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Enabling Virtual Observatory Access to Planetary Resources through PDS4

AGU 2015 - IN33E-02
16 December 2015

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Topics

- Purpose and Background
- Overview of the PDS4
- Overview of the IVOA and EPN-TAP
- Proposed Testbed

Purpose

- Make planetary science resources available to the international space science community
  - *Develop an interface between the Planetary Data System (PDS) and the Virtual Observatory (VO) through the International Virtual Observatory Alliance (IVOA)*
  - *Build on previous work by the International Planetary Data Alliance (IPDA) to integrate international planetary data archives via common search protocols.*

Background

- PDS4, the next generation Planetary Data System (PDS), was developed using architectural principles that enable access to planetary science resources.
  - *Essentially all Solar System Exploration Science Data*
  - *Services, Tools, Documentation, and Expertise*

- EPN-TAP (Europlanet-VO Table Access Protocol) provides a good use case to demonstrate how an additional international protocol can be applied to allow access to international planetary science resources.

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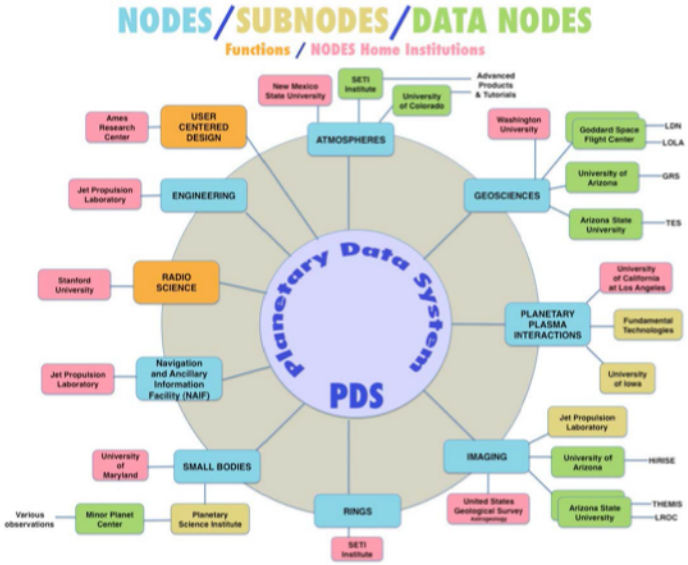
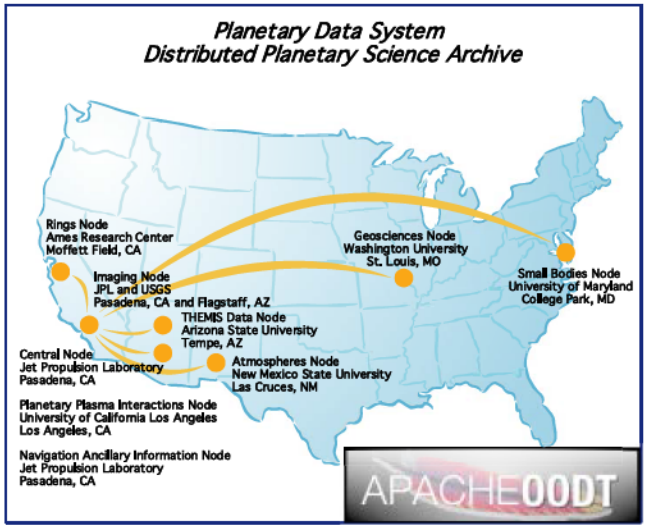
Planetary Data System

- Purpose: to collect, archive and make accessible digital data and documentation produced from NASA's exploration of the solar system from the 1960s to the present.

- Infrastructure: a highly distributed infrastructure with planetary science data repositories implemented at major government labs and academic institutions
  - System driven by a well defined planetary science ontology
  - Approximately 900 TBs of data
  - Movement towards international interoperability
  - Implemented Apache OODT (developed @ NASA) in 2002 to share data; scaled to a SOA implemented in 2010





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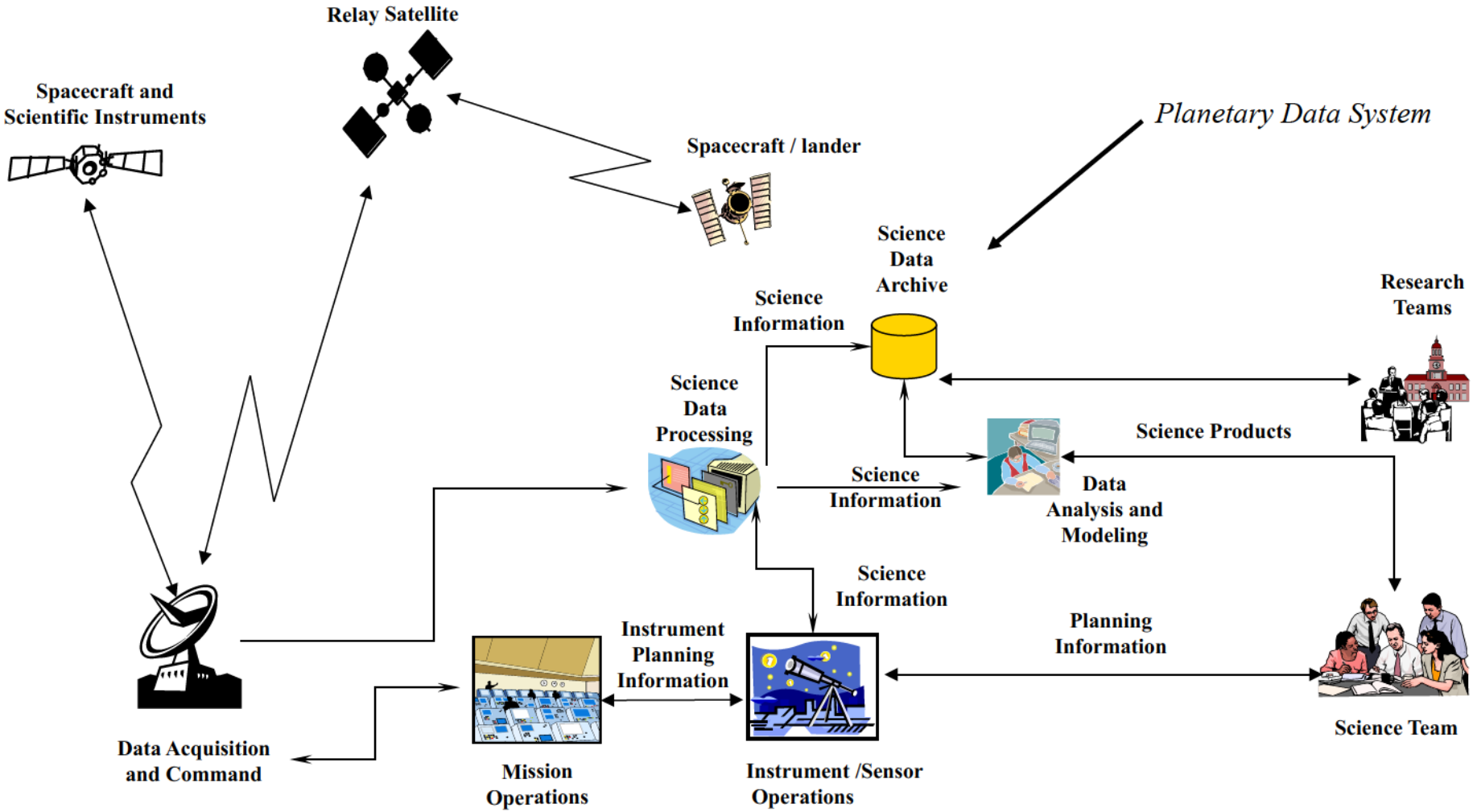
Reference Architecture Space Information Systems



Credit: CCSDS Reference Architecture for Space Information Management

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PDS4: The Next Generation PDS

- The NASA Planetary Data System (PDS) after about 20 years of operations has developed PDS4, a major revision and transition to a modern system based on best practices for data system development.
- An explicit information architecture
  - *All PDS data tied to a common model to improve validation and discovery*
  - *Use of XML, a well-supported international standard, for data product labeling, validation, and searching.*
  - *A hierarchy of data dictionaries built to the ISO 11179 standard, designed to increase flexibility, enable complex searches, and make it easier to share data internationally.*
- An explicit software/technical architecture
  - *Distributed services both within PDS and at international partners*
  - *Consistent protocols for access to the data and services*
  - *Deployment of an open source registry infrastructure to track and manage every product in PDS*
- An international collaboration for standards coordination and archiving and sharing data

Key PDS4 Features

- Data Reuse
  - *Designed a few simple formats for 80% of the data*
  - *All things are formally defined once*
  - *Everything is registered as a product*
  - *Multi-level governance*
- Model Driven
  - *Model evolves with changes in the science discipline*
  - *Implementation technologies evolve at their own speed.*
  - *Improves interoperability at the information level across international data systems*
- Subsumes legacy archive
  - *Proxy labels exist for each legacy product*
  - *High value data sets are migrated as needed*

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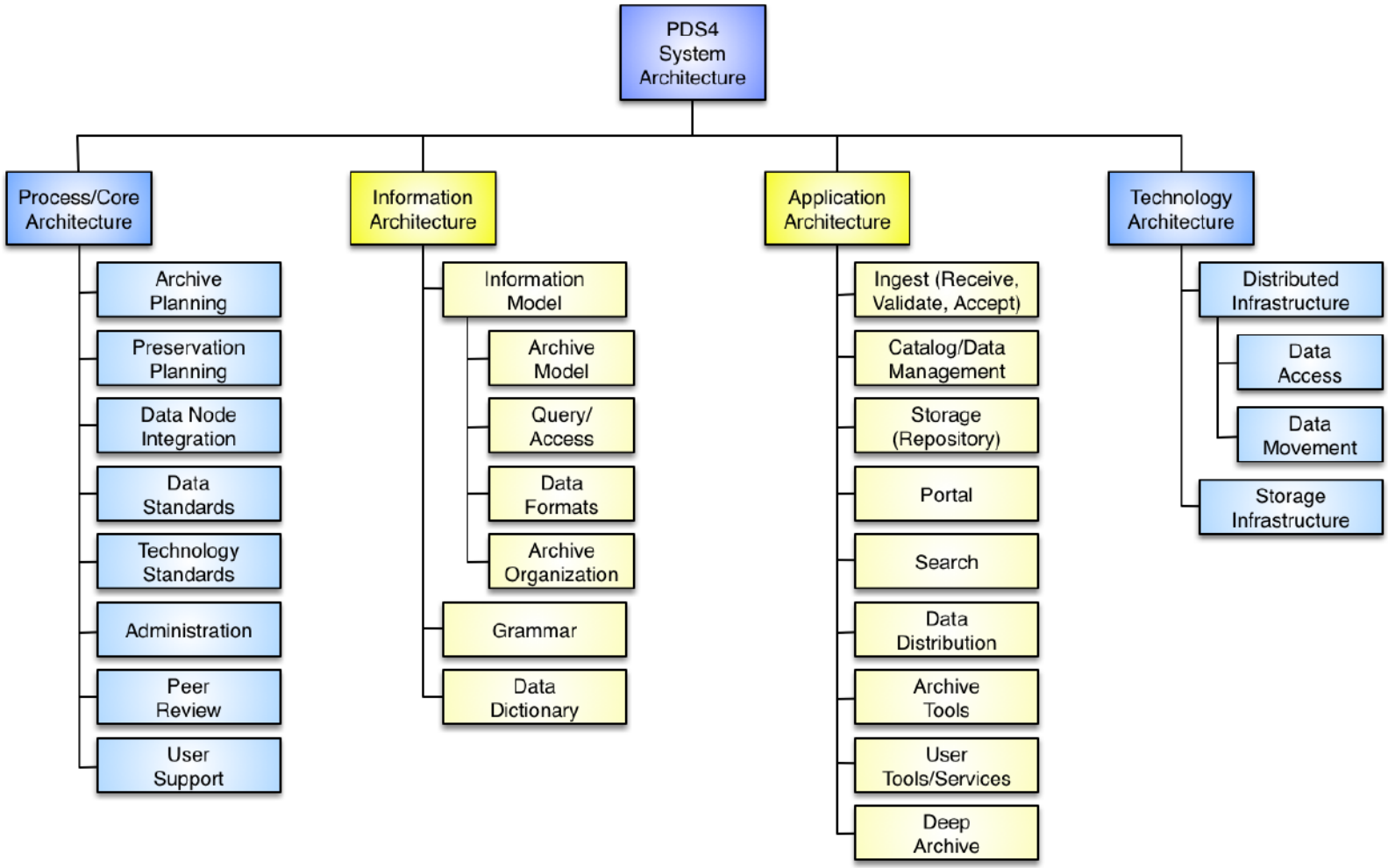
PDS4: System Architecture



Based on PDS Level 1, 2 and 3 requirements, the system architecture was decomposed into elements and organized accordingly.

PDS4 Information Architecture

- The information architecture is developed and maintained independent of the systems architecture

- Provides a formal, sharable, and stable set of requirements
  - *that enable understanding of the system*
  - *the configuration of system components*
  - *the basis for mapping to and from external systems.*

- Provides multi-level governance for flexibility

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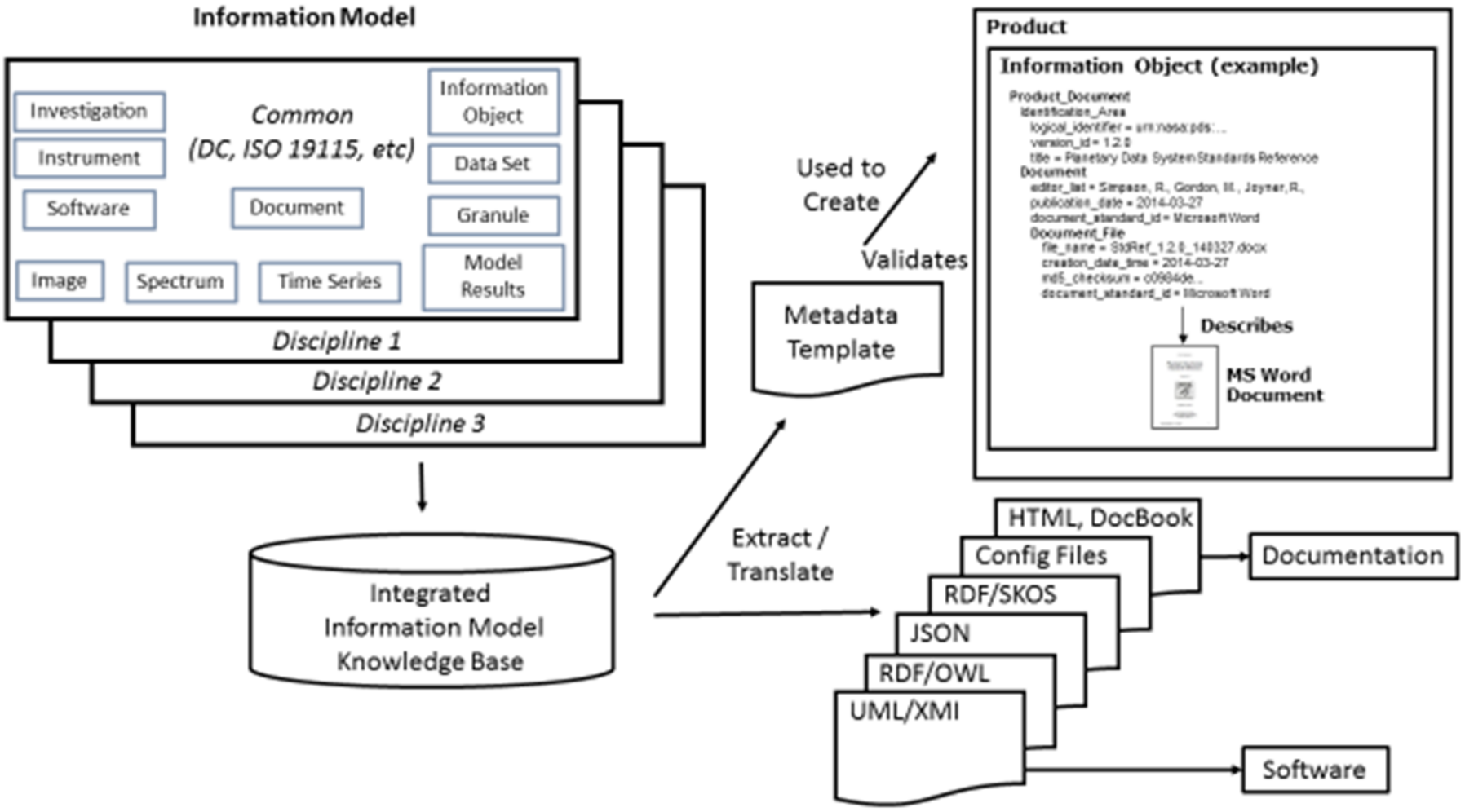
Information Model and Dependent Artifacts



PDS4 Application Architecture

- Service-Based Design
  - *Support remote access to data and services to bring the federation together both for ingestion and distribution.*
- System of Registries
  - *Adopt a system of registries to support improved tracking and access.*
  - *Facilitated by the PDS Registry Service with its REST-based API.*
- Common Search
  - *A publicly available layer facilitating search across PDS.*
  - *Facilitated by the PDS Search Service based on Apache Solr providing support for high performance facet-based search.*
  - *Currently supports the PDS4 Search Protocol and the Planetary Data Access Protocol (PDAP) for data discovery and access.*

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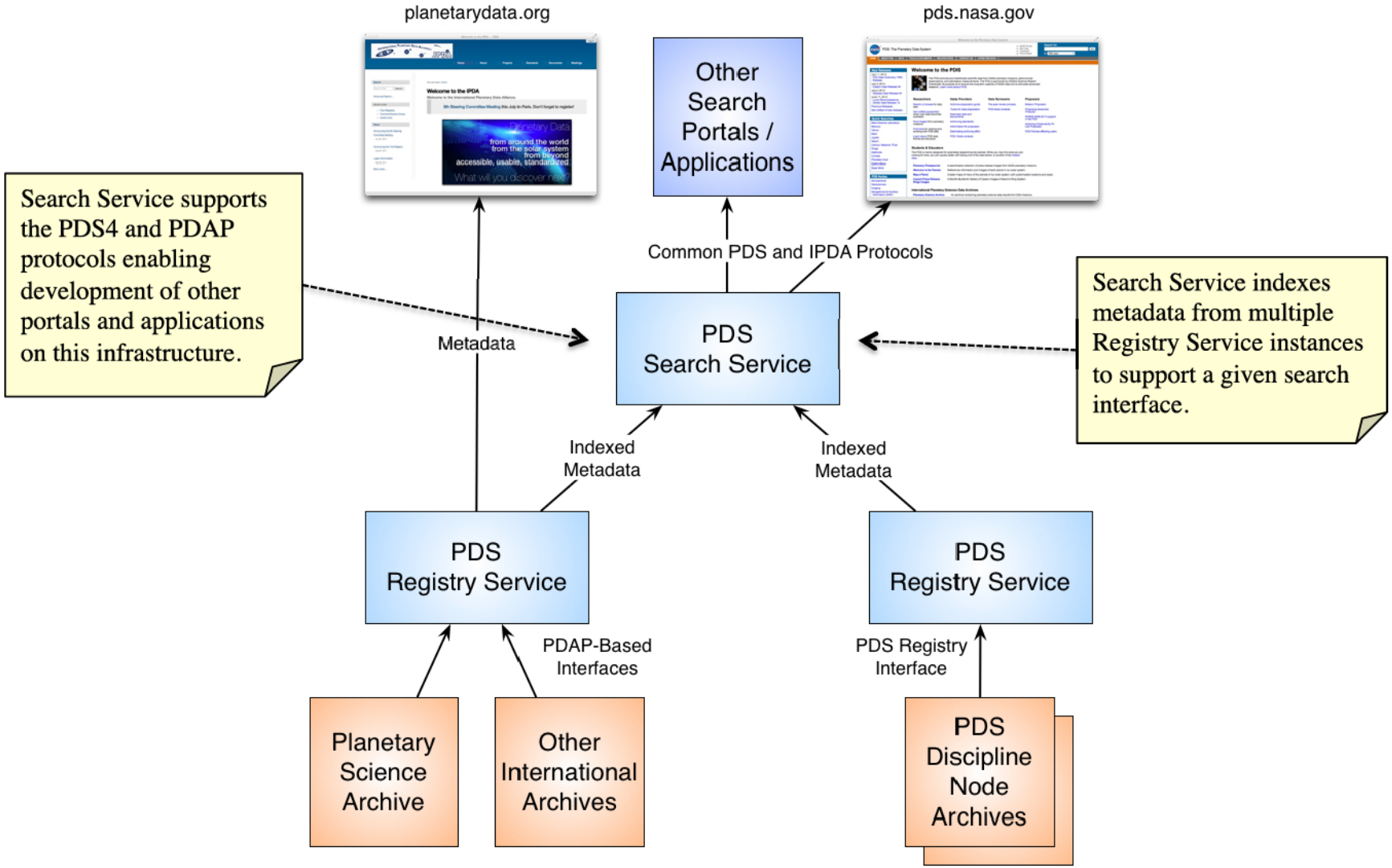
Search Architecture



Virtual Observatory (VO)

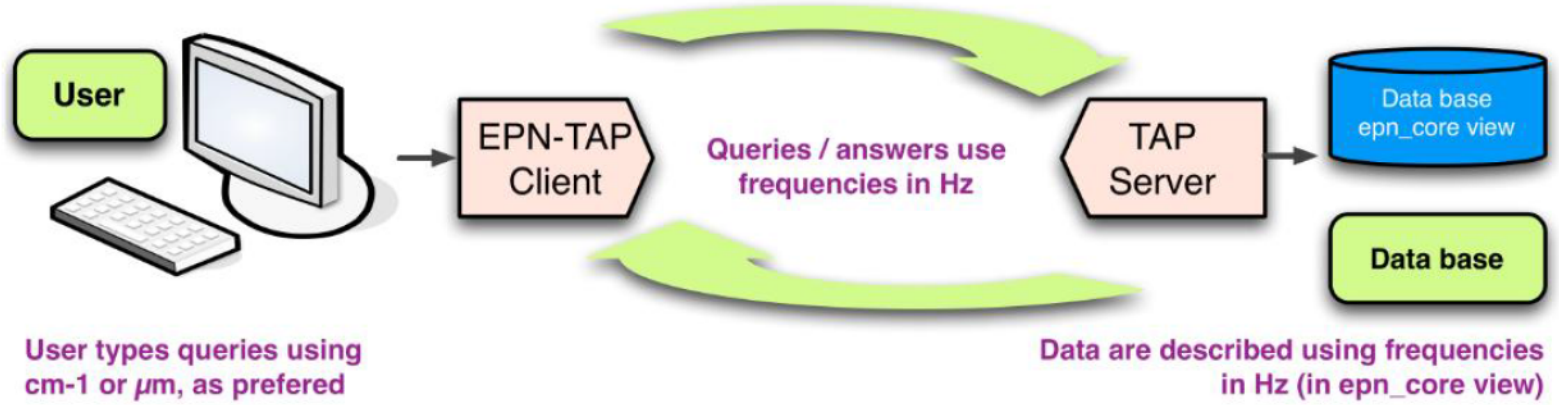
- The Virtual Observatory[1] (VO) is the vision that astronomical datasets and other resources should work as a seamless whole.

- The International Virtual Observatory Alliance[1] (IVOA) is an organization that [*develops consensus]* about the technical standards that are needed to make the VO possible.

[1] http://www.ivoa.net/

EPN-TAP

- The EPN-TAP protocol allows a user to select a subset of data from an archive in a standard way.
  - *Based on the IVOA Table Access Protocol (TAP).*
  - *The TAP mechanism is defined by an underlying data model and reference dictionaries.*



Practical implementation for EPN - TAP queries.[1]

[1]Erard, S.; Cecconi, B.; Le Sidaner, P.; Berthier, J.; Henry, F.; Molinaro, M.; Giardino, M.; Bourrel, N.; André, N.; Gangloff, M.; Jacquey, C.; Topf, F., "The EPN-TAP protocol for the Planetary Science Virtual Observatory", Astronomy and Computing, Volume 7, p. 52-61, 11/2014

Testbed

- A testbed is planned as a part of the continuing International Planetary Data Alliance (IPDA) *Registration and Search* project
  - *Goal is to expose PDS4 registered data and services through the PDS4 search service.*
  - *Search is based on the Apache Solr open source search engine supporting the PDS4 and PDAP protocols.*

- Capability has been demonstrated by the interface to the European Space Agency (ESA) Planetary Science Archive (PSA)
  - *PSA products are searchable through the PDS4 interface.*

Summary

- We have a plan to make planetary science resources available to the international spaces science community
  - *Develop an interface between the PDS and the Virtual Observatory.*
  - *The project is a collaboration of members from the International Virtual Observatory Alliance (IVOA) and the International Planetary Data Alliance (IPDA).*

- A testbed is planned as a part of an IPDA project, IPDA Registration and Search
  - *Integrate the EPN–TAP protocol with the PDS Search Service.*
  - *Plan to report progress at the IPDA 2016 summer meeting.*

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Thank You!

A portion of this research was carried out by the Jet Propulsion Laboratory, managed by the California Institute of Technology under a contract with the National Aeronautics and Space Administration.