The Virtual Observatory

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Outline

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**ccessible
- **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 descpription 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 feasable 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 (columnn 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).

Data Publishing

Publish your data. Don't let it rot on a hard drive. Even if your data did not give you the results you expected/needed, there might be treasures in them waiting to be found by others.

How do I publish ?
Get in touch with one of the many VO datacenters, or with the IVOA:
`https://www.ivoa.net/`https://www.ivoa.net/

(Bug)Report back

Give feedback to service providers and software developers when you find wires sticking out, or something seems buggy to you. Honestly: usually we don't bite.

Write your own code

When writing your own code, think about interoperaibility and if your software would benefit from it. Have a look at PyVO: `https://pyvo.readthedocs.io/en/latest/`

Tutorials

- VO-Text-Treasures
  `http://dc.g-vo.org/VOTT`
- Euro-VO tutorials
  `https://www.euro-vo.org/scientific-tutorials/`
- ADQL-course
  `http://docs.g-vo.org/adql/html/`