



# Science Platforms and the IVOA The SKA Regional Centres Network Use Case

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And the SRCNet members



## SKA1-low – the SKA's low-frequency instrument

The Square Kilometre Array (SKA) is a next-generation radio astronomy facility that will revolutionise our understanding of the Universe. It will have a uniquely distributed character: **one** observatory operating **two** telescopes on **three** continents. Construction of the SKA will be phased and work is currently focused on the first phase named SKA1, corresponding to a fraction of the full SKA. SKA1 will include two instruments – SKA1-mid and SKA1-low – observing the Universe at different frequencies.



Total collecting area:  
**0.4km<sup>2</sup>**

Maximum distance between stations:  
**>65km**



Data transfer rate:  
**7.2 Terabits**  
per second

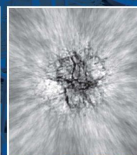
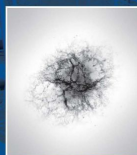


Image quality of SKA1-low (left) versus the best current facility operating in the same frequency range, the LOF Frequency ARray (LOFAR), in the Netherlands (right). SKA-low's resolution will be similar to LOFAR.

Compared to LOFAR Netherlands, the current best similar instrument in the world



**25%**  
better  
resolution

**8x**  
more  
sensitive

**135x**  
the survey  
speed

## SKA1-mid – the SKA's mid-frequency instrument

The Square Kilometre Array (SKA) is a next-generation radio astronomy facility that will revolutionise our understanding of the Universe. It will have a uniquely distributed character: **one** observatory operating **two** telescopes on **three** continents. Construction of the SKA will be phased and work is currently focused on the first phase named SKA1, corresponding to a fraction of the full SKA. SKA1 will include two instruments – SKA1-mid and SKA1-low – observing the Universe at different frequencies.



Total collecting area:  
**33,000m<sup>2</sup>**

or  
**126**  
tennis  
courts

Maximum distance between dishes:  
**150km**



Data transfer rate:  
**8.8 Terabits**  
per second

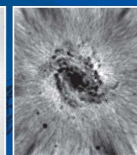
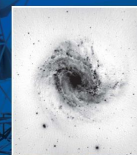


Image quality of SKA1-mid (left) versus the best current facility operating in the same frequency range, the Jansky Very Large Array (JVLA) in the United States (right). SKA-mid's resolution will be 4x better than JVLA.

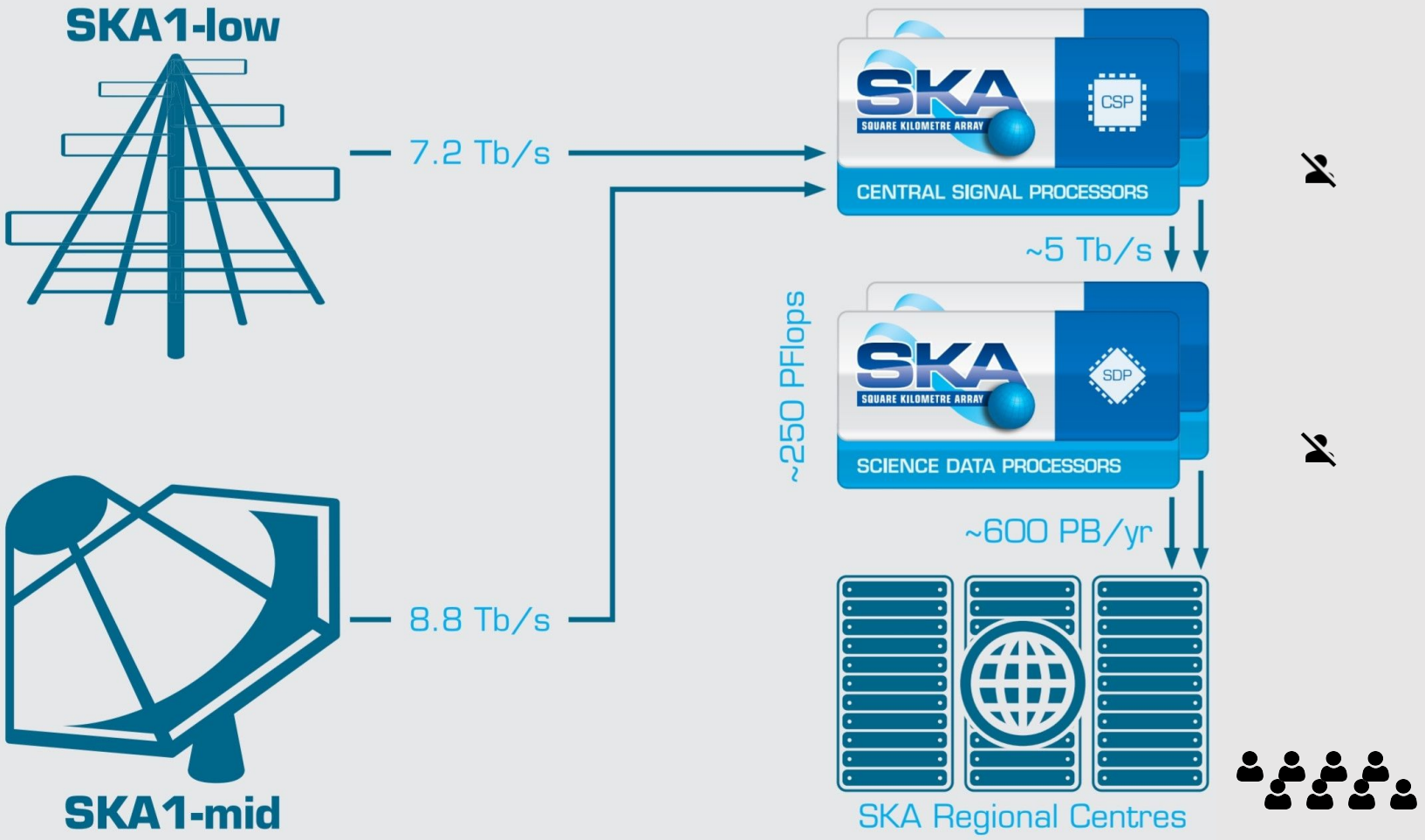
Compared to the JVLA, the current best similar instrument in the world:



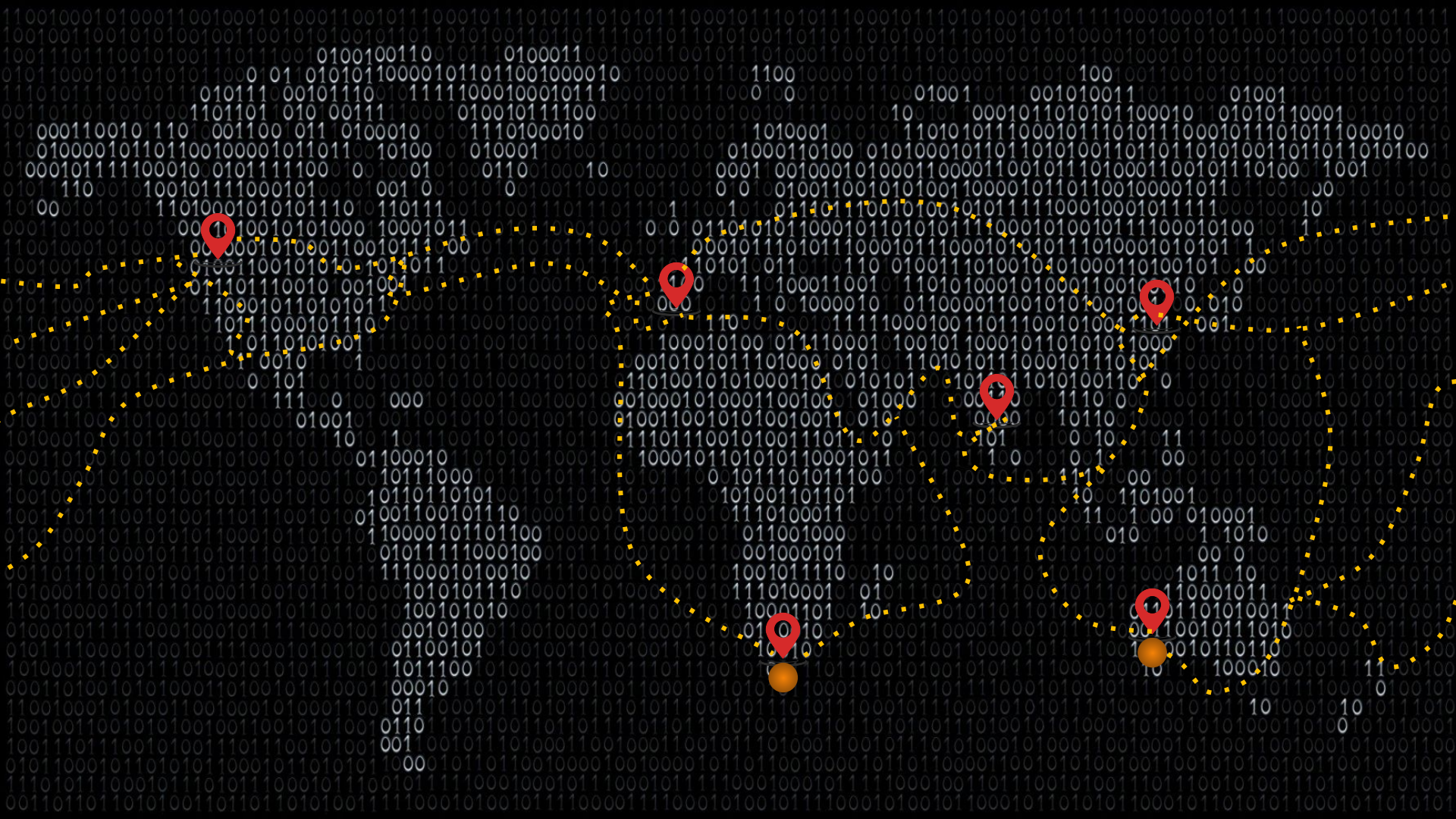
**4x**  
the  
resolution

**5x**  
more  
sensitive

**60x**  
the survey  
speed

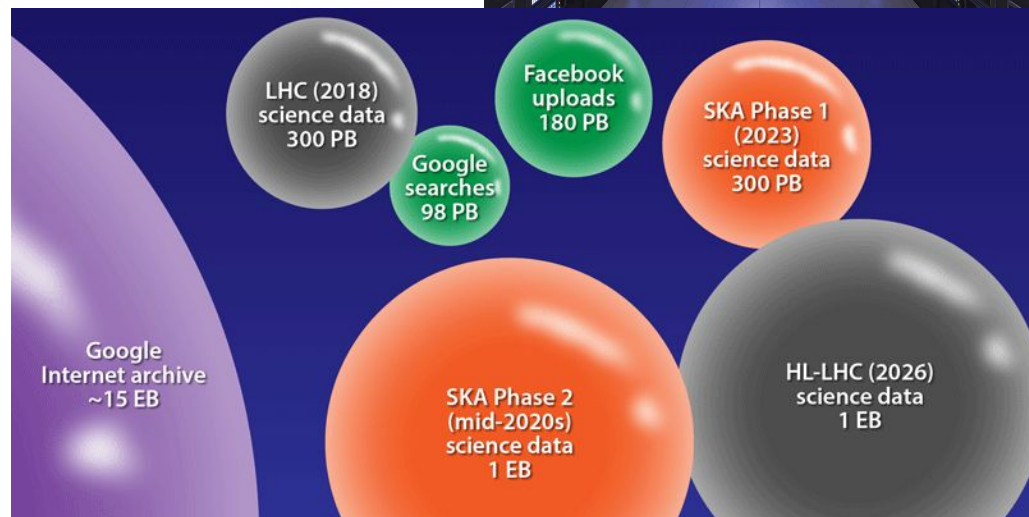
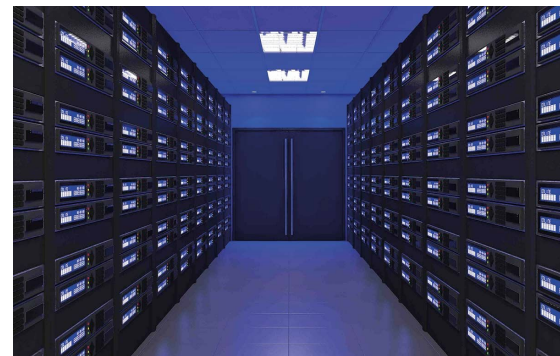




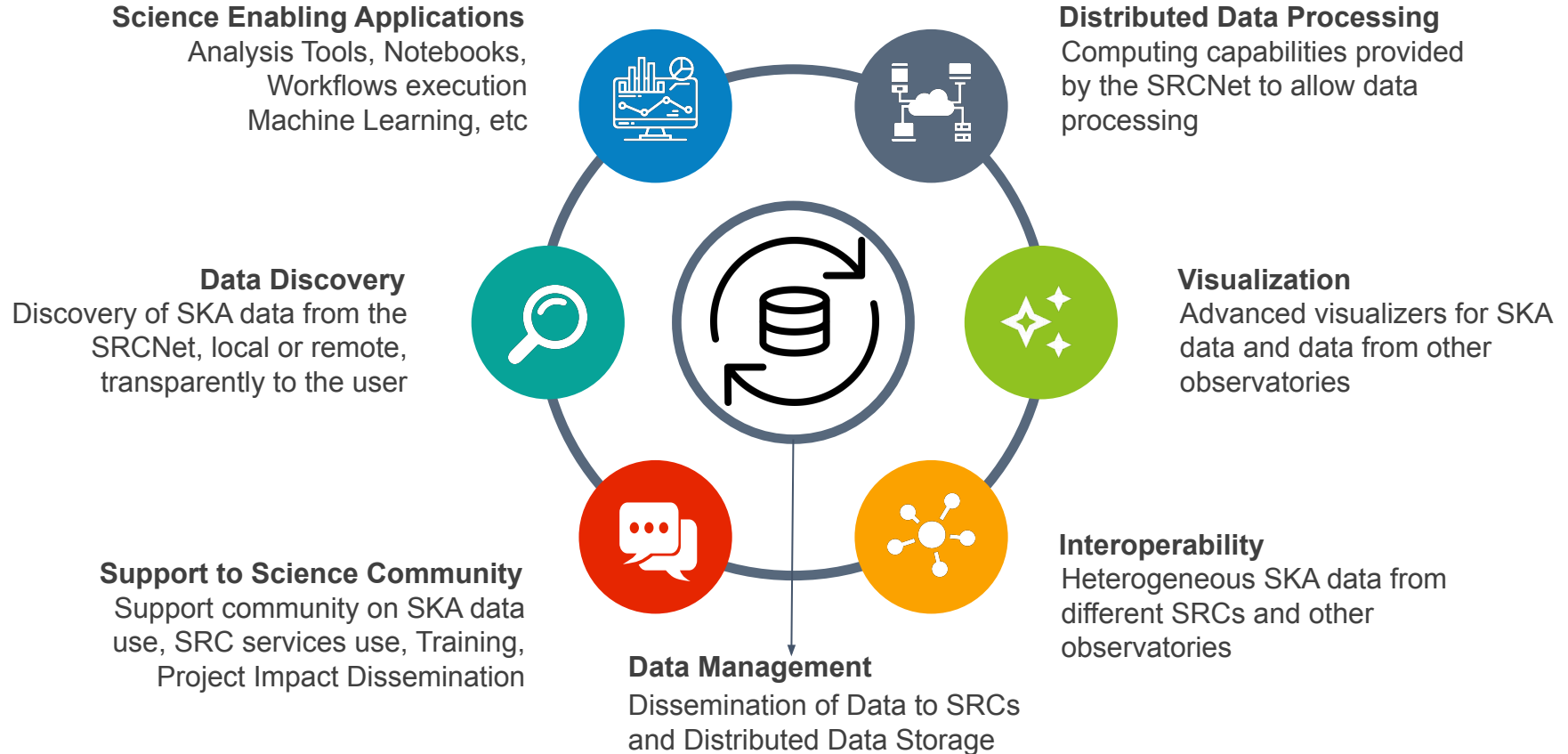


# SKA Regional Centres (SRC) Network in Numbers

- ~ 600 PB/year of Scientific Data
- 16 countries involved
- Up to 100 FTEs during development phase
  
- Collaboration agreements with CERN, GEANT, CTAO
- Collaborations with CNRS, Vera Rubin and others

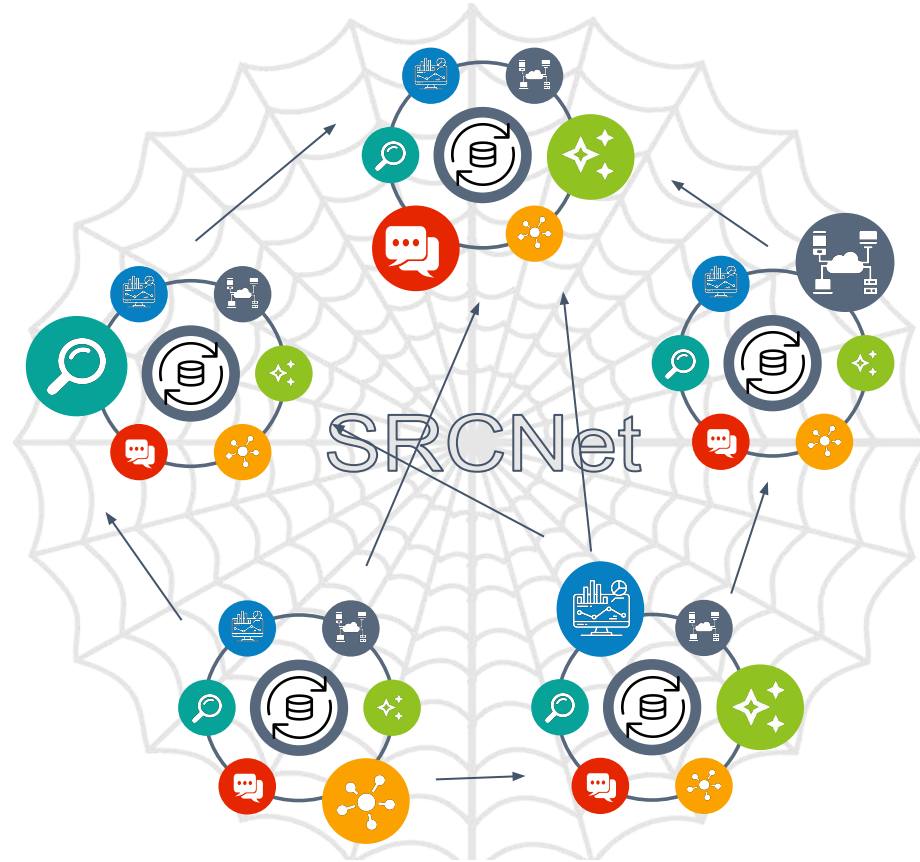


# SKA Regional Centre Capabilities Blueprint





# SRC Network global capabilities



# SRCNet Principles

1

## Data Management

Avoid unnecessary duplication and transfers  
Roughly 5-10 million dollars per year in new data, for one copy

3

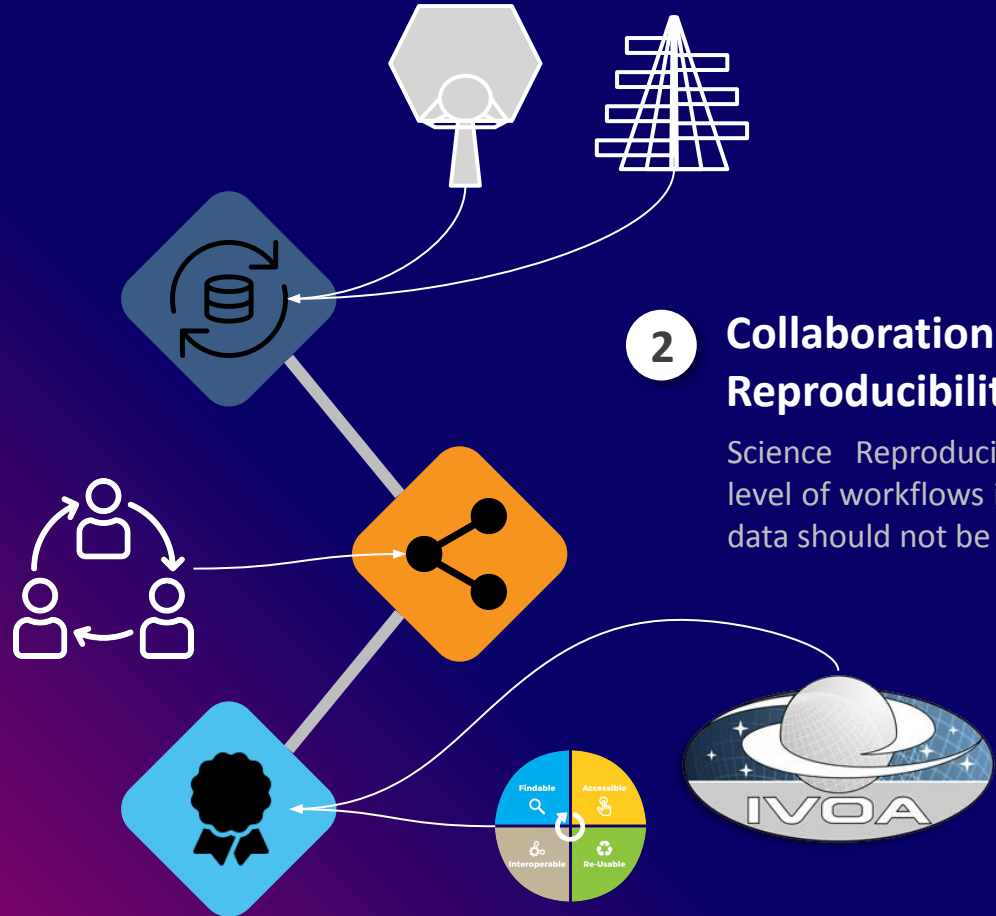
## Use of Standards

Build SKA science archive around FAIR and IVOA standards

2

## Collaboration and Reproducibility

Science Reproducibility at the level of workflows is essential as data should not be downloaded





# The IVOA Context





## Democratic Science and AI

Harmonisation  
Transparent Data Access  
Combined Computing Resources

## Science Enabling Applications

Astropy and Astroquery  
Notebooks  
Users environments

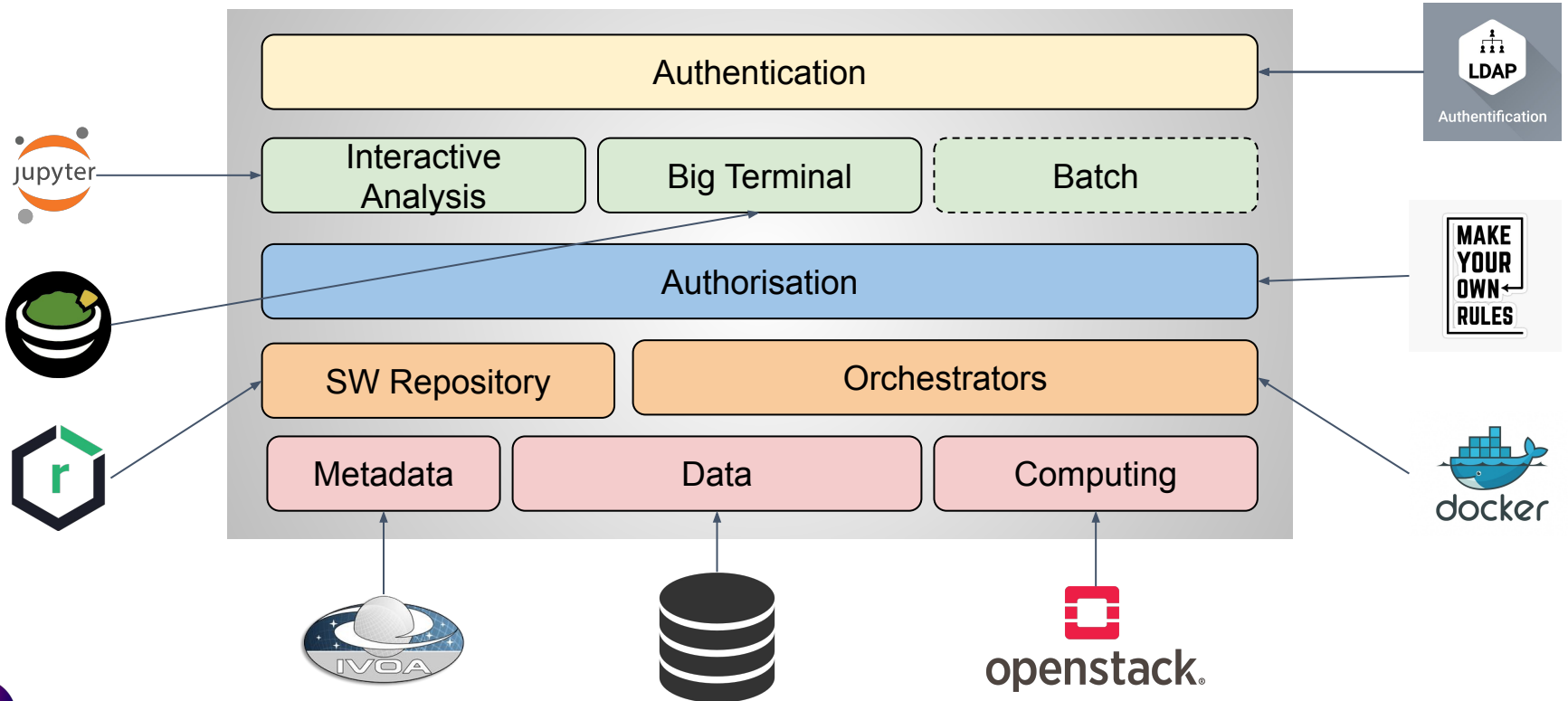
## Discovery And Access Services

Cone Search  
SSAP, SIAP  
TAP

## InterOperability and Federation

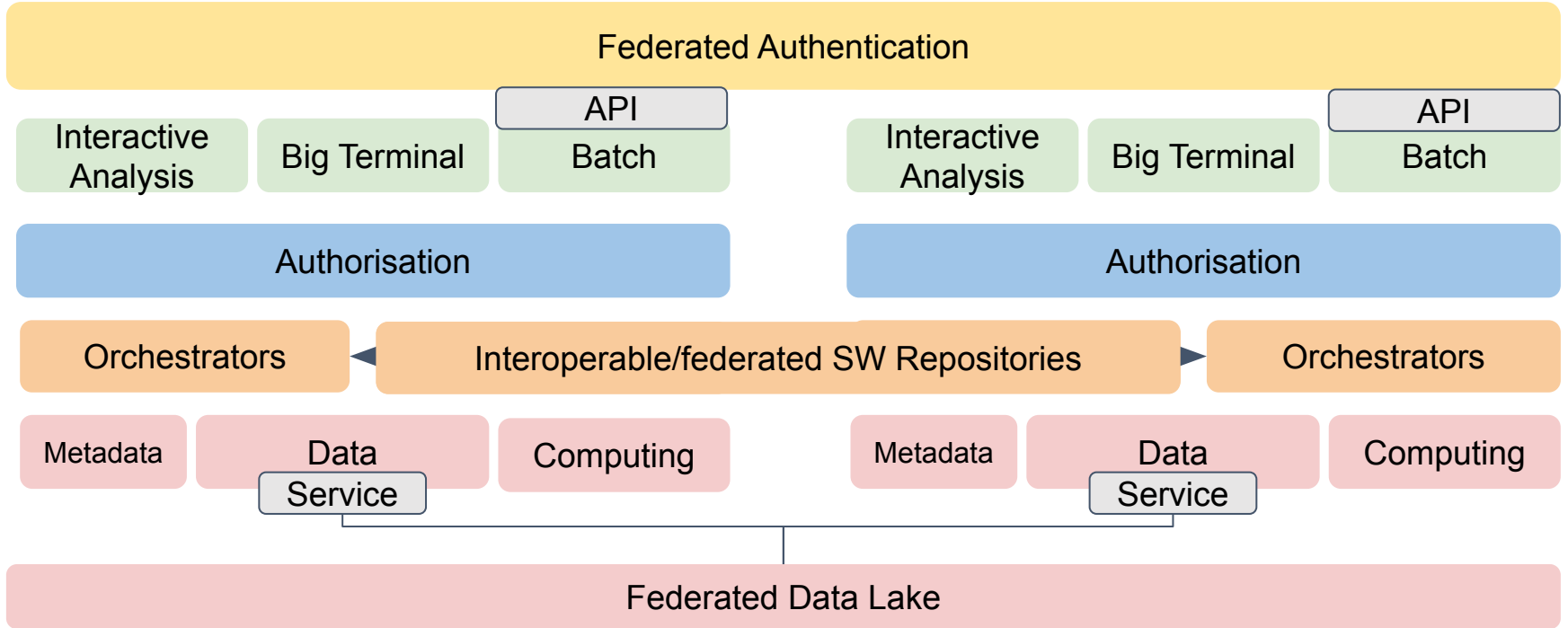
Federated Authentication  
and Distributed Processing  
Platforms interconnected  
Data Lakes

# Science platforms

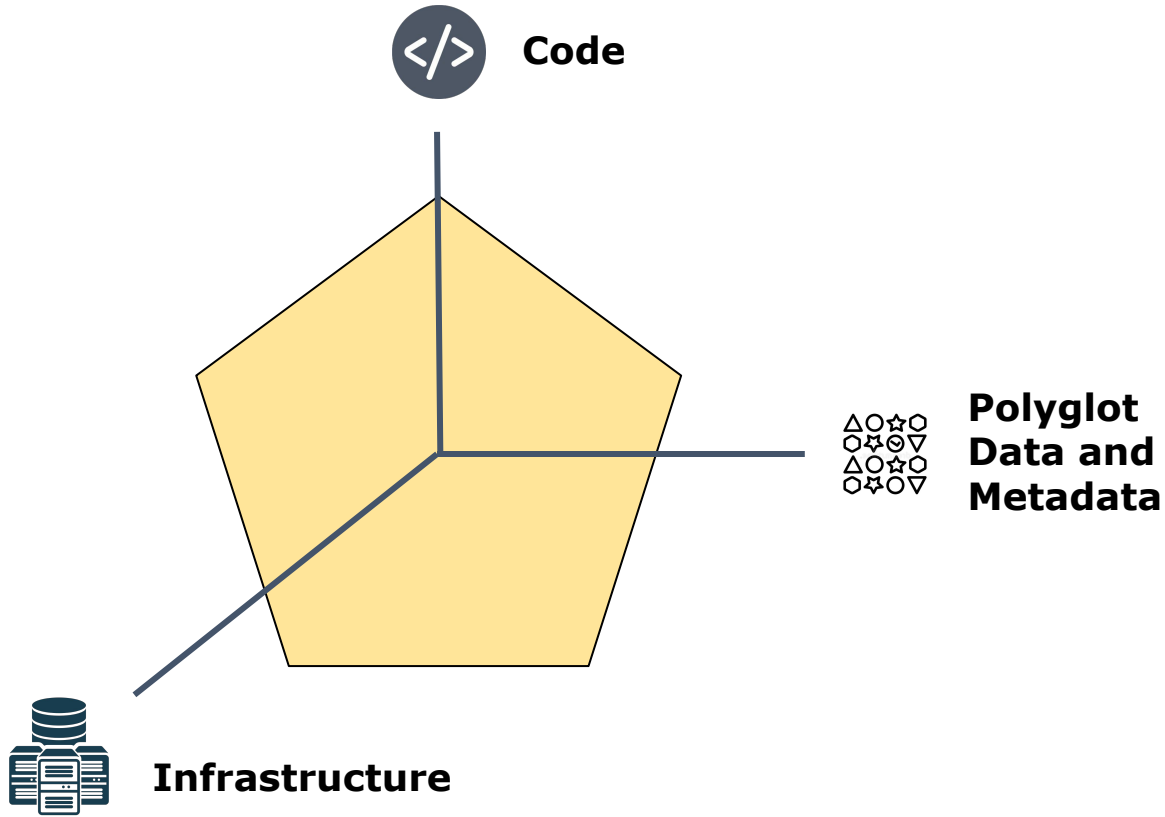




# Science Platforms Interoperability



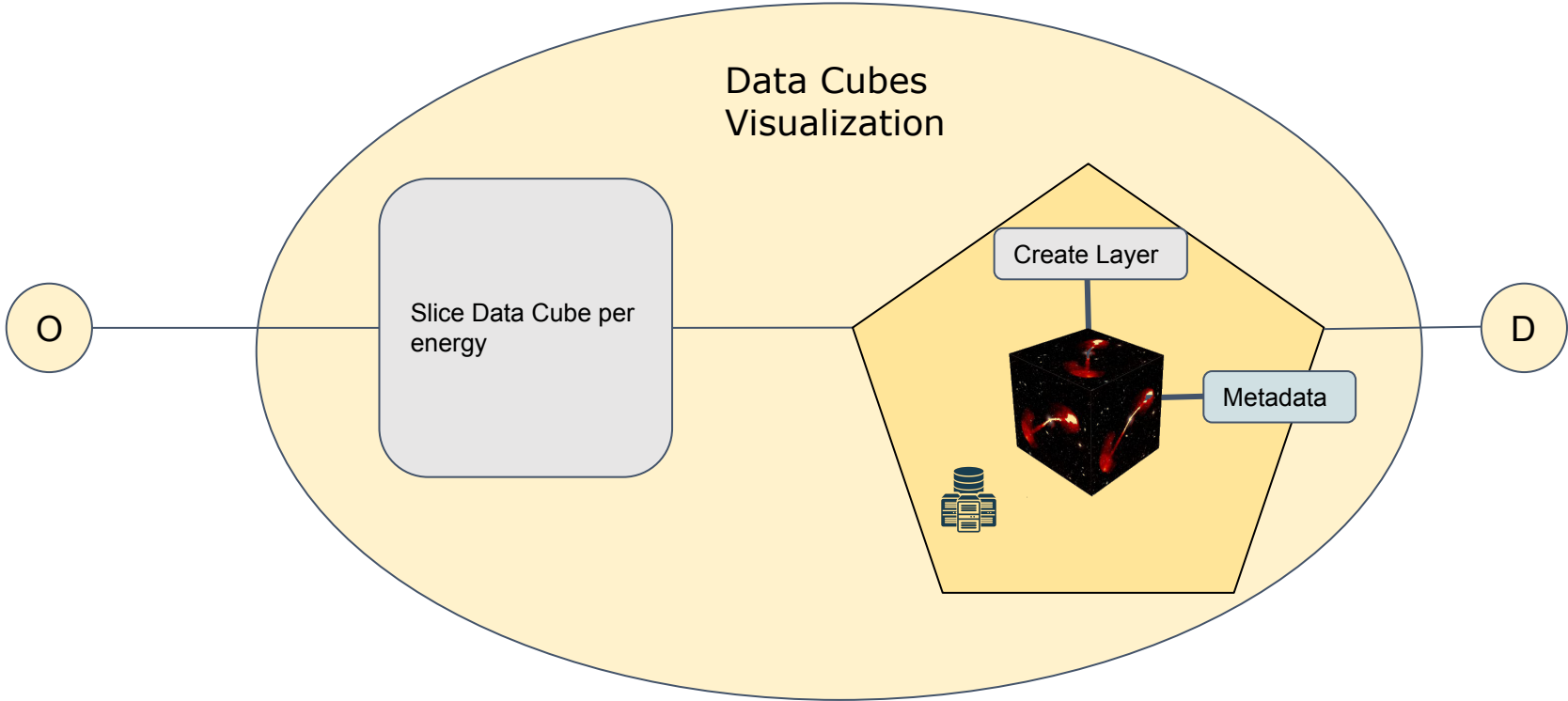
# Domain Data as a product



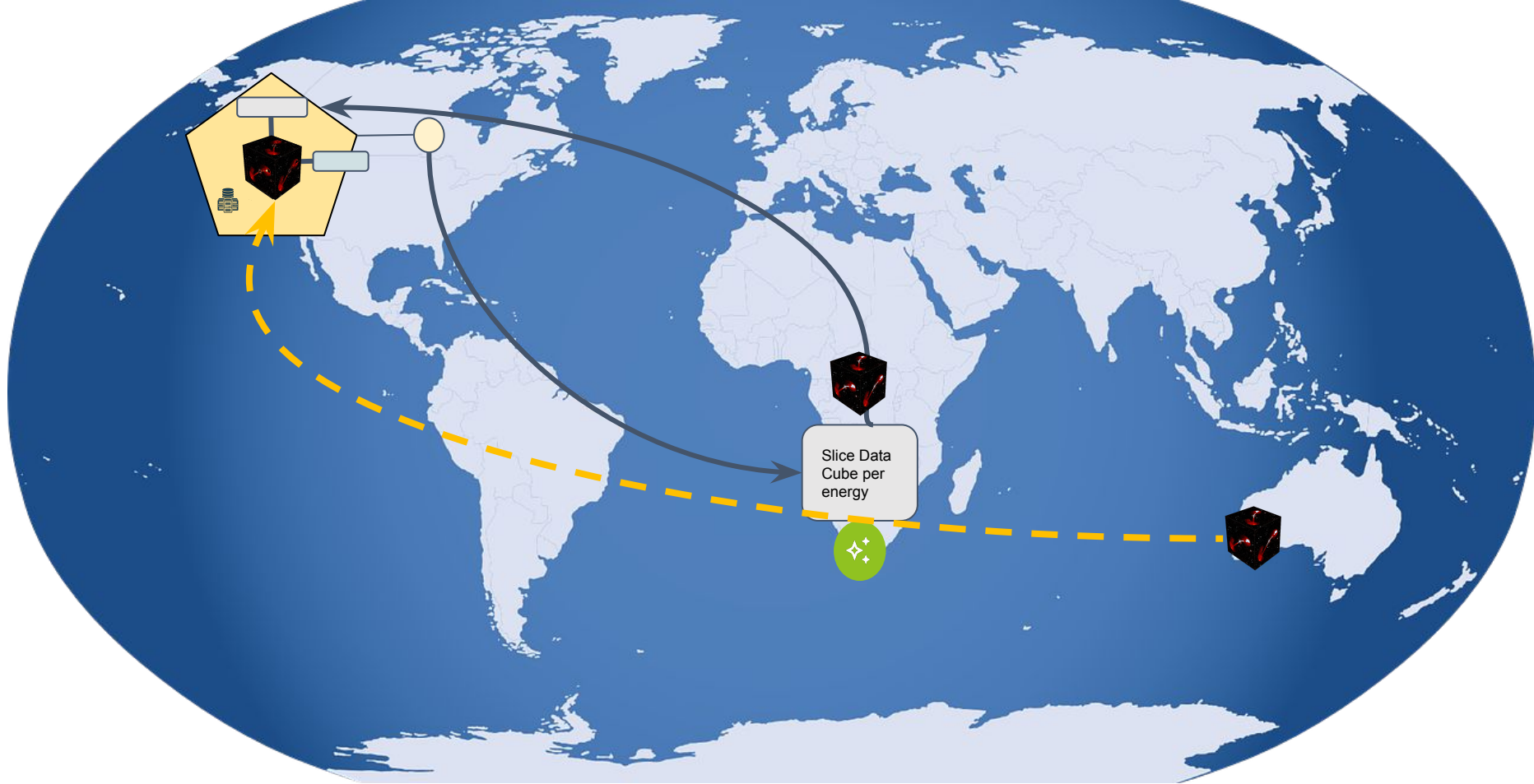
- **Discoverable**
- **Addressable**
- **Self-describing**
- **Trustworthy**
- **Secure**
- **InterOperable**



# Data Product in Domain







# Some possible data mesh services

Data Type	Operation	Input	Output
Any Type	Get Stream	ID	Input Stream
Data Cube	Cut-out	ra, dec, size, resolution	Data Cube
Data Cube	Get Spectra	ra, dec, size	Spectrum
Data Cube	Get Time Series	ra, dec, size	Time Series
Data Cube	Get Slice	wavelength	Image
Image	Change Resolution	ra, dec, size, resolution	Image (FITS to HiPS)
Image	Source Extraction	ID, algorithm params	Source Catalogue
Spectrum native	Convert to VO	ID	Spectrum VO
Source Catalogue	Similar Source	Source ID	Source Catalogue

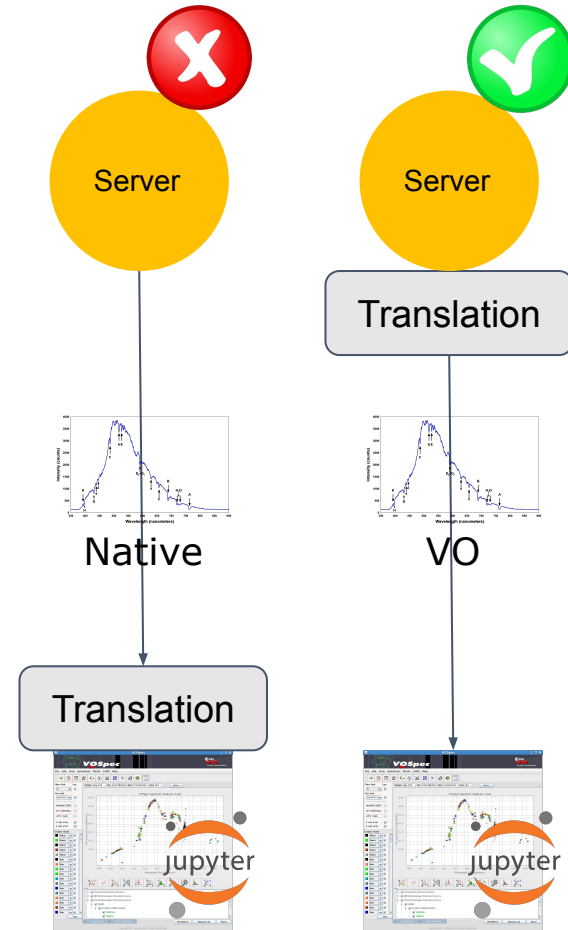
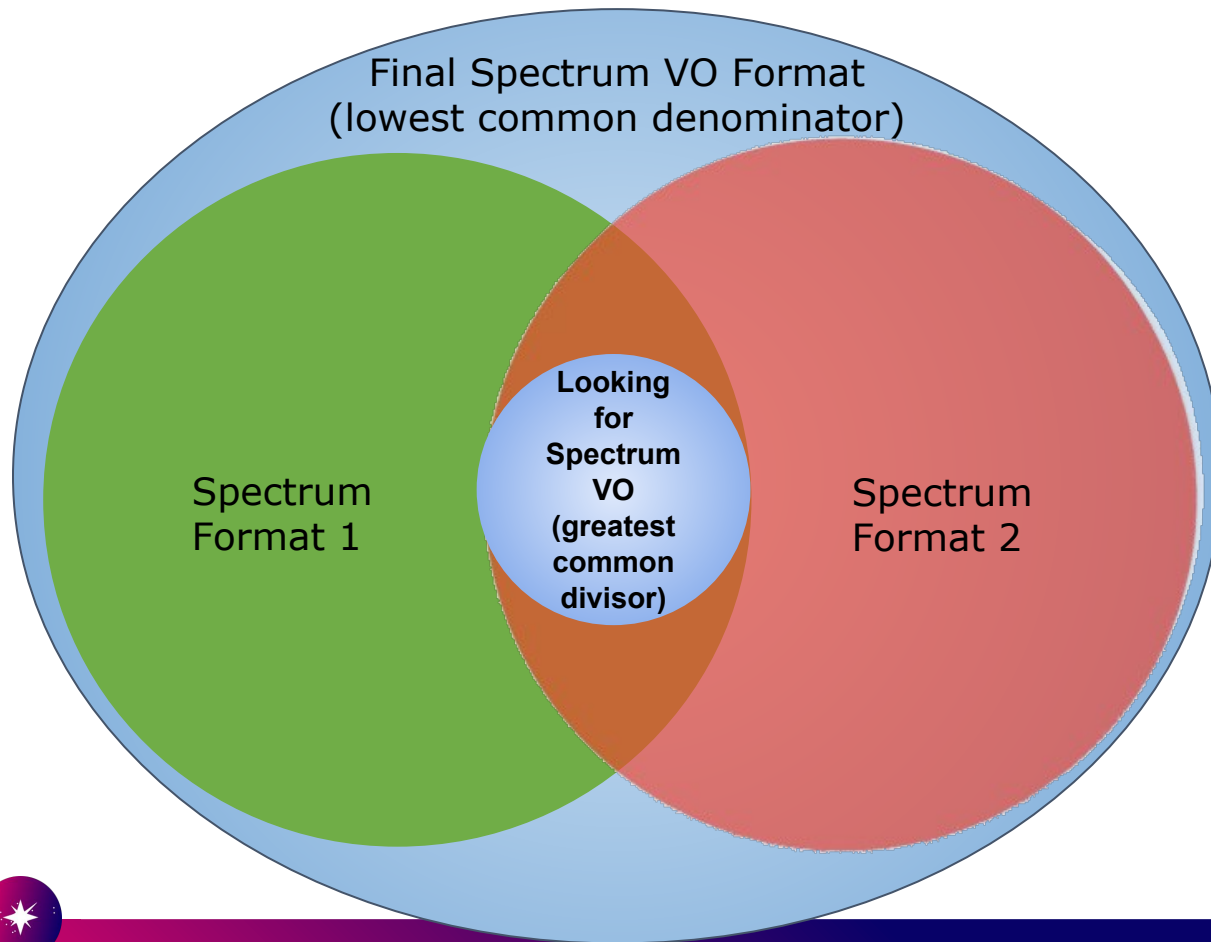
Standard to define

Remote (Data Atomic)

Operations APIs

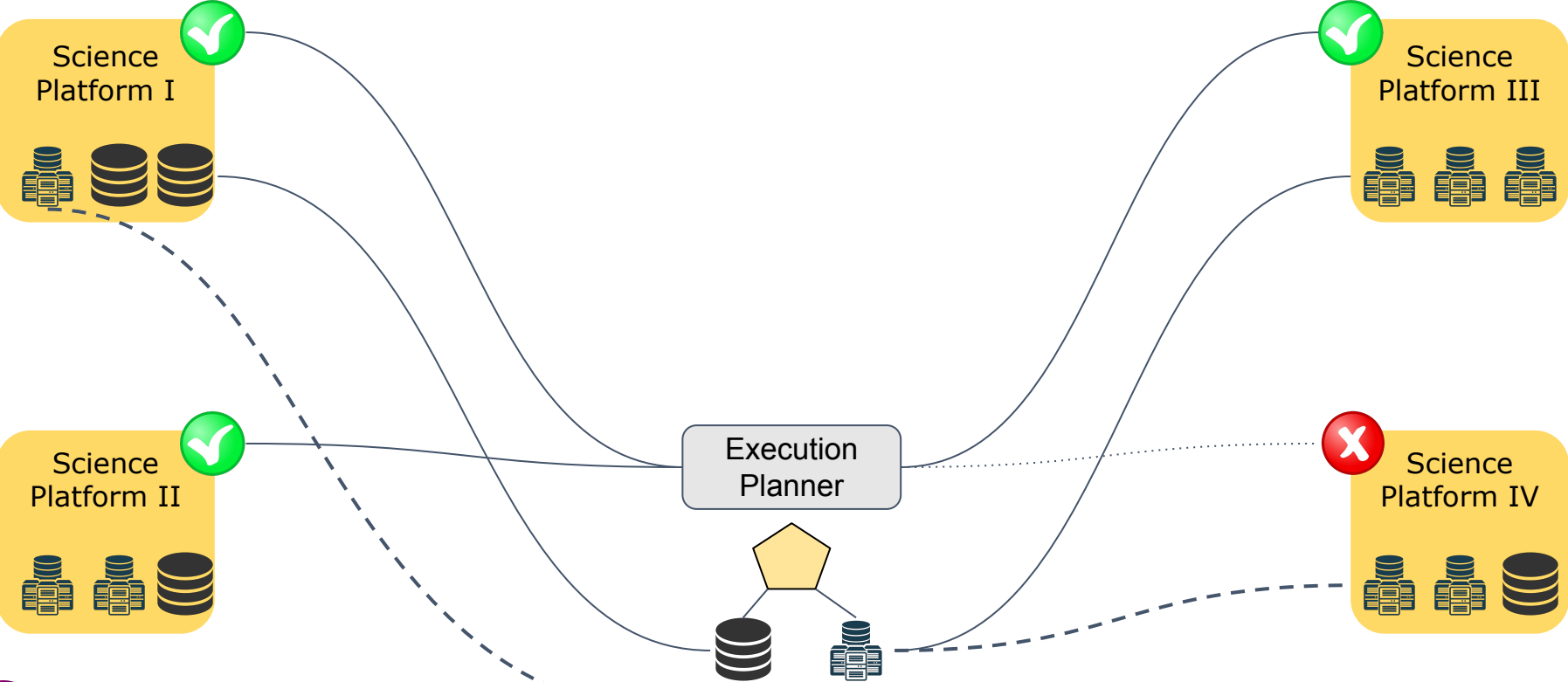


# The problem of the formats

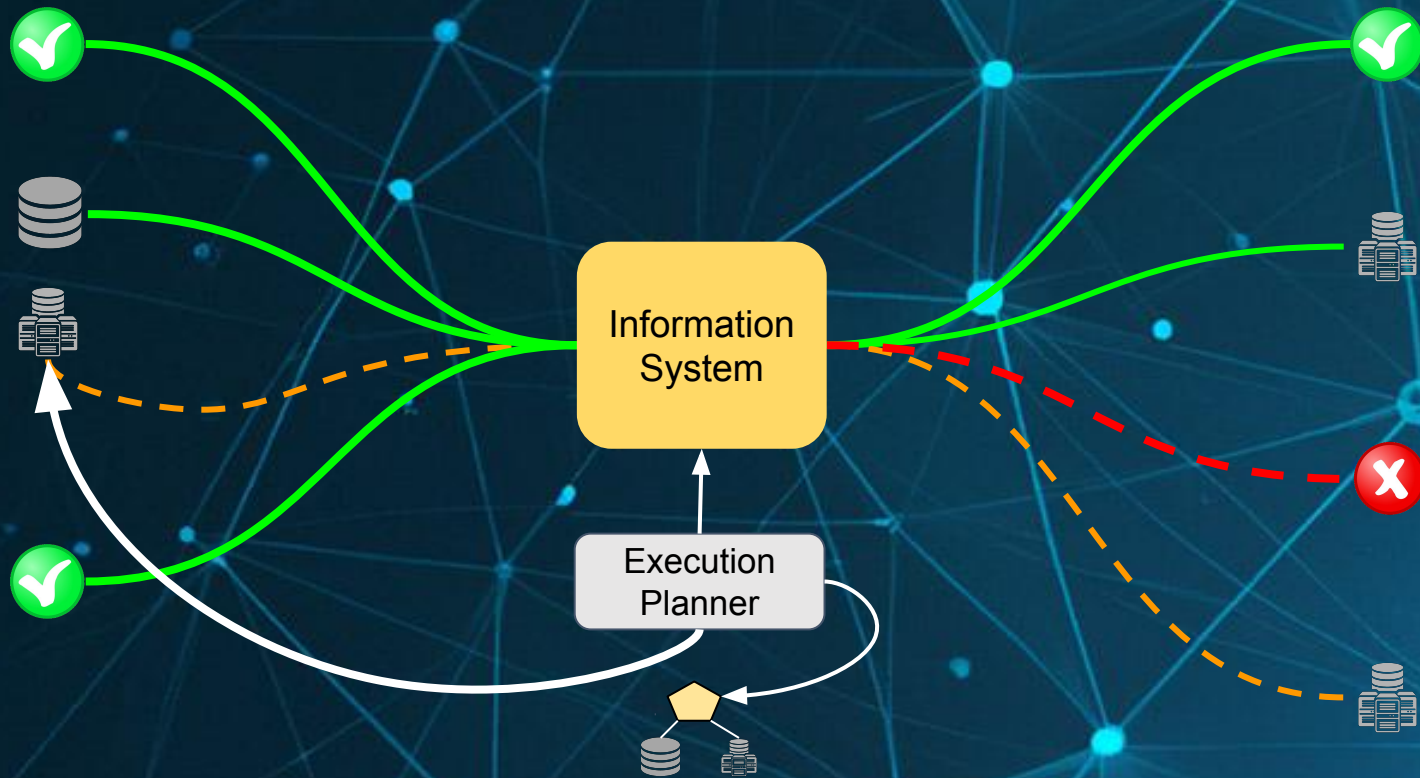




# Execution Planner



# Solving the Topology



# Summary

- IVOA provides discovery and access protocols for most of the astronomical data
  - Standards, Integration with scripting languages, Easy publication and collaboration environments
- Many astronomical use cases are enabled due to IVOA standards
  
- Possible “interoperable science platform” new phase with:
  - Federated Authentication Protocols
  - Improved data access
  - Federated Processing
    - Remote operations
    - (Simplified) federated execution
      - Execution planner
      - Topologies
      - Software characterisation



**Thanks for your attention**

