

Europlanet-RI / Europlanet Table Access Protocol Implementation using DACHS

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Reference documents

[RD1] DACHS GAVO German Astronomical Virtual Observatory. Contain the documentation and a tutorial for installation and configuration.

<http://vo.ari.uni-heidelberg.de/docs/DaCHS>

[RD2] EPN-TAP document

soon to be distributed at <http://voparis-europlanet.obspm.fr/> after approval

[RD3] Virtual Observatory Support Interface (VOSI)

<http://ivoa.net/Documents/VOSI/20101206/index.html>

[RD4] TAP protocol

<http://ivoa.net/Documents/TAP/>

[RD5] ObsTAP and ObsCore

<http://ivoa.net/Documents/ObsCore/>

[RD6] [EPN data model version 1.18a \(last version to date\) can be found here:](#)

http://www.europlanet-idis.fi/documents/public_documents/Data_Model_v1.18a.pdf

[RD7] UCD + UType concept

<http://ivoa.net/Documents/cover/UCDlist-20070402.html>

[RD8] [IVOA Registry interface](#)

<http://ivoa.net/Documents/RegistryInterface/>

[RD9] Unit in the IVOA (current draft)

<http://ivoa.net/Documents/VOUnits/>

[RD10] EPN-core documentation:

<http://voparis-europlanet.obspm.fr/xml/TAPCore/>

Acronym list

EPNCore	Set of core parameters from EPN-DM, mandatory for EPN-TAP compatibility
EPN-TAP	Specific protocol to access Planetary Science data in Europlanet-VO
EPN-DM	Specific Data Model to describe Planetary Science data in Europlanet-VO
epn_core	Name of table / view of a database which contains the EPN-TAP parameters. Required for EPN-TAP compatibility.
GAVO	German Astronomical Virtual Observatory
DACHS	GAVO Data Center Helper Suite
IVOA	International Virtual Observatory Alliance
PDAP	(Planetary Data Access Protocol) Protocol to access planetary data space archives, developed and maintained by IPDA
TAP	(Table Access Protocol) One of the protocols developed by the IVOA to access astronomical data
ObsTAP	TAP protocol applied to the Observation Data Model of IVOA
ObsCore	Set of core parameters from the Observation Data Model of IVOA
ADQL	Astronomical Data Query Language
UCD	(Unified Content Descriptor) Define measured physical quantities in the IVOA
Utype	Description of data properties, in relation with a Data Model
VOSI	Virtual Observatory Support Interface

Abstract

The goal of this document is to describe how to install the framework necessary to promote the EPN-TAP protocol on your data. It shows how to create a database view compliant with the EPN-TAP protocol from your PostgreSQL database, and how to describe it in DaCHS.

This document contains examples implemented at Observatoire de Paris with a link to the associated available services.

Status of this document

This document is a draft, and must be approved by EuroPlaNet-IDIS partners.

Acknowledgements

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1 - Introduction

The EPN-TAP protocol is fully described in the EPN-TAP document [RD 2]. Here, we only present a technical step-by-step procedure to implement the TAP [RD 4, RD 3] framework in DaCHS [RD 1]. Since EPN-TAP is an extension of IVOA-TAP, we were able to use the DaCHS framework developed for the IVOA by the German VO (GAVO).

The DaCHS framework is also able to promote images and spectra using specific protocols, as well as to provide a publishing registry. Since all these functionalities are out of the scope of this document, we encourage the reader to look at the DaCHS documentation for further information about these capabilities.

Once DaCHS is working, we describe one of the multiple ways to create a database view (a virtual table) called **epn_core** [RD10] and compliant with EPN-TAP. Then we describe how to configure DaCHS to make that view available through EPN-TAP.

In the second part of the document we describe how to register a service in the IVOA registry, so it becomes searchable through VO tools.

Practical use cases are listed in Appendix A, B and C to help practical implementation of EPN-TAP.

2 - DaCHS

DaCHS [RD1] is a framework developed by Markus Demleitner to provide data in the Virtual Observatory. A dedicated web site is also maintained by Markus for installation and configuration <http://vo.ari.uni-heidelberg.de/docs/DaCHS/>. We will not rewrite his documentation but just provide some advices as we only use the TAP protocol in the DaCHS framework.

A few other frameworks and libraries deliver the software necessary to provide TAP (for example SAADA by Laurent Michel at Strasbourg University <http://code.google.com/p/saada/>). But the specificity of DaCHS is that we can work with our existing SQL database provided that it's a PostgreSQL one.

2.1 Installing DaCHS

As mentioned previously, the installation procedure is very well described in [RD1], so we recommend following it step by step. The additional advice we can give is:

- use a stable Debian distribution if you want the installation to be straightforward
- start by creating a dachs UNIX user that will be the owner of all source code and configuration files.
- Perform an installation from the SVN repository, this provides up-to-date code, and

makes updates easier. If you're not familiar with SVN, you only need to use the two following SVN commands:

- `svn co` for checking out (you will use that command only once to get all the code from the repository)
- `svn update` to update the source code that (you can use that command often to update the code from the repository)

Think about creating a user gavo with group gavo.

2.2 Setup

If you have problems installing PostgreSQL (even with packages), note that the PostgreSQL installation is very sensitive to local language settings.

We suggest the following command to help (used as sudo or root):

```
export LANGUAGE=en_US.UTF-8
export LANG=en_US.UTF-8
export LC_ALL=en_US.UTF-8
locale-gen en_US.UTF-8
dpkg-reconfigure locales
```

Then check that you have selected en_US and also your own language (e.g. fr_FR). en_US should be the default.

After that configuration, you can restart the PostgreSQL installation. Always use version 8.4 or earlier if you want to use PGSPHERE:

```
aptitude reinstall postgresql-8.4
pg_createcluster 8.4 main
```

As you have followed the DaCHS installation documentation, you should now define a directory where all configuration files and programs will be stored. In the following we have used /var/gavo (and dachs_usr user as owner). All the services are described by their name in a subdirectory of /var/gavo/input/.

3 – Specific requirement for EPN-TAP

As previously defined, EPN-TAP is a TAP compliant service, so there is no need to modify DaCHS since it provides TAP compliant service.

The specificity of EPN-TAP is that all services must have a specific schema in the database. The name of this schema must be identical to the short name of the service described in VO-resource (see paragraph 4).

Under this schema a specific table or view must be called **e pn_core** containing at least all the mandatory fields defined in document [RD 2]. Examples of such views are given at

<http://voparis-europlanet.obspm.fr/implementation/examples/>.

Under that link we suggest a set of examples that are in production at http://voparis-tap.obspm.fr/_system_/tap/run/tap . You will there find some PostgreSQL facilities to transform DateTime into Modified Julian day for example.

Usually not all the mandatory fields are applicable to a given service. In this case we assign the NULL value to the unused fields in the epn_core view.

3.1 Description of the service in DaCHS

In the directory of services we suggest to name `q.rd` the description file of each field in the database. All the fields must be described using the syntax shown in the DaCHS Operator guide: <http://vo.ari.uni-heidelberg.de/docs/DaCHS/opguide.html>.

For all services implemented at VO-Paris we make available the `q.rd` files so they can be reused – see for example

<http://voparis-europlanet.obspm.fr/implementation/examples/exoplanet/q.rd>.

The description file `q.rd` file may contain:

- a metadata that will be presented in the response of the service. For EPN-TAP all services are by definition open to public usage. This field could be used as acknowledgement. Service providers are supposed to write the very short text they expect to see as an acknowledgement when data are used for scientific publication.
- Example: `<meta name="copyright">This work has been conducted using data from IPSL on the frame of VO Paris Data Centre</meta>`
- For each field:
 - the name of the field in the database following the same order as in the table or view they come from.
 - units should be described when they are available. Units must follow the syntax defined in the IVOA document <http://www.ivoa.net/Documents/VOUnits/>
 - types of the variable defined from the list in <http://vo.ari.uni-heidelberg.de/docs/DaCHS/tutorial.html>
 - UCDs defined from a list of terms, see <http://www.ivoa.net/Documents/latest/UCDlist.html>. A tool have been developed by GAVO to help user to define its UCDs <http://dc.zah.uni-heidelberg.de/ucds/ui/ui/form>
 - then a short description to provide the user with a quick information on the content.

4 – Service registration

There is not yet a specific service to register EPN services. But as EPN-TAP is an IVOA TAP protocol, EPN-TAP services can be registered in the IVOA registry.

We provide some examples of VO resources representing EPN-TAP registered services. Note that the short name of the service must be identical to the schema name in the database. Note also that for the moment the IVOA identifier of the service must contain “_epn” to help the discovery of EPN-TAP services. Later on, a more adequate way based on the data model will be implemented.

Services can be registered at NVO registry [<http://nvo.ncsa.uiuc.edu/nvoregistration.html>], and soon at VO-Paris and also in the ESAC Euro-VO Registry.

Appendix

A: Example of epn_core view

This is an example taken from atmospheric data of Mars available at <http://voparis-europlanet.obspm.fr/implementation/examples/mars/>

```
CREATE or REPLACE VIEW vo_mars.epn_core AS SELECT
text 'granule' AS resource_type,
text 'profile' AS dataproduct_type,
name AS target_name,
text 'planet' AS target_class,
cast(to_char(date::date,'J') as double precision) AS time_min,
cast(to_char(date::date,'J') as double precision) AS time_max,
NULL AS time_sampling_step_min,
NULL AS time_sampling_step_max,
NULL AS time_exp_min,
NULL AS time_exp_max,
NULL AS spectral_range_min,
NULL AS spectral_range_max,
NULL AS spectral_sampling_step_min,
NULL AS spectral_sampling_step_max,
NULL AS spectral_resolution_min,
NULL AS spectral_resolution_max,
ls_inf AS c1min,
ls_sup AS c1max,
latitude_inf AS c2min,
latitude_sup AS c2max,
NULL as c3min,
NULL as c3max,
NULL as c1_resol_min,
NULL as c1_resol_max,
NULL as c2_resol_min,
NULL as c2_resol_max,
NULL as c3_resol_min,
NULL as c3_resol_max,
text 'body' AS spatial_frame_type,
NULL as incidence_min,
NULL as incidence_max,
NULL as emergence_min,
NULL as emergence_max,
NULL as phase_min,
NULL as phase_max,
text 'phobos' AS instrument_host_name,
text 'august' AS instrument_name,
text 'pos.longitude pos.latitude' AS measurement_type,
filename AS access_url,
text 'VOTable' AS access_format,
integer '1' AS access_estsize,
integer '5' AS processing_level,
text 'vo paris data centre on behalf of IPSL' AS publisher,
text 'http://cdsads.u-strasbg.fr/abs/1989Natur.341..600B' AS reference,
text 'aerosols profil on mars from august' AS title,
NULL AS collection_id,
text 'atmosphere' AS target_region,
text 'UTC' AS time_scale
```

```
FROM vo_mars.aerosols
UNION ALL
SELECT
text 'dataset' AS resource_type,
text 'profile' AS dataproduct_type,
cast(vvarchar(32) 'mars' as text) AS target_name,
text 'planet' AS target_class,
min(cast(to_char(date::date,'J') as double precision)) AS time_min,
max(cast(to_char(date::date,'J') as double precision)) AS time_max,
NULL AS time_sampling_step_min,
NULL AS time_sampling_step_max,
NULL AS time_exp_min,
NULL AS time_exp_max,
NULL AS spectral_range_min,
NULL AS spectral_range_max,
NULL AS spectral_sampling_step_min,
NULL AS spectral_sampling_step_max,
NULL AS spectral_resolution_min,
NULL AS spectral_resolution_max,
min(ls_inf) AS c1min,
max(ls_sup) AS c1max,
min(latitude_inf) AS c2min,
max(latitude_sup) AS c2max,
NULL as c3min,
NULL as c3max,
NULL as c1_resol_min,
NULL as c1_resol_max,
NULL as c2_resol_min,
NULL as c2_resol_max,
NULL as c3_resol_min,
NULL as c3_resol_max,
text 'body' AS spatial_frame_type,
NULL as incidence_min,
NULL as incidence_max,
NULL as emergence_min,
NULL as emergence_max,
NULL as phase_min,
NULL as phase_max,
text 'phobos' AS instrument_host_name,
text 'august' AS instrument_name,
NULL AS measurement_type,
NULL as access_url,
text 'VOTable' AS access_format,
NULL AS access_estsize,
integer '5' AS processing_level,
text 'vo paris data centre on behalf of IPSL' AS publisher,
text 'http://cdsads.u-strasbg.fr/abs/1989Natur.341..600B' AS reference,
text 'aerosol profil on mars from august' AS title,
NULL AS collection_id,
text 'atmosphere' AS target_region,
text 'UTC' AS time_scale
FROM vo_mars.aerosols
UNION ALL
SELECT
text 'granule' AS resource_type,
text 'profile' AS dataproduct_type,
```

```
name AS target_name,  
text 'planet' AS target_class,  
NULL AS time_min,  
NULL AS time_max,  
NULL AS time_sampling_step_min,  
NULL AS time_sampling_step_max,  
NULL AS time_exp_min,  
NULL AS time_exp_max,  
NULL AS spectral_range_min,  
NULL AS spectral_range_max,  
NULL AS spectral_sampling_step_min,  
NULL AS spectral_sampling_step_max,  
NULL AS spectral_resolution_min,  
NULL AS spectral_resolution_max,  
ls_inf AS c1min,  
ls_sup AS c1max,  
latitude_inf AS c2min,  
latitude_sup AS c2max,  
NULL as c3min,  
NULL as c3max,  
NULL as c1_resol_min,  
NULL as c1_resol_max,  
NULL as c2_resol_min,  
NULL as c2_resol_max,  
NULL as c3_resol_min,  
NULL as c3_resol_max,  
text 'body' AS spatial_frame_type,  
NULL as incidence_min,  
NULL as incidence_max,  
NULL as emergence_min,  
NULL as emergence_max,  
NULL as phase_min,  
NULL as phase_max,  
text 'phobos' AS instrument_host_name,  
text 'august' AS instrument_name,  
NULL AS measurement_type,  
filename AS access_url,  
text 'VOTable' AS access_format,  
integer '1' AS access_estsize,  
integer '5' AS processing_level,  
text 'vo paris data centre on behalf of IPSL' AS publisher,  
text 'http://cdsads.u-strasbg.fr/abs/1989Natur.341..600B' AS reference,  
text 'ozones profil on mars from august' AS title,  
text 'no information' AS collection_id,  
text 'atmosphere' AS target_region,  
text 'UTC' AS time_scale  
FROM vo_mars.ozone  
UNION ALL  
SELECT  
text 'dataset' AS resource_type,  
text 'profile' AS dataproduct_type,  
cast(varchar(32) 'mars' as text) AS target_name,  
text 'planet' AS target_class,  
NULL AS time_min,  
NULL AS time_max,  
NULL AS time_sampling_step_min,
```

```
NULL AS time_sampling_step_max,  
NULL AS time_exp_min,  
NULL AS time_exp_max,  
NULL AS spectral_range_min,  
NULL AS spectral_range_max,  
NULL AS spectral_sampling_step_min,  
NULL AS spectral_sampling_step_max,  
NULL AS spectral_resolution_min,  
NULL AS spectral_resolution_max,  
min(ls_inf) AS c1min,  
max(ls_sup) AS c1max,  
min(latitude_inf) AS c2min,  
max(latitude_sup) AS c2max,  
NULL as c3min,  
NULL as c3max,  
NULL as c1_resol_min,  
NULL as c1_resol_max,  
NULL as c2_resol_min,  
NULL as c2_resol_max,  
NULL as c3_resol_min,  
NULL as c3_resol_max,  
text 'body' AS spatial_frame_type,  
NULL as incidence_min,  
NULL as incidence_max,  
NULL as emergence_min,  
NULL as emergence_max,  
NULL as phase_min,  
NULL as phase_max,  
text 'phobos' AS instrument_host_name,  
text 'august' AS instrument_name,  
text 'pos.longitude pos.latitude' AS measurement_type,  
NULL AS access_url,  
text 'VOTable' AS access_format,  
NULL AS access_estsize,  
integer '5' AS processing_level,  
text 'vo paris data centre on behalf of IPSL' AS publisher,  
text 'http://cdsads.u-strasbg.fr/abs/1989Natur.341..600B' AS reference,  
text 'ozones profil on mars from august' AS title,  
text 'no information' AS collection_id,  
text 'atmosphere' AS target_region,  
text 'UTC' AS time_scale  
FROM vo_mars.ozone  
;
```

A.1 BDIP

This example is related to a service of telescopic images (planetary disk on the sky).

A.3 Exoplanet

This example is related to the Encyclopedia of exoplanets.

Appendix B: Example of VO-Resource for service registration

As mentioned in section 4, a service is described in the registry as a VOResource. This consists of an xml file compliant to the VO Resource definition schema [RD 10] and can be edited with your favourite xml editor.

If this is your first registration, you should first declare a naming authority ID from where the service identifier will be derived. An example is given in C2.

B1 registration of vo_mars service

```
<?xml version="1.0" encoding="UTF-8"?>
<ri:Resource status="active" updated="2010-02-11T00:14:00.00" created="2009-01-01T12:00:00.00"
  xmlns:ri="http://www.ivoa.net/xml/RegistryInterface/v1.0"
  xmlns:cs="http://www.ivoa.net/xml/ConeSearch/v1.0"
  xmlns:cea="http://www.ivoa.net/xml/CEA/v1.0rc1"
  xmlns:osn="http://www.ivoa.net/xml/OpenSkyNode/v0.2"
  xmlns:sia="http://www.ivoa.net/xml/SIA/v1.0"
  xmlns:sla="http://www.ivoa.net/xml/SLA/v0.2" xmlns:ssa="http://www.ivoa.net/xml/SSA/v0.4"
  xmlns:tsa="http://www.ivoa.net/xml/TSA/v0.2"
  xmlns:stc="http://www.ivoa.net/xml/STC/stc-v1.30.xsd"
  xmlns:vg="http://www.ivoa.net/xml/VORegistry/v1.0"
  xmlns:vr="http://www.ivoa.net/xml/VOResource/v1.0"
  xmlns:vs="http://www.ivoa.net/xml/VODataService/v1.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xsi:schemaLocation="http://www.ivoa.net/xml/RegistryInterface/v1.0
http://www.ivoa.net/xml/RegistryInterface/RegistryInterface-v1.0.xsd
http://www.ivoa.net/xml/VOResource/v1.0 http://www.ivoa.net/xml/VOResource/VOResource-v1.0.xsd
http://www.ivoa.net/xml/VODataService/v1.0 http://www.ivoa.net/xml/VODataService/VODataService-
v1.0.xsd http://www.ivoa.net/xml/VOTable/v1.2 http://www.ivoa.net/xml/VOTable/v1.2
http://www.ivoa.net/xml/ConeSearch/v1.0 http://www.ivoa.net/xml/ConeSearch/ConeSearch-v1.0.xsd
http://www.ivoa.net/xml/SIA/v1.0 http://www.ivoa.net/xml/SIA/SIA-v1.0.xsd
http://www.ivoa.net/xml/SSA/v0.4 http://www.ivoa.net/xml/SSA/SSA-v0.4.xsd
http://www.ivoa.net/xml/CEA/v1.0rc1 http://software.astrogrid.org/schema/vo-resource-
types/CEAService/v1.0rc1/CEAService.xsd"
  xsi:type="vs:CatalogService">
  <title>august onboard Phobos2, atmospheric composition of mars</title>
  <shortName>vo_mars</shortName>
  <identifier>ivo://vopdc.obspm/ipsl/eprn_august</identifier>
  <curation>
    <publisher ivo-id="ivo://vopdc.obspm/IPSL">VO-Paris Data Centre - IPSL</publisher>
    <creator>
      <name>Institut Pierre Simon Laplace</name>
      <logo></logo>
    </creator>
    <date>2009-01-01</date>
    <version>1</version>
    <contact>
      <name>A. Sarkissian</name>
```

```

    <address> LATMOS / UVSQ / CNRS 11,boulevard d'Alembert 78280 GUYANCOURT
  France</address>
    <email>alain.sarkissian@latmos.ipsl.fr</email>
    <telephone>+33180285265</telephone>
  </contact>
</curation>
<content>
  <!-- subject = IAU thesaurus key words (http://www.mso.anu.edu.au/library/thesaurus/) -->
  <subject>Virtual Observatory</subject>
  <subject>Planets</subject>
  <description>
    </description>
    <source>http://cdsads.u-strasbg.fr/abs/1989Natur.341..600B</source>
  <referenceURL>TBD</referenceURL>
  <type>Archive</type>
  <contentLevel>General</contentLevel>
  <contentLevel>University</contentLevel>
  <contentLevel>Research</contentLevel>
  <contentLevel>Amateur</contentLevel>
  <relationship>
    <relationshipType>related-to</relationshipType>
    <relatedResource ivo-id="ivo://vopdc.obspm">VO-Paris Data Centre</relatedResource>
  </relationship>
</content>
  <!-- Table Access Service -->
  <capability standardID="ivo://ivoa.net/std/TAP">
    <interface role="std" xsi:type="vs:ParamHTTP">
      <accessURL use="base">http://voparis-tap.obspm.fr/__system__/tap/run/tap</accessURL>
    </interface>
  </capability>
  <instrument>Phobos2/August</instrument>
  <!-- TBD Coverage -->
</ri:Resource>

```

B2 registration of vopdc as naming authority ID

```

<ri:Resource xmlns:ri="http://www.ivoa.net/xml/RegistryInterface/v1.0"
  xmlns:cs="http://www.ivoa.net/xml/ConeSearch/v1.0"
  xmlns:osn="http://www.ivoa.net/xml/OpenSkyNode/v0.2" xmlns:sia="http://www.ivoa.net/xml/SIA/v1.0"
  xmlns:sla="http://www.ivoa.net/xml/SLA/v0.2" xmlns:ssa="http://www.ivoa.net/xml/SSA/v0.4"
  xmlns:tsa="http://www.ivoa.net/xml/TSA/v0.2" xmlns:vg="http://www.ivoa.net/xml/VORegistry/v1.0"
  xmlns:vr="http://www.ivoa.net/xml/VOResource/v1.0"
  xmlns:vs="http://www.ivoa.net/xml/VODataService/v1.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" created="2010-05-05T15:45:33Z"
  status="active" updated="2010-05-05T15:45:33Z"
  xsi:schemaLocation="http://www.ivoa.net/xml/RegistryInterface/v1.0
  http://www.ivoa.net/xml/RegistryInterface/v1.0
  http://www.ivoa.net/xml/VOResource/v1.0 http://www.ivoa.net/xml/VOResource/v1.0
  http://www.ivoa.net/xml/VORegistry/v1.0 http://www.ivoa.net/xml/VORegistry/v1.0
  http://www.ivoa.net/xml/VODataService/v1.0 http://www.ivoa.net/xml/VODataService/v1.0
  http://www.ivoa.net/xml/SIA/v1.0 http://www.ivoa.net/xml/SIA/v1.0
  http://www.ivoa.net/xml/ConeSearch/v1.0 http://www.ivoa.net/xml/ConeSearch/v1.0
  http://www.ivoa.net/xml/OpenSkyNode/v0.2 http://www.ivoa.net/xml/OpenSkyNode/v0.2

```



```
http://www.ivoa.net/xml/SSA/v0.4 http://www.ivoa.net/xml/SSA/v0.4
http://www.ivoa.net/xml/SLA/v0.2 http://esavo.esa.int/xml/SLA-v0.2.xsd
http://www.ivoa.net/xml/TSA/v0.2 http://esavo.esa.int/xml/TSA-v0.2.xsd" xsi:type="vg:Authority">
  <title>VO-Paris Data Center Naming Authority</title>
  <identifier>ivo://vopdc</identifier>
  <curation>
    <publisher>VO-Paris Data Centre</publisher>
    <creator>
      <name>Observatoire de Paris - VOPDC</name>
      <logo>http://vo.obspm.fr/logo/vopdc.png</logo>
    </creator>
    <contact>
      <name>J. Normand</name>
      <address>Observatoire de Paris VOPDC, bat. Perrault, 77 av. Denfert Rochereau, 75014
Paris, FRANCE</address>
      <email>vo.paris@obspm.fr</email>
    </contact>
  </curation>
  <content>
    <subject>Authority</subject>
    <description>This naming authority is the root of the naming of the resources from VO-Paris
Data Center and partners</description>
    <referenceURL>http://vo.obspm.fr</referenceURL>
    <type>Other</type>
    <contentLevel>General</contentLevel>
  </content>
  <managingOrg ivo-id="ivo://vopdc">VO-Paris Data Centre</managingOrg>
</ri:Resource>
```

Appendix C: Example of description file in DACHS

This is an example of q.rd file that describes the structure of tables or view in GAVO
<http://voparis-europlanet.obspm.fr/implementation/examples>
Others examples can be accessed from this URL

C.1 Case of Mars atmosphere

```
<?xml version="1.0" encoding="iso-8859-1"?>

<resource schema="vo_mars">
  <meta name="title">Mars atmospheric profile auguste</meta>
  <meta name="creationDate">2012-02-27T08:42:00Z</meta>
  <meta name="description" format="plain">
    Ozone profile in mars atmosphere data from Alain Sarkissian
  </meta>
  <meta name="copyright">Free to use</meta>
  <meta name="creator.name">A. Sarkissian</meta>
  <meta name="subject">Mars atmosphere</meta>
  <meta name="subject">Ozone profile</meta>
  <meta name="subject">Extinction</meta>

  <table id="epn_core" onDisk="True" adql="True">
    <meta name="info" infoName="SERVICE_PROTOCOL" infoValue="0.3"> EPN-TAP </meta>
    <meta name="description"> ozone in mars atmosphere. </meta>
    <meta name="referenceURL">http://cdsads.u-strasbg.fr/abs/1989Natur.341..600B
  </meta>
    <column name="resource_type" type="text"
      ucd="meta.id;class"
      description="ressource type can be dataset or granule"/>
    <column name="dataprodukt_type" type="text"
      ucd="meta.id;class"
      description="Organization of the data product, from enumerated list"/>
    <column name="target_name" type="text"
      ucd="meta.id;src"
      description="name of target (from a list depending on target type)/>
    <column name="target_class" type="text"
      ucd="src.class"
      description="type of target from enumerated list"/>
    <column name="time_min"
      ucd="time.start;obs.exposure" unit="d"
      description="Acquisition start time (in JD)/>
    <column name="time_max"
      ucd="time.end;obs.exposure" unit="d"
      description="Acquisition stop time (in JD)/>
    <column name="time_sampling_step_min"
      ucd="time.interval;stat.min" unit="s"
      description="Min time sampling step"/>
    <column name="time_sampling_step_max"
      ucd="time.interval;stat.max" unit="s"
      description="Max time sampling step"/>
  </table>
</resource>
```

```
<column name="time_exp_min"
  ucd="time.duration;obs.exposure;stat.min" unit="s"
  description="Min integration time"/>
<column name="time_exp_max"
  ucd="time.duration;obs.exposure;stat.max" unit="s"
  description="Max integration time"/>
<column name="spectral_range_min"
  ucd="em.freq;stat.min" unit="Hz"
  description="Min spectral range (frequency)"/>
<column name="spectral_range_max"
  ucd="em.freq;stat.max" unit="Hz"
  description="Max spectral range (frequency)"/>
<column name="spectral_sampling_step_min"
  ucd="em.freq.step;stat.min" unit="Hz"
  description="min spectral sampling step"/>
<column name="spectral_sampling_step_max"
  ucd="em.freq.step;stat.max" unit="Hz"
  description="max pectral sampling step"/>
<column name="spectral_resolution_min"
  ucd="spec.resolution;stat.min" unit="Hz"
  description="Min spectral resolution"/>
<column name="spectral_resolution_max"
  ucd="spec.resolution;stat.max" unit="Hz"
  description="Max spectral resolution"/>
<column name="c1min"
  ucd="pos;stat.min" unit="deg"
  description="Min longitude on mars"/>
<column name="c1max"
  ucd="pos;stat.max" unit="deg"
  description="Max longitude on mars"/>
<column name="c2min"
  ucd="pos;stat.min" unit="deg"
  description="Min latitude on mars"/>
<column name="c2max"
  ucd="pos;stat.max" unit="deg"
  description="Max latitude on mars"/>
<column name="c3min"
  ucd="pos;stat.min" unit=""
  description="Min of third coordinate (not used)"/>
<column name="c3max"
  ucd="pos;stat.max" unit=""
  description="Max of third coordinate (not used)"/>
<column name="c1_resol_min"
  ucd="pos.angResolution;stat.min" unit="deg"
  description="Min resolution on mars longitude"/>
<column name="c1_resol_max"
  ucd="pos.angResolution;stat.max" unit="deg"
  description="Max resolution on mars longitude"/>
<column name="c2_resol_min"
  ucd="pos.angResolution;stat.min" unit="deg"
  description="Min resolution on mars latitude"/>
<column name="c2_resol_max"
  ucd="pos.angResolution;stat.max" unit="deg"
  description="Max resolution on mars latitude"/>
<column name="c3_resol_min"
  ucd="pos.Resolution;stat.min" unit=""
```

```

description="Min resolution in third coordinate"/>
<column name="c3_resol_max"
  ucd="pos.Resolution;stat.min" unit=""
  description="Min resolution in third coordinate"/>
<column name="spatial_frame_type" type="text"
  ucd="meta.id;class"
  description="Flavor of coordinate system, defines the nature of coordinates (enumerated list)"/>
<column name="incidence_min" unit="deg"
  ucd="pos.posang;stat.min"
  description="Min incidence angle (solar zenithal angle)"/>
<column name="incidence_max" unit="deg"
  ucd="pos.posang;stat.max"
  description="Max incidence angle (solar zenithal angle)"/>
<column name="emergence_min" unit="deg"
  ucd="pos.posang;stat.min"
  description="Min emergence angle"/>
<column name="emergence_max" unit="deg"
  ucd="pos.posang;stat.max"
  description="Max emergence angle"/>
<column name="phase_min" unit="deg"
  ucd="pos.posang;stat.min"
  description="Min phase angle"/>
<column name="phase_max" unit="deg"
  ucd="pos.posang;stat.max"
  description="Max phase angle"/>
<column name="instrument_host_name" type="text"
  ucd="meta.code"
  description="Standard name of the observatory or spacecraft"/>
<column name="instrument_name" type="text"
  ucd="meta.id;instr"
  description="Standard name of instrument"/>
<column name="measurement_type" type="text"
  ucd="meta.ucd"
  description="UCD(s) defining the data"/>
<column name="access_url" type="text"
  ucd="meta.ref.url"
  description="URL of the data files."/>
<column name="access_format" type="text"
  ucd="meta.id;class"
  description="file format type."/>
<column name="access_estsize" type="integer" unit="kB" required="True"
  ucd="phys.size;meta.file"
  description="estimate file size in kB."/>
<column name="processing_level" type="integer" required="True"
  ucd="meta.class.qual"
  description="type of calibration from CODMAC."/>
<column name="publisher" type="text"
  ucd="meta.name"
  description="publiher of the ressource"/>
<column name="reference" type="text"
  ucd="meta.ref"
  description="publication of reference"/>
<column name="title" type="text"
  ucd="meta.note"
  description="Title of the ressource"/>
<column name="collection_id" type="text"

```

```
    ucd="meta.id"  
    description="IVOA ID of the collection"/>  
<column name="target_region" type="text"  
    ucd="meta.id;class"  
    description="region of interest from a enumerated list"/>  
<column name="time_scale" type="text"  
    ucd="time.scale"  
    description="time scale taken from STC"/>
```

```
</table>
```

```
<data id="import">  
  <make table="epn_core"/>  
</data>
```

```
<data id="collection" auto="false">  
  <register services="__system__/_tap#run"/>  
  <make table="epn_core"/>  
</data>  
</resource>
```

C.2 Several related tables

Example to be provided