IPDA Planetary Data Access Protocol (PDAP); an effort to share planetary scientific data

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ABSTRACT

The IPDA (International Planetary Data Alliance) has among its objective to allow the interoperability and interchange of planetary scientific data among the planetary community. Using the PDS (Planetary Data Standard) as a common language and the experience of other VOs from the technical point of view, a new interchange protocol has been created.

The PDAP (Planetary Data Access Protocol) is a basic two step protocol designed and evolved by IPDA technical experts from different IPDA organization members (ESA/PSA, NASA/PDS, JAXA, etc)

The two steps performed when executing the protocol are the following:

Step 1: Metadata Access

Step 2: Data Access

In the first step, the archive is asked for the metadata pertaining to the data that obey a certain restriction in the input parameters. Among the compulsory output parameters of this metadata is a reference to the real file holding data. This allows for the second step of the protocol to be executed, as the data are readily made available through the declared link.

In this contribution, we will describe the protocol, implementations (both server and clients) and current and future evolution efforts.

Keywords: IPDA, PDAP, PDS, PSA, Planetary, Protocol

INTRODUCTION

The *International Planetary Data Alliance* (IPDA) [2][3] is an international effort focused on the development and collaboration of standards for data archiving and promotion of interoperability among planetary science data archive systems in order to share scientific results returned from exploration of the solar system.

Initially, it was created to allow other institutions than ESA/NASA to share their Planetary Data. This effort was transformed in a global effort by the creation of the aforementioned IPDA that includes the

main planetary data providers (ESA/PSA[5], NASA/PDS [6], JAXA [7], etc). This organization is opened to new members.

One of the main objectives of IPDA was to ensure interoperability promoting standards like PDAP (Planetary Data Access Protocol) to be described in present paper.

PLANETARY DATA ACCESS PROTOCOL (PDAP)

One of the main deliverables from the IPDA has been the creation of a protocol designed to interchange planetary data and to guarantee interoperability among their members. This procotol is called PDAP (Planetary Data Access Protocol) [1]

The protocol concept was born at the ESA/PSA and NASA/PDS Technical Interoperability Meeting, held January 10-12, 2006 in Madrid Spain. Today, other IPDA members are collaborating in the definition and refinement of the protocol, like JAXA technical experts among others.

PDAP is a simple HTTP based protocol. The protocol accepts HTTP GET/POST operations and it is based in a <service URL> for the PDAP server and a set of keyword=value to define the query constraints.

The protocol characteristics can be summarized as follows:

- PDAP is a two steps protocol:
    - Metadata Access: Software Clients search for available data that match certain criteria. The matching criteria includes specific protocol metadata and PDS keywords
    - Data Retrieval: Software client retrieve through a synchronous HTTP GET/POST request using a reference URL returned from first step
- Different granularity levels: RESOURCE_CLASS (DATA_SET, PRODUCT, IMAGE,..)
- Data Set or Product specific PDS keywords: INSTRUMENT_TYPE, INSTRUMENT_NAME, TARGET_TYPE, TARGET_NAME, MISSION_NAME,…etc
- Time Constraints: START_TIME, END_TIME and geometrical constraints
- Different response output: RETURN_TYPE (VOTABLE, HTML, ASCII)
- Input fields could have different meaning at different granularity levels
- RESOURCE_CLASS=METADATA gives service capabilities

The PDAP protocol is very basic in nature: few input/output parameters are required, making the protocol very flexible and open. This flexibility allows the handling of as different data types as images, spectra, plasma information, atmospheric information, etc.

LINKS TO VO FOR ASTRONOMY AND OTHER VOs

The PDAP protocol is quite close to other VO interoperability protocols like IVOA's SIAP [3], to prevent deviation and to facilitate future interoperability between planetary and astronomical data. This would be especially important for some science use cases like, e.g., to make use of planetary images from both ground telescopes and Solar System missions.

IPDA and IVOA organizations maintain synergy between projects and IPDA was presented during a special session during IVOA interop meeting at Trieste.

Protocols created are close enough to be interoperable in the future by general clients but they contain specific planetary characteristics.

- Use of VOTable and Simple protocols concept for PDAP
- Not need of specific data models or dictionary (semantics) from scratch. Use of *Planetary Data System* (PDS) [4] Data Model.
- Use of PDS [4] keywords

That means PDAP try to use the best of both worlds; knowledge of planetary data from planetary community and the experience in interoperability from other VOs.

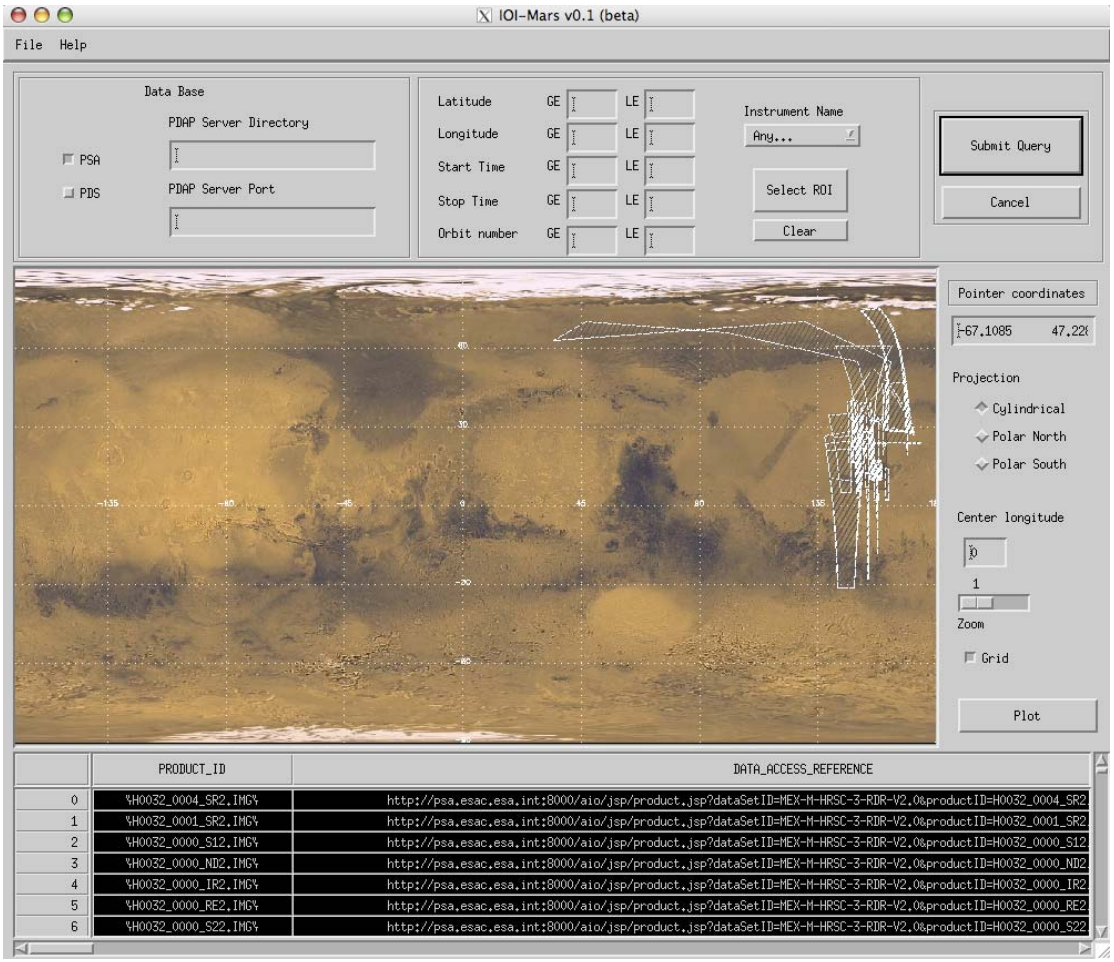
PDAP Implementations

There are already different PDAP implementations already in place from PDS, PSA and JAXA data resources.

PSA Mars Map client: Geometrical searches for PDS/PSA products

In this use case, two different PDAP servers (one at NASA/PDS and one at ESA/PSA) were created on datasets that contains Mars Map projected data. At the same time, a client prototype was created by ESA/PSA members to query and display the results from the servers.

The PDAP servers accept geometrical queries and they contain in the response products (PDS format both for the metadata keywords and the data contain) and a footprint associated to every product.



Both servers receive same query and return VOTable responses.

The geometrical queries are constrained using a box range in longitude and latitude as follows:

http://<serviceURL>?RESOURCE_CLASS=IMAGE&TARGET_NAME=MARS&LATITUDE=19.0/19.1&LONGITUDE=225.8/225.9

The footprints are defined as a set of polygons, circles or ellipses, e.g.,

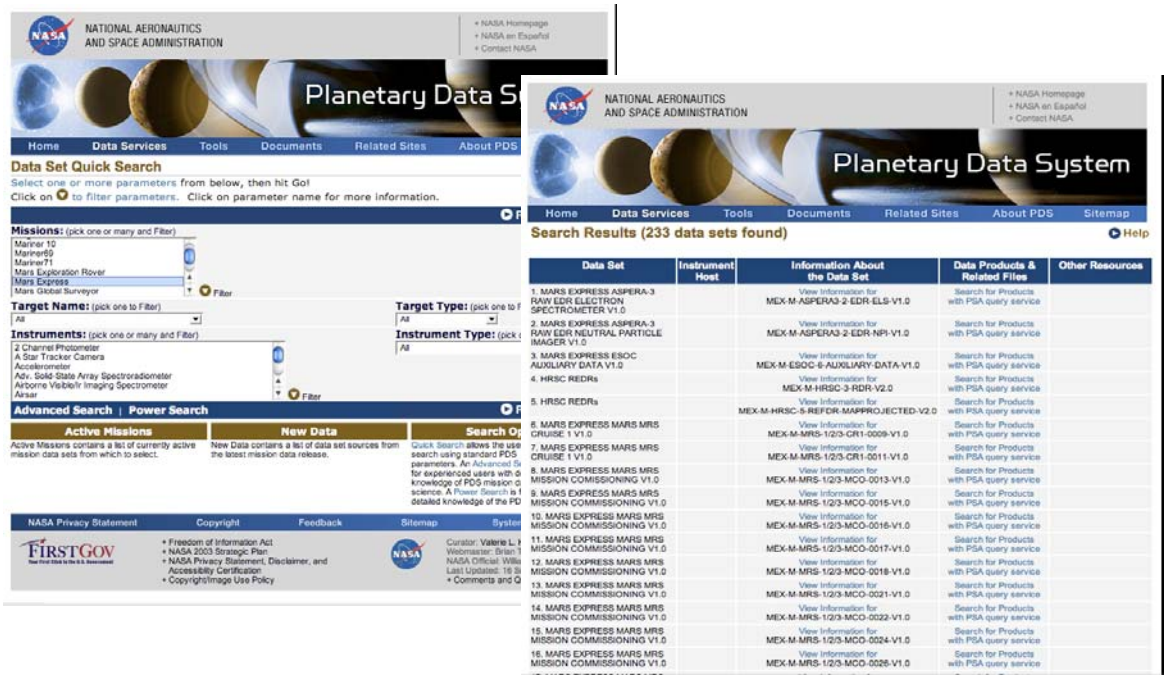
POLYGON(LON_1:LAT_1,LON_2:LAT_2,….,LON_n:LAT_n)

For a formal description of footprint definitions and "IMAGE" RESOURCE_CLASS details, please review protocol specification.

PDS OODT/PDAP Client

A second client/server implementation was done also in coordination between NASA PDS/ESA PSA technicians. Using a transformation layer, a standard NASA/PDS client was adapted to connect to PSA datasets by using the PDAP interface.

Datasets are shown in PDS pages using PDAP interface in a way transparent for the final user.



Hayabusa and Selene JAXA Services

During last year, JAXA technicians have developed PDAP services (not public yet) on Hayabusa and Selene data. From this effort, a significant feedback to PDAP specification has been received. In particular, a extension to cover images of non-map-projected data has been analyzed, discussed and it will be added to the PDAP specification very soon.

VEX (Venus express) Interoperability

As per agreement between NASA and ESA, Venus Express Mission [8] data should be shared between both organizations but the location of the data (ESA) must be preserved. In order to fulfill this requirement, a extension at file level of PDAP has been implemented.

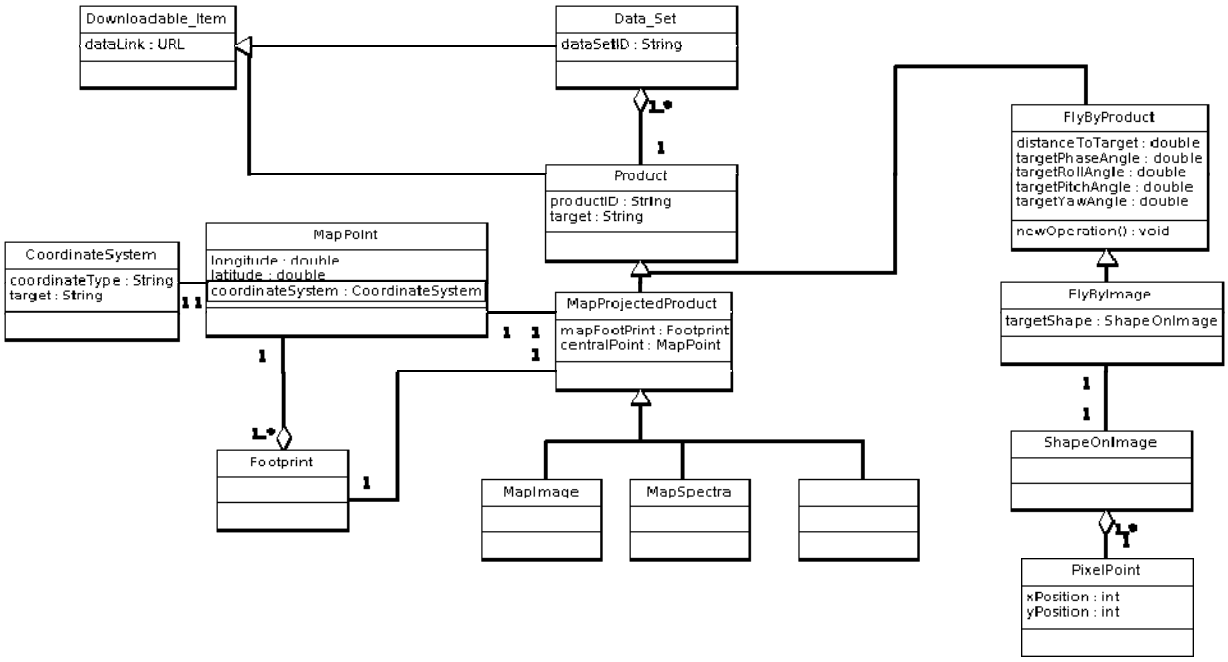
All available VEX data is currently offered by ESA/PSA in PDAP format. A client wrapper implementation has been developed at PDS Atmospheres Node to provide access from PDS node pages, but making PDAP calls behind to the PSA PDAP server.

FUTURE EVOLUTION

Currently, the following issues are under discussion to incorporate them to the PDAP specification, within the context of the IPDA Technical Experts Group:

- **Non-map projected data:**

During Hayabusa PDAP implementation, issues were found to define PDAP service for non-map projected data. UML model created to identify possible approach in the protocol. Possible approach at protocol level also discussed and solutions have been prototyped.



- **Free query:**

One of the more demanded extensions of PDAP has been the definition of a free query syntax that allows clients to query PDAP servers in a more flexible way, by the definition of a query language to limit/select the returned fields and to allow more flexible query conditions extending the parameter=value concept of the current PDAP.

- **Pagination:**

Number or records to be included in the PDAP response and input parameters (FROM record TO record).

- **Asynchronous jobs:**

This could be especially useful for data access requests that require a long process to be generated. Full download of entire dataset, level 2 data on-the-fly generated, etc

- **User credentials:**

Useful to provide access to proprietary data but also to have control of the archive use

CONCLUSIONS

IPDA is an independent organization created by and for the planetary community and intends to support, share knowledge and solve issues within the planetary community.

Main organizations with planetary data are already represented and it is open to new ones.

One of the main to be solved within IPDA is to ensure the proper interoperability among the different organization members.

PDAP is the first specification created to fulfill this need. It is a simple HTTP based protocol, close to other VOs protocols and Map Server-like services that allows the interchange of datasets and products in PDS format.

Different PDAP servers and clients have been implemented of the working draft version and the protocol is evolving to get the IPDA Recommendation status.

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