

The Virtual Observatory

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November 23, 2021



Outline

What is the VO?

The challenge

Finding Data

Accessing Data

Interoperability

Reusing Data

Putting it together



Linking ESFRIs with EOSC...

A collaborative cluster of next generation European Strategy Forum on Research Infrastructures (ESFRI) facilities in the area of astronomy- and accelerator-based particle physics in order to implement a functional link between the concerned ESFRI projects and European Open Science Cloud (EOSC).



...through the VO

Connecting ESFRIs with EOSC using the VO



What is the VO?

A historical view: The goal of the Virtual Observatory (VO) is to provide a

comprehensive set of
data and **services**
relevant to **astronomy**
accessible from **clients** of **your choice**
regardless of where you are and
preserving products of digital astronomy.



What it's (actually) not:

A bundle of software used to work with data in astronomy.

But of course you will find and use VO-client implementations in lots of software like TOPCAT, Aladin, Splat-VO or PyVO.

"FAIR"

There's tens of thousands of data collections somewhere online, and more should be.

To unlock the treasures hidden there, the data has to be

- ▶ **F**indable
- ▶ **A**ccesible
- ▶ **I**nteroperable
- ▶ **R**eusable

Registry and Metadata

To make Data findable it needs to be enriched with metadata, that gives data a meaning. Publishing an image without a description of the position, or publishing table data without describing the contents of the columns makes the data useless. The VO defines standards for exactly this sort of metadata which a service can publish to the VO-registry, which is the entry point for Data discovery in the VO. To enable this, a surprisingly lot of standards for metadata, data description have to be developed and maintained.



Registry and Metadata

The registry enable users to issue queries like:

- ▶ Where are image services specialized on radio?
- ▶ What data sets are out there containing x-ray fluxes and proper motions?
- ▶ What services are out there dealing with time standards?
- ▶ What services expose the data associated to a paper?

Clients: web interfaces, VO Desktop, WIRR, and all clients with a search option.

The simple protocols: SCS, SIAP, SSAP

... to just name a few. Depending on the preferred data access there are many standards and protocols defined within the VO. Defined “typed interface” let you talk to services in the same fashion. “Typed” means types of data. The Simple Cones Search Protocol (SCS) for tables containing positions, the Simple Image Access Protocol (SIAP) for images of the sky, and Simple Spectral Access Protocol (SSAP) for accessing spectra.

Clients: Topcat, Aladin, SplatVO.

TAP/ADQL

The Table access protocol (TAP) and the Astronomical Data Query Language (ADQL) always come in pairs. They enable you to make a selection on table data based on algebraic expression. It's a feasible way to deal with huge catalogues like SDSS, 2MASS, WISE or Gaia.

Clients: Topcat, Aladin, PyVO.

VOTable, SAMP, UCDs

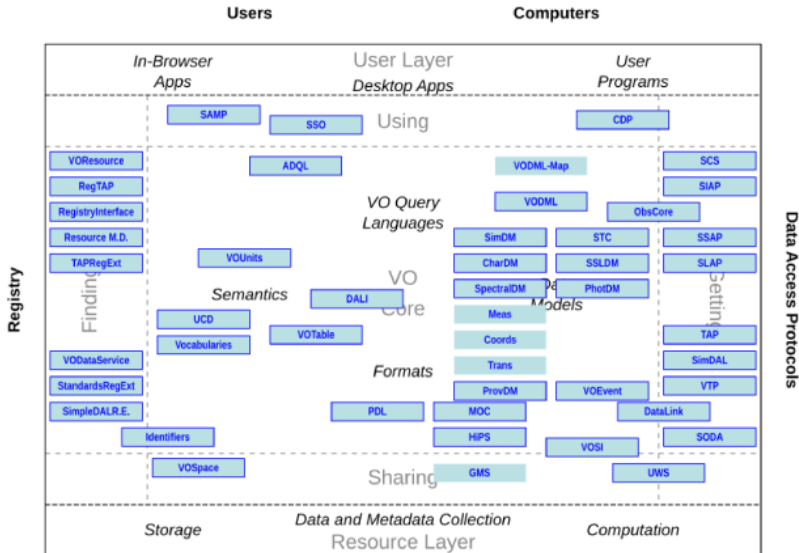
To exchange data across different machines demands agreed on structure of the data (column names like "RA", "DEC"), or agreed on ways to annotate the data ("Column X contains a position in ra"). The VO is about the latter. Keeping the description of the data close to it (best: in the same file) helps understanding the data and enables automated access to the data. VO tools make use of this a lot, and you may not even notice.

Clients: Topcat, Aladin, SplatVO, PyVO...

All and ProvTAP, ProvDM

Reusing data of course is about describing data in a way that somebody in the future will be able to understand the meaning of the data and use it (this somebody may be you in 12 months time).

All at one glance:



Standards...

The IVOA constantly develops new standards and evolves existing ones.

This work is done in Workings Groups (WG) and Interest Groups (IG).



Working Groups and Interest Groups

There are a lot of working groups within the IVOA and it might be a bit overwhelming to get the overview. Some titles are selfexplaining, for others an introduction may be necessary.

The Working Groups are: Applications, Data Access Layer, Data Model, Grid and Web Services, Resource Registry, and Semantics.

The Interest Groups are: Data Curation and Preservation, Education, Knowledge Discovery, Operations, Radio Astronomy, Solar System, Theory, and Time Domain.



CEVO in the IVOA

CEVO is involved at a lot of levels within the IVOA and therefore in the development of standards and protocols. The strongest example is the establishing of the Radio Astronomy IG which is working on standards towards this community this directly linking ESFRIs like SKA and Astron with to the VO.

VO school

You like the taste of the VO ? Apply for the 2nd ESCAPE VO school in Strasbourg from 22 to 24 February 2022:

<https://indico.in2p3.fr/event/25225/>

