PDS Overview

March 22, 2010

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Chief Scientist

Topics to be Discussed

- PDS Mission, Vision and Structure
- PDS Level 1 Requirements
- PDS Challenges
- Scope of Mission Activities
  - NASA
  - International
  - What PDS is Doing to Improve
  - User Access
  - Mission Interface
- What is PDS Not Doing/Not Providing
- Recommendations

PDS Mission and Vision Statement

- Mission: The mission of the Planetary Data System is to facilitate 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

- Vision:
  - To gather and preserve the data obtained from exploration of the solar system by the U.S.
  - To facilitate new and exciting discoveries by providing access to and ensuring usability of those data to the worldwide community
  - To 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.

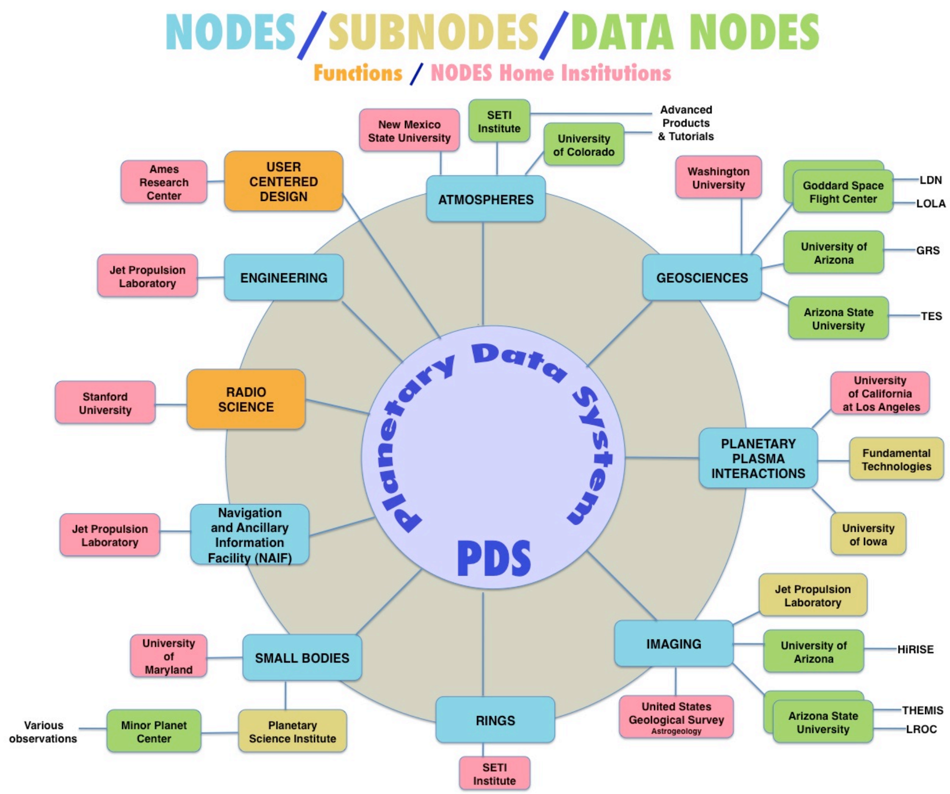
Credit: PDS Roadmap 2006 - 2015.

PDS Structure

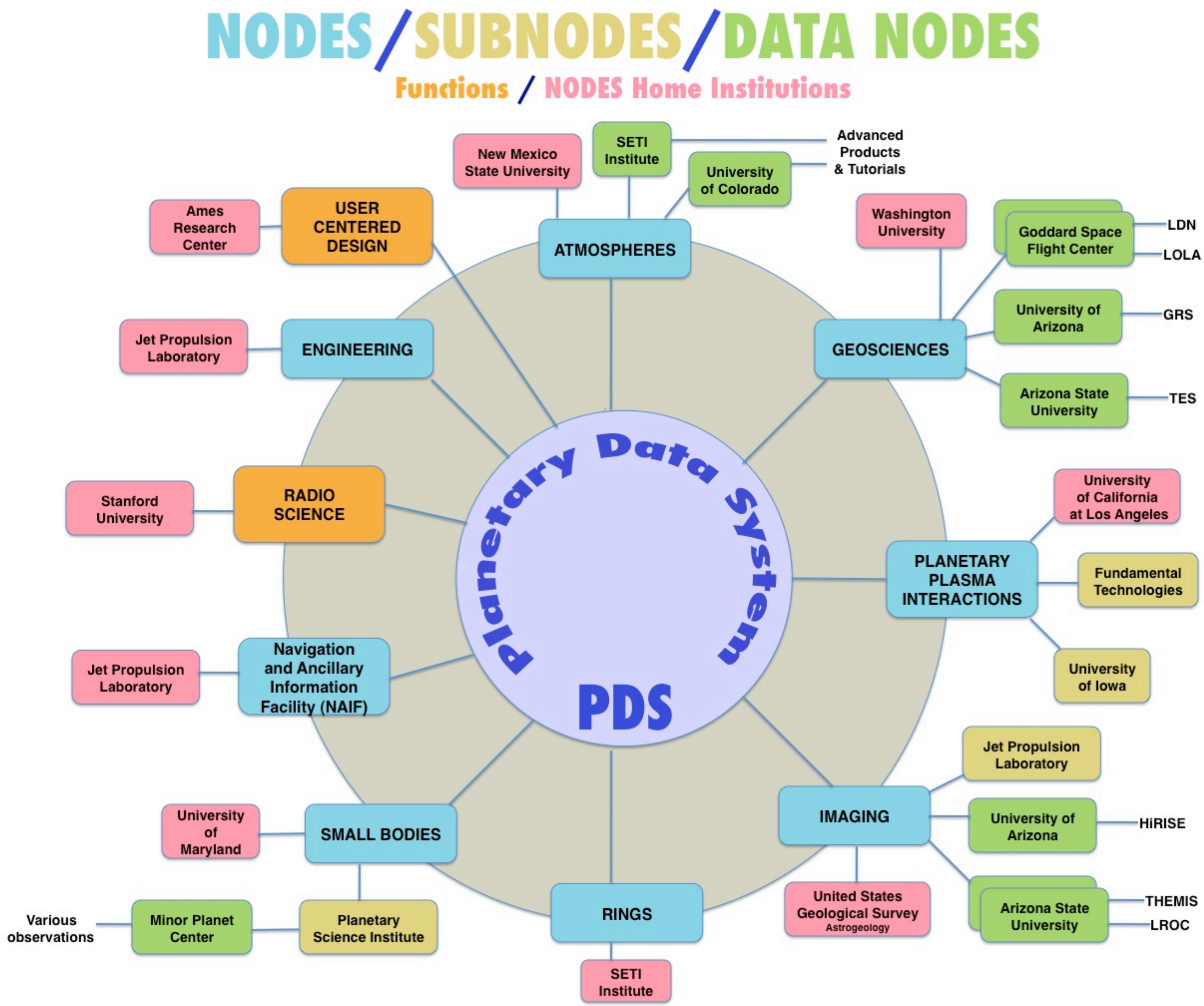
- PDS is composed of discipline and service nodes

Program Executive – Bill Knopf
Program Scientist – Michael Kelley
Program Manager – Ed Grayzeck/GSFC

In 2005 NASA separated the Central node into a management office and an Engineering node (JPL).



Internally the Management Council – with representation from each node- deals with PDS issues and planned revisions – has monthly telecons and 3 annual meetings – chaired by Reta Beebe, who serves as Chief Scientist and Coordinator.


NODES / SUBNODES / DATA NODES
Functions / NODES Home Institutions
Planetary Data System
PDS
ATMOSPHERES
New Mexico State University
SETI Institute
University of Colorado
Advanced Products & Tutorials
USER CENTERED DESIGN
Ames Research Center
GEOSCIENCES
Washington University
Goddard Space Flight Center
LDN
LOLA
University of Arizona
GRS
Arizona State University
TES
ENGINEERING
Jet Propulsion Laboratory
RADIO SCIENCE
Stanford University
PLANETARY PLASMA INTERACTIONS
University of California at Los Angeles
Fundamental Technologies
University of Iowa
Navigation and Ancillary Information Facility (NAIF)
Jet Propulsion Laboratory
IMAGING
Jet Propulsion Laboratory
University of Arizona
HiRISE
Arizona State University
THEMIS
LROC
United States Geological Survey
Astrogeology
SMALL BODIES
University of Maryland
Planetary Science Institute
Minor Planet Center
Various observations
RINGS
SETI Institute

PDS Level 1 Requirements

1. 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

2. PDS will collect suitable and well-documented data into archives that are peer reviewed and maintained by members of the scientific community

3. PDS will make these data accessible to users seeking to achieve NASA's goals for exploration and science

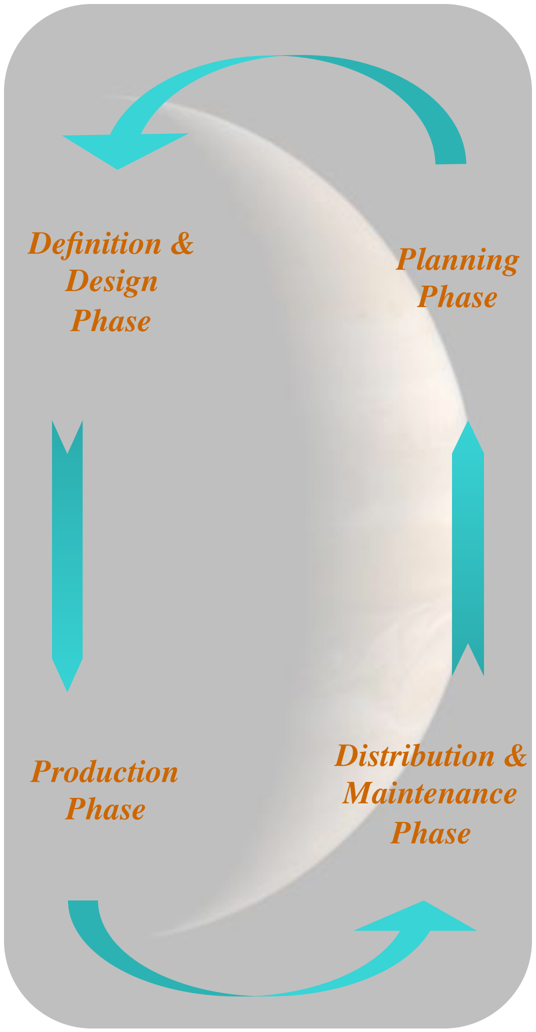
4. PDS will ensure the long-term preservation of the data and their usability

Credit: PDS Level 1,2,3 Requirements. August 2006.

PDS Challenges

- Number and diversity of missions and instruments
  - PDS is currently receiving data from 110 instruments from 15 active missions as well as concurrently working with missions in development
  - New mission data nodes being added to PDS (LROC, for example)
- Requirements for preservation of data and for usability are sometimes in conflict
- Budget pressures which affect archiving/usability across data providers/missions, PDS and the users
- International collaborations, including ingestion of archives into the PDS and providing advice on generating PDS-complaint archives
- Increasing volume of data
  - In 2001, the PDS archive was 4 TBs
  - In 2010, the PDS online archive is over 100 TBs
- ITAR
- Replacing aging technology, tools, standards and processes

PDS Participates Throughout a Project Lifecycle



Planning Phase:

- Data archiving requirements defined in mission AO
- Pre-proposal briefing on PDS requirements to potential proposers
- Proposal data archiving section reviewed by PDS
- PDS orientation to project staff & data archiving working groups formed

Definition & Design Phase:

- Project Data Management and Archive Plans define data products to be archived
- Data Product and Volume Organization Software Interface Specifications detail the data and volume structure
- Preliminary metadata labels loaded into PDS catalog

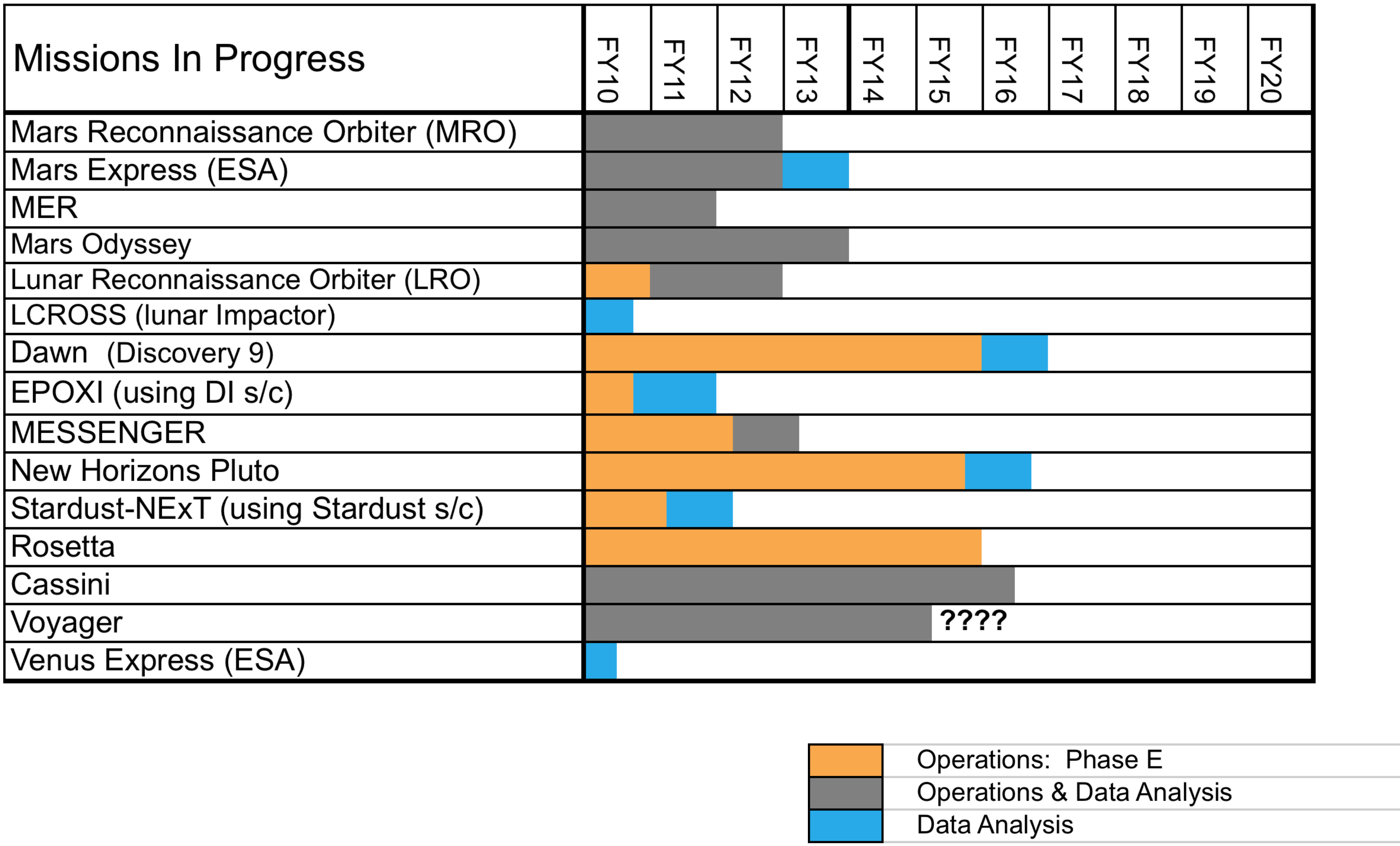
Production Phase (IV&T):

- Raw and processed data products, documentation (metadata) and labels produced with PDS/mission interaction
- Data archive products validated, peer-reviewed; liens addressed

Distribution & Maintenance Phase:

- Final data products added to archive and made available on-line
- Copies sent to National Space Science Data Center (NSSDC) @ GSFC
- PDS provides data, documentation and science expertise to users
- Data archive maintained via periodic media refreshes/audits, addition of new and updated data products

Phases of Missions in Progress



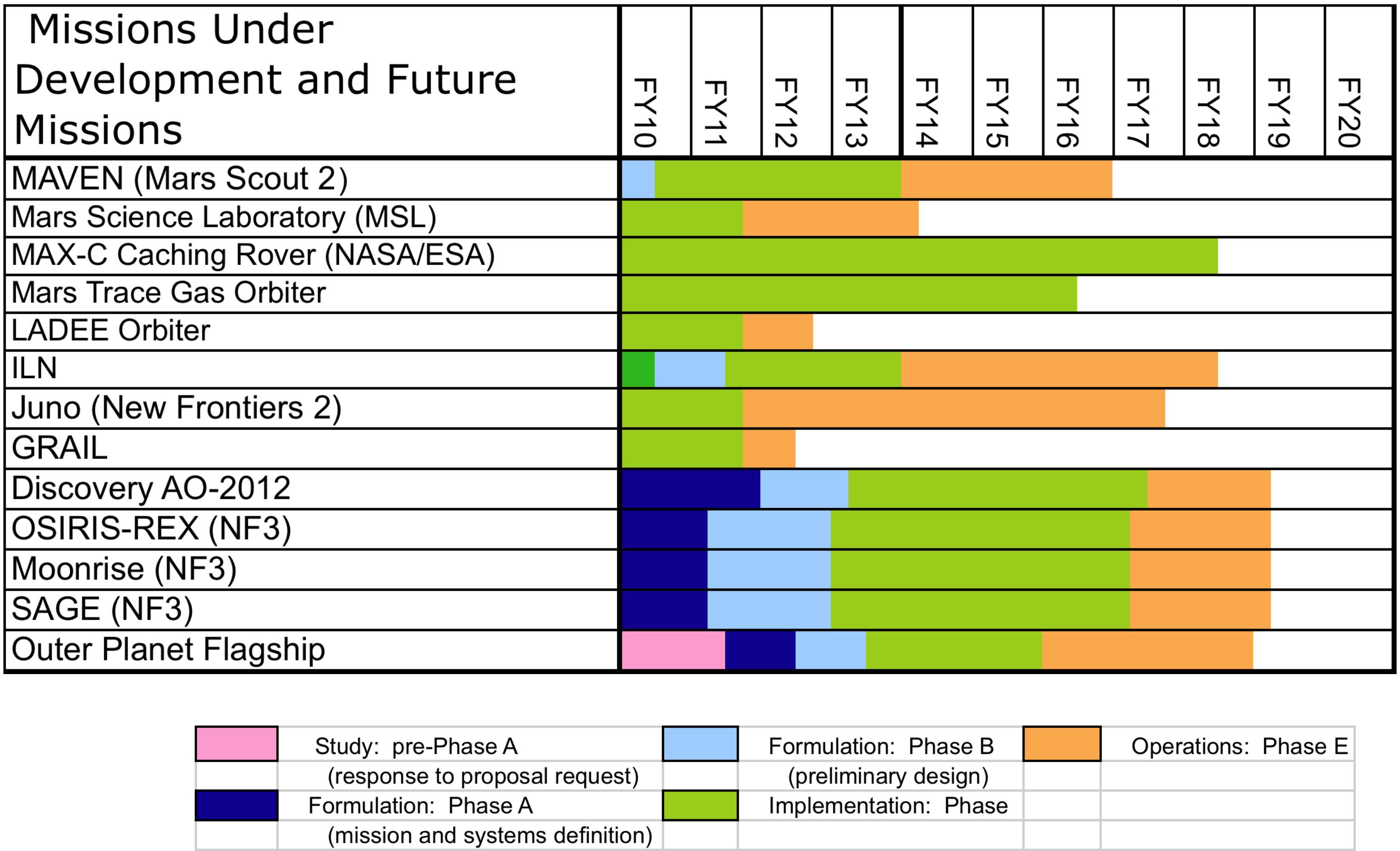
Types of data currently being ingested

- UV spectra and areal maps
- Infrared areal maps, high frequency spectra, imaging spectrometry & thermal emission (radiometry)
- Multi-wavelength stellar and solar occultation data (rings & atmospheres)
- High and low spatial resolution visual images & composited maps
- Radar areal mapping and altimeter ranging
- Magnetic fields & particles, dust and plasma data
- Gamma ray & x-ray spectroscopy & neutron detection data
- Radio occultation data and gravity field information
- Isotopic & chemical compositions (mass spectrometers)
- Rover/Lander surface observations and atmospheric sampling
  - Moessbauer Spectra
  - Microscopic imaging
  - Atmospheric entry data
- SPICE (pointing and geometry) data

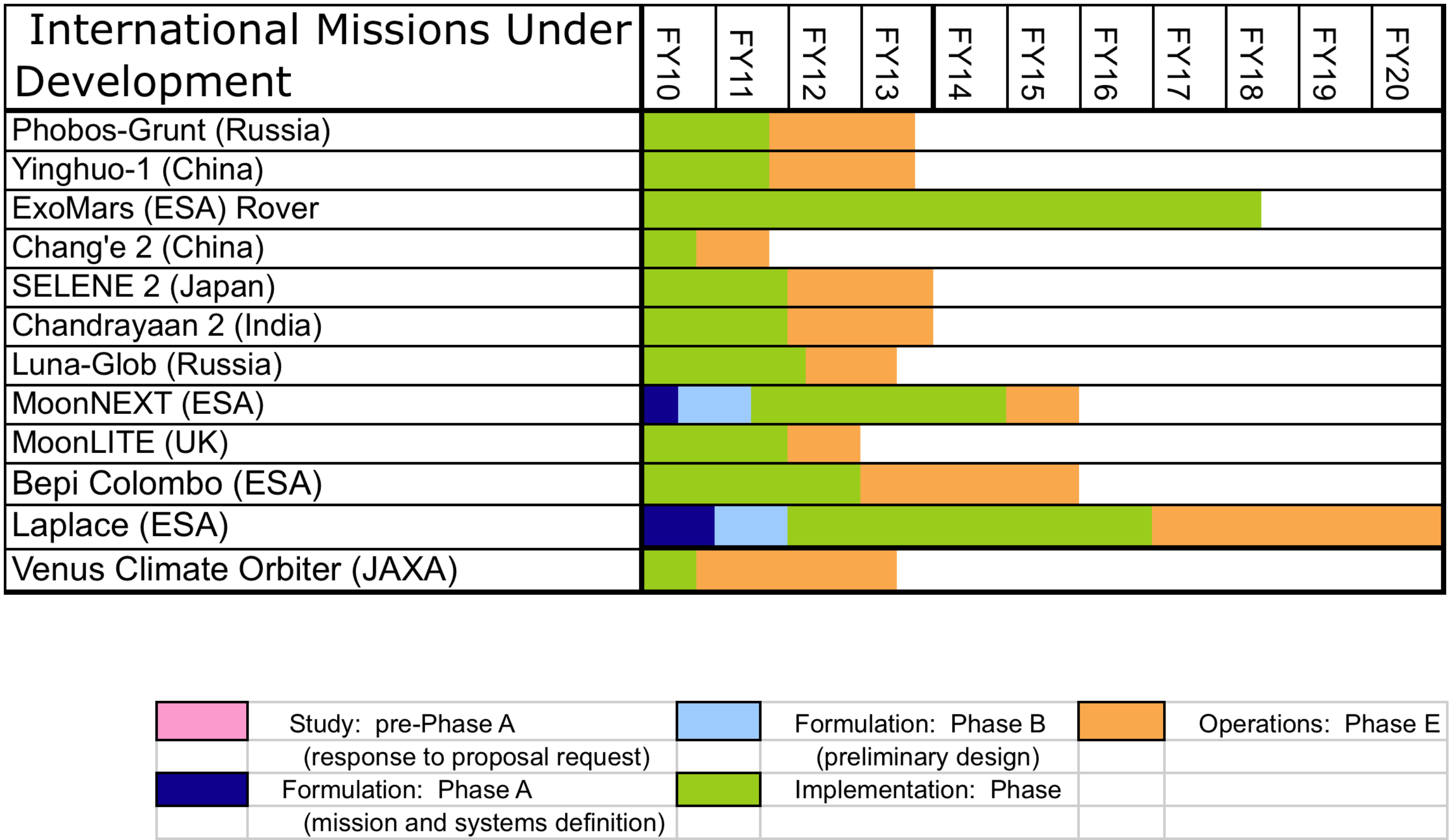
Scope of the Archive

- Regions sampled
  - Interplanetary region
  - Intraplanetary regions
  - Magnetospheric phenomenon
  - Atmospheric data – top to bottom
  - Surface phenomena and structure
  - Internal structures
- Disciplines spanned
  - Plasma physics
  - Ring composition, structure, dynamics, and evolution
  - Terrestrial Planet structure, evolution and surface processes
  - Nature of primitive bodies
  - Nature of gas and ice giants
  - Icy satellite structure and evolution

NASA Missions in Development



International Missions in Development



Mission Interface: International Missions

- PDS has been a leader in supporting movement towards internationalization to share data from planetary science archives
  - Trained Joe Zender from ESA on PDS standards who spent time at PDS and then embedded the standards into the Planetary Science Archive at ESA
  - Helped start the Planetary Data System in China (via Geosciences Nodes)
  - Founded along with Joe Zender the International Planetary Data Alliance
- PDS Standards are currently used as the de facto standard for archiving planetary science data internationally
- In 2006, ESA and NASA proposed and started the *International Planetary Data Alliance* to improve efficiency in coordinating data archiving for international missions and improving access to international archives
- In 2008, COSPAR passed a resolution recognizing IPDA and supporting its efforts to establish standards for archiving and sharing planetary science data
- Representatives include: ESA, NASA, ISRO, JAXA, DLR, BNSC, CNES, CSA, ASI, CNSA, RSA/IKI with Japan as the current chair

IPDA Steering Committee 2009-11

<u>Chair</u>	**Yasumasa Kasaba**	**(Tohoku Univ., Japan)**
<u>Deputy Chair</u>	Dan Crichton	(NASA/JPL, PDS)
<u>Former Chair (2006-2007)</u>	Joe Zender	(ESA: PSA)
<u>Former Chair (2007-2009)</u>	Maria Teresa Capria	(IASF/INAF, Italy)

NASA-PDS	Reta Beebe (NMSU), Dan Crichton (JPL)
ESA-PSA	Dave Heather, Jorge Vago
Canada (CSA)	Mickael Germain
France (CNES)	Richard Moreno, Thierry Levoir, Alain Sarkissian (IPSL)
Germany (DLR)	Thomas Roatsch, Karin Eichentopf
India (ISRO)	Gopala Krishna, R. Srinivasan
Italy (ASI)	Maria Teresa Capria, Paolo Giommi
Japan (JAXA)	Yukio Yamamoto, Iku Shinohara,
UK	Peter Allan (RAL). Mark Leese (Open Univ.))

Why a PDS-based IPDA*?

- The world-wide science community uses the PDS archive and is used to the standards.
- Constrained budgets across agencies drives collaboration and use of existing standards.
- Missions are few-and-far between, creating a demand to access all archives.
- The past practice of ingesting all international data into PDS isn't feasible
  - Agencies need to retain provenance of the data
  - Ineffective use of funds and resources

*Progress Report - The International Planetary Data Alliance (IPDA): Activities in 2008-2010Space Research Today, 176, 40-45, Dec. 2009.

What is PDS doing to improve user access?

- Improving search and access through
  - Working with teams to produce and archive descriptive, consistent labels and metadata
  - Modernization and application of newer search strategies and technologies (e.g., advanced search and access tools – Image Atlas, ODE, Analyst's Notebooks for landers, OPUS; generating enhanced metadata for some data sets; Google and Google-like search options)
- Peer reviewing data for usability
  - Instrument teams beginning to set up PDS complaint pipelines
  - Establish peer review teams with external reviewers
  - Working with teams when products are deemed inadequate
- Expanding commonly used tools to support newer product formats
  - Works with USGS to expand ISIS to support HiRISE and LROC data products using JPEG2000 for higher order products
  - Supports OGC (Open Geospatial Consortium) data access tools

What is PDS doing to improve user access (cont...)?

- Improving the look and feel of PDS websites
  - A new PDS look and feel was released in 2008
  - Improving navigation between nodes
- Working with international missions to ensure proper linkages are in place so users of PDS can access international data sets
- Crafting online tutorials for using data (for example, Cassini INMS)
- Working one-on-one with users with specific and challenging needs.

Challenges in Working with Data Providers

- In general, teams are working well with PDS
- Contentious areas that can arise include:
  - Data sets and data products that
    - Lack good, consistent metadata and labels (key for usability)
    - Are difficult to use and/or preserve over time
    - Lack ancillary data or require proprietary or complex team-developed software
  - Higher order products
    - Funding pressures can change what is being delivered and what is needed by the science community
  - Products that do not comply with PDS Standards and/or are deemed inadequate during a PDS peer review
    - In some cases, PDS has reworked products to ensure they can be used
- Establishing mission requirements and working together early is critical to improve efficiency and usability the system

What is PDS doing to improve its mission interface?

- Works with NASA HQ to assure that AO's contain the appropriate constraints.
- Provides support for pre-proposal conferences.
- Supports Proposal Reviews to assure appropriate assessment of the data analysis and archiving component of the mission to ensure the proposers will supply data that will adequately support the team's science goals and that they have adequately sized the task to produce high quality data sets
- Provides checklist on the PDS home page for preparing the archiving component of a proposal
- Works with the mission Science Operations Center as early as possible to assure the mission develop a PDS conformant pipeline.
  - This helps to prevent erosion of science funding due to mission over runs.

What is PDS doing to improve its mission interface? (cont.)

- Works to get detailed Data Archiving Plans (DAP) and Systems Interface Documents (SIS). This is the “contract”; if you don’t get plans for reduced data and higher level products you are NOT going to get them.
- Provides label making tools and data validation tools to be integrated into the instrument data pipelines. If the tools are adequate and integrated into the pipelines, the labels will contain adequate keywords to provide effective searches, analysis and processing by the users.
- Encourages the instrument teams to develop PDS compliant pipelines. If the instrument team scientists use the same data that is archived this greatly enhances the reliability of the products. In addition, it provides a cost effective approach for recalibration of the data should problems be discovered and overcome.
- Serves on Data/Science Archive Working Groups.

What is PDS doing to improve its mission interface? (cont.)

- Works to provide free flow in ingesting data deliveries.
  - For new missions these procedures have streamlined the data ingestion and have led to more higher-level products and increased efficiency.
- Performs end-to-end tests with missions to validate the pipeline and science products prior to formal delivery
  - First tested on MRO
- Formed a PDS Mission Interface Working Group to coordinate node interactions with missions and insure consistency between the nodes.

What is PDS Not Providing?

- Generation of higher order products
  - In general, PDS is an archive and distribution system, it does not have the resources to produce higher order products that the community may desire
- Maintenance of software
  - PDS can not be expected to maintain software developed by instrument teams
  - Preserving software is a challenge because team software is frequently dated by end of mission
- Transformations and support to convert data in the archive to any format desired by a user
- Ability to search on any possible feature in a data product
  - Although, good labels in the data products will improve this

Recommendations to Decadal Survey Committee*

- Emphasize that the NASA Planetary Science Division assures its polices and procedures guarantee adequate, consistent support for data analysis within the missions and the community and to enable effective archiving.

- Recommend Archive planning be an integral part of the proposal planning, and funding should be identified in the award to ensure teams have adequate resources to meet this obligation.

- Emphasize NASA Planetary Science Division support for the upgrade of PDS including leveraging modern database and web technologies in order to ensure improved data standards and efficient, effective storage, search, retrieval and distribution of scientifically useful planetary data in the coming decades

* Beebe, et al. Data Management, Preservation and the Future of PDS. White Paper for Decadal Survey Committee.