The Consultative Committee for Space Data Systems

Draft Recommendation for Space Data System Standards

OPEN ARCHIVAL INFORMATION SYSTEM INTEROPERABILITY FRAMEWORK (OAIS-IF) ARCHITECTURE DESCRIPTION

PROPOSED DRAFT RECOMMENDED STANDARD

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FOREWORD

This document is a draft technical Recommended Standard for use in developing and maintaining broader consensus on what is required for an archive to provide permanent, or indefinite long term, preservation of digital information.

This draft Recommended Standard establishes a framework of specifications that forms the basis for the Open Archival Information System (OAIS) Interoperability Framework (IF). OAIS is a long-established Process Framework (PF) to enable digital preservation in trustworthy archives. The OAIS-IF supplements OAIS with interoperable technical specifications that will allow interoperability between users and multiple archives, and between multiple archives. The OAIS-IF is not required for an archive to cite compliance with OAIS.

OAIS provides a basis for further standardization within an archival context. OAIS-IF is an example of that further standardization.

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This Recommended Standard is therefore subject to CCSDS document management and change control procedures, which are defined in the *Organization and Processes for the Consultative Committee for Space Data Systems* (CCSDS A02.1-Y-4). Current versions of CCSDS documents are maintained at the CCSDS Web site:

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PREFACE

This document is a draft CCSDS Recommended Standard. Its 'Red Book' status indicates that the CCSDS believes the document to be technically mature and has released it for formal review by appropriate technical organizations. As such, its technical contents are not stable, and several iterations of it may occur in response to comments received during the review process.

Implementers are cautioned **not** to fabricate any final equipment in accordance with this document's technical content.

DOCUMENT CONTROL

Document	Title and Issue	Date	Status
CCSDS 000.0-W-0	[Document Title], Proposed Draft Recommended Standard, Issue 0	[Month Year]	Current proposed draft

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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) **Open Archival Information System** (OAIS) Implementation Framework (IF). An OAIS is an Archive, consisting of an organization, which may be part of a larger organization, of people and systems, that has accepted the responsibility to preserve information and make it available for a **Designated Community**. The OAIS-IF is a supplement to that overarching standard that adds capabilities for system interoperability between users and archives, and between coordinating archives. This document outlines a data system architectural approach and a set of specifications for interfaces that will be defined in additional subordinate standards to be issued subsequently. This standard is the Architecture Description document that sets the overall architectural framework for the OAIS-IF suite of standards.

The OAIS-IF is an implementable framework for digital repositories that enables international and collaborative research. Its aim is to provide set of interoperable protocols and interface specifications that will enable the access, merging, and re-use of the data, both within and across the operational boundaries of trusted digital repositories. The framework will also provide support for the fundamental scientific technique of checking the reproducibility of results. The OAIS-IF is designed to be effectively applied broadly across a spectrum of small, medium, and large use cases and involving a wide variety of stakeholders.

Implementers and system developers that plan to develop systems compliant with the OAIS-IF suite of standards should have a solid grasp of the precepts, concepts and terminology of the Reference Model for an OAIS as described in CCSDS 650.0-M-2.

The information being maintained in these Archives 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. Further treatment of the scope of Long Term preservation is in the RM for OAIS, CCSDS 650.0-M-2.-

1.2 APPLICABILITY

Like the OAIS Reference Model in CCSDS 650.0-M-2, this document may be applicable to any Archive that complies with that OAIS standard. It is specifically applicable to organizations with the responsibility of making information available for the Long Term. This includes organizations with other responsibilities, such as processing and distribution in response to programmatic needs.

This architecture is specifically designed to supplement OAIS Archives. However, this architecture or components of it may be used by archives that are partially or fully non-compliant to the Reference Model for OAIS. The authors of this standard cannot guarantee that these technical approaches will work to fulfill objectives of archives that are not fully OAIS compliant. It is hoped that in these cases partial implementation of the OAIS-IF will encourage greater adoption of the RM for OAIS as archives learn the value of the OAIS practices that enable truly trustworthy Archives for preserving valuable information.

It is intended that the functionality and components in OAIS-IF will exactly mirror the content of the RM for OAIS. However, since these are two separate documents with updates released at different times and different approval cycles, it may be that new functions can be added to OAIS-IF that are not yet in the RM for OAIS. Likewise, there may be new functions in OAIS that are not yet in the OAIS-IF. The intention is to keep the OAIS RM practice and the OAIS-IF specification as closely aligned as possible. However, perfect alignment may not be possible at every given point in time.

These specifications, including the functional and information modeling concepts, are relevant to the comparison and design of facilities which hold information, on a temporary basis, for three 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. Stable OAIS-IF standards will help abate the disruption of technology changes.

– 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 become active participants in the Long Term Preservation effort and adoption of OAIS-IF will facilitate that transition.

– Regardless of preservation objectives, this architecture enables interoperability for efficiency benefits, preservation benefits, and cross-discipline research benefits.

1.3 OAIS-IF STAKEHOLDERS

In a broad sense, OAIS-IF has applicability to the following stakeholders. This is not an exclusive list, but is intended to illustrate how the document should be of interest to key organization participants.

- **Any organization who has implemented or plans to implement an OAIS-compliant system.** Not all OAIS-compliant systems will have OAIS-IF capabilities. Indeed, as this first version of OAIS-IF is released, none of the OAIS systems in the world will be OAIS-IF compliant. But OAIS implementers should evaluate the benefits to themselves and their customers from implementing an OAIS-IF compliant interoperable archive. Therefore, they have a stake in OAIS-IF.

- **Managers**, who we assume are key decision makers and determine technology adoption and use. We use the Manager stakeholder broadly for anyone with management responsibility across procurement, development and/or operations.
- **Application Software Developers**, who are those responsible for providing software at an application level (i.e. software implementing any of the six functional entities[1] of an OAIS. Application software is likely to be repository-specific.
- **Infrastructure Software Developers**, who are those responsible for providing the underlying software framework or environment which may be used by application software developers. This software is much less likely to be repository specific. The distinction between application and infrastructure is not necessarily exact but the separation from application software is useful in identifying the parts of OAIS-IF that form part of the underling infrastructure and are more likely to be reused from repository to repository.

1.4 RATIONALE

The rationale for OAIS and the Reference Model for OAIS is captured in CCSDS 650.0-M-2.

The rationale for the OAIS Interoperability Framework includes the rationale for OAIS (not repeated here) because it supports OAIS by augmenting it with capabilities for interoperability.

The rationale and vision for OAIS-IF is that in the long-range future it will provide:

- A common user interface experience for users (providers and consumers) of OAIS archives when accessing many diverse kinds of OAIS-IF archives.

- An efficient standardized way for archives to exchange data between archives using the same standardized OAIS-IF interfaces.

- Given broad acceptance of OAIS-IF in the OAIS community, a better chance that long-term preservation will work because future generations can easily find the interfacing resources (plug-ins, etc.) that can be used to access legacy archives.

- Enhanced capabilities for cross-discipline research when many different disciplines use the same interface, and access to a new archive outside of your Designated Community can be accomplished via OAIS-IF.

1.5 CONFORMANCE

An Archive may conform to the Reference Model for OAIS without conforming to the OAIS-IF.

An OAIS archive that also conforms to OAIS-IF must implement the normative sections of this document, namely sections 3 and 4.

While the OAIS Reference Model does not define or require any particular method of implementation, the OAIS-IF must necessarily bound some implementation options in order to insure interoperability. However, the goal of OAIS-IF is to only limit implementation options necessary for interoperability. This is intended to restrict implementation at the interface of systems, but those interfaces are usually characterized to support underlying functionality as required by the OAIS Reference Model. Therefore the definitions at the interfaces and protocols may necessarily imply some underlying functionality as part of the OAIS-IF suite of standards.

A conformant OAIS-IF Archive may provide additional services that are beyond those required of the OAIS-IF standards.

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, technology, or media required for implementation.

The OAIS-IF is designed as an implementation framework to support the development of interoperability in OAIS Archives. As such, it attempts to address all the major activities of an ***interoperable*** information-preserving Archive in order to define a consistent and useful set of interoperability terms and concepts. A standard or other document that claim to be conformant to the OAIS-IF shall use the terms and concepts defined in the OAIS-IF in the same manner.

1.6 DOCUMENT STRUCTURE

1.6.1 ORGANIZATION BY SECTION

A general description of this document's sections are:

- Section 1 *Purpose and Scope* describes the problem space and rationale for OAIS-IF, and advice on what to expect from the document organization and conventions.
- Section 2 *Overview* provides an informative (non-normative) explanation of the relationships between OAIS-IF components and between them and the environment..
- Section 3 *Interoperability Framework* is a normative description of the requirements on the components of an OAIS-IF architecture. It presents the technical concepts that OAIS-IF uses in order to perform the functions of an OAIS in an interoperable way.
- (Add explanation of annexes once they are solidified)

This Blue Book begins with a description of the context for the creation of OAIS-IF in the form of the motivation and rationale for the framework. Further sections in this Blue Book then offer greater levels of detail about OAIS-IF generated directly from a formal model of the OAIS-IF. This detailed information is presented using the object-oriented paradigm. Each class, attribute, and relationship is formally defined using text and UML diagrams. It is anticipated that these sections will be primarily applicable to system developers but will be of interest to other stakeholders.

It is expected that after this document is approved and published by CCSDS, the model will be made available online by CCSDS. This should be a valuable aid to system developers of OAIS-IF systems.

1.6.2 TYPOGRAPHICAL CONVENTIONS

There are many terms which are used in this framework and which need to have well-defined meanings. These terms are defined in subsection 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.

1.7 DEFINITIONS

1.7.1 ACRONYMS AND ABBREVIATIONS

AIC	Archival Information Collection
AIP	Archival Information Package
AIU	Archival Information Unit
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee for Space Data Systems
CD-ROM	Compact Disk - Read Only Memory
CDO	Content Data Object
CRC	Cyclic Redundancy Check
CSV	Comma Separated Value
DBMS	Data Base Management System
DIP	Dissemination Information Package
DRM	Digital Rights Management

FITS	Flexible Image Transport System
FTP	File Transfer Protocol
HFMS	Hierarchical File Management System
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ISBN	International Standard Book Number
ISO	International Organization for Standardization
MPEG	Moving Picture Experts Group
OAIS	Open Archival Information System
PDF	Portable Document Format
PDI	Preservation Description Information
QA	Quality Assurance
RFC	Request For Comment
SIP	Submission Information Package
UML	Unified Modeling Language
VHS	Video Home System
WWW	World Wide Web
XFDU	XML Formatted Data unit
XML	eXtensible Markup Language

1.7.2 TERMINOLOGY

There are many terms which are used in this standard and which need to have well-defined meanings. These terms are defined in this subsection. When first used in the text, they are shown in bold and are capitalized. Subsequent use employs capitalization only.

As in RM-OAIS, this standard is applicable to all disciplines and organizations that do, or expect to, preserve and provide information in digital form, these terms cannot match all of those familiar to any particular discipline (e.g., traditional archives, digital libraries, science data centers). Rather, the approach taken is to use terms that are not already overloaded with meaning so as to reduce conveying unintended meanings. Therefore, it is expected that all disciplines and organizations will find that they need to map some of their more familiar

terms to those of the OAIS Reference Model and OAIS-IF. This should not be difficult and is viewed as a contribution, rather than a deterrent, to the success of these standards. For example, archival science focuses on preservation of the 'record'. This term is not used in these standards, but one mapping might approximately equate it with 'Content Data Object within an Archival Information Package'.

TERMS TO BE SUPPLIED (Probably after current OAIS Red Book is published)

1.8 REFERENCES

The following publications contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All publications are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the publications indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS publications.

[Only references required as part of the specification are listed in the References subsection. See CCSDS A20.0-Y-4, *CCSDS Publications Manual* (Yellow Book, Issue 4, April 2014) for additional information on this subsection.]

Reference Model for an Open Archival Information System (OAIS). Magenta Book. CCSDS 650.0-M-2 Issue 2. June 2012. (to be changed to Issue 3 when issue 3 is released)

OTHER REFERENCES TO BE SUPPLIED

2 OVERVIEW

The following concepts set the context for the normative definitions starting in section 3.

2.1 OAIS INTEROPERABILITY FRAMEWORK (OAIS-IF)

An Archive is an organization that intends to preserve information for access and use by a Designated Community.

An Open Archival Information System (OAIS) is an Archive, consisting of an organization, which may be part of a larger organization, of people and systems, that has accepted the responsibility to preserve information and make it available for a Designated Community. It meets a set of responsibilities that allows an OAIS Archive to be distinguished from other uses of the term 'Archive'.

The OAIS Interoperability Framework (OAIS-IF) is a framework based on the concepts presented in the OAIS Reference Model (RM) and augmented with features designed during several decades of digital archive development. The OAIS-IF is designed to be implementable and is an interoperable framework that fosters the acquisition, stewardship, and continuing access to data products, related information resources, and services for a designated community.

The environment surrounding an OAIS includes Management, Consumers, and Producers. The resulting environment of the OAIS-IF is illustrated in figure 1.

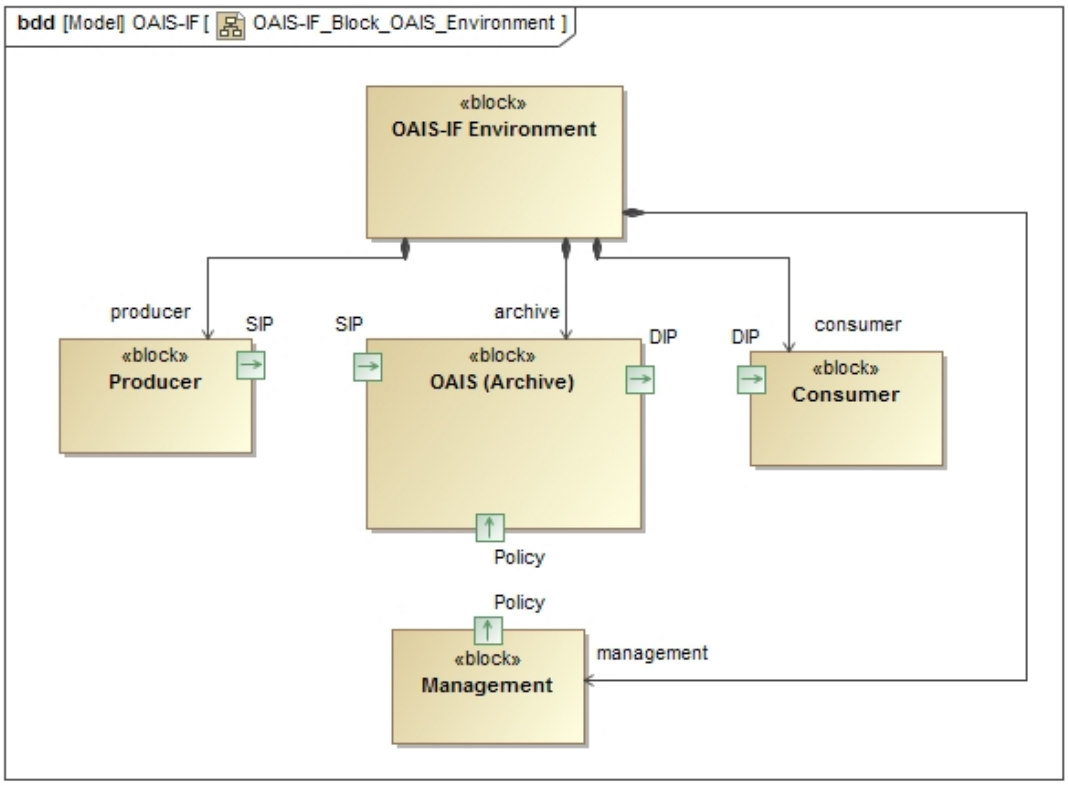

Figure 1 - OAIS Environment

Management is the role played by those who set overall OAIS policy as one component in a broader policy domain, for example as part of a larger organization.

Producer is the role played by those persons or client systems that provide the information to be preserved. This can include other OAISes or internal OAIS persons or systems. A Producer creates a Submission Information Package (SIP) and submits it to the Archive where it is processed into an Archival Information Package (AIP).

A Consumer is the role played by those persons, or client systems, who interact with OAIS services to find preserved information of interest and to access that information in detail. A consumer receives a Dissemination Information Package (DIP) from the Archive.

2.2 OAIS FUNCTIONAL ENTITY

Within an OAIS (archive), an OAIS Functional Entity is an entity responsible for a function that is required to ensure the reliable operation of a specific part of an Open Archive Information System (OAIS). The OAIS functional entities include Access, Administration, Archival Storage, Data Management, Ingest, and Preservation Planning. The OAIS

Interoperability Framework, being based on the OAIS model, has two additional functional entities the Archive Abstraction Layer and the Analytics Platform.

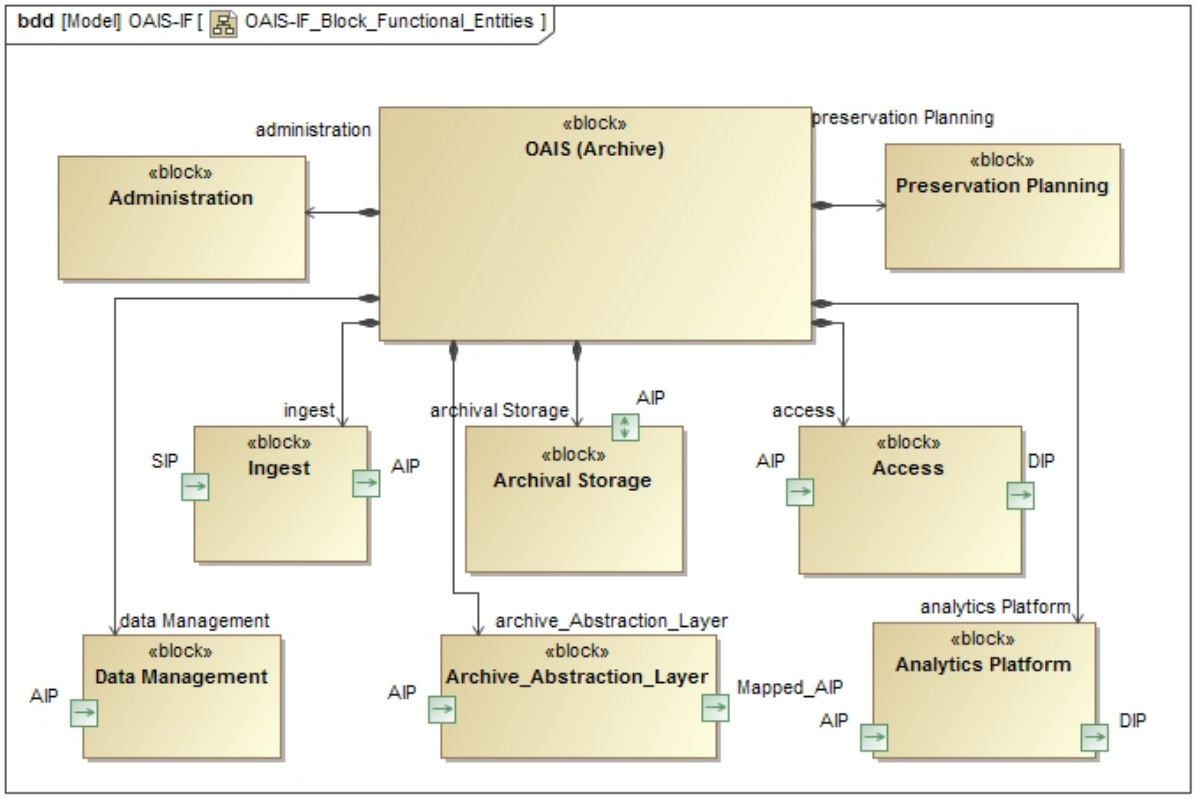

Figure 2 - OAIS Functional Entities

The Access Functional Entity (aka Access) contains the services and functions which make the archival information holdings and related services visible to Consumers. Access generates and provides a DIP to a Consumer, produces a Query Response for a Consumer, and provides Report Assistance to a Consumer.

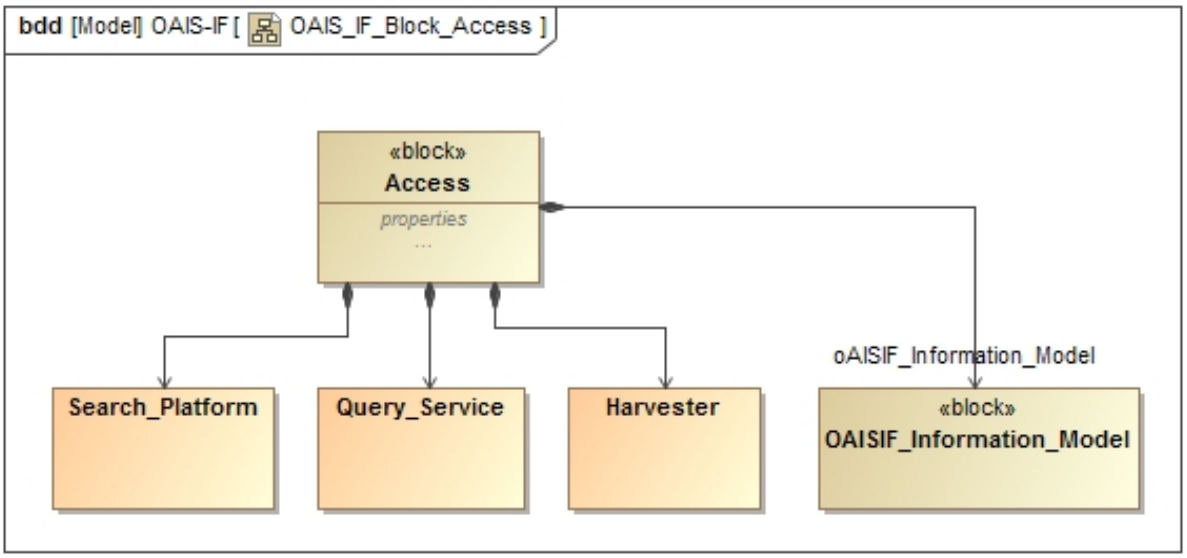

Figure 3 - Access Fuctional Entity

The Administration Functional Entity (aka Administration) contains the services and functions needed to control the operation of the other OAIS functional entities on a day-to-day basis. For Consumers and Producers Administration sends Information Requests, Bills and Special Request Responses to Consumers. Final Ingest Report and possible liens are sent to a Producer.

The Archival Storage Functional Entity (aka Archival Storage) contains the services and functions used for the storage and retrieval of Archival Information Packages.

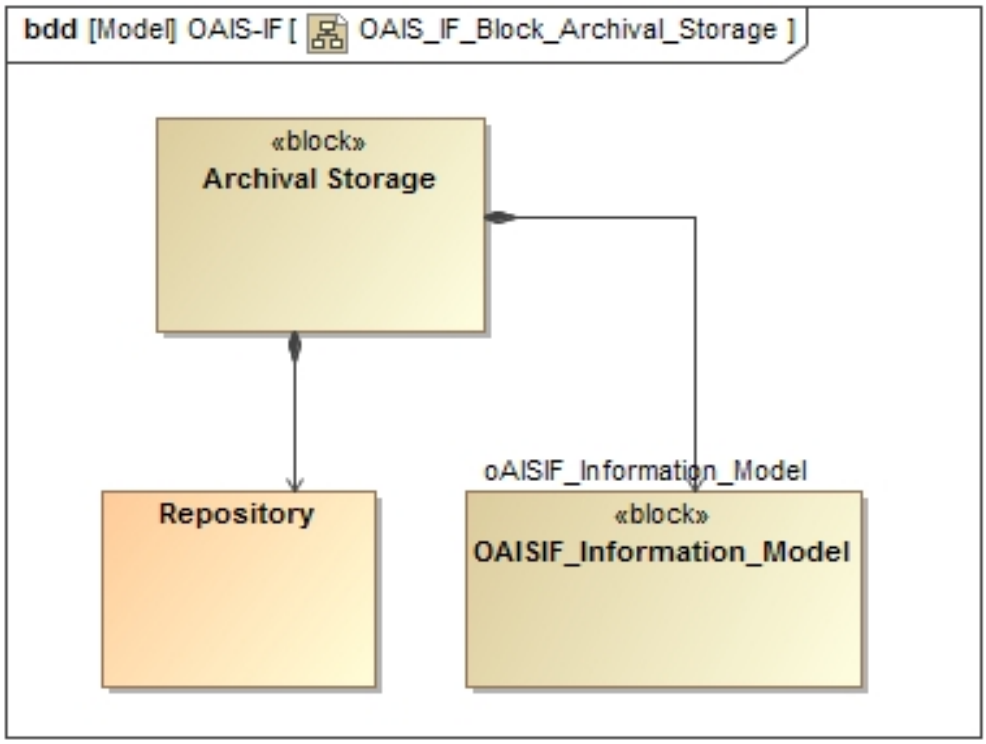

Figure 4 - Archival Storage Functional Entity

The Data Management Functional Entity (aka Data Management) contains the services and functions for populating, maintaining, and accessing a wide variety of information. Some examples of this information are catalogs and inventories on what may be retrieved from Archival Storage, processing algorithms that may be run on retrieved data, Consumer access statistics, Consumer billing, Event Based Orders, security controls, and OAIS schedules, policies, and procedures.

The Ingest Functional Entity (aka Ingest) contains the services and functions that accept Submission Information Packages from Producers, prepares Archival Information Packages for storage, and ensures that Archival Information Packages and their supporting Descriptive Information become established within the OAIS. Ingest sends Receipt Confirmation to a Producer.

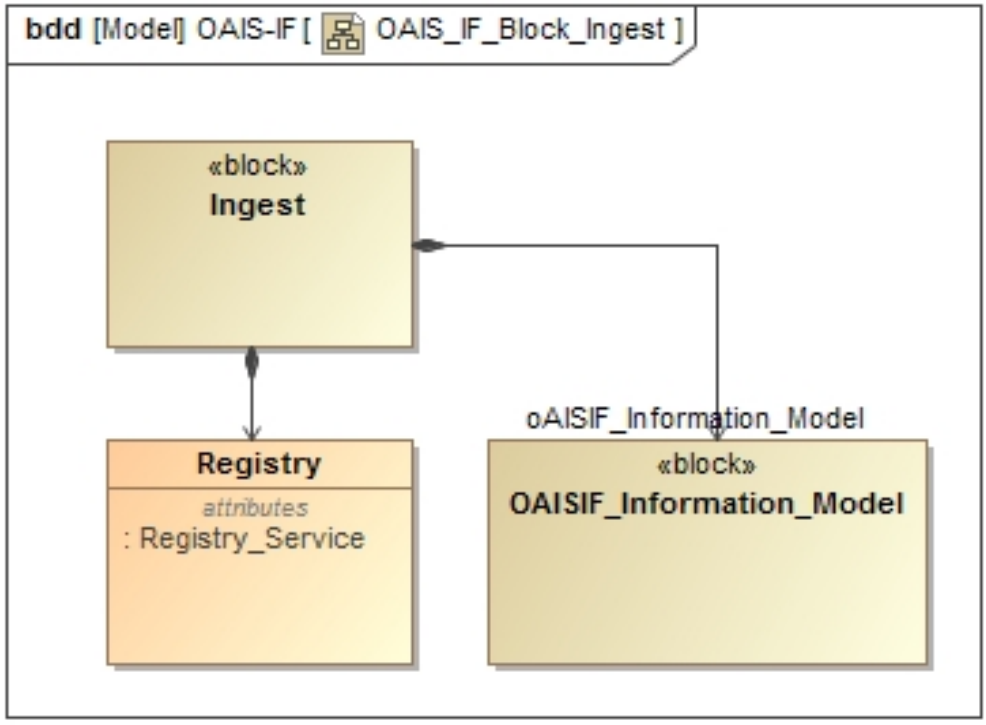

Figure 5 - Ingest Functional Entity

The Preservation Planning Functional Entity (aka Preservation Planning) provides the services and functions for monitoring the environment of the OAIS and provides recommendations and preservation plans to ensure that the information stored in the OAIS remains accessible to, and understandable by, and sufficiently usable by, the Designated Community over the Long Term, even if the original computing environment becomes obsolete. Preservation Planning surveys a Consumer and surveys a Producer.

The Archive Abstraction Layer Functional Entity (aka) provides a mapping and possible translation between an object in an OAIS AIP and an object in a non-conforming information package. For example a user asking for Provenance Information as defined for an OAIS AIP would receive information about a derived product, the source products, and processing software that was grouped and classified as processing history in a non-AIP information package. This is of course if the Archive Abstraction Layer had definitions of the two information packages, how their components were related, and how to translate from one to the other if needed.

The Analytical Platform is a unified data analysis solution designed to address the demands of users beyond the data management infrastructure necessary for maintaining a long-term trusted digital repository. In general it provides contextual analyzed data from across the repository and joins different tools for creating analytics systems.

2.3 DERIVED INTERFACE

Derived Interfaces are interfaces that are derived from relationships between OAIS Producers, Consumers, and Functional Entities. The following interfaces have been identified

1. Access_generates_DIP_for_Consumer
2. Access_produces_Query_Response_for_Consumer
3. Report_to_Producer
4. Administration_sends_Information_Requests_to_Consumers
5. Administration_sends_Lien_to_Producer
6. Response_to_Consumers
7. Consumer_Interface
8. Consumer_makes_Payment_to_Administration
9. Consumer_makes_Special_Service_Request_to_Administration
10. Consumer_submits_Service_Requirements_to_Preservation_Planning
11. Consumer_submits_a_Query_Request_to_Access
12. Consumer_submits_a_Report_Request_to_Access
13. Consumer_submits_an_Order_Assistance_Request_to_Access
14. Ingest_sends_Receipt_Confirmation_to_Producer
15. Ingest_sends_Resubmit_Request_to_Producer
16. Preservation_Planning_surveys_Consumers
17. Preservation_Planning_surveys_Producers
18. Producer_proposes_Product_Technologies_to_Preservation_Planning
19. Producer_provides_a_Submission_Interface_Package_to_the_Ingest_Functional_Entity

2.4 OAIS APPLICATIONS

An Application is a computer program designed to perform a group of coordinated functions, tasks, or activities for the benefit of the user. Many of these applications are services, software components that performs work that benefits another. In a service-oriented architecture (SOA) a service is a style of software design where services are provided to the other components by application components, through a communication protocol over a network. The basic principles of service oriented architecture are independent of vendors, products and technologies.

The OAIS Applications are computer programs written for each of the OAIS's Functional Entities outline in the previous section, for OAIS Consumers or Producers, or for OAIS system services.

The Producer Application class includes applications for users acting as a producer for a data archive. The Consumer Application class includes applications for users acting as a consumer of a data archive

An Access Aid is a software program or document that allows Consumers to locate, analyze, order or retrieve information from an OAIS. A Finding Aid is a type of Access Aid that allows a user to search for and identify Archival Information Packages of interest. An Ordering Aid is an application that assists the Consumer in discovering the cost of, and in ordering, AIPs of interest. A Retrieval Aid is an application that allows authorized users to retrieve the Content Information and PDI described by the Package Description.

A Harvester is a software tool used for extracting data from digital files for use by a search platform.

A Search Platform, also often called a Search Engine is a tool that provides a search capability that typically includes features such as full-text search, faceted search, database integration, and rich document (e.g., Word, PDF) handling. Its operations include the indexing of documents into a machine-readable format, the parsing of user queries, the mapping the of user queries to ingested documents to find the appropriate result, and ranking the outcome as per relevance.

TBD…

3 INTEROPERABILITY FRAMEWORK

3.1.1 COMPONENT

A component in represents a modular part of a system that encapsulates the state and behavior of a number of elements such as attributes or methods. Its behavior is defined in terms of provided and required interfaces, is self-contained, and substitutable.

3.1.1.1 Abstraction_Layer

The Abstraction_Layer contains the interfaces that define the contracts for the interoperability framework.

- Subclass of: Component

3.1.1.2 Binding_Layer

The Binding Layer contains "wrapper" libraries that bridges two programming languages, so that a library written for one language can be used in another language.

- Subclass of: Component

> *1. The Binding Layer component is an element of the OAIS Interoperabilty Framework component.*

3.1.1.3 Client

A Client is a computer system or process that requests a service of another computer system or process (a "server") using some kind of protocol and accepts the server's responses.

- Subclass of: Component

3.1.1.4 Consumer_Application_Layer

The Consumer Application Layer contains a program or group of programs designed for consumer end users.

- Subclass of: Component

> *1. The Consumer Application Layer component is an element of the Client component.*

3.1.1.5 Consumer_Interface

The Consumer Interface provides abstractions of consumer services.

- Subclass of: Component

> *1. The Consumer Interface component is an element of the OAIS Interoperabilty Framework component.*

3.1.1.6 Native_Archive

An Native Archive is an organization that intends to preserve information for access and use by a Designated Community and that does not conform to the Open Archival Information Systems (OAIS) Reference Model.

- Subclass of: Component

3.1.1.7 Native_Archive_Interface

The Native Archive Interface provides abstractions for non-OAIS archive services.

- Subclass of: Component

> *1. The Native Negotiate service is an element of the Native Archive Interface component.*

3.1.1.8 OAIS_Archive

An OAIS Archive is an organization that intends to preserve information for access and use by a Designated Community and that conforms to the Open Archival Information Systems (OAIS) Reference Model.

- Subclass of: Component

3.1.1.9 OAIS_Archive_Interface

The OAIS Archive Interface provides abstractions for OAIS archive services.

- Subclass of: Component

> *1. The OAIS Archive Interface component is an element of the OAIS Archive component.*

3.1.1.10 OAIS_Interoperabilty_Framework

The OAIS Interoperabilty Framework is an abstraction based on the OAIS Functional and Information Models in which software providing generic functionality can be selectively changed by additional user-written code to provide application-specific software that interoperates across digital repositories.

- Subclass of: Component

3.1.1.11 Object_Store

An Object Store is a computer data storage architecture that manages data as objects.

- Subclass of: Component

1. The Object Store component is an element of the Native Archive component.

2. The Object Store component is an element of the OAIS Archive component.

3.1.1.12 Producer_Application_Layer

The Producer Application Layer contains a program or group of programs designed for producer end users.

- Subclass of: Component

1. The Producer Application Layer component is an element of the Client component.

3.1.1.13 Producer_Interface

The Producer Interface is an abstraction of producer services.

- Subclass of: Component

1. The Producer Interface component is an element of the OAIS Interoperabilty Framework component.

3.1.2 DATA

The digital content of an archive.

3.1.2.1 Engineering_Data

Engineering Data is a package of digital data related to engineering and that is not structured as an OAIS Information Package.

- Subclass of: Archive

1. Engineering Data bindings are elements of the Binding Layer component.

2. The Engineering Information Package is realized by the Information Object Interface.

3. The Engineering Information Package uses the API of the Native Archive Interface.

3.1.2.2 OAIS_Data

OAIS Data is a package of digital data that is structured as an OAIS Information Package.

- Subclass of: Archive

1. The OAIS Information Package is realized by the Information Object Interface.

2. The OAIS Information Package uses the OAIS API of the OAIS Archive Interface.

3. OAIS Data bindings are elements of the Binding Layer component.

3.1.2.3 Other

Other is an arbitrary package of digital data and that is not structured as an OAIS Information Package.

- Subclass of: Archive

1. Other bindings are elements of the Binding Layer component.

2. e Other Information Package is realized by the Information Object Interface.

3. The Other Information Package uses the API of the Native Archive Interface.

3.1.2.4 Science_Data

Science Data is a package of digital data related to science and that is not structured as an OAIS Information Package.

- Subclass of: Archive

> *1. Science Data bindings are elements of the Binding Layer component.*
>
> *2. The Science Information Package is realized by the Information Object Interface.*
>
> *3. The Science Information Package uses the API of the Native Archive Interface.*

3.1.3 INTERFACE

An Interface is the abstraction of a service that only defines the operations supported by that service, but not their implementations.

3.1.3.1 Access_Interface

The Access_Interface interface is a well-defined entry point for the Access functional entity and provides a contract for the exchange of information.

- Subclass of: Interface

> *1. The Access Interface is an element of the Abstraction Layer component.*

3.1.3.2 Information_Object_Interface

The Information_Object_Interface interface is a well-defined entry point for an Information_Object and provides a contract for the exchange of information.

- Subclass of: Interface

> *1. The Information Object Interface is an element of the Abstraction Layer component.*

3.1.3.3 Ingest_Interface

The Ingest_Interface interface is a well-defined entry point for the Ingest functional entity and provides a contract for the exchange of information.

- Subclass of: Interface

1. The Ingest Interface is an element of the Abstraction Layer component.

3.1.3.4 Negotiate_Interface

The Negotiate_Interface interface is a well-defined entry point for negotiating protocols between two entities and provides a contract for the exchange of information.

- Subclass of: Interface

1. The Negotiate Interface is an element of the Abstraction Layer component.

3.1.4 SERVICE

A service is a software component that performs work that benefits another.

3.1.4.1 Access

Access Functional Entity (aka Access): The OAIS functional entity that contains the services and functions which make the archival information holdings and related services visible to Consumers.

- Subclass of: Functional_Entity

1. The Access service is an element of the Consumer Interface component.

2. The Access service is an element of the OAIS Archive Interface component.

3. The Access class has an Access Aid service.

4. The Access class is realized by the Access Interface.

5. The class requests an Archival Information Package

3.1.4.2 Access_Aid

Access Aid: A software program or document that allows Consumers to locate, analyze, order or retrieve information from an OAIS.

1. The Access Aid service is an element of the OAIS Archive Interface component.

2. The Access Aid service is an element of the Consumer Interface component.

3. Access_Aid uses Query Service.

3.1.4.3 Finding_Aid

Finding Aid: A type of Access Aid that allows a user to search for and identify Archival Information Packages of interest.

- Subclass of: Access_Aid

1. The Access Aid service is an element of the OAIS Archive Interface component.

2. The Access Aid service is an element of the Consumer Interface component.

3. The Finding Aid class is a subclass of Access Aid.

4. Access_Aid uses Query Service.

3.1.4.4 Ingest

Ingest Functional Entity (aka Ingest): The OAIS functional entity that contains the services and functions that accept Submission Information Packages from Producers, prepares Archival Information Packages for storage, and ensures that Archival Information Packages and their supporting Descriptive Information become established within the OAIS.

- Subclass of: Functional_Entity

1. The Ingest service is an element of the OAIS Archive Interface component.

2. The Ingest service is an element of the Producer Interface component.

3. The Ingest class is realized by the Ingest Interface.

4. Ingest sends an Archival Information Package to Archival Storage

3.1.4.5 Native_Access

The Native_Access class provides an access capability for a Native Archive.

1. The Native Access service is an element of the Native Archive Interface component.

3.1.4.6 Native_Ingest

The Native_Ingest class provides an ingest capability for a Native Archive.

1. The Native Ingest service is an element of the Native Archive Interface component.

3.1.4.7 Native_Negotiate

The Native_Negotiate class provides a negotiate capability for a Native Archive.

1. The Native Negotiate service is an element of the Native Archive Interface component.

3.1.4.8 Negotiate

The Negotiate class provides services to allow a users and the OAIS to negotiate protocols.

- Subclass of: Functional_Entity

1. The Negotiate service is an element of the Consumer Interface component.

2. The Negotiate service is an element of the OAIS Archive Interface component.

3. The Negotiate service is an element of the Producer Interface component.

4. The Negotiate class is realized by the Negotiate Interface.

3.1.5 APPLICATION

Application software is a program or group of programs designed for end users.

3.1.5.1 Consumer_Archive_Application

The Consumer_Archive_Application the class of applications for use by a user acting as a consumer of a data archive.

1. The Consumer Archive Application application is an element of the Consumer Application Layer component.

2. The Consumer Archive Application consumes the OAIS Interoperabilty Framework.

3. The Consumer Archive Application negotiates via the Negotiate service.

4. The Consumer Archive Application requests through the Access service.

5. Consumer_Archive_Application_Receives_Information_Package

3.1.5.2 Harvester

A Harvester is a software tool used for extracting data from digital files for use by a search platform.

- Subclass of: Active_Object

1. The Harvester application is an element of the OAIS Archive component.

2. The Harvester configures the Search Engine.

3. The Harvester harvests metadata from an Archival Information Package.

3.1.5.3 Producer_Archive_Application

The Producer_Archive_Application is the class of applications for use by a user acting as a producer for a data archive.

1. The Producer Archive Application application is an element of the Producer Application Layer component.

2. The Producer Archive Application consumes the OAIS Interoperabilty Framework.

3. The Producer Archive Application negotiates through the Negotiate service.

4. The Producer Archive Application produces the Submission Information Package.

5. The Producer Archive Application provides SIPs to the Ingest service.

3.1.5.4 Registry

Registry: A registry maintains a record of objects.

- Subclass of: Active_Object

1. The Registry application is an element of the OAIS Archive component.

2. The Registry tracks Archival Information Package.

3.1.5.5 Search_Platform

A Search Platform, also often called a Search Engine is a tool that provides a search capability that typically includes features such as full-text search, faceted search, database integration, and rich document (e.g., Word, PDF) handling. Its operations include the indexing of documents into a machine-readable format, the parsing of user queries, the mapping the of user queries to ingested documents to find the appropriate result, and ranking the outcome as per relevance.

- Subclass of: Active_Object

1. The Search Platform application is an element of the OAIS Archive component.

3.1.6 INFORMATION MODEL

An information model is a representation of concepts and the relationships, constraints, rules, and operations to specify data semantics for a chosen domain of discourse.

3.1.6.1 Archival_Information_Package

Archival Information Package (AIP): An Information Package, consisting of the Content Information and the associated Preservation Description Information (PDI), which is preserved within an OAIS.

- Subclass of: Information_Package

1. The Archival Information Package information object is an element of the Object Store component.

2. The Information Object class is realized by the Information Object Interface.

3. An Information Object has one Data Object. The relationship is an aggregation with cardinality (1..1).

3.1.6.2 Dissemination_Information_Package

Dissemination Information Package (DIP): An Information Package, derived from one or more AIPs, and sent by Archives to the Consumer in response to a request to the OAIS.

- Subclass of: Information_Package

1. The Dissemination Information Package information object is an element of the Consumer Application Layer component.

2. The Information Object is an element of the Object Store component.

3. The Information Object class is realized by the Information Object Interface.

4. An Information Object has one Data Object. The relationship is an aggregation with cardinality (1..1).

3.1.6.3 Information_Object

Information Object: A Data Object together with its Representation Information.

1. The Information Object is an element of the Object Store component.

2. The Information Object class is realized by the Information Object Interface.

3. An Information Object has one Data Object. The relationship is an aggregation with cardinality (1..1).

3.1.6.4 Native_Object

The Native_Object class is a data object in a Native Archive.

1. The Native Object information object is an element of the Object Store component.

3.1.6.5 Submission_Information_Package

Submission Information Package (SIP): An Information Package that is delivered by the Producer to the OAIS for use in the construction or update of one or more AIPs and/or the associated Descriptive Information. (Note: According to PAIS, a producer prepares a MOT. However an Information Package is also allowed if an AIP is to be derived directly from a SIP.)

- Subclass of: Information_Package

1. The Information Object is an element of the Object Store component.

2. The Submission Information Package information object is an element of the Producer Application Layer component.

3. The Information Object class is realized by the Information Object Interface.

4. An Information Object has one Data Object. The relationship is an aggregation with cardinality (1..1).

ANNEX A

[IMPLEMENTATIONS]

[INFORMATIVE]

[Annexes contain ancillary information. Normative annexes precede informative annexes. Informative references are placed in an informative annex. See CCSDS A20.0-Y-4, *CCSDS Publications Manual* (Yellow Book, Issue 4, April 2014) for discussion of the kinds of material contained in annexes.]**TECHNOLOGY**

This annex provides example implementations. Implementation is the realization of an application, model, design, specification, standard, algorithm, or policy.

A1.1 APACHE_JENA_FUSEKI

Apache Jena Fuseki: Apache Jena Fuseki is a SPARQL server. Fuseki can run as a operating system service, as a Java web application (WAR file), and as a standalone server. It provides security (using Apache Shiro) and has a user interface for server monitoring and administration. /Website

A1.2 APACHE_SOLR

Apache Solr: Solr is an open source enterprise search platform that provides full-text search, faceted search, real-time indexing, and rich document handling. /Wikipedia

A1.3 BAGIT

BagIt is a set of hierarchical file system conventions designed to support disk- based storage and network transfer of arbitrary digital content. A “bag” consists of a “payload” (the arbitrary content) and “tags”, which are metadata files intended to document the storage and transfer of the bag. A required tag file contains a manifest listing every file in the payload together with its corresponding checksum. The name, BagIt, is inspired by the “enclose and deposit” method, sometimes referred to as “bag it and tag it”. /Wikipedia

A1.4 JAVA

Java: Java is a general-purpose computer-programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible.

ANNEX B - OTHER ARCHIVES

B1 NON_OAIS

An archival information system that is not compatible with OAIS.

Subclass of: Archive

B2 ASTRONOMY_DATA_ARCHIVE

Astronomy_Data_Archive - A data archive for Astrononmy /jsh

Subclass of: Non_OAIS

B3 EARTH_SCIENCE_DATA_ARCHIVE

Earth_Science_Data_Archive - A data archive for Earth_Science /jsh

Subclass of: Non_OAIS

B4 MISSION_HOUSEKEEPING_ARCHIVE

Mission_Housekeeping_Data_Archive - A data archive for Mission_Housekeeping data /jsh

Subclass of: Non_OAIS

ANNEX C

IMPLEMENTATION CONFORMANCE STATEMENT (ICS) PROFORMA

(NORMATIVE)

C1 INTRODUCTION

C1.1 OVERVIEW

This annex provides the Implementation Conformance Statement (ICS) Requirements List (RL) for an implementation of [Specification]. The ICS for an implementation is generated by completing the RL in accordance with the instructions below. An implementation claiming conformance must satisfy the mandatory requirements referenced in the RL.

C1.2 ABBREVIATIONS AND CONVENTIONS

The RL consists of information in tabular form. The status of features is indicated using the abbreviations and conventions described below.

Item Column

The item column contains sequential numbers for items in the table.

Feature Column

The feature column contains a brief descriptive name for a feature. It implicitly means "Is this feature supported by the implementation?"

Status Column

The status column uses the following notations:

- M mandatory;
- O optional;
- C conditional;
- X prohibited;
- I out of scope;
- N/A not applicable.

Support Column Symbols

The support column is to be used by the implementer to state whether a feature is supported by entering Y, N, or N/A, indicating:

Y Yes, supported by the implementation.

N No, not supported by the implementation.

N/A Not applicable.

The support column should also be used, when appropriate, to enter values supported for a given capability.

C1.3 INSTRUCTIONS FOR COMPLETING THE RL

An implementer shows the extent of compliance to the Recommended Standard by completing the RL; that is, the state of compliance with all mandatory requirements and the options supported are shown. The resulting completed RL is called an ICS. The implementer shall complete the RL by entering appropriate responses in the support or values supported column, using the notation described in C1.2. If a conditional requirement is inapplicable, N/A should be used. If a mandatory requirement is not satisfied, exception information must be supplied by entering a reference X*i*, where *i* is a unique identifier, to an accompanying rationale for the noncompliance.

C2 ICS PROFORMA FOR [SPECIFICATION]

C2.1 GENERAL INFORMATION

C2.1.1 Identification of ICS

C2.1.1.1 Test

Date of Statement (DD/MM/YYYY)	
ICS serial number	
System Conformance statement cross-reference	

C2.1.2 Identification of Implementation Under Test

Implementation Name	
Implementation Version	
Special Configuration	

Other Information	

C2.1.3 Identification of Supplier

Supplier	
Contact Point for Queries	
Implementation Name(s) and Versions	
Other information necessary for full identification, e.g., name(s) and version(s) for machines and/or operating systems; System Name(s)	

C2.1.4 Identification of Specification

[CCSDS Document Number]	
Have any exceptions been required? NOTE – A YES answer means that the implementation does not conform to the Recommended Standard. Non-supported mandatory capabilities are to be identified in the ICS, with an explanation of why the implementation is non-conforming.	Yes [ ] No [ ]

C2.2 REQUIREMENTS LIST

[See CCSDS A20.1-Y-1, *CCSDS Implementation Conformance Statements* (Yellow Book, Issue 1, April 2014).]

ANNEX D

SECURITY, SANA, AND PATENT CONSIDERATIONS

(INFORMATIVE)

D1 SECURITY CONSIDERATIONS

D1.1 SECURITY CONCERNS WITH RESPECT TO THE CCSDS DOCUMENT

D1.1.1 Data Privacy

D1.1.2 Data Integrity

D1.1.3 Authentication of Communicating Entities

D1.1.4 Control of Access to Resources

D1.1.5 Availability of Resources

D1.1.6 Auditing of Resource Usage

D1.2 POTENTIAL THREATS AND ATTACK SCENARIOS

D1.3 CONSEQUENCES OF NOT APPLYING SECURITY TO THE TECHNOLOGY

D2 SANA CONSIDERATIONS

[See CCSDS 313.0-Y-1, *Space Assigned Numbers Authority (SANA)—Role, Responsibilities, Policies, and Procedures* (Yellow Book, Issue 1, July 2011).]

D3 PATENT CONSIDERATIONS

[See CCSDS A20.0-Y-4, *CCSDS Publications Manual* (Yellow Book, Issue 4, April 2014).]