

ESCAPE

European Science Cluster of Astronomy &
Particle physics ESFRI research Infrastructures

Virtual Observatory and EOSC - news from ESCAPE

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ASOV Annual Meeting, on-line 21-22 March 2021



Outline

- Brief intro to the ESCAPE project (previously presented at ASOV 2020)
- EOSC – European Open Science Cloud
 - pointers to info about the recent changes
 - some of the relevant aspects for VO
- Update on progress of the CEVO work package
 - Reports on:
 - Integration of VO into EOSC
 - Implementation of FAIR principles via VO for ESFRI data and services
- ESCAPE next steps... increased engagement with communities



ESCAPE: Astronomy and Particle Physics ESFRIs

- Builds on communities' complementary excellences in data stewardship:
 - Astronomy Virtual Observatory infrastructure
 - HE-NP expertise in Exabyte-scale data management and large-scale distributed computing

- Builds on existing inter-RI synergies, intersections.

- Recognises that ESCAPE communities will be Exascale data generators, early adopters of ICT and data management innovations, push state-of-the-art.

- Both Observatory- and Facility- operations require global, open access to data, long term curation, and sustainability.

<https://projectescape.eu>



Data Lake:

- Build a scalable, federated, data infrastructure as the basis of open science for the ESFRI projects within ESCAPE. Enable connection to compute and storage resources.

Software Repository:

- Repository of "scientific software" as a major component of the "data" to be curated in EOSC. Implementation of a community-based approach for the continuous development of shared software and for training of researchers and data scientists.

Virtual Observatory:

- Extend FAIR standards, methods, tools of the Virtual Observatory to a broader scientific context; demonstrate EOSC ability to include existing platforms

Science Platforms:

- Flexible science platforms to enable the analysis of open access data

Citizen Science:

- Open gateway for citizen science on ESCAPE data archives and ESFRI community CS projects



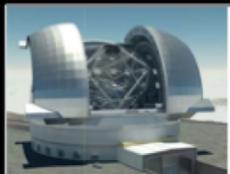
Radio



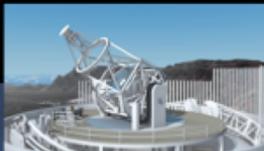
JIVE-VLBI

SKA

Visible light



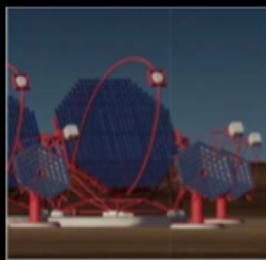
ELT



EST

ESO

Gamma rays



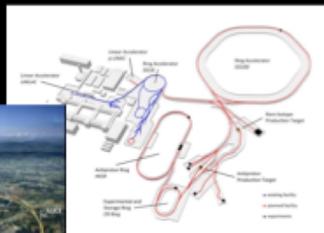
CTA

Accelerator-based Particle Physics



HL-LHC

Accelerator-based Nuclear Physics



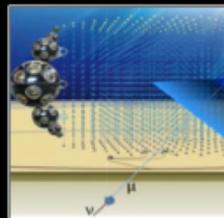
FAIR

Gravitational Waves



EGO-VIRGO

Cosmic-rays Neutrinos



KM3NeT

CERN

Midway point of the project – Month 24 of 48

Extends to Jan 2023.

First sets of Milestones/Deliverables. ✓

Mid-term review. ✓

Everything virtualised for now.

European Open Science Cloud



The European Open Science Cloud (EOSC) is a trusted digital platform for the scientific community, providing **seamless access to data and interoperable services** that address the whole research data cycle, from discovery and mining to storage, management, analysis and re-use across borders and scientific disciplines.

The idea of a European Open Science Cloud (EOSC) took shape in 2015, as a vision of the European Commission of a large infrastructure to **support and develop open science and open innovation** in Europe and beyond.

The EOSC is projected to become a reality in 2020 and will be **Europe's virtual environment for all researchers** to store, manage, analyse and re-use data for research, innovation and educational purposes.



[About](#) [Services & Resources](#) [Policy](#) [Use Cases](#) [Media](#) [For providers](#) [Subscribe](#) [Using the Portal](#)

ACCESS EOSC SERVICES & RESOURCES

A grid of eight icons representing different EOSC services. Each icon is a line-art style illustration. Below each icon is a label in blue, uppercase letters. The icons are: 1. Networking: A central server connected to two monitors. 2. Compute: A laptop with a gear icon. 3. Storage: A stack of three server racks. 4. Sharing & Discovery: A magnifying glass over a cloud. 5. Data Management: A computer screen with a list and two 'X' marks. 6. Processing & Analysis: A smartphone next to a globe with a target. 7. Security & Operations: A shield with a fingerprint scanner. 8. Training & Support: A person at a computer screen with two other people below.

What is EOSC ?

- The **European Open Science Cloud (EOSC)** initiative will offer researchers a virtual environment with **open and seamless services for storage, management, analysis and re-use of research data**
- **A Vision** – Open Science based on FAIR principles
- **A Partnership** – *(Co-programmed Partnership in line with Horizon Europe)*
- **Strategic Research and Innovation Agenda (SRIA)** – *published v0.9 Nov 2020)*
- An **Association** – legal entity created in 2020 (<https://www.eosc.eu>)
- A **WORK IN PROGRESS...**
- ***EOSC in France... see the Journées EOSC France and mailing list***
Also a topic in the Semi-Hack-athon *(links to all these provided at end)*

□ Uses a common language...

FAIR

Findable, **A**ccessible, Interoperable, **R**eusable

Open Science

Data sharing with open and seamless services to analyse and re-use research data to improve science

Stewardship

Human skills for curation, quality content, data management, services



EOSC – A work in progress...



2019-2020: EOSC Working Groups produced key documents:

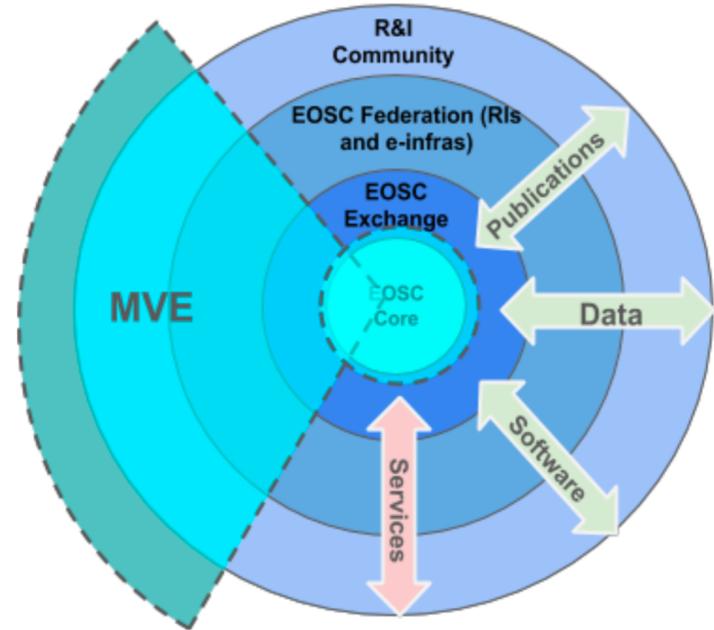
- 20 documents which are key to the EOSC **Strategic Research and Innovation Agenda (SRIA)**
 - roadmap for the next 7 years
 - SRIA – still at v0.9

EOSC EB wraps up activities by releasing key documents for the European Open Science Cloud



□ EOSC Architecture

- **EOSC-Core:** the set of enabling services required to operate the EOSC
- **EOSC-Exchange:** the set of federation services registered to the EOSC by RIs and clusters to serve the needs of research communities and the widening to the general public and private sector
- **EOSC Federation:** the set of scientific services provided by RIs and Clusters to the respective communities;
- **MVE = Minimum Viable EOSC**



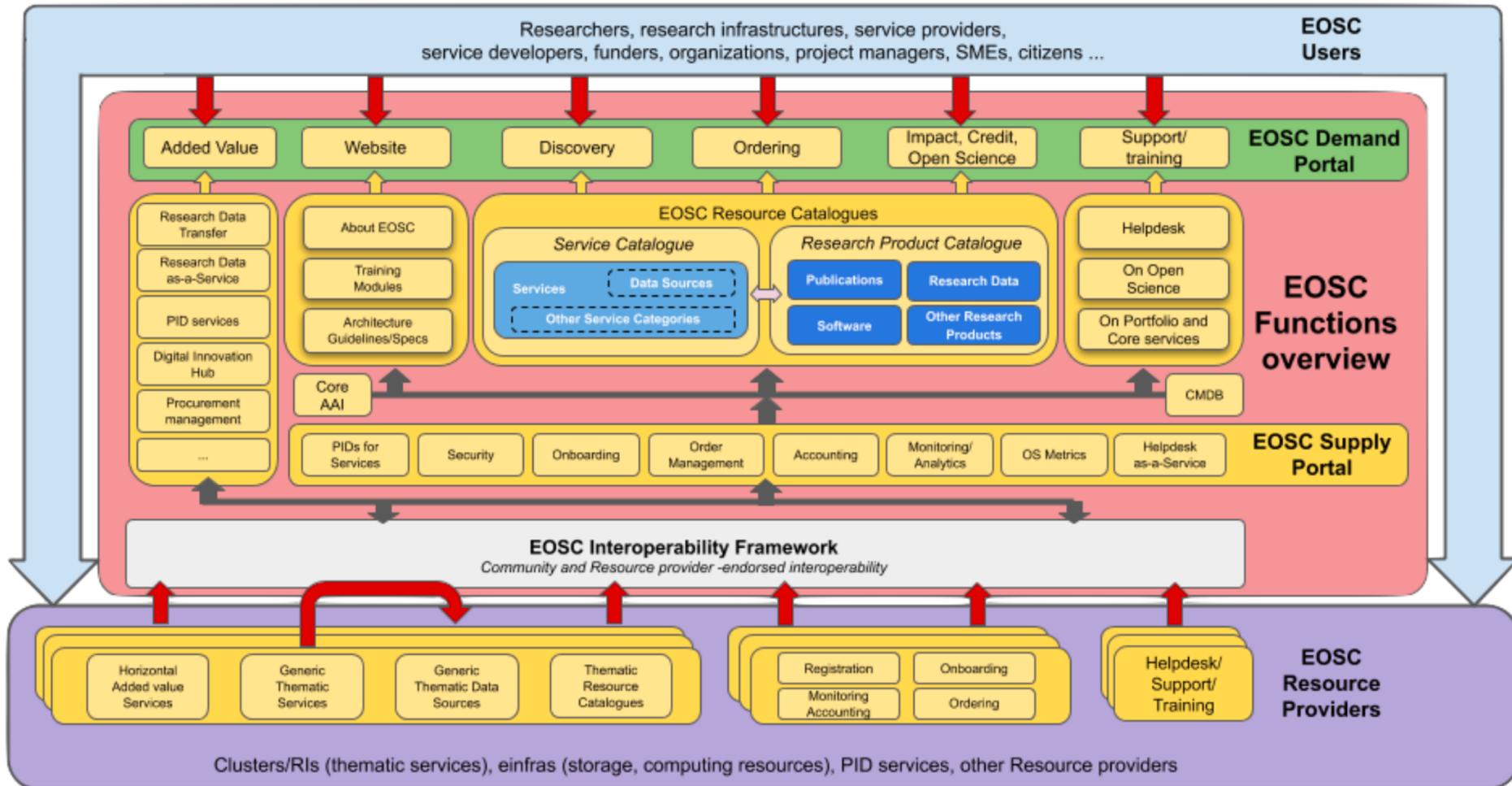


Figure 2. Architectural diagram illustrating EOSC-Core functions supporting the EOSC

Primary stakeholders in EUROPEAN OPEN SCIENCE CLOUD ecosystem

(5a)



EOSC
secretariat.eu

Setup and management of the EOSC Secretariat supporting the EOSC Governance

Regional Nodes / Thematic Projects (5b)



FAIR (5c)



EOSC Governance Board



EOSC Executive Board



EOSC Working Groups

- Landscape WG
- Sustainability WG
- Rules of Participation WG
- Architecture WG
- FAIR WG**
- Skills and Training WG

INFRAEOSC-5 Cross Project Collaboration Board (CPCB)

INFRAEOSC-5 Task Forces:

- Landscaping
- FAIR data and Infrastructures
- Services onboarding
- National policies and governance
- Training and skills
- Dissemination and events

FAIR WG Task Groups

- FAIR practice
- Interoperability
- PIDs
- Metrics and certification

EOSC Interest Groups

- Researcher engagement and use cases
- Service and research product catalogue
- Federating core
- Glossary
- Cluster Collaboration

"Horizontals"



ESFRI Clusters



Other FAIR Initiatives



Virtual Observatory related



ESCAPE WP4 “CEVO”

Connecting ESFRI projects to EOSC through the VO framework

- EOSC – European Open Science Cloud
- VO – Virtual Observatory

Virtual Observatory standards and methods for FAIR principles to a larger scientific context; demonstrating EOSC capacity to include existing frameworks.

Partners from ESFRIs and astronomy Research Infrastructures

ESO



SKAO

NWO-I-ASTRON



NWO
Netherlands Organisation
for Scientific Research

JIVE



CTAO

ObsParis



KIS

ORB



EGO



CNRS-OBAS
CNRS-CPPM
ObsParis



INAF



THE UNIVERSITY
of EDINBURGH

UEDIN



UHEI



INTA

Heidelberg Institute for
Theoretical Studies



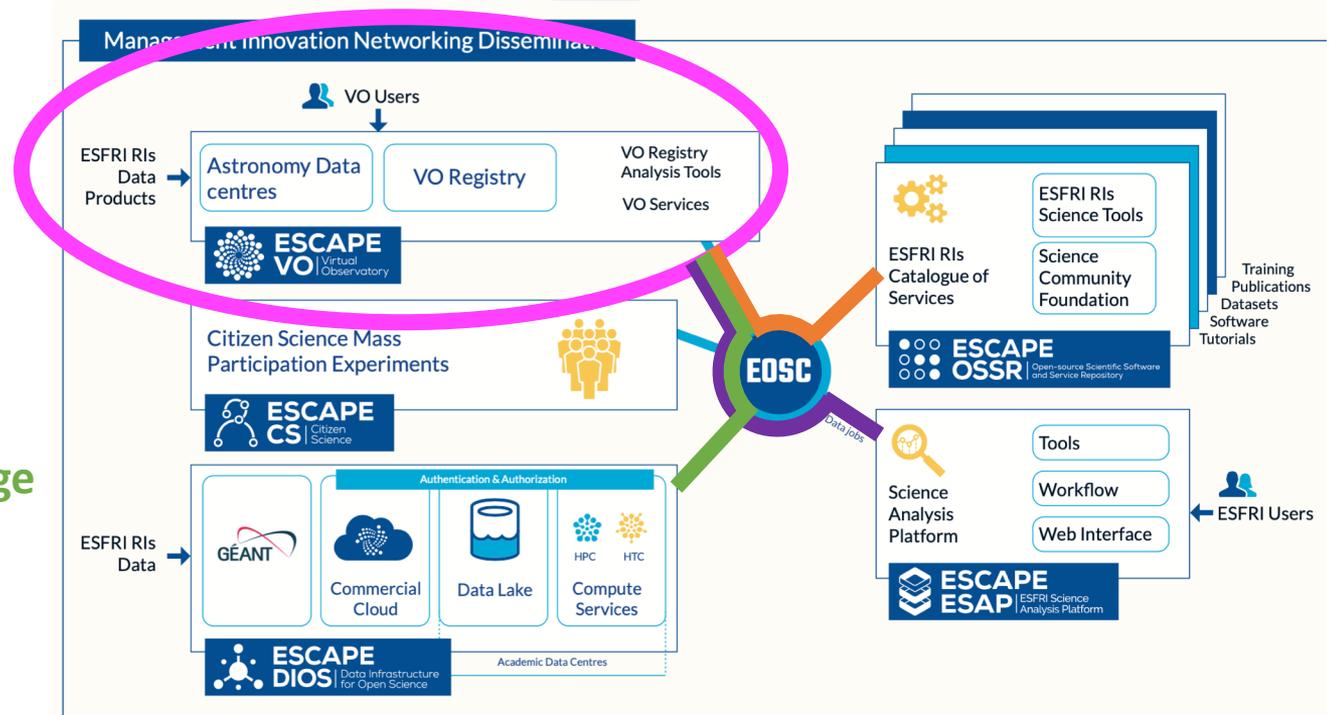
HITS
(WP3)

Partners bringing experience from European Virtual Observatory



Virtual Observatory – part of the ESCAPE cell

- Connect ESFRI and RI data to EOSC by VO
- Metadata standards based on ESFRI needs
- **Software connections on deep learning with WP3**
- **VO connected to storage and computing with WP2**
- **VO data via platform with WP5**



The aspects addressed by WP4 are to:

- Assess and implement the connection of **ESFRI** and other **astronomy research infrastructures** to the **EOSC** by the **Virtual Observatory**
- Refine and pursue implementation of **FAIR principles for astronomy** data via common interoperability standards - extending the VO to new communities
- Establish **data stewardship practices** for adding value to scientific content of ESFRI data archives



Making the Virtual Observatory a part of EOSC

- **Integration of an existing interoperability framework**
 - Domain specific thematic services supporting Open Science
 - VO makes data FAIR by use of standards
- **Brings common metadata standards**
 - IVOA standards responding to the needs of ESFRI, RIs and researchers
 - Building on significant national / European / International investment
- **EOSC to enable next steps of VO**
 - Connection to computing and integration into ESCAPE platform
 - Scalability for big data
- **Data stewardship practices of Astrophysics in EOSC context**
- **Developing the vision of next generation astro ESFRI archives**



WP4 Task 4.1 and 4.2 “intermediate reports”

Task 4.1 Integration of astronomy VO data and services into the EOSC

Lead: **Marco Molinaro (INAF)**

→ **D4.4 Intermediate analysis report of VO data and service integration into EOSC** - Published November 2020

Task 4.2 Implementation of FAIR principles for ESFRI data through the Virtual Observatory

Lead: **François Bonnarel (CNRS-ObAS)**

→ **D4.2 Intermediate Analysis Report on Use of IVOA Standards for FAIR ESFRI and Community Data.** - Published March 2020



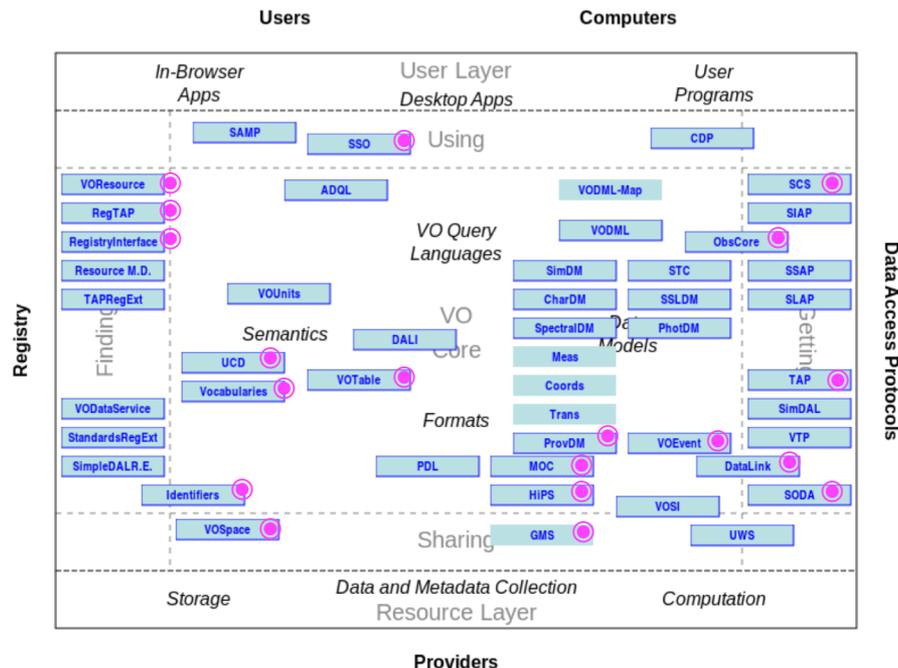
Task 4.2 Highlight: Implementations of IVOA standards



- **Gravitational Waves (EGO-Virgo)** – Space time indexing and use in applications for GW follow-up
- **Solar physics (EST)** – Analysis of IVOA semantic UCD metadata for solar physics.
- **Radio Astronomy** – interoperability and data volume aspects, new Radio Astronomy services registered in VO registry, standardized metadata for radio astronomy (JIVE, ASTRON, SKAO, ALMA) -- *See talk by F. Bonnarel*
- Relevant standards discussed in ESCAPE @ IVOA

Highlight – maturation of Provenance and applications to RIs (in particular for CTA)

- See the materials from ESCAPE Provenance workshop held September 2020



Task 4.2 Highlight: Science with Interoperable Data School

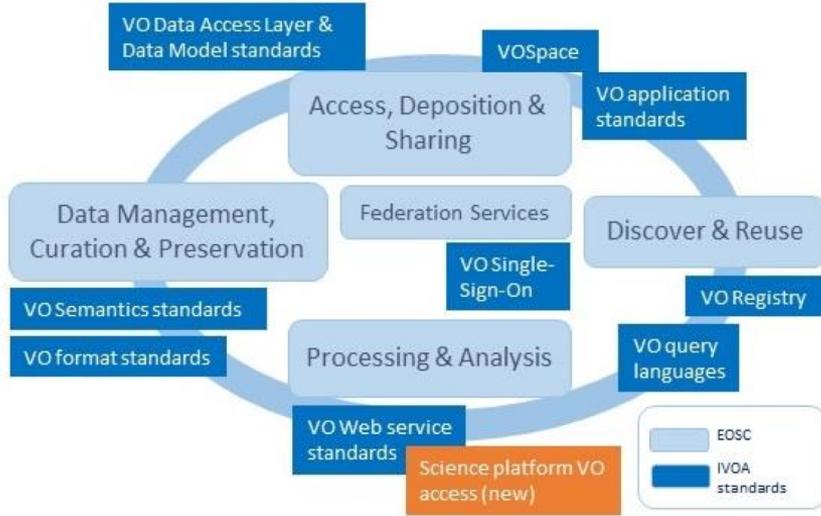
- Tutorials
- Advanced topics
- Participant use cases
- + feedback day
- Re-usable materials
- 44 participants
- 11 tutors

Held 8-12 Feb 2021
Next ~ early 2022



ESCAPE WP4: CEVO Task 4.1 - connecting

Connecting ESFRI projects to EOSC through VO framework

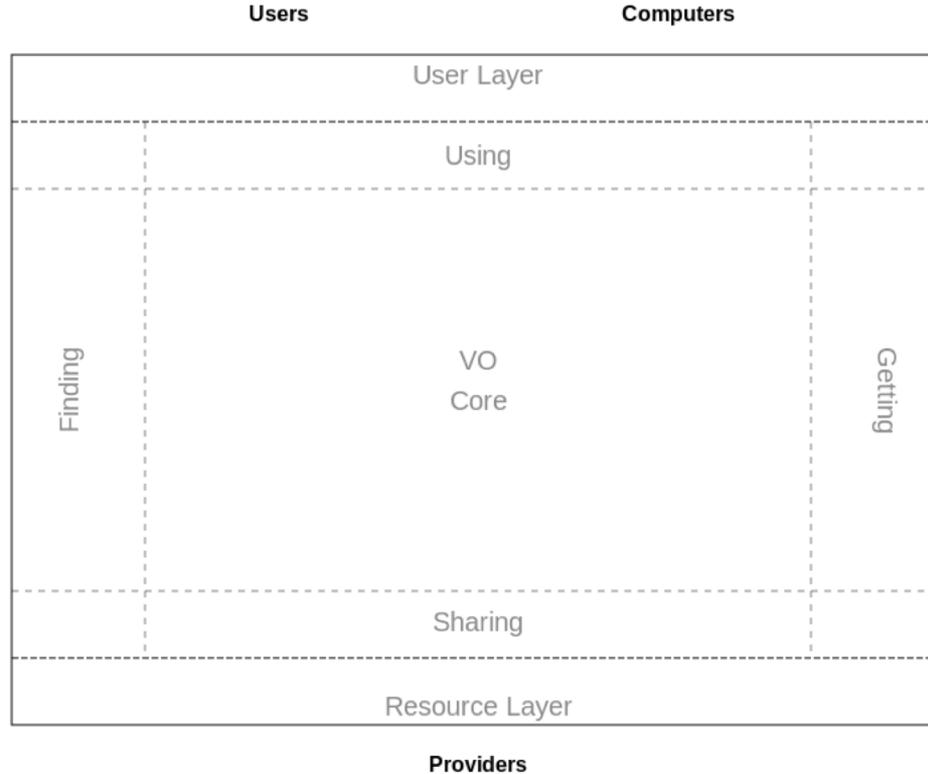


- Integrate astronomy VO architecture, data and services into the EOSC
- Refine and further implement **FAIR principles** for astronomy data through **common standards for interoperability**
- Establish data stewardship practices to **add value to the scientific content** of ESFRI data archives



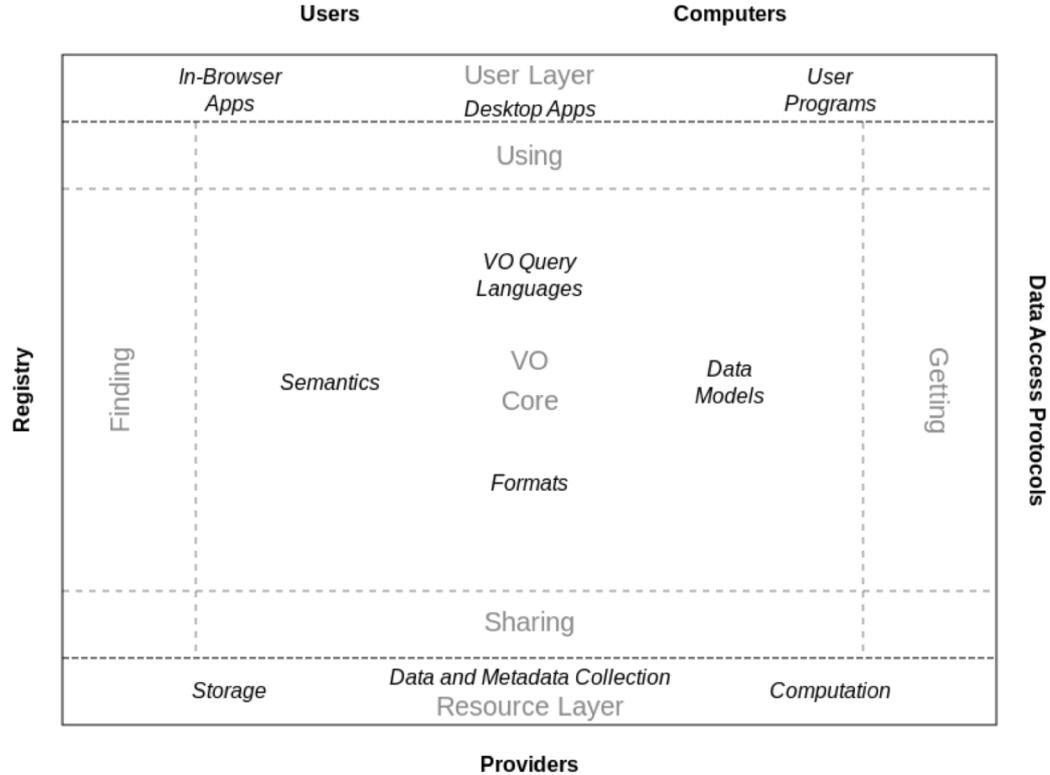


Architecture diagrams of standards



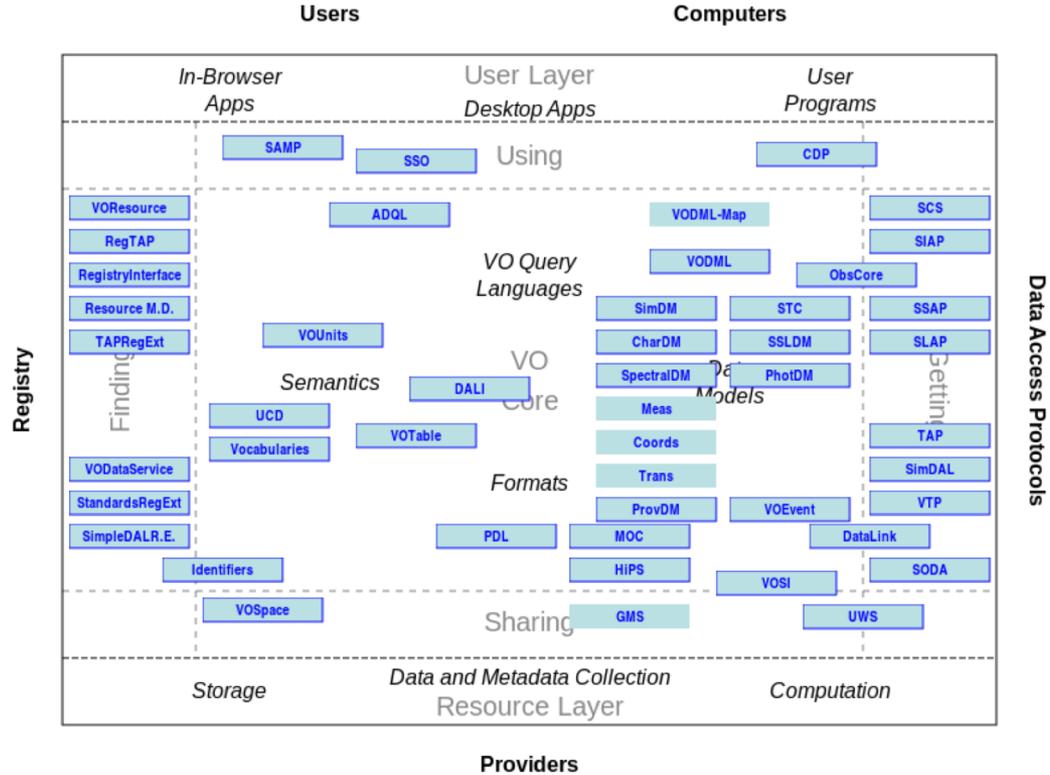
Level 0 - concepts





Level 1 - VO terminology

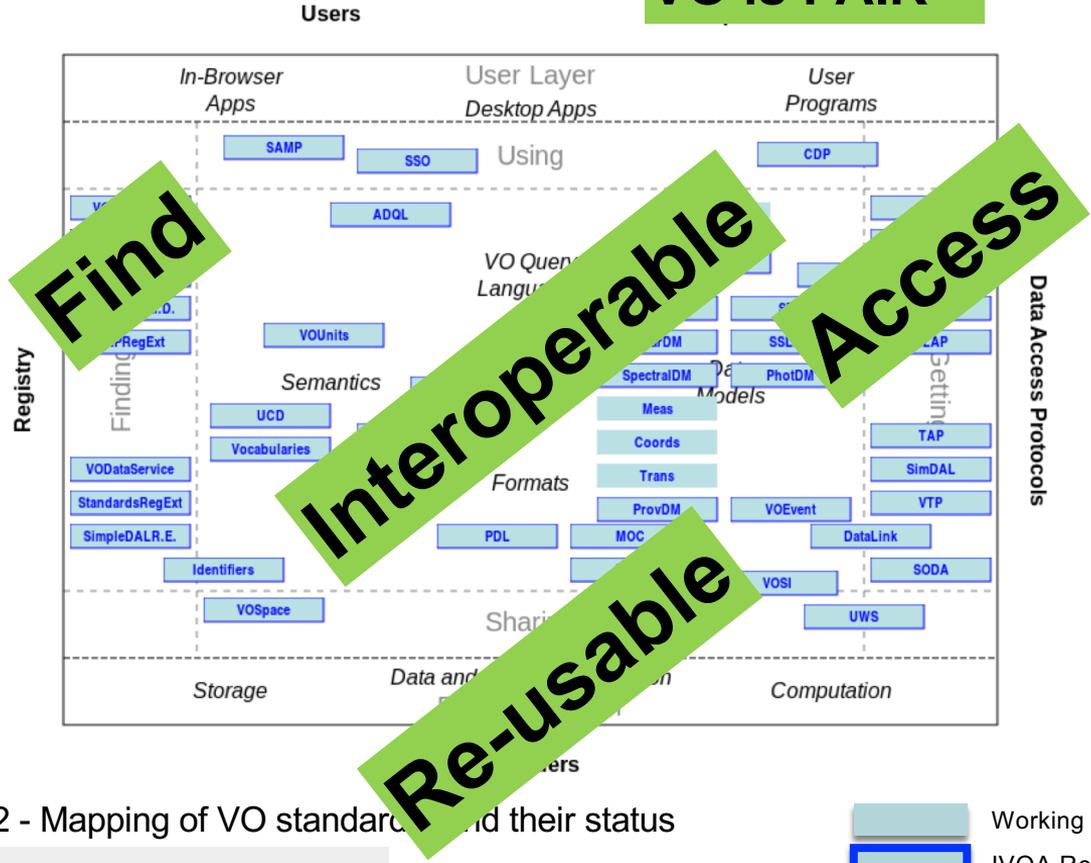




Level 2 - Mapping of VO standards, and their status



VO is FAIR



Level 2 - Mapping of VO standards and their status

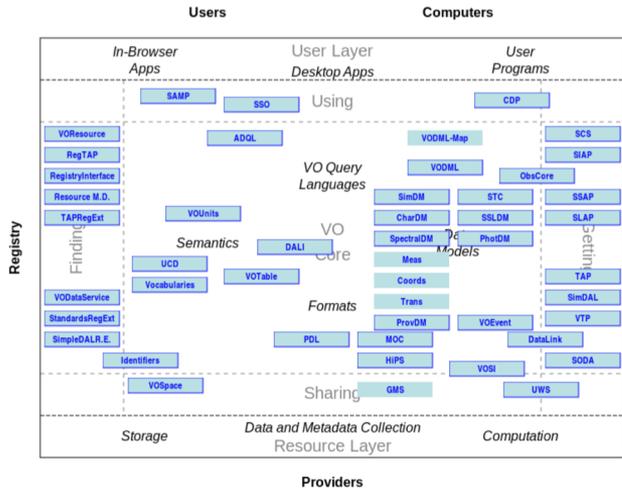
 Working Draft

 VOA Recommendation

Funded by the European Union's
Horizon 2020 - Grant N° 824064



Connecting VO to EOSC



... ??? ...

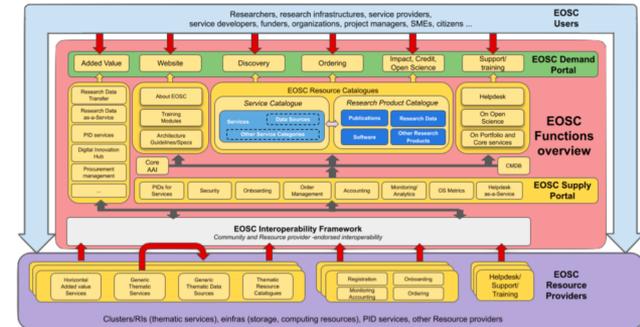
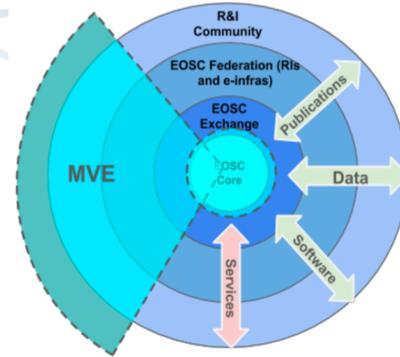


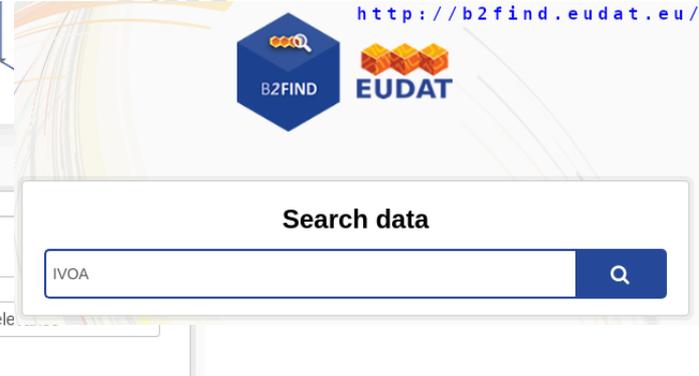
Figure 2. Architectural diagram illustrating EOSC-Core functions supporting the EOSC



Integration of astronomy VO data and services into the EOSC

- **Interfacing the VO framework with the EOSC**
 - IVOA **Registry**
 - Vocabularies
 - Connection to **EOSC projects**
- **Build an Astronomy Portfolio of VO services to be contributed to the EOSC**
 - VO services
 - Connection to ESCAPE WP3 (OSSR) **repository**
- **Contribution to EOSC Hybrid Cloud by federating astronomy data centres**
 - Connection to ESCAPE WP5 (ESAP) on **Science Platforms**
 - Including **AAI** (managed by WP2)
 - **VOSpace** integration
- **Containerised domain-specific services**
 - Test case containerisation of VO tools
 - Test harmonisation with ESCAPE WP2 data lake solutions





Home / Datasets

Filter by location [Clear](#)



Map data © OpenStreetMap contributors
Tiles by Stamen Design (CC BY 3.0)

Filter by time [Clear](#)

IVOA

23,019 datasets found for "IVOA"

Order by: Relevance

IVOA Identifiers

An IVOA Identifier is a globally unique name for a resource. A name can be used to retrieve a unique description of the resource.

IVOA Naming Authority

This registers the IVOA as the owner of the ivoa.net namespace.

- **EUDAT B2FIND identified as the contact point**
- **Checked technical compatibility of the 2 systems**
 - **IVOA VOResource**
 - **B2FIND model**
- **Both use OAI-PMH**
- **GAVO RegTAP has a DataCite extension**
 - **works as the harvest-able endpoint for the IVOA Registry**



IVOA Registry & EOSC Service Catalogue

▼ Communities ▼

▼ Keywords ▼

▼ Creator ▼

▼ Discipline ▼

▼ Language ▼

▼ Publisher ▼

▼ Contributor ▼

▼ ResourceType ▼

▼ OpenAccess ▼

▼ Keywords ▲

Filter 9-1 ▼

Galaxies (3521)

Stars (3503)

Photometry (3079)

Photometry wide band (2709)

Spectroscopy (2346)

Velocities (2148)

Stars variable (2099)

Redshifts (1905)

Abundances (1616)

Open_Clusters (1329)

More

▼ Publisher ▲

Filter 9-1 ▼

CDS (20147)

NASA/GSFC HEASARC (1064)

NASA/IPAC Infrared ... (490)

The GAVO DC team (198)

Space Telescope Sci... (119)

WFAU, Institute for... (119)

SVO CAB (52)

IA2 (35)

Sternberg Astronomi... (32)

Canadian Astronomy ... (30)

Mor

▼ ResourceType ▲

Filter 9-1 ▼

AstroObjects (1648)

AstroImage (290)

Spectrum (117)

AstroData (89)

Spectrall ines (3)

- Feature-based selection
 - Works on general content
- VO-style machine actionability not available !!

Michigan Catalogue of HD stars, Vol.4 (Houk+, 1988)

Please refer to the "adc.txt" file by Wayne H. Warren Jr.

| Identifier | |
|-----------------|---|
| Source | http://cdsarc.u-strasbg.fr/cgi-bin/Cat?III/133 |
| Metadata Access | http://dc.g-vo.org/rr/q/pmh/pubreg.xml?verb=GetRecord&metadataPrefix=oai_datacite&identifier=ivo://CDS.VizieR/III/133 |



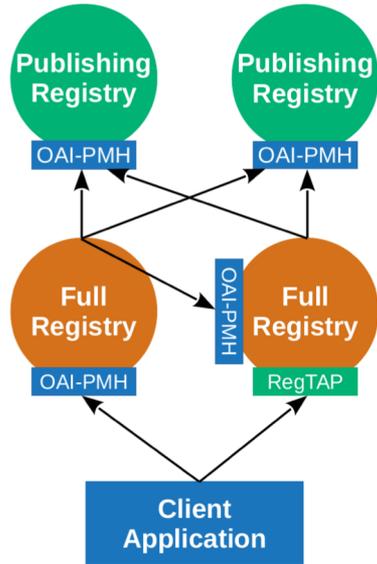
IVOA

- Authentication & Authorization
 - currently discussed
 - Machine consumable
 - Stress on credential delegation
- Currently not affected by accounting
- Public approach to data and services
 - in the majority of cases

EOSC

- Service providing projects already have AAI solutions
 - Federations
 - IdPs
 - Standards & proxies
- Harmonised while progressing
- Currently discussing “deep” delegation



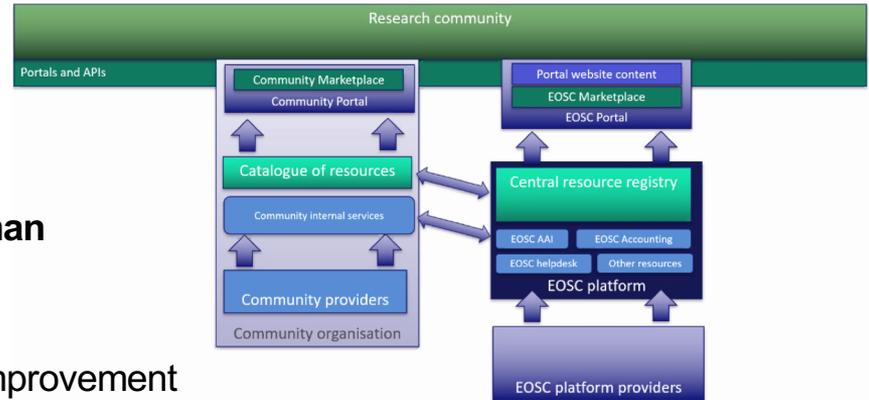


IVOA

- Resources and services provision can be fully automated
- A system of mirrored full registries keep the full repository content
- Tools can consume the services starting from the Registry records
- Validation comes through agreed standards compliance

EOSC (portal)

- Service on-boarding
 - **currently based on human interaction. :-/**
- Initial validation
- Registry integration promises improvement
- Could produce a slower take up



Mapping FAIR-ness

- **Applying FAIR principles is critical to the Open and Interoperable scenario**
 - Connecting ESFRI to VO, and connecting VO to EOSC
 - Connections at EOSC & global (RDA) level
 - EOSC FAIR Metrics
 - RDA FAIR Data Maturity Model

- **The IVOA vision**
 - To be preserved, i.e. EOSC federating existing frameworks
 - To be checked with respect to other research domains
 - Persistent ID solutions
 - Expectations of researchers
 - Licensing
 - Interoperability and Re-usability to lead to Findability and Accessibility



Box 2 | The FAIR Guiding Principles

To be Findable:

- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource

To be Accessible:

- A1. (meta)data are retrievable by their identifier using a standardized communications protocol
 - A1.1 the protocol is open, free, and universally implementable
 - A1.2 the protocol allows for an authentication and authorization procedure, where necessary
- A2. metadata are accessible, even when the data are no longer available

To be Interoperable:

- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles
- I3. (meta)data include qualified references to other (meta)data

To be Reusable:

- R1. meta(data) are richly described with a plurality of accurate and relevant attributes
 - R1.1. (meta)data are released with a clear and accessible data usage license
 - R1.2. (meta)data are associated with detailed provenance
 - R1.3. (meta)data meet domain-relevant community standards

*D4.2 analyses FAIR
practices in Astronomy
Input was provided to the
RDA FAIR data Maturity
Model WG*

Activity Will To Continue On...

- **Continue on with the WP4 work plan**

- Improvement of Registry / EUDAT / catalogues integration

Following the rapidly developing EOSC

- Service on-boarding tests
- VOspace integration tests
- FAIR metrics & interpretation

- **EOSC-related projects connections**

- VO vocabularies & EOSC – what level of integration is possible?
- Federating infrastructures – interaction with other domains
- Participation in EOSC events to contribute and learn



Vision

- **The integration of the VO architecture into the EOSC seems feasible.**
- **Main concern seems to be about machine-actionability data providing semi-automated solutions.**
- **Without having to duplicate efforts in management and research technologies.**
- **Idea is to try to have ESFRI & RI build their data resources and services adopting a VO aware vision and, as seamlessly as possible, find those same resources available in EOSC.**



Challenges

- **Attach data holdings to resource descriptions (not only PIDs for metadata).**
- **Provide relationships among data resources and attached services.**
- **Test, and make easier, the integration of VO-enabled data providers managed resources in the portal.**
- **Deal with current AAI services and solution without preventing public content access.**
- **Work at providing actionability for domain specific services and annotations through the EOSC portal.**
- **Evaluate the position of VO-enabled data with respect to EOSC FAIR Metrics.**

Next steps for ESCAPE VO activities

Technology Forum

13-15 April 2021 – on-line (WP4 project meeting + invited participants)

Upcoming Milestones:

IVOA Interoperability Meeting 24-28 May 2021 – on-line

Hands-on Workshop for Data Providers – ~23-35 June 2021

Open workshop – aiming for wide participation

Community engagement – EAS, LISA, Hands-on events (*virtual*)

ESCAPE integration: Software, VO, Platform, Data Lake
+ Test Science Projects...



Links

- EOSC Association: <https://www.eosc.eu>
- EOSC Partnership Proposal (version May 2020):
https://ec.europa.eu/info/sites/info/files/research_and_innovation/funding/documents/ec_rtd_he-partnership-open-science-cloud-eosc.pdf
- Strategic Research and Innovation Agenda for EOSC (v0.9 Nov 2020):
<https://www.eosc.eu/sites/default/files/EOSC-SRIA-V09.pdf>
- French National Plan for Open Science: <https://www.ouvrirelascience.fr/the-national-plan-for-open-science/>
- Journées France EOSC: <https://eoscfrance.sciencesconf.org>
- France EOSC mailing list: https://groupes.renater.fr/sympa/info/eosc_france_info
- ESFRI Roadmap: <https://www.esfri.eu/esfri-roadmap>
- FAIRsFAIR project: <https://www.fairsfair.eu>
- Turning FAIR into Reality report: https://ec.europa.eu/info/sites/info/files/turning_fair_into_reality_1.pdf
- Six Rec. for Implementation of FAIR Practice report: <https://op.europa.eu/en/publication-detail/-/publication/4630fa57-1348-11eb-9a54-01aa75ed71a1/language-en/format-PDF/source-166584930>
- RDA FAIR Data Maturity Model: <https://www.rd-alliance.org/group/fair-data-maturity-model-wg/outcomes/fair-data-maturity-model-specification-and-guidelines-0>
- ESCAPE: <https://projectescape.eu> -- Includes all Deliverable reports
- ESCAPE WP4 “Connecting ESFRI to EOSC via VO”: [wiki pages](#)
- Euro-VO web pages (renewed): <https://www.euro-vo.org>