NASA's Planetary Data System Status and Future Plans

Planetary Data System: Project Office Report to the Planetary Science Advisory Committee

March 9 - 10, 2020

Tim McClanahan
PDS Project Office Manager

Planetary Data System (PDS) Overview

NASA Planetary Mission Data Status

PDS Next Directions

PDS Survey

Planetary Data System
30 years and Counting…

1989: NASA established the PDS as a formal Planetary Data Archive

PDS Level 1 Requirements

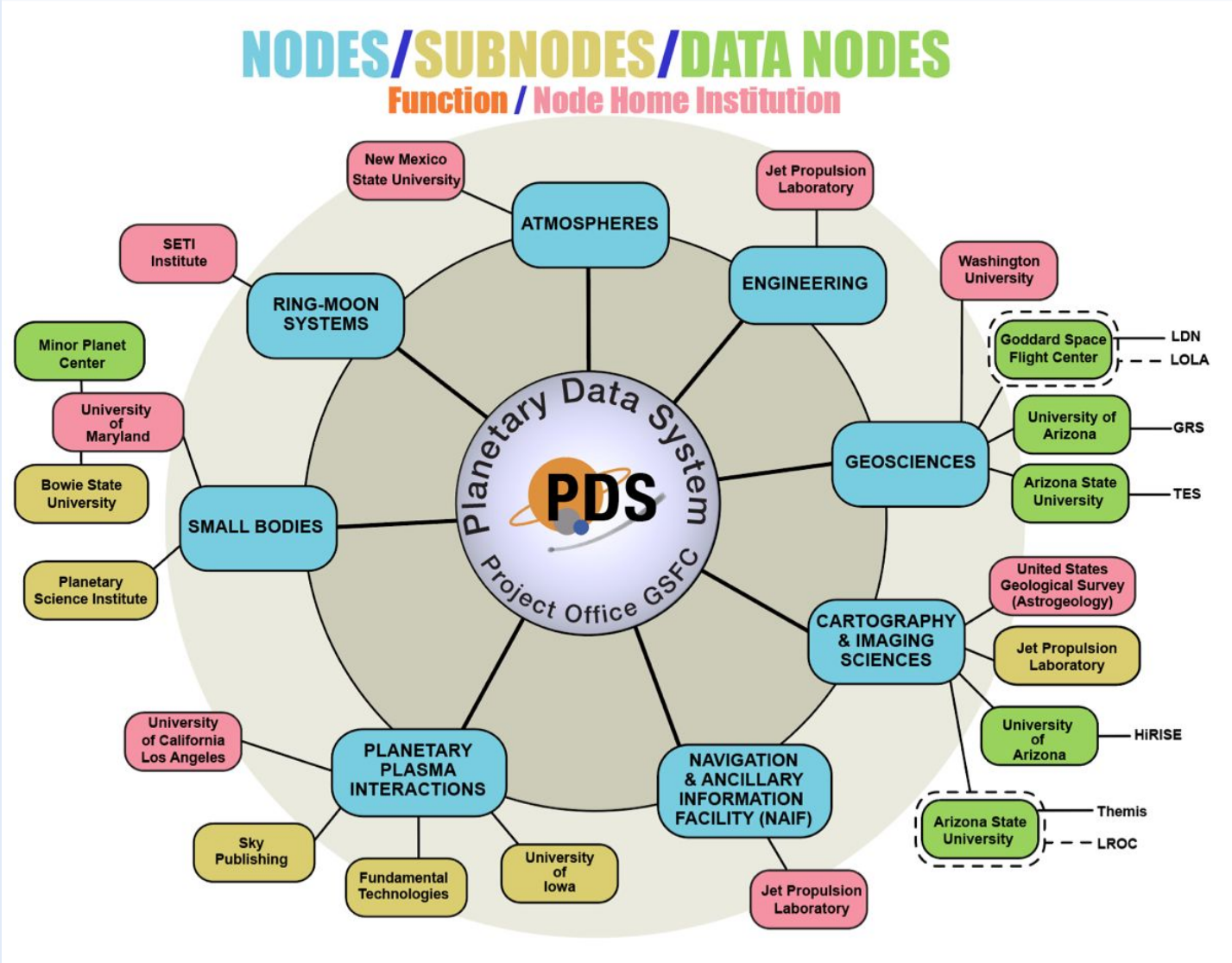
- Provide expertise to guide and assist missions, programs, and individuals to organize and document digital data supporting NASA's goals in planetary science and solar system exploration.
- Collect and curate suitably organized and well-documented data into peer archives that are maintained by members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

Evolving Community Needs……
Evolving Technologies …….

Level 1 requirements are levied by Headquarters.

Planetary Data System (PDS) Configuration

PDS
1 Project Office
6 Discipline Nodes
2 Support Nodes
6 Sub-Nodes
8 Data-Nodes



Planetary Data System (PDS) Management Team

NASA Headquarters

Lori Glaze
Planetary Science Division Director

Becky McCauley Rench
Planetary Data System Program Scientist

Eric Ianson
Planetary Science Division Deputy Director

Meagan Thompson
Planetary Data System Program Executive

Lunar & Planetary Institute

Louise Prockter
Planetary Data System
Chief Scientist

NASA - GSFC PDS Project Office

Timothy McClanahan
Planetary Data System
Project Manager

Discipline Nodes

Atmospheres:
New Mexico State University
Las Cruces, NM
(Nancy Chanover)

Planetary Plasma Interactions:
University of California
Los Angeles, CA
(Ray Walker)

Cartography & Imaging:
US Geological Survey
Flagstaff, AZ
(Lisa Gaddis)

Ring Moon Systems:
SETI Institute
Mountain View, CA
(Mark Showalter)

Geosciences:
Washington University
St. Louis, MO
(Ray Arvidson)

Small Bodies:
University of Maryland
College Park, MD
(J. 'Gerbs' Bauer)

Support Nodes

Engineering:
Jet Propulsion Lab,
Pasadena, CA
(Jordan Padams)

Navigation & Ancillary Information Facility:
Jet Propulsion Lab,
Pasadena, CA
(Chuck Action)

Planetary Data System (PDS) Project Office at GSFC

Solar System Exploration Division (SSED) 690
Director: Dr. Paul Mahaffy | Asst: Ms. Marley Fleishman

Solar System Exploration Data Services Office (SSEDSO) 690.1
Office Head: Dr. Thomas Morgan | Asst: Jessica Still

National Space Science Data Coordinating Archive (NSSDCA)

Director:
Dr. David Williams

NSSDCA Ingest Manager
Patrick McCaslin

NSSDCA Technical Manager
Edwin Bell

Planetary Data System Project Office (PDSPO)

PDSPO Project Manager:
Dr. Timothy McClanahan

Deputy PM for R&A, Node Liaison and PDS3-PDS4 Migration:
Dr. David Hollibaugh Baker

Deputy PM for Budget and Planning:
Dr. Thomas Morgan

Tools and IT Transformation Lead:
Dr. Maria Banks

Training and Public Outreach:
Sheri Loftin

Resource Analyst:
Lois Hughes

Project Support Analyst:
Laura Givens

Planetary Data System (PDS) Archive Metrics

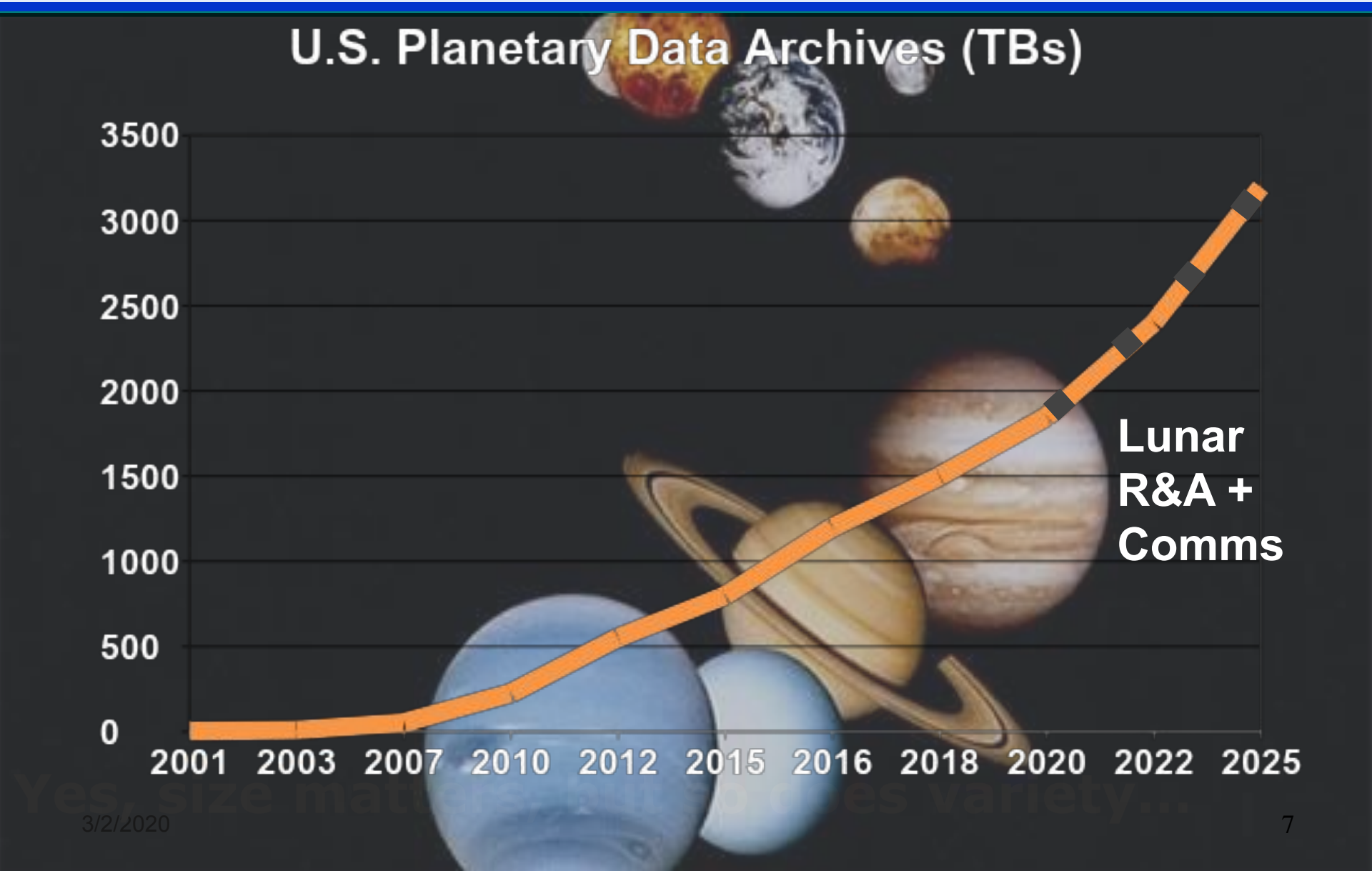
Web Statistics

- **PDS contains >1.85PB of data from >70 missions.**
- **Represents >2000 data sets from >600 unique instruments.**
- **10 active missions are currently delivering data to the PDS.**

PDS Summary Jan to Feb 2020

2020 (Jan to Feb)	PDS
Files Downloaded (2020)	48,314,932
Total Volume in PDS (Mb)	**184,293,428**
Visitors (2020)	605,720

Growth of Planetary Data Archived from U.S. Solar System Research



Active U.S. Missions: Stoplight Chart

Active US Missions	Budget				Schedule				Technical				External				Node
January 2020 Status	*Oct*	*Nov*	*Dec*	*Jan*	*Oct*	*Nov*	*Dec*	*Jan*	*Oct*	*Nov*	*Dec*	*Jan*	*Oct*	*Nov*	*Dec*	*Jan*	
2001 Mars Odyssey	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	GEO
2005 Mars Reconnaissance Orbiter	G	G	G	G	Y	Y	Y	Y	G	G	G	G	Y	Y	Y	Y	GEO
Lunar Reconnaissance Orbiter	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	GEO
Mars Science Laboratory	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	GEO
InSight	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	GEO
New Horizons	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	SBN
OSIRIS-REx	G	G	G	G	G	Y	Y	Y	G	G	G	G	G	Y	Y	Y	SBN
MAVEN	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	PPI
Juno	G	G	G	G	Y	Y	Y	Y	G	G	G	G	Y	Y	Y	Y	ATM
Cassini (EOM)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	ATM
DART (Future)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	SBN
Europa Clipper (Future)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	IMG
Lucy (Future)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	SBN
Mars 2020 (Future)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	GEO
Psyche (Future)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	SBN

January 2020 Status Report: U.S. Missions

Juno

JIRAM (YELLOW on External)

The Juno/JIRAM deliveries for Orbits 13-18 have been delayed pending the resolution of a navigation issue.

Data deliveries have been on time with the exception of FGM perijove data and JIRAM data.

MRO

SHARAD (YELLOW on External)

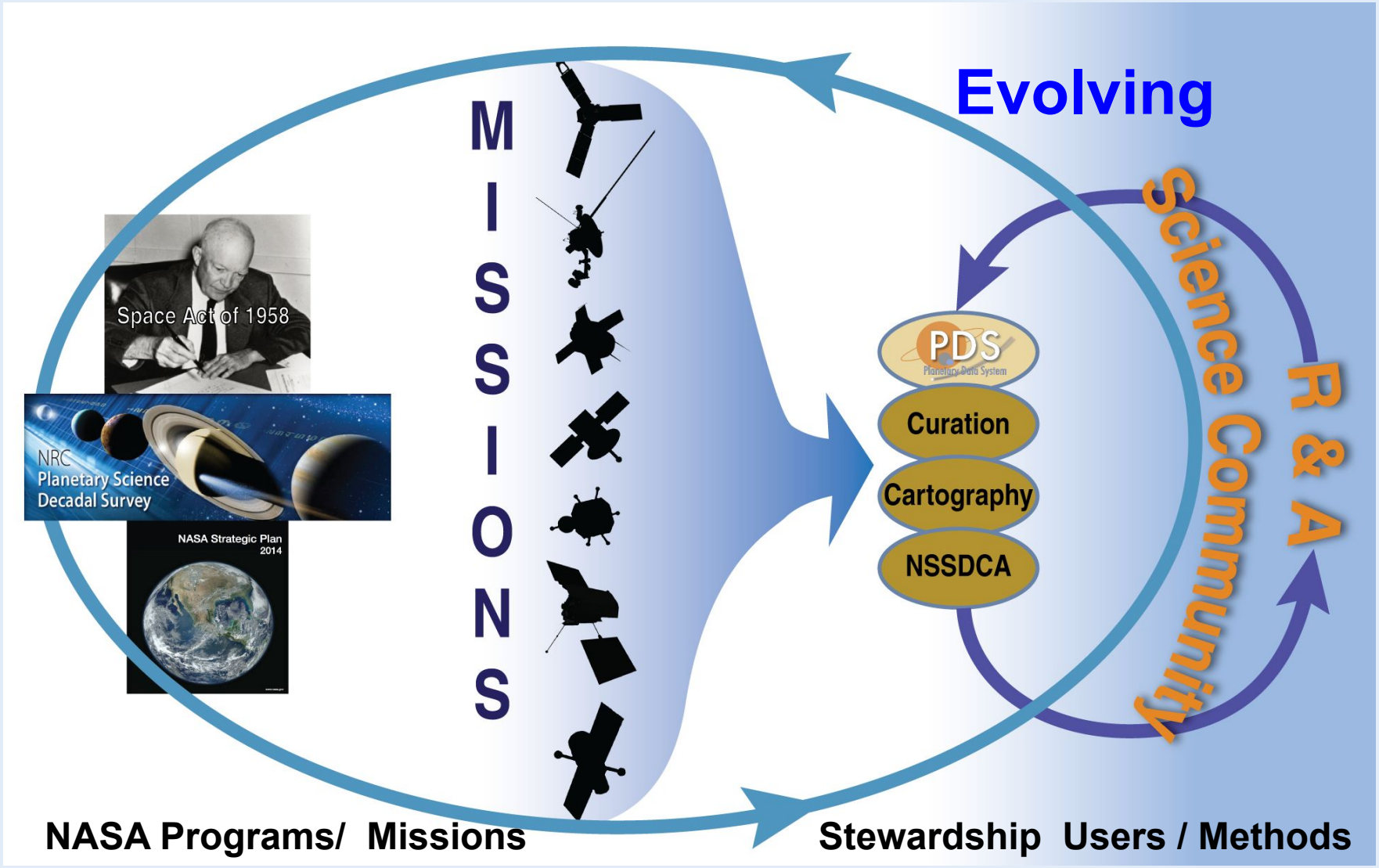
SHARAD-ASI RDR deliveries are still behind schedule, but have resumed with the RDR backlog.

OSIRIS-REx

Radio Science (YELLOW on External)

The first delivery of Radio Science data has been delayed due to health issues with a key team member.

An Evolving Planetary Data Environment



Planetary Data System (PDS) Evolving Requirements

Factors Impacting the PDS

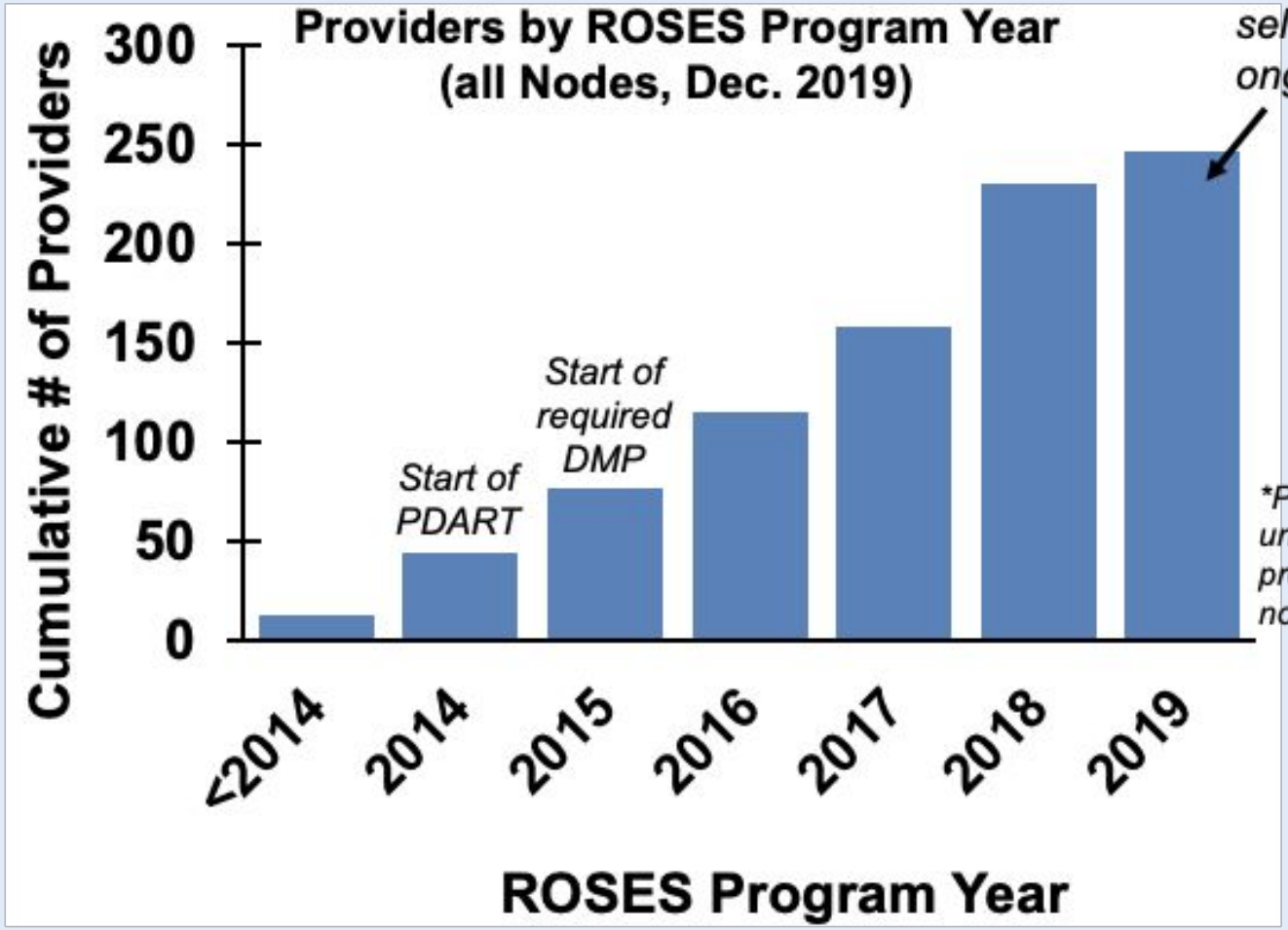
- Increasing Data Volume (Lunar, R&A, Journals Comms)
- Greater Complexity (instruments, Data)
- More Producer Interfaces
- Greater / New User Expectations
- Archive Usability
- Need for Internationalization
- Integrating a federated system
- Increasing IT security threats
- New Technology Opportunities

Funding Constraints

"Support the ongoing effort to evolve the Planetary Data System from an archiving facility to an effective online resource for the NASA and international communities."
-- Planetary Science Decadal Survey, NRC, 2013-2022

Source: D. Crichton, JPL

PDS R&A Growth



Also, Data from Journal Articles

Planetary Data System (PDS) Moving Forward...

2017 PDS Roadmap Study

- Data Discoverability
- Modernizing Metadata
- Documentation and Training
- Transparency
- Internationalization

} PDS4

2019 PDS Whitepaper: Discoverability via Data Services (D. Crichton)

- Develop Standardized Search API's
- Improved Search Engine Technology
- Link Search Engines across archives
- Comprehensive /consistent mission archive user guides
- Cloud Computing

2020 Strategy for Data Mgmt and Computing for Grndbreaking Sci.

- **Area #1: Open Data/ Open Software**
- Area #2: High End Computing
- **Area #3: Archive Modernization**
- **Area #4: Advanced Capabilities**

PDS4

- **An international, information model-driven data architecture for documenting planetary data archives**

- **An explicit information model**
  - Explicitly describe the diversity of planetary data in XML
  - A heirarchy of meta-data dictionaries that describe Planetary Data
  - Drive the definition of data to enable management, search and analytics across PDS and IPDA

- **Distributed software services architecture**
  - Services both within PDS and at international partners
  - Consistent protocols for access to the data and services
  - A distributed registry and search infrastructure
  - Tools that are built on top of the PDS4 information model

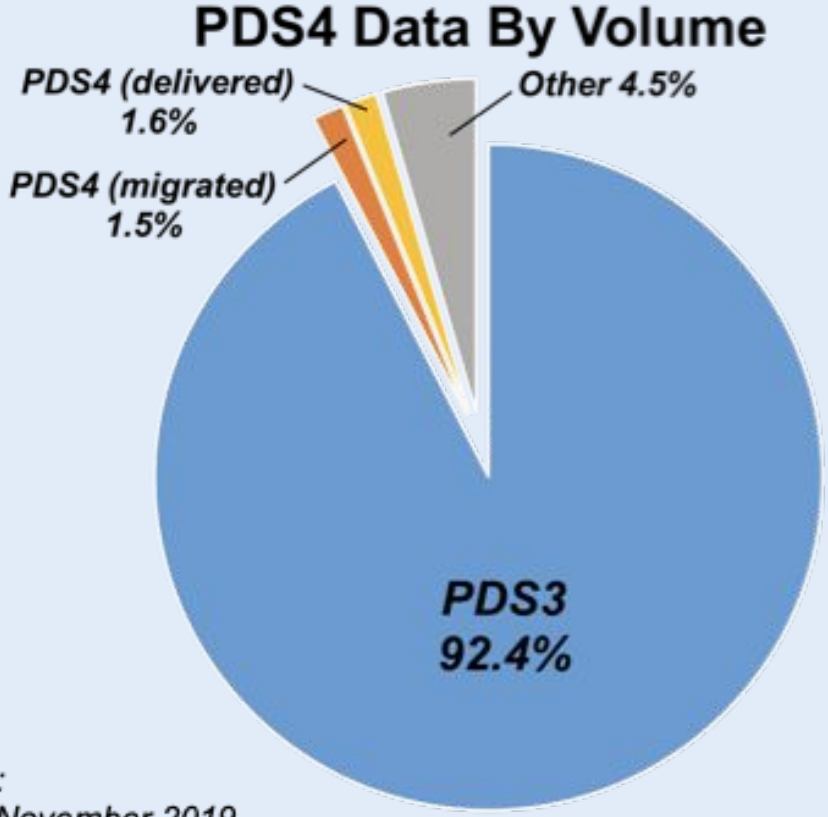
PDS4 is co-developed with the international Planetary community

Source: D. Crichton

Planetary Data System
PDS3 to PDS4 Migration

High Priority: PDS3 to PDS4 Migration of Existing PDS Archives

- Most data is in PDS3.
- Migration to PDS4 standards is still in the beginning stages.
- **~65% of PDS3 volume is LRO! (mostly LROC).**
- Migrations are planned over the next few years.



Delivered in PDS4:
LADEE, Maven, InSight, OSIRIS-REx

Notes:
As of November 2019

Planetary Data System
PDS3 to PDS4 Migration

Migrations in Progress

(whole or partial)

- Cassini
- Chandraayan
- Clementine
- Dawn
- Galileo Probe / Orbiter
- Ground-based / other
- Huygens Probe
- Juno
- LRO
- Mars Pathfinder
- MER
- MESSENGER
- Phoenix
- Viking
- Voyager 1
- Voyager 2
- Rosetta

Future migrations planned over the next few years

"Facilitate global access to, and exchange of, high quality scientific data products managed across international boundaries"

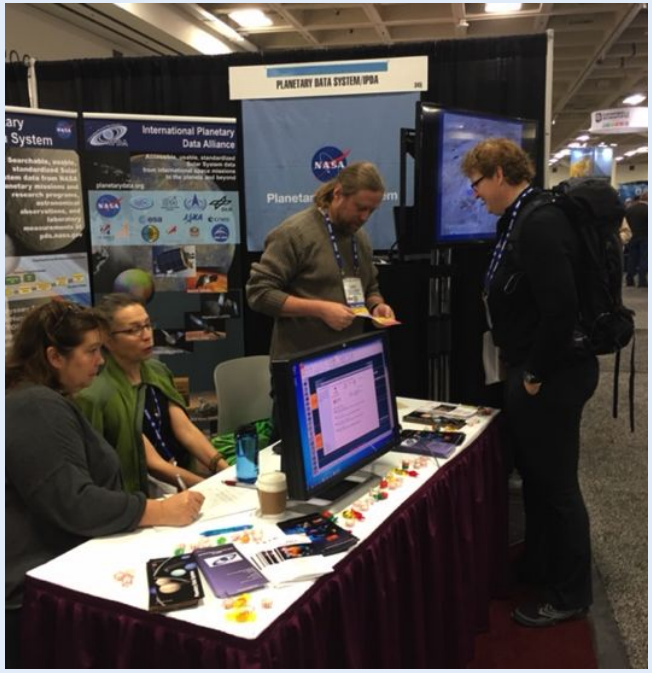
IPDA Membership

Armenian Astronomical Society
China National Space Agency (CNSA)
European Space Agency (ESA)
Finnish Space Agency (FSA)
German Aerospace Center (DLR)
Indian Space Research Organization (ISRO)
Italian Space Agency (ASI)
Japanese Aerospace Exploration Agency (JAXA)
Korean Astronomy and Space Administration
National Air and Space Administration (NASA)
National Centre for Space Studies (CNES)
Space Research Institute (IKI)
UAE Space Agency
UK Space Agency

The Cornerstone: Adoption of PDS4 Standards

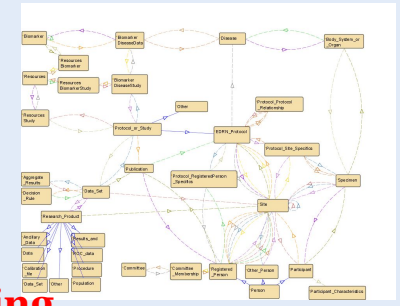
Source: D. Crichton, JPL

Planetary Data System (PDS) Training and Outreach



Images of some of the more than 70 scientists, engineers, archivists, and IT professionals who make the PDS work.

Cloud Computing



Initial Cloud Deployments ….

Machine Learning and Deep Learning

Several PDS Nodes implementing Cloud Systems

- Backups, Data Services, EN General Services

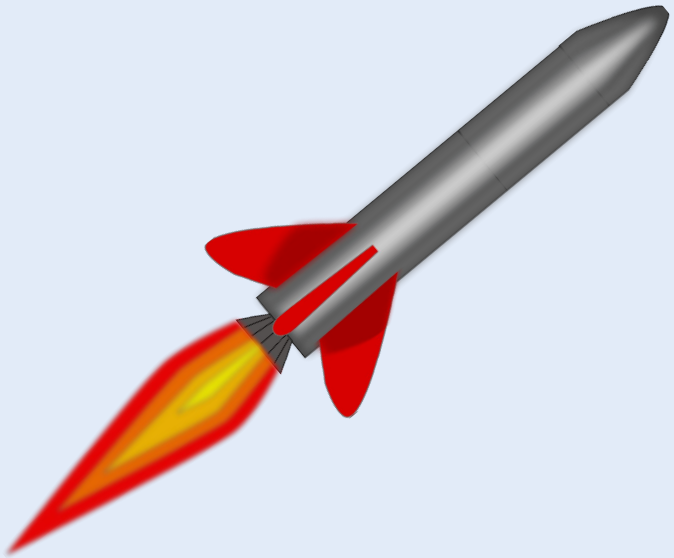
Investigating full archive deployments …..

PDS Whitepaper on Cloud Computing. (D. Crichton / J. Padams, JPL)

- In Development
- Factors:
  Providers, Services, Models, Tradeoffs, IT Security, Administration, Costs
- Recommendations
- April 2020

Planetary Data System (PDS) Customer Satisfaction Survey

Please help NASA define the next generation of the PDS!



The PDS Customer Satisfaction Survey will be used to set the future priorities of the Planetary Data System (PDS). The results will indicate areas for improvement and what new services are needed, ensuring the needs of the scientific community are met both now and in the future.

For more information:

https://feedback.app.cfigroup.com/l/r/NASAPDSGen

Summary

Upcoming NASA HQ Planetary Data Ecosystem Study

PDS Priorities

1. **Curate High Quality Archives**
2. **PDS3 to PDS4 Migration**

3. **Ongoing Effort**
   - Training Modules and Outreach
   - Expand PDS4 Information Model
   - Increase scalability, accessibility: IPDA
   - PDS User Interfaces / Website
   - Improve Usability
     - Develop Data Services, App Programming Inter. (API)
   - PDS Cloud Whitepaper and Study

PDS Survey: