

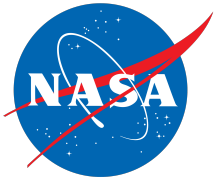


PDS4 Operational Readiness Review

Software Tools and Services for LADEE/MAVEN

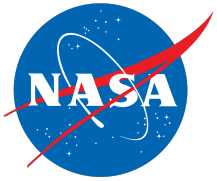
Sean Hardman
Engineering Node





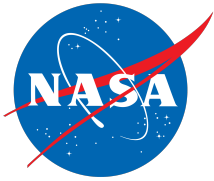
Topics

- Overview
- Components
- Features
- Wrap Up



Overview

- This presentation focuses on the tools and services available for supporting the LADEE and MAVEN missions.
- There are other components of the PDS4 system (in operations and planned for future builds) that won't be discussed here.
- That said, we will mention a couple of them because they will be useful in supporting these missions.



Requirements

Related to LADEE/MAVEN Mission Support

Req 1.4 Archiving Standards: PDS will have archiving standards for planetary science data.

LADEE - LDEX and UVS data products are tab delimited ASCII tables while NMS is comma delimited. MAVEN - NGIMS, MAG and ACC are stored in time-ordered ASCII tables. IUVS is in FITS and STATIC, SEP, SWEA, SWIA, LPW and LPW-EUV are stored in conformed CDF tables.

Req 1.2.1 PDS will provide examples and suggestions on organization of data products, metadata, documentation and software.

PDS is required to generate templates for data and documents

Req 2.4 Peer Review: PDS will conduct peer reviews of all data submissions to ensure completeness, accuracy, and scientific usability of content.

PDS will provide assistance and review of SIS and sample data files

Req 1.5.2 PDS will provide tools to assist data producers in validating products against PDS standards.

PDS will provide validation tools to the teams so they can validate that the data with PDS4 standards

Req 2.5.2 PDS will implement procedures for accepting archival data.

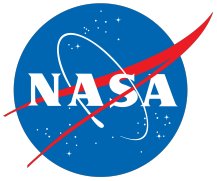
PDS will carry out final review and acceptance

Req 3.1 Search: PDS will allow and support searches of its archival holdings.

Req 3.2 Retrieval: PDS will facilitate transfers of its data to users.

PDS will provide data distribution to science community

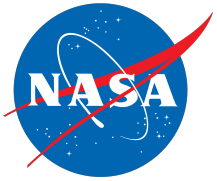




Requirements

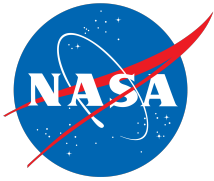
Component Mapping

- 1.5.2
 - The Validate Tool addresses this requirement.
- 3.1.X
 - The combination of the Harvest Tool, Registry Service and Search Service address these requirements.
- 3.2.X
 - The combination of the Search Service and the Transport Service addresses these requirements.



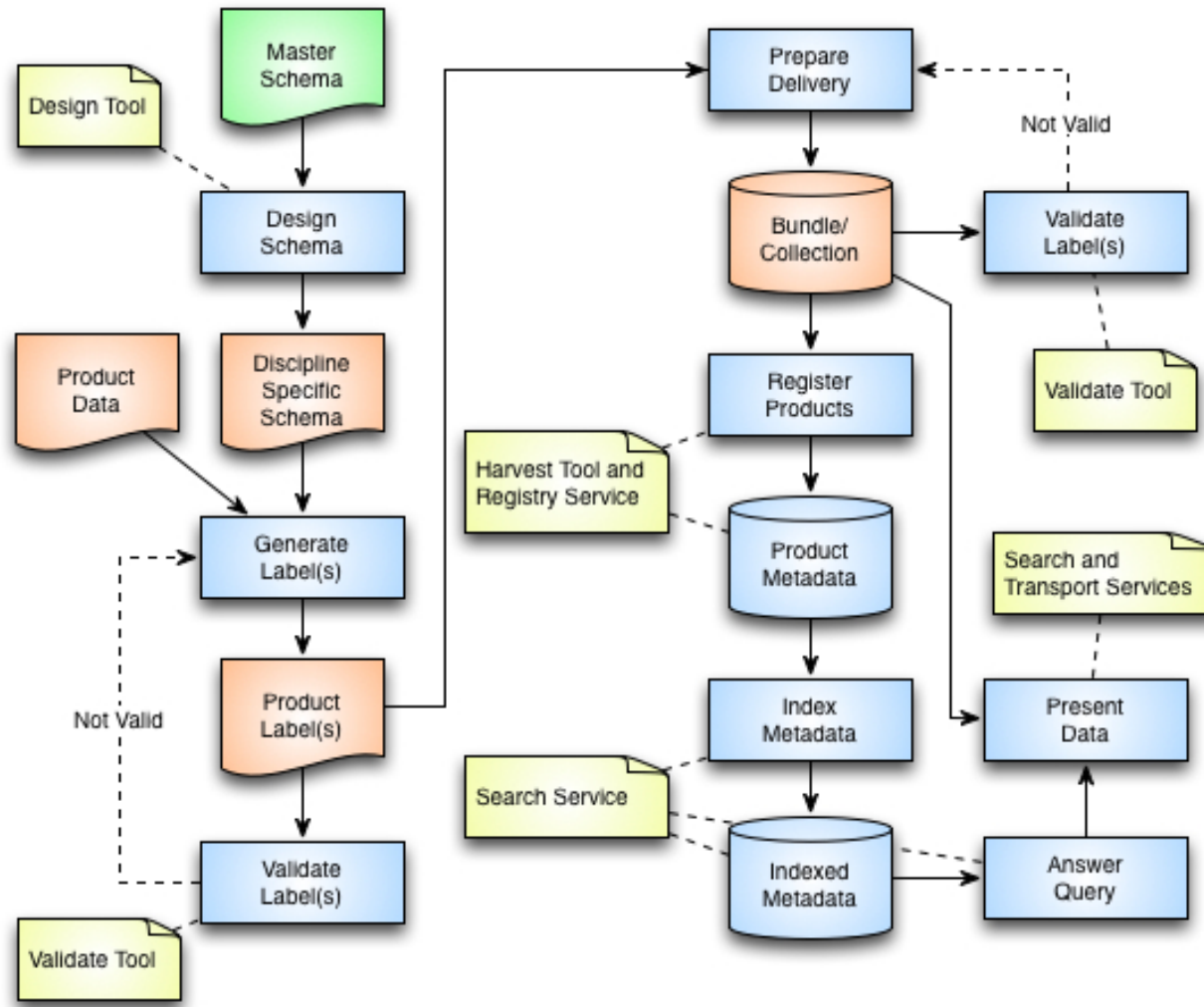
Topics

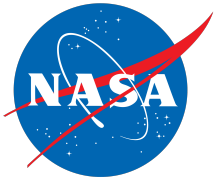
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Components

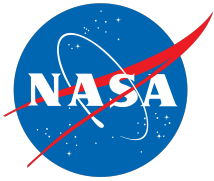
Mapped to System Flow





Design Tool

- This tool provides functionality for designing product label schemas and product label samples.
- Commercial Off-The-Shelf (COTS) and Open Source tools have been identified to satisfy this functional need.
 - The suggested tools are Oxygen and Eclipse, commercial and open source tools, respectively.



Design Tool

oXygen Interface

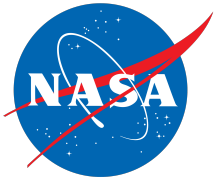
The screenshot displays the oXygen XML Design Tool interface for editing the XSD schema `PDS4_PDS_1000.xsd`. The main workspace shows a tree diagram of the schema structure:

- Product_Mission_PDS3** (Base Type: `pds:Product`): An Mission product describes a mission. This product captures the PDS3 catalog mission information.
- pds:Product (extension base)**: A Product is a uniquely identified object that is managed by a registry/repository. It consists of one or more tagged...
- Product_Observational** (Base Type: `pds:Product`): A Product_Observational is a set of one or more information objects produced by an observing system.
- Product_Proxy_PDS3** (Base Type: `pds:Product`): The Product Proxy PDS3 class defines a product with enough information to register a PDS3 data product.

The diagram shows the following elements and their relationships:

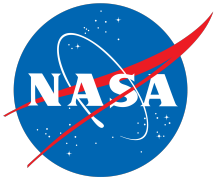
- `pds:Product` (extension base) contains:
 - `Identification_Area` (Type: `pds:Identification_Area`)
 - `Product_Observational` (Base Type: `pds:Product`)
 - `Product_Proxy_PDS3` (Base Type: `pds:Product`)
- `Product_Observational` contains:
 - `Observation_Area` (Type: `pds:Observation_Area`)
 - `Reference_List` (Type: `pds:Reference_List`)
 - `File_Area_Observational` (Type: `pds:File_Area_Observational`, multiplicity: 1..∞)
 - `File_Area_Observational_Supplemental` (Type: `pds:File_Area_Observational_Supplemental`, multiplicity: 0..∞)

The interface also features a **Project** panel on the left showing the current project structure, and a **Palette** on the right with sections for **Basic components** (element, group, attribute, attribute group, complex type, simple type), **Attributes** (Target Namespace, Element Form Default, Attribute Form Default, Block Default, Final Default, Default Attributes, XPath Default Namespace), and **Facets**.



Validate Tool

- This tool provides functionality for validating product labels.
- The associated schemas and schematrons for the product label specify syntactic and semantic constraints.
- Provides command-line and Java library interfaces for utilizing the functionality.



Validate Tool

Example Execution



```
%. /validate -t /Users/shardman/test/pds/collections/Archive-Pages/ -e "*.xml"
```

PDS Validate Tool Report

Configuration:

Version	1.3.1
Time	Tue, Sep 03 2013 at 01:30:28 PM
Core Schemas	[PDS4_PDS_1000.xsd]
Core Schematrons	[PDS4_PDS_1000.sch]
Model Version	1000

Parameters:

Target(s)	[/Users/shardman/test/pds/2010/collections/Archive-Pages]
Severity Level	Warnings
Recurse Directories	true
File Filter(s) Used	/*.xml]

Validation Details:

```
PASS: file:/Users/shardman/test/pds/collections/Archive-Pages/resource_cassini_archive_info_1.0.xml
```

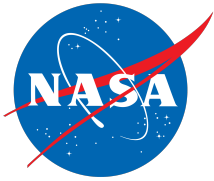
```
PASS: file:/Users/shardman/test/pds/collections/Archive-Pages/resource_phoenix_archive_info_1.0.xml
```

Summary:

```
2 of 2 file(s) processed, 0 skipped  
2 of 2 file(s) passed validation
```

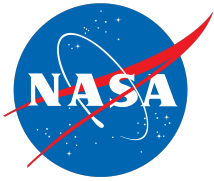
End of Report





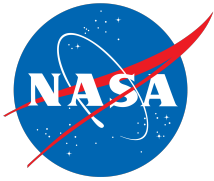
Harvest Tool

- Crawler-based tool for capturing and registering product metadata.
- Allows for periodic or on-demand registration of products.
- Configurable to support registration of products residing in PDS3 and PDS4 archives.
- Designed to integrate well with existing Node operations.
- Provides the first line of metadata harvesting within the system in order to facilitate tracking of and access to products.



Registry Service

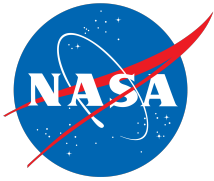
- Provides functionality for tracking, auditing, locating, and maintaining artifacts within the system.
- Provides a common implementation for registry service instances based on the Registry Reference Model effort which in turn is based on ebXML.
- Provides a metadata store interface for supporting different databases.
- Provides a REST-based external interface via HTTP.



Registry Service

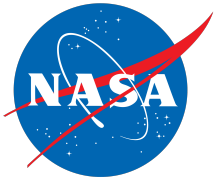
REST-Based API

- This interface delegates all functions involving a product:
 - <http://pds.nasa.gov/services/registry/extrinsics/>
 - GET: Retrieves a paged list of products from the registry.
 - POST: Publishes a product to the registry.
- This interface acts on a specific product (lid stands for logical identifier):
 - <http://pds.nasa.gov/services/registry/extrinsics/logicals/{lid}/>
 - GET: Retrieves the product from the registry.
 - POST: Updates the product in the registry.
 - DELETE: Removes the product from the registry.



Search Service

- This service is a deployable component that accepts queries for data and returns a set of matching results.
- Using Apache's Solr for the search engine portion of the service.
- Provides the public interface (REST-based over HTTP) to the metadata contained in the federated registries.
- Provides the second line of metadata harvesting within the system in order to facilitate discovery of products.
- Generation of search indices from registry metadata supports multiple query formats and is tailor-able for customized search interfaces.

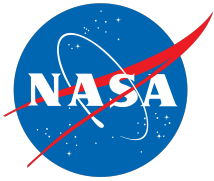


Search Service

Protocol



- PDS search protocol implemented as a REST-based interface over HTTP.
 - <http://pds.nasa.gov/services/search?target=mars>
- Supports return of paged results in a defined structure (e.g., XML or JSON).
- Implementation of this protocol across PDS facilitates parameter passing and integration.
- The architecture allows support for other protocols.
 - For example, IPDA's Planetary Data Access Protocol (PDAP)



Search Service

Catalog-Level Search

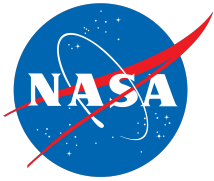


The screenshot displays the PDS Search Results interface. At the top, there's a search bar with 'clementine' entered and a 'Go' button. Below the search bar, there are navigation tabs for 'HOME', 'ABOUT PDS', 'DATA', 'TOOLS & DOCUMENTS', 'RELATED SITES', 'CONTACT US', and 'CITING PDS DATA'. The 'DATA' tab is active, showing sub-links for 'Data Search', 'Text Search', 'Form Search', 'How to Search', 'Data Set Status', and 'Data Release Summary'. The main content area is titled 'Search Results' and shows '1-35 of 35 results (0.006 seconds)'. A 'Search Tools' section is highlighted, listing tools like 'Clementine Image Search' and 'Lunar Orbital Data Explorer'. Below this, a 'Data Sets and Information' section lists various data collections and bundles, including 'Clementine 750nm UVVIS Basemap Digital Image Model Basemap Mosaic - Data' and 'Clementine 750nm UVVIS Basemap Digital Image Model Basemap Mosaic - XML Schema'. A sidebar on the left, 'Refine Your Search', provides facets for 'Type', 'Target', 'Investigation', and 'Instrument' with counts for each category.

Search facets tailored to the catalog-level metadata.

Direct links to search tools matching the query criteria.

Search results including PDS3 and PDS4 data.



Search Service

Product-Level Search

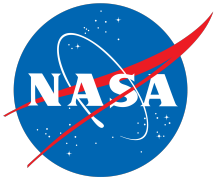


The screenshot shows the PDS Search Results interface. At the top, there is a search bar with the text 'Search for:' and a 'Go' button. Below the search bar, there are navigation links: HOME, ABOUT PDS, DATA, TOOLS & DOCUMENTS, RELATED SITES, CONTACT US, and CITING PDS DATA. The 'DATA' link is highlighted. Below the navigation bar, there are search options: Data Search, Text Search, Form Search, How to Search, Data Set Status, and Data Release Summary. The 'Data Search' option is selected. On the left side, there is a 'Refine Your Search' section with the following categories and counts: Type (Observational Product (15), Collection (4), Bundle (3)), Investigation (Phoenix (22), MET (19)), Instrument (MET (20), LIDAR (1), SSI (1)), and Processing Level (Partially Processed (10), Raw (5)). The main content area is titled 'Search Results' and shows a search for 'met' with 'Search' and 'New Search' buttons. Below the search bar, it indicates '1-22 of 22 results (0.007 seconds)'. The results are organized into sections: 'Bundles and Collections' and 'Products'. The 'Bundles and Collections' section lists: Bundle: MET Bundle, Bundle: LIDAR Bundle, and Bundle: SSI Bundle. The 'Products' section lists four 'Observational Product' entries, each with a table character and a file name.

Search facets tailored to observational product metadata.

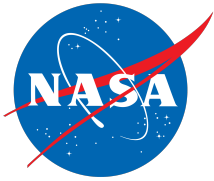
Results list tailored as well, focusing on Bundles, Collections and Products.





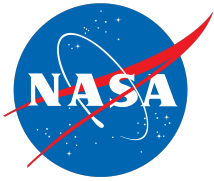
Transport Service

- The Transport Service provides functionality for transporting, transforming and packaging PDS products.
- The core functionality for this service is satisfied by the Apache OODT Web Grid Product Server.
- The transformation functionality for this service is satisfied by the Transform Tool and its underlying libraries.



Transform Tool

- This tool provides functionality for transforming product labels and data to/from PDS4 formats.
 - Utilizes the underlying PDS4 Tools package which reads and writes PDS4 data products.
- Designed to take advantage of third-party conversion routines.
- Supported transformations include...

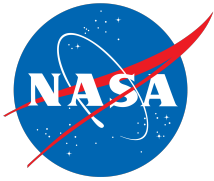


Transform Tool

Supported Transformations



Input Format	Output Format
PDS3 Image	BMP, GIF, JPEG, JPEG2000, PNG, PNM, RAW, TIFF, WBMP
PDS4 Binary Table	CSV
PDS4 Character Table	CSV
PDS4 Delimited Table	CSV
PDS4 2D Image	BMP, GIF, JPEG, JPEG2000, PNG, PNM, RAW, TIFF, WBMP
PDS4 Label	PVL, HTML



Transform Tool

XML Transformation

MS000EMH_00896227783_10C6M1.xml

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```

<?xml-model
  href="http://pds.nasa.gov/pds4/schema/released/pds/v1/PDS4_PDS_1000.sch"
  ?>
<?xml-model
  href="http://atmos.nmsu.edu/pub/PDS4/sc
  ?>
<Product_Observational xmlns="http://pds.
  xmlns:pds="http://pds.nasa.gov/pds4/pds/v
  xmlns:phxmd="http://pds.nasa.gov/pds4/phx
  xmlns:xsi="http://www.w3.org/2001/XMLSche
  xsi:schemaLocation="http://pds.nasa.gov/p
  http://pds.nasa.gov/pds4/schema/released/
  http://pds.nasa.gov/pds4/phxmd/v02
  http://atmos.nmsu.edu/pub/PDS4/schema/PHX
  <Identification_Area>
    <logical_identifier>
      urn:nasa:pds:phx_met:raw:MS000EMH_00
    </logical_identifier>
    <version_id>1.0</version_id>
    <title>PHOENIX MARS MET Experiment</t
    <information_model_version>1.0.0.0</i
    <product_class>Product_Observational<
  <Modification_History>
    <Modification_Detail>
      <modification_date>2013-07-26</mod
      <version_id>1.0</version_id>
      <description>This label was modifi
    </Modification_Detail>
  </Modification_History>
</Identification_Area>

```

MS000EMH_00896227783_10C6M1-pvl.xml

```

BEGIN_OBJECT = PRODUCT_OBSERVATIONAL
BEGIN_OBJECT = IDENTIFICATION_AREA
LOGICAL_IDENTIFIER = "urn:nasa:pds:phx_met:raw:MS000EMH_00896227783_10C6M1";
VERSION_ID = 1.0;
TITLE = "PHOENIX MARS MET Experiment";
INFORMATION_MODEL_VERSION = "1.0.0.0";
PRODUCT_CLASS = "Product_Observational";
BEGIN_OBJECT = MODIFICATION_HISTORY
BEGIN_OBJECT = MODIFICATION_DETAIL
MODIFICATION_DATE = "2013-07-26";
VERSION_ID = 1.0;
DESCRIPTION = "This label was mod
END_OBJECT = MODIFICATION_DETAIL;
END_OBJECT = MODIFICATION_HISTORY;
END_OBJECT = IDENTIFICATION_AREA;
BEGIN_OBJECT = OBSERVATION_AREA
BEGIN_OBJECT = TIME_COORDINATES
START_DATE_TIME = "2008-05-26T00:08
STOP_DATE_TIME = "2008-05-26T20:20
LOCAL_MEAN_SOLAR_TIME = "16:49:31";
LOCAL_TRUE_SOLAR_TIME = "17:03:01";
END_OBJECT = TIME_COORDINATES;
BEGIN_OBJECT = PRIMARY_RESULT_SUMMARY
TYPE = "Meteorology";
PURPOSE = "Science";
DATA_REGIME = "Pressure";
DATA_REGIME = "Temperature";
PROCESSING_LEVEL_ID = "Raw";
END_OBJECT = PRIMARY_RESULT_SUMMARY;
BEGIN_OBJECT = INVESTIGATION_AREA
NAME = "MET";
TYPE = "Mission";
BEGIN_OBJECT = INTERNAL_REFERENCE

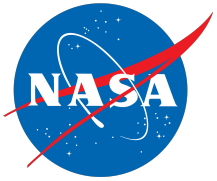
```

PHOENIX MARS MET Experiment

Identification_Area	
logical_identifier	urn:nasa:pds:phx_met:raw:MS000EMH_00896227783_10C6M1
version_id	1.0
title	PHOENIX MARS MET Experiment
information_model_version	1.0.0.0
product_class	Product_Observational

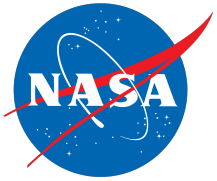
Modification_History	
Modification_Detail	
modification_date	2013-07-26
version_id	1.0
description	This label was modified to convert to PDS4.

Observation_Area	
Time_Coordinates	
start_date_time	2008-05-26T00:08:36.308Z
stop_date_time	2008-05-26T20:20:20.202Z

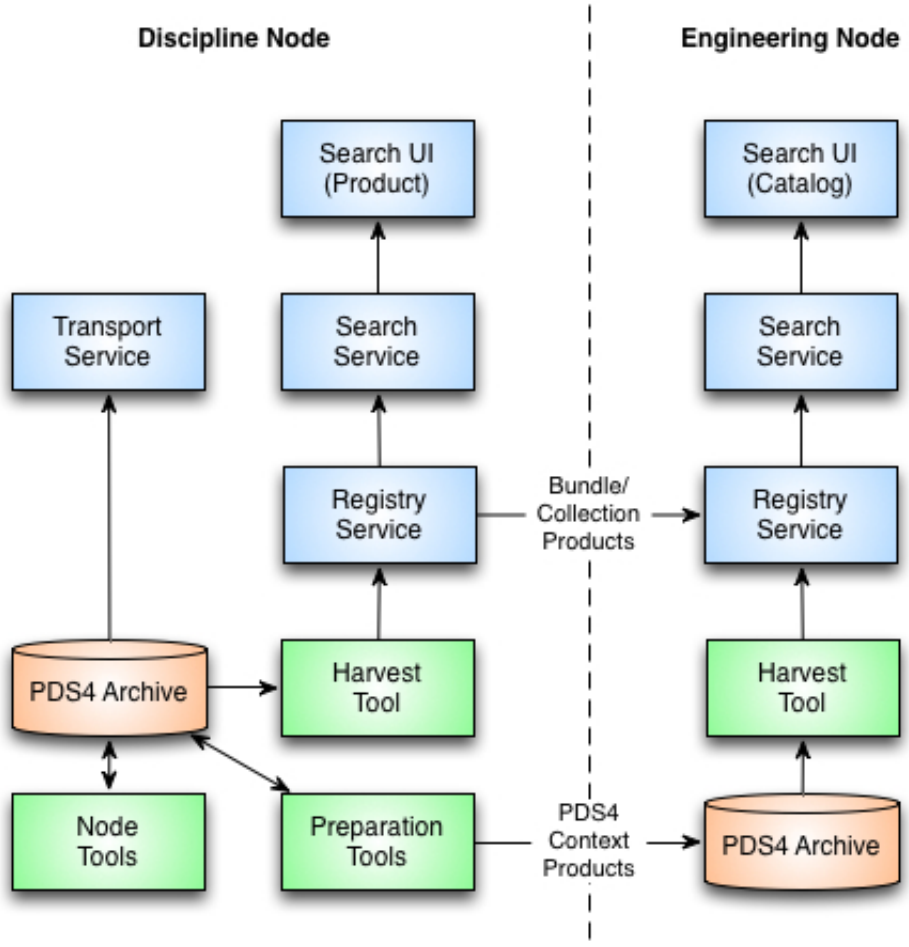


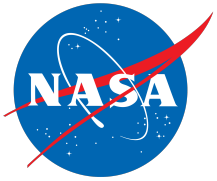
Node-Developed Tools

- Label generation tools for migrating PDS3 ODL labels to PDS4 XML labels.
- CDF file reader, checker and converter tools.
- Other tools and interfaces for discovering, displaying and transforming data intended for their discipline-specific users.



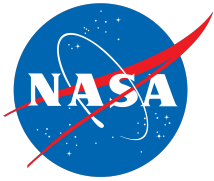
Deployment for LADEE/MAVEN





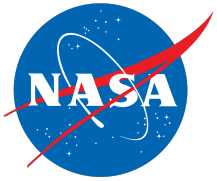
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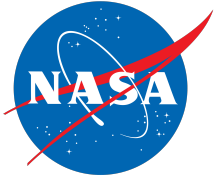
Build 3b Features

- Search added support for discovering and viewing Bundle and Collection information.
- Added support for filtering search results based on space agency and model version.
- Search was modified to address inconsistent results when specifying more than one term or parameter in the search criteria.
- Registry was modified to address performance issues.
- Validate, Harvest, Catalog and Search modified to keep pace with data model changes.



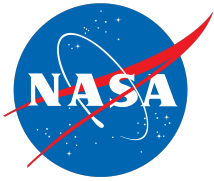
Build 4a Features

- Continue to tune the search index.
 - The service has been refactored and upgraded to Apache Solr 4.
- Add support for additional transformations.
 - Currently focusing on table transformations supported by the pds4-tools package.
- Add initial support for product-level search and distribution.



Topics

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Wrap Up

- The core of the PDS4 system has been in operations at the Engineering Node since the Build 3a release (September 2012).
 - This includes the Validation Tool, Harvest Tool, Registry Service and Search Service.
- Subsequent builds have focused on resolving issues, adding additional functionality and preparing for Discipline Node deployment.

Questions/Comments