



Fig. 1

1. VO – what for?

The Virtual Observatory (VO) is (or will be), 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.

Why bother?

This talk will try to discuss some challenges in modern astronomy and the VO's answers.

(Notes with links at <http://docs.g-vo.org/vowf2011.pdf>)

2. Data Paradise I: Diversity

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

To unlock the treasures hidden there, you have to be able to

- Find the data
- Get it
- Use it

(vgl. Fig. 1)

Remember Astronomy and Astrophysics Abstracts? The VO is to old data management what the ADS is to AAA.

3. Finding Services

The data centers in the VO deliver descriptions of their resources to the **registry**. There, users can 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 interfaces¹, VO Desktop².

4. Finding Data Sets

The VO has defined **typed interfaces** (SCS, SIAP, SSAP) that let you talk to all services in the same fashion. This lets programs query all (or a selected subset) of servers at the same time. These are suitable for tasks like: like:

- Find all images containing NGC3141
- Are there infrared spectra of a source at 271.8281, +23.42?
- What is known about sources within 2 arcminutes of Geminga?

Clients: Aladin³ for images, Splat⁴ for spectra, VO Desktop⁵ multi-protocol, and more.

Upcoming, there's ObsTAP that lets you post even more expressive queries against database tables.

These protocols also usually say how you can get the data once you have located it. There is work in progress on server-side manipulations, though (cutouts, cube cuts, etc) – but standards for that are hard.

5. Using Data

The VO uses existing data formats where they are appropriate (e.g., FITS for images). Where they aren't it uses its own: **VOTable**, containing rich metadata. This saves you from having to write code everytime you want to use a new data source.

And it comes with descriptions, units, UCDS, and more.

The VO also defines data models (e.g., for spectra) that say what metadata items are necessary for a useful description.

Clients: TOPCAT⁶ and STILTS⁷ for generic VOTables; the clients for typed interfaces also consume VOTables.

¹ <http://nvo.stsci.edu/vor10/index.aspx>

² <http://www.astrogrid.org/wiki/Install/Downloads>

³ <http://aladin.u-strasbg.fr/aladin.gml>

⁴ <http://star-www.dur.ac.uk/~pdraper/splat/splat-vo/>

⁵ <http://www.astrogrid.org/wiki/Install/Downloads>

⁶ <http://www.star.bris.ac.uk/~mbt/topcat/>

⁷ <http://www.star.bristol.ac.uk/~mbt/stilts/>



Fig. 2

6. Data Paradise II: A Sea of Bytes

We now have 10^9 sources in catalogs, the time domain is coming. Ftping ASCII tables of those is tedious, and mostly you only want some 10^3 of those objects in the first place. So:

- Keep the data on the servers as long as possible
- have servers exchange data on the user's behalf
- only download data when most of the stuff irrelevant to your research is weeded out.

(vgl. Fig. 2)

That's the Hipparcos catalog. With about 10^5 objects, it's positively small by today's standards.

7. Trawling the Sea of Bytes

ADQL lets you write simple programs, **TAP** lets you run them on remote servers, upload your tables, and retrieve the results.

If you know CASJobs: about the same thing, only with a solid standard and supported by more services.

Clients: TOPCAT⁸ and STILTS⁹, tapsh¹⁰.

⁸ <http://www.star.bris.ac.uk/~mbt/topcat/>

⁹ <http://www.star.bristol.ac.uk/~mbt/stilts/>

¹⁰ <http://vo.ari.uni-heidelberg.de/soft/tapsh>

8. User Paradise: Freedom of Choice

The VO is about standards. Any client implementing a standard can query any server implementing a standard. This gives users a choice of software, and using libraries or frameworks, they can simply write their own clients.

Plus, most VO software interoperates – you can send tables, selections, etc. from one program to the next using a protocol called **SAMP**. Try it, it's fun.

Clients: Almost all of them. You won't even notice.

9. See You in Paradise

The road to Paradise is long and rocky. That's true for us service providers, but unfortunately for users, too.

We put some roses on the way: Our short hands-on courses Wed through Fri. You're welcome to pop in, you're allowed to pop out.

If you have data: Let us publish it in the VO (<http://g-vo.org>)

If you have ideas or wishes: Let us know

If you have problems: Complain, to us or the operators