Archive Prototypes in the Cherenkov Telescope Array : INAF Contributions

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on behalf of the Whole CTA Rome Archive Team

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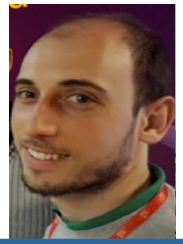

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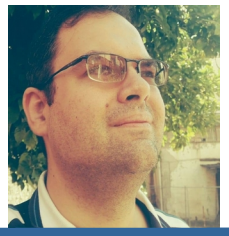
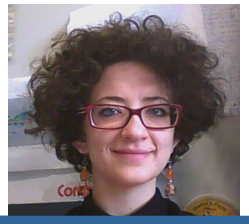
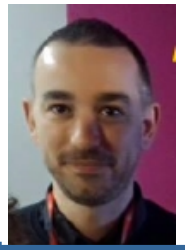


F. G. Saturni



Martina Cardillo



Antonino D'Aì

ASTRI

I.Bi.S.Co.

SSDC SPACE SCIENCE DATA CENTER

AC DC Astri/CTA Data Challenge

INAF ISTITUTO NAZIONALE DI ASTROFISICA NATIONAL INSTITUTE FOR ASTROPHYSICS

Asterics Astronomy ESFRI & Research Infrastructure Cluster

INDIGO - DataCloud

Teche.it

cta

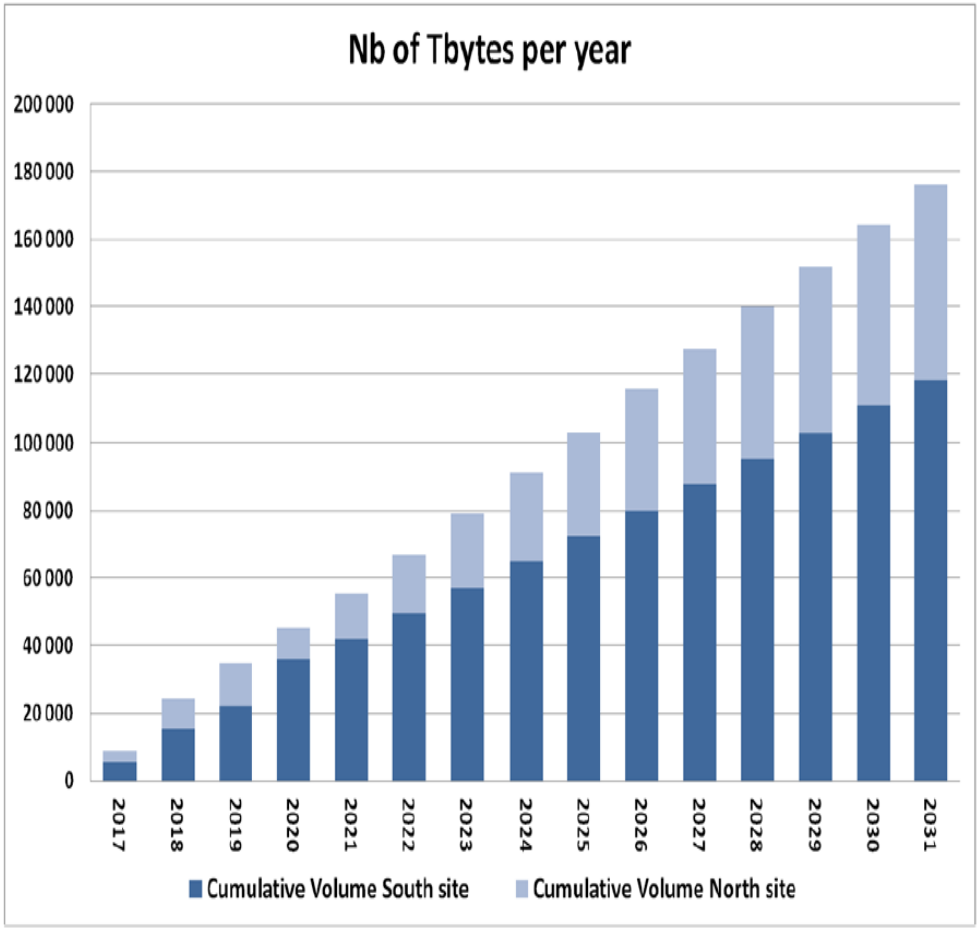
cherenkov telescope array

How much BIG are DATA?

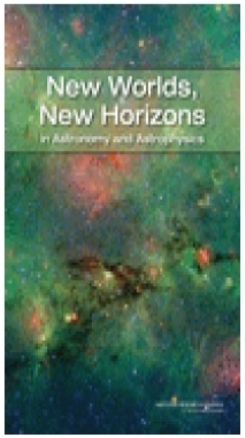
Without data compression and assuming 165 operational nights/yr:

ASTRI/Prot. → ~0.8 TB/night
→ **~0.3 PB/year**
Mini-Array → ~3 TB/night
→ **~6.1 TB**/night A.R.
→ **~1.0 PB/year** A.R.

… and for CTA ?
A pessimistic scenario can involve more than 100PB/year !
→ triggering systems?
→ data reduction on site?
or…
→ challenging with big data



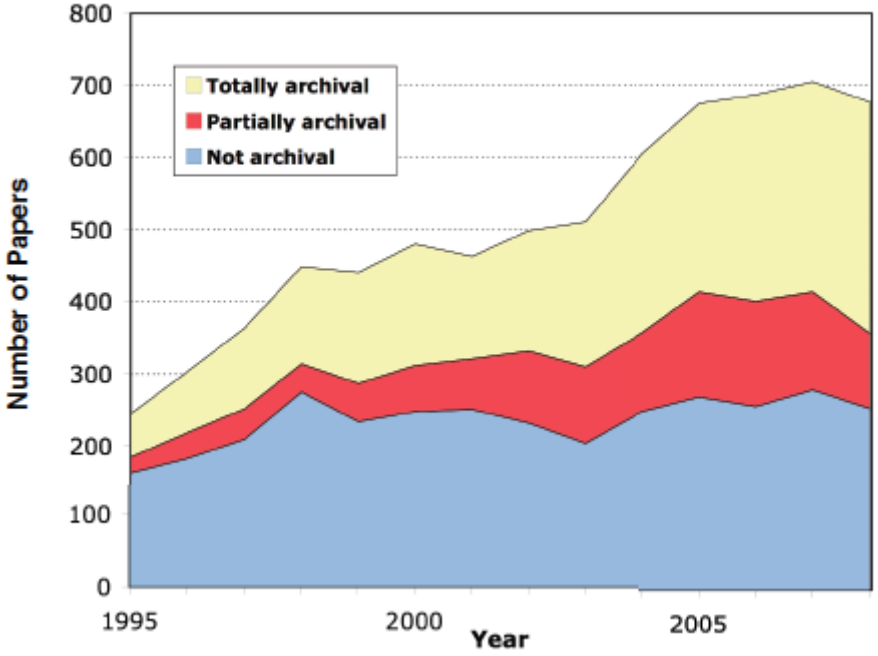
Once (period 2012-2016) the Archive's principal requirement was:
CTA Archive system must store, manage, preserve and provide easy access to a such huge amount of data for a long time.



New Worlds, New Horizons in Astronomy and Astrophysics

Committee for a Decadal Survey of Astronomy and Astrophysics; National Research Council

ISBN: 0-309-15800-1, 270 pages, 7 x 10, (2010)



Data Archives

Data archives are central to astronomy today, and their importance continues to grow. The science impact of these archives is large and increasing rapidly. Papers based on archival data from the Hubble Space Telescope now outnumber those based on new observations in any year and include some of the highest-impact science from the HST, as shown in Figures 5.6 and 5.7. Data from the 2 Micron All

Archive is not a…

…simple “repository”!!!

Archive role is “central” for…

...an Astronomical Observatory

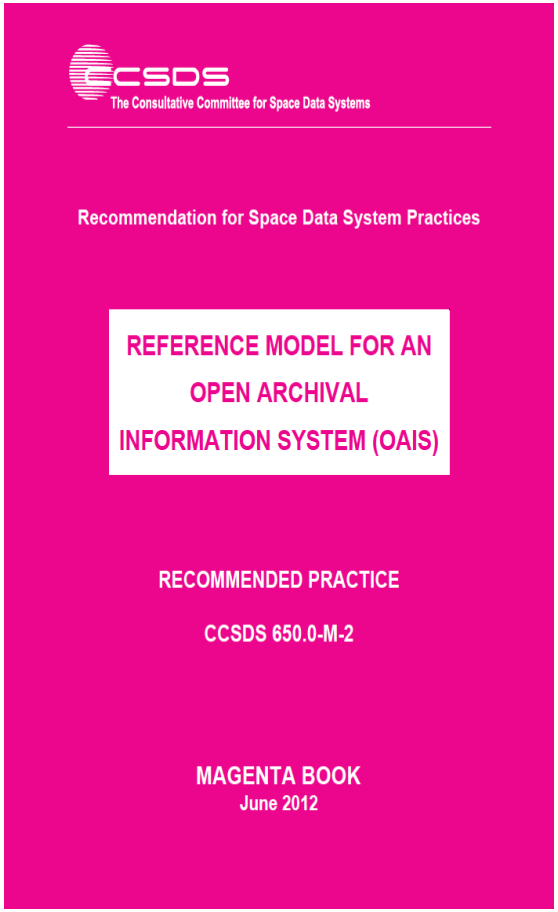
In the scientific data lifecycle of any **OBSERVATORY** the role of the Archive is central.

The major aim of a Scientific Archive is to guarantee **data preservation and access** information for the **Long Term** and for **all data science products**.

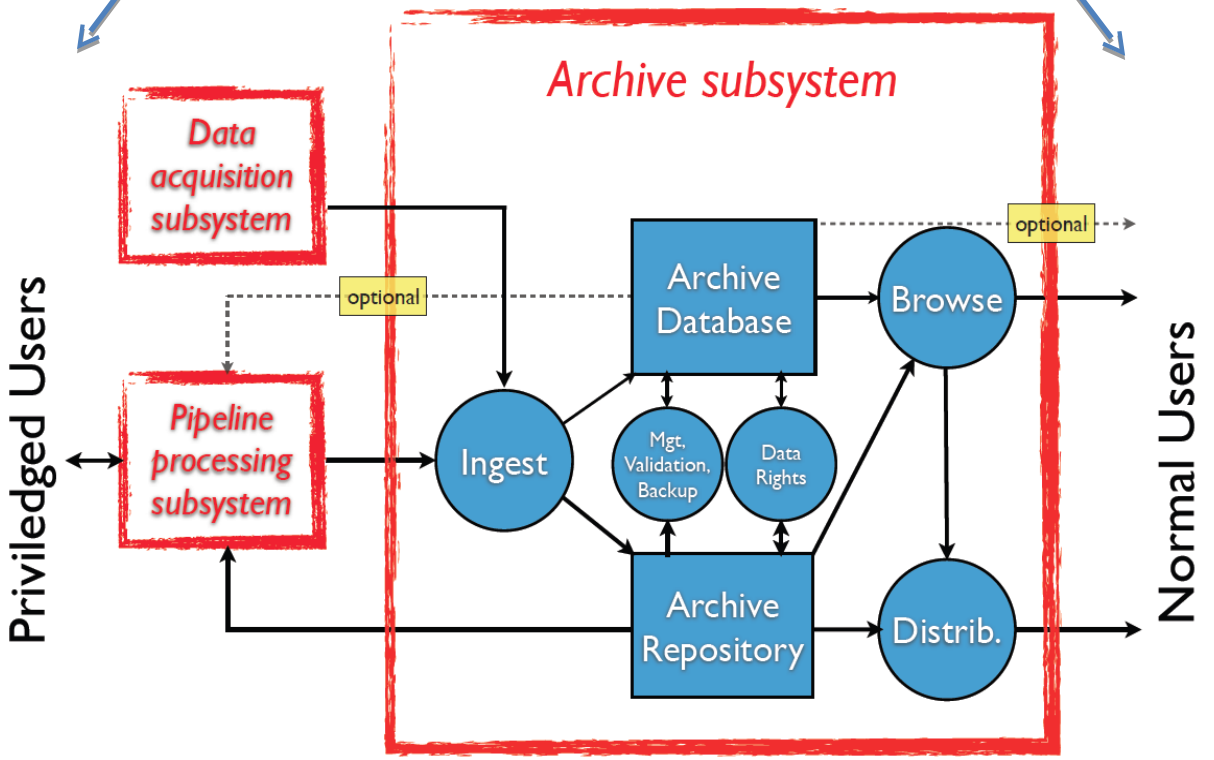
The **archived information** must be also usable by **different user categories (*data consumers*)** who are separate in time, space and background from the ***data producers***.

Archive **MUST** be accessible well beyond the end of the operational life of the observatory

B-DPPS-1840 Storage Standard: The DPPS long-term storage must follow the OAIS standard

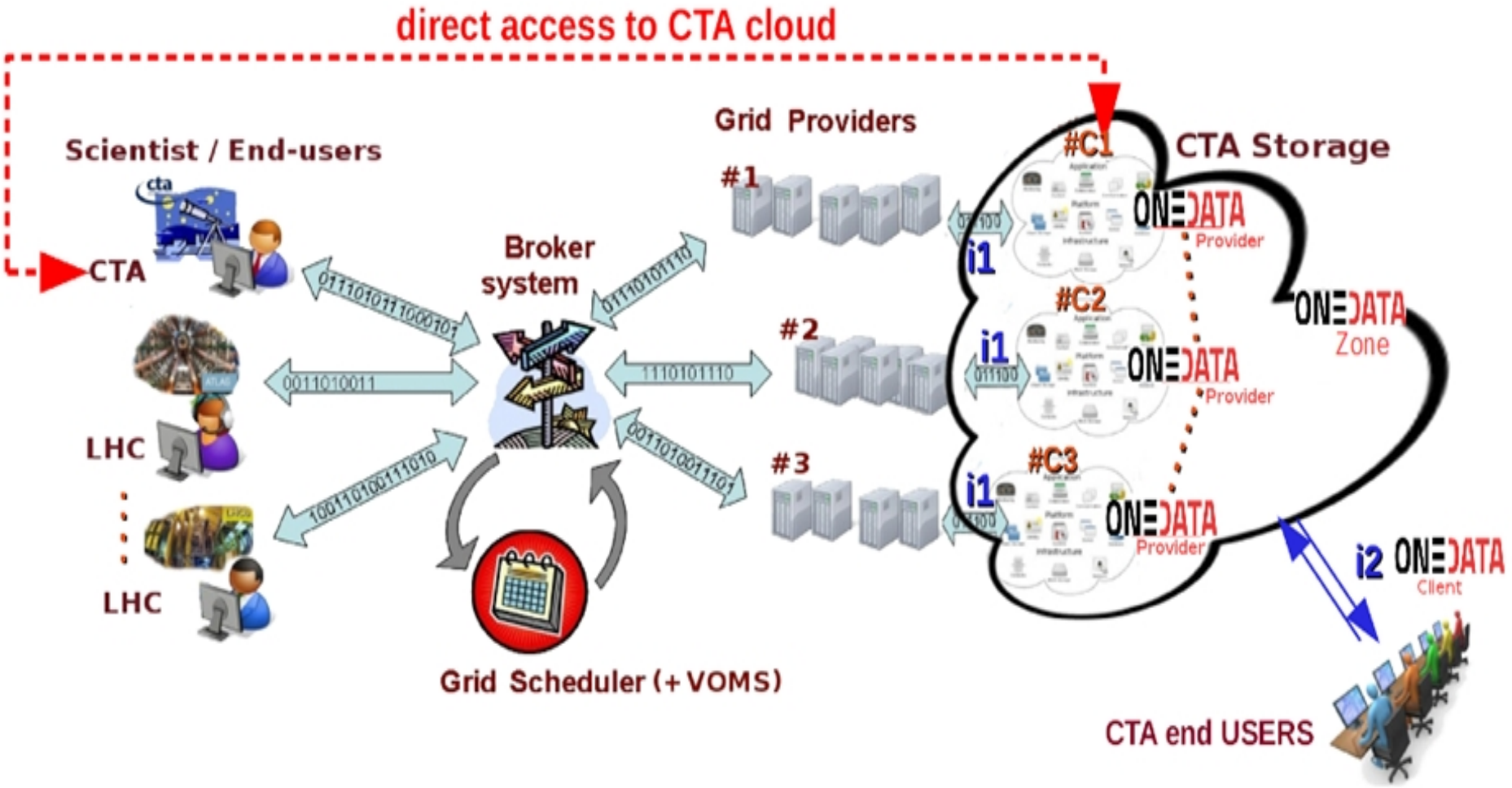


Data Producers and **Data Consumers** are rigidly separated by the **Archive System**



Prototyping CTA Archive

INDIGO - DataCloud

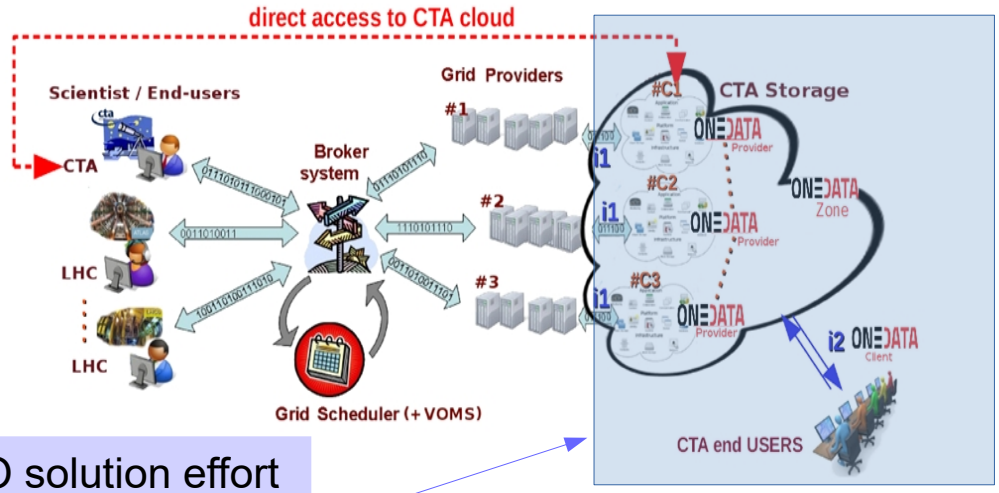


Prototyping CTA Archive

INDIGO - DataCloud

CTA Collaboration & Community participated to the INDIGO-Data Cloud H2020 Project AS **"Use Case"** for the **INDIGO infrastructure**.

The aim of our commitment was the very fruitful multi-disciplinar collaboration with INDIGO Communities in order to include the **BigData challenges** coming from the CTA Archive as an INTERNAL INDIGO Use CASE / Case Study
→ to be investigated with a distributed approach ←



BIG-DATA Archive still needed?

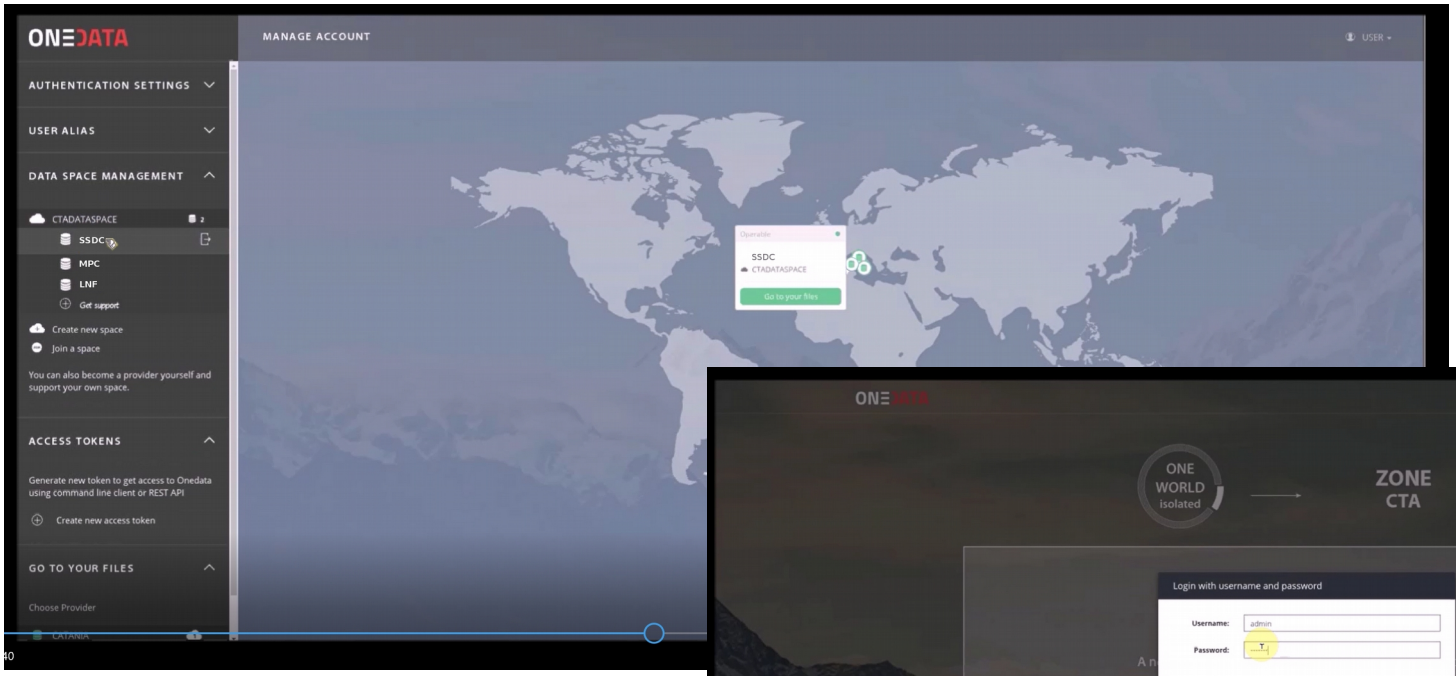
INDIGO - DataCloud

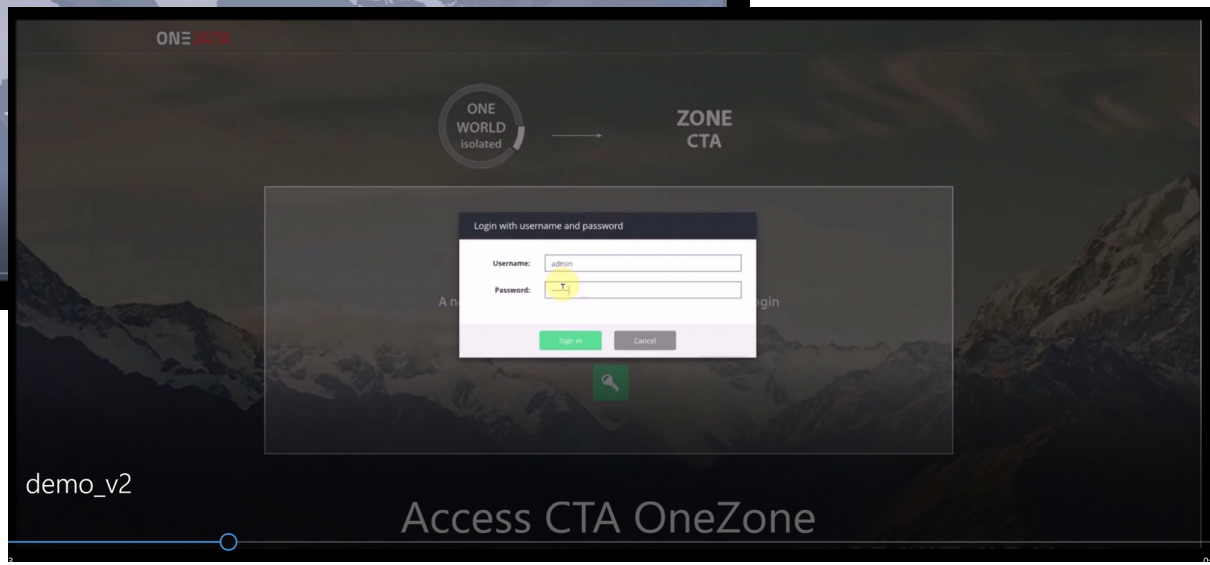
INDIGO solution effort
In the Distributed
Federation of Storage

OneDATA solutions are ready for *CTA A&A*

Prototyping CTA Archive

INDIGO - DataCloud





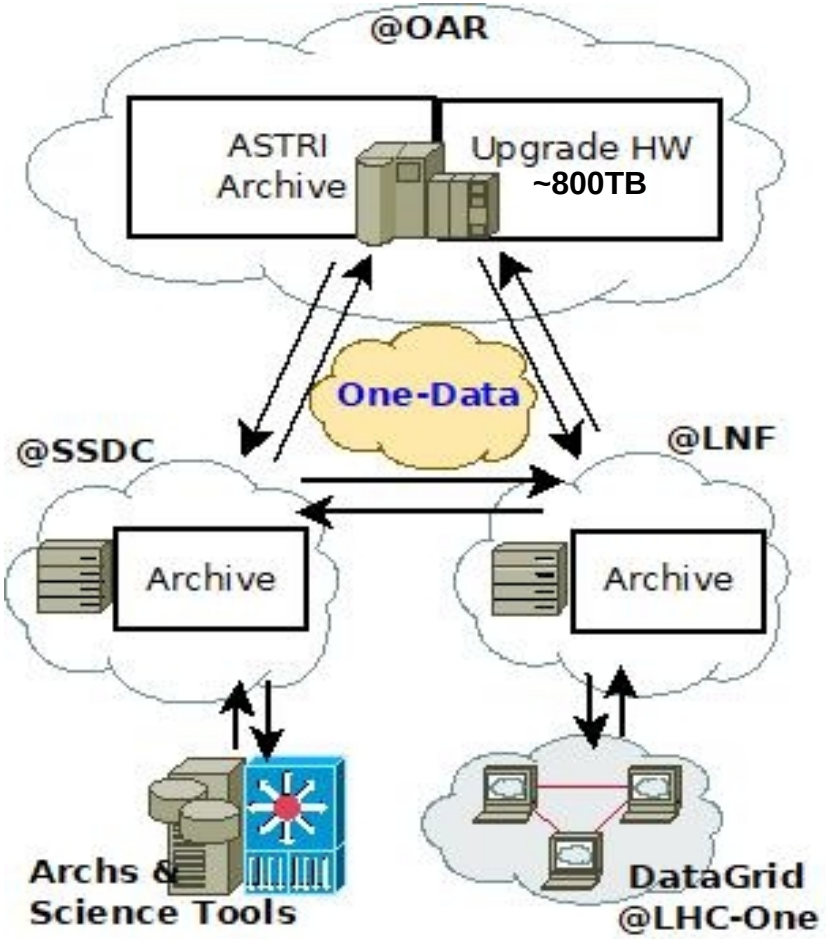
Few Snapshots from CTA workspace DISTRIBUTED ARCHIVE

Prototype → Onedata's REST API's as well as oneclient command line tool for mounting virtual Onedata filesystem on the local machine

Prototyping CTA Archive

INDIGO - DataCloud

Archive Prototype testbed … (REAL+SIMUL ASTRI&CHEC DATA)



Currently working the **Archive Prototype Solution** using:

→ the **ASTRI camera real data**

- → the **INAF-PRIN ASTRI CTA Data Challenge (AC-DC)** for mini-array based simulation

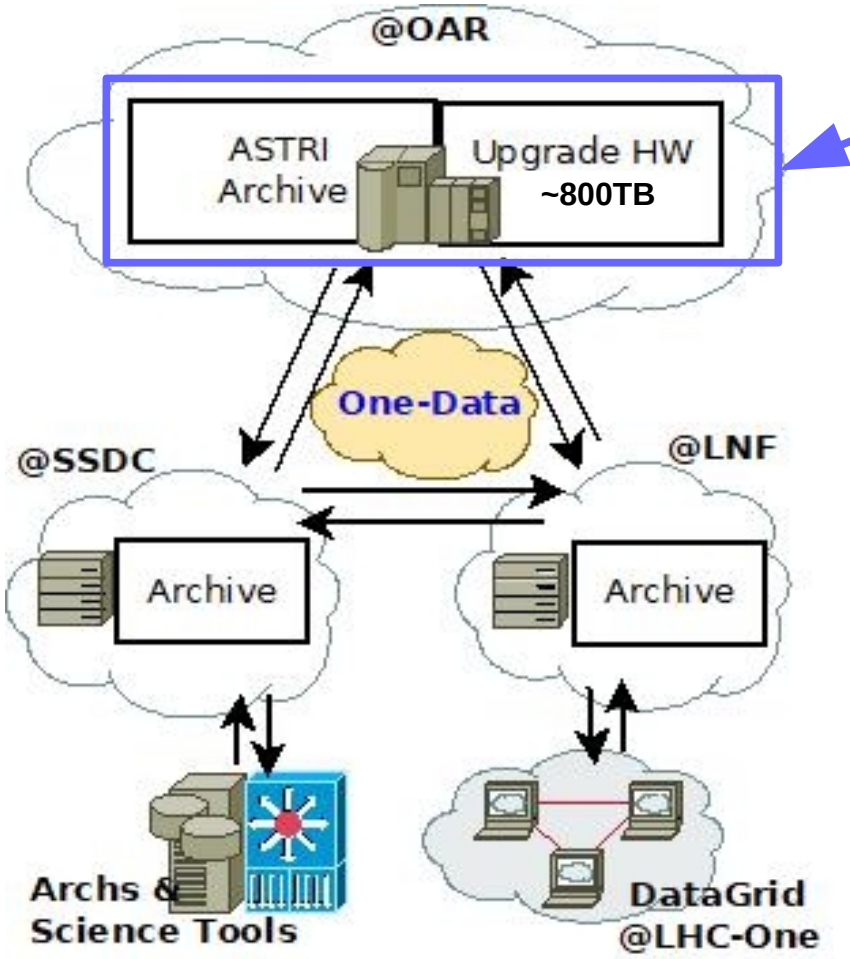
→ the **CHEC-M Camera real data**

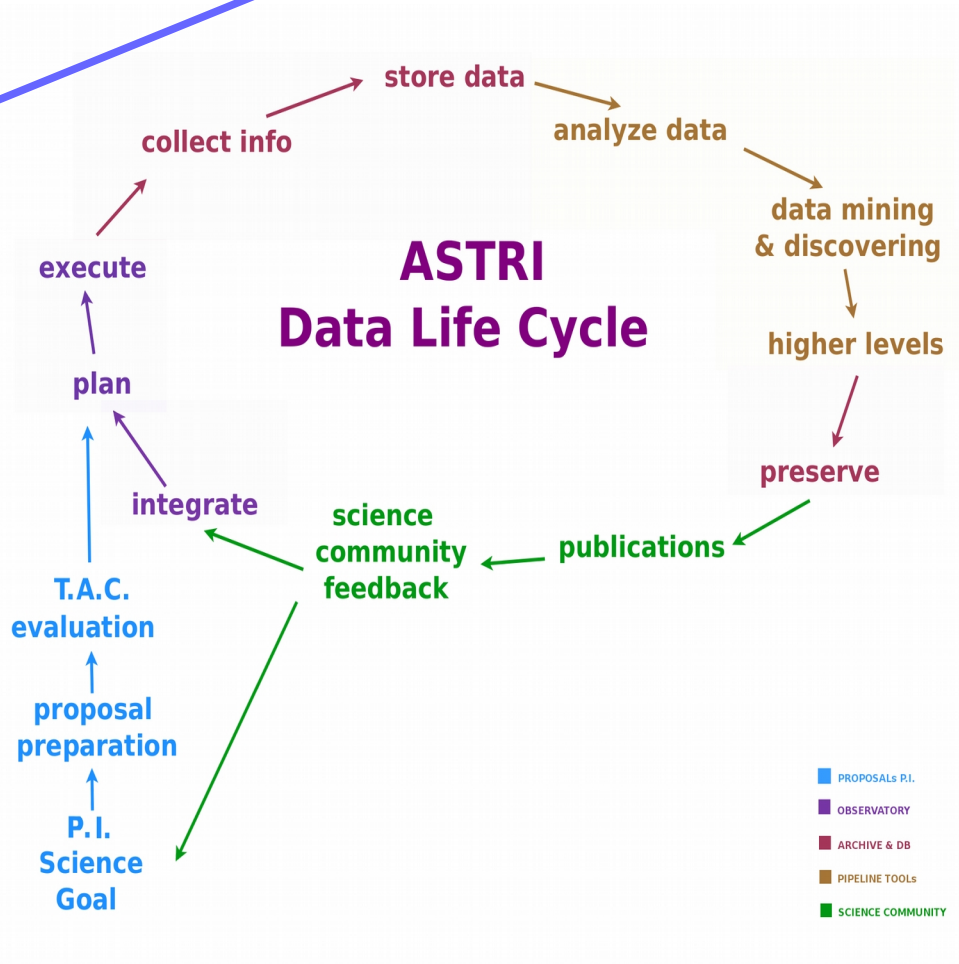
since in last weeks CHEC-M Camera was hosted to the ASTRI prototype design and The ASTRI Archive is going to manage and store CHEC real data. Three CTA SST: GATE (left), ASTRI (centre), SST-1M (right).

Prototyping CTA Archive

INDIGO - DataCloud

Using the end-to-end **ASTRI Archive System** as data feeder

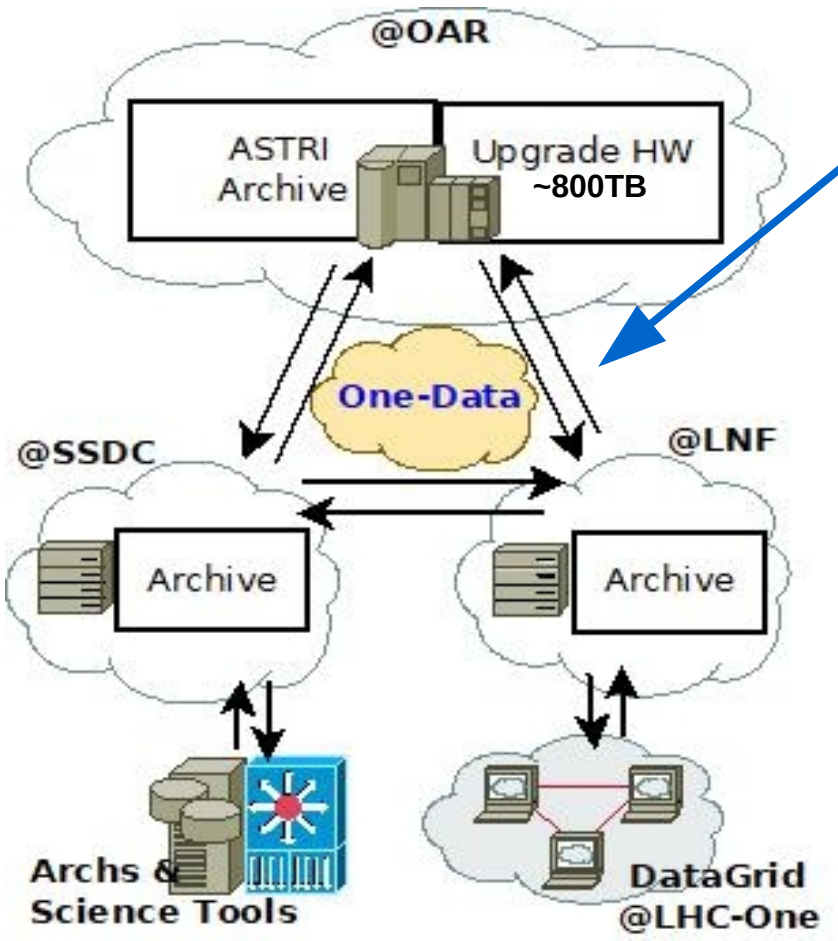




Prototyping CTA Archive

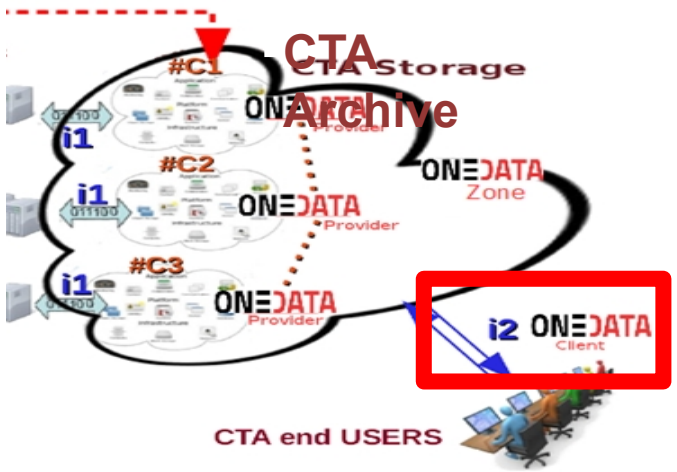
INDIGO - DataCloud

Archive Prototype testbed



- **CTA clients & End Users** able to access to the CTA federated storage cloud through One Data interfaces (clients) + Users A&A.

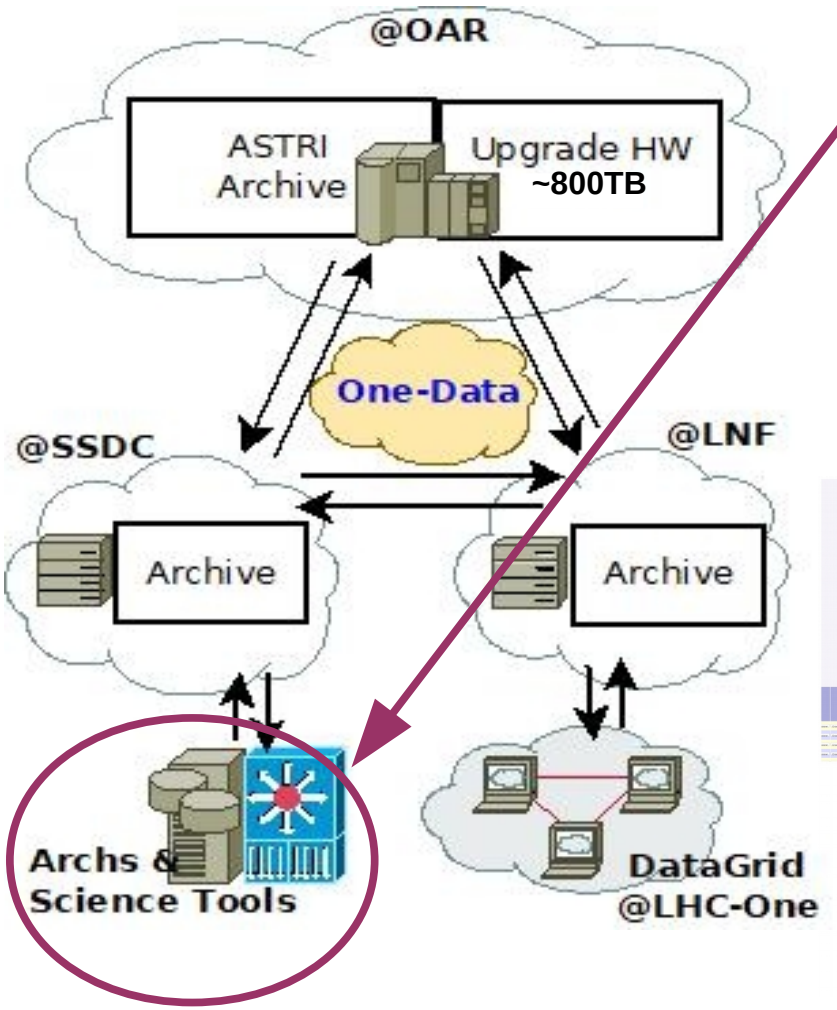
  OneClient: a command-line based application for **accessing** and **managing** user spaces (mounted in local FS) via **virtual file system**.



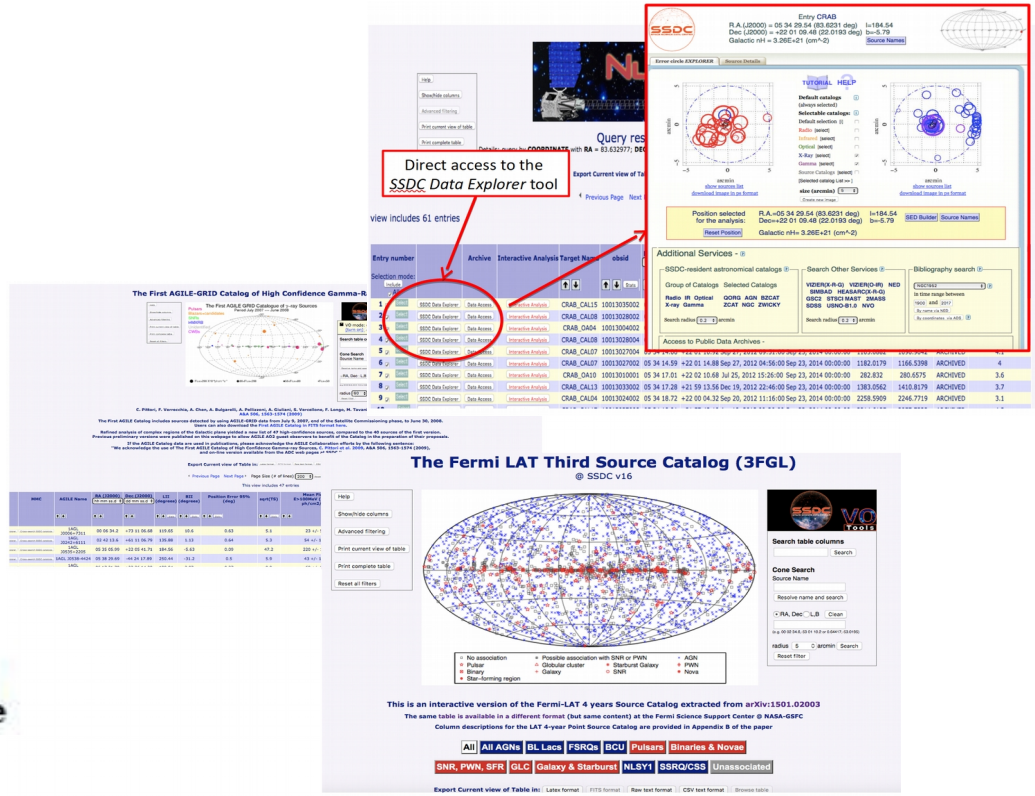
Prototyping CTA Archive

INDIGO - DataCloud

Archive Prototype testbed



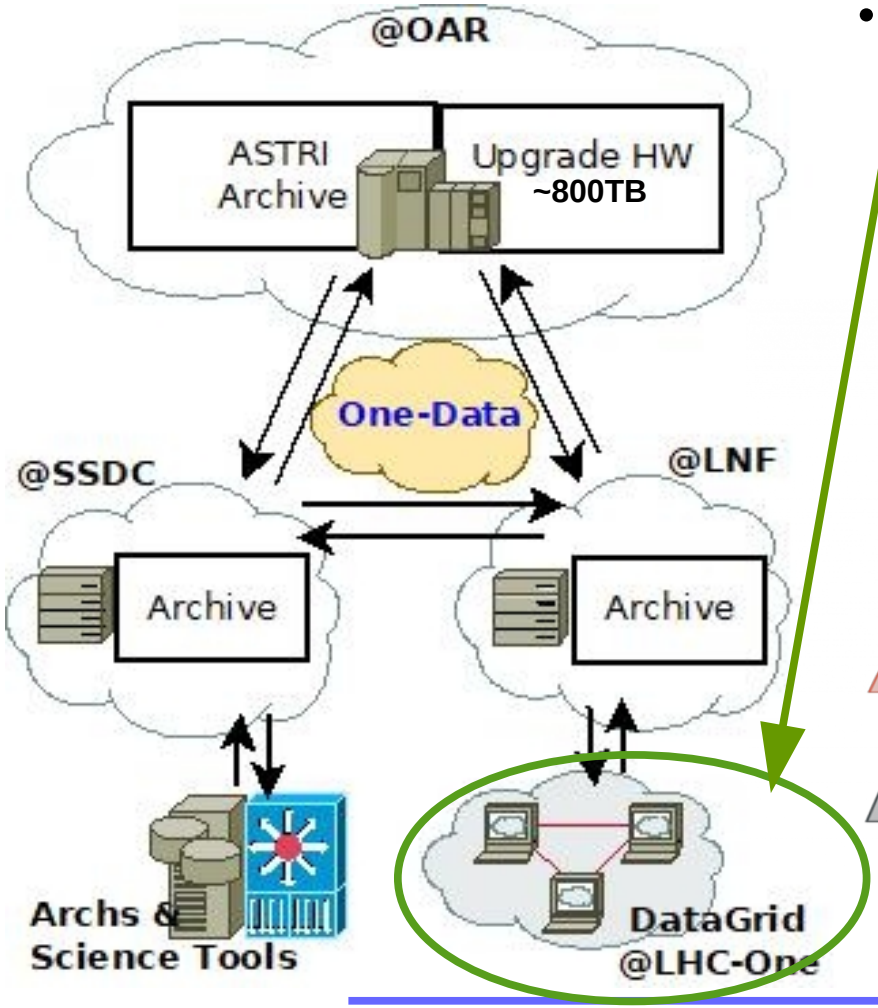
- Access **Catalogs, Multimission Archive, VOtools and MWC Science tools** @SSDC node



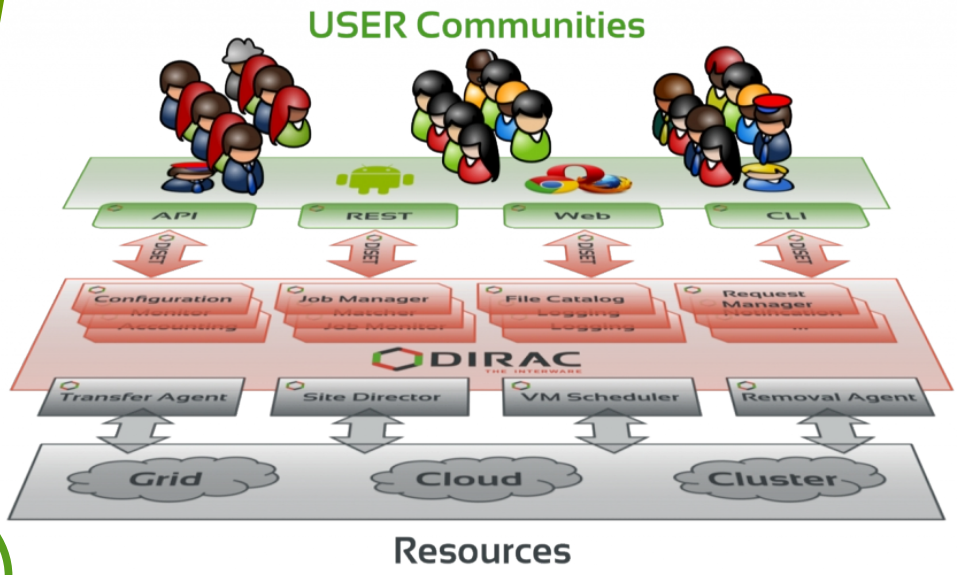
Prototyping CTA Archive

INDIGO - DataCloud

Archive Prototype testbed



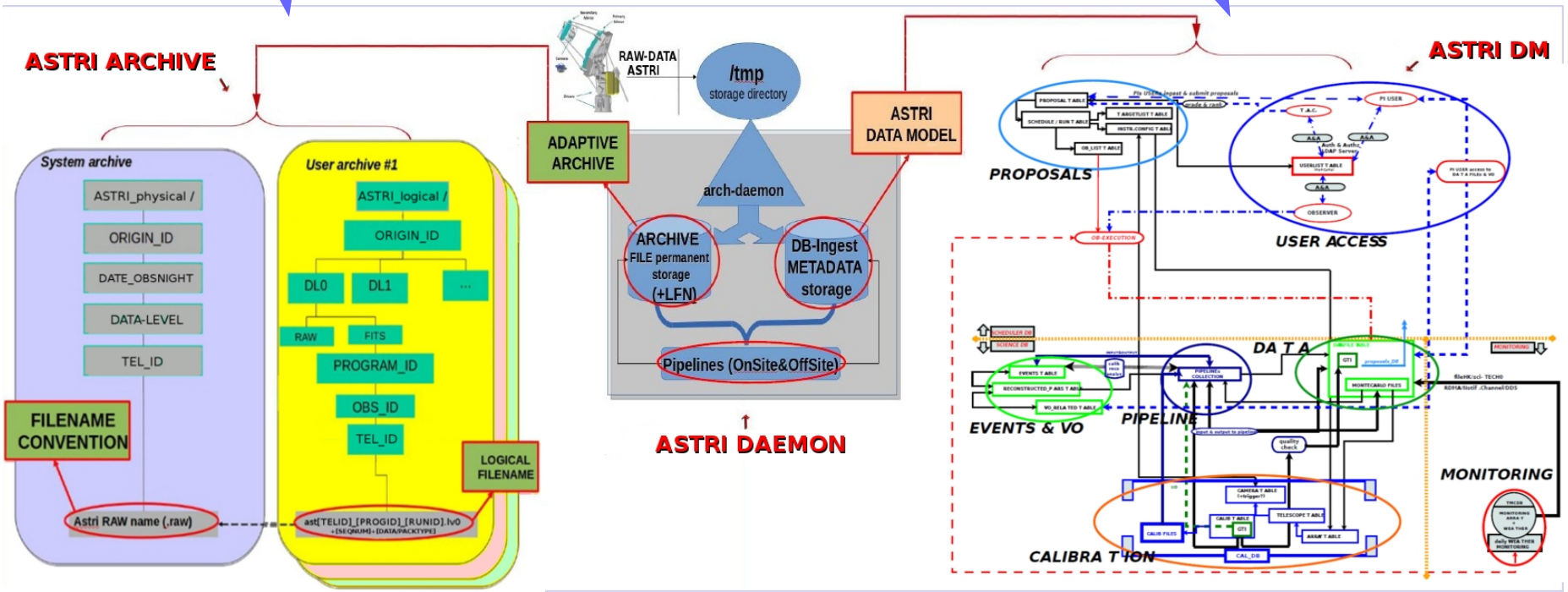
- Access LHC-infrastructure (*~10Gb connection*) on **DATA GRID** using DIRAC for Simulations and Pipeline runtime @LNF (Frascati) node.



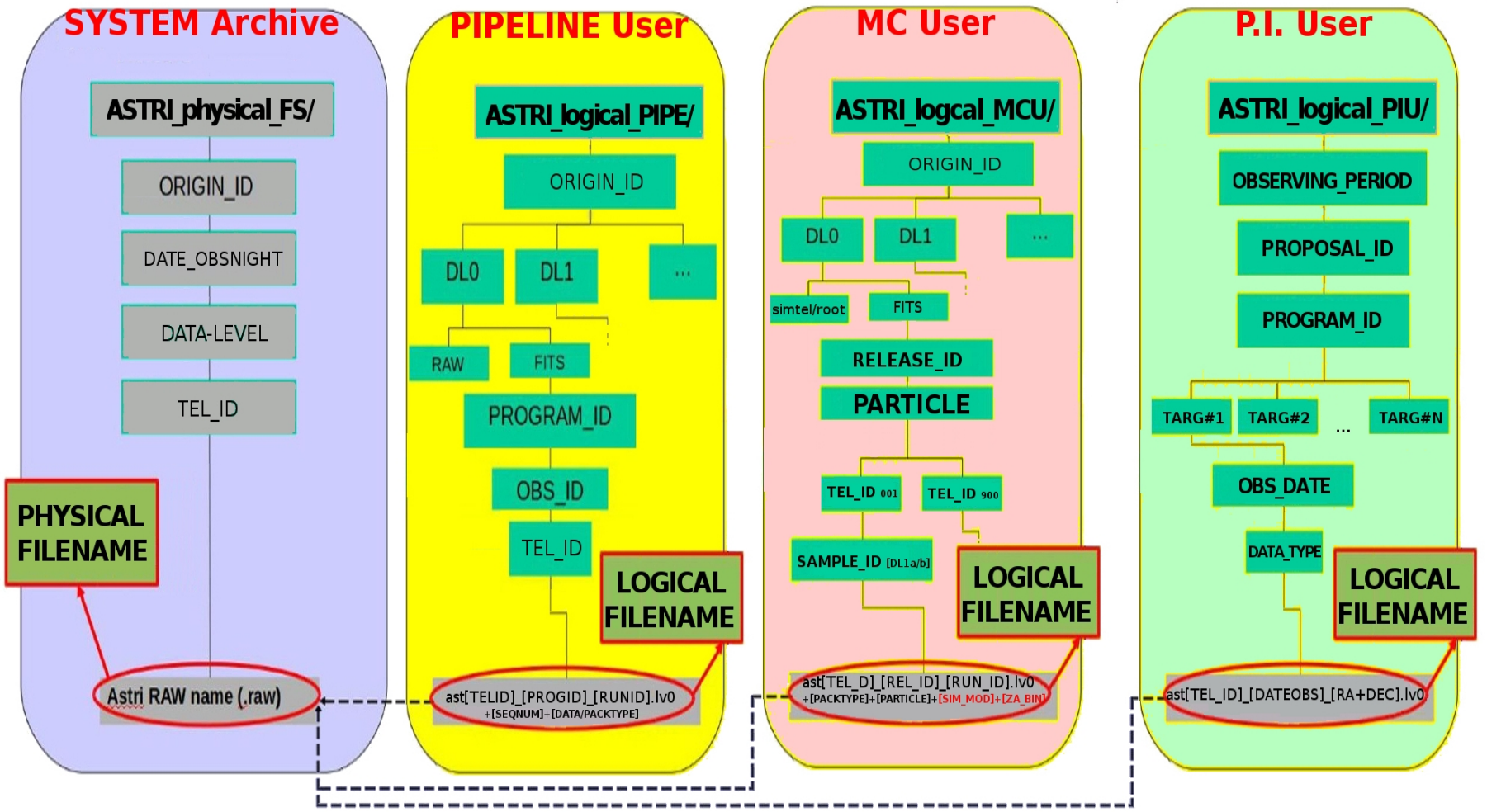
ASTRI Archive System

REPOSITORIES (physical & logical)

DATABASES (mySQL & mongo) + couch-base

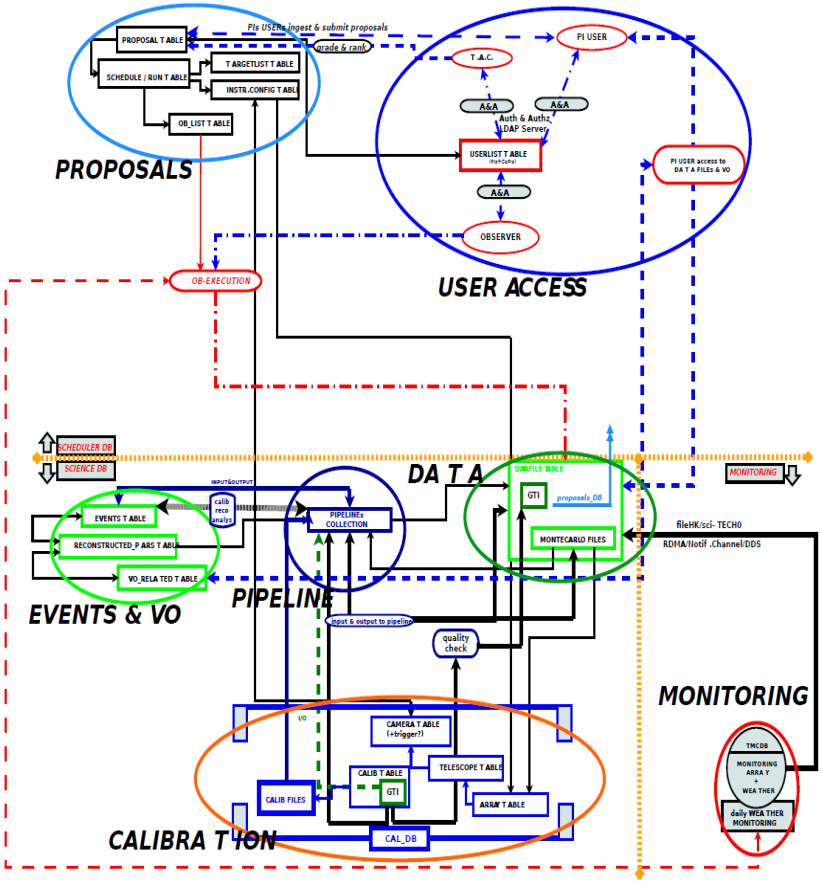


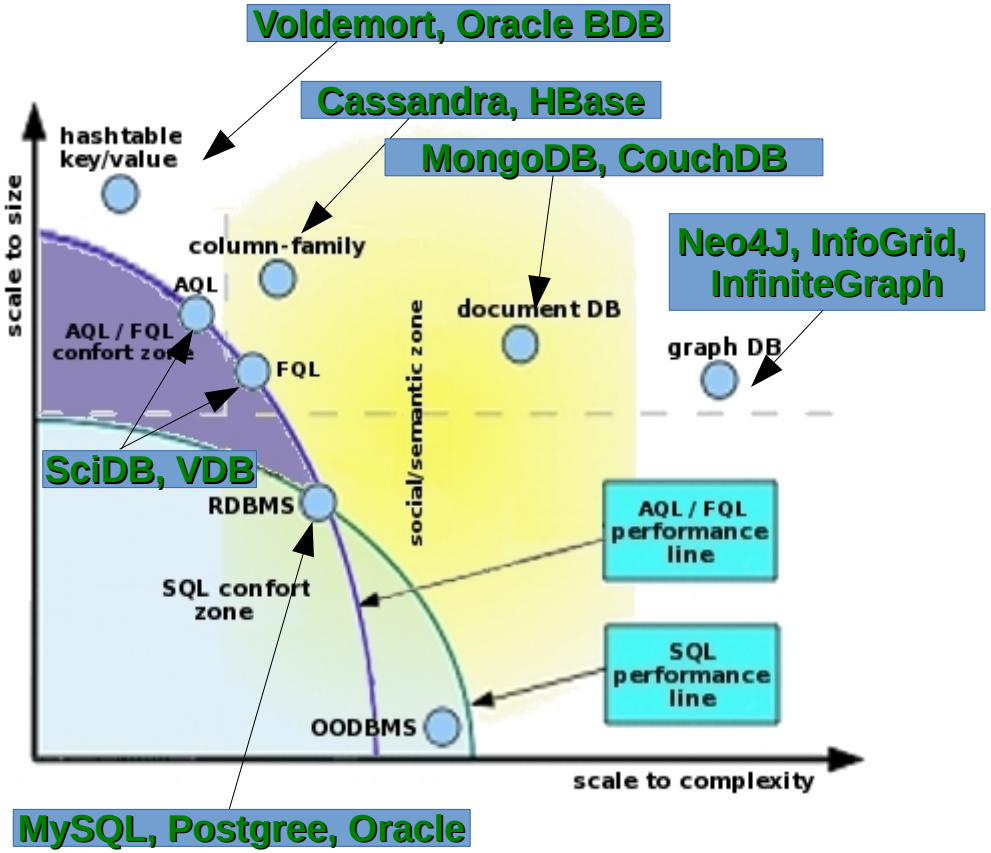
Physical & Logical Archives



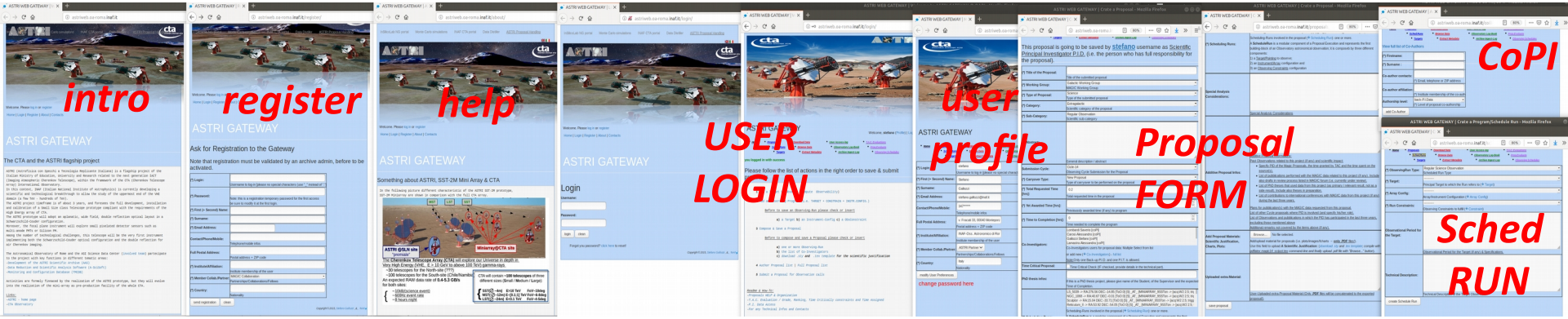
Knowledge Discovery DBs

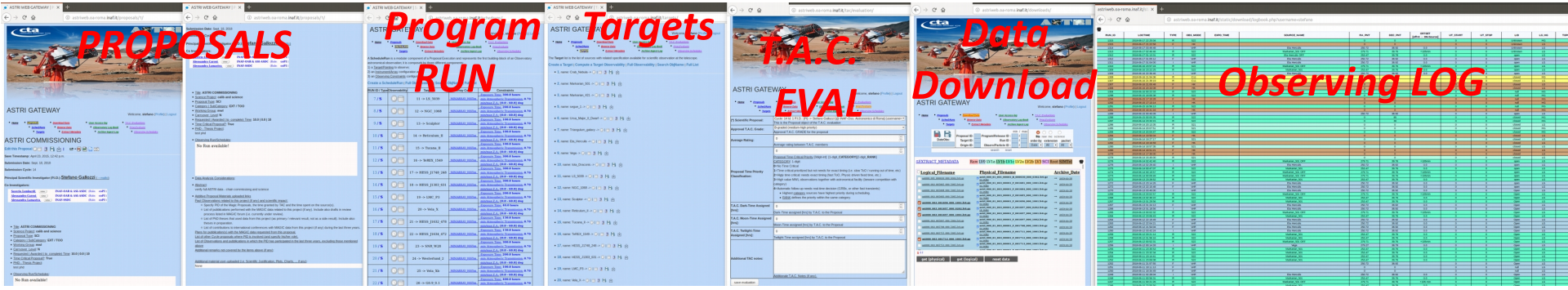
...testing databases technology using ASTRI data-model...

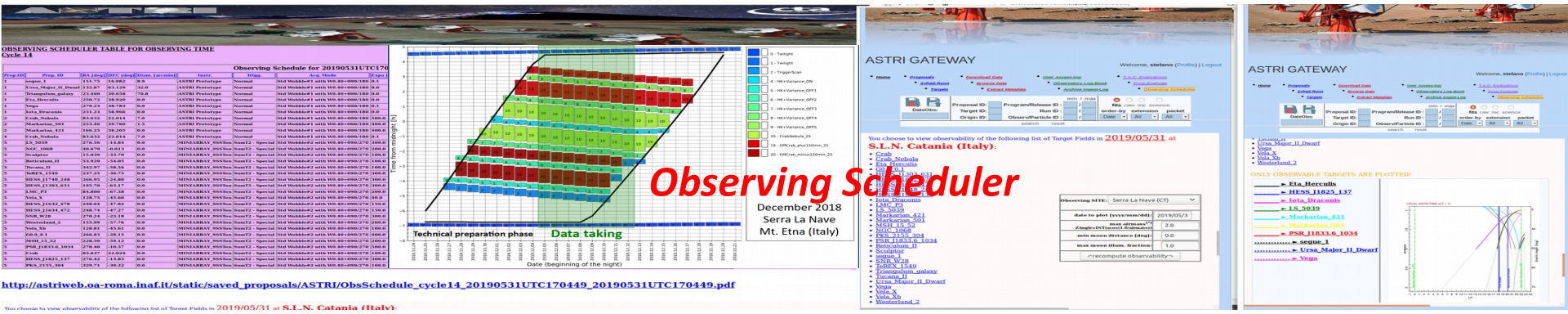




ASTRI Gateway

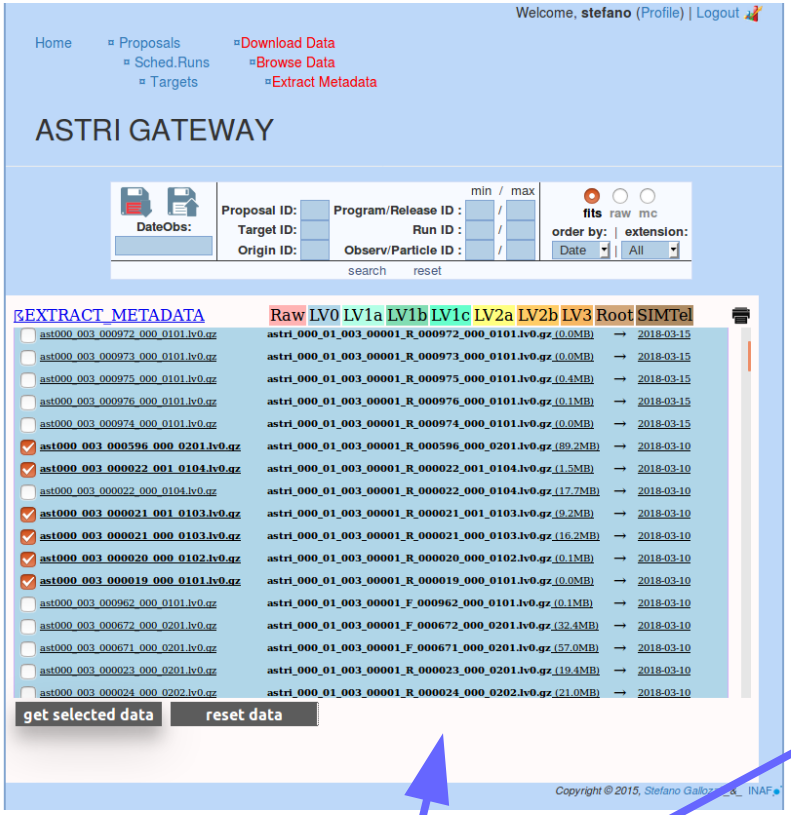


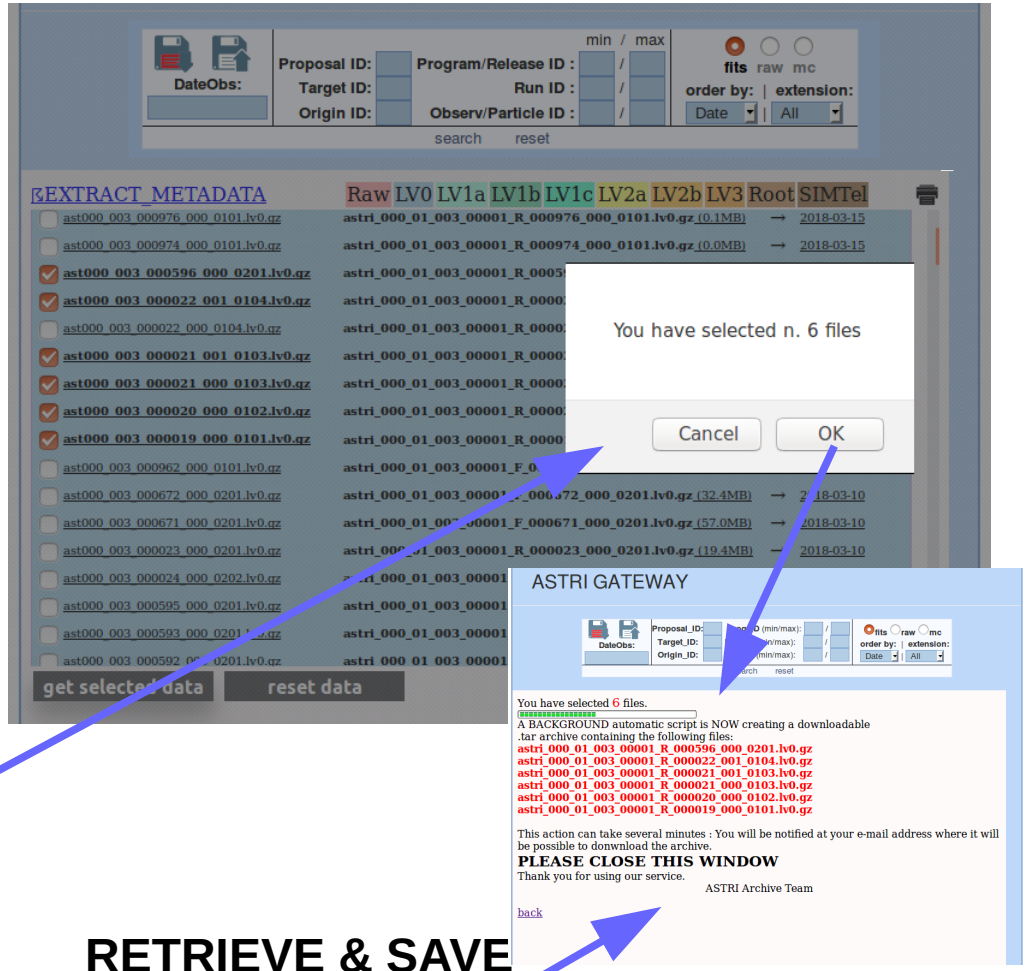




http://astriweb.oa-roma.inaf.it/static/saved_proposals/ASTRI/ObsSchedule_cycle14_20190531UTC170449_20190531UTC170449.pdf

ASTRI User Access #1

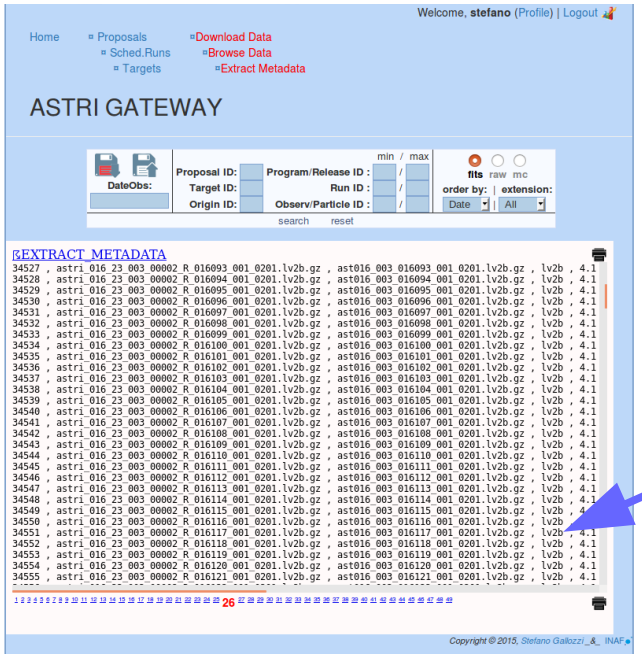




QUERY & SELECT DATA
(from lev0 to lev5 / photon list)

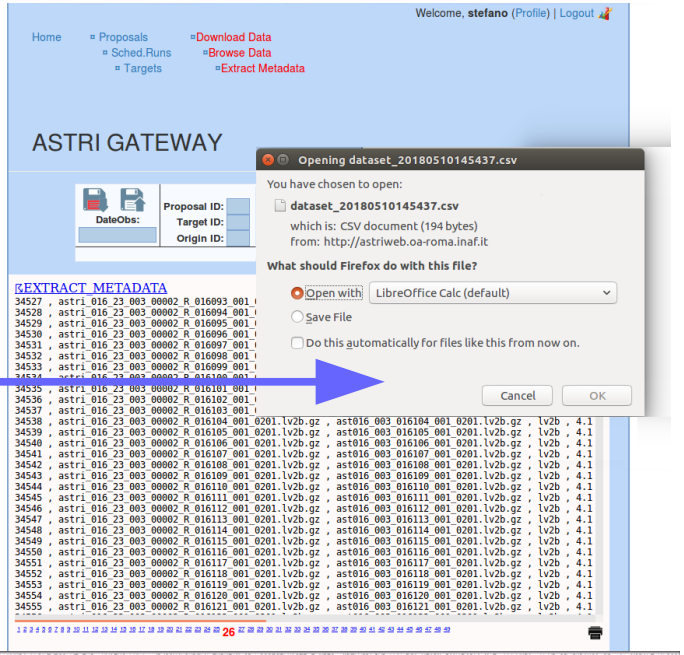
RETRIEVE & SAVE
ALL LEVEL
DATASETs

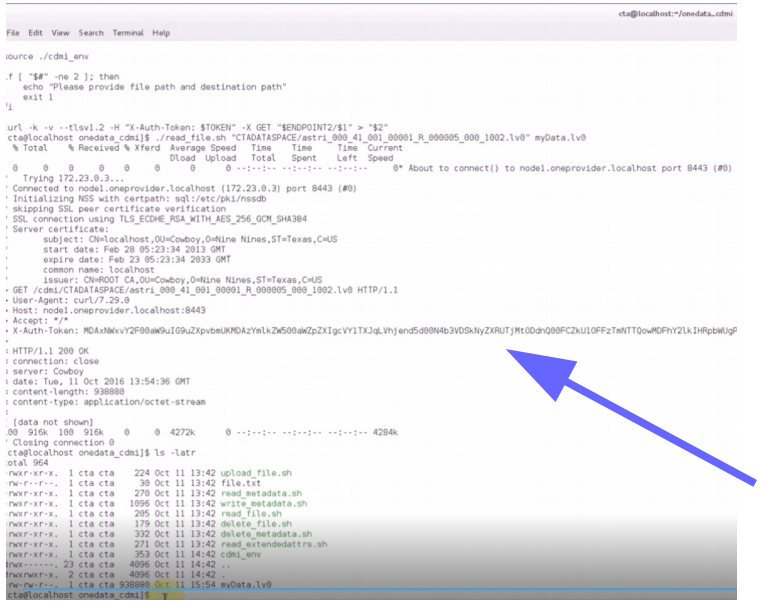
ASTRI User Access #2

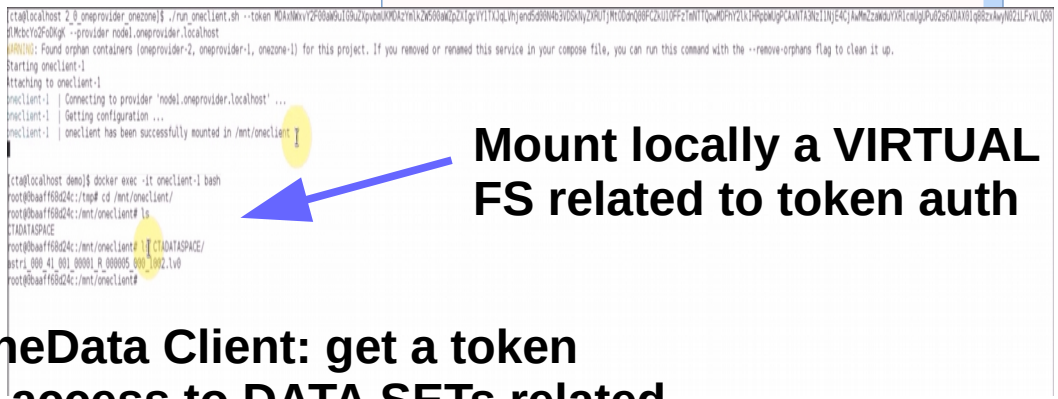


BROWSE, INSPECT DATA & SIMULATIONS (from lev0 to lev5)

EXTRACT META-DATA SETs







Mount locally a VIRTUAL FS related to token auth

OneData Client: get a token to access to DATA SETs related to a custom query

ASTRI Hardware

- Switch T.O.R. 1→ 10Gb/s
- Other OneData nodes???
- OneData Provider#3 (@SSDC)
- OneData Provider#2 (@LNF)
- OneData Provider#1 (@OAR-MPC)
- Redundant ASTRI services
- ASTRI Gateway (gitLab & redmine)
- Mirror ASTRI Gateway
- Switch KVM
- Other Computing???
- DBs Service and File Catalogs & Pipeline (devel & Runtime)
- STORAGE (expanding ~1PB)
- Other Storage???
- UPS downstream and stabilized by the Institute's UPS

Archive Prototype for CTA

CTA Observatory Archive Assumptions

→ **2 Data Production Sites**

→ **Low-Lev BigData Storage ("close" data-prod Sites?)**

→ **Data Compression & Reduction (on-site?)**

On-site?

NO

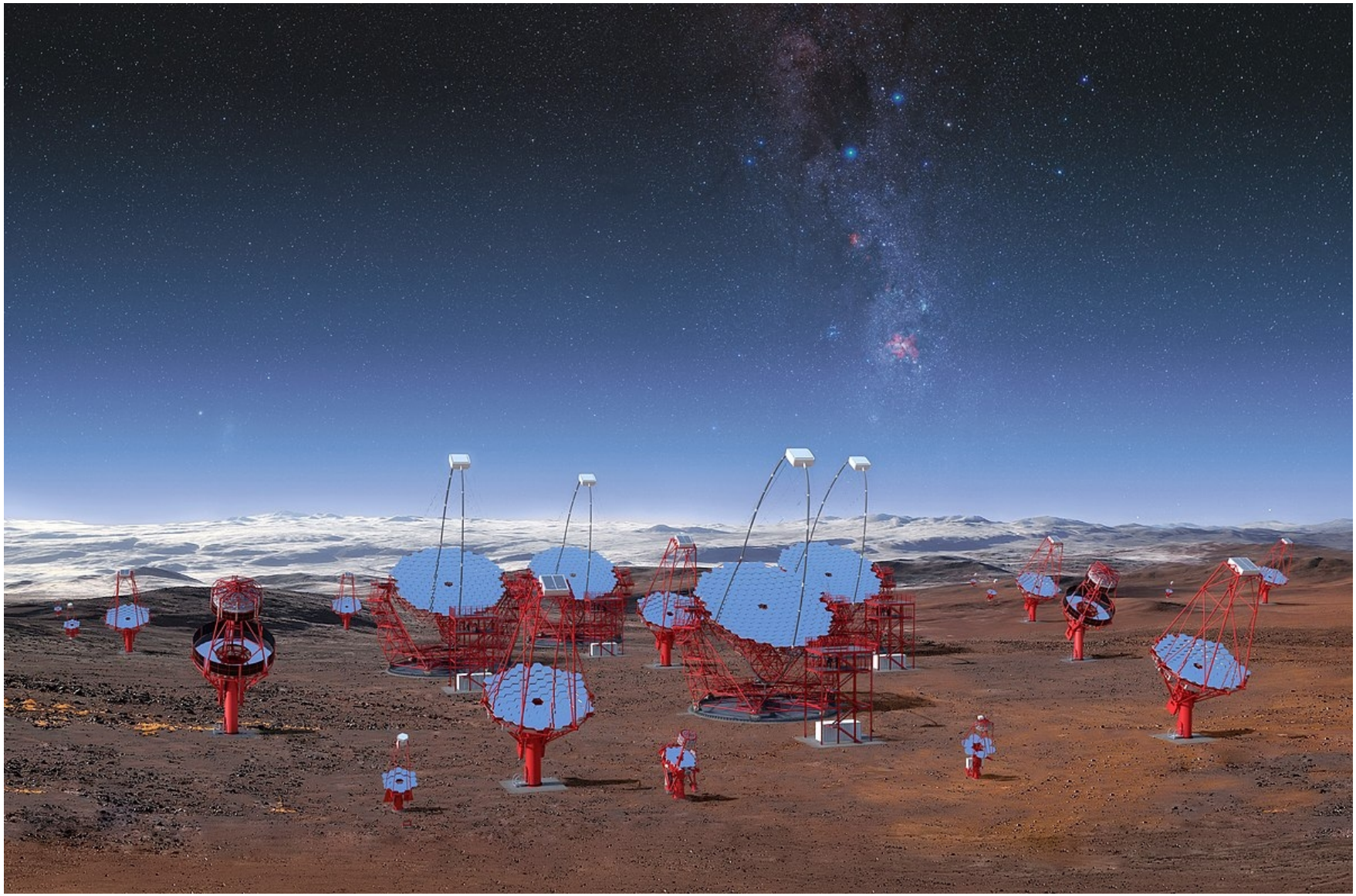
Coherent (big) Data Aggregated & Distributed in **few different Sites**
=> fast&high throughput LAN (i.e. LHC-One)
=> large computing and large storage
(medium-size data centers:
1-2 full rack dedicated to CTA)
→ use-case "ready" for both the BULK (DPPS) Arch. and SCIENCE (SUSS) Arch.
→ On site only redundant RAW Storage ←

YES

All Dataset (small) Distributed
in **many EUROPEAN sites**
=> providers must be connected (see C.A.P.)
=> medium computing and storage
(small-size data centers:
"half"-rack hosted in institutes' CED)
→ use-case is "ready" for SCIENCE (SUSS) Arch.
→ BULK (DPPS) Arch. on-sites ←

ASTRI-miniArray environment is ready for both solutions even centralized data centers on site (incremental archive)

QUESTIONS?



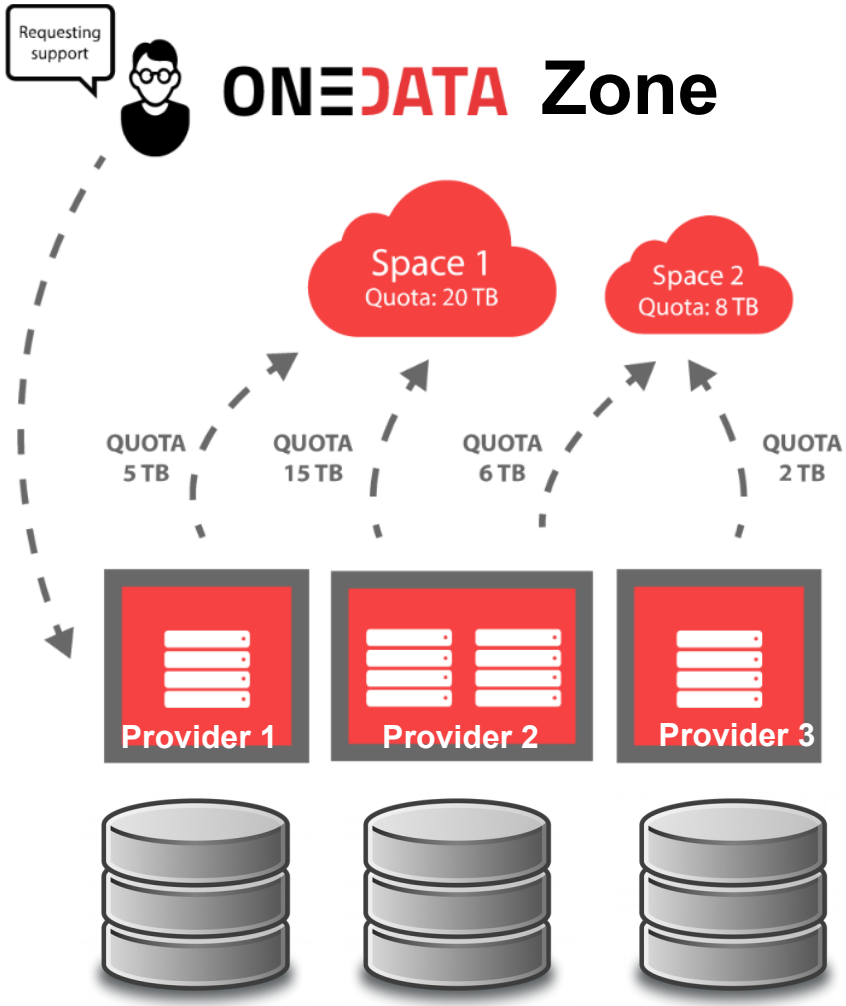
BACK-UP SLIDES

OneData Overview

OneData system **virtualizes** storage systems provided by storage resource providers **distributed** globally.

The most important concepts of the platform are:

- **Spaces** - distributed virtual volumes, where users can organize their data
- **Providers** - entities who support spaces with actual storage resources
- **Zones** - federations of providers which enable creation of closed or interconnected communities.



CTA OneZone

- **OneZone** is the gateway for users to the OneData system. It is responsible for connecting to the **authentication** and **authorization** infrastructure.

- It allows users to:

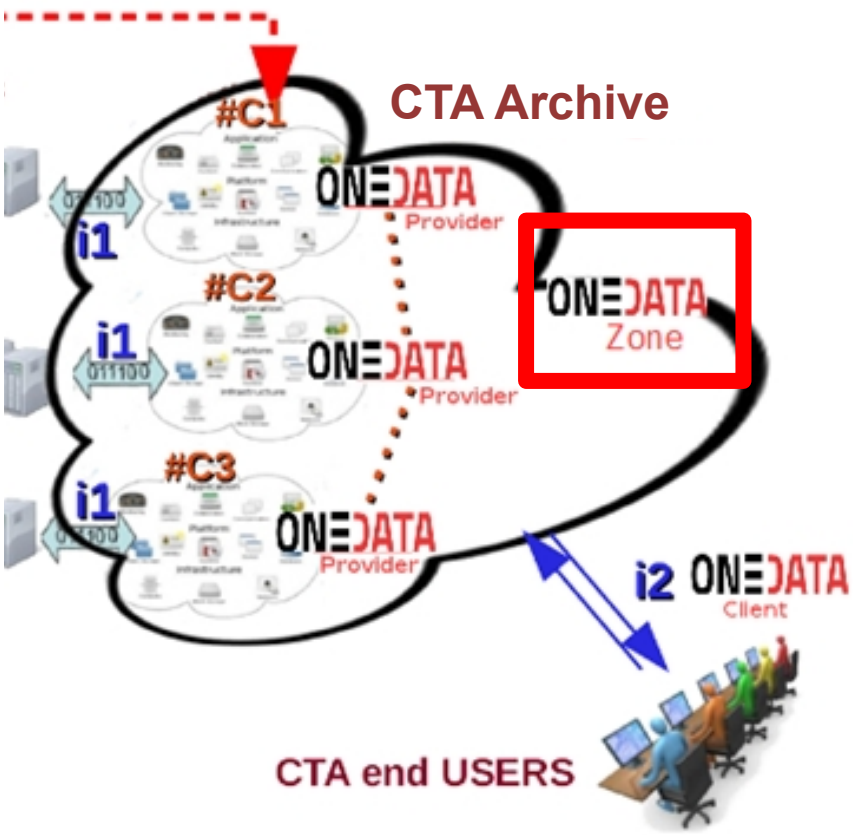
✓ create **user spaces**

✓ generate space **support tokens**, that can be used to support user spaces with storage from a dedicated storage provider

✓ **monitor availability** of storage providers that support user spaces

✓ see the **geographical distribution** of storage providers

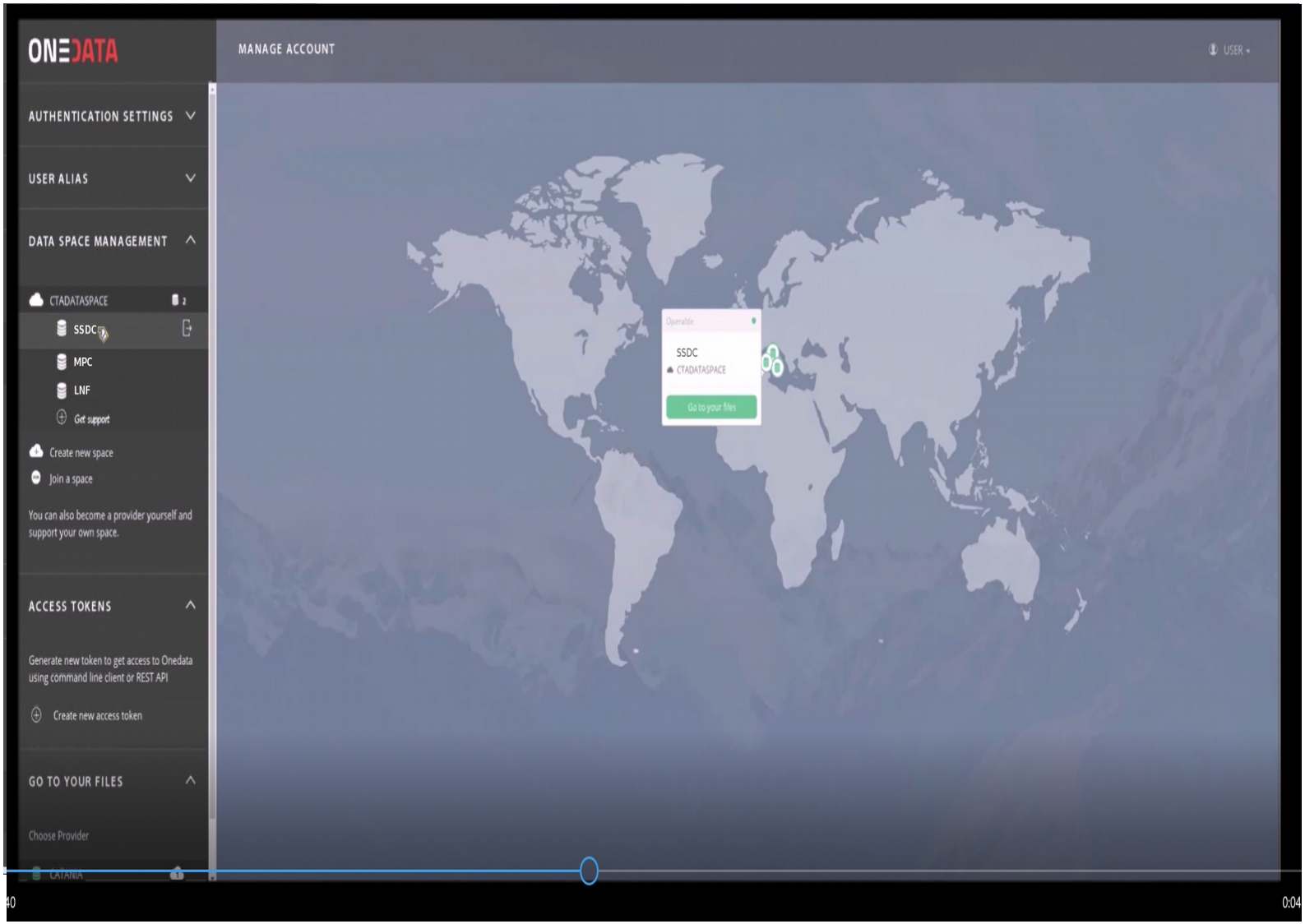
✓ **choose storage provider** for spaces



CTA OneZone

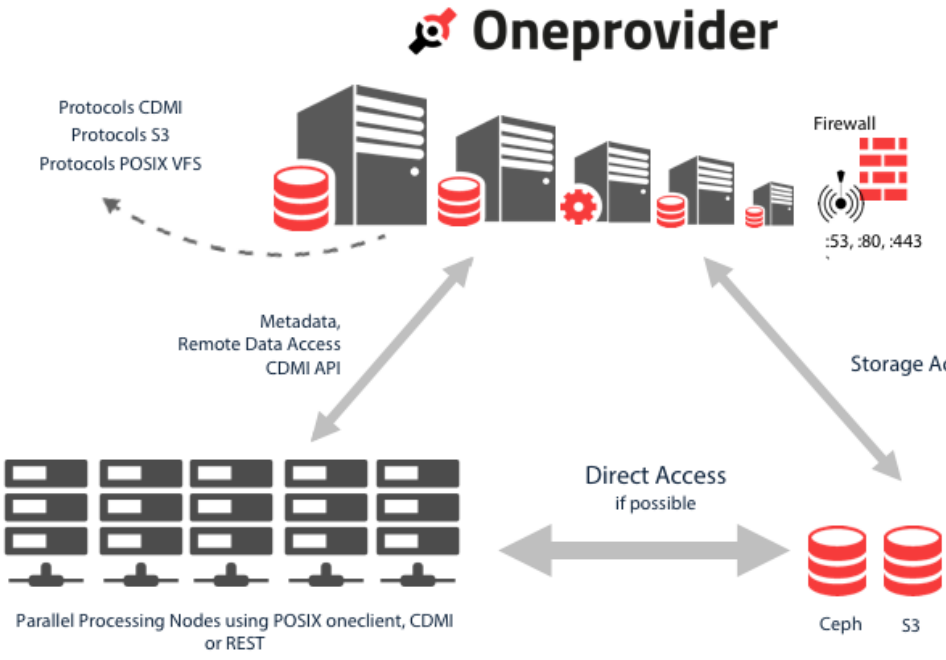
Spaces

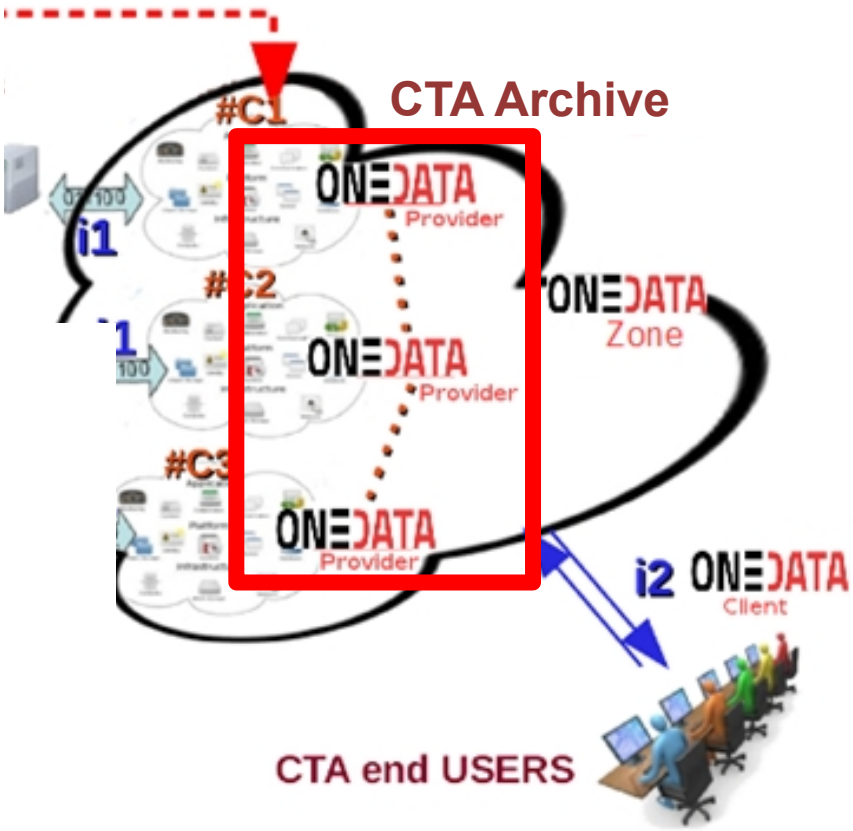
Providers



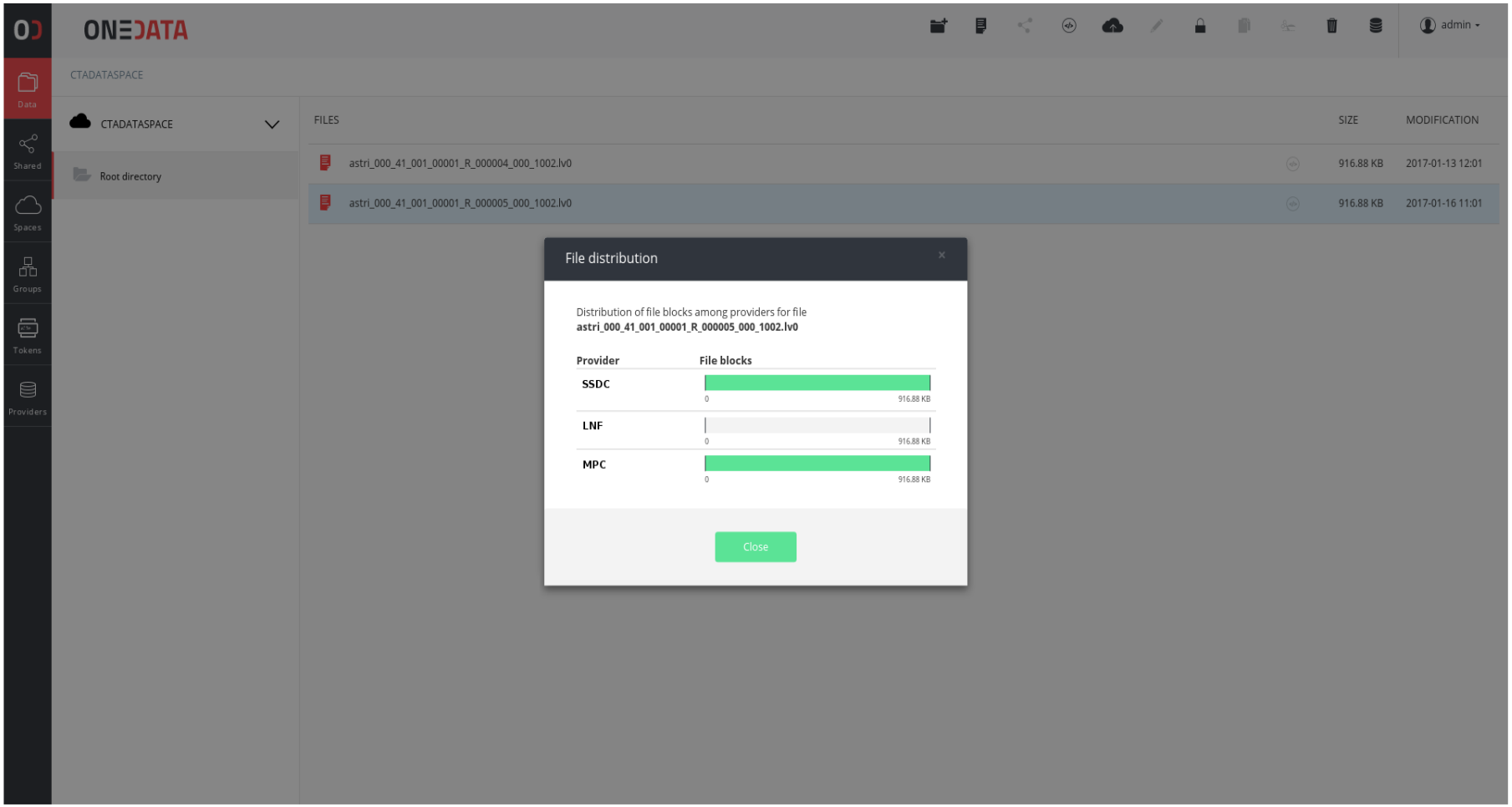
CTA OneProvider(s)

- **OneProvider exposes** storage resources. It is deployed in a data or computing center, on the nodes equipped with high speed **connections** to **storage resources**.





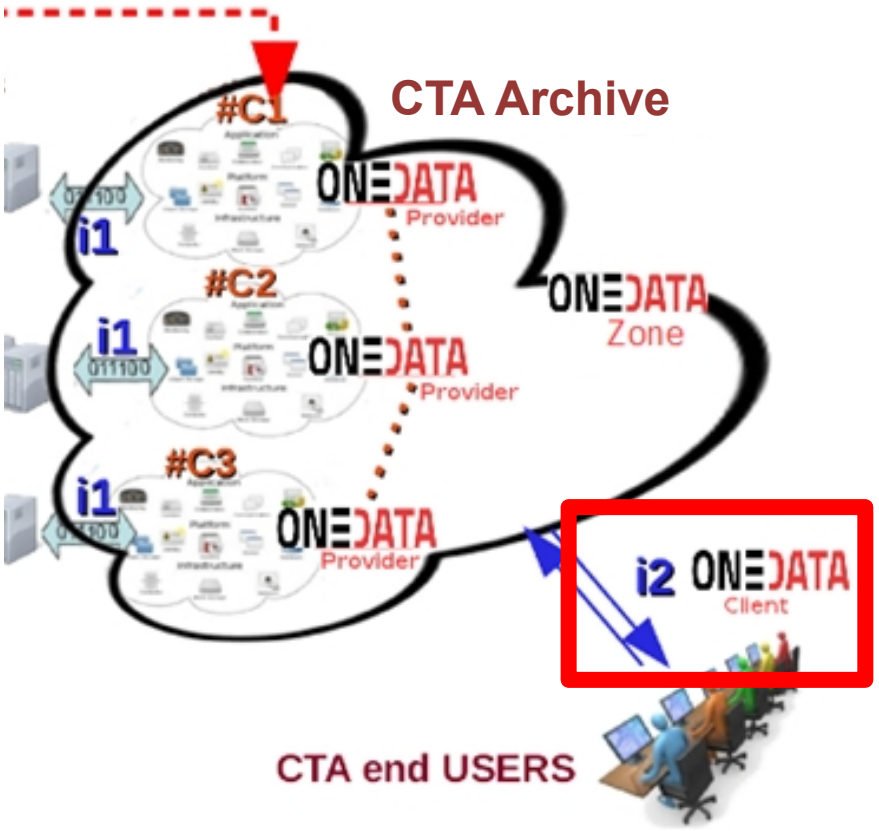
CTA OneProvider(s)



CTA OneClient

- **OneClient** is a command-line based application for **accessing** and **managing** user spaces via **virtual file system**.

- User spaces are **mounted** in the local file system tree (i.e. in a Grid Storage-Element FS as well).



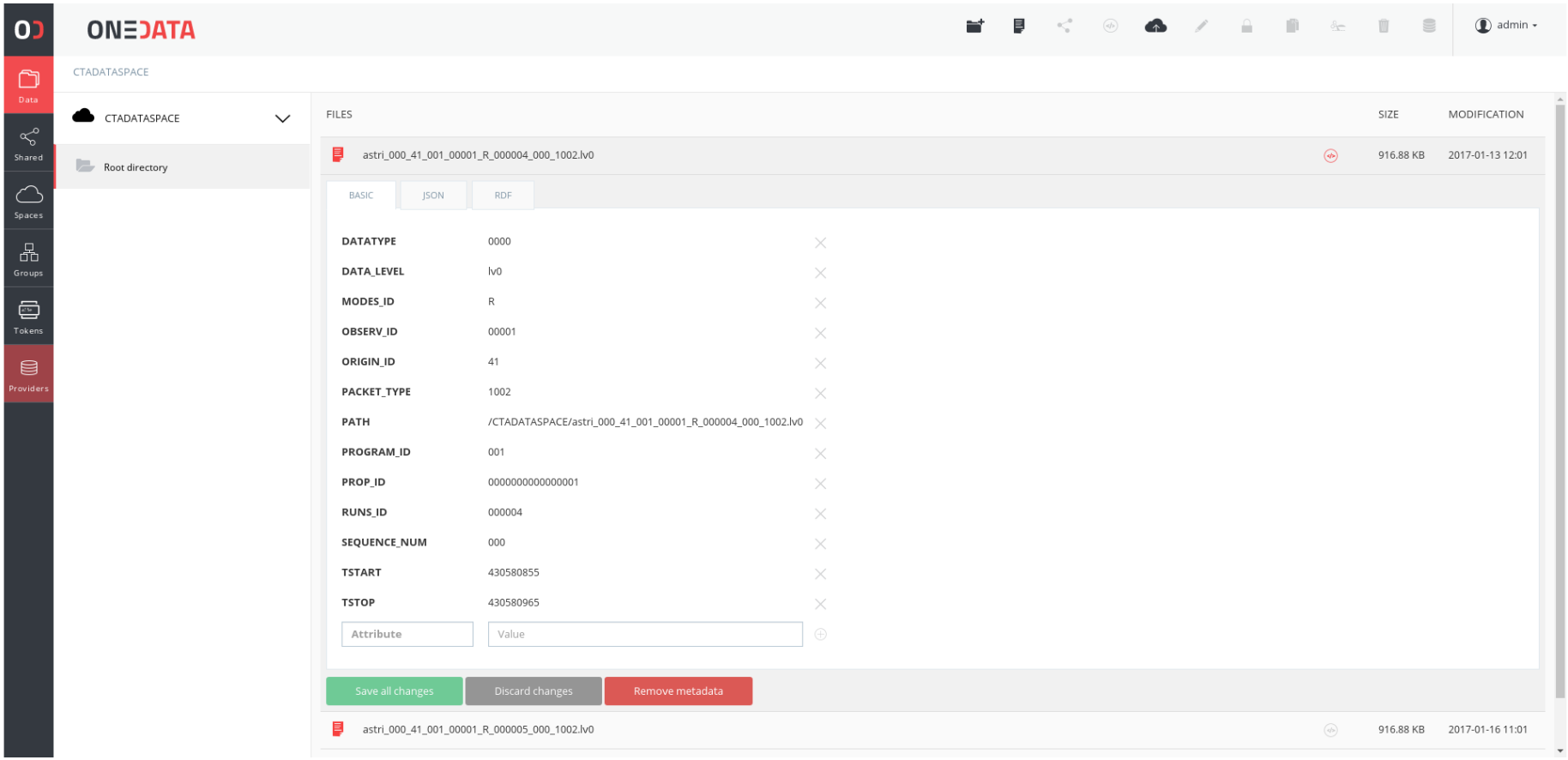
Metadata

Metadata in OneData are organized into 3 levels:

- ✓ **Filesystem attributes** - basic metadata related to file system operations such as file size, creation and modification timestamps, POSIX access rights, etc.,
- ✓ **Extended attributes** - these attributes enable assigning custom key-value pairs.
- ✓ **User metadata** - this level provides most flexibility and OneData itself does not assume any schema related with these metadata. For each resource, user can assign a separate document in one of supported metadata formats (currently JSON and RDF).

The filesystem and extended level attributes are accessible via **REST-API** and **CDMI** or directly through queries to the embedded database.

Metadata


ONEDATA
admin
Data
Shared
Spaces
Groups
Tokens
Providers
CTADATASPACE
CTADATASPACE
Root directory
FILES
SIZE
MODIFICATION
astri_000_41_001_00001_R_000004_000_1002.lv0
916.88 KB
2017-01-13 12:01
BASIC
JSON
RDF
DATATYPE 0000
DATA_LEVEL lv0
MODES_ID R
OBSERV_ID 00001
ORIGIN_ID 41
PACKET_TYPE 1002
PATH /CTADATASPACE/astri_000_41_001_00001_R_000004_000_1002.lv0
PROGRAM_ID 001
PROP_ID 0000000000000001
RUNS_ID 000004
SEQUENCE_NUM 000
TSTART 430580855
TSTOP 430580965
Attribute
Value
Save all changes
Discard changes
Remove metadata
astri_000_41_001_00001_R_000005_000_1002.lv0
916.88 KB
2017-01-16 11:01

Metadata

Sample Ingestion

```
curl -k -H $TOKEN_HEADER -H $CDMI_VSN_HEADER -H
'Content-Type: application/cdmi-object'
-d '{"metadata" : {"PROGRAM_ID" : "001"}}' -X PUT
"$ENDPOINTDATA"
```

Sample indexing function

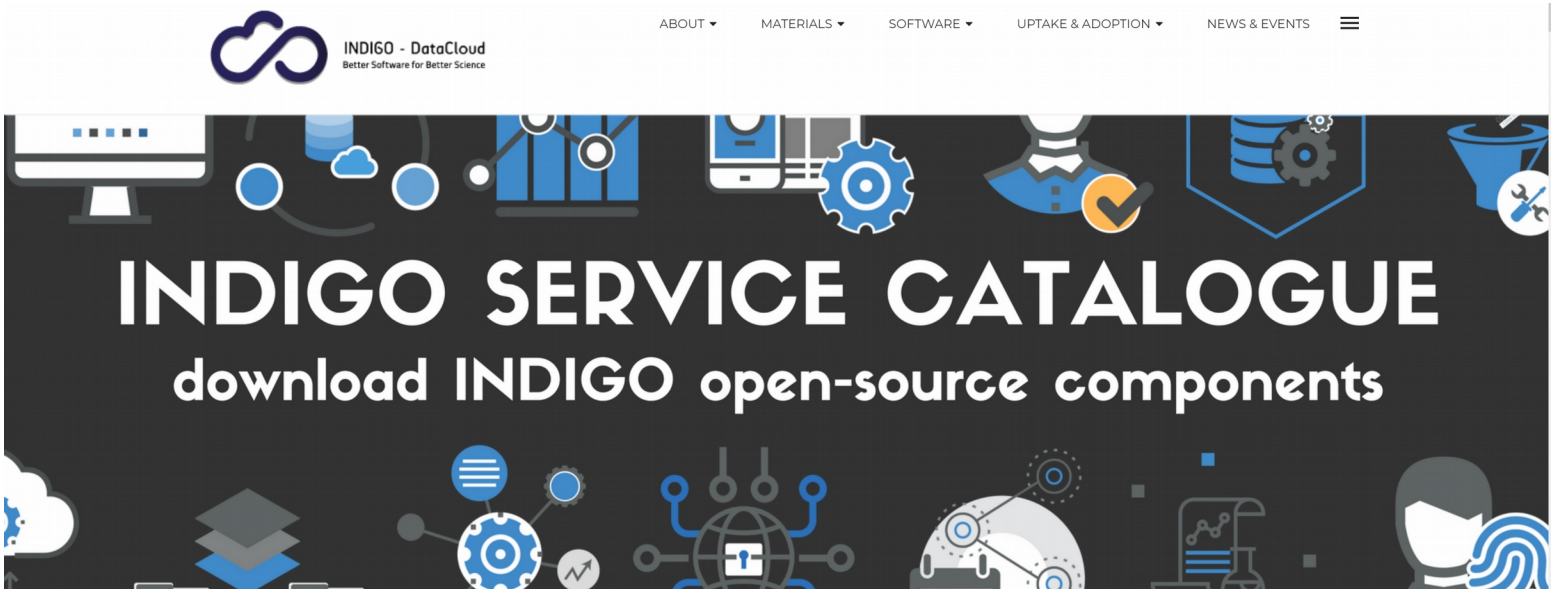
```
function(meta)
{
    if(meta['PROGRAM_ID'])
    {
     return meta['PROGRAM_ID'];
    }
    return null;
}
```

Query using a REST-API call

```
curl -v -k --tlsv1.2 -Ss -H "X-Auth-Token:
$TOKEN" \
-X GET
"https://$HOST:8443/api/v3/oneprovider/que
ry-index/$INDEX_ID?
key=\"0001\"&stale=false"
```

References

- CTA web page: http://www.cta-observatory.org/
- ASTRI web page: http://www.brera.inaf.it/astri/
- YouTube demo: https://youtu.be/UhOWnJluIgE
- INDIGO Data Cloud: https://www.indigo-datacloud.eu
- OneData documentation: https://onedata.org/docs/index.html
- OneData @ docker hub: https://hub.docker.com/u/onedata/



SSDC as server of CTA data products

- The ASI-SSDC (Space Science Data Center):
  - wide experience as MWL data center, both for low-level data products (AGILE data center, Fermi-LAT/SWIFT/… data mirror center) and high-level data, data products and catalogs.
  - Data and data products integrated in a fully MWL environment (MMIA: Multi-Mission Interactive Archive).
  - Possibility to perform cross-catalog searches betweeen resident and external catalogs.
  - Powerful tools to extract SED of sources and modelization.
  - VHE catalog products from literature already integrated in the TeGeV Catalogue.