EPN-TAP and EPNcore v2.0

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EPN-TAP / Motivation

- Europlanet EU programme(s): consistent access to Solar System data (including derived data)? VO framework seemed appropriate. Scope = Planetary Science, Heliophysics, exoplanets

- Difficulties:
  - Moving objects / targets, seldom clearly identified in existing archives
  - Targets are resolved: many coordinate systems - related to targets or configurations
  - More diverse types of measurements:
    - Not only light, but also particles, fields + lab samples

- TAP is adapted to searches in catalogues (one of the main expected usages)
- ObsCore provides similar concepts for general parameters
  - Missing vocabulary to name observing and configuration parameters
    - but this exists to some extent in PDS (space archives) and SPASE (plasma related)
- Missing UCDs for reflected light, in-situ and sample measurements

EPN-TAP = Usual TAP mechanism
  - EPNCore vocabulary + associated UCDs
  - Set of rules related to services and tables
EPN-TAP status

- First published in Astronomy and Computing (Erard et al 2014) — v1.0
- Proto-version 2.0 presented by Baptiste Cecconi at Interop 2015, Sesto
- **Mature v2.0 recently submitted as a Working Draft to DAL WG**
  This relies on publication of 55 data services worldwide (~ 20 teams) and is now mature
- All existing services are in v2.0, being reviewed and updated to latest version
- Validator in place at VOParis (PADC) (P. Le Sidaner, Interop 2015): TAP validation using TAPLINT, includes check on EPNcore keywords/ucd/units
- Preliminary EPN-TAP2 mixin in DaCHS (to be reviewed and completed)
## Europlanet VESPA: Data services connected via EPN-TAP / field

### Atmospheres
- Titan profiles - CIRS (Cassini, LESIA)
  - CIRS (ground based spectroscopy, IMCCE)
  - 1P/Halley spectroscopy - IKS / Vega-1, LESIA
  - BaseCom - Nançay Obs, LESIA
  - TNOs are cool - (Herschel & Spitzer + compilation, LESIA & LAM & Utinam)
  - SBNAF - (from H2020 prog, Konkoly Obs)
  - Cometary lines catalogue (IAPS)
  - Vesta & Ceres spectroscopy - VIR/DAWN (IAPS)
  - DynAstVO: NEO refined parameters (IMCCE)
  - M4ast: Small bodies orbital cat (MPC/Heidelberg)
    - Rosetta ground-based support
    - 67P illumination config (IRAP)
  - Meteor_showers predictions (IMCCE)
  - Occultations predictions, ast & sat (IMCCE)
  - LuckyStar, occultations (ERC prog, LESIA)
  - Natural satellites db (IMCCE)

### Small bodies
- SSHADE ices & minerals spectro (IPAG & network)
  - Planetary Spectral Library (DLR)
- PDS spectral library (LESIA)
- Berlin Reflectance Spectral Lib (DLR)
- Hoserlab (Winnipeg U)

### Surfaces
- CRISM WCS service (MRO, Jacobs U)
  - M4ast (ground based spectroscopy, IMCCE)
  - 1P/Halley spectroscopy - IKS / Vega-1, LESIA
  - BaseCom - Nançay Obs, LESIA
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### Magnetospheres / radio
- M3 WMS service (Chandrayaan-1, Jacobs U)
  - CRISM WCS service (MRO, Jacobs U)
  - Mars craters (Jacobs U, + update by GEOPS)
- USGS planetary maps WMS (Jacobs U)
  - Mars craters (Jacobs U, + update by GEOPS)
- HRSC nadir images, WMS (MEx, Frei Univ)
  - M3 WMS service (Chandrayaan-1, Jacobs U)
- OMEGA cubes and maps (MEx, IAS)
  - VIMS satellites, w/geometry (Cassini, LPG)
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  - MarsSIS GIS (Lyon)
  - Global spectral param of Mercury (DLR)

### Solar
- HELIO AR & 1T3 solar features (from FP7 prog, LESIA)
  - Bass2000 (LESIA)
  - Radio Solar db (Nançay, LESIA)
  - CLIMSO (Pic du Midi, IRAP)
  - IPRT/AMATERAS (Tohoku Univ, Jap)
  - Gaia-DEM (SDO, IAS)
  - e-Callisto (Windisch, Sw)

### Generic / interdisciplinary
- BDIP (LESIA)
  - BDIP (LESIA)
  - PVOL (UPV/EHU & amateur network)
  - Telescopic planetary spectra collection (LESIA)
  - PSA complete archive (ESA)
  - HST planetary data (LESIA, to CADC archive)
    - Catalogues of planetary maps (Budapest)
  - Vizier catalogues in Planetary Science (CDS)
    - Gas absorption cross-sections (Granada)
  - NASA dust catalogue (IAPS)
    - Stellar spectra, support for observations & expl. (LESIA)
  - DARTS (JAXA - currently via PDAP)
    - Herschel planetary data (ESA)
      - Interface with VAMDC (TBD)

### Exoplanets
- Encyclopedia of exoplanets (compilation, LUTH/LESIA)
  - Catalogue of exo disks (LESIA)
  - Interface with DACE (Geneva)
  - ARTECS climate simulations (AOTS/INAF)
  - Atmospheric studies (UCL)
  - surface simulations (GEOPS)
EPN-TAP rules

Tables

• One table / service (similar to ObsCore) - called <service>.epn_core
• One product / row (= “granule”) - associated thumbnail is allowed and recommended
• Products can be sets of scalar in the table, or provided through a unique URL: either files or web services
• Related products, especially docs, can be associated with datalink

Parameters

• Most parameters appear as pair of min/max values and both must be provided in all cases
  (=> search intersections of coverages)
• Multivalued parameters are provided as #-separated lists
• Some parameter values must be taken from predefined lists
EPNCore design

- Mandatory parameters allow simultaneous search in all services on basic quantities (e.g. in VESPA portal)
  
  e.g.: target, time, location, spectral range, illumination, instrument, data type, IDs, references…
  
  measurement_type: identifies physical quantity through UCD

- Other, optional parameters belong to various categories:
  
  - common ones: file name & url, bib reference, filter, extra time scales…
  
  - sets of more specialized parameters are defined as topical extensions: maps, lab spectroscopy, particles…
  
  - extensions are only related to the definition process. These parameters are free to use whenever relevant
  
  - extra parameters can be defined / included in a service when nothing fits

Currently ~ 180 parameters in EPNCore

The main parameters are listed in the next slides, as an introduction to the vocabulary
EPNcore — Resource

(EPN-TAP parameter - optional in blue)

- **service_title:**
  full name of resource / schema name

- **creation/ modification/ release/ _date:**
  required for mirrors & proprietary periods

- **publisher:**
  Publisher from VOResource

- **bib_reference:**
  publication related to granule

- **processing_level:**
  can adapt to existing nomenclature
  default is to use CODMAC levels (PDS3)

(equivalent in ObsCore)

- **obs_title**

- **obs_creation_date**

- **publisher_id**

- **bib_reference**

- **calib_level**
  not the same definition/values
EPNcore — Product

(EPN-TAP parameter)

- **granule_uid**: unique id for granule in service = 1 granule per row
- **obs_id**: original observation id, to cross-reference granules with various processing, but from the same original observation
- **granule_gid**: granule group id for granules that have same processing, coordinate system, etc, to cross-reference granules with comparable processing
- **dataproduct_type**: predefined list: **im** (image), **ma** (map), **pr** (profile), **sp** (spectrum), **ds** (dynamic spectrum), **sc** (spectral cube), **vo** (volume), **mo** (movie), **cu** (cube), **ts** (time series), **ca** (catalogue), **ci** (catalogue item), **sv** (spatial vector), **ev** (event)
- **instrument_host_name**: spacecraft of observatory name (archive names recommended)
- **instrument_name**: name of instrument (archive names recommended)
- **measurement_type**: ucd - allows searching by physical quantity

(equivalent in ObsCore)

- **obs_publisher_did?** definition are alike
- **obs_id** same definition
- **obs_collection?** very similar definition
- **dataproduct_type** predefined list: **image**, **cube**, **spectrum**, **sed**, **timeseries**, **visibility**, or **event**. **same name, but not the same list!**
- **facility_name** from VODataservice (but no constraints)
- **instrument_name**
- **o_ucd**
EPNcore — Target

- **target_name:**
  Solar System target(s) or exoplanet name from IAU standard lists or sample / meteorite name or ID

- **target_class:**
  predefined list:
  *planet*, *satellite*, *dwarf_planet*, *asteroid*, *comet*, *exoplanet*, *sample*, *sky*, *star*,
  *interplanetary_medium*, *calibration*, *spacecraft*, *spacejunk*

- **alt_target_name:**
  other names of the target(s)

- **feature_name:**
  local name on target (e.g., crater, region...)

- **target_region:**
  type of region on target (atmosphere, surface...)

(equivalent in ObsCore)

- **target_name**
  (which standard?)

- **target_class**
  (list to be defined?)
EPNcore — Time

(EPN-TAP parameter - optional in blue) (equivalent in ObsCore)

- **time_min, time_max**: 
  Time range min and max value of data product  
  Unit: JD

- **time_exp_min, time_exp_max**: 
  Exposure time min and max values of data product  
  Unit: seconds

- **time_sampling_step_min, time_sampling_step_max**: 
  Sampling step min and max values of data product  
  Unit: seconds

- **time_scale**: 
  = UTC, except for modeling

- **time_origin**: 
  Where time is measured (important for space obs)
EPNcore — Spectral

(EPN-TAP parameter)

• `spectral_range_min, spectral_range_max`: Spectral range min and max value
  Unit: Hz

• `spectral_resolution_min, spectral_resolution_max`: Filter bandwidth min and max values
  Unit: Hz
  (will evolve to resolving power f / Δf)

• `spectral_sampling_step_min, spectral_sampling_step_max`: Spectral sampling min and max values
  Unit: Hz

(equivalent in ObsCore)

• `em_min, em_max`: same definition, but unit in meter

• `em_res_power`: not the same definition
  relative resolution here: |λ / Δλ| = |f / Δf|
EPNcore — Spatial

(EPN-TAP parameter) (equivalent in ObsCore)

- **spatial_frame_type**: none / celestial / body / cartesian / cylindrical / spherical

- **c1_min, c2_min, c3_min, c1_max, c2_max, c3_max**: Spatial ranges min and max values on 3 axes, as defined in spatial_frame_type
  Unit: degrees or km / au

- **c1_resol_min, c2_resol_min, c3_resol_min, c1_resol_max, c2_resol_max, c3_resol_max**: Spatial resolutions min and max values
  Unit: degrees or km / au

- **spatial_coordinate_description**: full identification of frame with std ID - TBD

- **s_region**: STC-S string (or MOC?), ambiguous

- **s_ra, s_dec, s_fov**: • s_resolution

- **spatial_origin**: origin of frame in case of ambiguity
EPNcore — Illumination & geometry

(EPN-TAP parameter) (no equivalent in ObsCore)

- **incidence_min**, **incidence_max**: The incidence angle parameters define the upper and lower bounds of the incidence angle variation in the data (also known as Solar Zenithal Angle)
  Unit: degrees (0° = normal to surface)

- **emergence_min**, **emergence_max**: The emergence angle parameters define the upper and lower bounds of the emergence angle variation in the data (viewing angle)
  Unit: degrees (0° = normal to surface)

- **phase_min**, **phase_max**: The phase angle parameters define the upper and lower bounds of the phase angle variation in the data
  Unit: degrees (0° = opposition)

- **solar_longitude_min/max**: ~ true anomaly counted from N spring equinox position defines the season on the target at time of observation
  Unit: degrees (0° = N spring equinox)

- **local_time_min/max**: Local time on FoV at time of observation
  Unit: degrees (0° = midnight)

- **target_distance_min/max**: distance to observed FoV at time of observation

- **target_time_min/max**: time at target location, to handle simultaneous observations from different locations in the Solar system
EPNcore — Access

(EPN-TAP parameter) (equivalent in ObsCore)

- **access_url**: URL used to access the data may be a web service

- **access_format**: VO-compliant formats preferred, but anything is acceptable to accommodate archive data: VOTable, Fits, CSV, ASCII, PDS (+ standard image formats), etc

- **access_estsize**: approximate size of data file Unit: kB

- **file_name**: name of the data file, in case this bears information

- **thumbnail_url**: URL used to get a preview of data as a small sized image
Open issues

- Vocabulary will keep growing with more extensions. Need for more UCDs!
- Datalink may be difficult to handle (need to grab links provided in dl tables)
- Some flexibility expected in ADQL? Non-ambiguous support of contours, etc
- Extra standards required:
  - Target names (small bodies) => IAU / SSODNet service
  - Coordinate systems => being listed. Body-fixed frames need be OGS compliant
  - Observatory / space mission catalogues and ID => current VO project
Work Plan

- EPN-TAP document submitted as WD to DAL
- XSD schema was issued for v1.0, to be updated
- EPN-TAP services are declared in the registry with an ivo-id, to be reviewed (there are remnants of older versions)
- TAP clients can query all services
  - optimized clients: VESPA portal; EPN-TAP lib in CASSIS and 3Dview
- TAP validator at VOParis / PADC has an EPN-TAP mode
  - Existing mixin in DaCHS, to be checked and completed
- Plans for a future v2.1, would imply major upgrade of existing services (and clients?)