Planetary Data System

Architectural Properties for Data Reusability

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Introduction

- A fundamental requirement for long-term digital repositories is to ensure the reusability of data that have been entrusted to the repositories.
- Of the FAIR principles (Findable, Accessible, Interoperable, Reusable), Reusable is proving to be the most challenging.
- Two mature ISO level standards[1,2] exist that provide guidance for the long-term preservation of digital data.
  - *Several important architectural properties have been identified that help enable data reusability.*

[1] Open Archival Information System (OAIS) Reference Model (ISO 14721)
[2] Metadata Registry Specification (ISO/IEC 11179)

Shared Understanding

- Reusability depends on the existence of a shared understanding of the data.

- In 2001, Uschold [1] argued that a “single shared ontology” is critical for developing a digital library that enables semantic interoperability across disciplines.

  – *A single shared ontology by definition promotes a shared understanding.*

[1] M. Uschold and Gruninger. M., "Ontologies and Semantics for Seamless Connectivity," SIGMOD Record, vol. 33, 2004.

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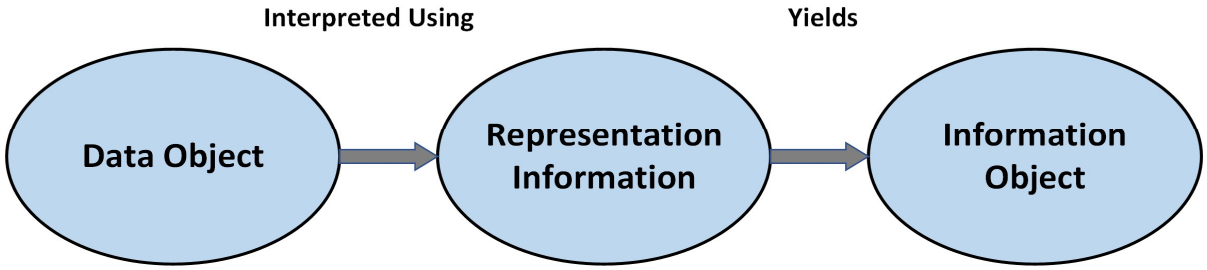
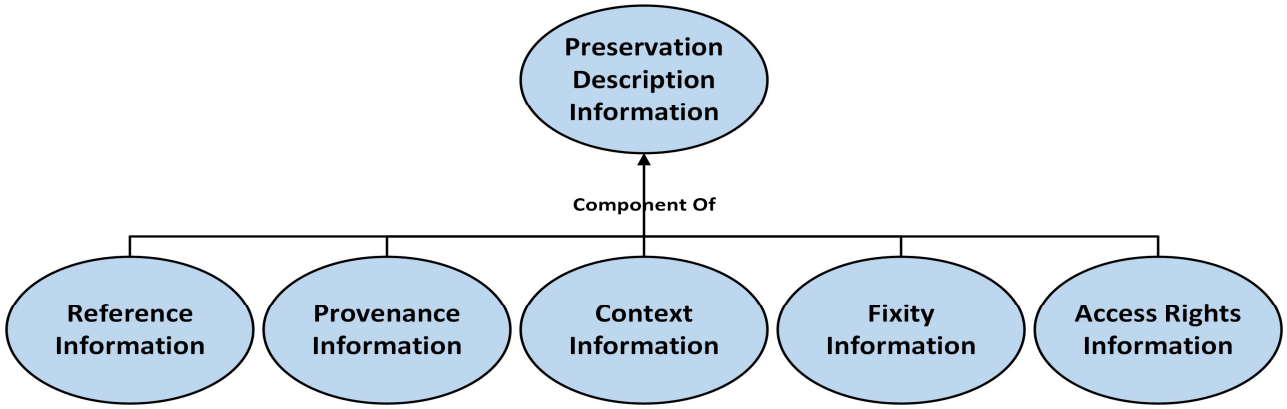
The Information Object[1]



- Information Object = Data Object + Representation Information
  - *Data Object = Physical Object or a Digital Object*
  - *Representation Information is the information that maps a Data Object into more meaningful concepts so that the Data Object may be understood.*
  - *It is a fundamental building block in the development of a common understanding.*

[1] Open Archival Information System (OAIS) Reference Model (ISO 14721)

Preservation Description Information PDI

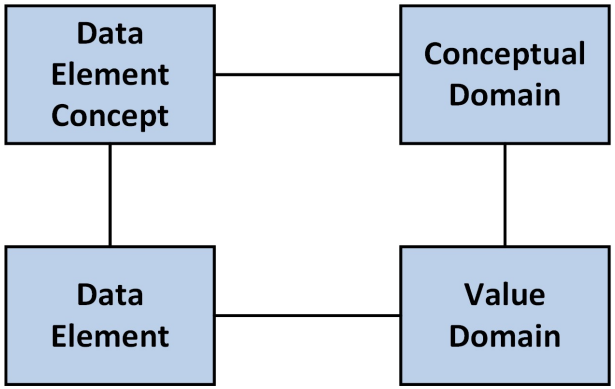


- Reference Information is necessary for referencing this data as well as referencing data that is in a meaningful relationship with this data.
- Provenance Information provides the history of the data and is essential for authenticity.
- Context Information is the information that helps orient the data within an environment.
- Fixity Information is required to ensure that data in general has not been unintentionally altered
- Access Rights Information identifies the access restrictions pertaining to the data, including the legal framework, licensing terms, and access control.

PDI (cont)

- The information, which along with Representation Information which is necessary for adequate preservation of the Data Object
- Each category of PDI is itself an Information Object
  - *This ensures that each has its own Representation Information to ensure that that it can be interpreted.*
  - *For example, each instance of Provenance Information has its own Representation Information so that the consumer can understand it.*
- PDI is an information object.
- Context Information in particular has an important role in enabling data reusability
  - *It can be used to define the relationships of the Data Object to the things within its environment*
  - *Adds semantic information.*

Metadata Registry[1]



- A data dictionary schema for "data element" information
  - *Example the "start_time" of an event.*
  - *alternate names, definition sources, definitions in other languages, effective dates, submitting organization, and stewardship.*
  - *data representation, units of measurement, effective dates, submitter, and steward.*
  - *permissible values and value meanings*

[1] Metadata Registry Specification (ISO/IEC 11179)

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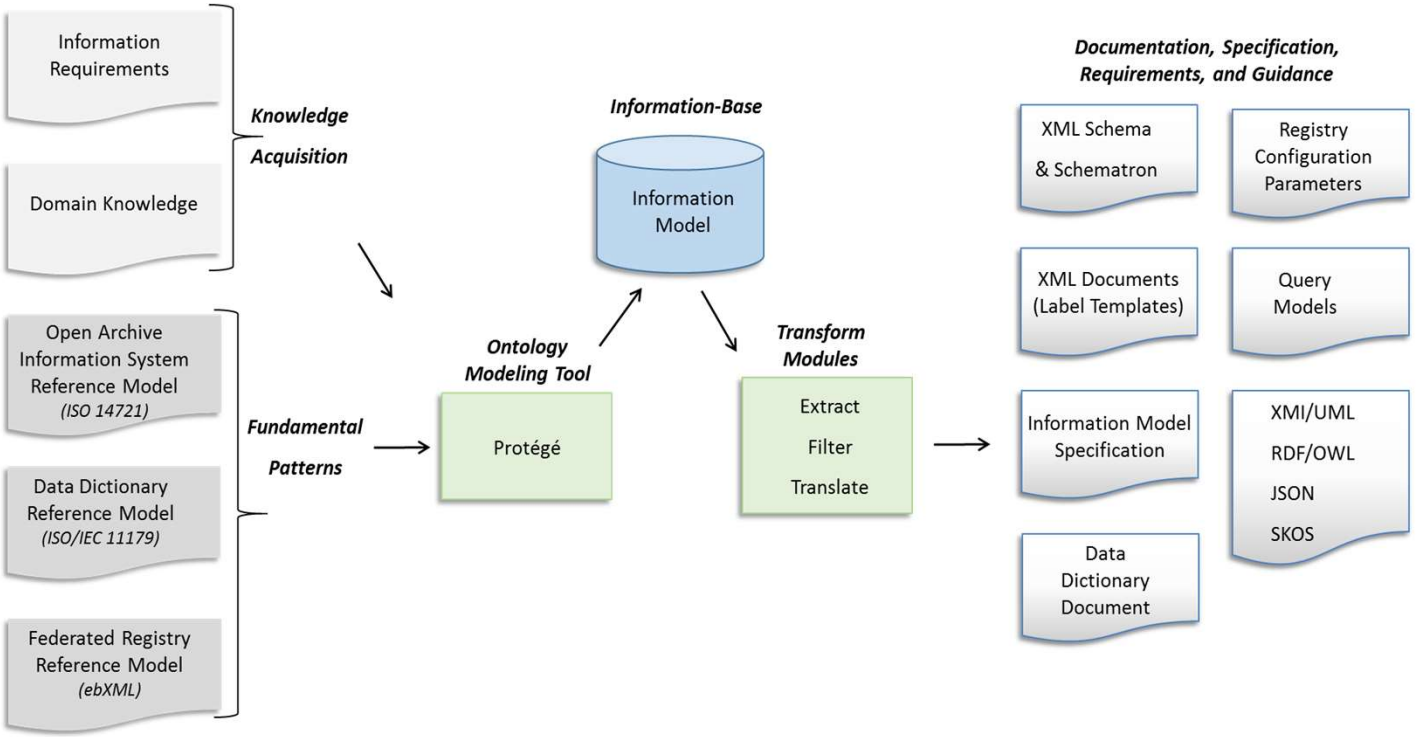
PDS4 Information Model



- The PDS4 Information Model is implemented and maintained in the Protégé ontology modeling tool.
- Two separate instances
  - *Entity Model – ISO 14721 - OAIS RM*
  - *Data Dictionary Model – ISO/IEC 11179 – Metadata Registry*

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Trustworthy Digital Repository (TDR)

- A Trustworthy Digital Repository (TDR) is an organization or system responsible for the long-term preservation and access to digital materials, such as data, records, documents, and other digital objects.
  - *A TDR must be able to guarantee the authenticity, integrity, and usability of its digital content over time.*

- The aim of a TDR is to ensure that digital content remains accessible, usable, and reliable for as long as it is needed.
  - *This is particularly important for materials that have long-term value, such as cultural heritage objects, scientific research data, and government records.*

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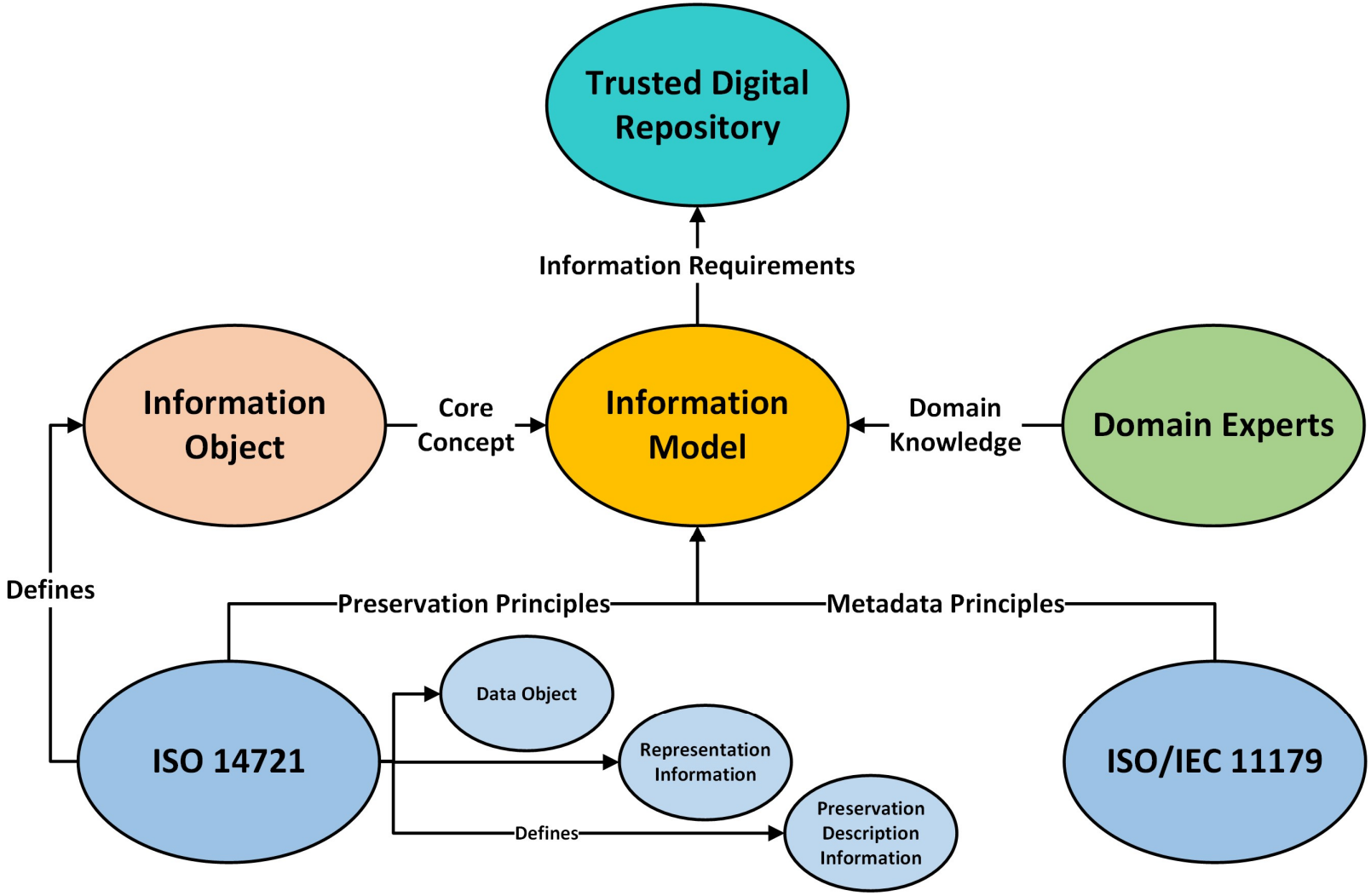
Architectural Properties as a Graph



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Conclusion

- A framework for capturing the information required to support data reusability has been developed using principles adopted from two ISO information systems standards.
- Key properties have been identified that support reusability.
- However this is simply a framework.
  - *The really hard work involves acquiring the appropriate knowledge from domain experts and populating an domain information model using the framework as a guide.*

Acknowledgements

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Questions / Answers

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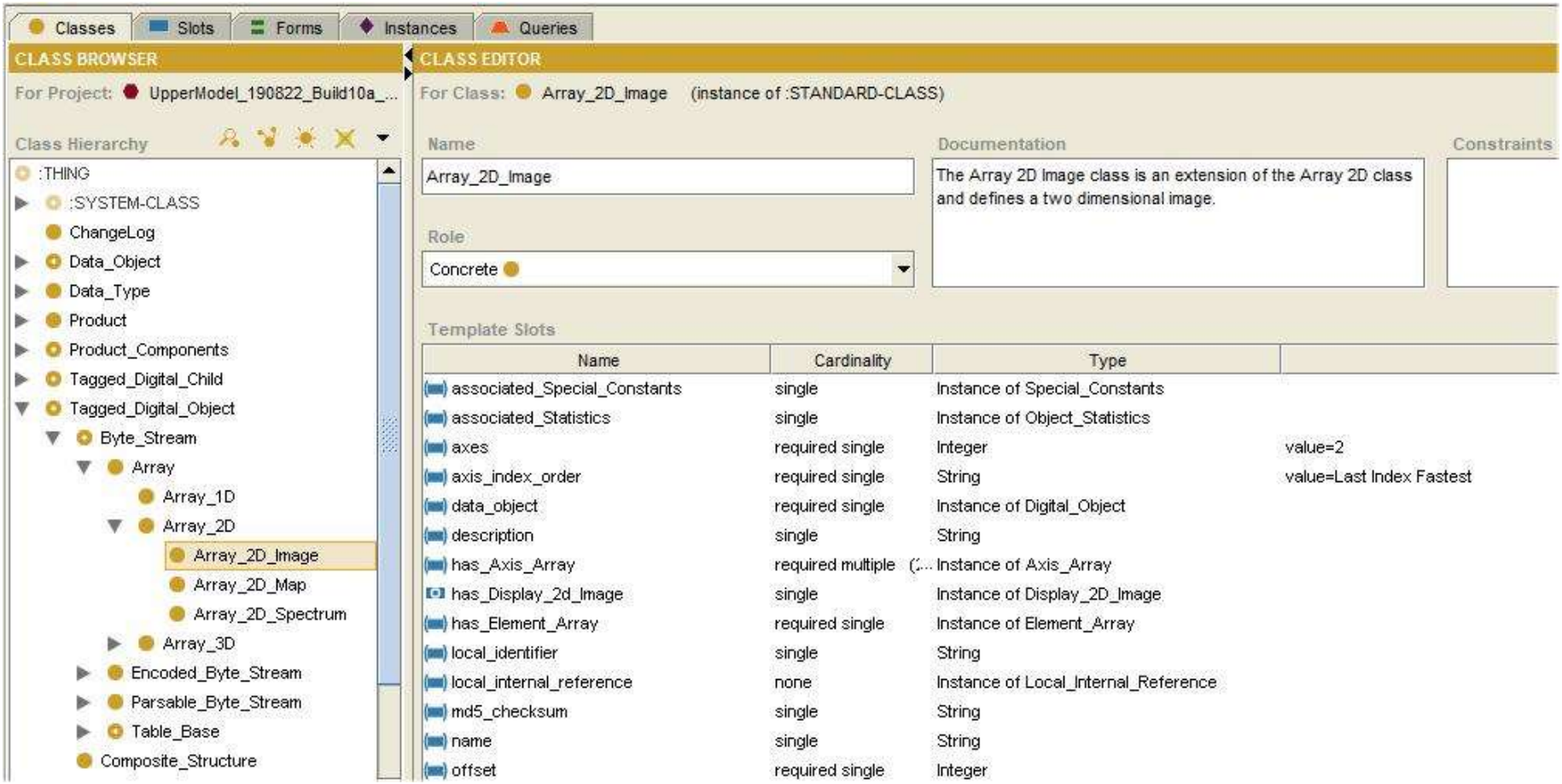
Ontology



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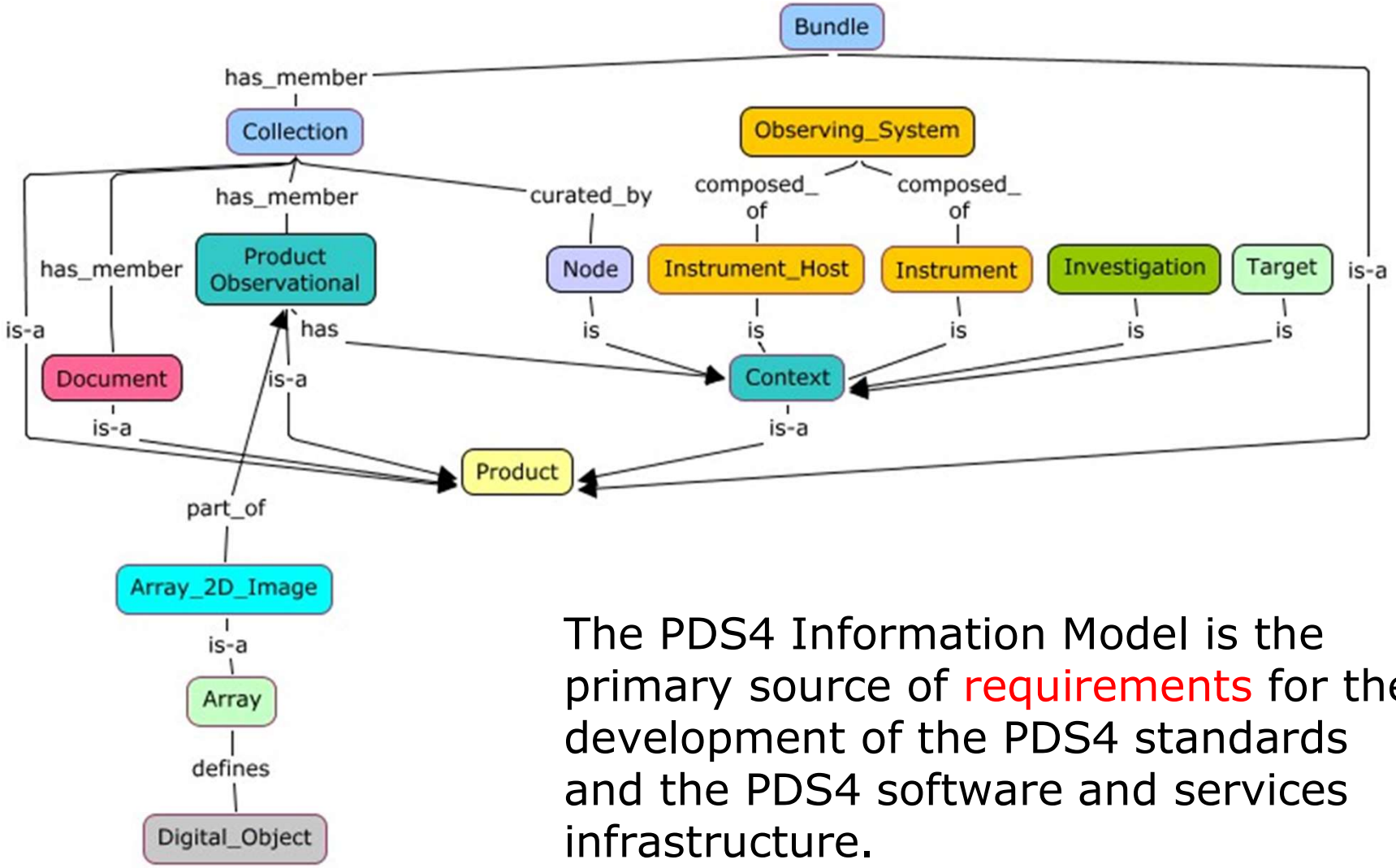
General Concept Map



The PDS4 Information Model is the primary source of requirements for the development of the PDS4 standards and the PDS4 software and services infrastructure.