



# Investigate IPDA/IVOA Interactions

## Authors

Baptiste Cecconi	Obs. Paris/CNES	baptiste.cecconi_AT_obsprm.fr
Christophe Arviset	ESA/ESAC	christophe.arviset_AT_esa.int
Stéphane Erard	LESIA/VO-Paris	stephane.erard_AT_obsprm.fr
Nicolas André	IRAP/CNRS	nicolas.andre_AT_irap.omp.eu
Chuck Acton	NASA/PDS/NAIF	charles.h.acton_AT_jpl.nasa.gov
Jean Abouharham	LESIA/VO-Paris	jean.abouharham_AT_obsprm.fr
Benoît Carry	IMCCE/VO-Paris	benoit.carry_AT_obsprm.fr
Mireille Louys	CDS/Univ. Strasbourg	mireille.louys_AT_unistra.fr
Chiara Marmo	GEOPS/Univ. Paris Sud	chiara.marmo_AT_u-psud.fr
Angelo Pio Rossi	Jacobs Univ. Bremen	an.rossi_AT_jacobs-university.de
Florian Topf	Austrian Acad. Science	florian.topf_AT_oeaw.ac.at
Enrique Solano	CAB/INTA-CSIC	esm_AT_cab.inta-csic.es
Maria Teresa Capria	INAF/IASF	mariateresa.capria_AT_iaps.inaf.it
Dan Crichton	NASA/PDS	daniel.j.crichton_AT_jpl.nasa.gov
Todd King	UCLA/SPASE/PDS	tking_AT_igpp.ucla.edu



# Table of Contents

<b>AUTHORS</b>	<b>1</b>
<b>TABLE OF CONTENTS</b>	<b>2</b>
<b>INTRODUCTION</b>	<b>3</b>
<b>TASK 1.</b>	<b>5</b>
<b>DETERMINE THE GROUPS / TEAMS WHICH ARE INVOLVED BOTH IN IPDA AND IVOA</b>	<b>5</b>
<b>IDENTIFY AND CONTACT OTHER PLANETARY (OR SOLAR SYSTEM) SCIENCE GROUPS</b>	<b>5</b>
<b>TASK 2.</b>	<b>6</b>
<b>1. STANDARD LIST COORDINATE SYSTEMS AND REFERENCE FRAMES</b>	<b>6</b>
<b>2. STANDARDIZATION OF OBSERVATION GEOMETRY</b>	<b>6</b>
<b>3. LINK WITH EUROPLANET DEVELOPMENTS</b>	<b>7</b>
<b>4. EXTENSION OF IVOA CONE SEARCH TO MOVING TARGETS</b>	<b>8</b>
<b>5. STANDARD LIST OF GROUND BASED OBSERVATORIES</b>	<b>8</b>
<b>6. STANDARD LIST OF SPACE BASED MISSIONS</b>	<b>9</b>
<b>7. LINK WITH ESO PLANETARY IMAGES (SAME WITH HST DATABASE OR ELSE)</b>	<b>9</b>
<b>8. CROSS-MATCHING OF REGISTRIES</b>	<b>10</b>
<b>9. PROMOTING AND EXTENDING SAMP (SIMPLE APPLICATION MESSAGING PROTOCOL)</b>	<b>10</b>
<b>10. EXTENDING IVOA DATA MODELS AND SEMANTICS TO PLANETARY SCIENCES</b>	<b>11</b>
<b>11. PROPOSING NEW SERIALIZATION EXAMPLES IN IVOA STANDARDS FOR FORMAT USED IN PLANETARY SCIENCES</b>	<b>12</b>
<b>12. FITS KEYWORD STANDARDIZATION FOR PLANETARY TARGETS</b>	<b>12</b>
<b>13. IMPLEMENTATION OF IVOA STANDARDS IN MPC</b>	<b>12</b>
<b>14. EXOPLANETS</b>	<b>13</b>
<b>SUMMARY TABLE FOR IVOA/IPDA STANDARDS AND OTHER GROUPS</b>	<b>14</b>
<b>PRELIMINARY LIST FOR PROPOSED ACTIONS</b>	<b>15</b>
<b>LIST OF ACTIONS SELECTED BY IPDA FOR 2015</b>	<b>16</b>

## Introduction

Various groups in the world are actively involved in the development of standards and tools to support the capture, management, access and use of scientific data across planetary science, astrophysics, and heliophysics missions, experiments and models. Many of these communities have established online systems and efforts have been made across each of these communities to establish an international presence. These groups are linked with the IVOA ([International Virtual Observatory Alliance](#)), the IPDA ([International Planetary Data Alliance](#)), the SPASE ([Space Physics Archive Search and Extract](#)) group, and various other projects (such as the EU funded Europlanet project, but not restrictively). These groups have been assessing and tailoring standards that need to be coordinated with acknowledged international entities such as IVOA, IPDA, SPASE or IAU ([International Astronomical Union](#)).

The IVOA defines interoperability standards mainly driven by astronomy science cases. Some IVOA standards are also used in other disciplines and in particular for some planetary science related projects (i.e., Europlanet developments, see [Europlanet page at VO-Paris](#)). In this context, closer collaboration between the two alliances (IPDA and IVOA) could be envisaged to determine if there are some common interests, possibility of knowledge sharing and eventually re-use of interoperable standards that might require slight adaptation to cover both disciplines.

The IPDA defines standards for the capture of compatible archives based on a common information model and a set of standards for constructing planetary science archives. A significant amount of the IPDA efforts revolve around developing the interface between missions/data providers and planetary science data archives to ensure that data products can be delivered and archived using common metadata and data definitions based on the PDS4 standards.

In exploring a possible IPDA/IVOA areas for collaboration, the most obvious opportunity for collaboration is around data access/usage, particularly around specific planetary science disciplines where there is a connection between data capture in planetary science archives and those captured in astronomy archives. However, it is clear from the past experience, and from the points listed in this document, that some standards from IVOA can be used in a larger scope than its initial specification.

The following tasks have been identified by IPDA in order to go forward:

- Task 1. Determine the groups / teams which are involved both in IPDA, IVOA and IAU.
- Task 2. List the potential common interests for interoperability standards
- Task 3. Potential organization of common sessions at the next IVOA interoperability meeting that will take place at ESA-ESAC, Spain on 19-23 May 2014
- Task 4. Based on the previous, determine if there is common benefit and interest for a closer and more formal coordination between IPDA and IVOA

The collaboration between, the IPDA and IVOA (and the liaison with IPDA) was discussed during the Heidelberg IVOA Interop meeting (May 2013), at the Exec meeting (see item 1. of the [minutes](#)), and an action item to follow up has been set during the following telecon ([FM48S-1](#)).

The IPDA discussed the collaboration at the July Steering Committee meeting in Paris, France with a follow-up project to begin exploring possible opportunities.

The scope of this document is to retrieve the inputs from the people involved in IVOA, IPDA, IAU and any other communities of interest in planetary data and astronomy interoperability. Hence, only tasks 1 and 2 are addressed in this document.

## Task 1.

As mentioned, the most obvious areas for collaboration between IVOA and IPDA are in areas of data access and usage, particularly for specific planetary science disciplines where there is a relationship between data captured within planetary science and those within astronomy. The following identify specific tasks which would enhance such cases.

### **Determine the groups / teams which are involved both in IPDA and IVOA**

- VO-Paris Data Center (Paris, France):  
*Baptiste Cecconi, Stéphane Erard, Pierre Le Sidaner*
- CDPP (Toulouse, France):  
*Nicolas André, Vincent Génot, Natalya Bourrel, Michel Gangloff*
- INAF (Rome, Italy):  
*Maria Teresa Capria, Marco Giardino*
- ESAC (Madrid, Spain):  
*Christophe Arviset, Pedra Osuna, Jesus Salgado*

### **Identify and contact other planetary (or solar system) science groups**

Groups that could be interested with including IVOA standards in their infrastructure (or the reverse: enhancing IVOA standards from their experience and standards):

- Geoscience and planetary surfaces (OGC-GIS standards) :
  - Angelo Pio Rossi (Jacobs Univ., Bremen, Germany)
  - Chiara Marmo (IDES, Orsay, France)
- Space Physics (SPASE standards) :
  - Todd King, Steve Joy, Joe Mafi (PDS / UCLA, USA)
  - Florian Topf (IWF, Graz, Austria)
- Solar Physics (HELIO project):
  - Jean Abouadarham (LESIA, Meudon, France)
  - Xavier Bonnin (LESIA, Meudon, France)
  - André Csillaghy (FHNW, Switzerland)
- Space mission and planetary reference frames/coordinate systems
  - Chuck Acton (NASA/NAIF)
  - Benoît Carry (IMCCE/Obs. Paris, France)

## Task 2.

### List the potential common interests for interoperability standards

#### 1. Standard List Coordinate Systems and Reference Frames

*Proposed by:* S. Erard

*Contribution by:* B. Cecconi, J. Aboudarham, C. Acton, C. Marmo, A.P. Rossi

Need for a list of standard Coordinate Systems in use for the solar System, which probably needs to be discussed with IVOA's STC. A unique ID/description would be most helpful (a first draft in preparation at VOParis and CDPP). IAU should also be approached (partially done on VO-Paris' side). SPASE team may be also involved (people from PDS/PPI in IPDA/TEG for instance), as well as the NASA/SPICE team. It should also include Solar and Heliospheric Coordinate Systems in order to be able to have a complete and unique description for the Solar System. For each coordinate system (or reference frame), list should provide unique ID, description, references, usual synonyms, as well as an operational description (either IVOA-STC, SPICE, or both?). Discussions with [IAU-WGCCRE](#) should be initiated.

*See also item 11.*

#### Proposed Action:

[AI-1.1] SPASE to provide a list of planetary coordinate systems (+definitions/references)

[AI-1.2] IPDA to provide a list of planetary coordinate systems (+definitions/references)

[AI-1.3] EPN to provide a list of planetary coordinate systems (+definitions/references)

[AI-1.4] IMPEx to provide a list of planetary coordinate systems (+definitions/references)

[AI-1.5] IPDA to merge the lists into a common list

[AI-1.6] IPDA to submit the list to IAU for evaluation and standardization

[AI-1.7] IVOA to build descriptors for each item of the standard list in STC standard.

[AI-1.8] IPDA/NAIF to build descriptors for each item of the standard list in SIPCE standard.

#### 2. Standardization of observation geometry

*Proposed by:* D. Crichton

*Contribution by:* B. Cecconi

The development of standard geometry in planetary science is a major effort within the PDS4 development teams, in coordination with the IAU. The observation geometry includes the description of the trajectory and orientation of the spacecraft, the orientation and field of view of the instrument, as well as the target geometry (distance, orientation, viewing angles such as phase, incidence, emergence...). It is planned to include part of this into the Geometry extension of PDAP. It has also been partially implemented into EPN-TAP, as query optional keywords. Discussion with IVOA STC and ObsTAP should be engaged.

*Geometry Extension of PDAP:*

[http://planetarydata.org/projects/previous-projects/copy\\_of\\_2011-2012-projects/geometry](http://planetarydata.org/projects/previous-projects/copy_of_2011-2012-projects/geometry)

**Proposed Action:**

**[AI-2.1]** IPDA and PDS4 to provide documentation for geometry observation.

**[AI-2.2]** IVOA to study how to describe / include this into STC

**3. Link with EuroPlaNet developments**

*Proposed by:* S. Erard

*Contribution by:* B. Cecconi, F. Topf

Europlanet extension of TAP (EPN-TAP) has already been presented at previous Interop meetings as well as during IPDA meetings. This protocol is proposing a “data discovery access” to resources based on simple observational criteria (such as: target name, spectral range, observation time...). The data repositories responding to such queries are providing a link (URL) to the resource(s) of interest, as defined by the request.

We propose that EPN-TAP could be endorsed by IVOA as a new standard. EPN-TAP is similar to the IVOA ObsTAP (still in draft currently), but adapted to planetary sciences. The two protocols are not in competition, but rather complementary. Interest for EPN-TAP was also expressed at the Bangalore IPDA (2012) meeting by ISRO and JAXA teams. This standard may also be endorsed by IPDA.

There is also an ongoing action in the [IMPEX](#) project to connect its resource tree with EPN-TAP. The IMPEX resource tree is using the SPASE standard. This development should be usable on any SPASE resource tree. Such a study is also ongoing on the data services produced in the course of the HELIO project

*Description of the EPN-TAP standard is provided here (draft version):*

<http://voparis-europlanet.obspm.fr/Tdocum.shtml>

Publication:

*Erard, S., B Cecconi, P. Le Sidaner, J. Berthier, F. Henry, M Molinaro, M Giardino, et al. 2014. “The EPN-TAP protocol for the Planetary Science Virtual Observatory.” Astronomy and Computing. [doi:10.1016/j.ascom.2014.07.008](https://doi.org/10.1016/j.ascom.2014.07.008).*

**Proposed Action:**

**[AI-3.1]** IPDA to study EPN-TAP as a new standard for data discovery in planetary sciences.

**[AI-3.2]** IVOA to study EPN-TAP as a new standard for data discovery in planetary sciences.

#### **4. Extension of IVOA Cone Search to moving targets**

*Proposed by:* S. Erard

*Contribution by:* B. Cecconi, M. Louys

Use cases in the planetary dynamics field show a need for an extended Cone Search including time in addition to a FoV. We want to be able to search for a moving location in sky coordinates. The implementation of this feature could be envisaged in various ways, in terms of query parameters:

1. spatio-temporal bounding box (e.g.: [Pos\_start, Radius\_start, time\_start] and [Pos\_end, Radius\_end, time\_end]);
2. time-indexed trajectory on sky (series of locations, or orbital parameters);
3. target name (and then link with orbital parameter database, like [SSODnet](#)) and a time interval.
4. series of polygon (search area) with temporal variability.

NB : Polygon search area capability is present in PostgreSQL (DaCHS implementation of TAP). Temporal dependence of polygon should be studied, but would provide very promising in planetary sciences. Search on polyhedra to be studied also.

The ObsTAP protocol should be able to provide such capability (i.e., solution 1.), when the target trajectory is linear enough on the sky. Furthermore, the Skybot service developed by IMCCE is partially addressing solution 1.

*The Cone Search protocol is described here:*

<http://www.ivoa.net/documents/latest/ConeSearch.html>

*The ObsTAP protocol is discussed here:*

<http://wiki.ivoa.net/twiki/bin/view/IVOA/ObsTap>

*Skybot service at IMCCE :*

<http://vo.imcce.fr/webservices/skybot/>

#### **Proposed action:**

**[AI-4.1]** EPN group to prepare use case documents and proposed implementation using IVOA standards.

#### **5. Standard List of Ground based Observatories**

*Proposed by:* S. Erard

*Contribution by:* B. Cecconi

Need for an extension of IAU's Minor Planets Center list of ground-based and orbital observatories, including radio facilities. Each observatory should have a unique ID to identify the origin of the data. The current list of observatories contains those which provide observations relevant to the small bodies community. It covers most of the observatories, but not all, especially many radio telescopes are not present. This does not concern directly space missions, but concerns supporting observations (for instance, ground based radio observations of Jovian radio emissions, to be compared with Voyager, Cassini, Ulysses, Galileo, Juno

observations...). The current list is available here:

<http://www.minorplanetcenter.net/iau/lists/ObsCodesF.html>

Further ideas:

- It may be useful and more consistent to distinguish between sites/ observatories and telescopes themselves. IDs such as site.tel may be helpful.
- In addition to long/lat/alt, other characteristics may be stored in the list. In particular, minimum elevation as a function of azimuth is useful to simply determine the visibility of an object at a given time.

### **Proposed actions:**

**[AI-5.1]** IVOA to propose a to IAU standard list of unique observatory identifiers combined with a list of known names and synonyms for each observatory, as well as location and contact details.

## **6. Standard List of Space based Missions**

*Proposed by:* B. Cecconi

*Contribution by:* N. André

Concerning space missions, there are several naming conventions, such as the full name used in the official archive, many nicknames, the NSSDC id, the NASA/SPICE kernel id. It would be good to have either a unique supported convention (N.B: difficult, NA), or to provide a conversion table (N.B.: more realistic, NA). The CCSDS is proposing a registry for space mission related documentation ([SANA](#)). We can approach them to evaluate if it is relevant for this topic. IPDA, SPASE, IVOA and IAU should work together to build a standard list for space missions identifiers (respectively: planetary, space physics, astronomy)

### **Proposed actions:**

**[AI-6.1]** IPDA to propose a standard list of unique spacecraft identifiers (for planetary missions) combined with a list of known names and synonyms for each spacecraft.

**[AI-6.2]** IVOA to propose a standard list of unique spacecraft identifiers (for astrophysics missions) combined with a list of known names and synonyms for each spacecraft.

**[AI-6.3]** SPASE to propose a standard list of unique spacecraft identifiers (for space physics missions) combined with a list of known names and synonyms for each spacecraft.

**[AI-6.4]** IPDA to merge the inputs and build the final standard list

## **7. Link with ESO planetary images (same with HST database or else)**

*Proposed by:* B. Cecconi

*Contribution by:* N. André, B. Carry

There are a lot of planetary images and spectra in the databases of many observatories (ESO, StSci, Keck, NASA, ...). The most common case are small bodies of our solar system in the FoV. It is very difficult to access them as no resources list the FoV in which a given solar system

object (SSO) can be found. The HST archive conducted an improvement some years ago, where all the FoV can be searched for a SSO. This is possible only if all the FoV have been previously cross-matched with the orbits of all SSO. Triggered by M. Kueppers, ESA and IMCCE did a prototype of such a database (linking FoV to SSO and vice versa) on the test case of ESA/Rosetta/OSIRIS data archive.

We can enhance the access to these data if some meta-data are present for each FoV: RA/DEC, time, size of the FoV, and limiting magnitude.

### **Proposed Action:**

**[AI-7.1]** IPDA and IVOA to contact ESA and NASA to study how enhance metadata descriptors of large observatories, in order to better describe planetary targets

## **8. Cross-matching of registries**

*Proposed by:* B. Cecconi

*Contribution by:* F. Topf, T. King, M. Louys

There is an ongoing action at PDS/PPI (Todd King, Joe Mafi, Steve Joy...) to cross-map PDS3/PDS4/SPASE registry resource descriptors. This task should be extended to IVOA VOResource and EPNresource descriptors. If successful, this project we would enable to automatically declare PDS4 resources in the SPASE and the IVOA registries, enhancing a lot the visibility of IPDA resources. This task could be done in coordination with the IMPEX team. The goal is to discover resources from various registries from the same tools (either IVOA, SPASE or PDS4). It could be implemented either in setting up real-time translation, or to publish converted resources descriptors in each registry. The IVOA situation is not very favorable, as registry harvesting and updating in the IVOA has proven to be very tricky. We have to find a solution that can be implemented with the current versions of registries.

### **Proposed Action:**

**[AI-8.1]** SPASE, PDS and IVOA to study the feasibility of basic metadata translation.

## **9. Promoting and extending SAMP (Simple Application Messaging Protocol)**

*Proposed by:* B. Cecconi

*Contribution by:* N. André, M. Louys

The SAMP protocol is a very simple and efficient way to share data between VO-aware applications or web pages. During the Europlanet studies, it was clearly identified as a key element of the future planetary science VO, and even implemented for some prototype applications (e.g., connection between the [CDPP/AMDA](#) and [TOPCAT](#) / [Aladin](#) tools) as well as within the IMPEX project. In the field of Space Plasma it is interesting to note that the SAMP protocol has been included in the ESA Cluster Final Archive with Common Data Format now being read (cf. recent developments within TOPCAT). One advantage of the SAMP protocol is that it is very easy to set up on a web page (list of examples to be given ?), and can distribute

data “blindly” (independent of their format).

SAMP allows to pass a reference on a dataset from one VO Tool to another and then delegate the metadata and/or data consumption to some dedicated tools. Heterogeneous data dealing with spectra, images, catalogs, spectra , etc. can be visualised, or used via the appropriate tool corresponding to its appropriate data product type.

Hence, it is proposed that this protocol is advertized as a first step in the VO for data providers together with the use of standard data format for data distribution. On the other side, the existing tools shall be encouraged to implement it as an input and output protocol.

There is an ongoing project at PDS (“Planetary Plasma Interactions” node), by Todd King, to implement SAMP of PPI/PDS pages to send data files to SAMP-enabled tools.

*Description of SAMP:*

<http://www.ivoa.net/documents/SAMP/index.html>

### **Proposed Action:**

**[AI-9.1]** IPDA and PDS to study the adoption of SAMP on their data distribution webpages.

## **10. Extending IVOA Data Models and Semantics to Planetary Sciences**

*Proposed by:* B. Cecconi, M. Louys

In the frame of the Europlanet project, the IVOA standards have been studied in order to use them for planetary sciences applications. Many IVOA Data Models were found to be very close to fit the needs, but a few marginal modifications are foreseen to be fully consistent with the planetary science resources. These adaptations are mainly originating from 2 facts:

- Coordinates in planetary sciences are not sky coordinates (most of the time)
- Many experiments are measuring *in situ* (i.e., not measuring photons, but physical materials in contact with the instrument)
- Measurements of emitted, reflected and transmitted light (instead of emitted and transmitted only).

Hence, there are already discussions with the IVOA semantics group (M. Louys and others) to propose an update to the UCD (Universal Content Descriptors) list, in order to adapt it, keeping in mind that we don't want any major modification, but marginal changes in definitions and scope of keywords.

*Description of IVOA UCD:*

<http://www.ivoa.net/documents/latest/UCD.html>

*Current discussion is going on on this wiki page*

<http://wiki.ivoa.net/twiki/bin/view/IVOA/PlanetaryUCD>

### **Proposed Action:**

**[AI-10.1]** IVOA to continue the inclusion of planetary science needs into their data models

**[AI-10.2]** PDS4 to study if IVOA metadata and UCDs can be integrated into the PDS4

[information model](#)

### **11. Proposing new serialization examples in IVOA standards for format used in planetary sciences**

*Proposed by:* B. Cecconi

*Contribution by:* C. Marmo, M. Louys

In IVOA documentation, serialization examples are provided as implementation guidelines for various file formats (usually: [XML](#), [FITS](#) and [VOTable](#)). Other formats are used in the planetary science community, such as [KML](#), [json](#), [CDF](#), [netCDF](#) or [HDF5](#). We propose to study serialization examples for the IVOA standards in these formats.

New formats will probably also be considered in the IVOA for the support of N-dimensional data, like HDF or others.

#### **Proposed Action:**

[\[AI-11.1\]](#) IVOA to study and propose serialization examples for those formats

[\[AI-11.2\]](#) PDS4 to study these file formats as archive formats and output formats

### **12. FITS keyword standardization for Planetary targets**

*Proposed by:* C. Marmo

*Contribution by:* A.P. Rossi

The FITS standard is not yet including planetary target specific keywords. However observations of planetary targets (images, spectra...) are generally stored in FITS. Hence, there is a need for standardization, in order to enhance interoperability. This action should be conducted in coordination with item 1. (*Standard List Coordinate Systems and Reference Frames*). This item should be coordinated with OGC standards used for planetary surfaces.

#### **Proposed Action:**

[\[AI-12.1\]](#) EPN group to propose FITS keywords extension for planetary sciences

[\[AI-12.2\]](#) IVOA to study FITS keywords additions for planetary sciences

[\[AI-12.3\]](#) PDS4 to study the FITS model and link it to PDS4 information model

### **13. Implementation of IVOA standards in MPC**

*Proposed by:* E. Solano

The [Minor Planet Center](#) is the IAU body responsible for the designation of minor bodies in the solar system as well as for the collection, computation, checking and dissemination of astrometric observations and orbits for minor planets and comets. All this information is presently provided in a large variety of formats which limits the interoperability with other services.

The implementation of already existing IVOA standards like TAP will minimize this issue and benefit the MPC data discovery and access.

**Proposed Action:**

**[AI-13.1]** MPC to implement IVOA standards

**14. Exoplanets**

*Proposed by:* B. Cecconi

There is a growing number of known exoplanets. This thematic is at the boundary between the planetary sciences and astrophysics. Hence, exoplanet data distribution shall not be solely treated as astrophysics data, but also as planetary data, in order to be able to compare the new planetary systems to ours. Note that the EPN-TAP protocol (see item 3.) is exoplanet-ready by construction.

**Proposed Action:**

**[AI-14.1]** IVOA to study inclusion of exoplanetary observations in their standard

**[AI-14.2]** IPDA to study the interaction with the exoplanetary community

**[AI-14.3]** IPDA and IVOA to contact ESA, NASA and CNES (Corot mission) to study how enhance metadata descriptors and access layers to exoplanetary observations, in order to better describe exoplanetary targets and help the comparison with solar system planets.

## Summary Table for IVOA/IPDA standards and other groups

#	Title	IPDA standards	IPDA Projects	IVOA standards	IVOA WGs	Other Groups
1.	<b><i>Standard List Coordinate Systems and Reference Frame</i></b>	PDS4	Geometry Project	STC	DaM	IAU, SPASE, IPDA, PDS4
2.	<b><i>Standardization of observation geometry</i></b>	PDS4	Geometry Project	STC, ObsTAP	DAL, DaM	IAU, IPDA, NAIF, PDS4
3.	<b><i>Link with EuroPlaNet developments</i></b>	none yet	none yet	TAP, SAMP, ObsTAP, VOTable, Obscore	DAL, App, DaM	SPASE
4.	<b><i>Extension of IVOA Cone Search to moving targets</i></b>			ConeSearch	DAL	
5.	<b><i>Standard List of Ground based Observatories</i></b>	PDS4	PDS4 Implementation Project	ivo-id	Semantics, ReR	IPDA
6.	<b><i>Standard List of Space based Missions</i></b>	PDS4	PDS4 Implementation Project	ivo-id	Semantics, ReR	SPASE, PDS, NAIF, NSSDC, IPDA
7.	<b><i>Link with ESO planetary images (same with HST database or else)</i></b>			ObsTAP	DAL	ESO, HST...
8.	<b><i>Cross-matching of registries</i></b>	PDS4	PDS4 Registry and Search Project	ivo-id, VOResource	ReR	PDS, SPASE, IPDA
9.	<b><i>Promoting and extending SAMP</i></b>			SAMP	App	SPASE, PDS
10.	<b><i>Extending IVOA Data Models and Semantics to Planetary Sciences</i></b>	PDS4	PDS4 Implementation Project	UCD, VOResource, Characterization, STC, SpectrumD M...	DaM, ReR, Semantics	IPDA, IVOA
11.	<b><i>Proposing new</i></b>	PDS4	PDS4 Implement		DAL, DaM	SPASE, PDS

	<i>serialization examples in IVOA standards for format used in planetary sciences</i>		ation Project			
12.	<i>FITS keyword standardization for Planetary targets</i>	PDS4	PDS4 Implementation Project	FITS, STC	DAL, DaM	IPDA
13.	<i>Implementation of IVOA standards in MPC</i>			VOTable, ObsTAP, ConeSearch,	App, DAL	IAU
14.	<i>Exoplanets</i>	none yet	none yet	ObsTAP, STC...	DAL, DaM	EPN, PDS

## Preliminary List for proposed actions

- [AI-1.1] SPASE to provide a list of planetary coordinate systems (+definitions/references)
- [AI-1.2] IPDA to provide a list of planetary coordinate systems (+definitions/references)
- [AI-1.3] EPN to provide a list of planetary coordinate systems (+definitions/references)
- [AI-1.4] IMPEX to provide a list of planetary coordinate systems (+definitions/references)
- [AI-1.5] IPDA to merge the lists into a common list
- [AI-1.6] IPDA to submit the list to IAU for evaluation and standardization
- [AI-1.7] IVOA to build descriptors for each item of the standard list in STC standard.
- [AI-1.8] IPDA/NAIF to build descriptors for each item of the standard list in SIPCE standard.
  
- [AI-2.1] IPDA and PDS4 to provide documentation for geometry observation.
- [AI-2.2] IVOA to study how to describe / include this into STC
  
- [AI-3.1] IPDA to study EPN-TAP as a new standard for data discovery in planetary sciences.
- [AI-3.2] IVOA to study EPN-TAP as a new standard for data discovery in planetary sciences.
  
- [AI-4.1] EPN group to prepare use case documents and proposed implementation using IVOA standards.
  
- [AI-5.1] IVOA to propose to IAU a standard list of unique observatory identifiers combined with a list of known names and synonyms for each observatory, as well as location and contact details.
  
- [AI-6.1] IPDA to propose a standard list of unique spacecraft identifiers (for planetary missions) combined with a list of known names and synonyms for each spacecraft.
- [AI-6.2] IVOA to propose a standard list of unique spacecraft identifiers (for astrophysics missions) combined with a list of known names and synonyms for each spacecraft.
- [AI-6.3] SPASE to propose a standard list of unique spacecraft identifiers (for space physics missions) combined with a list of known names and synonyms for each spacecraft.

- [AI-6.4]** IPDA to merge the inputs and build the final standard list
- [AI-7.1]** IPDA and IVOA to contact ESA and NASA to study how enhance metadata descriptors of large observatories, in order to better describe planetary targets
- [AI-8.1]** SPASE, PDS and IVOA to study the feasibility of basic metadata translation.
- [AI-9.1]** IPDA and PDS to study the adoption of SAMP on their data distribution webpages.
- [AI-10.1]** IVOA to continue the inclusion of planetary science needs into their data models
- [AI-10.2]** PDS4 to study if IVOA metadata and UCDS can be integrated into the PDS4 information model
- [AI-11.1]** IVOA to study and propose serialization examples for those formats
- [AI-11.2]** PDS4 to study these files formats as archive formats and output formats
- [AI-12.1]** EPN group to propose FITS keywords extension for planetary sciences
- [AI-12.2]** IVOA to study FITS keywords additions for planetary sciences
- [AI-12.3]** PDS4 to study the FITS model and link it to PDS4 information model
- [AI-13.1]** MPC to implement IVOA standards
- [AI-14.1]** IVOA to study inclusion of exoplanetary observations in their standard
- [AI-14.2]** IPDA to study the interaction with the exoplanetary community
- [AI-14.3]** IPDA and IVOA to contact ESA, NASA and CNES (Corot mission) to study how enhance metadata descriptors and access layers to exoplanetary observations, in order to better describe exoplanetary targets and help the comparison with solar system planets.

## **List of actions selected by IPDA for 2015**

- [AI-3.1]** IPDA to study EPN-TAP as a new standard for data discovery in planetary sciences.
- [AI-6.1]** IPDA to propose a standard list of unique spacecraft identifiers (for planetary missions) combined with a list of known names and synonyms for each spacecraft.