Planetary Data System (PDS)

At the DPS Astrophysics Assets Workshop

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Introduction

The Planetary Data System (PDS) archives electronic data products from NASA planetary missions -- as well as some ground-based and laboratory data sets -- sponsored by NASA's Science Mission Directorate. It actively manages the archive to maximize its usefulness. All PDS-curated products are stored in a well-defined format, peer reviewed, fully documented, and available online to scientists and to the public.

In August the PDS recently completed a competitive selection for the scientific Discipline Nodes and that system now includes the Ring-Moon Systems and Cartography and Imaging Sciences Nodes.

The PDS is moving to an “institute” governance model with our key science archiving teams funded through cooperative agreements.

NASA is initiating a PDS roadmap activity targeted at the 2017-2026 period.
PDS Interrelationships
The PDS is one of four organizations that together form the data and sample architecture for robotic planetary exploration. The other organizations are:

• *The Minor Planet Center* which is responsible for the designation of minor bodies in the Solar System and for the efficient collection, computation, checking and dissemination of astrometric observations and orbits for minor planets and comets;

• *NASA’s Astromaterials Acquisition and Curation Office*, whose goal is to protect, preserve, and distribute samples for study from the Moon, Mars, and interplanetary space in support of solar system exploration; and,

• The joint NASA-USGS Astrogeology Science Center whose mission includes producing planetary maps and cartographic products that reveal topography, geology, topology, image mosaics and more, all made available to the international scientific community and the general public as a national resource.
Architecture

PDS in the Planetary Science Division
“phase space”
Why the Planetary Data System?  
In the early 1980’s both the scientific community and NASA identified the need of an archive for planetary mission data in order to assure that data were preserved and not lost.

The Committee on Data Management and Computation (CODMAC) of the NAS/NRC Space Science Board issued a series of reports in the 1980’s which led NASA to form the PDS (Russell, Planetary & Space Science, 44, 1-2, 1996).

Principles derived from the COPMAC Reports  
Management and not technology limitations are the major impediments to successful archives.

Highest quality archives are those housed with scientists who use the data and with oversight by those individuals.

Successful archives must have instrument and other data providers deliver well documented archives in standard form.

Formats and archive structure should be designed for use by scientists and strike balance between flexibility and economies of non-changing structures.
Mission Statement
The Planetary Data System facilitates achievement of NASA’s planetary science goals by efficiently collecting, archiving, and making accessible digital data and documentation produced by or relevant to NASA’s planetary missions, research programs, and data analysis programs.

Our vision
• Gather and preserve the data obtained from exploration of the Solar System.
• Facilitate new and exciting discoveries by providing access to and ensuring usability of those data to the worldwide community.
• Inspire the public through availability and distribution of the body of knowledge reflected in the PDS data collection.

PDS is a federation of distributed discipline and service nodes (shown on next page). Missions work with PDS teams whose expertise matches the science focus of the mission.
Current Organization of the Planetary Data System

Discipline Nodes
- Atmospheres NMSU
- Geosciences WUSTL
- Cartography & Imaging Sciences USGS Flagstaff
- PPI UCLA
- Ring-Moon Systems SETI Inst.
- Small Bodies U Md

Technical Support Nodes
- NAIF JPL
- Engineering JPL

Project Management Support
- Chief Scientist
- Radio Science Advisor
- Change Control Board

PDS Project Office NASA GSFC

NASA HQ
Who are we?

**Discipline Nodes**
- **Atmospheres Node:** New Mexico State University, Las Cruces, New Mexico (Nancy Chanover, Manager)
- **Geosciences Node:** Washington University in St. Louis, Missouri (Ray Arvidson, Manager)
- **Cartography & Imaging Sciences Node:** US Geological Survey, Flagstaff, Arizona (Lisa Gaddis, Manager)
- **Planetary Plasma Interactions Node:** University of California, Los Angeles, California (Raymond Walker, Manager)
- **Ring-Moon Systems Node:** SETI Institute, Mountain View, California (Mark Showalter, Manager)
- **Small Bodies Node:** University of Maryland, College Park, Maryland (Michael A'Hearn, Manager)

**Support Nodes**
- **Engineering Node:** Jet Propulsion Lab, Pasadena, California (Dan Crichton, Mgr.)
- **Navigation and Ancillary Information Facility:** Jet Propulsion Lab, Pasadena, California (Chuck Acton, Mgr.)

**Management**
- **William Knopf:** Program Executive, NASA Headquarters
- **Micheal New:** Program Scientist, NASA Headquarters
- **Ralph McNutt:** PDS Chief Scientist, JHU Applied Physics Lab
- **Tom Morgan:** Project Manager, NASA GSFC
The Planetary Data System is a project, and therefore it has Level 1 requirements:

- PDS will provide expertise to guide and assist missions, programs, and individuals to organize and document digital data supporting NASA's goals in planetary science and solar system exploration.
- PDS will collect suitably organized and well-documented data into archives that are peer reviewed and maintained by members of the scientific community.
- PDS will make these data accessible to users seeking to achieve NASA's goals for exploration and science.
- PDS will ensure the long-term preservation of the data and maintain their usability.

PDS works both with mission providers to archive mission data and the user community.
What does PDS do? (2)

- PDS curates data collections from more than 70 missions and maintains web-assessable and searchable catalogs of that data.
- PDS works with mission teams and instrument teams to assist them in every stage of the archiving process, working to see that data finally accepted by PDS meets PDS standards. This includes verifying submissions, organizing peer reviews, maintaining documentation.
- PDS develops PDS tools for use by teams working to archive their data, and tools for PDS data users.
- PDS works with data users to find PDS data relevant to user science objectives and to transfer and work with the data.
- PDS provides high-level web access to PDS and respond to changes in IT technology to provide new opportunities for our providers and users (for more information about PDS contact Thomas Morgan, Project Manager, thomas.h.morgan@nasa.gov).
What does PDS do? (3)

- Many planetary data collections are unique in that the observations cannot be duplicated.
- The archives include data products derived from a very wide range of measurements, e.g., imaging experiments, magnetic and gravity field measurements, altimetry data, and various spectroscopic observations ion and electron data, and geometrical information about observations.
- The wide range of archival products and associated disciplines are fundamental reasons for why the PDS has organized itself as a coordinated federation serving various science communities.
- The PDS archives and makes available data sets from space-borne, ground-based, and laboratory experiments from NASA-based exploration of comets, asteroids, moons, rings and planets.
- The increased volume and complexity associated with data from new missions represent challenges that must be met with innovative management and technology solutions.
What does PDS do? (4)

- PDS has upgraded our archive system to support the future needs of planetary science. Since PDS was established, instruments used to collect planetary data have increased in sophistication, sensitivity, and speed by orders of magnitude; the communications systems used to deliver data now handle terabytes on time scales of a week.

- The upgrade (known as PDS4) has improved both the software system and the data standards, capitalizing on newer data system approaches. PDS4 is a strict data standard, and it provides increased interoperability among international planetary science data archives.

- PDS4 meets three fundamental system goals: (1) Providing more efficient client delivery of data by data providers to the PDS; (2) Enabling a stable, long-term usable planetary science data archive; and (3) Enabling services for the data consumer to find, access, manipulate, and use the data they require, and in contemporary data formats.

- PDS has adopted a stable international standard, The Extensible Markup Language (XML) for PDS4.
Mission-PDS Archive Process

**Phase A: Study**
- Complete Data Management and Archiving Plan
- Produce SISs* and sample data collections
- Contact PDS (Step 1)
- Begin archive planning (Step 2)

**Phase B: Design**
- Continue archive planning
- Complete Data Management and Archiving Plan
- Support mission teams as negotiated

**Phase C/D: Build & Test**
- Lead peer review of SIS and sample data collections to establish certified pipeline

**PDS**
- Acknowledge archive intent (Node)
- Help scope/refine archive task (Node)
- Identify lead/supporting Nodes

* SIS: Systems Interface Specification document
Mission-PDS Archive Process

**Phase C/D**
- **Build & Test (Cont.)**
  - Jointly establish data delivery schedule

**Phase E Operations**
- **Operations**
  - Peer review first data delivery (PDS-lead)
  - Address liens; Complete and deliver certified data collections
  - Process additional deliveries through certified pipeline
  - Receive and make data publically available
  - Treat deliveries as accumulating data collections

**EOM**
- Deep-archive data at the NSSDCA
Improved Access to Data

Text-based Searching

Archive Help Pages and Support
Orbital Data Explorers

- Forms and map-based searches
- Feature-based searches, e.g., by crater name
- Cross PDS Node searches
- Granular level searches
- Custom archives for delivery
- Representational State Interface (REST) included to allow users to design their own interfaces to archives
Simultaneously searching for MESSENGER MASCs (UV-IR spect.) and MLA (laser altimeter) data at Geosciences Node; and MDIS-NAC Image data at Imaging Node for Cahokia Vallis.
User Tools (3)

PDS4 Viewer

- Reads PDS4 product labels (XML) to display images, spectra, and tables.
Reaching outward –
International Planetary Data Alliance

IPDA Members

• Italian Space Agency
• National Centre for Space Studies (CNES – France)
• China National Space Agency
• German Aerospace Center
• European Space Agency
• Space Research Institute (Russia)
• Indian Space Research Organization
• Japanese Aerospace Exploration Agency
• National Air and Space Administration
• United Kingdom Space Agency
PDS Roadmap Activity

Goal
Develop an implementable Vision for the PDS that sits within NASA’s broad principles for archiving all products from planetary Exploration. Focus of the activity if 2017 – 2026.

Approach
• Think 20 years out for Missions.

• Think 10 years out for flight technologies.

• Think 5 years out for changes in the IT infrastructure.

• Ask the community: Request for Information (RFI), informational sessions at National meetings.

• Insure that IT implementation is consistent with current Federal Best Practices (https://playbook.cio.gov/).

• Effort led by our PDS Chief Scientist, Dr. Ralph McNutt.
PDS Roadmap Activity

Request for Information: NNH15ZDA012L (Preparation for the development of a community-based roadmap for the Planetary Data System and associated organizations.)

Solicitation: NNH15ZDA012L

Dates
Release: Nov 04, 2015
Close: Jan 05, 2016
PDSRFI15 RFI Responses Due: Jan 05, 2016

Announcement Documents
PDS RFI Description

OK
PDS Roadmap Activity

Key Questions

• What tools, resources, workflows, tutorials, and interfaces will future users expect or require?

• How can the interaction between the PDS and data providers -- missions and individual researchers -- be improved in order to make the archiving process seamless and less costly to both data providers and the PDS?

• How can the interaction between the PDS and data providers be improved to move data from the provider to the public as rapidly as possible?

• What role should the PDS play, relative to other archiving alternatives including scientific journals, in providing the public access to the data that is the product of NASA’s funded research and the basis of published scientific studies?
PDS Roadmap Activity

Key Questions (Cont’d)
• What is the highest priority need for integration between PDS data products and either cartographic products, sample material, or data from the Minor Planets Center (or all of them?)

• What role should the PDS play in encouraging the development of higher-order data products, and ensuring archive quality is quickly achieved?

• Are there identifiable improvements to the current search capabilities of the PDS that would allow researchers improved access to data products and metadata?

Questions concerning this RFI:
Dr. Michael New, NASA HQ, 202-358-1766, michael.h.new@nasa.gov.

Questions concerning the post-RFI PDS Roadmap Activities:
Dr. Ralph McNutt, JHU APL, 443-778-5435, ralph.mcnutt@jhuapl.edu.