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

Open
Open in test | upgrade required
Being drafted
Scheduled 2024 (selection)
• New or upgraded in 2020
• New content in 2020

Atmospheres

• - **Titan profiles - CIRS (Cassini, LESIA)**
••- ***Venus spectroscopy - VIRTIS (VEx, LESIA)***
- **Mars Climate Database** (modeling, **LMD**)
• - **Venus profiles - SPICAV/SOIR (VEx, IASB-BIRA)**
- **Mars profiles - SPICAM (MEx, LATMOS)**
- *All MEx derived atmospheric products (via MEx IDS)*
- *Venus cloud products (LATMOS)*
- *ExoMars/NOMAD (BIRA-IASB)*

Small bodies

- ***M4ast*** *(ground based spectroscopy,* ***IMCCE)***
- **1P/Halley spectroscopy - (IKS / Vega-1, LESIA)**
• - ***BaseCom - (Nançay Obs, LESIA)***
- **TNOs are cool** - **(Herchel & 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)**
• - ***MPCorb****: 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)*

Solid spectroscopy

••- **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)**
••- **Mars craters (Jacobs U,** *+ update by GEOPS***)**
- **USGS planetary maps** WMS **(Jacobs U)**
- ***M3*** *WMS service* ***(Chandrayaan-1, Jacobs U)***
- **HRSC nadir images**, WMS **(MEx, Frei Univ)**
- **OMEGA cubes and maps** ***(MEx, IAS)***
• - **VIMS satellites**, w/geometry ***(Cassini, LPG)***
- *MarsSI GIS (Lyon)*
- *Global spectral param of Mercury (DLR)*

Magnetospheres / radio

• - **APIS (HST/Cassini, LESIA)**
• - **NDA (Jupiter radio Nançay, LESIA)**
• - **AMDA (CDPP / IRAP)**
- **MAG data (VEx, IWF Graz)**
• - ***MASER*** *& related services* ***(LESIA)***
- ***RadioJove*** **(LESIA & US amateur network)**
- **Iitate HF data of Jupiter (Tohoku Univ, Jap)**
- ***UTR-2*** *Juno ground support* ***(Kharkiv)***
- **MDISC & JASMIN (modeling, UCL)**
- **Cluster & Themis data (IAP, Prague)**
- **IMPEx models** (from FP7 prog, **IWF Graz)**
• - ***Hisaki (Tohoku Univ., Jap)***
- **Transplanet (CDPP / IRAP)**
- **LOFAR Jupiter (CBK/PAS, Warsaw)**
- ***Magnetic field simus (LMSU)***
- ***ASPERA & MARSIS atm obs (MEx, Iowa U)***

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)**
••- **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)**
- **Planets** *then satellites characteristics* **(LESIA/IMCCE)**
- ***Nasa dust catalogue (IAPS)***
- *Stellar spectra, support for observations & exopl. (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

(EPN-TAP parameter)

- **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)

- **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)

(equivalent in ObsCore)

- t_min t_max
  same definition, but in MJD
- t_exptime
  single valued (no min/max)
- t_resolution

  single valued (no min/max)

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 / Δ f |

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
  - s_ra
    s_dec
    s_fov
- **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
  - s_resolution
- **spatial_coordinate_description**:
  full identification of frame with std ID - TBD
- **s_region**:
  STC-S string (or MOC?), ambiguous
  - s_region
- **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)

- **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

(equivalent in ObsCore)

- access_url
- access_format
- access_ estsize

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?)