An Innovative Proposal for the CTA Science Gateway

http://cta-sg.oact.inaf.it/

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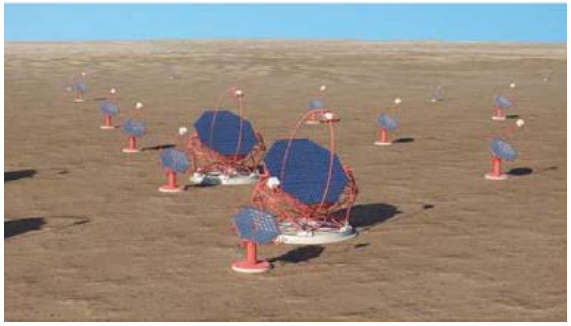
INAF-OACT

The Cherenkov Telescope Array Concept

- 2006: The CTA concept was first proposed to the ESFRI committee
- CTA Consortium : consists of more than 1000 scientist and engineers.
- More than 160 institutions from 27 countries

The CTA Concept



Current systems of Cherenkov telescopes use at most four telescopes, providing best stereo imaging of particle cascades over a very limited area, with most cascades viewed by only two or three telescopes. An array of many tens of telescopes will allow the detection of gamma-ray induced cascades over a large area on the ground, increasing the number of detected gamma rays dramatically, while at the same time providing a much larger number of views of each cascade. This results in both improved angular resolution and better suppression of cosmic-ray background events.
In a possible design scenario, the southern hemisphere array of CTA will consist of three types of telescopes with different mirror sizes in order to cover the full energy range. The northern hemisphere array would consist of the two larger telescope types.

ASTRI SST-2M at Serra La Nave (CT)
Work in progress…
Inauguration on September 24, 2014

LST designed to detect showers at low-energy range < 100 GeV mirror diameter ~23m
MST core energy range 0.2-10 TeV mirror diameter ~12m
SST high-energy range > 10 TeV

https://portal.cta-observatory.org/Pages/Home.aspx

The CTA Concept

Table 1: Cumulated data for the construction phase (scenario close to minimum with zero suppression from second year)

Year	2017	2018	2019	2020	2021
Raw data (PB)	2.8	8	1.4	1.9	2.5
Cumulated raw data (PB)	2.8	3.6	5	6.9	9.4
Processed and reprocessed data (PB)	0.5	2.3	4.5	6.8	9
Cumulated Observation data (TB)	3.3	6.4	12.3	21	32.5
Monte-Carlo data (PB)	3.3	**6.4**	1.23	20	20
Cumulated Data (PB)	**6.7**	**12.8**	**24.6**	**41**	**53.5**

Table 2: Cumulated data for the operation phase (scenario close to minimum)

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Raw data (PB)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Cumulated raw data (PB)	12.2	15	17.7	20.5	23.3	26.1	28.9	31.6	34.9	37.1
Processed and reprocessed data (PB)	19.7	25.4	31	36.6	42.3	47.9	53.6	59.2	64.8	70.4
Cumulated Observation data(TB)	46	60	74.1	88.1	102.1	116.2	130.2	144.3	158.3	172.3
Monte-Carlo data (PB)	20	20	20	20	20	20	20	20	20	20
Cumulated Data(PB)	**66**	**80**	**94**	**108**	**122**	**136**	**150**	**164**	**178**	**192**

Table 3: Computing needs in construction phase. All values are in (Milliard kHS06 · sec)

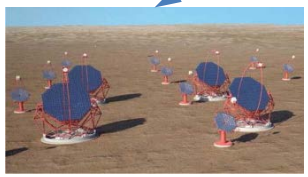
Year	2017	2018	2019	2020	2021
Data pipeline needs	19.7	59.1	98.5	138	177
Simulation needs	360	360	360	360	360
Re-processing needs	0	19.7	78.8	177	315
Cumulated needs	**380**	**439**	**537**	**675**	**853**

Table 4: Computing needs in operation (from t0 to t0+10 years). All values are in (Milliard kHS06 · sec).

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Data pipeline needs	197	197	197	197	197	197	197	197	197	197
Simulation needs	360	360	360	360	360	360	360	360	360	360
Re-processing needs	493	690	887	1084	1281	1478	1675	1872	2070	2267
Cumulated needs	**1050**	**1247**	**1444**	**1641**	**1838**	**2035**	**2232**	**2430**	**2627**	**2824**

HEP-SPEC06 (HS06) is the new HEP-wide benchmark for measuring CPU performance.
One HS06 is providing a processing capacity of $3600 \times 24 \times 365 = 31536$ kHS06 · sec · year^{-1}.

High Throughput Data Analysis for CTA



CTA sites

CTA Science Gateway

CTA Applications

App. 1 | App. 2 | ... | App. N

Authentication

Authorization

CTA IdP

CTA LDAP

InsilicoLab Service Stack

Liferay Portlet set

Middleware services set

gUSE/WS-PGRADE Service Stack

Liferay Portlet set

Middleware services set

Liferay Installation

Integration Layer

CTA resources

computation

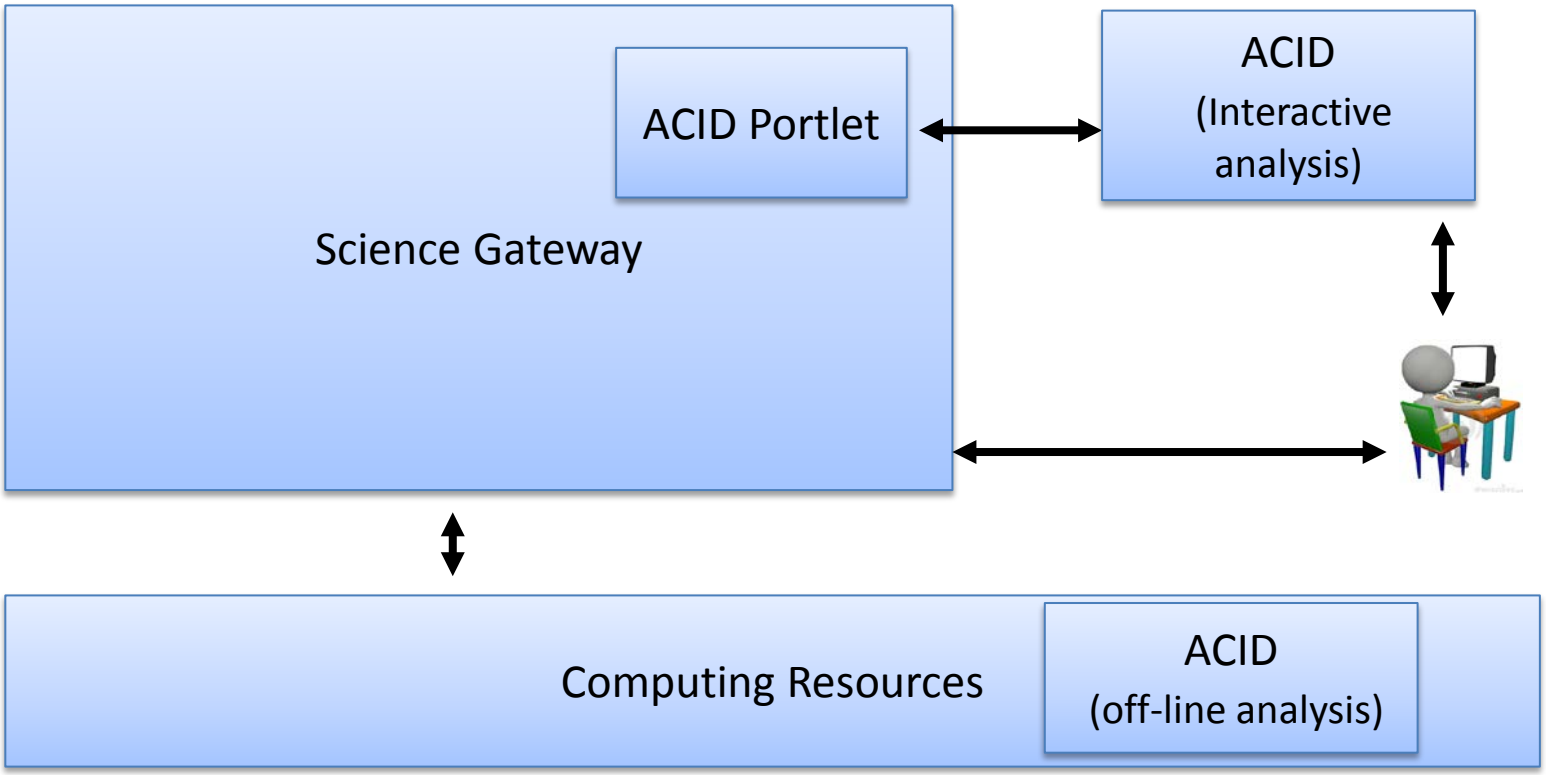
EGI HTC and data facilities

CTA Science Gateway Prototype

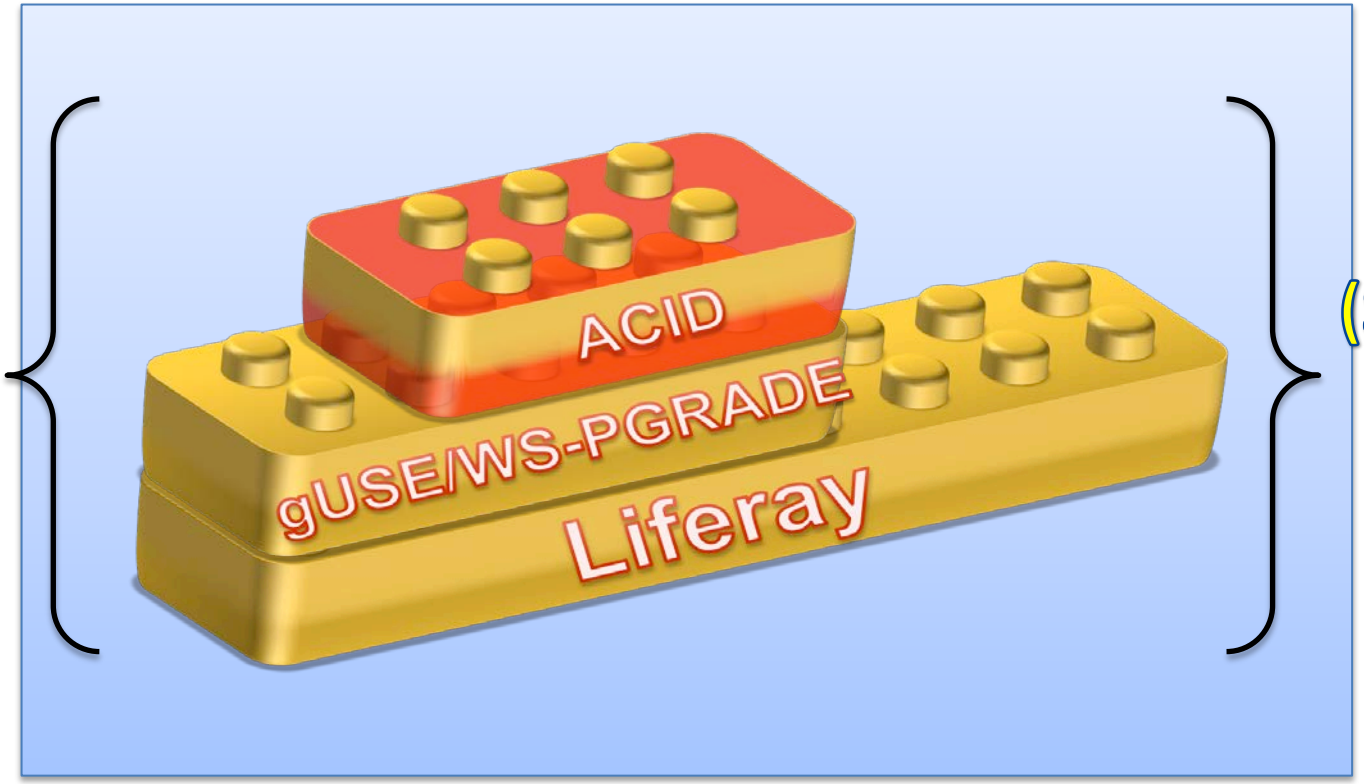
- **A CTA gUSE/WS-PGRADE Science Gateway implemented by INAF.**

  https://cta-sg.oact.inaf.it/
- Workflows Sharing (SHIWA repository)
- **Single Sign On:** SAML 2, **Shibboleth**.
- **CTA Identity Provider**
- Easy integration with **Identity Federation**
- **Astronomical & physics Cloud Interactive Desktop (ACID)**
- ACID is an **"Application As A Service" & "Data As A Service"**
- Cloud Data through the use of OwnCloud
- More than 150 astronomical and physics tools!
- **ACID can be accessed by mobile devices**

Overall Architecture



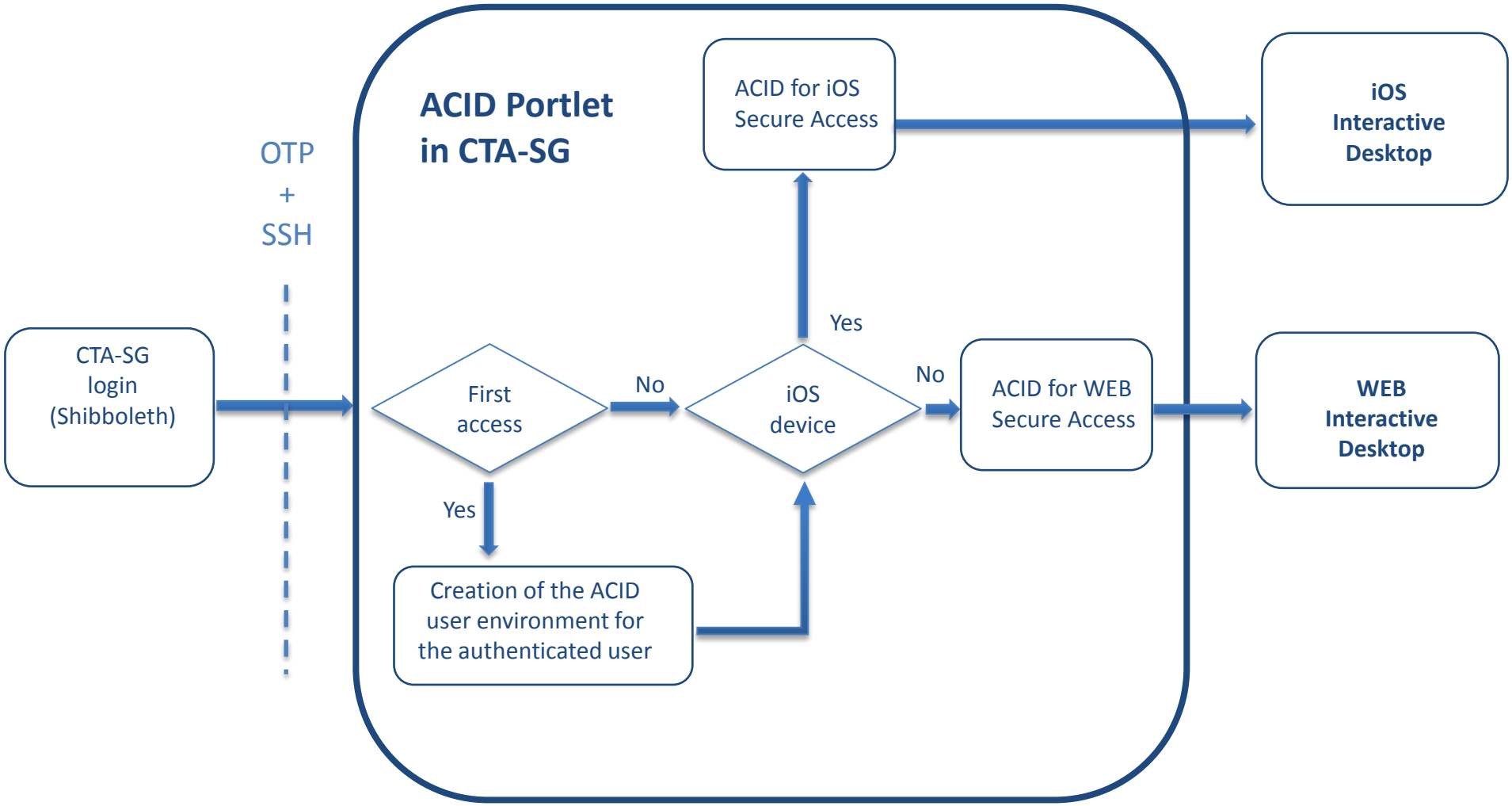
Overall Architecture



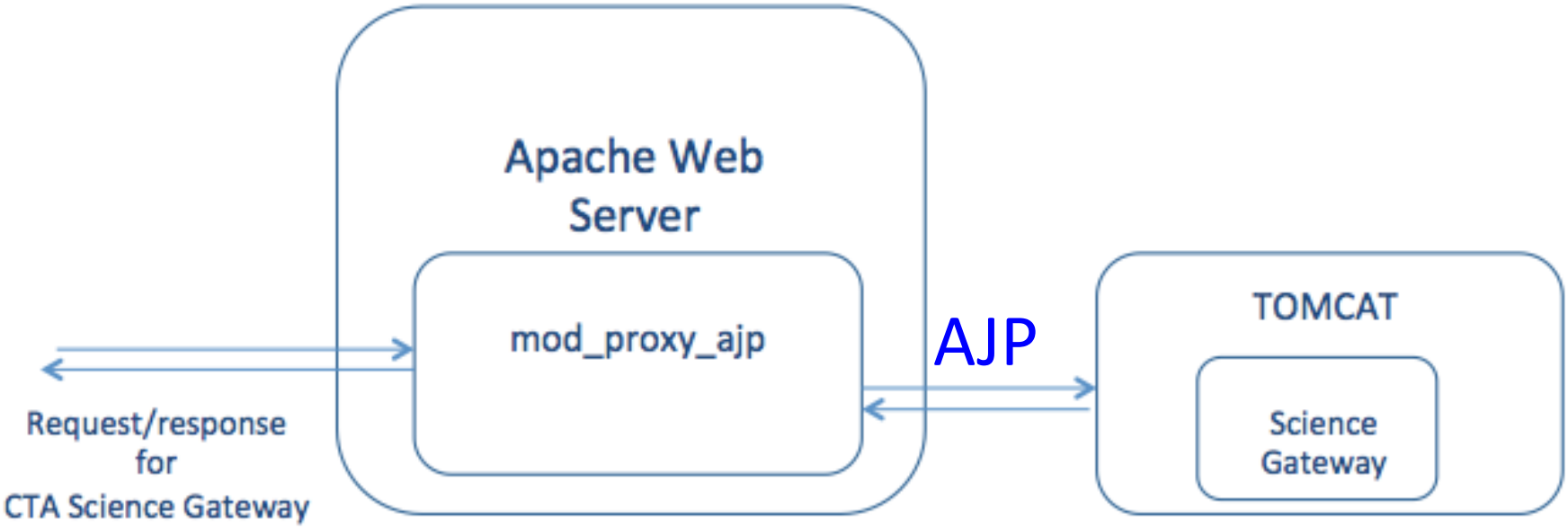
SSO

(Shibboleth)

Overall Architecture



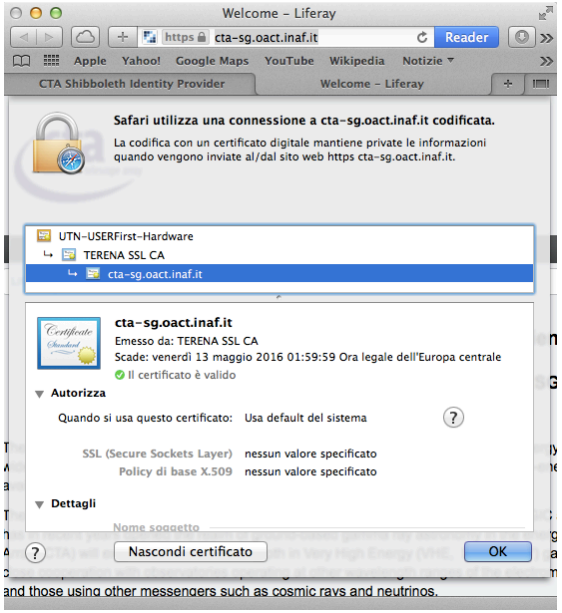
Scalability



- Tomcat runs the Scientific Gateway.
- Tomcat is integrated with Apache by AJP
- This Architecture allows **Load Balancing**

Single Sign On & Security

- *SAML 2 (Security Assertion Markup Language): The standard.*
- *Shibboleth*
- Most widely used in education, government
- Broadly adopted in Europe
- The new 2.0 release implements SAML 2 !
  - Backward compatible with 1.3
- Free & Open Source
  - *Apache 2.0 license*



- **Identity Provider**
- **Service Provider**
- **Liferay AAI (Authentication Authorization Infrastructure)**

- **HTTPS via ssl Certificates issued by a trusted Certificate Authority's Root Certificate: TERENA (Trans-European Research and Education Networking Association)**

Shibboleth

Single Sign On (Liferay Attribute Management)

- *Auto creation of a new LIFERAY user using Shibboleth attributes (email, first name, last name)*
- *Auto update of user information upon login*
- *Role mapping*

Supported Cloud Standards

- Since **Jan 2014** Direct Cloud Access is provided (*gUSE version 3.6.2)*

- By this feature the user can easily submit jobs directly to an accessible cloud.

- **Any clouds that implements the Amazon EC2 interface**
- **(e.g. OpenNebula) are accessible CTA Science Gateway**

Overall Architecture

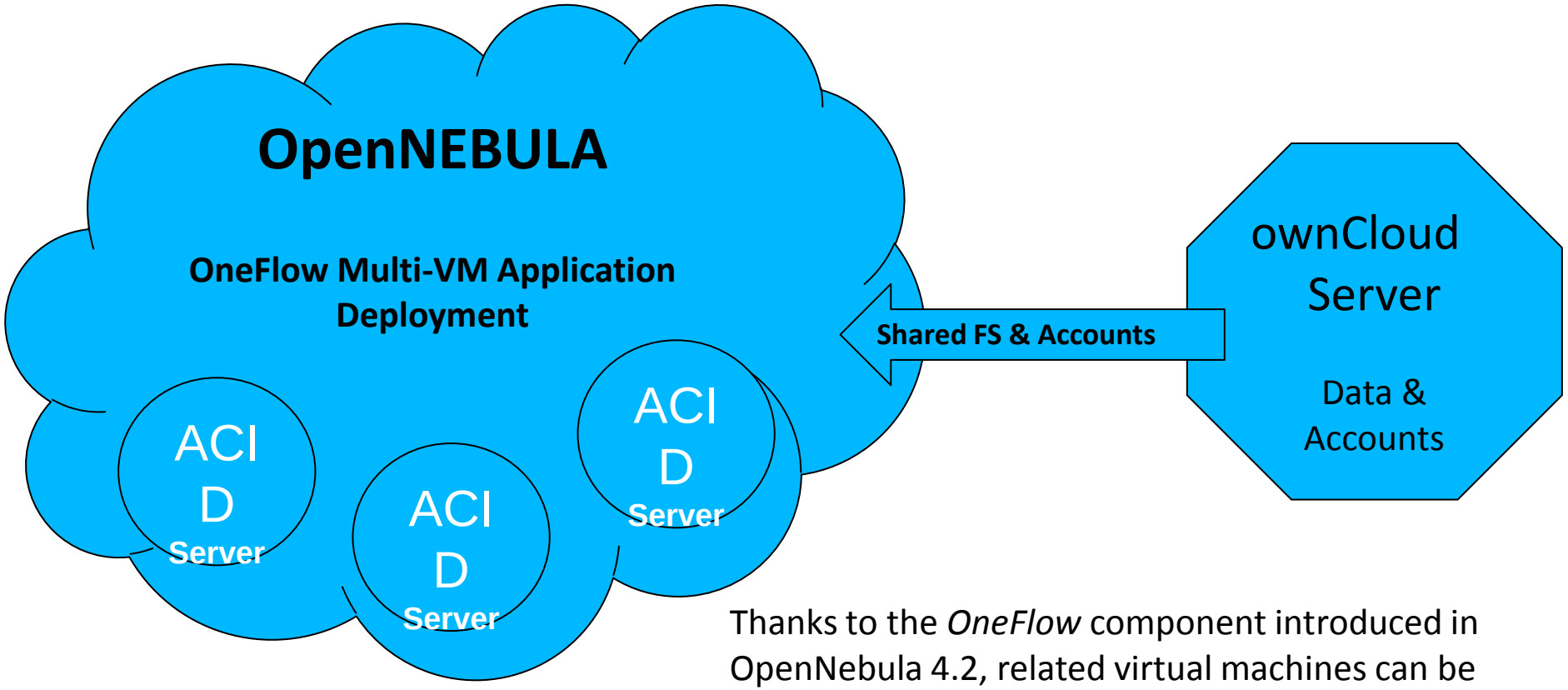
- ACID
- gUse/WS-PGRADE
- Liferay

SSO

(Shibboleth)

ACID

Astronomical & Physics Cloud Interactive Desktop



Thanks to the *OneFlow* component introduced in OpenNebula 4.2, related virtual machines can be grouped into a Service

ACID

Astronomical & Physics Cloud Interactive Desktop

- **Application Service Provider** :
  - It offers more than 150 applications as a service accessible by the CTA INAF prototype
- **Data Cloud environment**
  - Data Cloud is available to Applications and it is shared with your local computer

SSO

(Shibboleth)

Storage (data cloud)

CTA Gateway

Unison File Synchronizer

Thanks to **Unison** and **ownCloud** the user will find his data on CTA Gateway

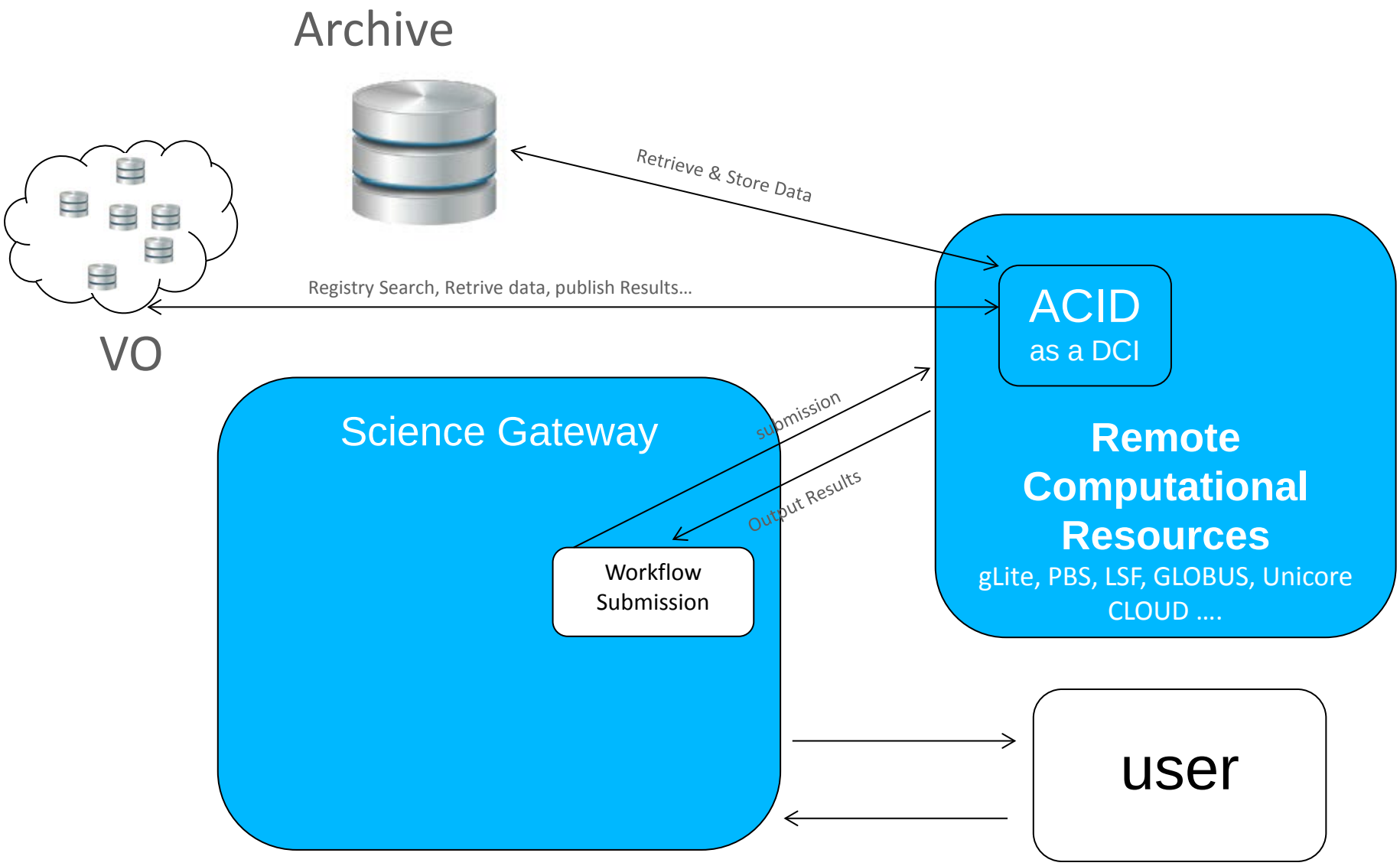
ownCloud Server

ownCloud client allows end user to share files on his desktop or smartphone

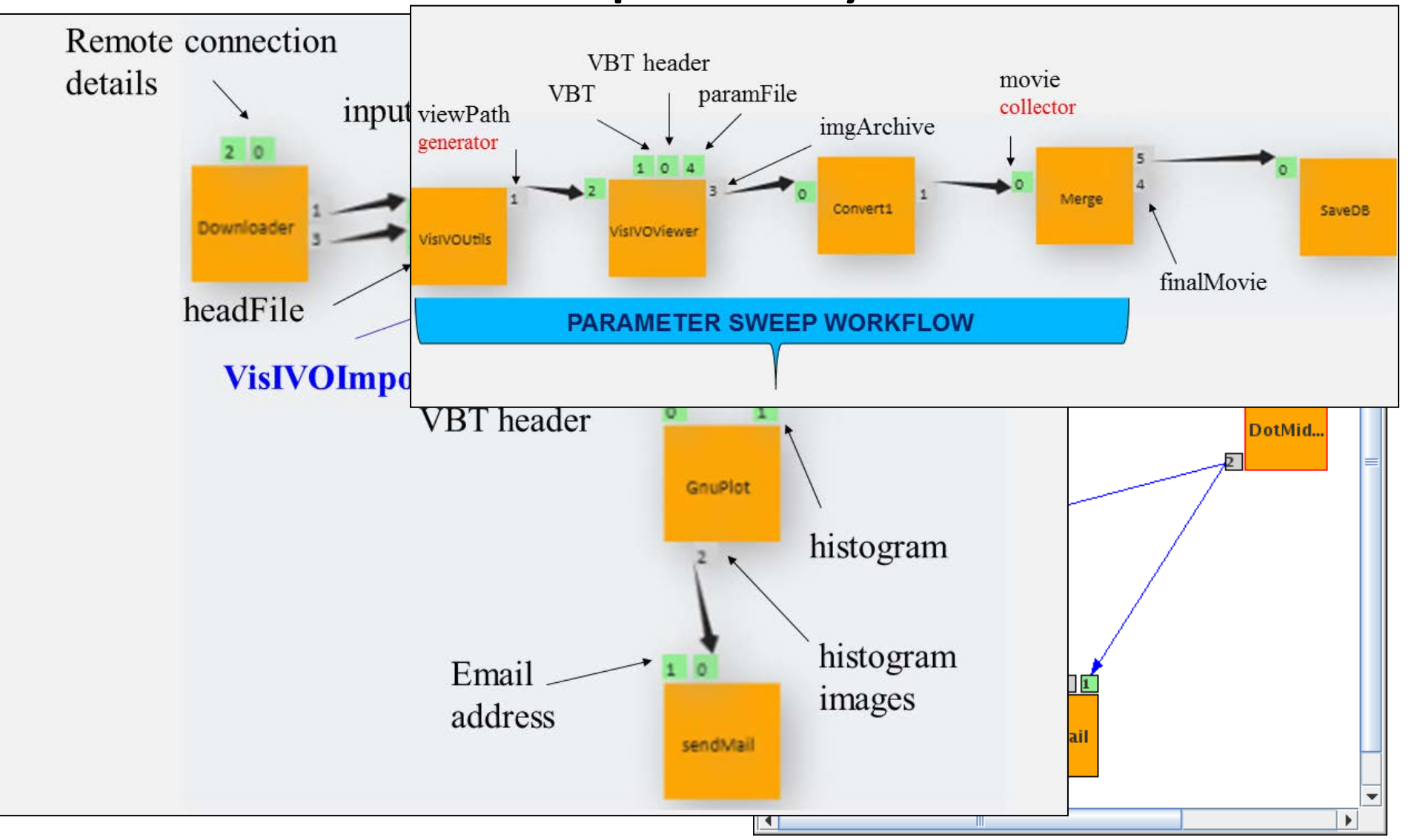
Function and Purpose

- This CTA Science Gateway is a **web environment**
- It is an environment: **Gateway** + **Data Cloud**
- It includes different tools that are necessary for the science analysis of CTA data.
- It allows to implement
  - **Standard reduction pipelines (OffLine mode)**
  - **Real-Time analysis pipelines (Interactive mode)**

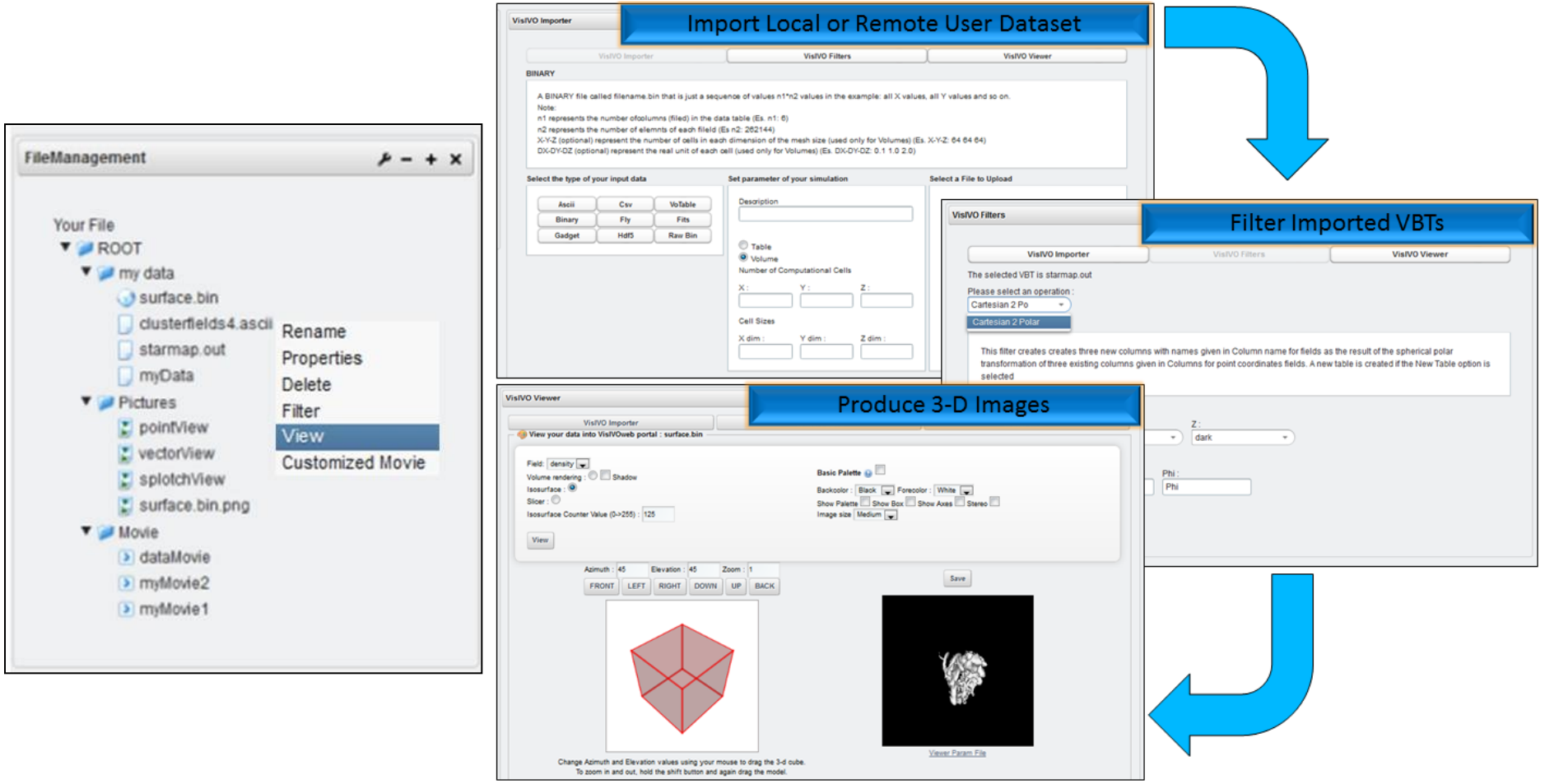
Offline analysis



Workflow Editor & Repository



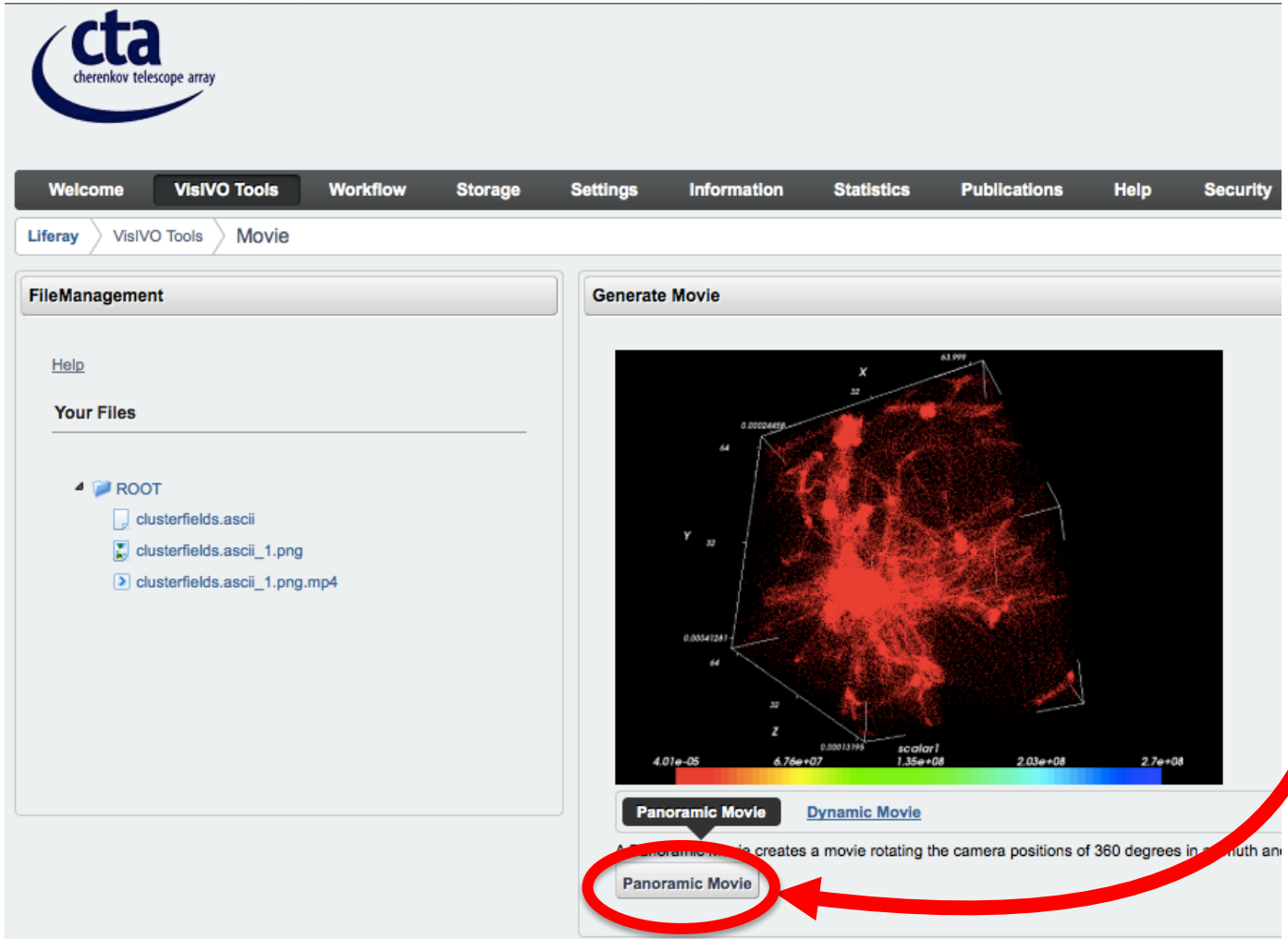
Science Gateway Features



Workflows through a Simple Interface

Workflow submission

ASM (Application Specific Module) in ACTION



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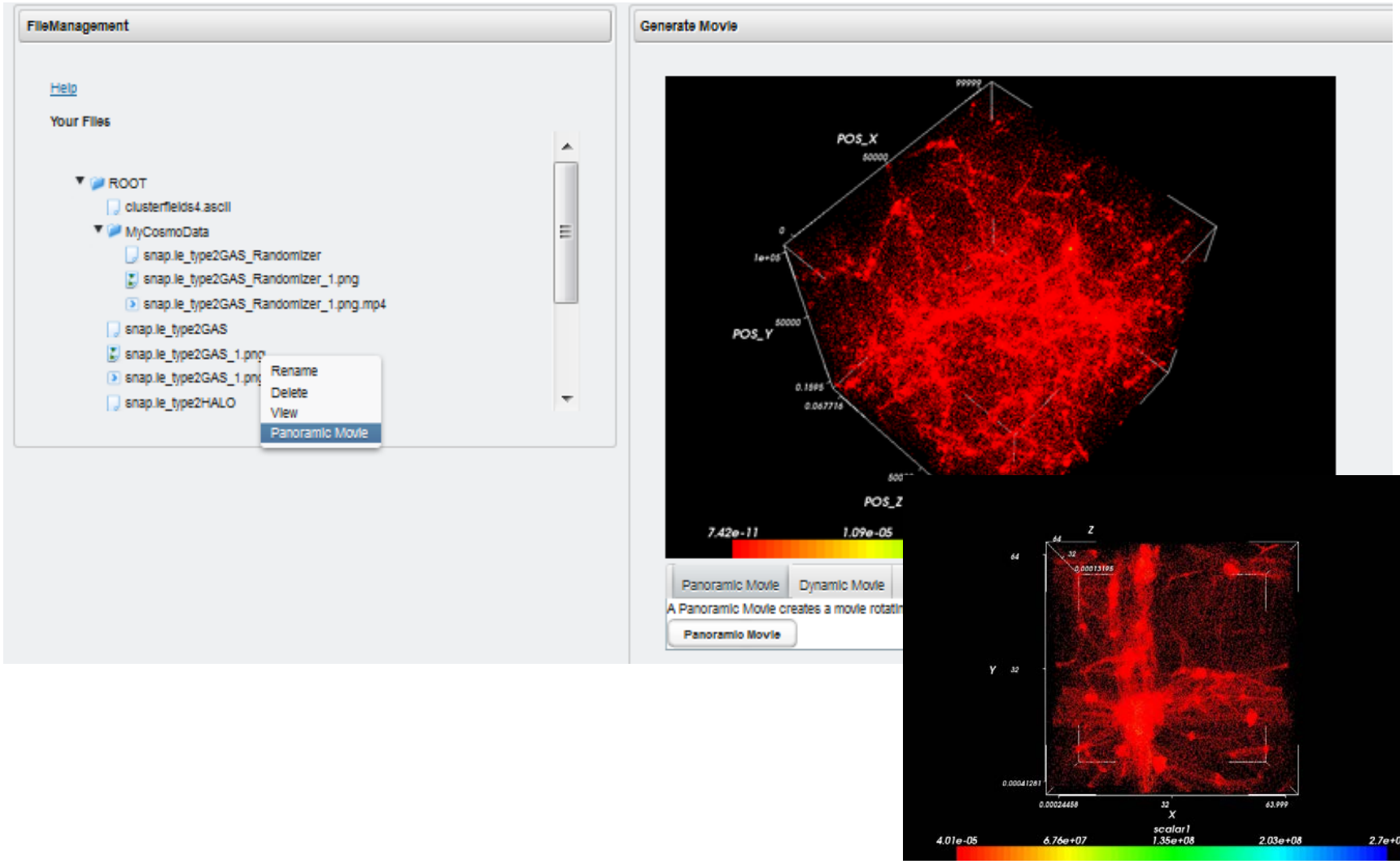
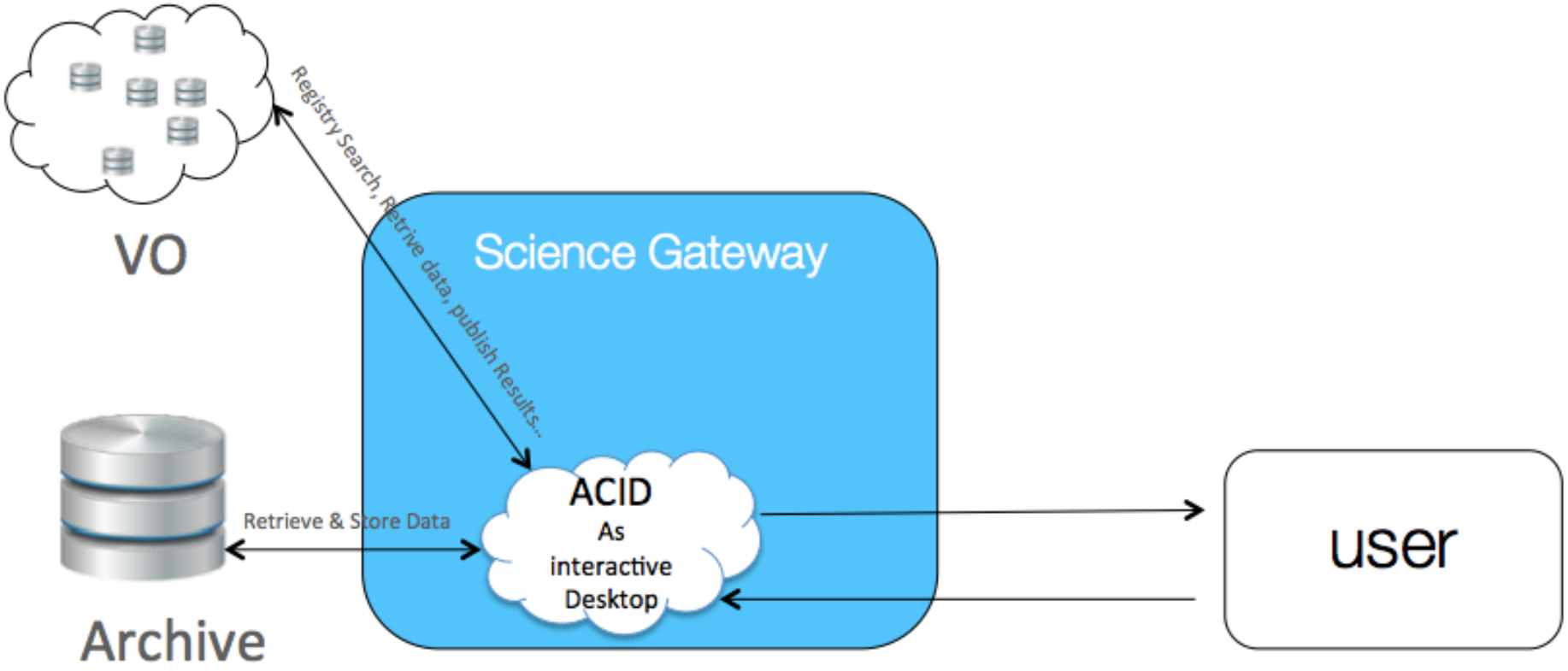
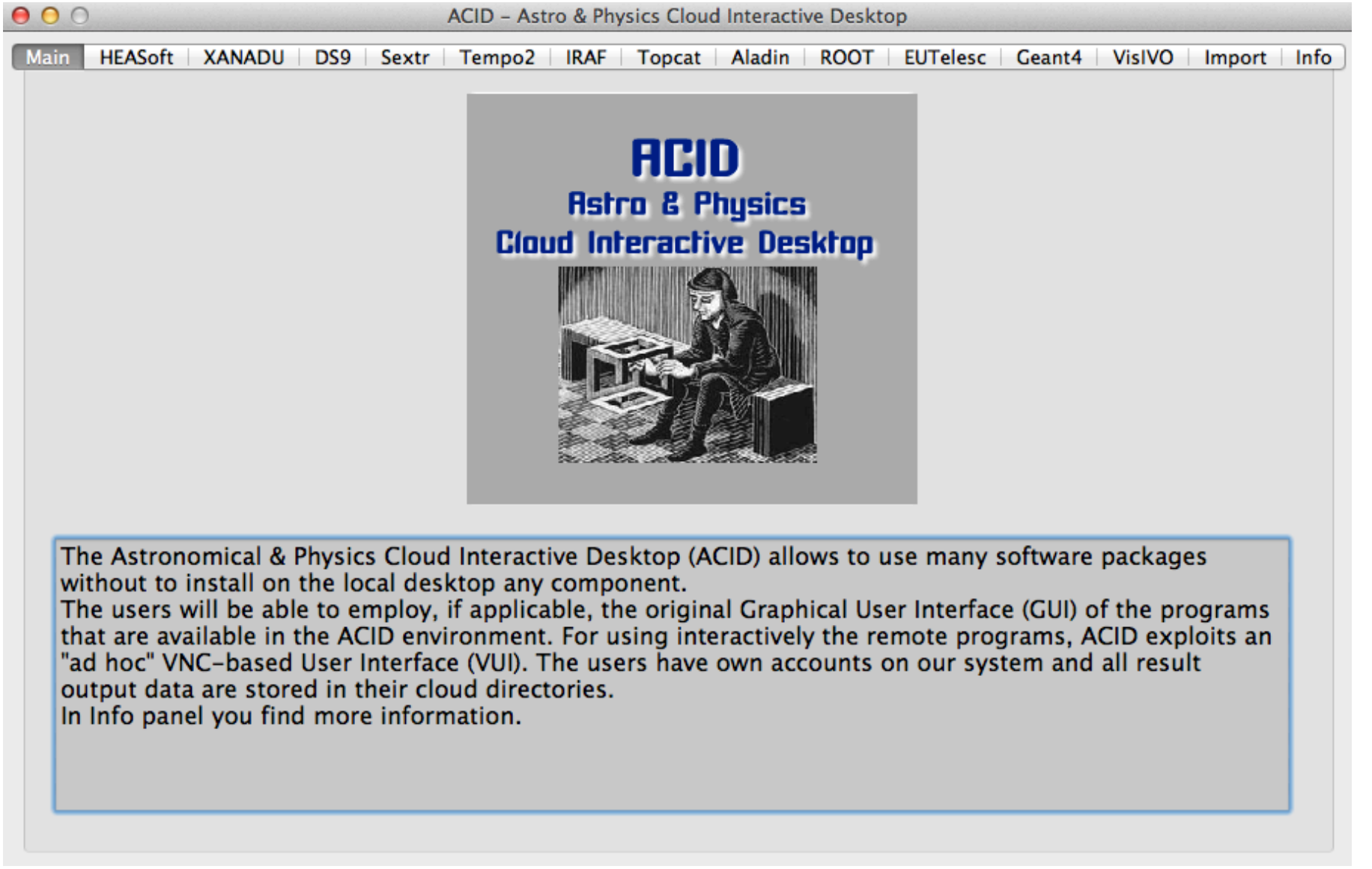


ONLine (Interactive) Analysis



ACID

Astronomical & Physics Cloud Interactive Desktop



ACID

Astronomical & Physics Cloud Interactive Desktop

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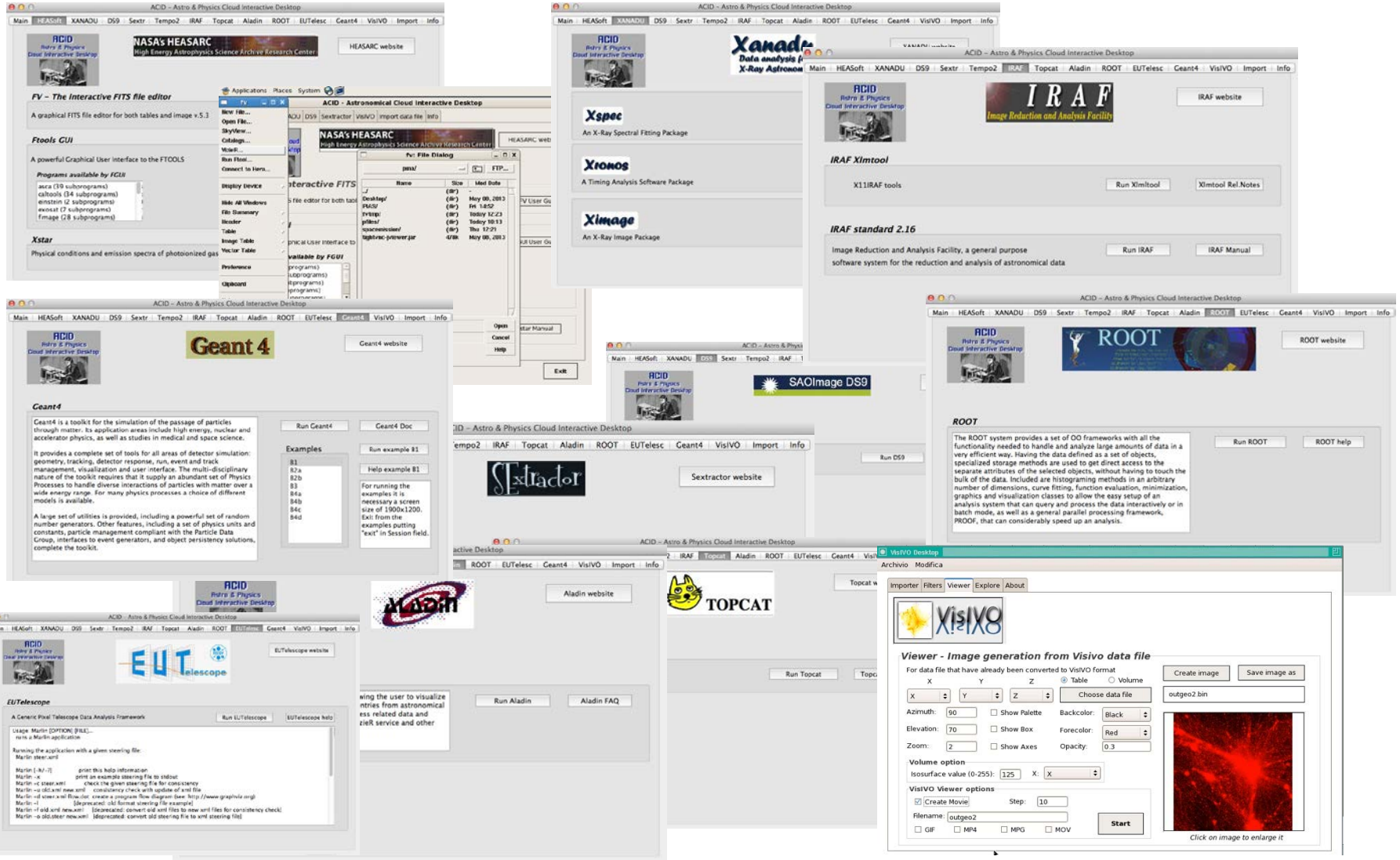

Conclusions

- Standards
  - Java Portlet Specification (JSR168)
  - SAML 2.0
  - WS-PGRADE/gUSE
- Enlarge the developer community
- Improve the sustainability of the software
- An ecosystem of new technologies:
  - Mobile access
  - Federated authentication
  - Workflow engine
  - Cloud services
- Tailor a product that suits the present and future requirements of the CTA community.