

Planetary Science Resources Data Model

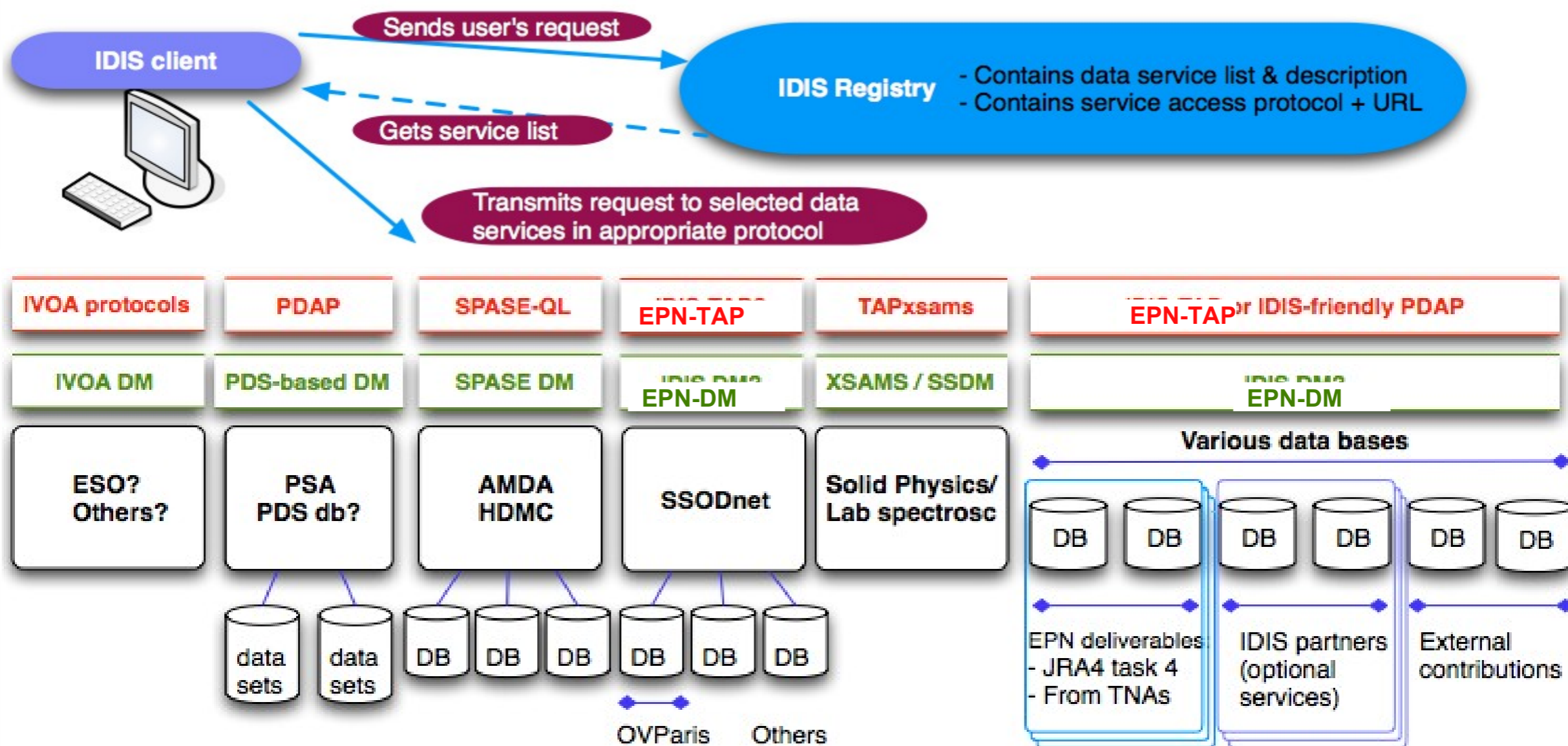
B. Cecconi and many people from the Europlanet-IDIS project

Nov 6, 2012. IDIS Meeting, Vienna, Austria.

Context

- Europlanet/IDIS: prototyping a Planetary Sciences VO
- Several of science thematics: atmospheres, surfaces, interiors, small bodies, orbital parameters, in situ exploration, plasma (waves, particle and fields), radio astronomy...
- Large variety of data types: images, spectra, times series, movies, dynamic spectra, profiles, maps...
- Even larger variety of physical parameters
- Including: remote data, in-situ data, models, lab experiments, field analogs

Architecture



Existing Models and Protocols for Planetary Sciences ?

- IPDA (International Planetary Data Alliance):
 - close to PDS4 (new version of NASA Planetary Data System, based on XML and on interoperable standards)
 - PDAP (Planetary Data Access Protocol)
 - => Archive-oriented format and access protocol

- IVOA (International Virtual Observatory Alliance):
 - Many data models (Characterisation, VOResource, VODataService, Space Time Coordinates...)
 - TAP (Table Access Protocol): generic protocol for accessing tabular data
 - Existing Registry

- - SAMP (Simple Application Messaging Protocol):
 - => Generic models and protocols using sky-coordinates

- VAMDC (Virtual Atomic and Molecular Data Centre)
 - XSAMS: XML Schema for Atomic, Molecular and Solid Data

- HDMC (Heliophysics Data and Model Consortium):
 - SPASE (Space Physics Archive Search and Extract): Data model and query language

- OGC-GIS (Open Geospatial Consortium):
 - not assessed yet...

Data Model Required Metadata

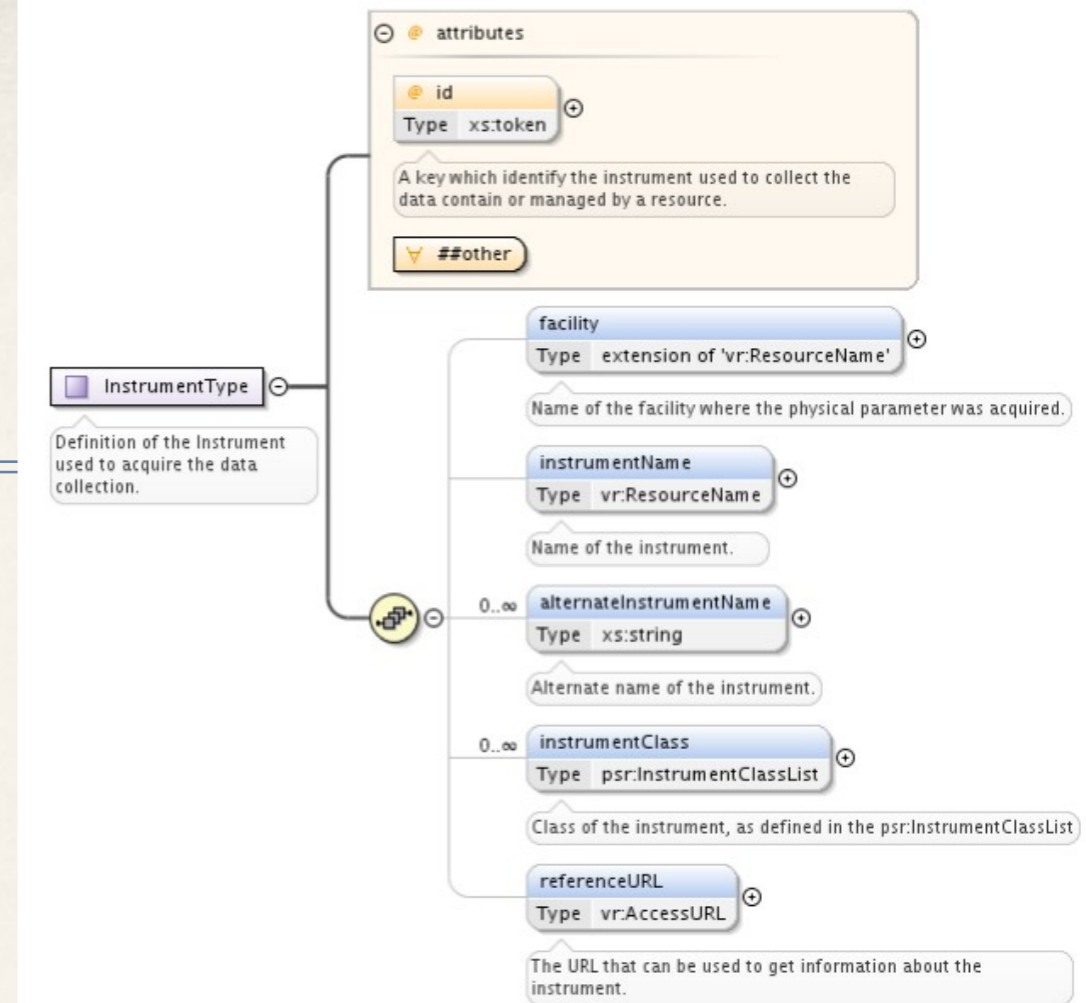
- We describe Datasets and Granules (i.e., product, file, or the smallest granularity distributed by the service) content, not the access to the data.
 - Resource identification
 - Target
 - Instrument (including hosting facility)
 - Axis (including bounds, resolution, sampling, unit)
 - Physical parameter (including UCD, unit)

Data Model Heritage

- IDIS-DM v1 was build almost from scratch. Simple but restricted and not compatible with IVOA (especially registries).
- IDIS-DM v2, now called Europlanet (EPN)-DM, is based on VOResource, VODataService and VODataCollection. It makes use of several other IVOA data models, such as STC, Utypes, UCDs...
- Units: specific EPN-Unit data model (inspired by Osuna&Salgado 2008)
- We planned to use ObsCoreDM at some point, but not done in curent implementation (I couldn't find an official XML schema for validation).
- Latest version (not final) of documentation is available here:
<http://voparis-europlanet.obspm.fr/docs/PlanetaryScienceResource>

DM Details Instrument

- We define here the measurement device by
 - its name; name used in official archive is recommended
 - its class; from a (long) list of instrument classes
- Optionally, alternate names can be provided.
- We can also describe the facility hosting the instrument by
 - its name; the name used in official archive is recommended
 - its class; Spacecraft, Ground Based Telescope, Simulation, Laboratory, Field analog...
- Each instrument must have an instrument-id so that can be referred to internally.



DM Details Target

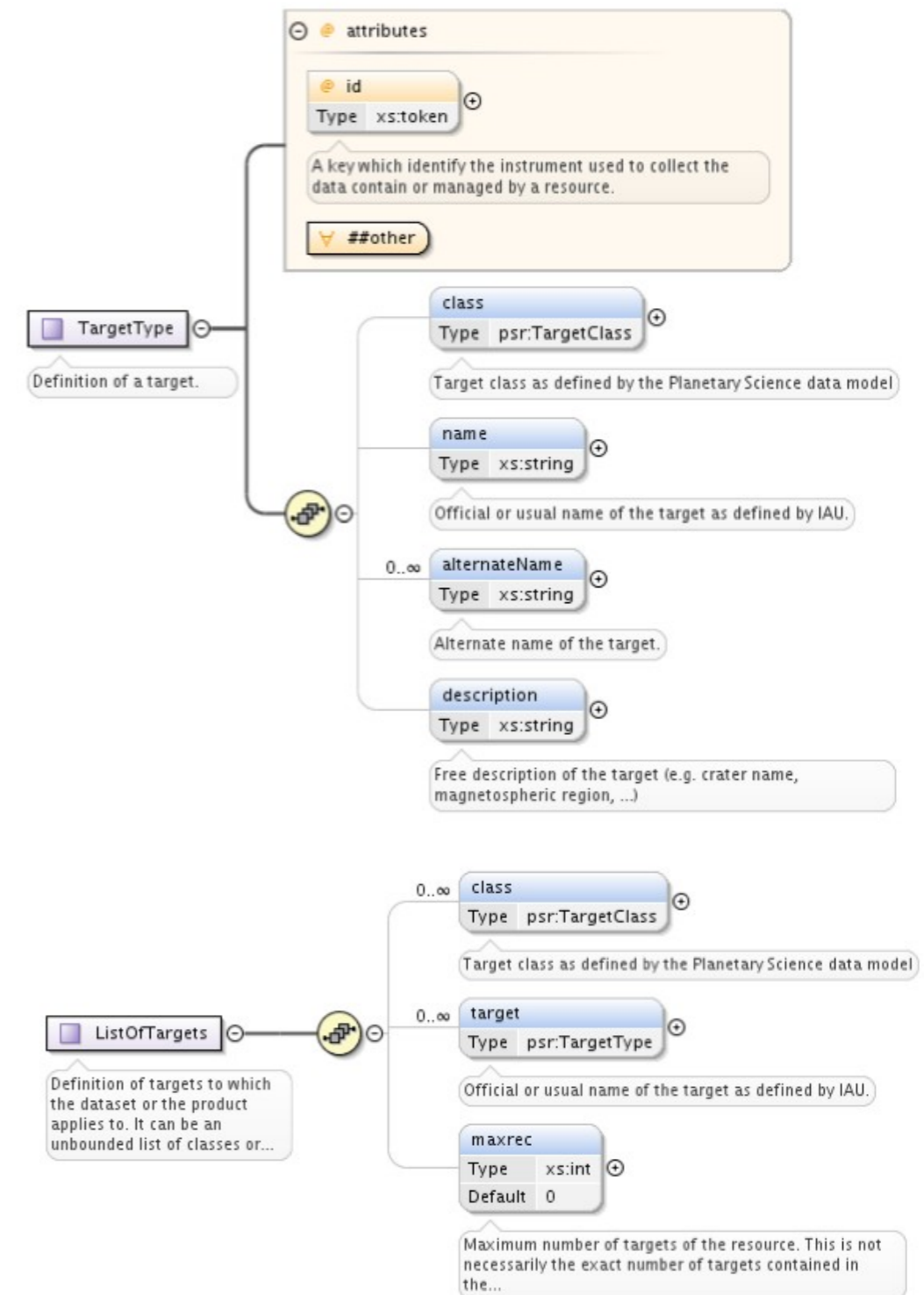
- We define here the observation target
 - its name; IAU name is recommended
 - its class; from a list of target classes

- Flexible:
 - Target Class only is allowed
 - List of Targets

- Alternate names.

- Description field: free text to describe in more details what is observed.

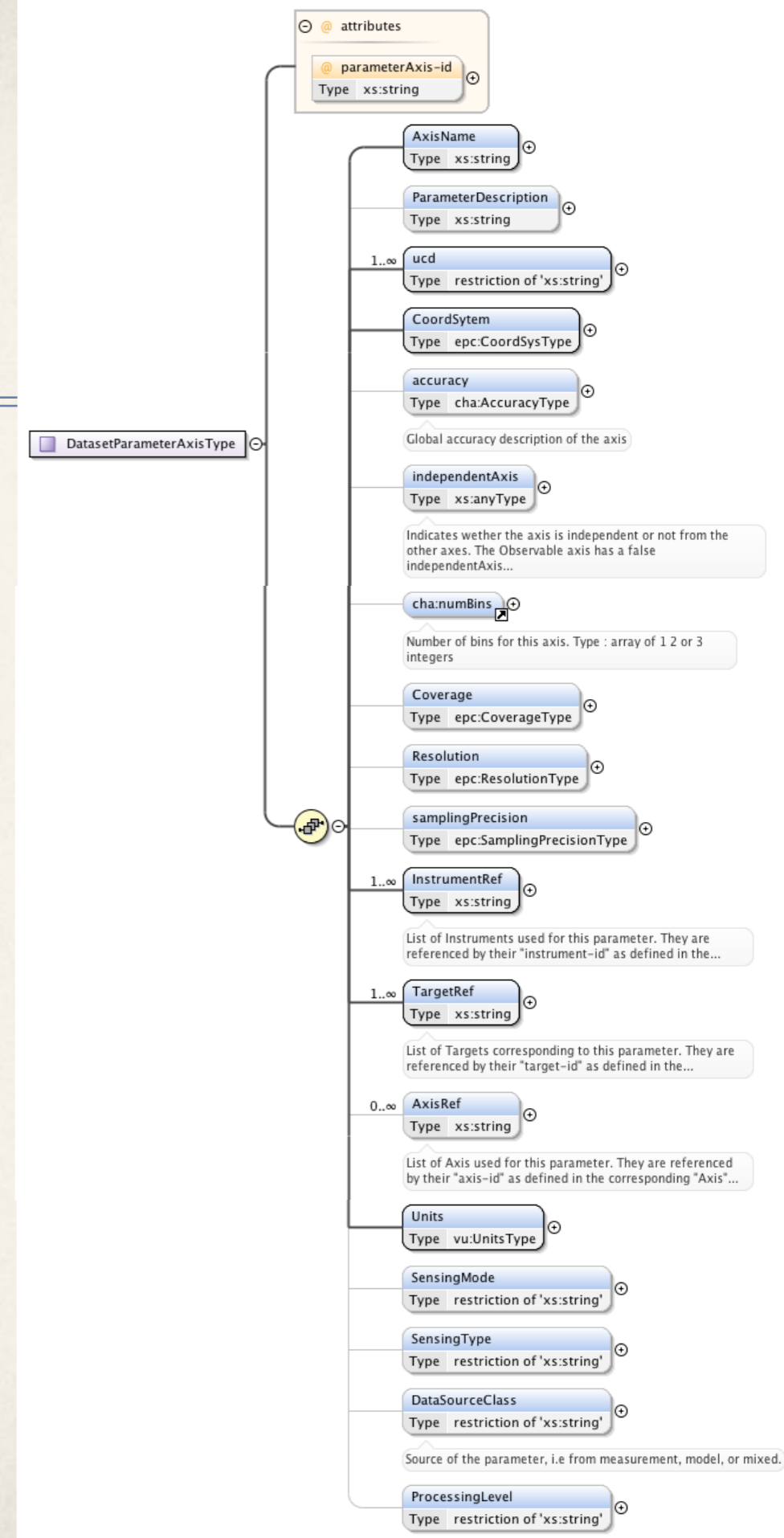
- Each target must have a target-id so that can be referred to internally.



DM Details

Parameter Axis

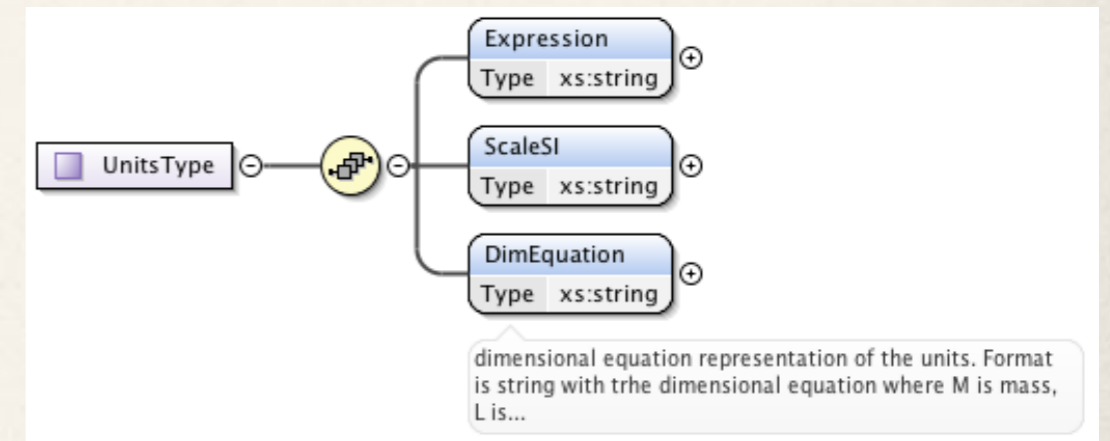
- Extension of CharaterizationDM
- Main Additions:
 - InstrumentRef, TargetRef, AxisRef
 - Units (modified)
 - SensingMode (active/passive)
 - SensingType (remote/in-situ)
 - DataSourceClass (measurement/model/mixed)
 - ProcessingLevel (list: raw, calibrated...)
 - Description field
- Axis type:
 - Abscissa axis: independentAxis «true»
 - Ordinate axis: independentAxis «false» + AxisRef
- Each axis must have an axis-id so that can be referred to internally.



DM Details

Coordinates

- Modified STC to include EPN-Units (following Osuna&Salgado 2008)



- Additional Frames for in-situ particle measurement (charge, mass, mass per charge...)
- Open questions:
 - provide list of well defined planetary reference frames ? (centered on planetary bodies, on spacecraft; equatorial, ecliptic, magnetic frames...)
 - back to VOUnits ?

DM Details

Data product type

- The data product type describes the high level scientific organization of the data product being considered. The list of product values is:
 - **Image**: associated scalar fields with two spatial axes, e.g. image with multiple color planes, from multichannel cameras for example.
 - **Spectrum**: data product for which the spectral coverage is the primary attribute, e.g. a set of spectra
 - **DynamicSpectrum**: consecutive spectral measurements through time, organized as a time series.
 - **SpectralCube**: set of spectral measurements with 1D or 2D spatial coverage, e. g. imaging spectroscopy. The choice between Image and Spectral_cube is related to the characteristics of the instrument
 - **Profile**: scalar or vectorized measurements along one spatial dimension, e.g. atmospheric profiles, atmospheric paths, sub-surface profiles, etc.
 - **Volume**: any measurement with three spatial dimensions
 - **Movie**: set of chronological 2D spatial measurements
 - **Cube**: multidimensional data with three or more axes, e.g. all that is not described by other 3D data types such as spectral cubes
 - **TimeSeries**: measurements organized primarily as a function of time (with exception of dynamical spectra). A light curve is a typical example of a time series dataset.
 - **Catalogue**: it can be a list of events, a catalog of object parameters, a list of feature, ..., e.g. list of asteroid properties
 - **SpatialVector**: list of summit coordinates defining a vector, e.g. vector information from GIS, spatial footprints, ...

Details

Other

- `<content>` :
from IAU Thesaurus
=> move to IVOAT ? (IVOA Thesaurus)
- `<coverage>` :
ok for time and space, but not for spectral domain (only list of bands)
- `<ucd>` :
new items to be proposed to cover planetary science data (especially for in-situ data)
=> ongoing, next Interop?

Discussion

- Under testing phase. Minor modifications (especially completion of predefined lists).
- No big changes in : Europlanet project ends at the end of 2012. Further changes will be done.
- Used for EPN-TAP at VOParis and PDAP implementation at CDPP.
- Possible use for heliophysics.
- Future version use closer to ObsCoreDM ?

TAPcore DataModel

- Restriction/Adaptation of EPN-DM, Data Model for EPN-TAP: «TAPcore data model»
- EPNCore 19 mandatory keywords:
 - resource_type: 'dataset' or 'granule'
 - dataproduct_type: described before
 - target_name, target_class
 - time keywords: time_min, time_max, time_exp_min, time_exp_max, time_sampling_step_min, time_sampling_step_max)
 - spectral keywords: spectral_range_min, spectral_range_max, spectral_resolution_min, spectral_resolution_max, spectral_sampling_step_min, spectral_sampling_step_max
 - spatial keywords: spatial_frame_type ('celestial', 'body', 'cartesian', 'cylindrical', 'spherical'), c1_min, c2_min, c3_min, c1_max, c2_max, c3_max, c1_resol_min, c2_resol_min, c3_resol_min, c1_resol_max, c2_resol_max, c3_resol_max
 - observation geometry keywords: incidence_angle, emergence_angle, phase_angle
 - instrument keywords: instrument_host_name, instrument_name
 - measurement keyword: measurement_type (UCDs)
- EPNResponse contains the description of the response of an EPN-TAP service.
- Technical documentation available here:
<http://vo-paris-europlanet.obspm.fr/xml/TAPCore/doc/html/>

TAPcore DataModel

- EPNCore extra keywords:

- Build for services

- **index** to use between client and server and datalink
 - **DatasetID** to relate granule to dataset

- Use of optional parameters

- **species**: chemical species
 - **Particle SpectralType**: used by plasma
 - **Particle SpectralSamplingStep**: used by plasma
 - **Particle SpectralResolution**: used by plasma

- Service return

- **processing_level** : from pre define list
 - **preview_url** : useful for client visualization

- Technical documentation available here:

- <http://voparis-europlanet.obspm.fr/xml/TAPCore/doc/html/>
 - http://voparis-europlanet.obspm.fr/docs/EPN_TAPV_0.34.pdf