The Role of Technological Innovation in the Earth Observation Enterprise: Data management, Open Standards and Open Source Software perspectives

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Open Geospatial Consortium

- International Standards Development Organization (circa 1994)
- Industry, Government, Academia (over 400 organizations)
- FAIR data principles
- EO and Earth System Data is geospatial (and temporal!)
- Standards development
  - Data (formats)
  - APIs (interfaces)
- Domain implementation
  - MetOcean, Hydro, etc.

FOSS in Earth observation / Earth system data activities

- FOSS has been a longstanding activity for decades
- FOSS is now mainstream and part of policy directives of many institutions
- FOSS provides freedom, return on investment, and opens doors for wider collaboration
- FOSS provides industry opportunities for various business models

ESA EOEPCA: Common, open architecture for EO exploitation

EOEPCA
BETTER ACCESS TO EARTH OBSERVATION

Problem

Many platforms in a fragmented ecosystem

Difficult for users to exploit their complementary offerings

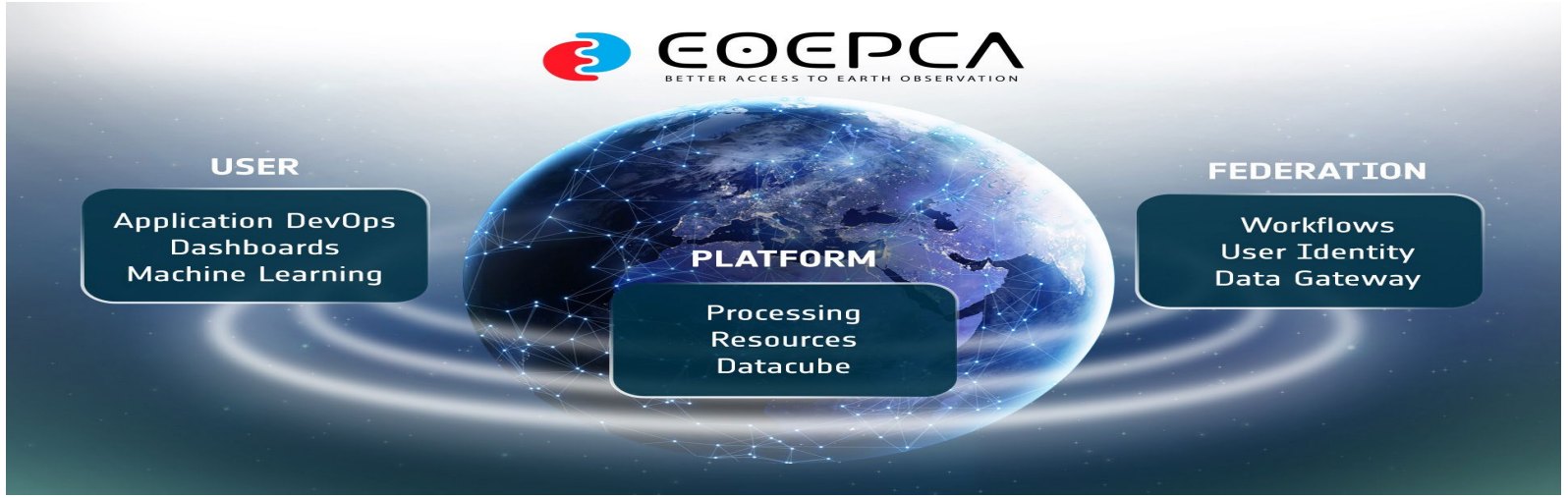
Approach

Common Architecture

- **Open Standards (OGC, W3C, IETF)**
- Enabling **Federation** among EO cloud platform offerings
- Promote and develop **Interoperability** standards

Reference Implementation

- **Open Source**
- Avoid further fragmentation
- **Reusable Building Blocks**
- Reduce development costs



WMO: Technological change / drivers

> “Technological advances and the increasing demand for more and more diverse services from increasingly sophisticated and capable users changes rapidly the service delivery and business models in many parts of the world.”
>
> WMO Strategic Plan (2020-2023)

> “Most Members are ill-prepared for the explosion in data volumes and the growing diversity of new data sources.”
>
> Cg-17

> “Cloud computing, Web services, data analytics, machine learning and other technologies present new operating concepts that will improve operational efficiency, information sharing and service delivery, and enable users to more effectively exploit data.”
>
> CBS led review of emerging data issues

WMO: Evolution of data exchange

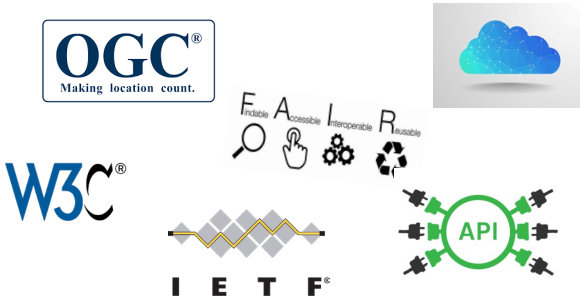
1963 World Weather Watch

1970s Global Telecommunication System (GTS)

2007 WMO Information System (WIS)

2019 WMO Reform (Earth System Approach)

2021 WMO Unified Data Policy (Core, Recommended)



WIS 2.0

… collaborative system of systems using Web-architecture and open standards to provide simple, timely and seamless sharing of trusted data and information …

- **Open Standards (OGC, W3C, IETF)**
- **Free and Open Source tooling**
- Data sharing through Web and real-time notifications with publication/subscription (pub/sub) protocols
- Cloud ready (turn-key solutions)
- Web APIs (Application Programming Interface)

WMO Task Team on Open Source Software

- Defining FOSS Guidance for WMO
  - Users, Contributors
  - WMO alignment
- Roles and responsibilities
- Strategies and guidelines in alignment with WMO Technical Regulations and standards
- Use of FOSS to accelerate WMO initiatives
- FOSS for digital transformation
- Coordination with external Open Source communities
  - Open Source Geospatial Foundation (OSGeo)
- Risk management

The Role of Technological Innovation in the Earth Observation Enterprise:
Data management considerations

- **Lowering the barrier**: addressing all communities of all sizes and capacities
- **Broad interoperability**: beyond the usual suspects
  - Enabling cross domain integration
- FAIR data principles
- Harmonized data management principles
  - Metadata!
  - Granularity
  - Identifiers and deduplication
  - Identification: Attributions and roles

The Role of Technological Innovation in the Earth Observation Enterprise:
Data exploitation considerations

- Data is too big
- Supporting AI/ML
  - Analysis ready data (ARD)
  - Data reduction / subsetting services
    - APIs
  - Bringing the user to the data

The Role of Technological Innovation in the Earth Observation Enterprise: Open Standards and Open Source Software perspectives

- Harmonized innovations in data sharing are critical to handling the data and metadata explosion to enable FAIR data principles
- A Modular approach is key to DRY, reusable innovation (“Core and Extension”)
  - Extend by exception
- Open Standards (OGC, W3C, ISO, IETF) provide clear and testable agreements for data access and exploitation
- Open Source Software provides transparent collaboration, co-development, and a business model for viability and sustainability
- Key EO and Earth System Data activities are heavily investing in Open Standards and Open Source Software (WMO, ESA)
- A modular, extensible Open Standards and Open Source Software “Commons” helps scientific data communities innovate by re-using baselines and extending by exception