

# International Virtual Observatory Alliance (IVOA) Newcomers Introduction

IVOA interop, October 2022

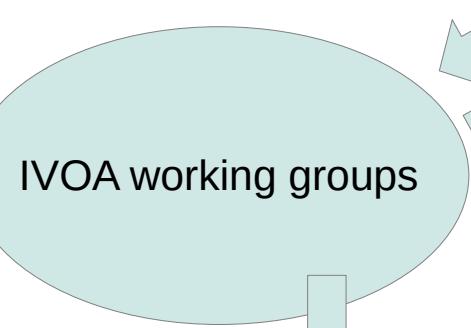
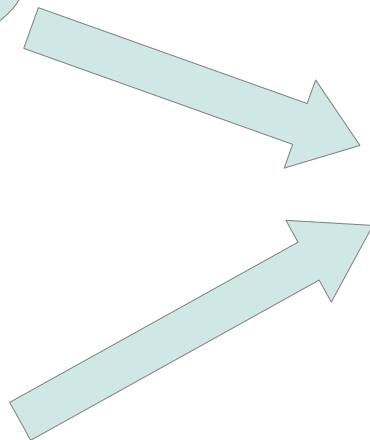
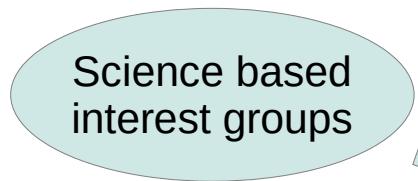
Hendrik Heinl, Dave Morris

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.

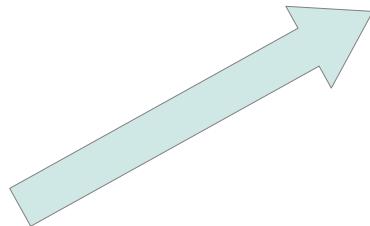




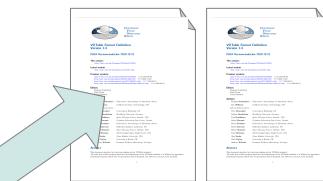
Everyone invited to develop  
science use cases



Scientists from IVOA members  
and major astronomy projects



Request For Comment  
(RFC) document

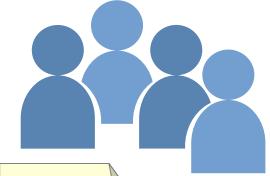
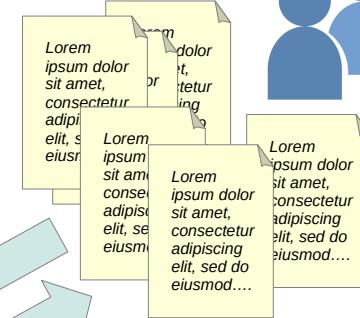


Everyone invited  
to comment

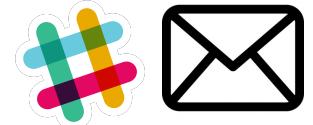
IVOA recommendation

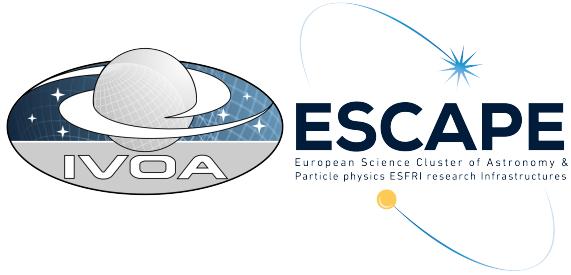


Working group discussions



Everyone invited  
to discuss





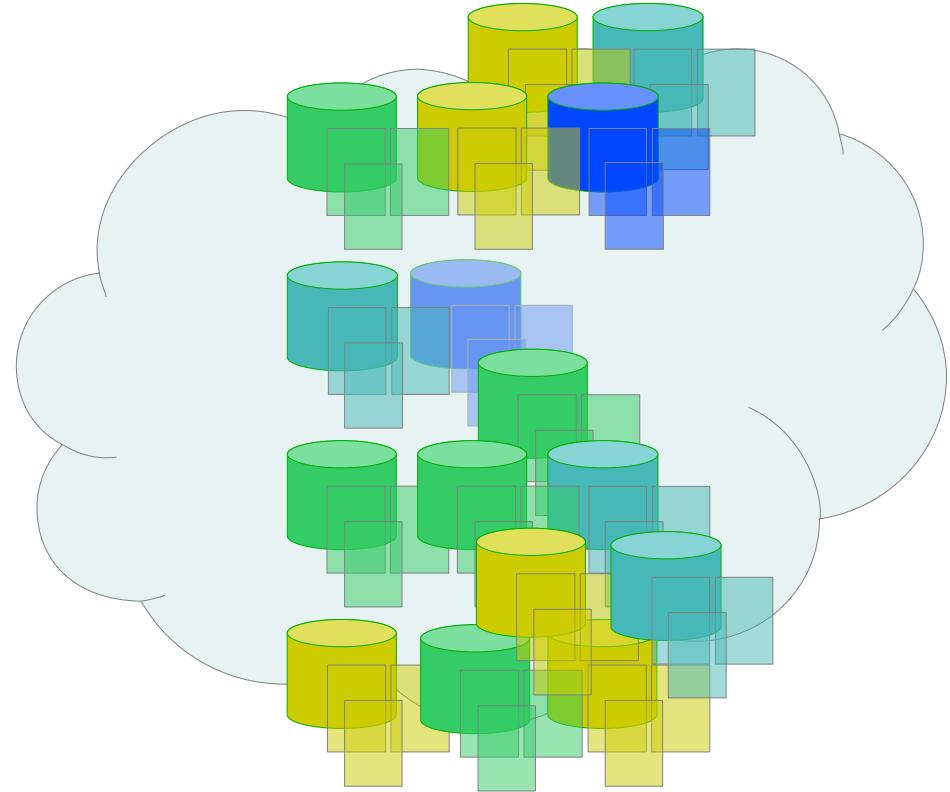
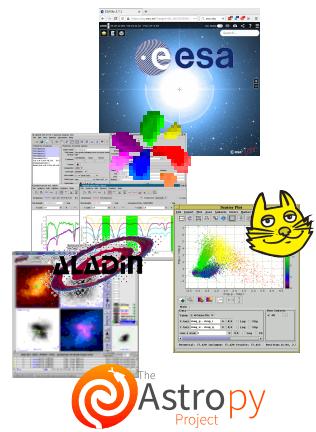
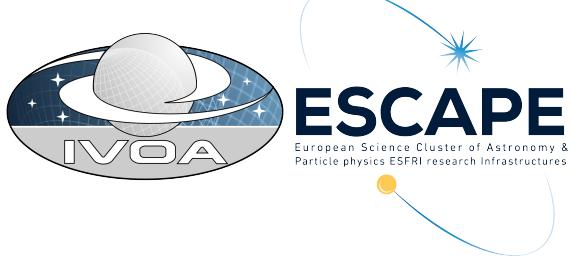
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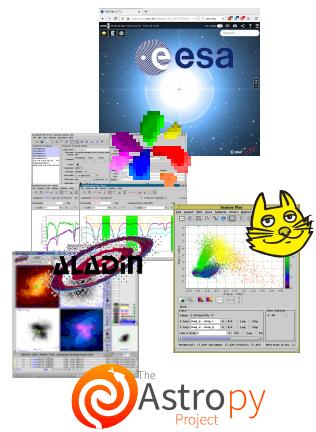
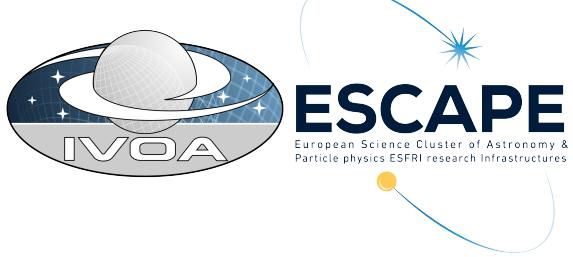
## The Virtual Observatory

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

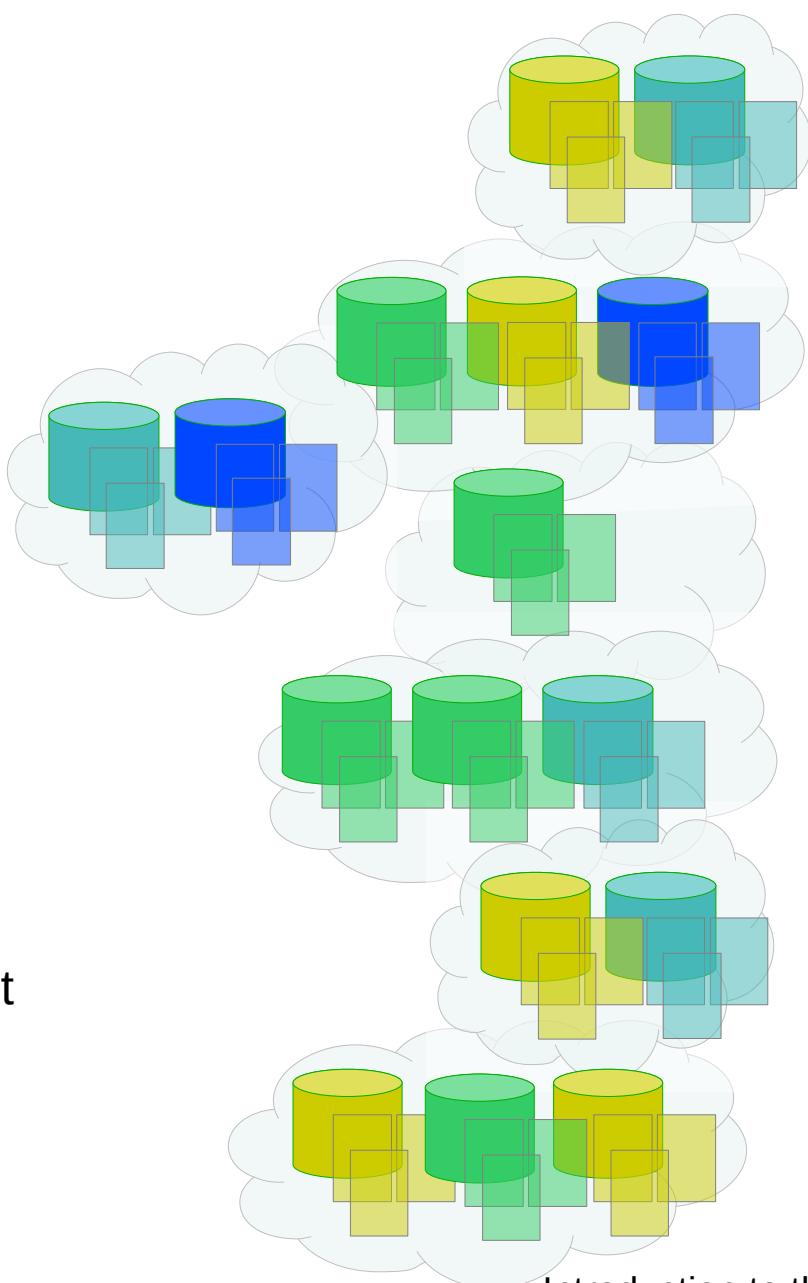
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Lots of individual services each playing their part  
But ... how do you know where everything is ?



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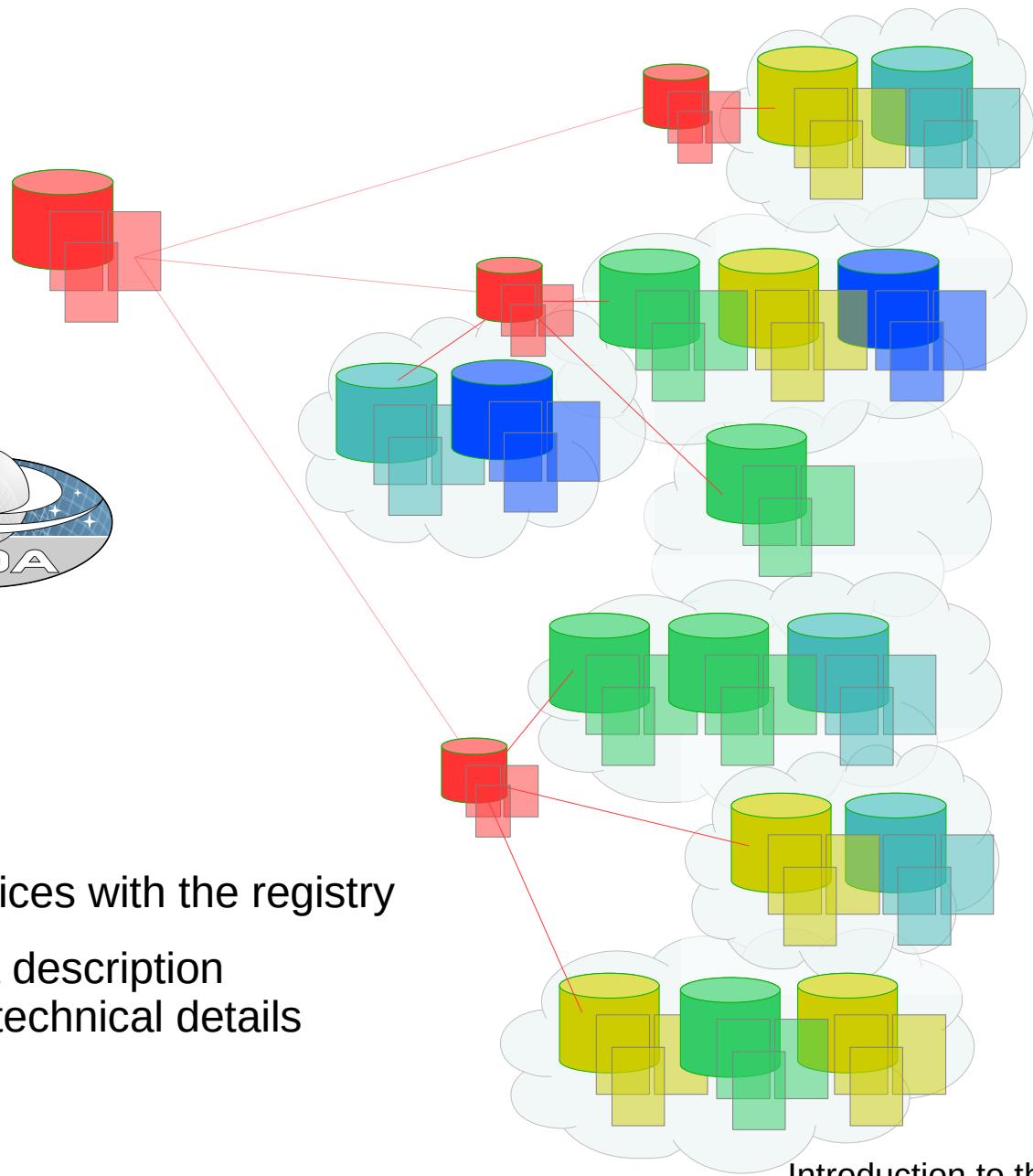




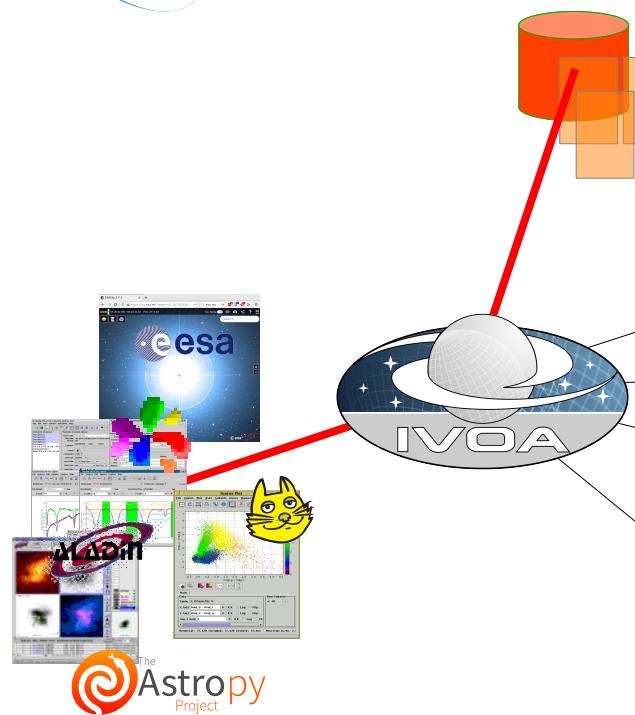
Data providers register their services with the registry

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

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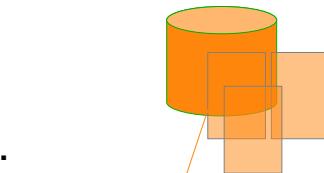
The registry is the initial contact point for interactions with IVOA services

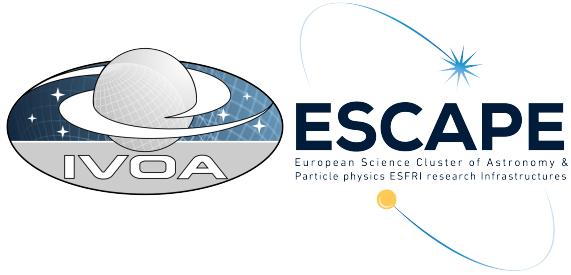
Clients query the registry to find services that contain data they are interested in



The Astropy  
Project

Search for:  
“Services with neutrino data”





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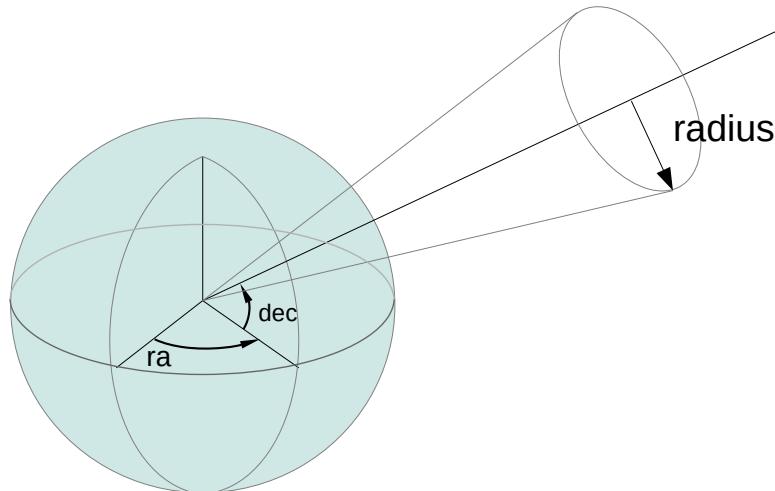
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# Simple Cone Search

One of the earliest services  
defined by the IVOA

RA =  $170^\circ$  (deg)  
DEC =  $25^\circ$  (deg)  
SR =  $30^\circ$  (deg)

Version 1.0 adopted as an  
IVOA recommendation in 2006



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

# Simple Cone Search

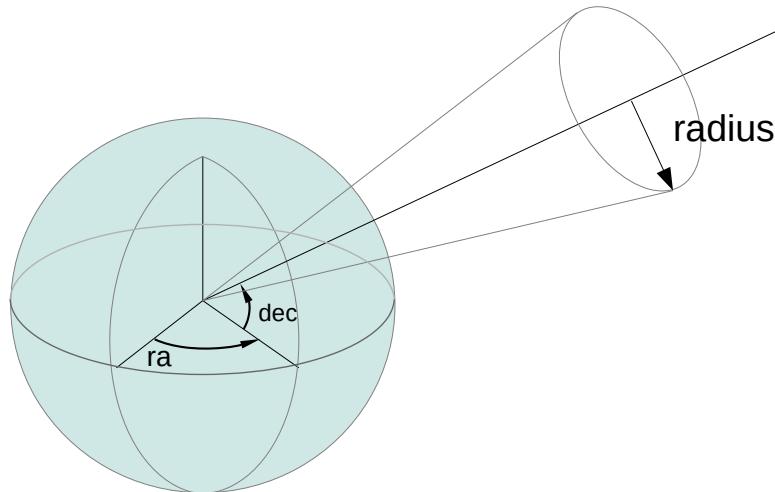
Simple HTTP GET request

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

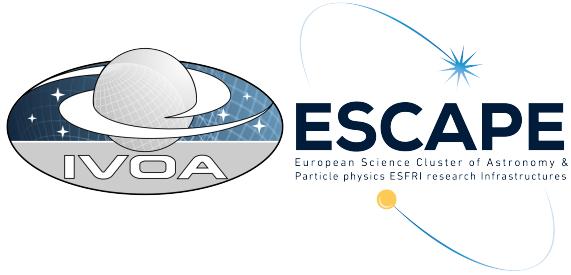
RA = 170° (deg)

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
....
....

Data provider #2

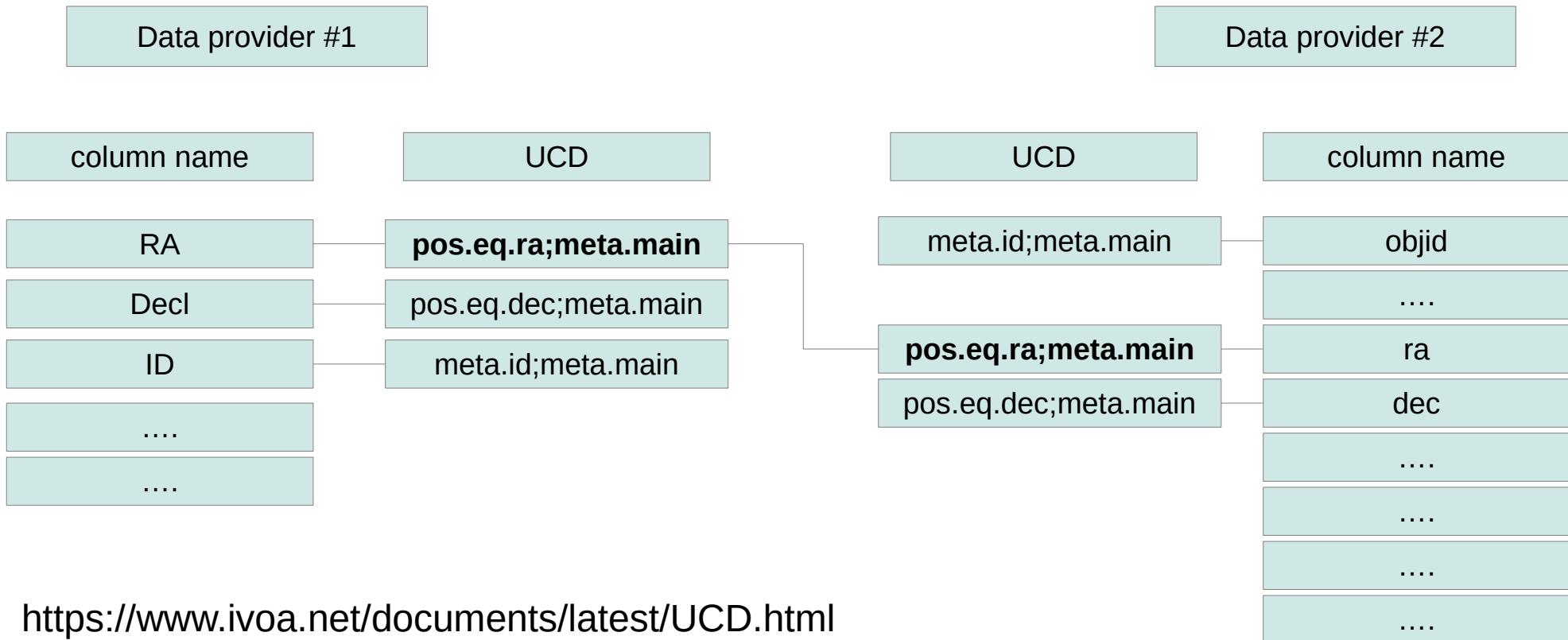
column name
objid
....
ra
dec
....
....
....
....





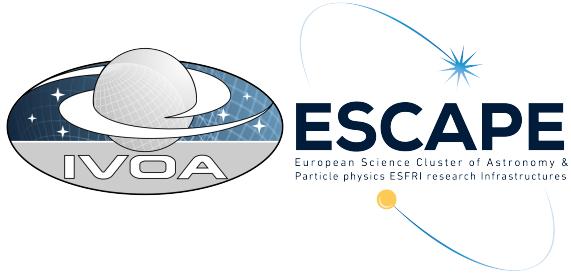
# Unified Content Descriptors (UCD)

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



<https://www.ivoa.net/documents/latest/UCD.html>





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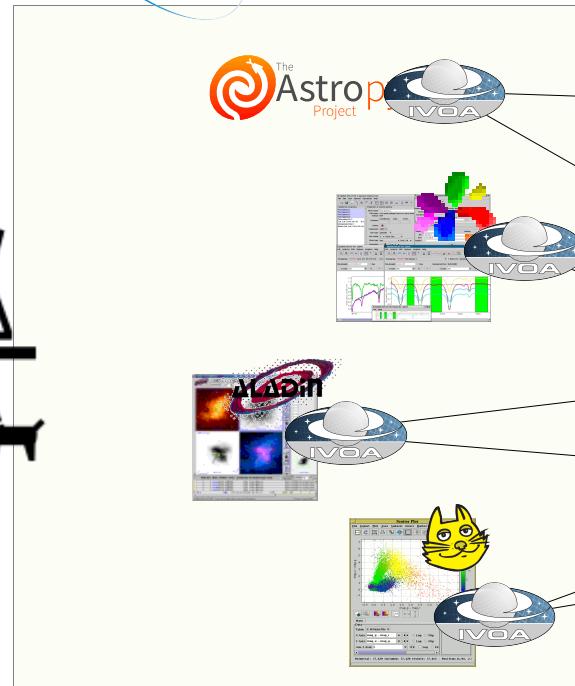


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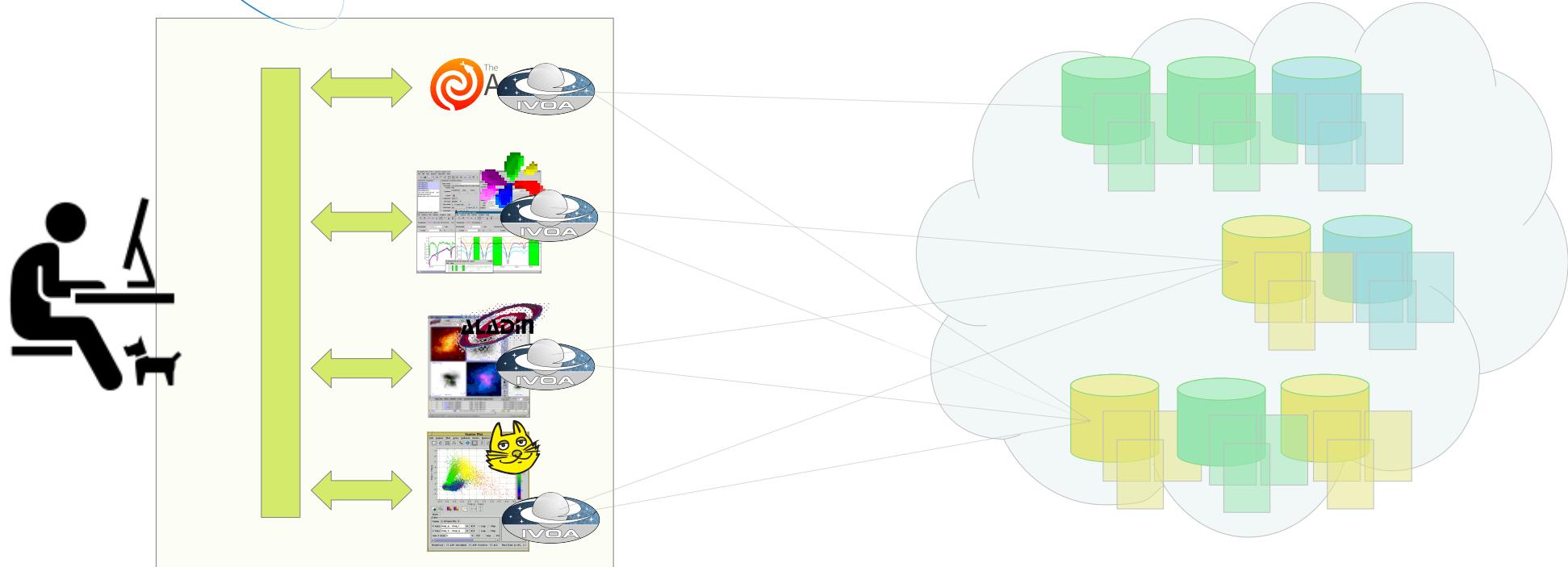
## The Virtual Observatory

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



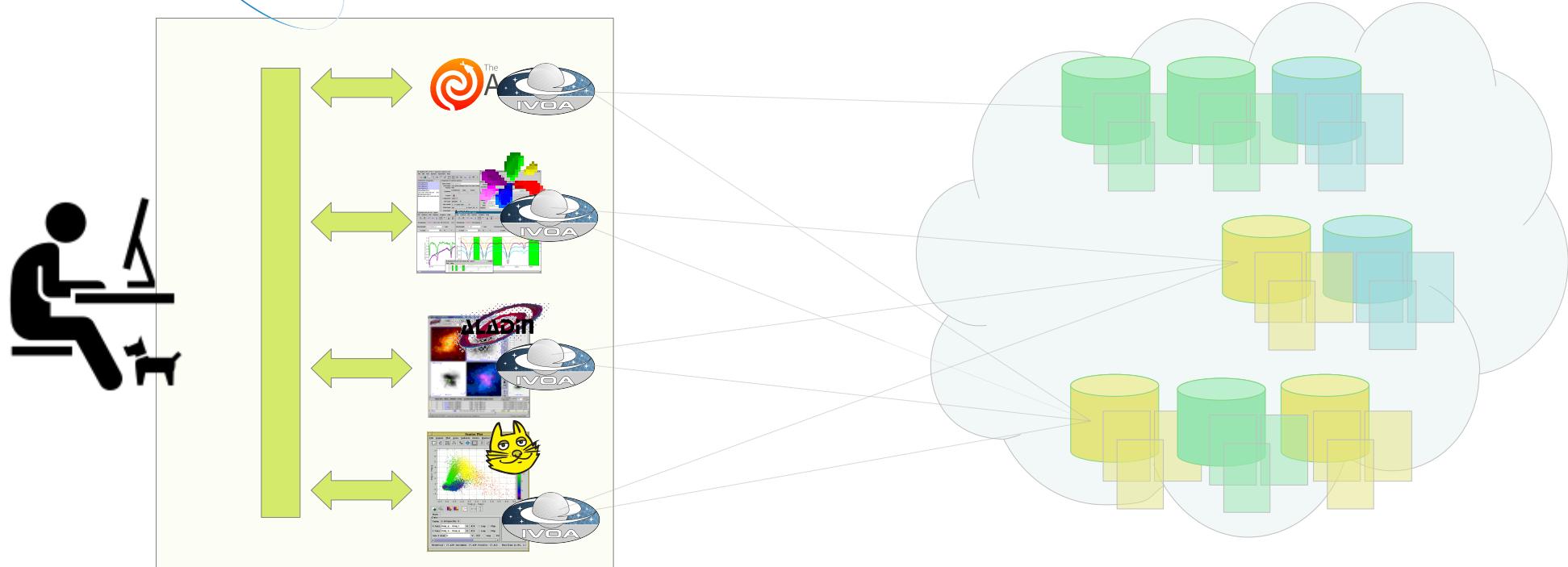
SAMP is a message bus within your local computer

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

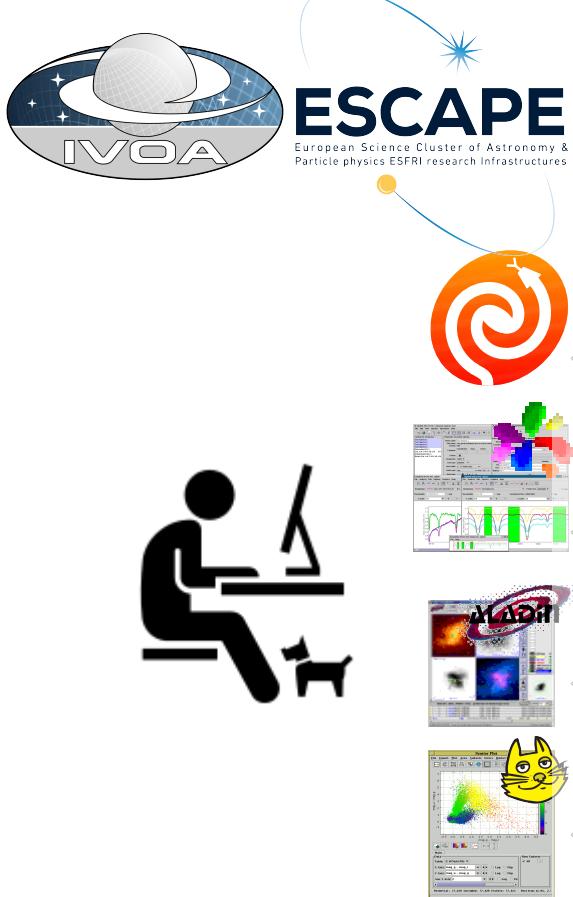
Send to Aladin:

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

Or broadcast to all listeners

Send to all:

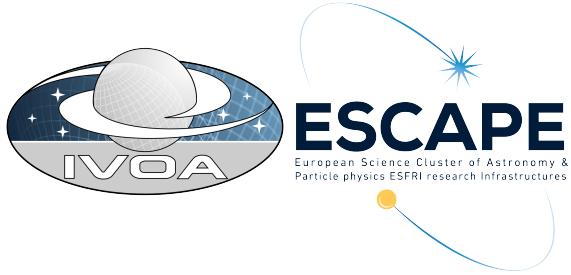
`coord.pointAt.sky <ra,dec>`



## 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



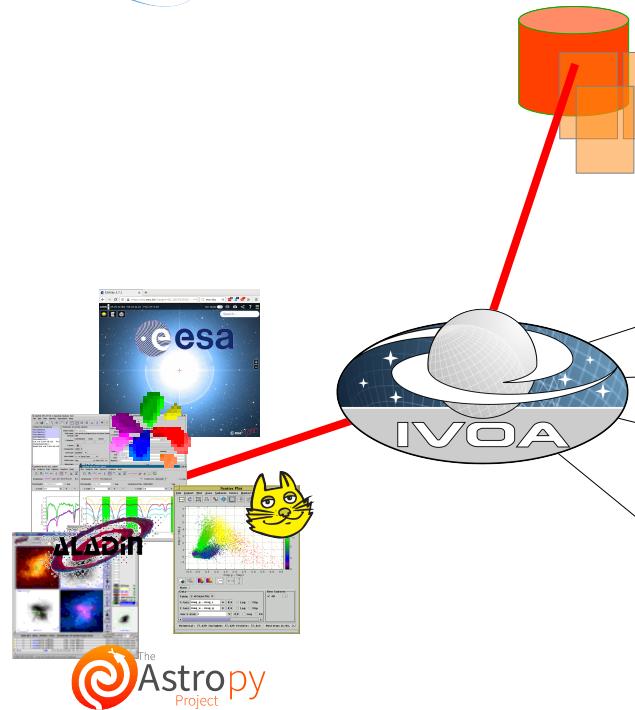
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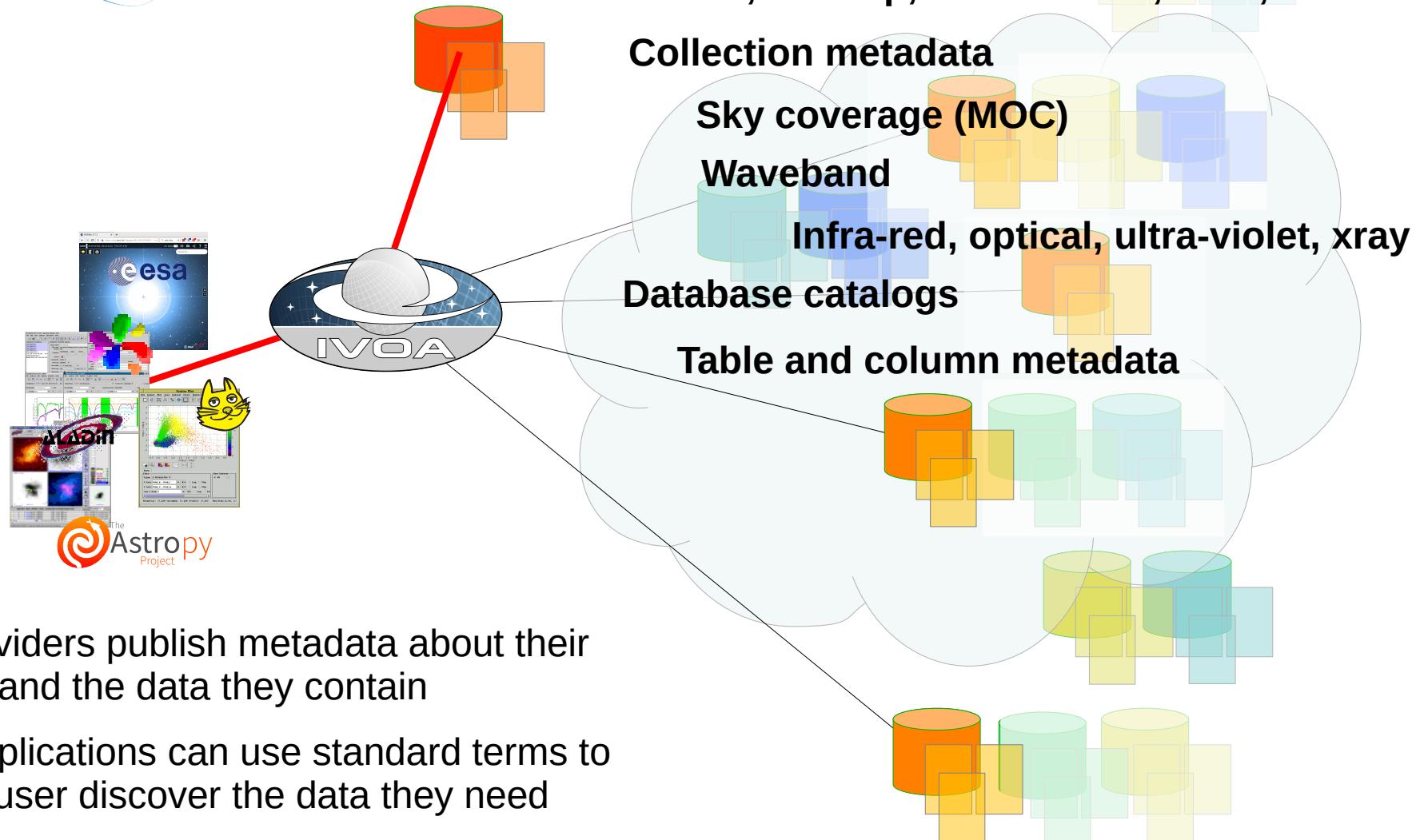
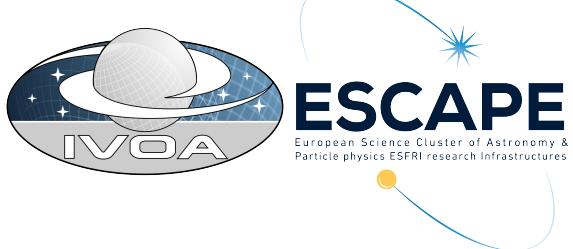


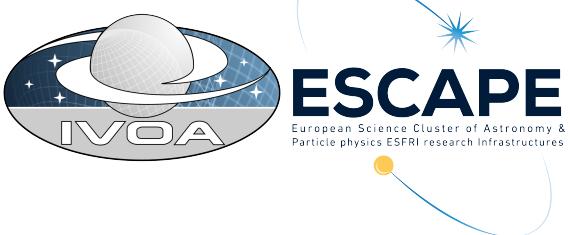
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The registry is the initial contact point for interactions with IVOA services

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





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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Registry Resource Record :

Service capabilities

TAP, ObsTap, ConeSearch, SIAP, SSAP

Collection metadata

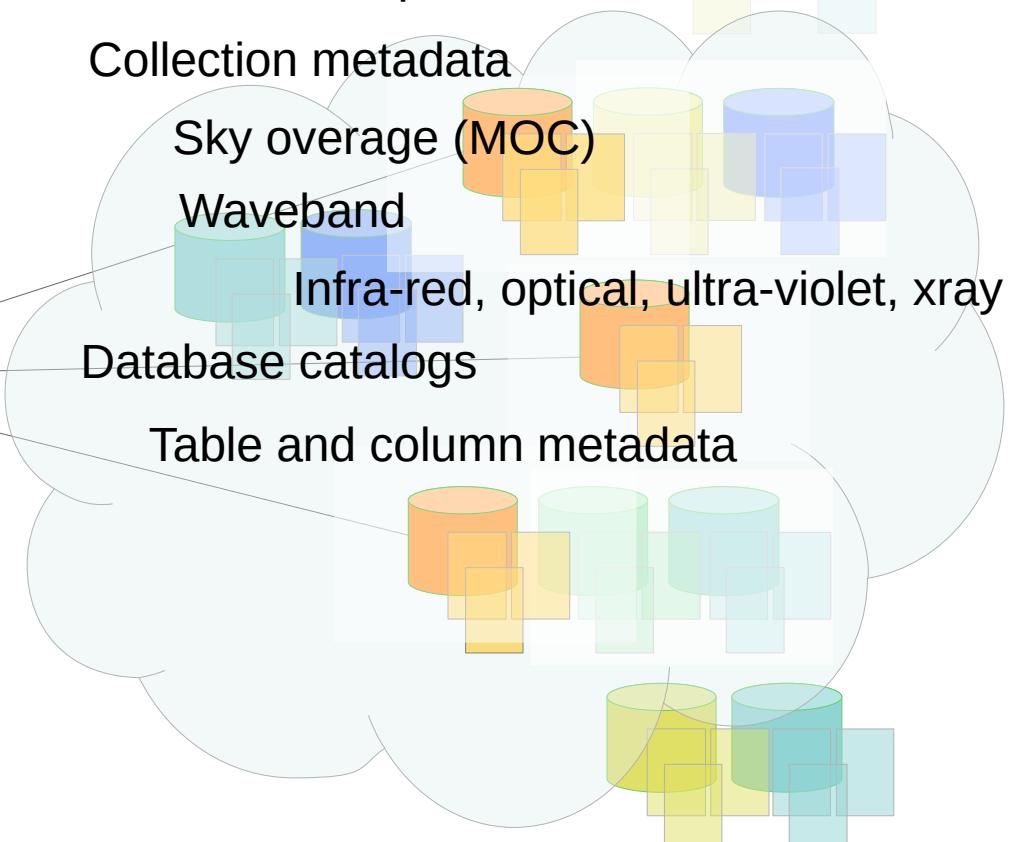
Sky coverage (MOC)

Waveband

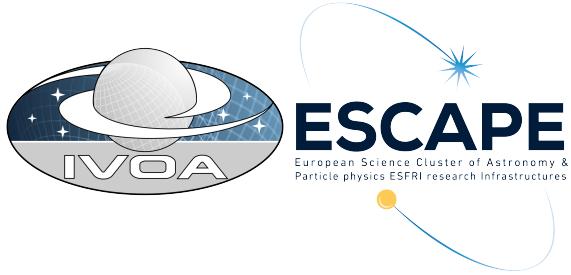
Infra-red, optical, ultra-violet, xray

Database catalogs

Table and column metadata



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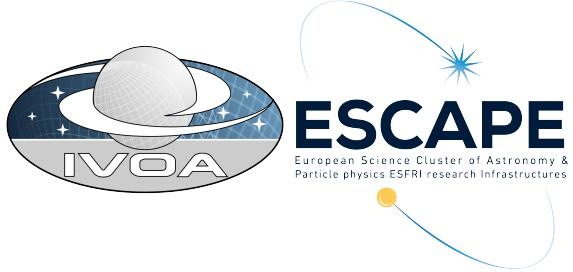
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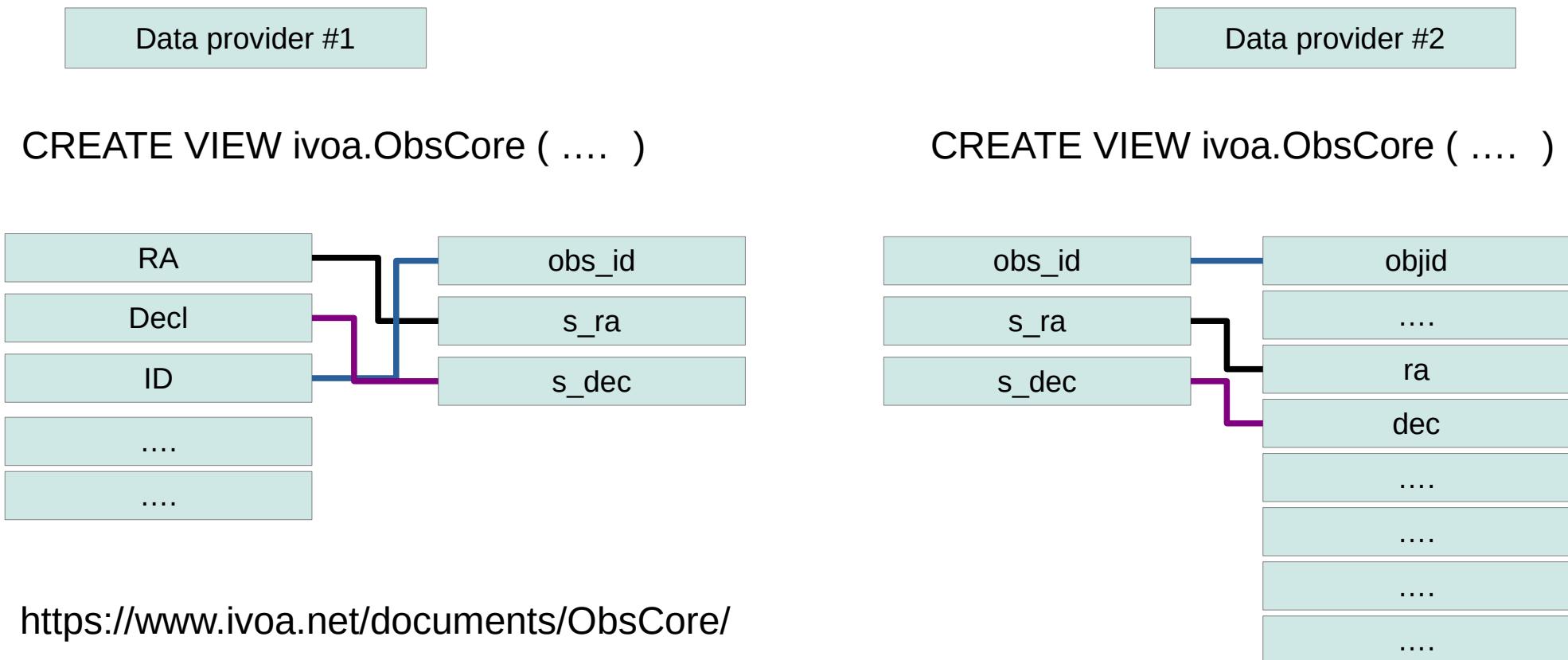


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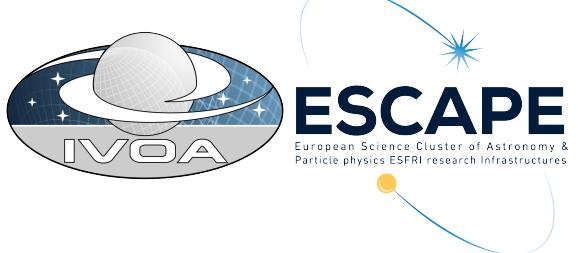
# Observation Data Model Core Components

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



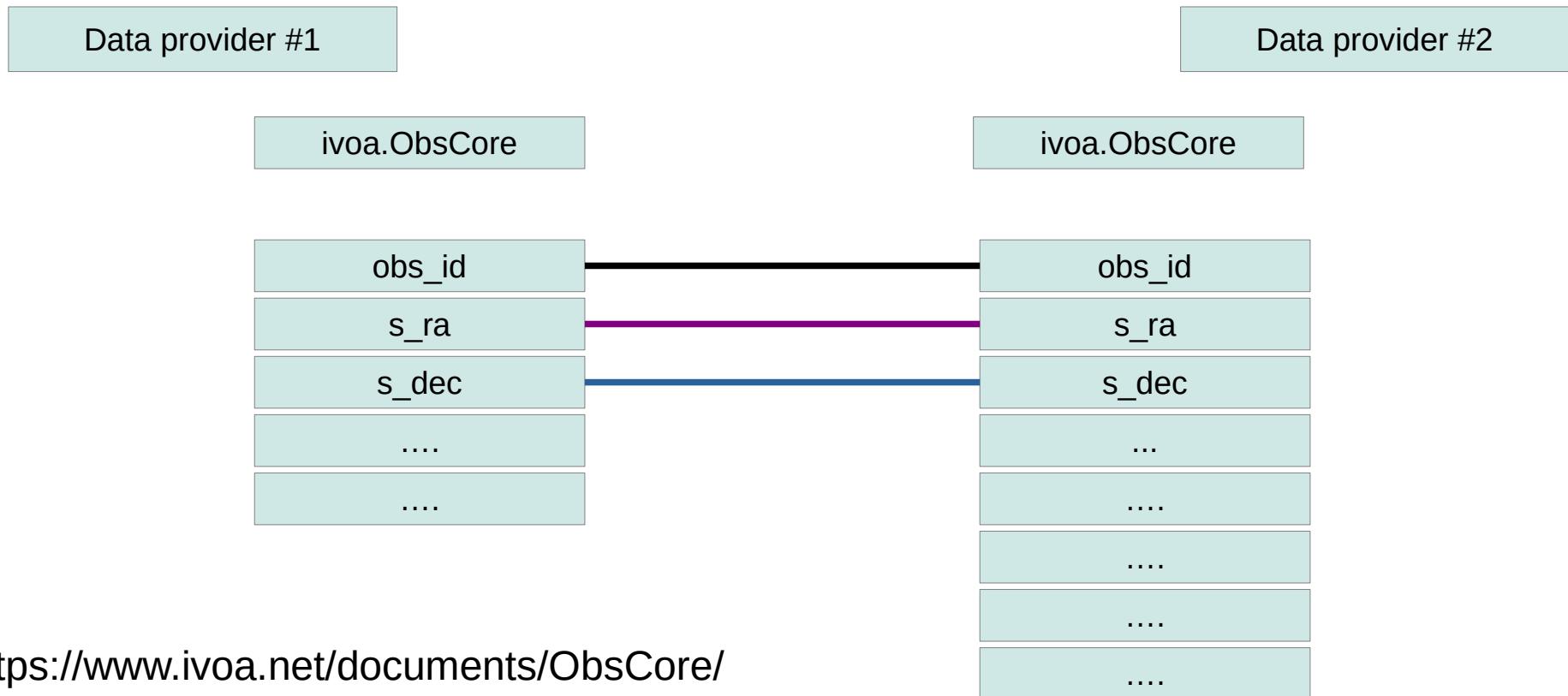
<https://www.ivoa.net/documents/ObsCore/>

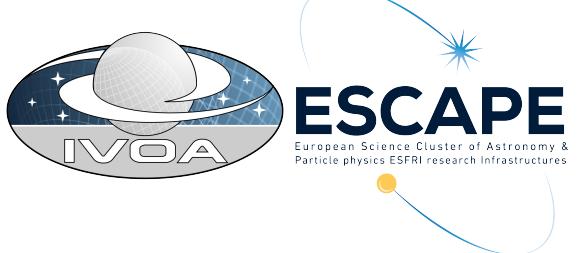




# Observation Data Model Core Components

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





# Observation Data Model Core Components

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

Data provider #1

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'
```

Data provider #2

ivoa.ObsCore

obs\_id

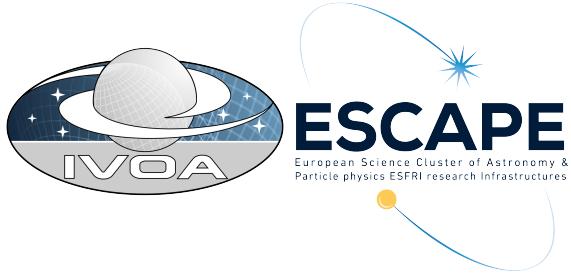
s\_ra

s\_dec

...

...

...



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Everyone invited to develop science use cases

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

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



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