



# ESCAPE

European Science Cluster of Astronomy &  
Particle physics ESFRI research Infrastructures

## International Virtual Observatory Alliance (IVOA) Newcomers Introduction

IVOA interop, October 2022

Hendrik Heinl, Dave Morris

ESCAPE - The European Science Cluster of Astronomy & Particle Physics ESFRI Research Infrastructures has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n° 824064.





Everyone invited to develop science use cases

Science based interest groups

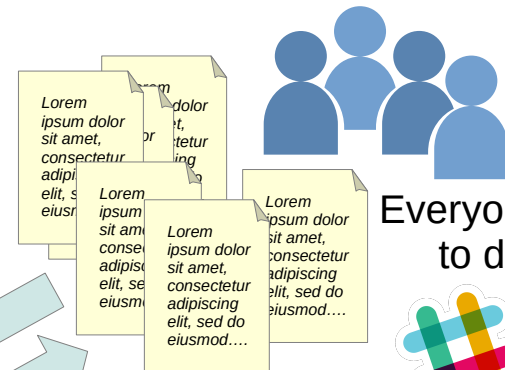
Science priorities committee



Scientists from IVOA members and major astronomy projects

IVOA working groups

Working group discussions

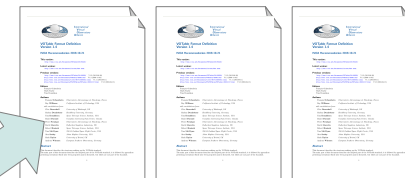
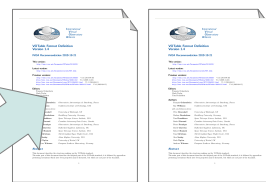


Everyone invited to discuss



Request For Comment (RFC) document

IVOA recommendation



Everyone invited to comment



Anyone can raise issues





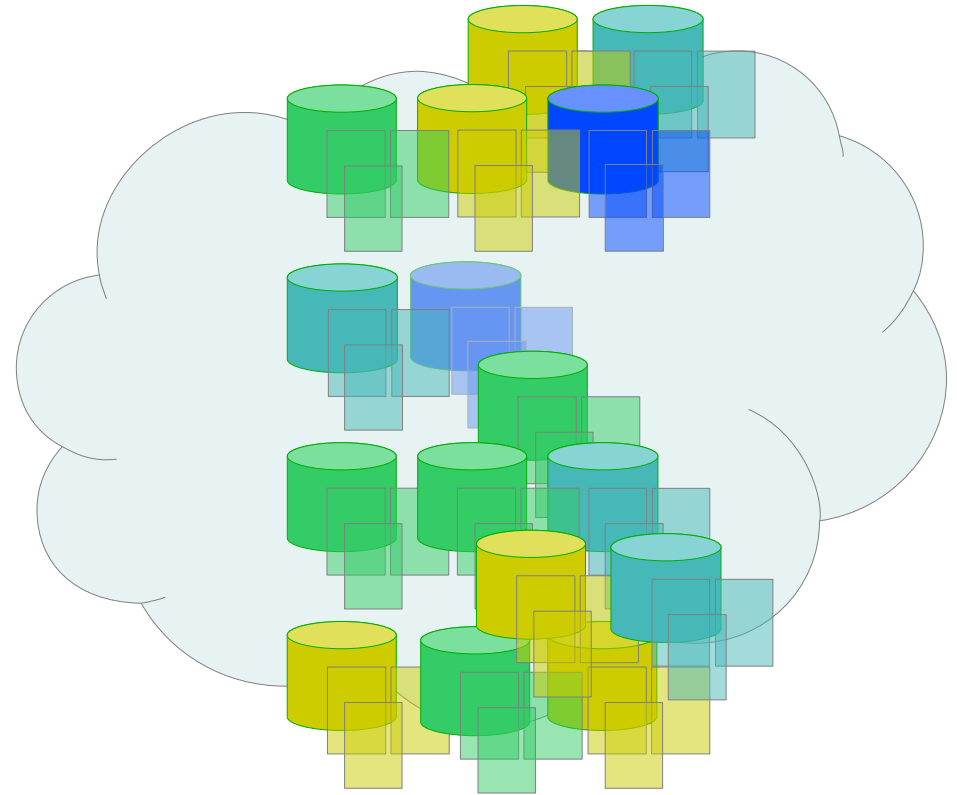
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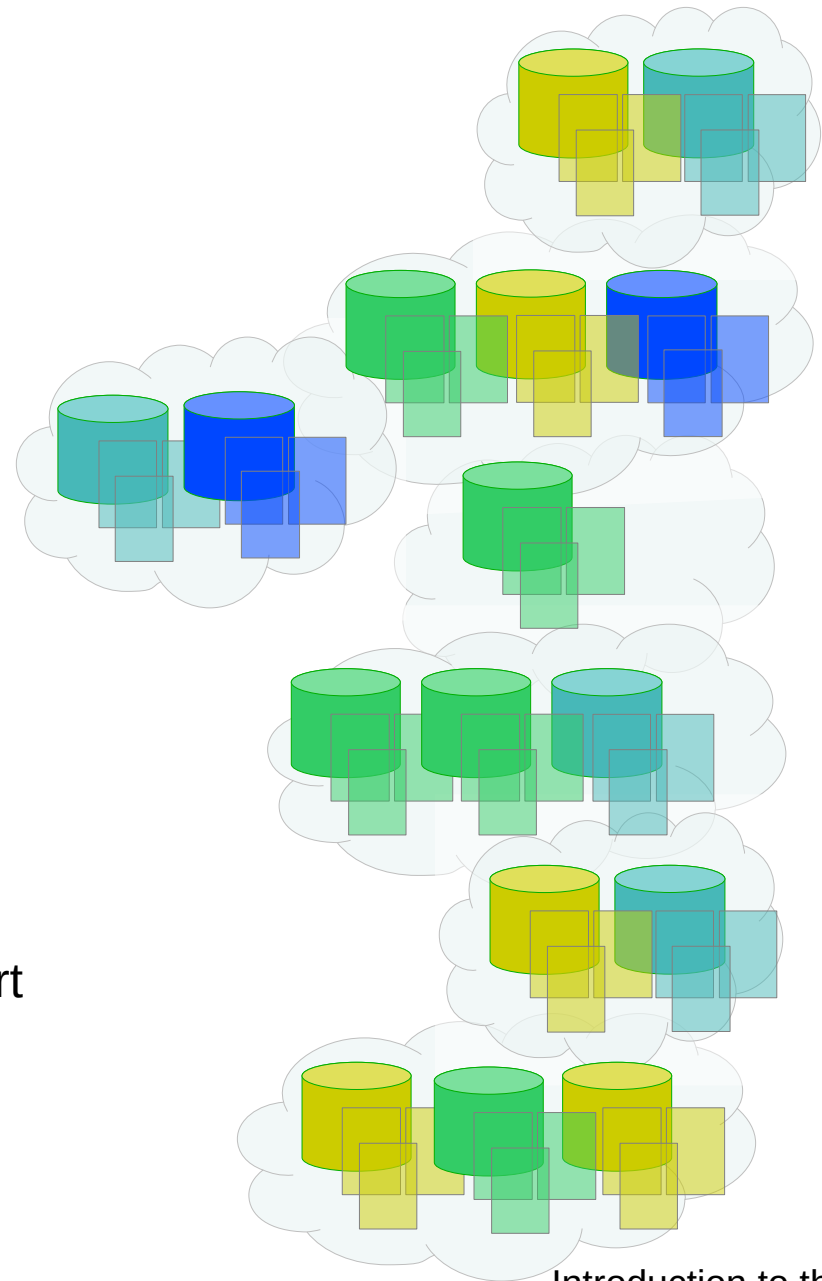
## The Virtual Observatory

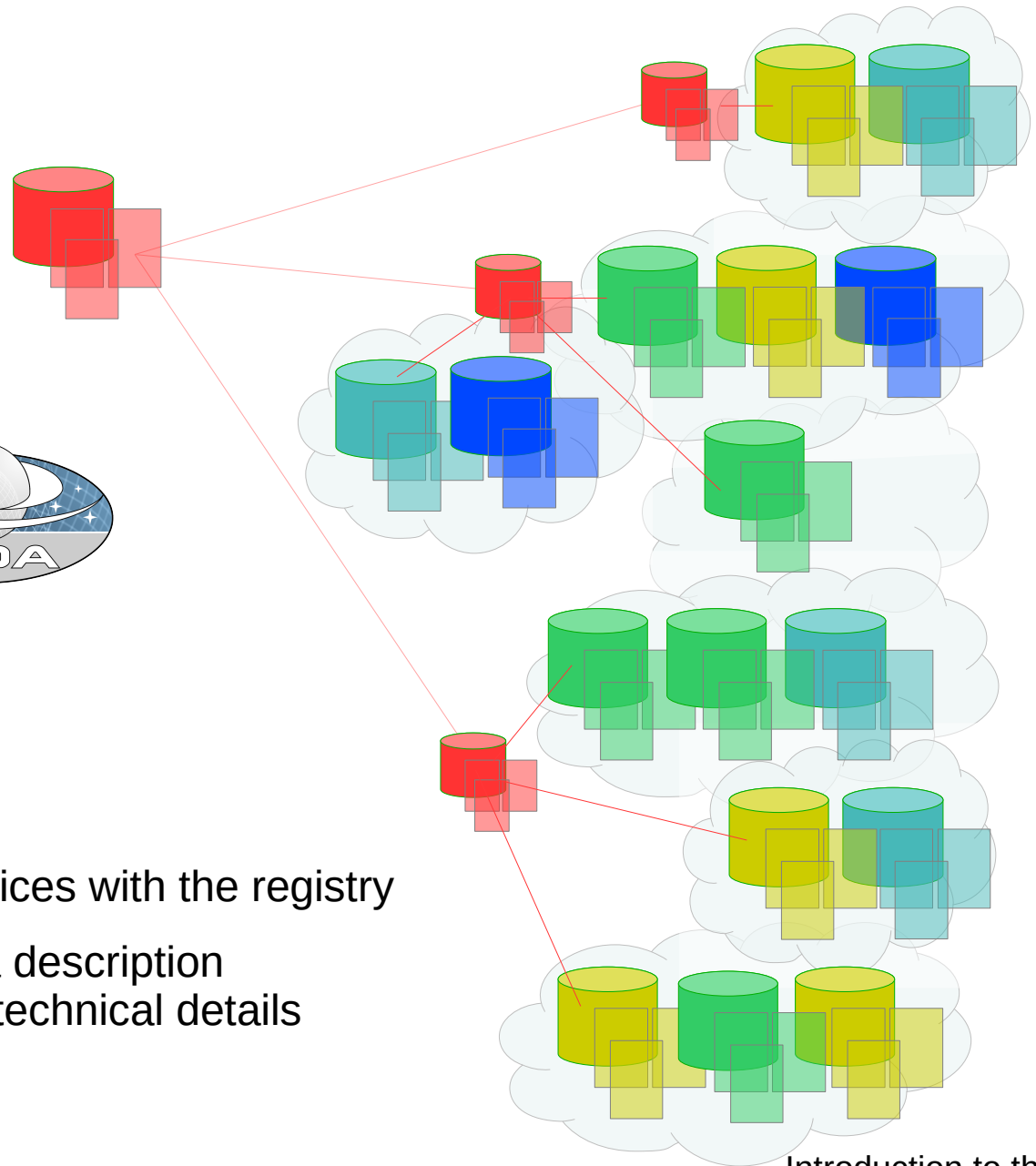
Data from all over the world .... in the cloud





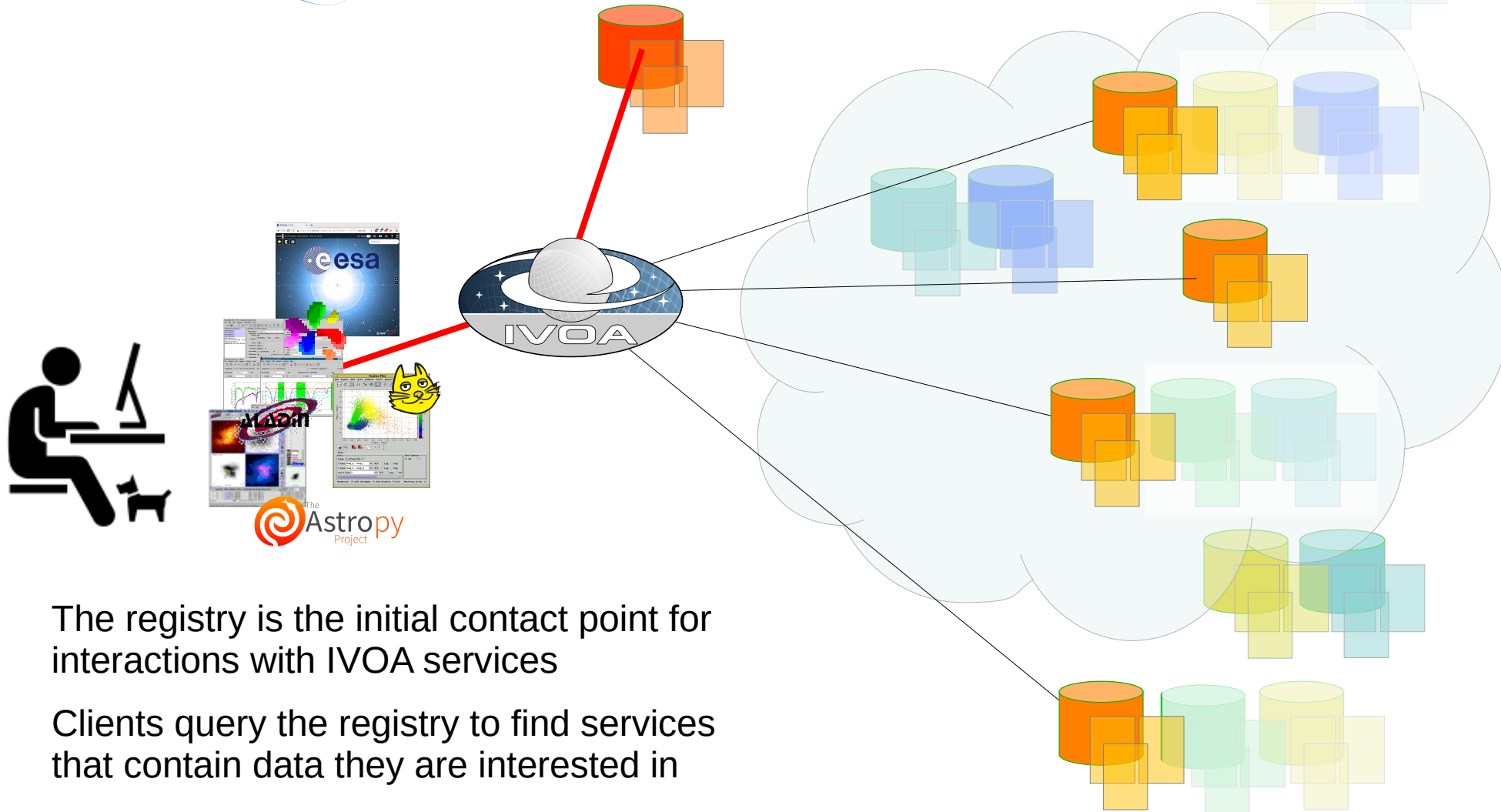
Lots of individual services each playing their part  
But ... how do you know where everything is ?





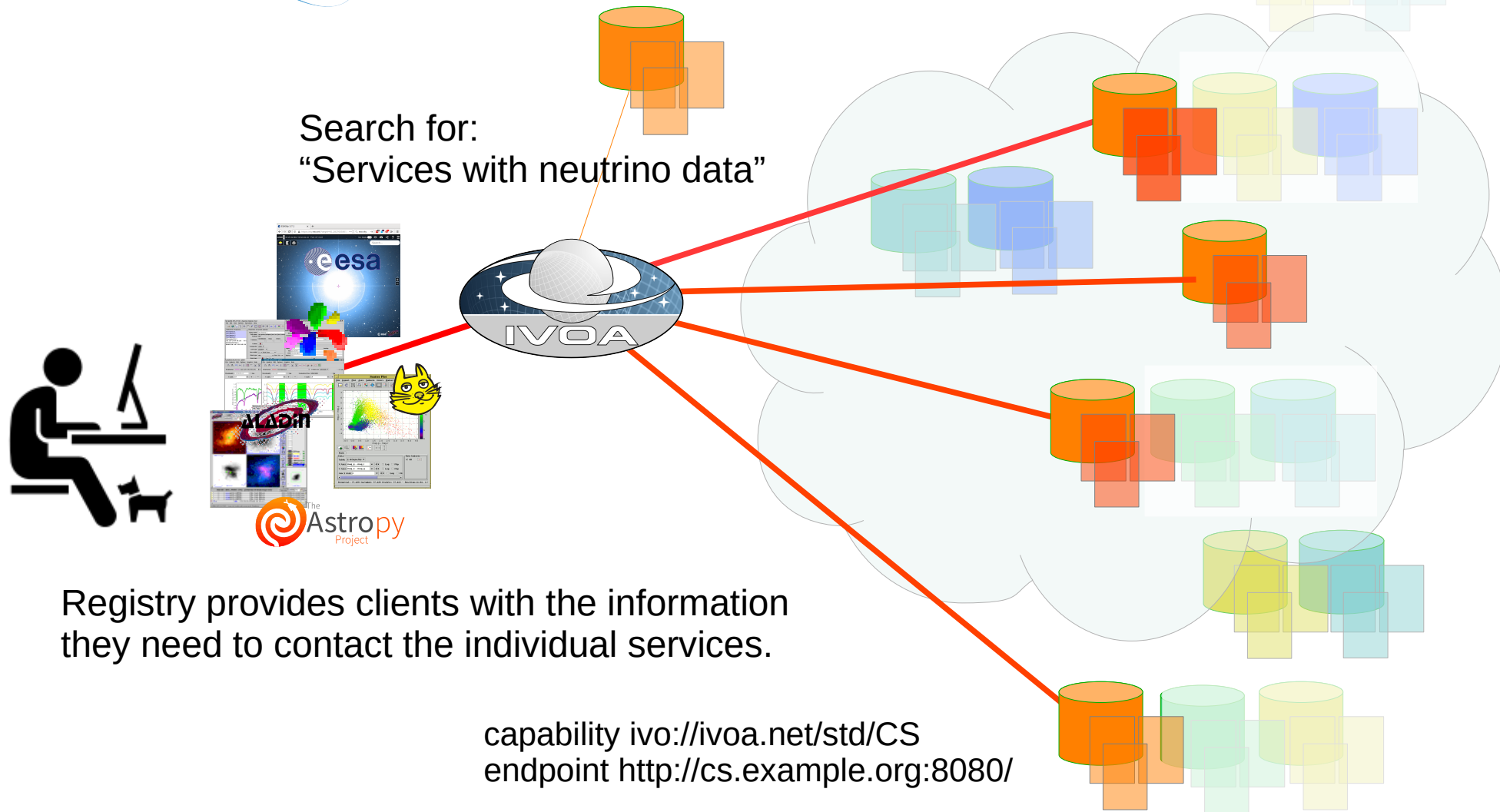
Data providers register their services with the registry

Registration metadata includes a description of the data they provide and the technical details of how to connect



The registry is the initial contact point for interactions with IVOA services

Clients query the registry to find services that contain data they are interested in







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## Simple Cone Search

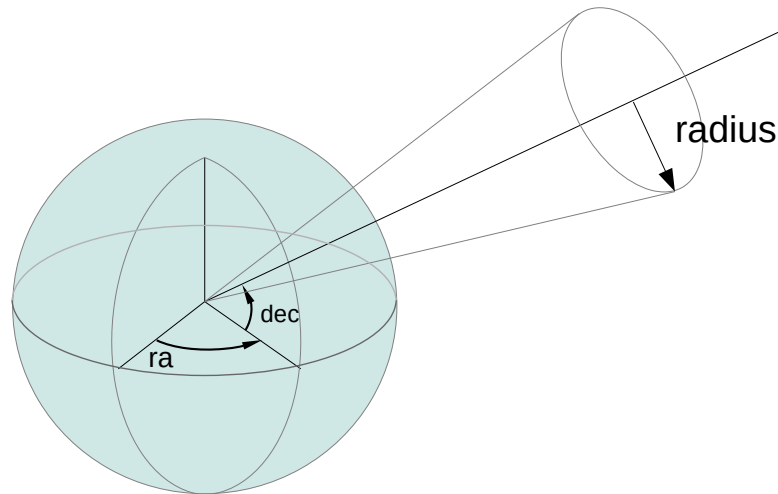
One of the earliest services  
defined by the IVOA

Version 1.0 adopted as an  
IVOA recommendation in 2006

RA =  $170^\circ$  (deg)

DEC =  $25^\circ$  (deg)

SR =  $30^\circ$  (deg)



<https://ivoa.net/documents/latest/ConeSearch.html>

# Simple Cone Search

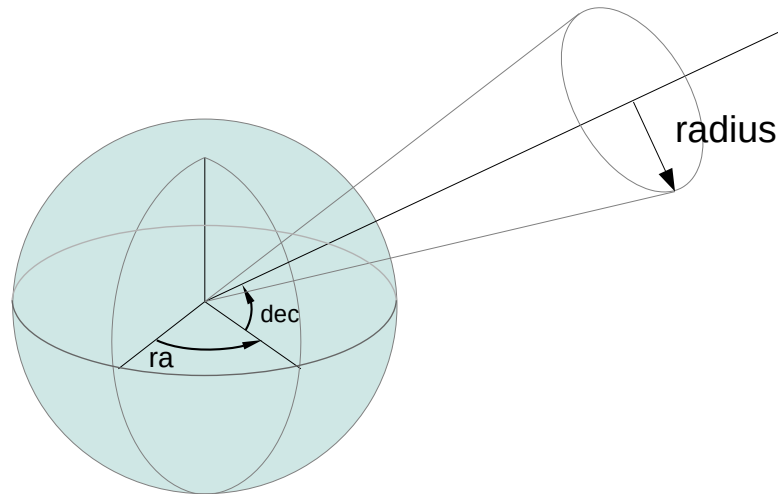
Simple HTTP GET request

<https://ivoa.example.net/cone?RA=170&DEC=25&SR=30>

RA = 170° (deg)

DEC = 25° (deg)

SR = 30° (deg)



<https://ivoa.net/documents/latest/ConeSearch.html>



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# Unified Content Descriptors (UCD)

Different data providers have a different table structures

Data provider #1

column name

RA

Decl

ID

....

....

column name

objid

....

ra

dec

....

....

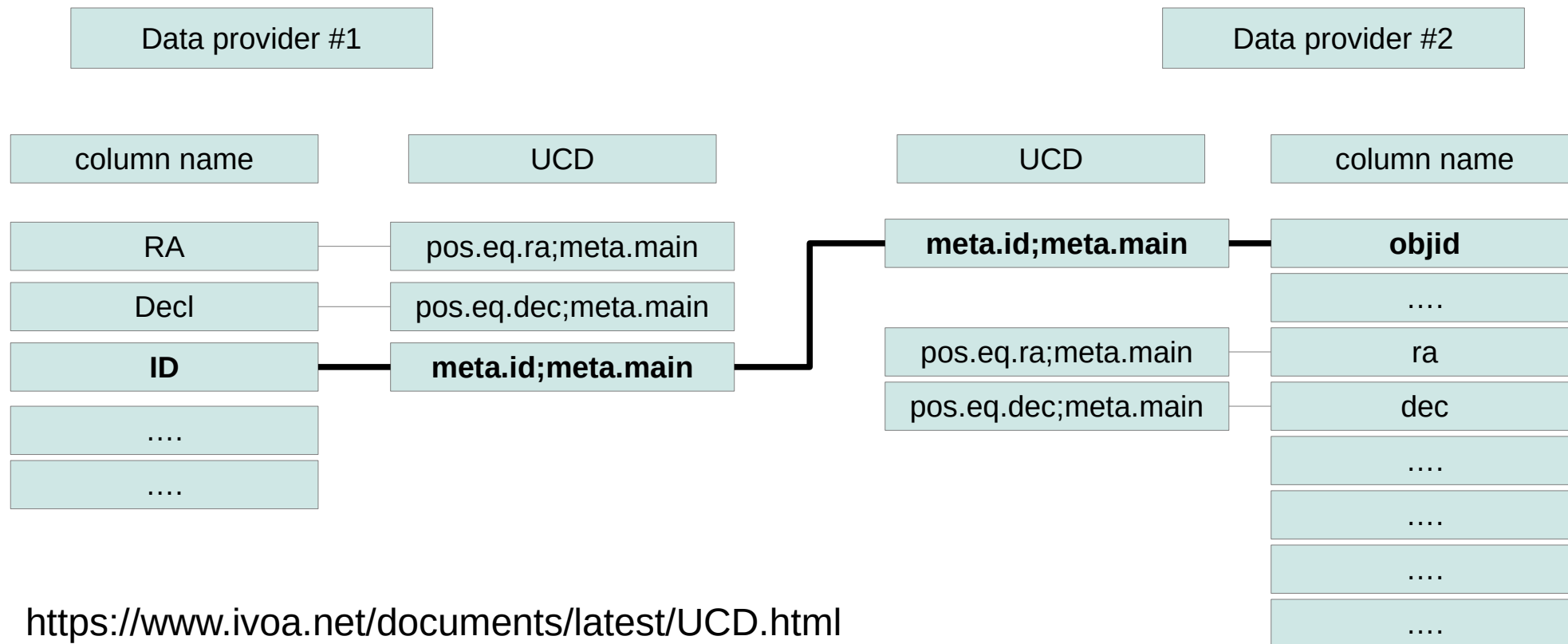
....

....

?

# Unified Content Descriptors (UCD)

TAP schema and UCDs enable **clients** to figure out the mapping





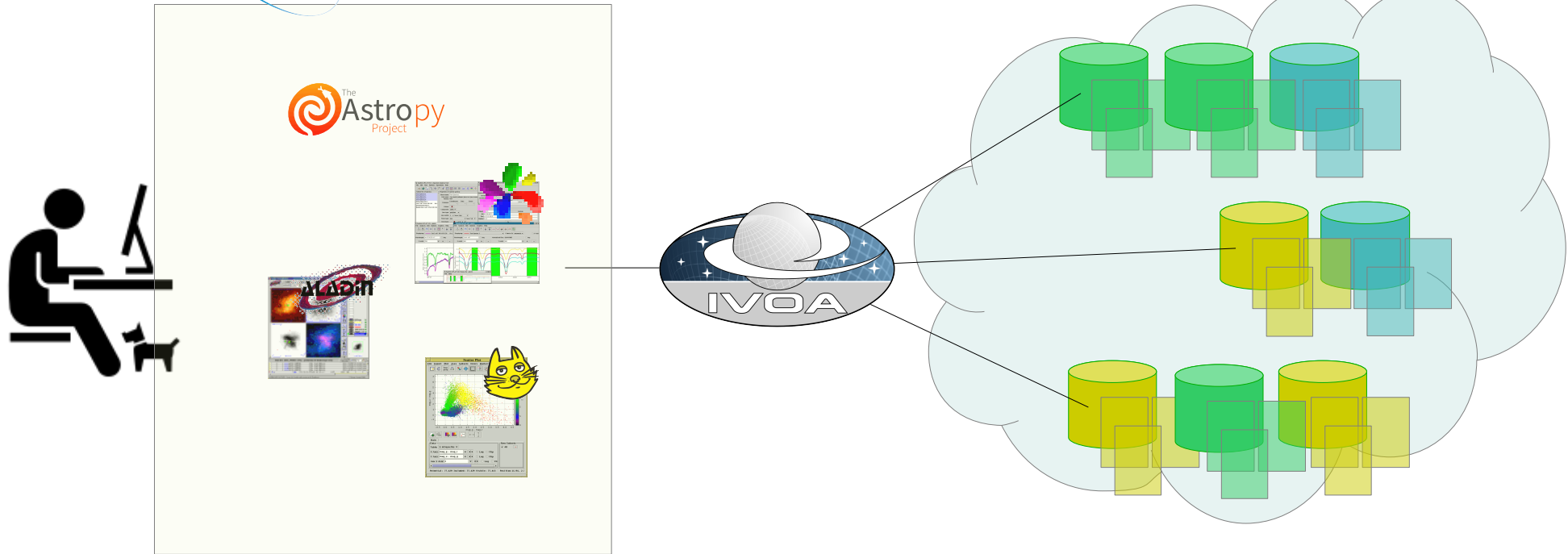
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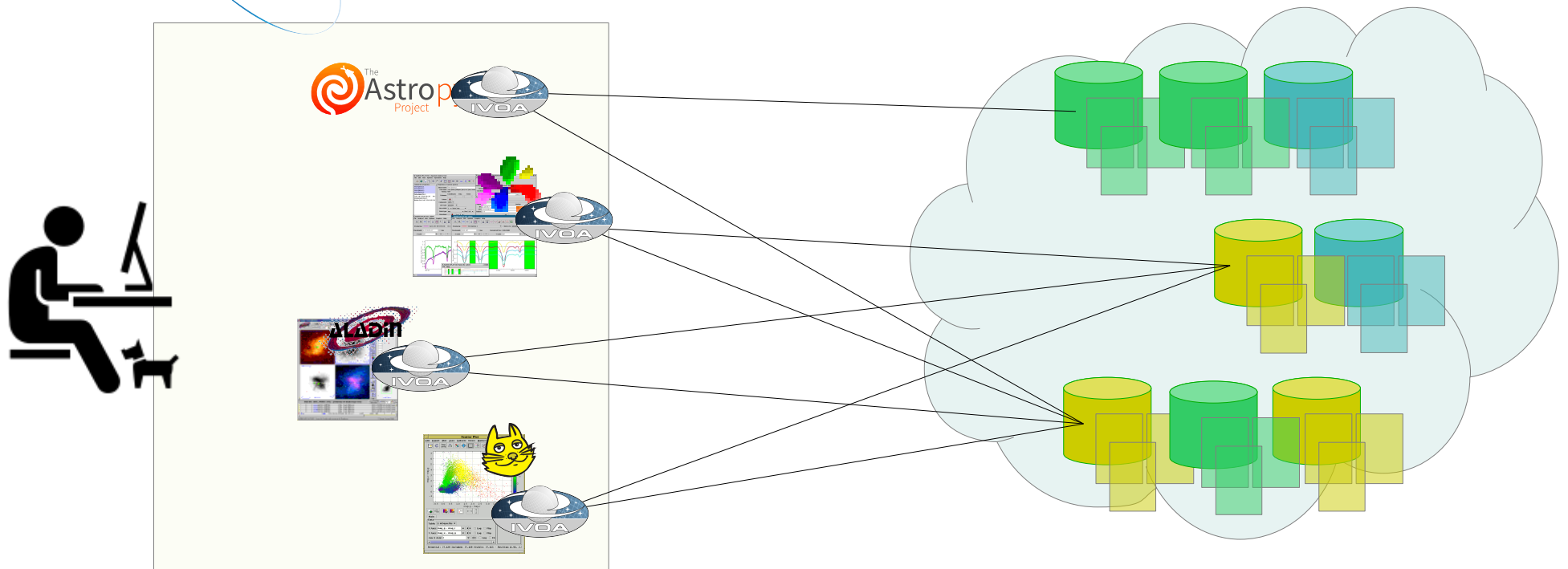
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## The Virtual Observatory

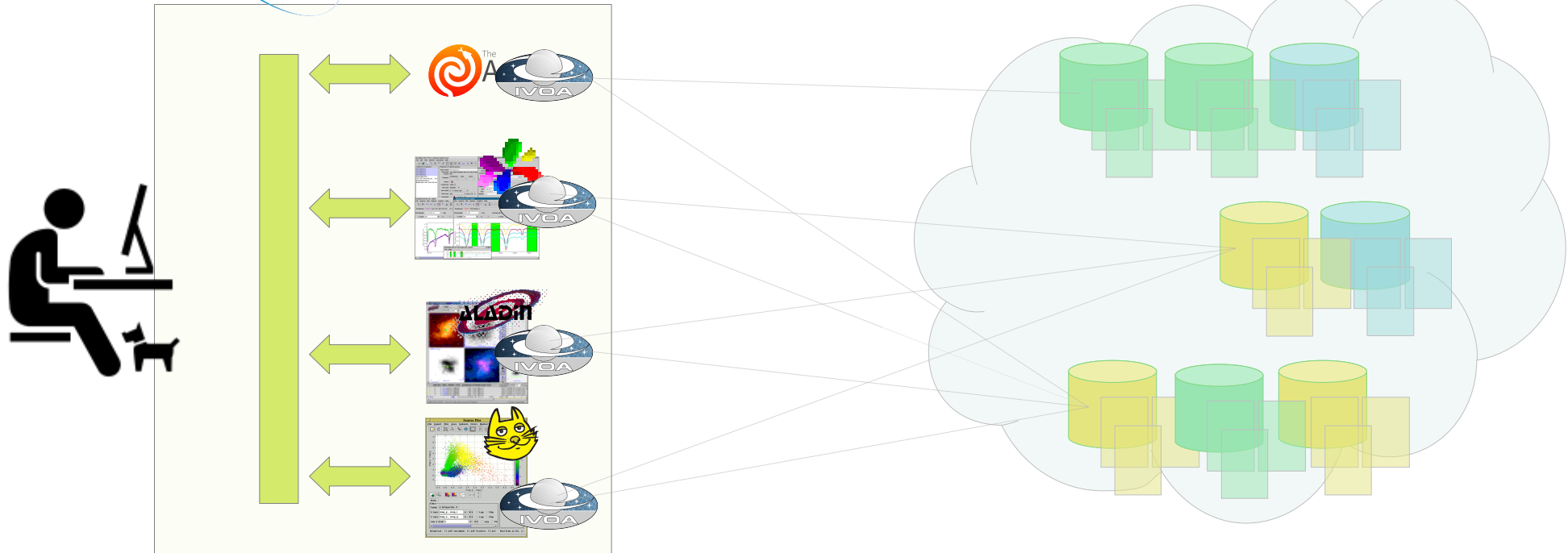
All the data from the cloud .... available on your desktop





All the data from the cloud .... to each desktop app

Each application maintains its own connection to the VO



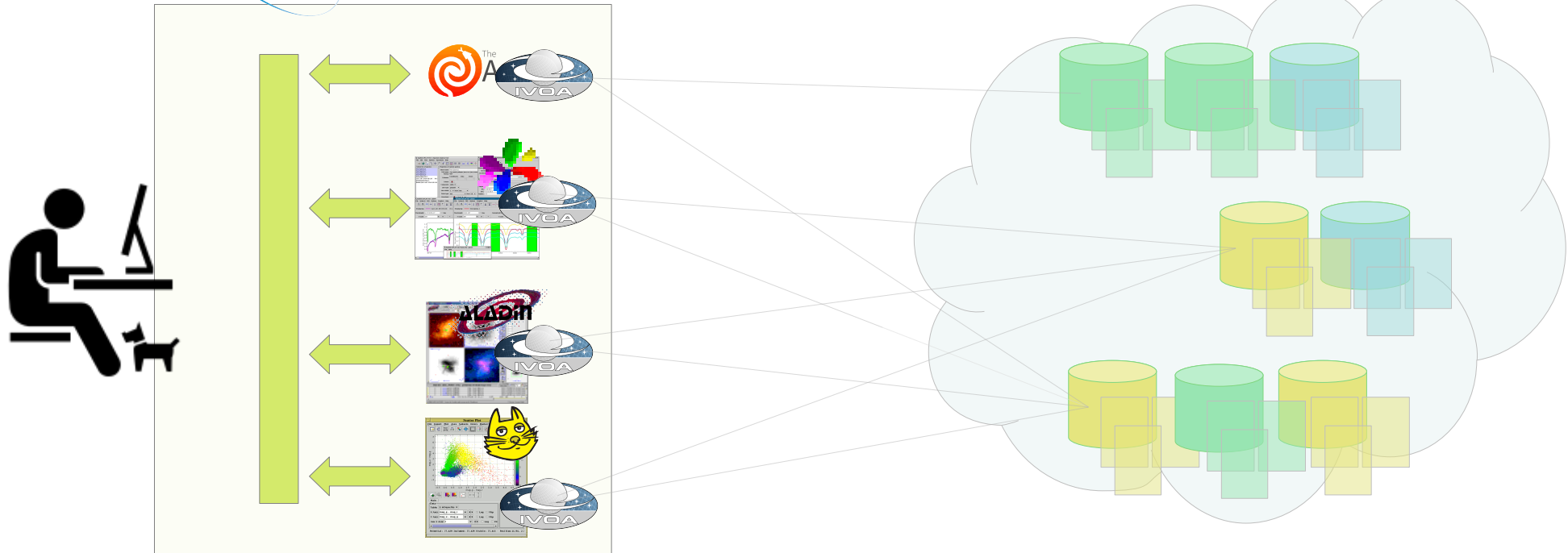
SAMP is a message bus within your local computer

Applications can use SAMP to send messages to each other

```
table.load.votable <http://example.org/.../table.vot>
```

```
image.load.fits <http://example.org/.../image.fits>
```

```
coord.pointAt.sky <ra,dec>
```



Messages can be sent to specific applications

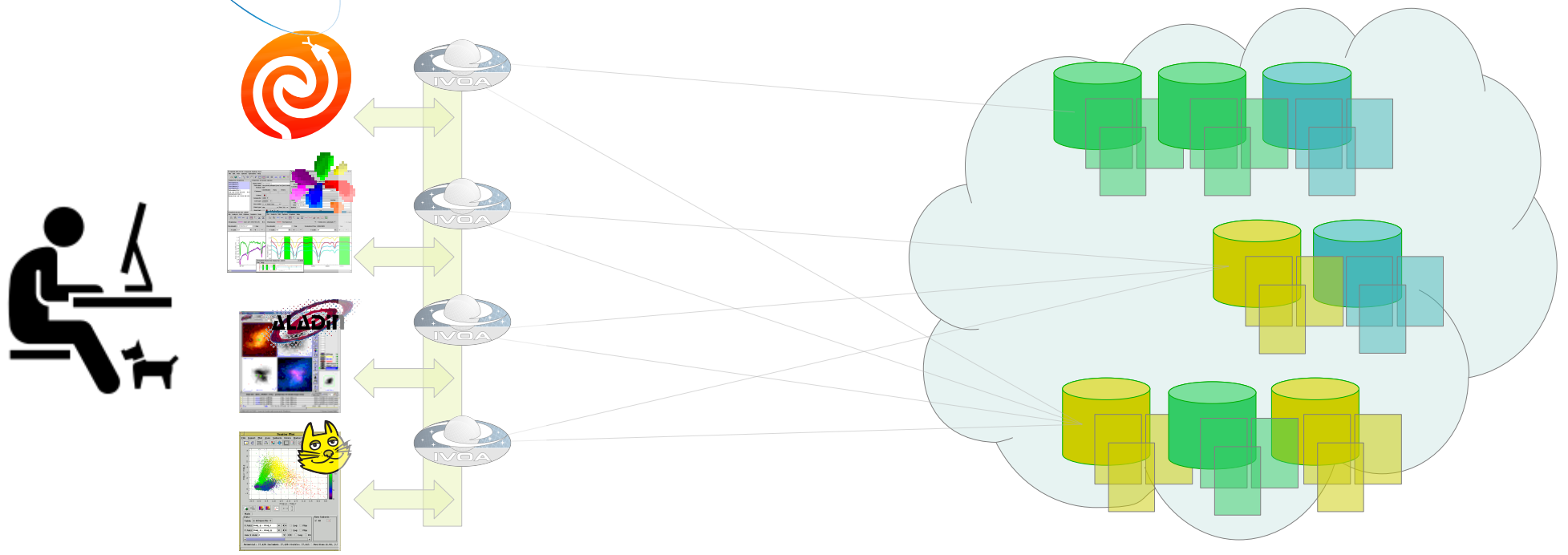
Send to Aladin:

`image.load.fits <http://example.org/.../image.fits>`

Or broadcast to all listeners

Send to all:

`coord.pointAt.sky <ra,dec>`



## The Virtual Observatory

If we have done our job right, all the details disappear

All the data from the cloud appears to be one big dataset accessible through your desktop



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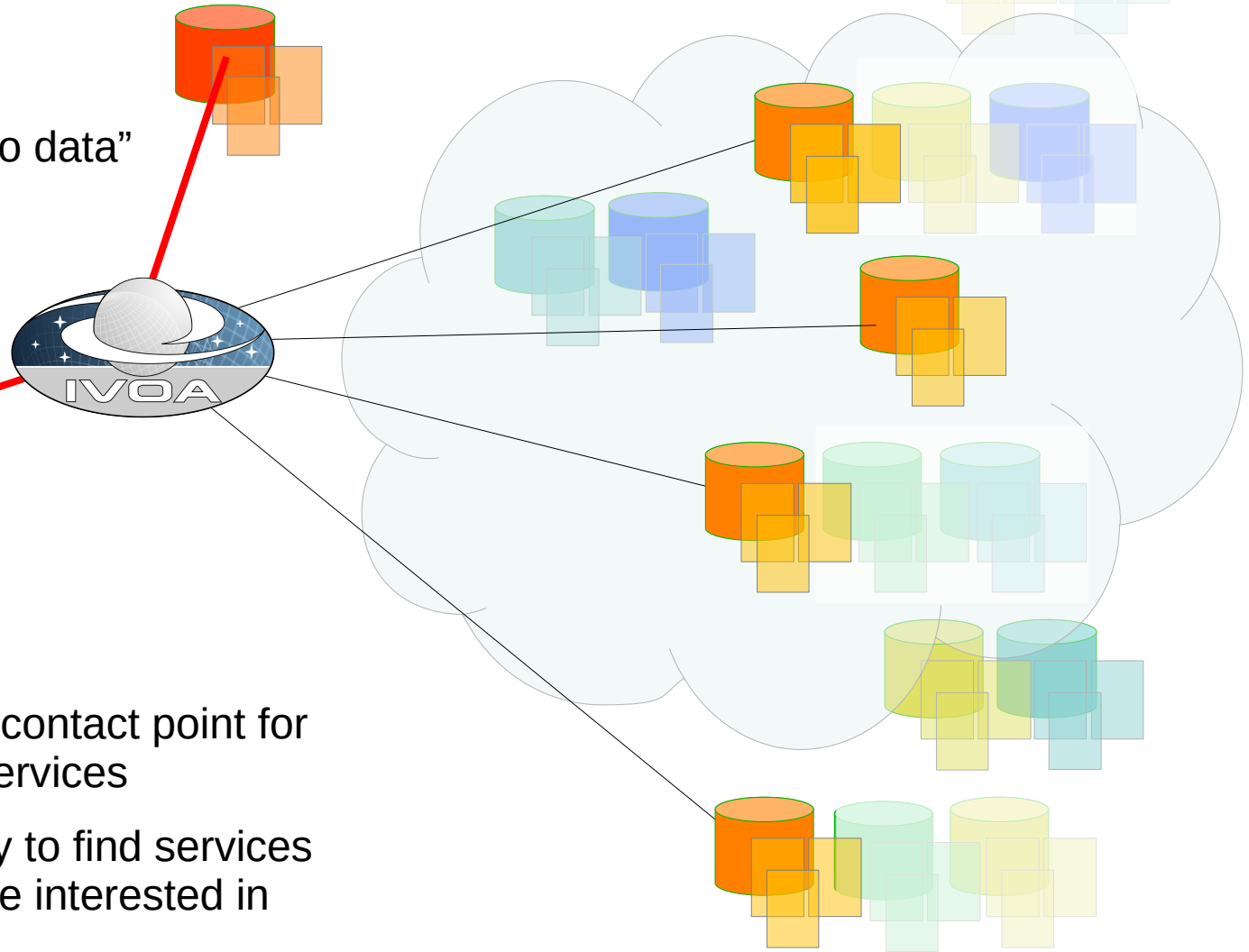


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Search for:  
“Services with neutrino data”



The registry is the initial contact point for interactions with IVOA services

Clients query the registry to find services that contain data they are interested in

## Registry Resource Record :

### Service capabilities

TAP, ObsTap, ConeSearch, SIAP, SSAP

### Collection metadata

Sky coverage (MOC)

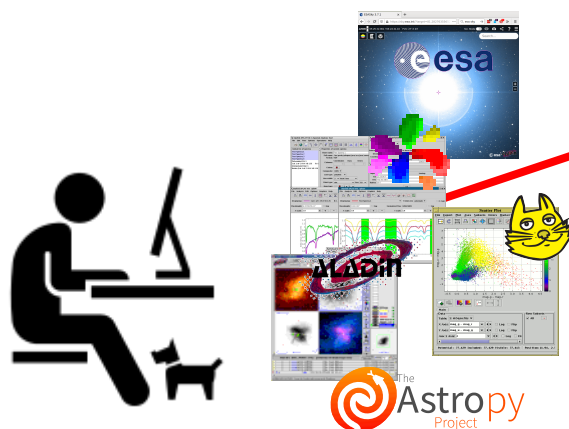
Waveband

Infra-red, optical, ultra-violet, xray

### Database catalogs

### Table and column metadata

Search for:  
"Services with neutrino data"



Data providers publish metadata about their services and the data they contain

Client applications can use standard terms to help the user discover the data they need

## Registry Resource Record :

Service capabilities

TAP, ObsTap, ConeSearch, SIAP, SSAP

Collection metadata

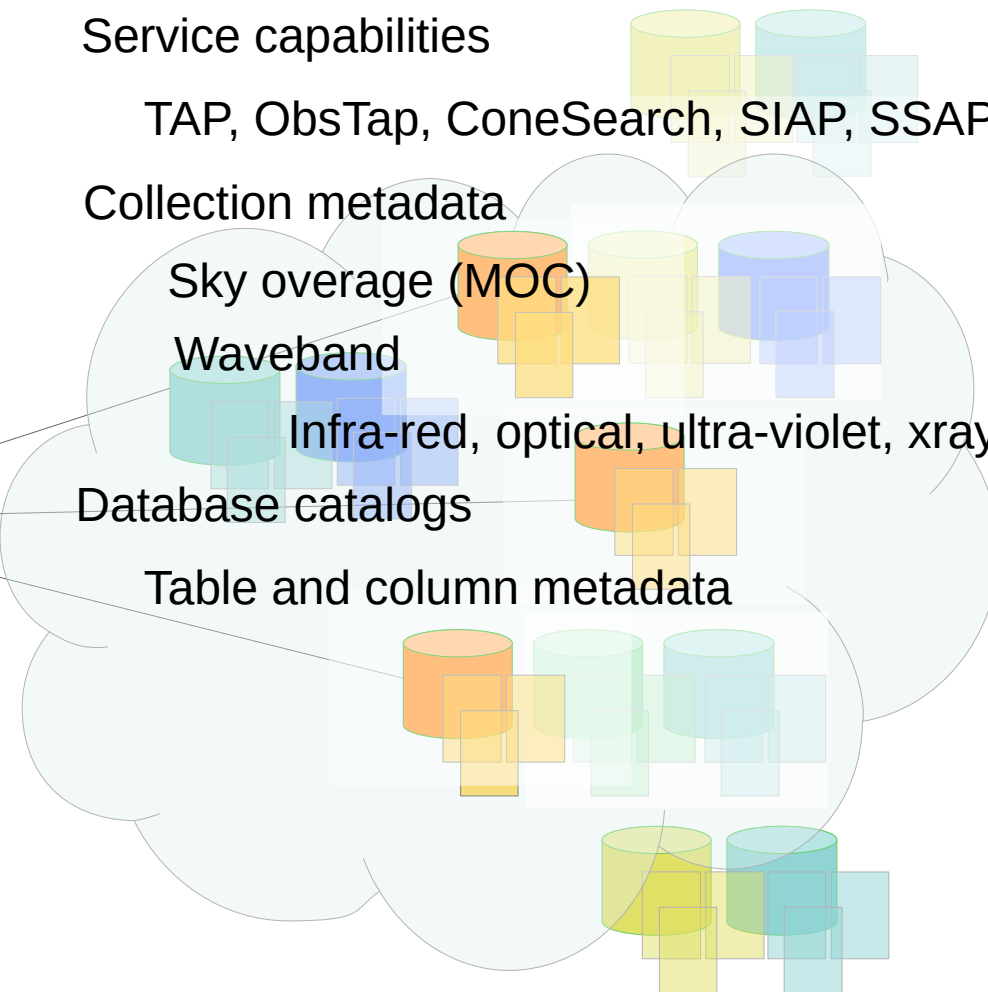
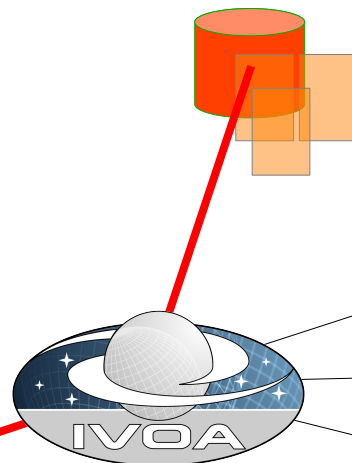
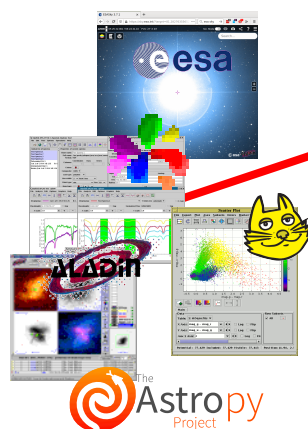
Sky overage (MOC)

Waveband

Infra-red, optical, ultra-violet, xray

Database catalogs

Table and column metadata



For more details on how to publish data:

<https://wiki.ivoa.net/twiki/bin/view/IVOA/PublishingInTheVO>

The service standards define what metadata is required for each type of service





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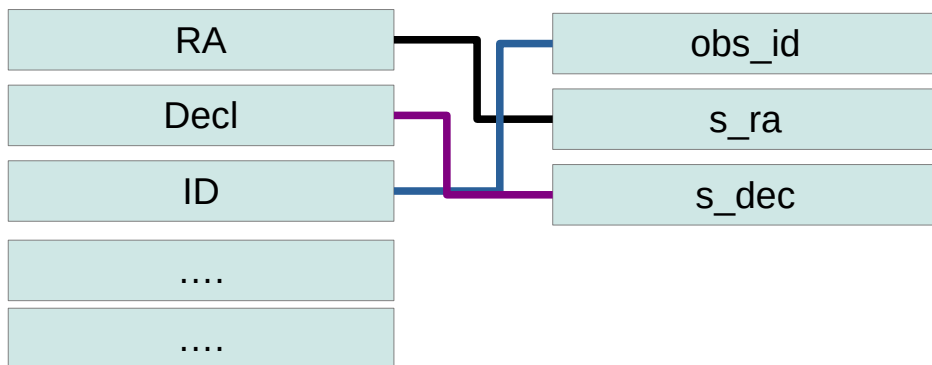
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# Observation Data Model Core Components

ObsCore adds a standard view to the data in each data provider

Data provider #1

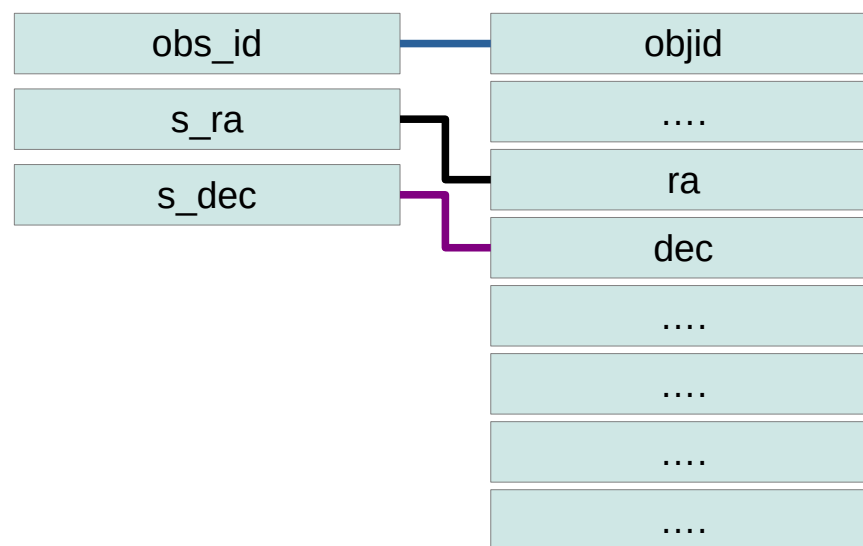
```
CREATE VIEW ivoa.ObsCore ( .... )
```



<https://www.ivoa.net/documents/ObsCore/>

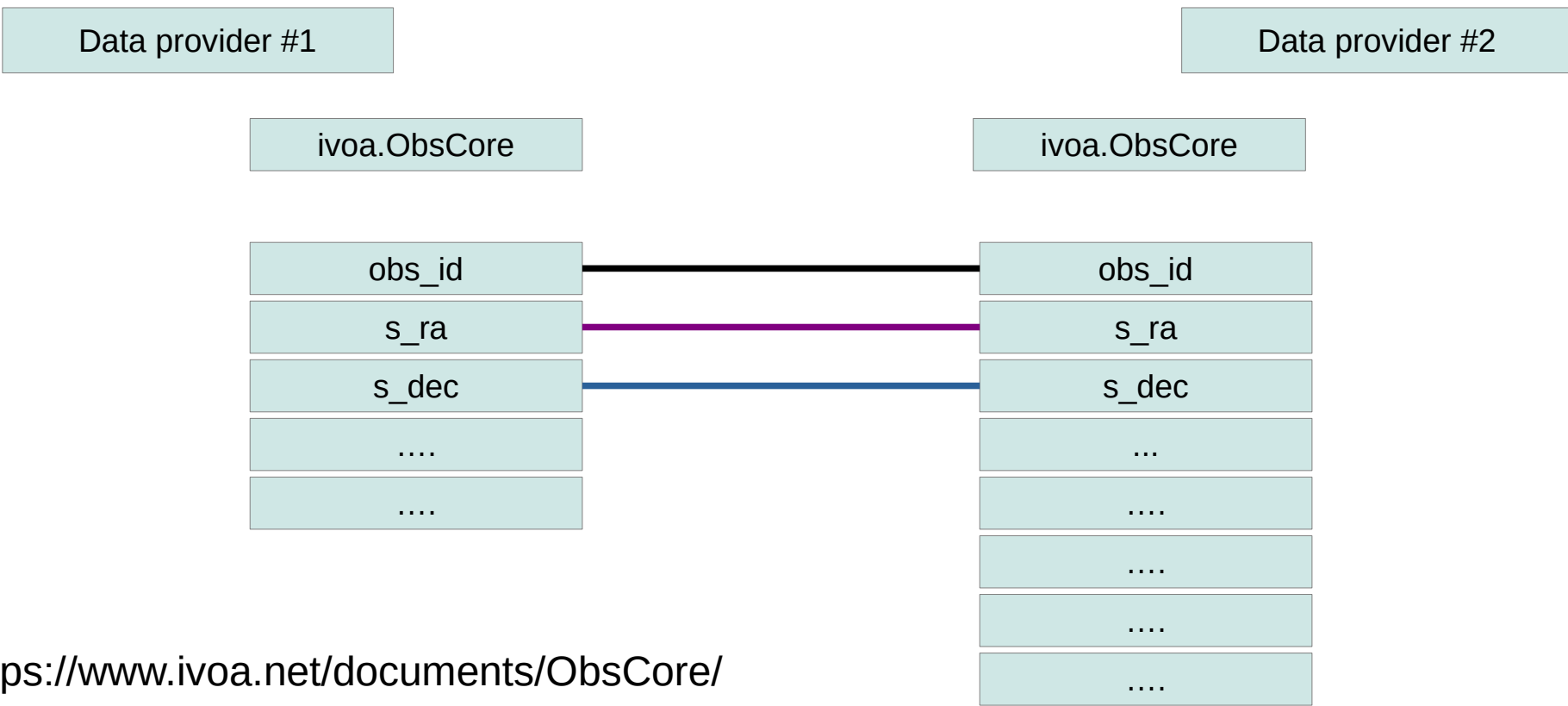
Data provider #2

```
CREATE VIEW ivoa.ObsCore ( .... )
```



# Observation Data Model Core Components

Now the public tables in **both** providers are the same



<https://www.ivoa.net/documents/ObsCore/>



# Observation Data Model Core Components

Now, the same query can be applied to **both** services

Data provider #1

Data provider #2

ivoa.ObsCore

ivoa.ObsCore

**SELECT**

**\*** obs\_id

**FROM** ivoa.obscore AS db

**JOIN** TAP\_UPLOAD.It AS mine

**ON** 1=CONTAINS (

POINT('ICRS', db.s\_ra, db.s\_dec),

CIRCLE('ICRS', mine.RA, mine.Decl, mine.Beta)

)

**AND**

db.dataproduct\_type='image'

obs\_id

s\_ra

s\_dec

...

....

....

....



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Science based interest groups

Scientific use cases

theory  
time-series

Science priorities for the IVOA

Science platforms

Machine learning

Multi-messenger astronomy

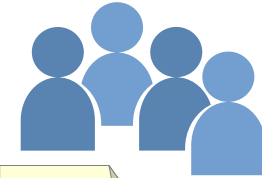
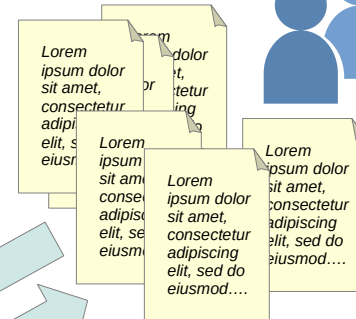
Science priorities committee



Scientists from IVOA members and major astronomy projects

IVOA working groups  
e.g. DataAccessLayer,  
Applications,  
Semantics

Working group email list



Everyone invited to discuss

New standards being developed

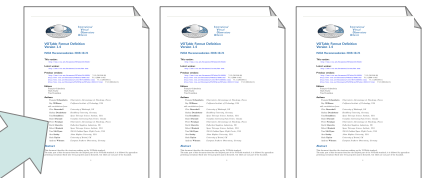
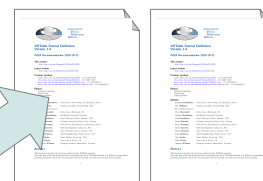
ObjVisSAP    ObsLocTAP

TIMESYS    Multi-order Coverage (MOC)

Hierarchical Progressive Surveys (HiPS)

Request For Comment (RFC) document

IVOA recommendation



Everyone invited to comment



Anyone can raise issues

