International Standard

ISO 14721

Space Data System Practices — Reference model for an open archival information system (OAIS)

Pratiques des systèmes de données spatiales — Modèle de référence pour un système ouvert d'archivage d'information (SOAI)

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Foreword

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

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This document was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 650.0-M-3, December 2024) and drafted in accordance with its editorial rules. It was assigned to Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 13, *Space data and information transfer systems* and adopted under the "fast-track procedure".

This third edition cancels and replaces the second edition (ISO 14721:2012), which has been technically revised.

The main changes are as follows:

— Changes from the current issue are too numerous to permit meaningful markup.

— This issue has additions to, and clarifications of, concepts and terminology, for example:

  — The relationship between Preservation Description Information (PDI) and Content Data Object has been clarified, emphasizing that, as has been stated since the original version of OAIS, any Information Object may serve as Content Information.

— The concept of Preservation Objectives has been introduced to allow "Independently Understandable" to be more consistently testable.

— Consistency with the Producer-Archive Interface Specification (PAIS) (CCSDS 651.1-B-1) has been improved.

— Diagram conventions have been clarified.

— Some definitions in the Glossary have been clarified.

— Consistency between the diagrams of the Functional Entities and supporting text has been improved.

— A Preservation Watch function has been added to the Preservation Planning Functional Entity.

— The definition of the Information Package has been updated for consistency.

— Additional preservation techniques have been described explicitly in addition to Migration.

— Additional types of Archive interaction have been added, including primary-supporting Archives.

— Annex A is marked as Informative. It had previously erroneously been marked as Normative.

— Annex B from the previous issue described the relationship of OAIS to other standards; but its contents were continually out of date as those other standards develop along different directions and timelines as compared to OAIS development. Also, subsection 1.5 from the previous issue, which provided a roadmap to related Standards which could be developed was removed since a number of those standards are now available. Both have been replaced by pointers in annex B to informative documents on the CCSDS web site which can be updated more rapidly.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this document is to define the CCSDS and International Organization for Standardization (ISO) Reference Model for an **Open Archival Information System** (OAIS). An OAIS is an Archive system consisting of hardware, software, information, and policy-based processes and procedures put in place and operated by an organization and its staff. The organization has accepted the responsibility to preserve information and make it available for a **Designated Community**. The organization may be part of a larger organization. The system meets a set of mandatory responsibilities that allow an OAIS Archive to be distinguished from other uses of the term 'archive'. The set of mandatory responsibilities an OAIS Archive must perform are defined in 3.2. The term 'Open' in OAIS is used to imply that this Recommended Practice, as well as future related Recommended Practices and standards, are developed in open forums, and it does not imply that access to the Archive is unrestricted. The information being maintained has been deemed to need **Long Term Preservation**, even if the OAIS itself is not permanent. **Long Term** is long enough to be concerned with the impacts of changing technologies, as well as support for new media and data formats, or with a changing **Knowledge Base** of the Designated Community or changes within the Designated Community or its definition. Long Term may extend indefinitely. In this **Reference Model** there is a particular focus on digital information, both as the primary forms of information held and as supporting information for both digitally and physically preserved materials. Therefore, the model accommodates information that is inherently non-digital (e.g., a physical sample), but the modelling and preservation of such information is not addressed in detail. This Reference Model:

- provides a framework for the understanding and increased awareness of archival concepts needed for Long Term digital information preservation and access;
- provides the concepts needed by non-archival organizations to be effective participants in the preservation process;
- provides a framework, including terminology and concepts, for describing and comparing architectures and operations of existing and future Archives;
- provides a framework for describing and comparing different Long Term Preservation strategies and techniques;
- provides a basis for comparing the data models of digital information preserved by Archives and for discussing how the data models and the underlying information may change over time;
- provides a framework that may be expanded by other efforts to cover Long Term Preservation of information that is NOT in digital form (e.g., physical media and physical samples);
- expands consensus on the elements and processes for Long Term digital information preservation and access, and promotes a larger market which vendors can support;
- guides the identification and production of OAIS-related standards.

The reference model addresses a full range of archival information preservation functions including ingest, archival storage, data management, access, and dissemination. It also addresses the migration of digital information to new media and forms, the information models used to represent the information, the role of software in information preservation, and the exchange of digital information among Archives. It identifies both internal and external interfaces to the Archive functions, and it identifies a number of high-level services at these interfaces. It provides various illustrative examples and some 'best practice' recommendations. It defines a minimal set of responsibilities for an Archive to be called an OAIS, and it also defines a maximal Archive to provide a broad set of useful terms and concepts.

1.2 APPLICABILITY

The OAIS model in this document may be applicable to any Archive. It is specifically applicable to organizations, which may themselves be part of larger organizations, with the responsibility of making information available for the Long Term (as defined in 1.6.2). This includes organizations with other responsibilities, such as receiving, processing and distribution in response to programmatic needs.

Organizations may require their information, from the start, to be re-processable to enable the results created by others to be reproduced, interoperable with other information, and re-used in new ways. Such organizations will find this document relevant because of the requirement that, to be preserved, the information must be understandable and usable.

This model is also of interest to those organizations and individuals who create information that may need Long Term Preservation and those that may need to acquire information from such Archives.

The model, including the functional and information modelling concepts, is relevant to the comparison and design of facilities which hold information, on a temporary basis, for two reasons:

- When taking into consideration the rapid pace of technology changes or possible changes in a Designated Community, there is the likelihood that facilities, thought to be holding information on a temporary basis, will in fact find that some or much of their information holdings will need Long Term Preservation attention.
- Although some facilities holding information may themselves be temporary, some or all of their information may need to be preserved indefinitely. Such facilities need to be active participants in the Long Term Preservation effort.

Standards developers are expected to use this model in conjunction with related standards and community documents as a basis for further standardization in this area. Many related standards are possible and some have already been developed. Annex B includes links to websites containing references to a selection of related standards.

This reference model does not specify a design or an implementation. Actual implementations may group or break out functionality differently.

1.3 RATIONALE

A tremendous growth in computational power, and in networking bandwidth and connectivity, has resulted in an explosion in the number of organizations making digital information available. Transactions among all types of organizations are being conducted using digital forms that are taking the place of more traditional media such as paper.

Preserving information in digital forms is much more difficult than preserving information in forms such as paper and film. This is not only a problem for traditional archives, but also for many organizations that have never thought of themselves as performing an archival function. Along with the many advantages in terms of, for example, searchability and replication, the spread of digital technology in every field brings certain disadvantages. The rapid obsolescence of digital technologies creates considerable technical dangers, particularly a much greater risk than in the past of losing the possibility of restoring, rendering or interpreting the information. Ways of avoiding or reducing these dangers will be detailed throughout this Recommended Practice. Nevertheless, it would be unwise to consider the problem from a solely technical standpoint. There are also organizational, legal, industrial, scientific and cultural issues to be considered. To ignore the problems raised by preserving information in digital forms would lead inevitably to the loss of this information. In addition, information is more and more easily altered or faked. Ways to be more sure of the authenticity of information, by knowing its provenance and being sure that it has not been altered, will help to counter these threats

It is expected that this reference model, by establishing minimum requirements for an OAIS Archive along with a set of archival concepts, will provide a common framework from which to view archival challenges, particularly as they relate to digital information. This should enable more organizations to understand the issues and take the proper steps to ensure Long Term information preservation. It should also provide a basis for more standardization and, therefore, a larger market that vendors can support in meeting archival requirements.

1.4 CONFORMANCE

A conforming OAIS Archive implementation shall support, and be able to map to the components of, the model of information described in 2.3 and 4.3, which provides more formal definitions of the model using UML. The OAIS Reference Model does not define or require any particular method of implementation of these concepts.

A conforming OAIS Archive shall fulfil the responsibilities listed in 3.2. Subsection 3.3 provides examples of the mechanisms that may be used to discharge the responsibilities identified in 3.2. These mechanisms are not required for conformance.

A conformant OAIS Archive may provide additional services that are beyond those required of an OAIS.

This reference model does not specify a design or an implementation. Actual implementations may group or break out functionality differently.

It is assumed that implementers will use this reference model as a guide while developing a specific implementation to provide identified services and content. This document does not assume or endorse any specific computing platform, system environment, system design paradigm, system development methodology, database management system, database design paradigm, data definition language, command language, system interface, user interface, technology, or media required for implementation.

The OAIS Reference Model is designed as a conceptual framework in which to discuss and compare Archives. As such, it attempts to address all the major activities of an information-preserving Archive in order to define a consistent and useful set of terms and concepts. A standard or other document that claims to be conformant to the OAIS Reference Model shall use the terms and concepts defined in the OAIS Reference Model in the same manner. Subsection 1.6.2 defines OAIS terminology and is normative.

To summarize, to be conformant with OAIS, an Archive must support the basic terminology specified in section 1.6.2, must be able to map its practices to the OAIS Information Model, which is defined at very high level in 2.3 and in more detail in 4.3, and must also fulfill the Mandatory Responsibilities specified in 3.2.

1.5 DOCUMENT STRUCTURE

1.5.1 HOW TO READ THIS DOCUMENT

All readers should read the Purpose and Scope (1.1), Applicability (1.2), and Conformance (1.4) subsections to obtain a view on the objectives and applicability of the document.

Those who want just an overview of the major concepts should also read OAIS Concepts (section 2) and OAIS Responsibilities (section 3).

Those who will implement OAIS Archives or administer them should read the entire document.

1.5.2 ORGANIZATION BY SECTION

Section 1 provides purpose, scope, applicability, and definitions sections typical of many standards. It also provides rationale for the effort and conformance requirements.

Section 2 provides a high-level overview of the major concepts involved in an OAIS Archive. It provides a view of the environment of an OAIS Archive and the roles played by those who interact with it. It discusses what is meant by ‘information’ and what is necessary to preserve it for the Long Term. It contains key information concepts relevant to OAIS-conforming implementations.

Section 3 describes the responsibilities required of an OAIS. Subsection 3.2 defines mandatory responsibilities an OAIS Archive must discharge in preserving its information, and 3.3 provides clarifying material of the types of activities that may be needed in many Archives to discharge these responsibilities.

Section 4 provides model views needed for a detailed understanding of an OAIS Archive. It breaks down the OAIS into a number of informative abstract functional entities and it describes some abstract high-level services provided at the interfaces of these entities. It also provides normative information models using Unified Modeling Language (UML) class diagrams.

Section 5 provides some perspectives on the issues of information preservation. It also provides some perspectives on the issues of preserving access services to digital information using software porting, wrapping, and emulation of hardware.

Section 6 is an introduction to the various alternatives for Archive-to-Archive associations to provide increased or more cost-effective services.

The annexes B-F are not part of the Recommended Practice and are provided for the convenience of the reader:

- annex A provides a composite diagram of the detailed functional entities described in 4.2;
- annex B contains pointers to external documents which relates parts of this reference model to other standards work and provides a guide for development of related standards;
- annex C provides a brief tutorial on the Unified Modeling Language class diagrams (UML);

- annex D provides a list of informative references;
- annex E provides a layered model of information;
- annex F provides an overview of security considerations.

1.5.3 DIAGRAM CONVENTIONS

Except where indicated otherwise, diagrams show entities such as people or organizations as round cornered long rectangles, functions as rectangles with round corners and functional entities as rectangles with cut corners, with information between them as arrows, and special information objects as ellipses as illustrated in figure 1-1.

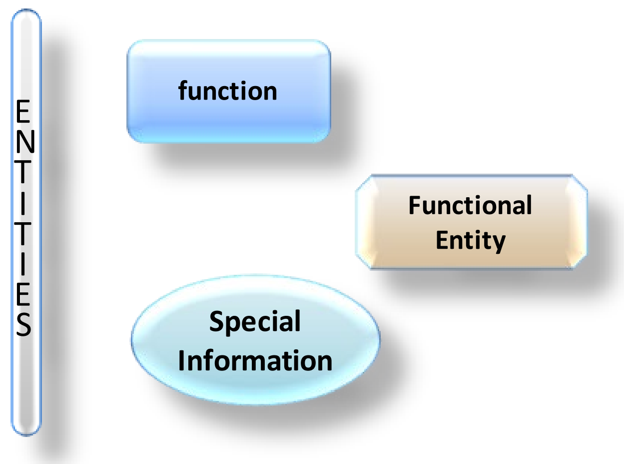

Figure 1-1: Examples of Diagram Conventions

To serve as visual clues, consistent colors have been adopted for each Functional Entity and its component Functions; however, the diagrams do not depend upon these colors to be usable.

1.5.4 TYPOGRAPHICAL CONVENTIONS

There are many terms which are used in this reference model and which need to have well-defined meanings. These terms are defined in 1.6.2. When first used in the text, they are shown in bold and are capitalized. Subsequent use employs capitalization only. Because of their extensive use in this document, the defined terms 'data' and 'information' will not always be capitalized unless they are part of another defined term. The defined term 'archive' will not be capitalized unless it is used as the equivalent of an 'OAIS Archive'.

Many diagrams are included throughout this reference model, primarily in sections 4 and 6. In text discussing the diagrams, block names are capitalized and flows are italicized.

1.5.5 NOMENCLATURE

1.5.5.1 Normative Text

The following conventions apply for the normative specifications in this Recommended Practice:

a) the words 'shall' and 'must' imply a binding and verifiable specification;

b) the word 'should' implies an optional, but desirable, specification;

c) the word 'may' implies an optional specification;

d) the words 'is', 'are', and 'will' imply statements of fact.

NOTE – These conventions do not imply constraints on diction in non-normative text.