introduce this new term for convenience, as a single denominator for several OAIS functions.

- *Access* is the process of making archival information holdings and related services visible to consumers as DIPs.

2.2.3 Actors

We recognise several actors involved in the interaction with an LTP system:

- *Producer* is the role played by those who provide the information to be preserved. The producer may be a direct creator of information or a publisher.

- *Consumer* is the role played by those who interact with services to find preserved information of interest and to access that information in detail.

- *Manager* is the role played by those who set overall policy.

- *Operator* is the role played by those who operate and manage the system.

2.2.4 Information packages

Following OAIS terminology, we define three types of information packages:

- An *Archival Information Package* (AIP) is an information package consisting of the content information and associated preservation information which is preserved within an OAIS.

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[1] Definition from [LEINER].

- A *Dissemination Information Package* (DIP) is an information package received by a consumer in response to an access request.
- A *Submission Information Package* (SIP) is an information package that is delivered by the producer to the OAIS for use in the construction of one or more AIPs.

2.2.5 Domain entities

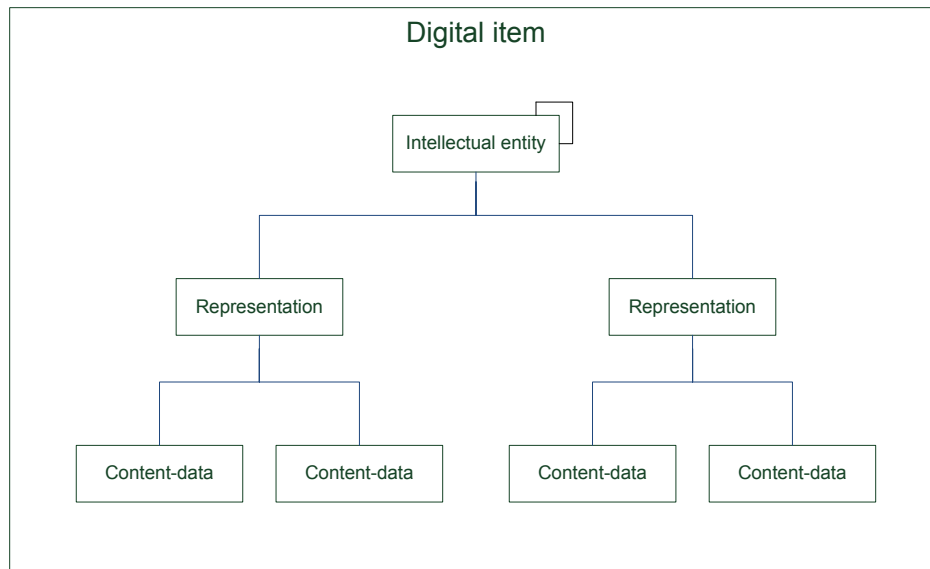Figure 1 illustrates the domain entities that we define for this document:

Figure 1: Domain entities

- An *intellectual entity* is a set of content that is considered a single intellectual unit for purposes of management and description. For example: a particular book, map, photograph, or database.

  An intellectual entity can include other intellectual entities; for example, a web site can include a web page; a web page can include an image.

  An intellectual entity usually has descriptive/bibliographic metadata, with properties such as: author, title, language, publisher.

  An intellectual entity may have one or more digital representations.

- A *representation* is the set of files, including structural metadata, needed for a complete and reasonable rendition of an intellectual entity.

  For an intellectual entity to be displayed, played, or otherwise made useable to a human, all of the files making up at least one version of that intellectual entity must be identified, stored, and maintained so that they can be assembled and rendered to a user at any given point. A representation is the set of files required to do this. In [OAIS] all information needed to define such a representation is called Representation Information. An example is the ASCII definition that describes how a sequence of bits is mapped into a symbol.

  We use the term "representation" rather than the term "manifestation" for the reason outlined by [PREMIS].[2] However, at this level of description, we use them as equivalent terms.

- *Content-data* is the generic name for the file/filestream/bitstream that contains (part of) the digital representation of an intellectual entity.

  A content-data entity has technical metadata, with properties such as: size in bytes, file format, access permissions, and last-modified date. We can think loosely of "content-data" as "file", but we use the new term to remind ourselves that the data may not be a file *per se*.

  PREMIS uses the term "object" for the generic name of instance-level content information that could be stored in either a file, a filestream or a bitstream. We do not want to use the term "object" because it is over-committed and has a common meaning within the library community

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[2] See [PREMIS] p8.

that is different from the PREMIS definition.[3] Therefore, we use the term "content-data" for the generic name of instance-level content data that could be stored as a bitstream in a file.

- *Digital item* is a single term to represent the grouping of an intellectual entity with its representations and content-data.

2.2.6 Change management

Digital items change over time. Each change will have an effect on the digital item, because the new state of the item will be different than before the change was applied. We distinguish two types of change based on the way the change is recorded:

- An *update* is a change to an entity that does not preserve the previous state of the entity. For example, an update to the title of a document would change the title's value *in situ* and leave no indication of the previous title.

- A *version* is a change to an entity that preserves the previous state of the entity as well as the new state of the entity. For example, a versioned change to the title of a document would store the new title in addition to the old title, ensure that the new title is marked as the most current, and record the (historical) relationship between the new and the old values.

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[3] As noted in [PREMIS] p216 note 5.

3   Key scenarios

In order to understand what an LTP system does, we need to understand the role it plays within the wider context of a digital library. We ask:

- What are the key scenarios that an LTP/DL will address?

- What are the problems that an LTP/DL can solve?

We have already mentioned that institutions will naturally have differing opinions on which services are part of the LTP system, and which are part of the wider digital library. We will indicate some typical points of difference in the scenarios below, which are intended as brief summaries.

3.1   Ingest, store and preserve any type of digital items indefinitely

A digital library must be able to store any type of digital material, including text, graphics, audio, video and web content. The LTP will be at the core of this functionality.

Some producers will deposit digital material with the digital library; other producers will ask the digital library to fetch new material from them. In both cases, the digital library must ensure the integrity of the submitted material. Some perspectives view this functionality as part of the LTP, some view it as part of the wider digital library.

The candidate digital material is often not archival quality, so the LTP system must be able to transform it to meet the archival standards of the institution. Again, some perspectives view this functionality as part of the LTP, some view it as part of the wider digital library. In fact there are specific requirements for object validation from the LTP-perspective.

Over a sufficiently long-term, it is inevitable that an LTP system will suffer disasters, common-mode engineering faults and deliberate attacks, so it must be able to withstand these challenges.

An LTP system must be able to receive updates to the metadata it holds.

3.2   Ensure the authenticity of digital items

The institution has a duty of custodianship over the digital items in its care. Since digital items are stored in perpetuity on digital media, some will become corrupted. An LTP store must be able to detect corruption and recover from it, whether the corruption is accidental or malicious.

An LTP system can provide assurance that the digital items it stores and disseminates are identical to the digital items it was given.

3.3   Provide access to digital items to users with appropriate permissions

The management of digital rights may be complex. For example, an item may have been supplied under national legal deposit legislation, and in addition there may be a licence whereby the same item could be supplied by the library after payment of a copyright fee. This is an example where there can be a set of usage conditions that relate to the same item. In another case, public access to an item might not be allowed for a specified time period.

The set of usage conditions that applies to a digital item may change during its lifetime (for example, it may move out of copyright). A digital library must reflect to these changes as they happen, and always control access appropriately. In order to control access appropriately, there can be a need to authenticate and authorise users. Opinions differ as to whether access control should be considered part of LTP or part of the wider digital library – for example, [TRAC] states that access controls should be included. See also [DRAC] for follow-up initiative.

Additionally, each representation of an item may be deemed to have a different set of usage conditions, and these must be enforced correctly.

3.4   Ensure that digital items are easy to find

Digital libraries will have a large number of digital items, so they must help users to find what they seek.

The quality of descriptive metadata varies widely. In cases where producers submit excellent metadata, the digital library must preserve the metadata according to their required standards of quality. In cases where the descriptive metadata is not so good, the digital library can enrich it where possible.

When digital items have transcriptions, the digital library can enable consumers to search the transcriptions as well as the metadata. For example, a transcription can be a text sequence of what is spoken on an audio stream, or text extracted from a digital image via OCR.

3.5 Ensure that users can view the digital items with contemporary applications

Digital formats become obsolete, so an LTP system must offer services which support an institution to ensure that the underlying intellectual content of each digital item is always available in formats that can be understood.

Digital preservation can require transformation of content-data. The duty of custodianship requires that a digital library records the actions taken upon the old representation to produce the new, so that consumers can trace the provenance of any digital item.

One may also produce representations for convenient access to digital items by consumers (e.g. representations for specific mobile devices). However, this activity is not seen as part of the LTP system.

4   Contextual framework for long-term preservation services

4.1   Summary

Figure 2 shows the top-level services involved in a long-term preservation architecture. The services are grouped vertically and horizontally.

The vertical groups are the three core functions of any long-term preservation system: to **ingest**, **retain** and provide **access** to digital content. We can see which services are involved in each core function by reading downwards. In section 4 we will take each of the three core functions and group together all the service interactions that are involved. This view of the service interactions tells the "story" of the core functions. Section 5 will describe each of the services in more detail.

The horizontal arrangement of the services has a looser meaning than the vertical arrangement. We have tried to place the more generic services that underlie other services toward the bottom of the diagram. For example, it is possible (though not required) to use a single type of Workflow Services to orchestrate the Ingest Services, Preservation Services and Delivery Services.
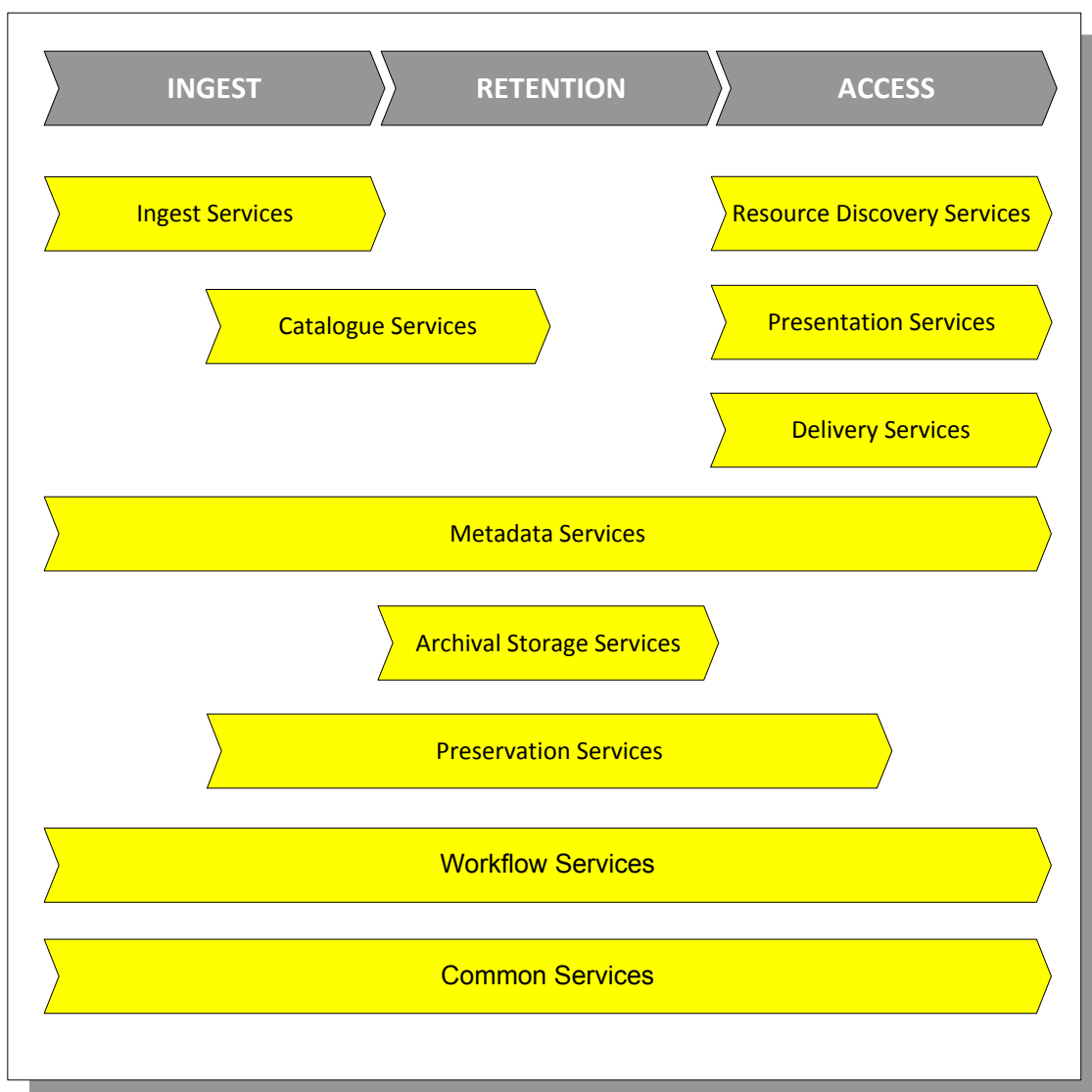
Figure 2: Contextual framework for long-term preservation services

We have mentioned that institutions will naturally have differing opinions on which services are part of the LTP system, and which are part of the wider digital library. We can now provide some examples.

Our first example institution already has a workflow engine, appropriate cataloguing facilities and a library-wide tool for resource discovery. They also decide that presentational capabilities (rendering tools) are out-of-scope for their digital library. This institution might define their LTP system as the services highlighted in Figure 3.
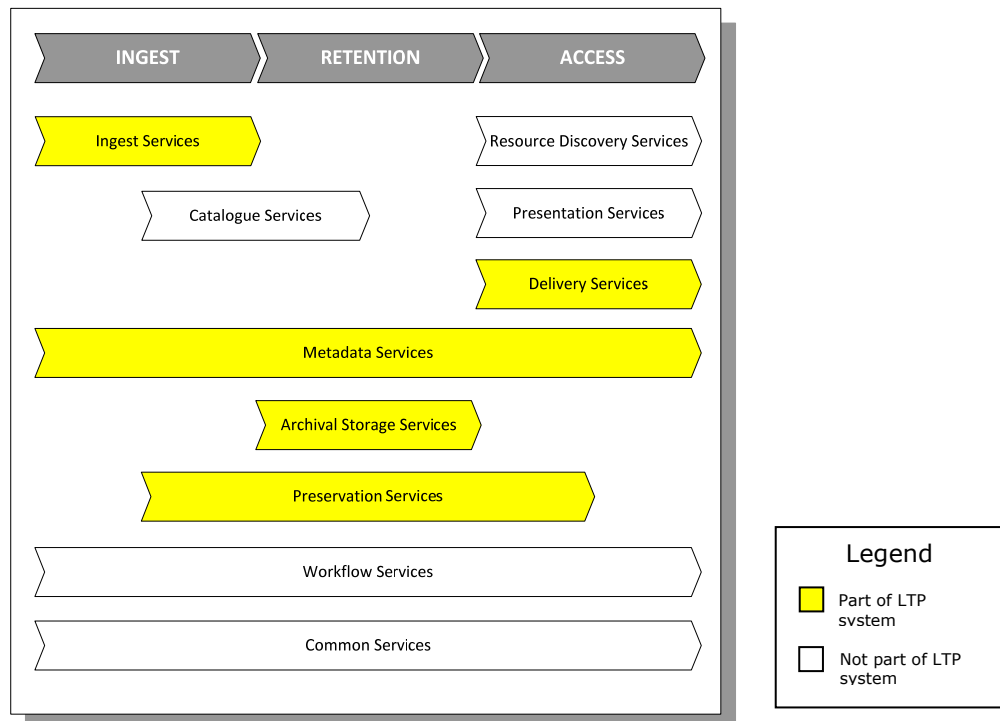

Figure 3: First example demarcation of an institutional LTP system

Our second example institution is not quite so far advanced with their digital library, and do not have a re-usable workflow engine, etc. This institution might define their LTP system as the services highlighted in Figure 4.
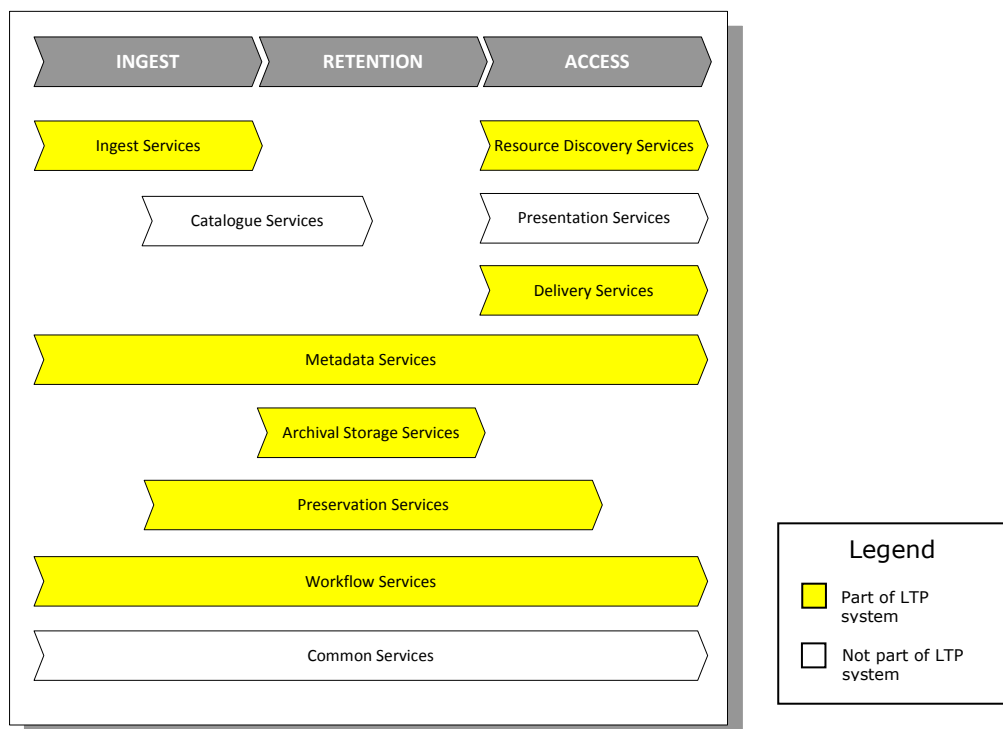

Figure 4: Second example demarcation of an institutional LTP system

4.2   Service actions and interactions

In the previous section we introduced the core functions of any LTP system: ingest, retention and access. Each of these functions require several services to perform its job. In this section we present an overview of all services in relation to the three functions. Section 5 will explain each service in more detail.

4.2.1   Ingest

a) **Workflow Services** orchestrate the ingest procedures, using other services to meet the institution's own particular requirements for each content source and type.

b) **Ingest Services** receive or take a SIP (metadata and/or content-data from a provider) and transform them into an AIP that meets the requirements of the institution. This includes tasks such as the validation and normalisation of the provided metadata and/or content-data, and metadata creation and enrichment.

c) **Ingest Services** work with **Catalogue Services** to enrich the metadata (or create a link between an item in the LTP system and a catalogue record).

d) **Ingest Services** provide persistent identifiers as required.

e) **Ingest Services** provide **Metadata Services** with metadata to hold in perpetuity.

f) **Ingest Services** provide **Archival Storage Services** with files to hold in perpetuity.

g) **Ingest Services** may be employed by **Preservation Services** to execute preservation actions and ingest the resulting package into the LTP system.

h) **Ingest Services** help operators to monitor and control the ingest procedures.

4.2.2   Retention

a) **Workflow Services** orchestrate the retention procedures, using other services to meet the institution's own particular requirements for ongoing preservation.

b) **Archival Storage Services** and **Metadata Services** keep safe the ingested content-data and metadata for each intellectual entity, and prove that they are doing so.

c) **Metadata Services** provide information for **Archival Storage Services** to handle the content-data.

d) **Metadata Services** and **Catalogue Services** work together to keep the LTP system's copy of metadata up-to-date.

e) **Preservation Services** work with **Metadata Services** and **Archival Storage Services** to enact Preservation Watch and Preservation Planning for the digital formats and metadata formats within the LTP system. Preservation actions will typically involve **Delivery Services** to retrieve content-data and metadata from the store, and **Ingest Services** to ingest the migrated content-data and metadata back into the store.

f) **Metadata Services** allow operators and preservation officers to search (metadata of) digital items held within the LTP system. This could be necessary for the Preservation Watch function of **Preservation Services**.

g) **Preservation Services** may work with **Presentation Services** during preservation actions.

h) **Archival Storage Services** help operators to monitor and control the archival store.

4.2.3   Access

a) **Workflow Services** orchestrate the access procedures, using other services to meet the institution's own particular requirements for discovery and delivery.

b) **Resource Discovery Services** work with **Metadata Services** and **Catalogue Services** to help consumers find what they seek.

c) **Resource Discovery Services** work with **Archival Storage Services** to generate full-text indexes for searching.

d) **Delivery Services** allow users to request digital items (using their persistent identifier) in a particular DIP format.

e) **Common Services** authenticate the consumers who make access requests.

f)   **Delivery Services** authorise consumer requests and implement policies for digital rights and access control.

g)   **Delivery Services** work with **Archival Storage Services** to retrieve digital items or parts of digital items (like an embedded bit stream) from the LTP store.

h)   When the requested DIP format is different from the AIP format of the entity, the **Delivery Services** and the **Metadata Services** transform the content-data formats and metadata formats.

i)   **Delivery Services** work with the **Common Services** to route the content-data and metadata to the consumer.

j)   **Presentation Services** work with **Delivery Services** to take the content-data and metadata, and present them to consumer.

k)   **Delivery Services** help operators to monitor and control access procedures.

l)   **Presentation Services** may use **Preservation Services** to execute preservation actions which enable a user to understand the digital item.

4.3   Files, data and metadata

A DL stores, preserves and accesses digital items. To do so it will implement the services described earlier in this document. These services create, use or manipulate information objects that need to be stored and maintained within the scope of the systems that implement such a specific service.

As an LTP system is about storing content-data and maintaining the integrity, usability and understandability of digital items as a whole, the way this storage is structured has an impact on the services.

Within the OAIS model the unit of storage is called an AIP. An AIP comprises two things. First, it contains the original material, or content files, that constitute the digital item itself. Second, but equally important, it contains the library's knowledge about the digital item, how it is structured, and other technical attributes. This knowledge is commonly referred to as metadata. Both content and metadata are subject to long-term preservation.

The metadata is also used to operate and control the different services in the DL environment. As a result, the metadata held by Metadata Services can for a large part be the same data that is held by Archival Storage Services. The implementation of where metadata is kept can differ per organisation.

There is a difference between the methods used by Archival Storage Services to store content and metadata, and those used by Metadata Services to manage the metadata. The difference arises because Archival Storage Services and Metadata Services have different perspectives. Archival Storage Services concentrate on large volumes, data integrity and resilience, whereas Metadata Services concentrate on access, quick response times, and queries.

5   Description of services

5.1   Ingest Services

The term "Ingest Services" is a common denominator for the set of heterogeneous atomic services responsible for marshalling acquired content streams from producers (SIPs), and for performing all required actions against that content to obtain long-term preservation packages of appropriate quality (AIPs) to store in an LTP system.

Ingest Services perform such various tasks as issuing persistent identifiers, extracting metadata, enriching metadata, transforming content streams and metadata into standardised formats, validating content-data, checksums and metadata, characterizing file formats, generating full-text and perhaps scanning for viruses.

Differences in content type, producer and the way material is submitted require many distinct processes that each employ a number of Ingest Services in a tailor-made workflow.

5.1.1   Actions and interactions of the Ingest Services

- **Ingest Services** receive or take a SIP (metadata and/or content-data from a provider) and transform them into an AIP that meets the requirements of the institution. This includes tasks such as the validation and normalisation of the provided metadata and/or content-data, and metadata creation and enrichment.

- **Ingest Services** work with **Catalogue Services** to enrich the metadata (or create a link between an item in the LTP system and a catalogue record).

- **Ingest Services** provide persistent identifiers as required.

- **Ingest Services** help operators to monitor and control the ingest procedures.

- **Ingest Services** provide **Metadata Services** with metadata to hold in perpetuity.

- **Ingest Services** provide **Archival Storage Services** with files to hold in perpetuity.

- **Ingest Services** may be employed by **Preservation Services** to execute preservation actions and ingest the resulting package into the LTP system.

- **Preservation Services** work with **Metadata Services** and **Archival Storage Services** to enact Preservation Watch and Preservation Planning for the digital formats and metadata formats within the LTP system. Preservation actions will typically involve **Delivery Services** to retrieve content-data and metadata from the store, and **Ingest Services** to ingest the migrated content-data and metadata back into the store.

5.2   Catalogue Services

Catalogue Services provide access to metadata held outside of the LTP. The catalogues might be internal library catalogues, or they might be external to the library. The description of Catalogue Services provides context for the other services. It is described separately from the overall Metadata Services since we expect that institutions already have Catalogue Services in place with which an LTP system must interact.

An overall LTP architecture must define how metadata in the catalogues are associated with objects in the LTP system itself:

- The catalogues might provide metadata to the Ingest Services to enrich an SIP descriptor, which is then stored in the AIP.

- The LTP might link back to the catalogues as the master for this metadata (*e.g.* for elements whose values are under authority control).

An LTP architecture must determine which catalogue or system is the master for every element of the metadata, and define how updates to the element in the master catalogue are handled by the LTP system after ingest.

As outlined in section 5.9, Catalogue Services must be *transactional* (capable of acting as part of a larger transaction).

5.2.1   Actions and interactions of the Catalogue Services

- **Ingest Services** work with **Catalogue Services** to enrich the metadata (or create a link between an item in the LTP system and a catalogue record).

- **Metadata Services** and **Catalogue Services** work together to keep the LTP system's copy of metadata up-to-date.

- **Resource Discovery Services** work with **Metadata Services** and **Catalogue Services** to help consumers find what they seek.

5.3   Metadata Services

Metadata Services are used by all the core functions of in a digital library:

- During ingest, Metadata Services may help enrich metadata.

- During retention, Metadata Services are used to preserve the metadata, handle updates to the metadata (possibly *via* catalogues outside the LTP system), help to enact preservation plans, and implement the library's policy on metadata versioning.

- During access, Metadata Services provide means to retrieve metadata in order to help Delivery Services to generate the DIP requested by the consumer.

It is important to note that the LTP system will be the master for some, but not all, of the metadata it holds (and a metadata record for a single item may be a mixture of both types). Where it is the master, the LTP system must allow authorised users to edit the metadata that is eligible for change; where it is not the master, the LTP system must allow changes to come only from the master catalogue. The DL should ensure that changes to the catalogue are authorised and done correctly.

There could be dependencies of the Metadata Services to external services outside the LTP system or even outside the digital library. Metadata Services should deal with problems based on these dependencies (synchronisation, deleted referenced data, etc.).

Metadata Services could support several schemas of metadata for different purposes – for example:

- descriptive/bibliographic
- technical
- rights
- structure
- preservation/digital provenance
- file management

5.3.1   Interactions of Metadata Services

- **Ingest Services** provide **Metadata Services** with metadata to hold in perpetuity.

- **Archival Storage Services** and **Metadata Services** keep safe the ingested content-data and metadata for each entity, and prove that they are doing so.

- **Metadata Services** provide information for **Archival Storage Services** to handle the content-data.

- **Metadata Services** and **Catalogue Services** work together to keep the LTP system's copy of metadata up-to-date.

- **Preservation Services** work with **Metadata Services** and **Archival Storage Services** to enact Preservation Watch and Preservation Planning for the digital formats and metadata formats within the LTP system. Preservation actions will typically involve **Delivery Services** to retrieve content-data and metadata from the store, and **Ingest Services** to ingest the migrated content-data and metadata back into the store.

- **Metadata Services** allow operators and preservation officers to search (metadata of) digital items held within the LTP system. This could be necessary for the Preservation Watch function of **Preservation Services**.

- **Resource Discovery Services** work with **Metadata Services** and **Catalogue Services** to help consumers find what they seek.

- **Delivery Services** use **Metadata Services** to retrieve the related metadata records (descriptive, technical, structural, etc.) in the requested formats.

5.4 Archival Storage Services

The Archival Storage Services store content-data and optionally metadata reliably and indefinitely. These services will typically be provided by an enterprise storage vendor.

As outlined in section 5.9, Archival Storage Services must be *transactional* (capable of acting as part of a larger transaction).

5.4.1 Actions and interactions of Archival Storage Services

- **Ingest Services** provide **Archival Storage Services** with files to hold in perpetuity.

- **Archival Storage Services** and **Metadata Services** keep safe the ingested content-data and metadata for each entity, and prove that they are doing so.

- **Metadata Services** provide information for **Archival Storage Services** to handle the content-data.

- **Preservation Services** work with **Metadata Services** and **Archival Storage Services** to enact Preservation Watch and Preservation Planning for the digital formats and metadata formats within the LTP system. Preservation actions will typically involve **Delivery Services** to retrieve content-data and metadata from the store, and **Ingest Services** to ingest the migrated content-data and metadata back into the store.

- **Archival Storage Services** help operators to monitor and control the archival store.

- **Resource Discovery Services** work with **Archival Storage Services** to generate full-text indexes for searching.

- **Delivery Services** work with **Archival Storage Services** to retrieve digital items or parts of digital items (like an embedded bit stream) from the LTP store.

5.5 Preservation Services

Preservation Services address issues of (digital) obsolescence, to ensure continued access to the information contained in the digital items preserved in the LTP system. There are three broad elements to Preservation Services:

- Preservation Watch
- Preservation Planning
- Preservation Action

These three elements are described in detail by the Planets project [PLANETS] and denote the following:

Preservation Watch monitors a variety of internal and external entities. Where potential changes in the entities are identified (e.g. a new tool is available, a platform is no longer supported, or a new use case becomes popular), the resulting preservation risk is assessed. Critical or imminent risks are passed to Preservation Planning for further analysis and action. Information gathered from the entities should also result in updates of the Representation Information to a knowledge base.

Preservation Planning assesses constraints and risks received from Preservation Watch. It evaluates available preservation options (informed by Representation Information and by the organisation's policy on long-term access) and then trials them on sample content. It assesses the results of those trials and identifies the most appropriate options. Plans for implementing the selected preservation options are then created and passed to Preservation Action for implementation.

Preservation Action performs actions on digital items to ensure their continued accessibility, and sends appropriate feedback to Preservation Watch.

For example: if Preservation Planning requires a file migration, a Preservation Plan is passed to Preservation Action, describing the required process. The content is passed from access. As part of the preservation plan a characterisation of the content will be performed, both before and after the migration. The appropriate tools and services to perform the migration action are identified from a knowledge base and will be deployed in the relevant environment. The preservation action will then be executed and evaluated. If the result did not meet the requirements as recorded in the Preservation Plan, a new Preservation Planning process is required. If the action has been performed according to expectations, the migrated content is sent to Ingest Services for re-ingest, together with the updated metadata.

5.5.1   Actions and interactions of Preservation Services

- **Preservation Services** work with **Metadata Services** and **Archival Storage Services** to enact Preservation Watch and Preservation Planning for the digital formats and metadata formats within the LTP system. Preservation actions will typically involve **Delivery Services** to retrieve content-data and metadata from the store, and **Ingest Services** to ingest the migrated content-data and metadata back into the store.

- **Metadata Services** allow operators and preservation officers to search (metadata of) digital items held within the LTP system. This could be necessary for the Preservation Watch function of **Preservation Services**.

- **Preservation Services** may support **Presentation Services** such as offering an emulation strategy for a certain digital item, or perform migration-on-demand (not for re-ingest).

5.6   Resource Discovery Services

Resource Discovery Services allow consumers to search for digital items held within the LTP system. Resource Discovery Services use the content-data and metadata to build and maintain a diversity of indexes that support functionality for search and discovery. It allows users to navigate through the interrelationships between digital items.

Resource discovery Services can be made specific for classes of consumers by implementing specific vocabularies and/or ontologies. Functions can be added to adapt the behaviour of the Resource Discovery Services on the basis of profile information stored for each individual consumer or classes of consumers.

5.6.1   Actions and interactions of Presentation Services

- **Resource Discovery Services** work with **Metadata Services** and **Catalogue Services** to help consumers find what they seek.

- **Resource Discovery Services** work with **Archival Storage Services** to generate full-text indexes for searching.

5.7   Delivery Services

Delivery Services provide means to efficiently retrieve DIPs of digital items that are stored in the system. In contrast to the Archival Storage Services, the Delivery Services provide external interfaces to the consumer. That is why they must enforce personalized and item-specific restrictions for access and usage (e.g. as a consequence of the usage rights that apply to an item).

A DIP includes the content-data of a representation and/or metadata related to the content-data. The consumer may choose between various supported DIP formats. The requested format defines the combination of content format and metadata format used by the DIP. The requested content format may differ from the content format of the AIP - e.g. it may sometimes be necessary to provide a compressed and/or downscaled version of the content.

Depending on the overall architecture (especially depending on the connection to and performance of Archival Storage Services), it may be necessary for the Delivery Services to support caching.

5.7.1   Actions and interactions of Delivery Services

- **Delivery Services** allow consumers to request digital items or parts of digital items (like an embedded bit stream) using their persistent identifier in a particular DIP format.

- **Delivery Services** authorise consumer requests, and implement policies for digital rights and access control.

- **Delivery Services** work with **Archival Storage Services** to retrieve digital items from the LTP store.

- When the requested content format is different from the AIP format of the entity, the **Delivery Services** transform the content-data formats.

- The **Delivery Services** use **Metadata Services** to retrieve the related metadata records (descriptive, technical, structural, etc.) in the requested formats.

- **Preservation Services** work with **Metadata Services** and **Archival Storage Services** to enact Preservation Watch and Preservation Planning for the digital formats and metadata formats within the LTP system. Preservation actions will typically involve **Delivery Services** to retrieve content-data and metadata from the store, and **Ingest Services** to ingest the migrated content-data and metadata back into the store.

- **Presentation Services** work with **Delivery Services** to take the content-data and metadata, and present them to consumer.

5.8 Presentation Services

Presentation Services define the way that the consumer consumes the DIPs provided by the digital library. For example: a web page, a PDF viewer or a page-turner application.

Presentation Services render content-data to human-accessible media (via auditory, visual, or other means), re-establishing a certain "look and feel" of the digital item.

Preservation Services such as emulation tools can be used to enable execution of original software to recreate the behaviour and interaction with the digital item.

The description of Presentation Services provides context for the other services which a DL might deem to be relevant.

5.8.1 Actions and interactions of Presentation Services

- **Preservation Services** may work with **Presentation Services** during preservation actions.

- **Presentation Services** work with **Delivery Services** to take the content-data and metadata, and present them to consumer.

5.9 Workflow Services

Workflow Services provide a means for orchestrating business processes. In particular, these services will provide a workflow engine and a means for defining and deploying orchestrations to the workflow engine.

Each workflow will contain activities that are implemented by other services, and so the workflow engine must control the interaction with (and consumption of) these service interfaces. The workflow engine also must be able to load-balance multiple instances of worker services.

The workflow engine must support the definition and execution of exception-handling rules. Since workflow activities might change the state of parts of the system and an interruption of the workflow might lead to an inconsistent state, the workflow engine must support *transactions*. When an error happens, the workflow engine must be able to trigger rollbacks for all activities that modified the state during the transaction. Therefore Workflow Services, Archival Storage Services and Catalogue Services need to be transactional (capable of acting as part of a larger transaction).

5.9.1 Actions and interactions of Workflow Services

- **Workflow Services** orchestrate the ingest procedures, using other services to meet the institution's own particular requirements for each content source and type.

- **Workflow Services** orchestrate the retention procedures, using other services to meet the institution's own particular requirements for ongoing preservation.

- **Workflow Services** orchestrate the access procedures, using other services to meet the institution's own particular requirements for discovery and delivery.

5.10 Common Services

Common Services provide the organisation with essential infrastructure capabilities. These may include, but are not limited to:

- Authentication
- Network connectivity
- Enterprise infrastructure
- Directory services
- Backups and disaster recovery

Common Services support the integration of all services and enables their interaction.

5.10.1 Actions and interactions of Common Services

- **Common Services** authenticate the consumers who make access requests.

- **Delivery Services** work with the **Common Services** to route the content-data and metadata to the consumer.

6 References

ID	Reference
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