European Plate Observing System (EPOS): A FAIR Research Infrastructure

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GEOProcessing-2020 - Valencia, Spain, 21-25 November 2020

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A Simple Scenario

A researcher wishes to understand the relationships between a volcanic eruption and its effect on human and animal life, health, water supply, power supply, transport, agriculture….

This requires interoperation across geosciences, environmental sciences, and onward to health sciences, civil sciences, agricultural science…..

But the relevant assets are hard to **F**ind, **A**ccess, **I**nteroperate and **R**e-use (**FAIR**)

Location, description, rights, formats, language…….

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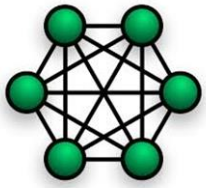
Common problem: Heterogeneous Metadata

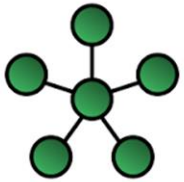
- Asset descriptions in many formats, languages
- Same asset described differently multiple times
- Many assets not described adequately (or at all)
- Asset descriptions with different and more-or-less formal syntax
- Asset descriptions with different and more-or-less formal semantics

2 approaches:

- Broker between any pair of asset metadata descriptions
  means n*(n-1) brokers



- A canonical rich metadata format and convert to it from each asset description
  means n brokers (convertors)



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FAIR Principles

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Findable:

F1. (meta)data are assigned a **globally unique and eternally persistent identifier**.
F2. data are described with **rich metadata**.
F3. (meta)data are **registered or indexed in a searchable resource**.
F4. metadata **specify** the data identifier.

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.

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. **metadata are accessible**, even when the data are no longer available.

Re-usable:

R1. meta(data) have 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 their **provenance**.
R1.3. (meta)data **meet domain-relevant community standards**.

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Fair Guiding principles

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Main concepts:

Data
Metadata
Identifiers
Protocols
AAAI
Standards
Semantics

policy & provenance

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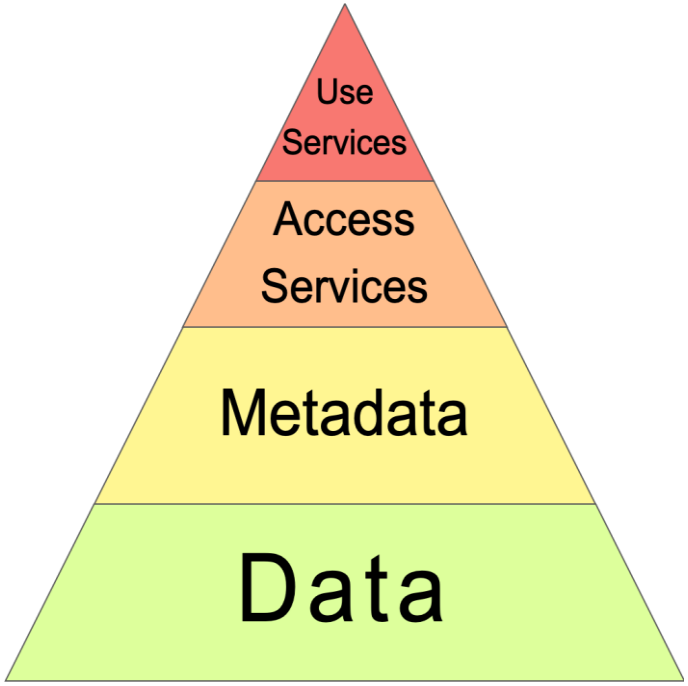
FAIRness Maturity and Implementation



(Bailo et al., 2020)

Stage	FAIR principle	Technological Solution
Services for use		Processing facilities
		Workflows
		Analysis or visualization tools
Services for access	F4. (meta)data are registered or indexed in a searchable resource.	Search/discovery service
	A1. (meta)data are retrievable by their identifier using a standardized communications protocol.	SOA, web services
	A1.1 the protocol is open, free, and universally implementable.	Standard communication Protocols
	A1.2 the protocol allows for an authentication and authorization procedure, where necessary.	Authentication, Authorisation services
Metadata	F2. data are described with rich metadata.	Rich metadata
	F3. metadata specify the data identifier.	
	I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.	Ontologies and Vocabularies
	I2. (meta)data use vocabularies that follow FAIR principles.	
	I3. (meta)data include qualified references to other (meta)data.	
	R1.3. (meta)data meet domain-relevant community standards.	Serialisation
	F1. Metadata are assigned a globally unique and eternally persistent identifier.	Persistent Identifier
	R1.1. (meta)data are released with a clear and accessible data usage license.	License handling

FAIR principles related to each IT component of the pyramid

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Metadata catalogs must have

- **Compliance with FAIR principles**
  - Work on how to achieve FAIRness from GO-FAIR, FAIR'sFAIR … and domain-specific projects e.g. FAIR4Health, ENVRIFAIR ….
  - Indicators of FAIRness developed by RDA FAIR Data Maturity WG
- **Sufficient information for intended use**
  - Discovery, contextualisation (relevance, quality, permissions), action
- **Formal syntax and declared semantics**
  - for autonomic processing
- **Referential and functional integrity**
  - For reliable processing

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FAIR and SERVICES

- **FAIR originally designed for DATA not SERVICES**
  - Problem: Implicit download
    - compare taking out a library book
    - Increasingly impractical (size, network latency)
  - Problem: processing associated with the data
    - Locality of data relative to computing resources, processing software and user
    - Resources required (computing, sensor networks, lab equipment)
    - Legalistics (permissions, security, privacy, liability)
- **FAIR for SERVICES**
  - If FAIR is applied to services which provide the data
    - Services intrinsically offer resources required
    - Services may be moved to the data (lower network latency)
    - Services may reduce the data (data management or analytics) for network transport
  - But…Metadata for services is different from metadata for data

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Key Characteristics Required for Implementation

Identity: Resolvable Universal Unique Persistent Identifier (RUUPID)

Identity is not the same as address (e.g. URL) but can resolve to a URL

Rich metadata: "plurality of attributes"

Sufficient to use the metadata to discover the relevant asset (using the resolvable RUUPID or address in the metadata record).

For automation: formal syntax and declared semantics.

For representativity: referential and functional integrity

Vocabulary: formal accessible, shared for knowledge representation

Involved in qualified references (as role)

Licence: Need to represent as authorisation assertions to control access

Provenance:

Used for contextualisation (relevance, quality) – needs to be integrated in catalog

Related to logs and audit

Related to curation (versions, partitions)

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EPOS: European Plate Observing System

Resarch Infrastructures and e-science for data and observations on geo-hazards and geo-resources

European Tectonic Plate covers a considerable geographical area

EPOS RI provides monitoring of the European Plate through distributed sensor-networks and laboratories

What is EPOS?

EPOS is a **long-term plan for the integration**
of research infrastructures for solid Earth Science in Europe

EPOS integrates the
existing (and future) advanced
European facilities into
a single, distributed,
sustainable infrastructure
taking full advantage of new **e-science opportunities**

25 COUNTRIES
Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Grecee, Hungary, Iceland, Ireland, Italy, Netherland, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom

4 INTERNATIONAL ORGANIZATIONS
Orfeus, Emsc, Euref, Intermagnet

256 NATIONAL RESEARCH INFRASTRUCTURES

4939 SEISMIC STATIONS

2272 GPS RECEIVERS

464 TB SEISMIC DATA

118 LABORATORIES

828 INSTRUMENTS

Several PetaBytes of solid Earth Science data will be available

Several thousands of **users** expected to access the infrastructure

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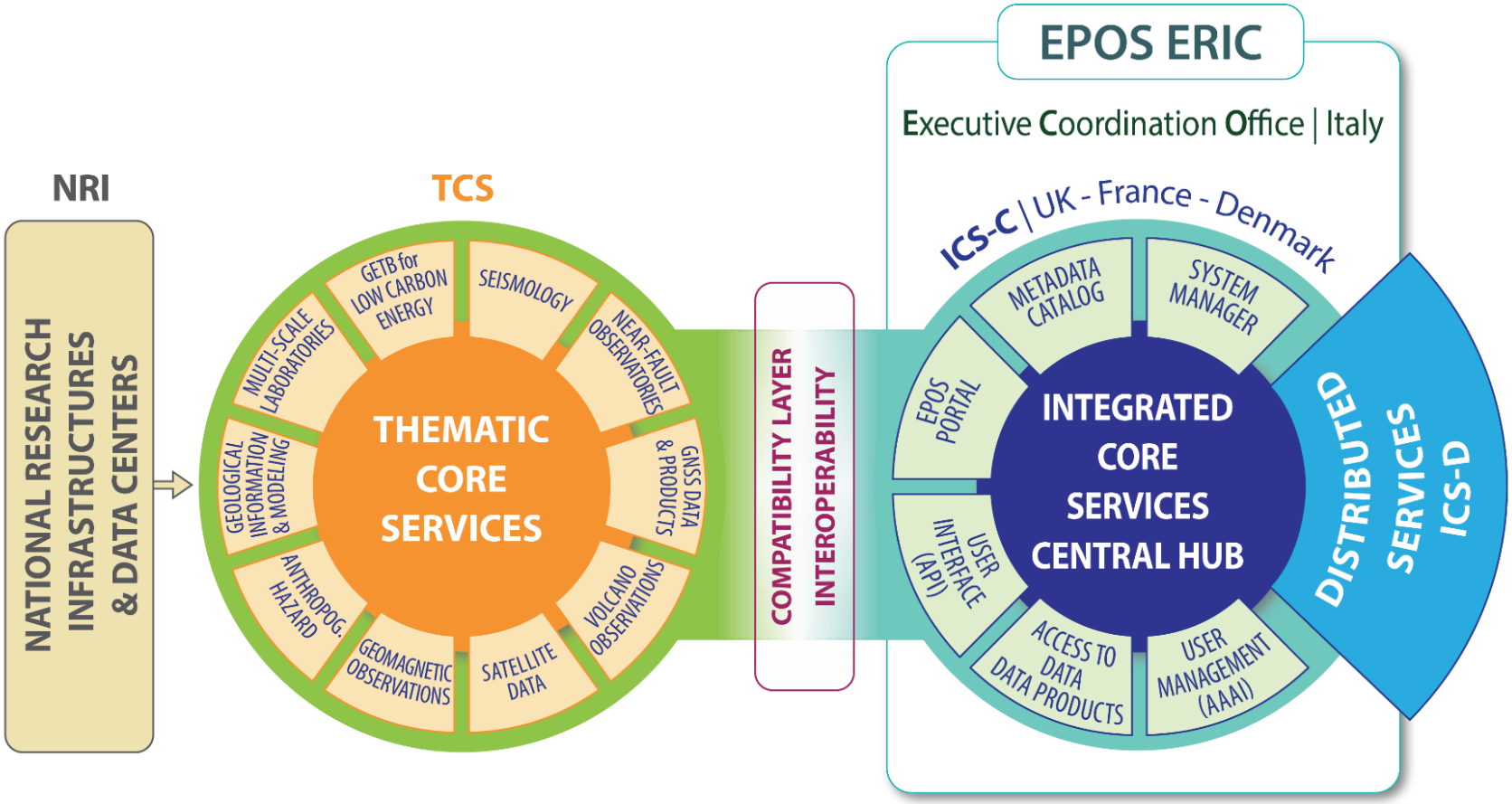
EPOS Architecture



Main elements of the EPOS Architecture, the Integrated Core Services Central Hub (ICS-C) and the Executive and Coordination Office (ECO) belong to the EPOS-ERIC legal subject.

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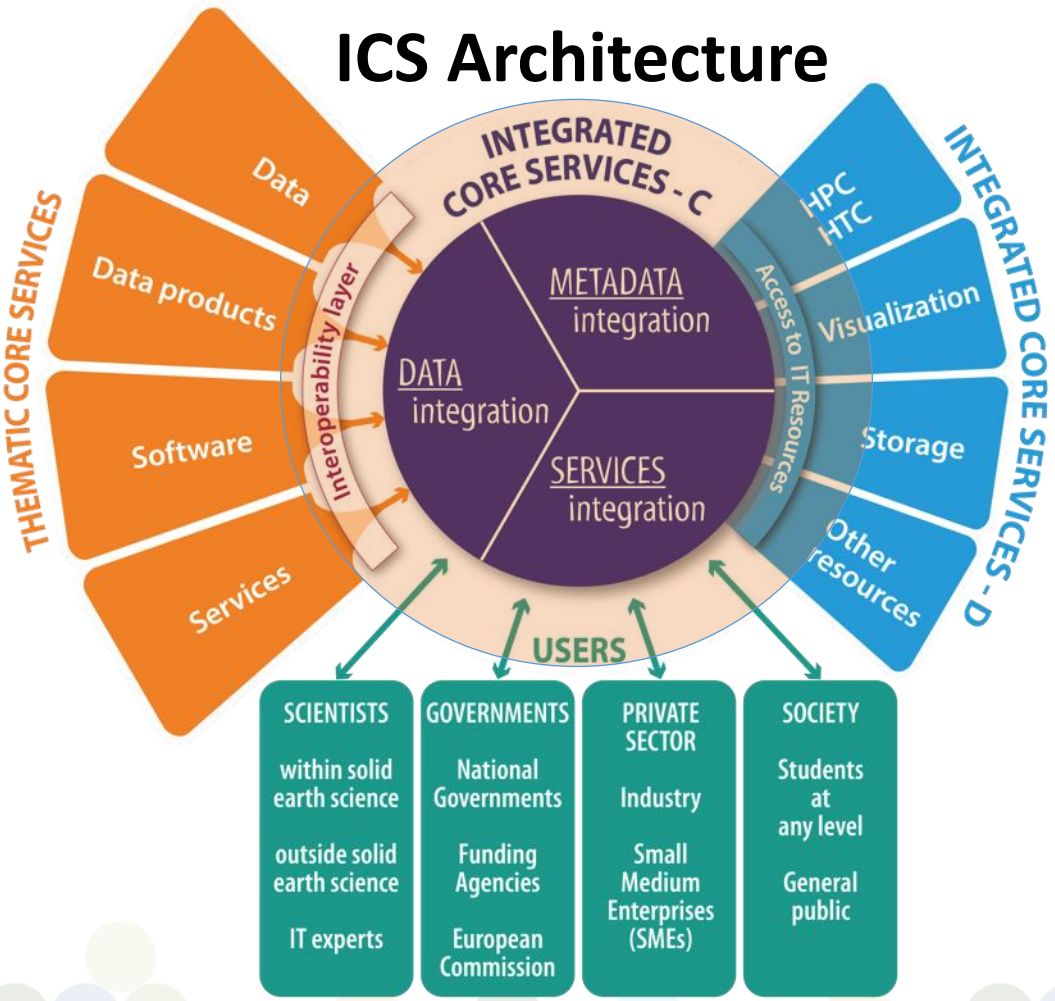
EPOS Integrated Core Services (ICS-C)

- Building new **Integrated Core Services** to foster **innovation** and **excellence** in science



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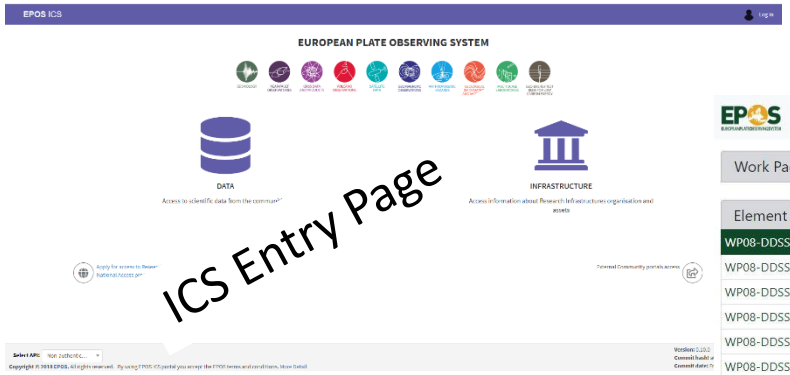
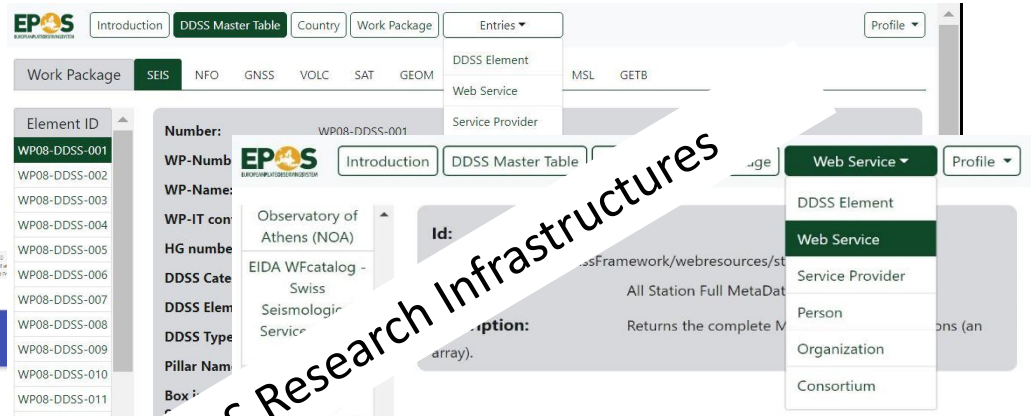
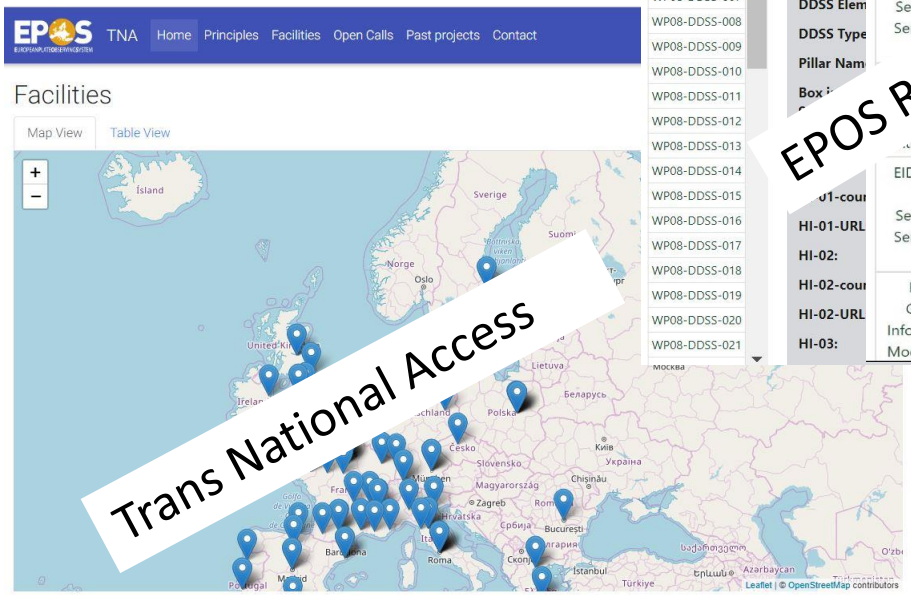
ICS-C Portal



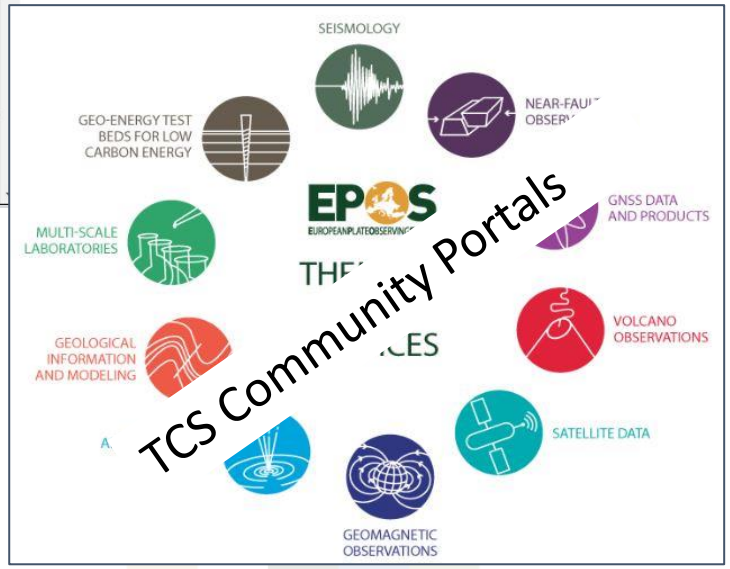
ICS Entry Page



EPOS Research Infrastructures



Trans National Access



TCS Community Portals

http://ics-c.epos-ip.org/

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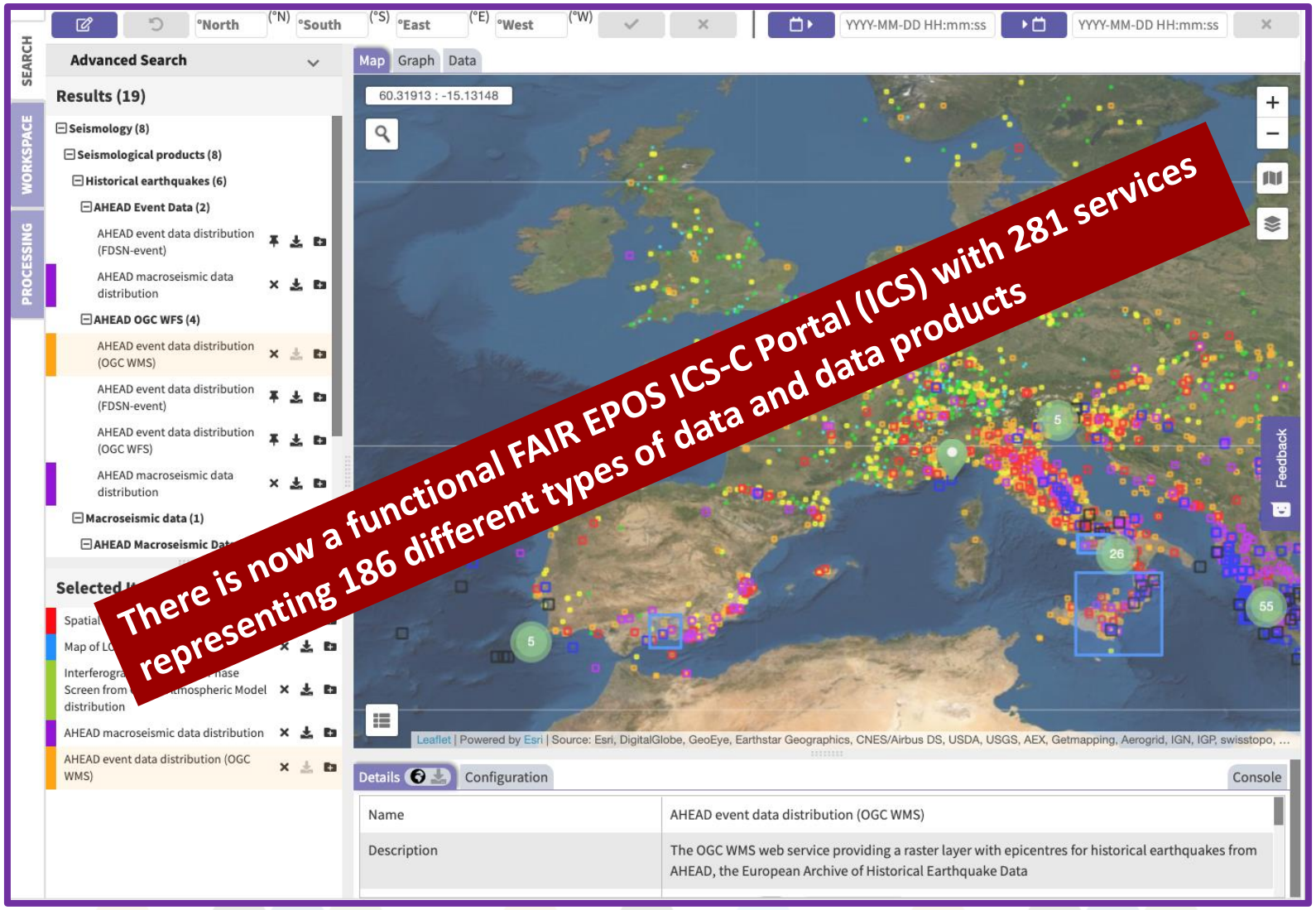
ICS-C Data Portal



https://www.ics-c.epos-eu.org/

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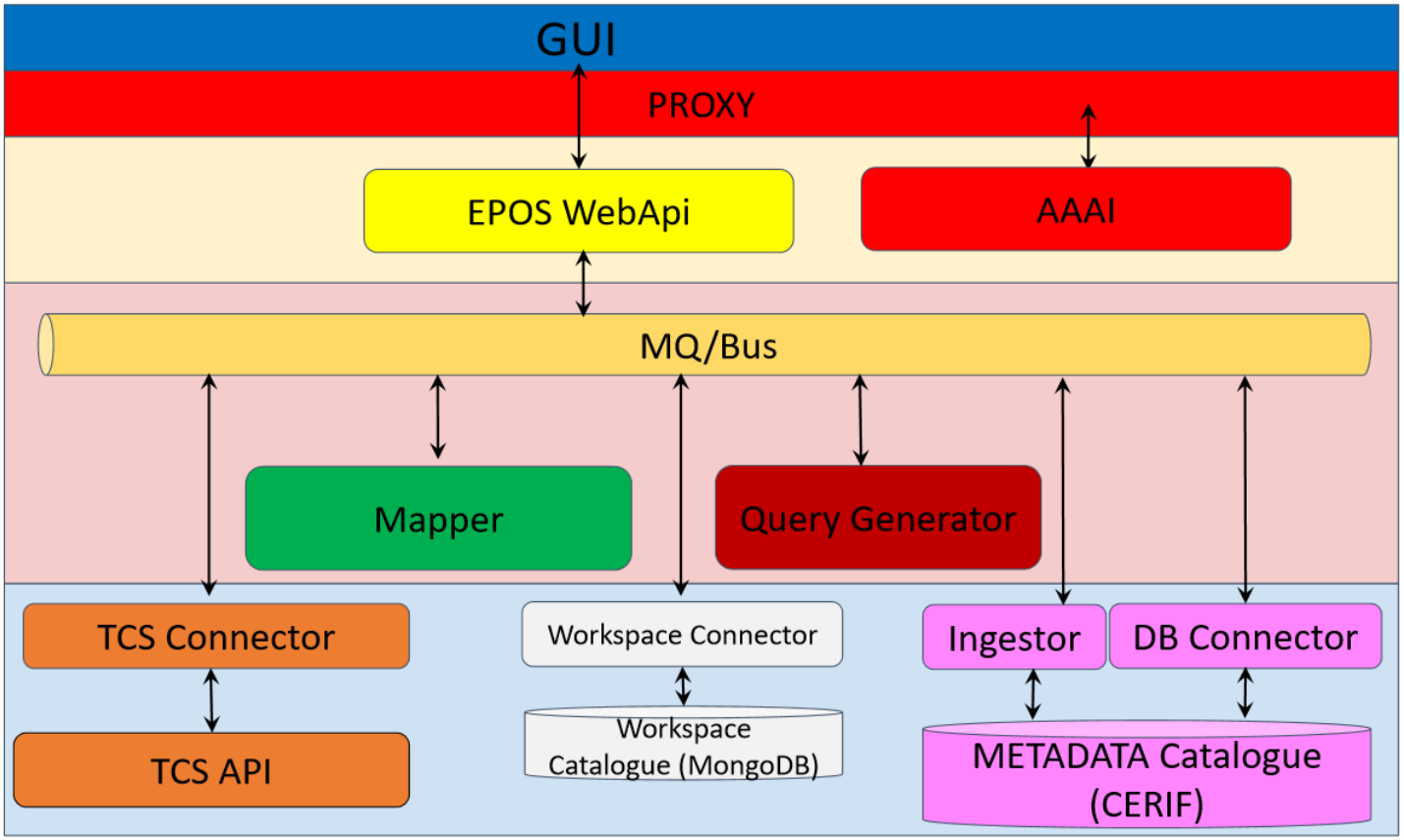
EPOS ICS-C Architecture



ICS-C Provides:

- Search/find/access
- Select/download
- Workspace with selected data
- Work-flows for advanced visualization and processing in ICS-D
- Microservices oriented
- New services easy to plug
- ICS-D ready
- Debugged
- TCS connectors

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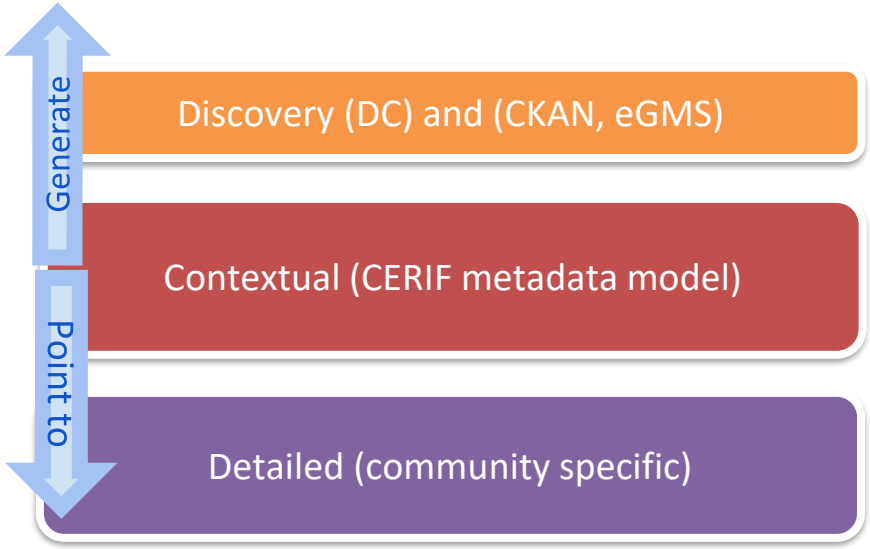
EPOS - FAIR implementation (1)

Compliant with A1, I3

Three layer metadata model



- Map & match only contextualized metadata
- Pointers to detailed metadata
- Export metadata in any standard

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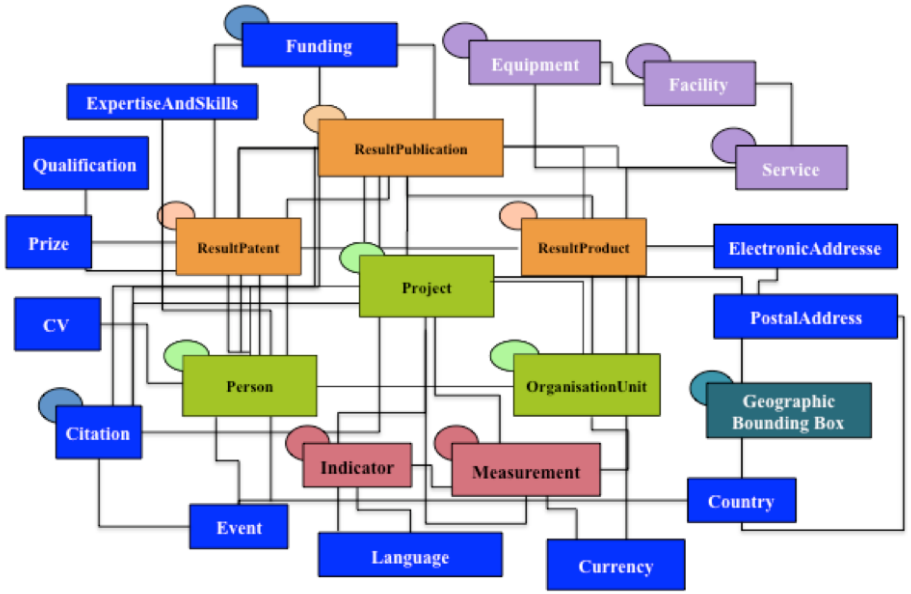
EPOS - FAIR implementation (2)

Compliant with F2, F3, F4, R1.3

Rich metadata model



- Supports several concepts
- Superset of many metadata standards
- Referential integrity
- Formal syntax, declared semantics

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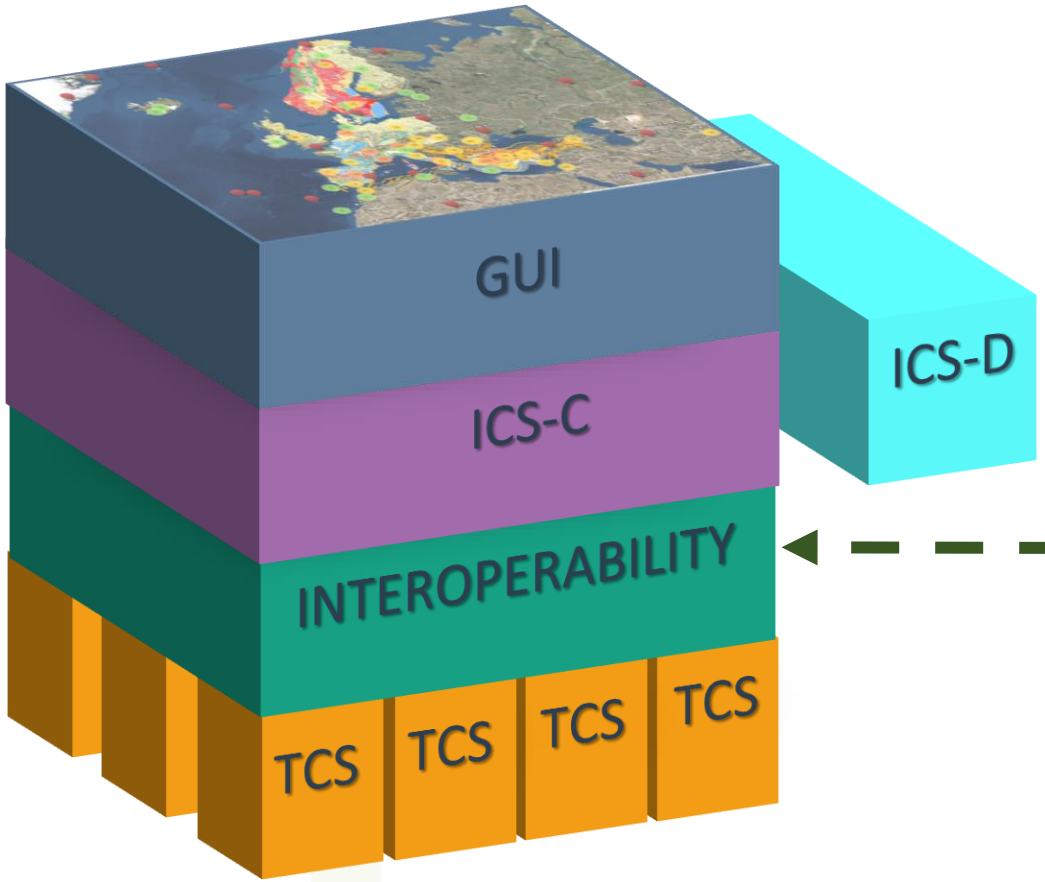
EPOS - FAIR implementation (3)

Compliant with A1.1



Multi layer approach

Web-API based

(standard protocols)

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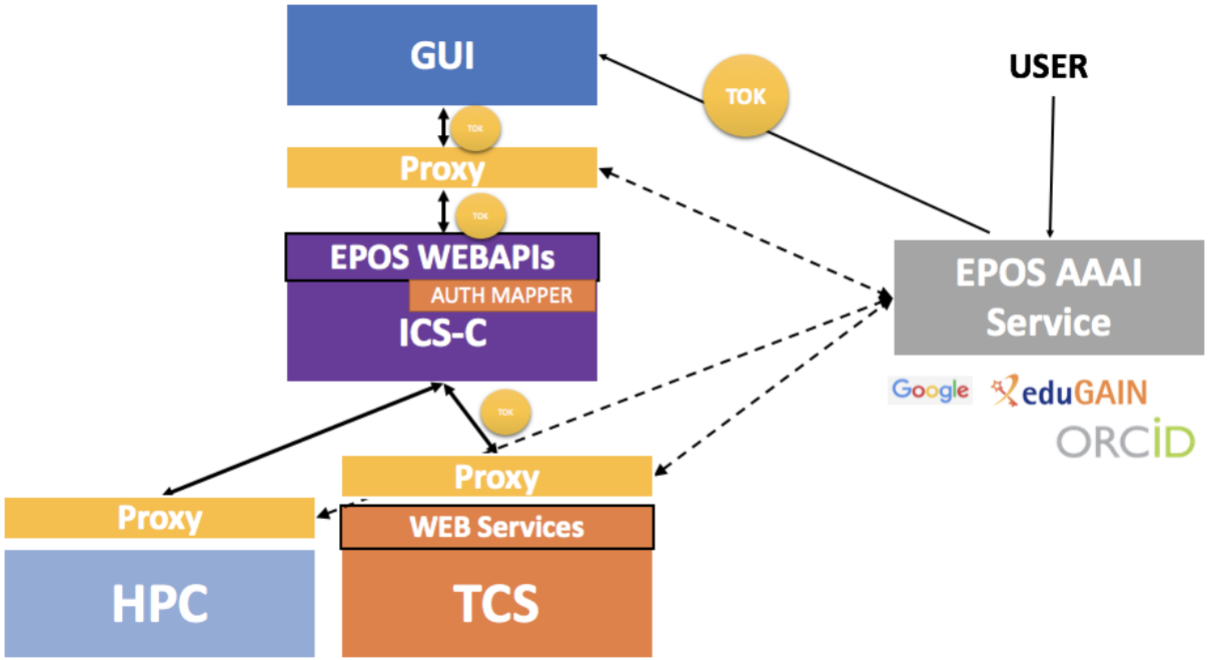
EPOS - FAIR implementation (4)

Compliant with A1.1, A1.2

AAAI integration system



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References for FAIR-EPOS

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