



A proposal for the EOSC Technical Architecture

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eosc-hub.eu



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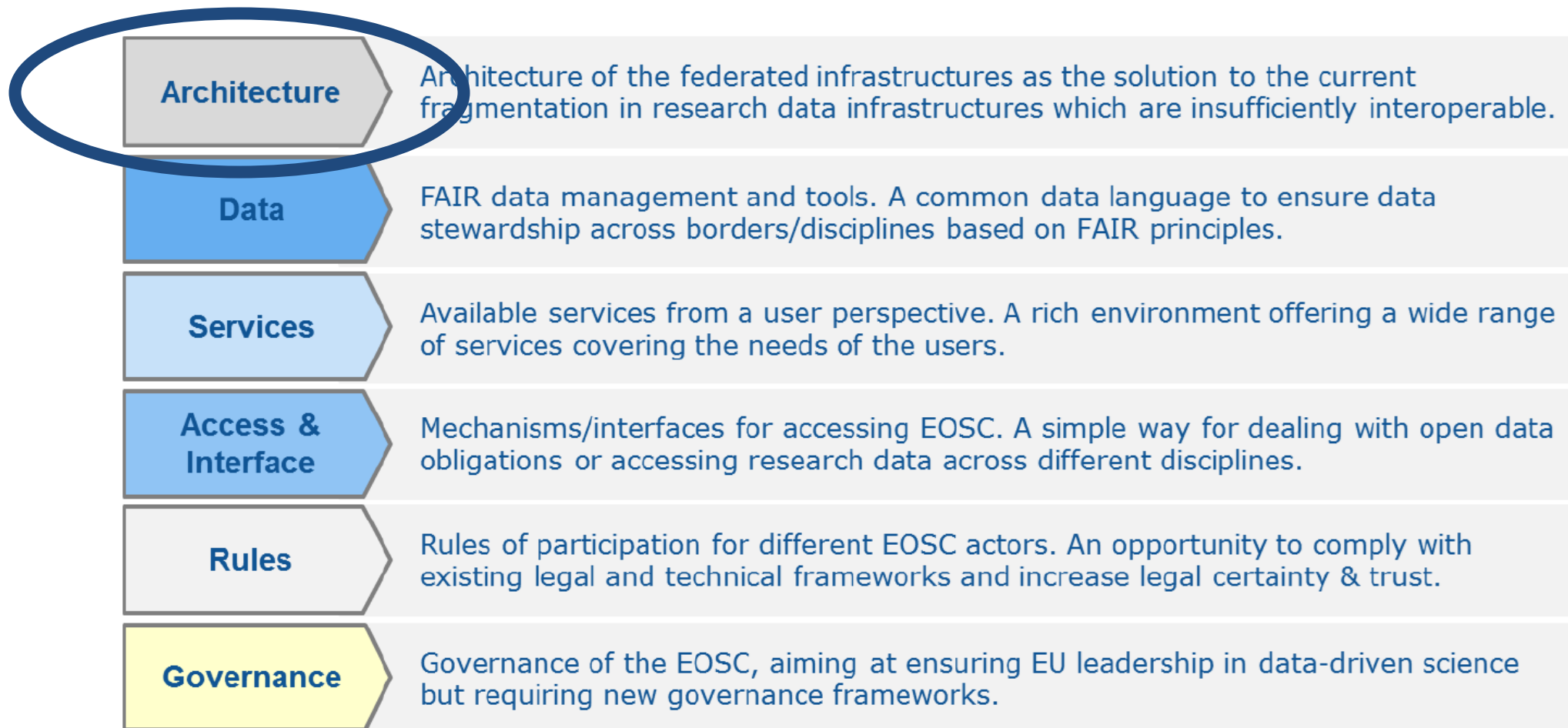
- Landscape
- Past work on EOSC Technical Architecture
- The EOSC Portfolios and EOSC Federating Core
- Service Composability
- The EOSC-hub approach to define the technical architecture
- EOSC Use Cases analysis
- Conclusions and next steps

EOSC Technical Architecture

Landscape

EC Implementation Roadmap
EOSC Architecture Working Group

COMMISSION STAFF WORKING DOCUMENT



- One of the WG setup by the EOSC Governance
- Main objective:
 - *Review of the current offering and the required evolution of the EOSC technical architecture, its standards and best practices*

The EOSC Architecture Working Group will describe and/or define:

1. EOSC core services and their interfaces
2. EOSC open source APIs for reuse by thematic services
3. EOSC portal components and federated catalogues of service offerings
4. the EOSC data description standards
5. Standards and best practices necessary to ensure the evolution of EOSC and the widening of its user base to the industry and the public sectors.

EOSC Technical Architecture

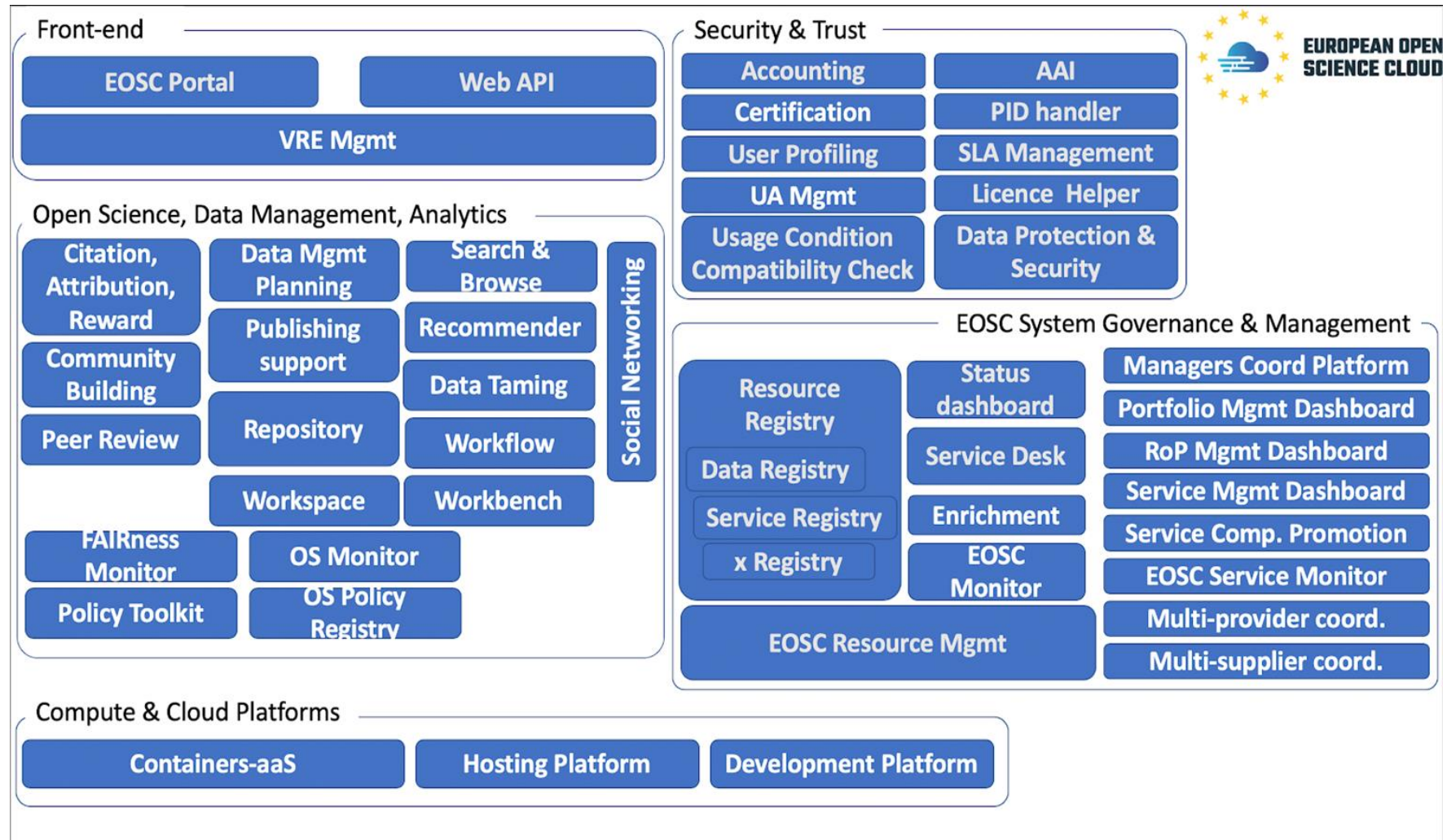
Past work

EOSC Pilot Service Architecture

EOSC-Hub “D10.3 EOSC Hub Technical Architecture and standards roadmap v1”

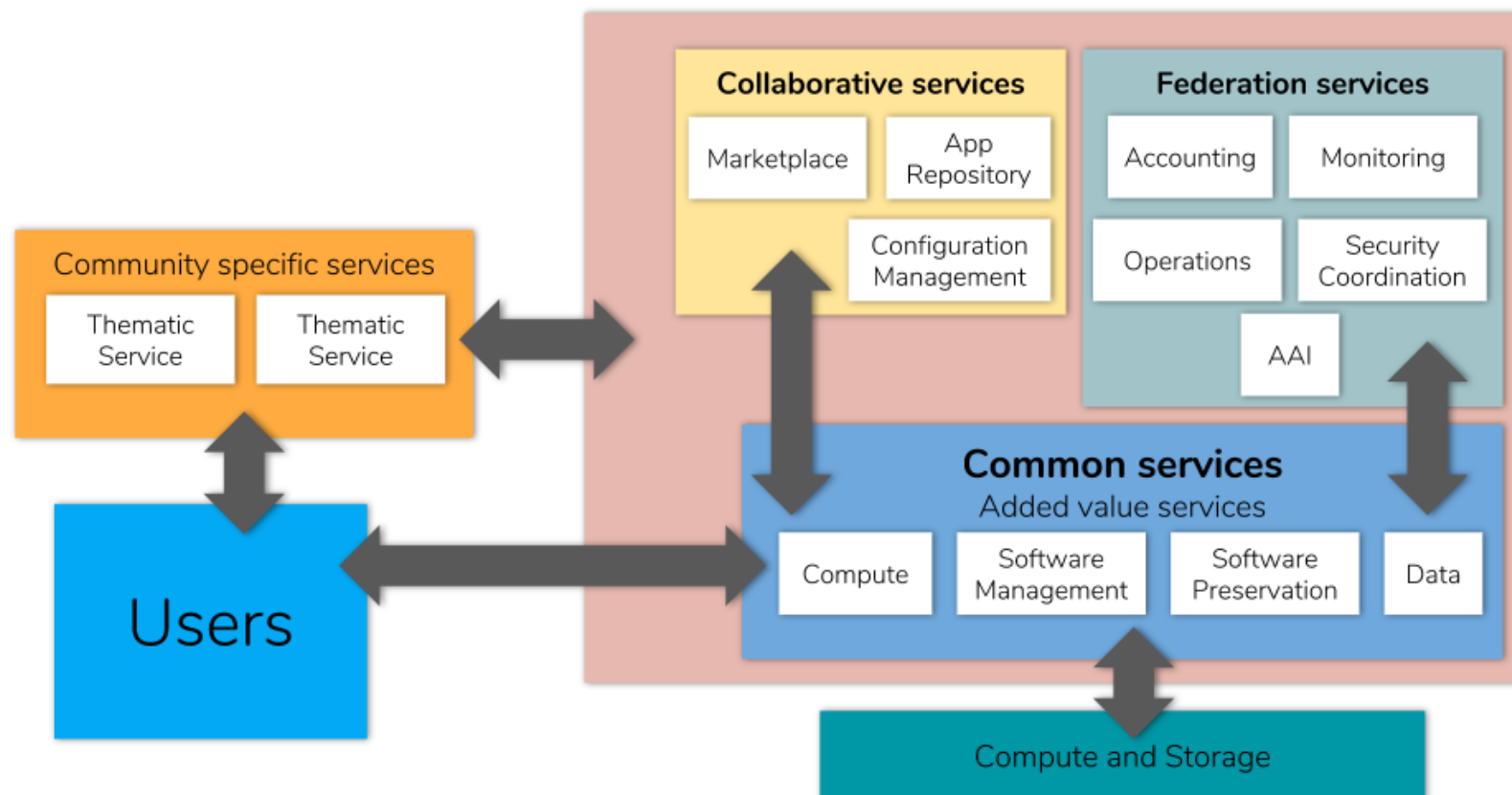
- Architecture model developed from an user & functional perspectives
- **47 classes of services** split in 5 categories
 - **Front-end services**, for implementing the part of the overall service with which users will interact directly, namely portals or APIs;
 - **Security & Trust**, aimed at guaranteeing that the overall system (and the services) operate securely and according to standard;
 - **Open Science, Data Management, Analytics**, aimed at providing their users with user- and open-science-friendly facilities, enabling users to focus on science tasks;
 - **EOSC System Governance & Management**, dedicated to supporting the operation and management of the overall EOSC System;
 - **Compute & Cloud Platforms**

EOSC Pilot Service Architecture



Reference: [EOSC-Pilot D5.4 Final EOSC Service Architecture](#)

- Details the **different service types**:
 - their functions
 - their relationships with other components of the architecture
 - their relationships with the end users
- **End-to-end compositions of services**
 - service integration and composability
- Extending the Hub
 - Onboarding
- Service offer in the Hub
- **Standards and protocols** adopted by each technical area
 - Interoperability



Reference: [EOSC-hub D10.3 Technical Architecture v1](#)

Defining the EOSC Technical Architecture

EOSC Portfolios and the EOSC Federating Core

The Hub Portfolio

The EOSC Portfolio

Compliance framework

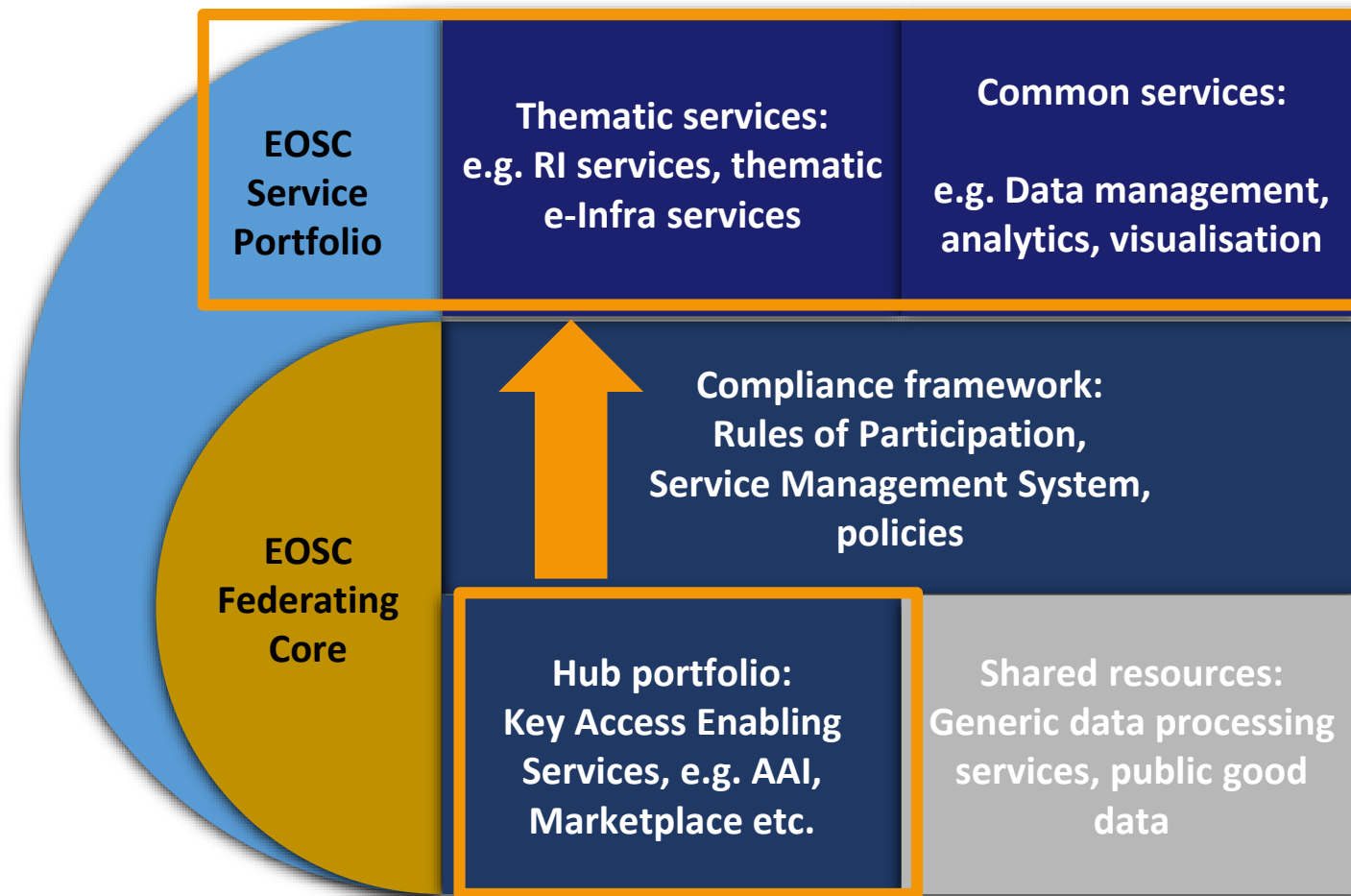
Shared resources

EOSC Service Portfolio

- **Thematic Services:** community-specific capabilities that provide value to researchers
- **Common Services:** address technical needs that are common to multiple research areas

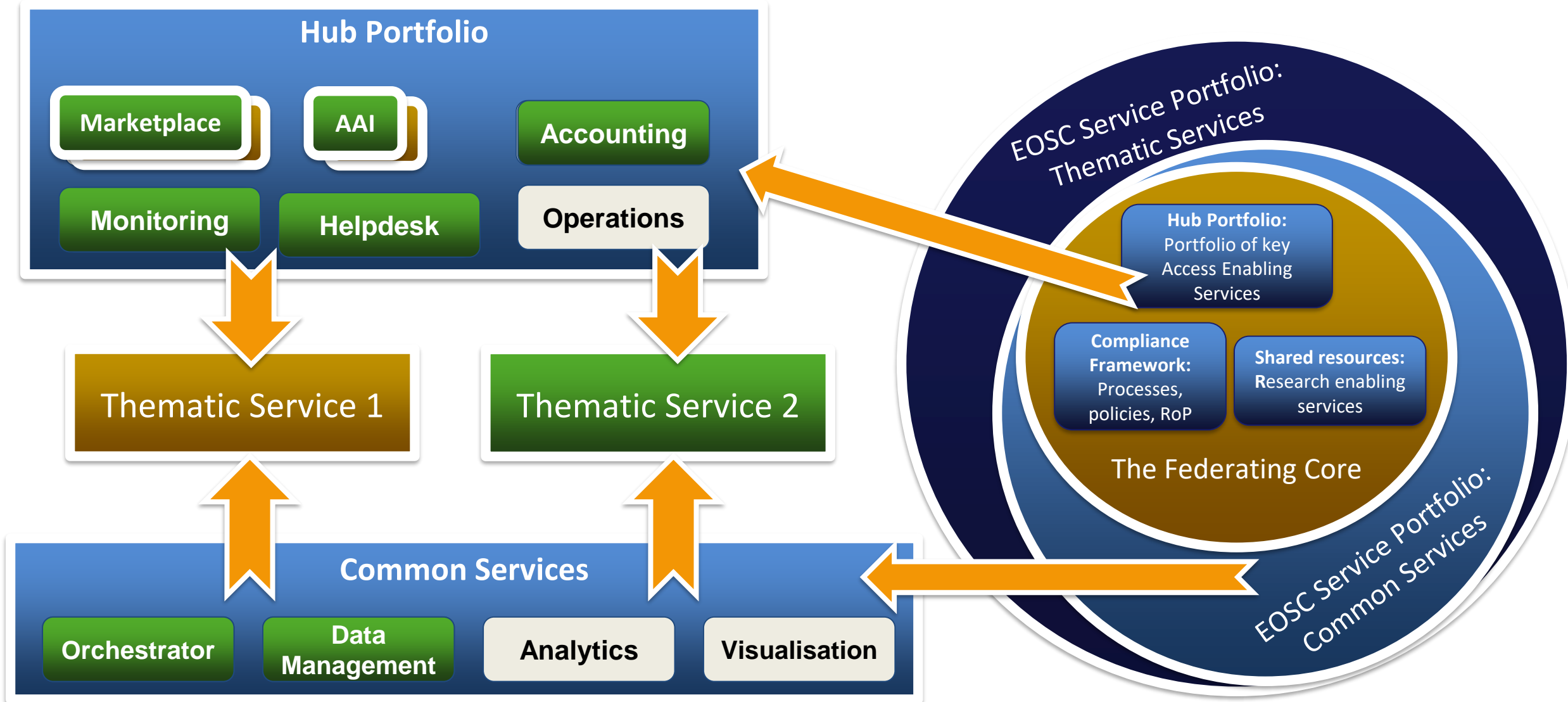
Hub Portfolio

- **Access-enabling services** e.g. for discovery, ordering and workflow enabling
- **Federation services** e.g. a common helpdesk, accounting information gathering, monitoring



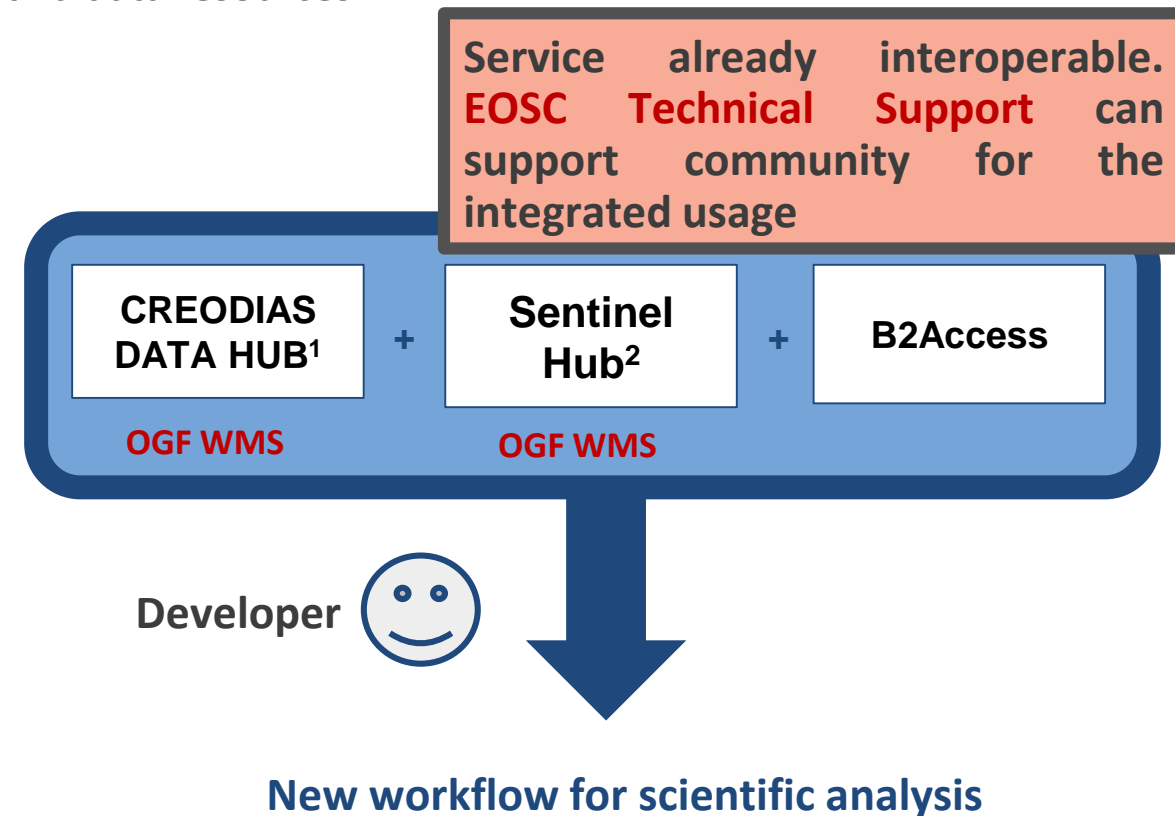
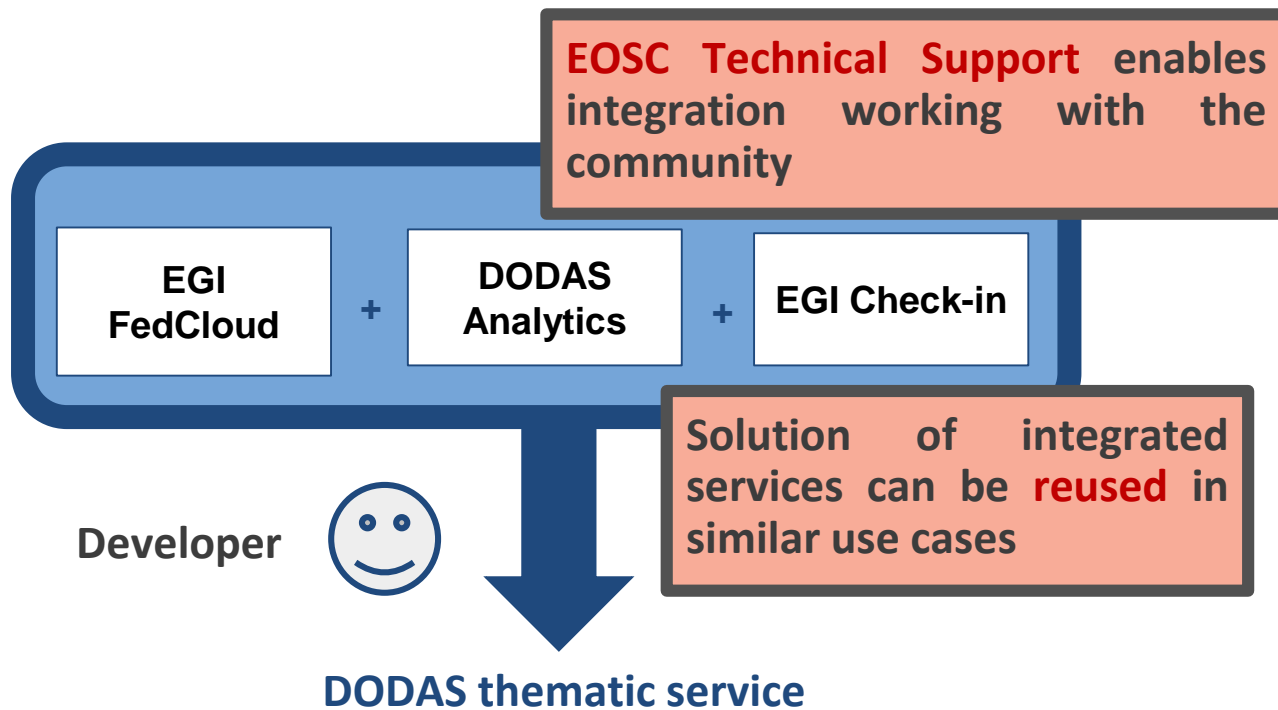
Defining the EOSC Technical Architecture

Service Composability



- **Service composability**

- Ability for the EOSC service providers/users to compose different **interoperable** services
 - Sub-classes of interoperable services being identified and extended (with integration activities)
- Typical service combinations
 - Re-using federation services to implement basic features (AAI, monitoring, accounting)
 - Adopt common services to better exploit compute, storage and data resources
 - Create new scientific workflows



The ground to build EOSC technical architecture

Interoperability is the key to make services composable!

- Identify services that can work together
 - Adopting same standards/interfaces
- Make **selected** services interoperable
 - Integration activities **driven by use cases**
 - Easier if we have **interoperability guidelines**
- Reusable Integrated/Composable services
 - Provide technical support to enable the combined usage

A proposal for the EOSC Technical Architecture

The approach

Reference architecture

EOSC Technical Architecture – Main Blocks

Macro-features and EOSC technical specification

Access Enabling and Federation Tools specification

Macro-features for Common and Thematic services

Interoperability guidelines

Reference Architecture

- A **reference architecture** in the field of software architecture or enterprise architecture provides a template solution for an architecture for a particular domain.
- It provides a common vocabulary with which to discuss implementations, often with the aim to stress commonality.
- A reference architecture often consists of a list of functions and some indication of their interfaces (or APIs) and interactions with each other and with functions located outside of the scope of the reference architecture.
- Reference architectures can be defined at different levels of abstraction.

Definition according to Wikipedia (https://en.wikipedia.org/wiki/Reference_architecture)

Building blocks, macro-features and interoperability guidelines

- We have to work at: Infrastructure/technical level
- Define: Main blocks, functions, interfaces, APIs, standard as technical concepts
- Define a Common vocabulary usable to define not only the already available services, but also the ones will be joining EOSC catalogue in the future



Users

GUI/API

Thematic services

Common services

Data/Compute/Storage Resources

EOSC Portal

Other Portals and Marketplace

Federated Discovery and Brokerin./supporting (Federated AAI)

Federations tools
AAI, Accounting, monitoring, Helpdesk, etc.

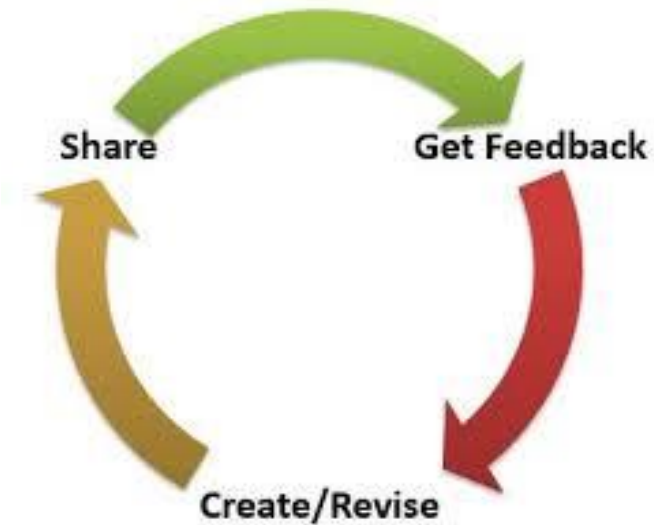
Define the main blocks of the EOSC architecture

- Working on defining the content of the [main blocks of the EOSC architecture](#)
 - Access Enabling and Federation services
 - Common services
 - Thematic services
 - EOSC Portal (special access enabling service)
- Common approach (for all blocks)
 - [Identify macro features](#) offered by each block of the architecture
 - Mapping the features to [Technical Specifications](#) including
 - High-level architecture
 - Interoperability guidelines
 - No specific services within each block but only macro features and related technical specification

- **Introduction**
 - *Short description of the macro-feature highlighting its main functions*
- **High-level Service Architecture**
 - *Reference architecture of the macro-feature with highlighted the interfaces towards the other macro-features.*
 - *It does not refer to any specific service*
- **Adopted Standard**
 - *List with references of the main adopted standards and protocols/API*
- **Interoperability guidelines**
 - *Describe how similar services can be made interoperable with this macro-feature*
- **Examples of solutions implementing this specification**
 - *→ real services*



- **Iterative approach** to identify macro-features per block and improve the technical specification
 - Start from the most relevant → use cases
 - Define the tech specification and get feedback
 - Involve external people with expertise in the area
- **Family of EOSC compliant services per macro-feature**
 - Services in this set follow the EOSC technical specification
 - Services in this set are able to interoperate
- Examples
 - AAI services compliant with the AARC Blueprint
 - Monitoring/Accounting systems able to exchange/share information



Access Enabling and Federation Services

Users

GUI/API

Thematic services

Generic services

Data/Compute/Storage **Resources**

Federated Discovery and Brokerin./supporting (Federated AAI)

EOSC Portal

Other Portals and Marketplace

Federations tools

AAI, Accounting, monitoring, Helpdesk, etc.



- Macro-features in the Access key access- and

- Leveraged experiences from large European e-infrastructure to identify the needed services
- Part of the Portfolio

Technical specification for each of these services

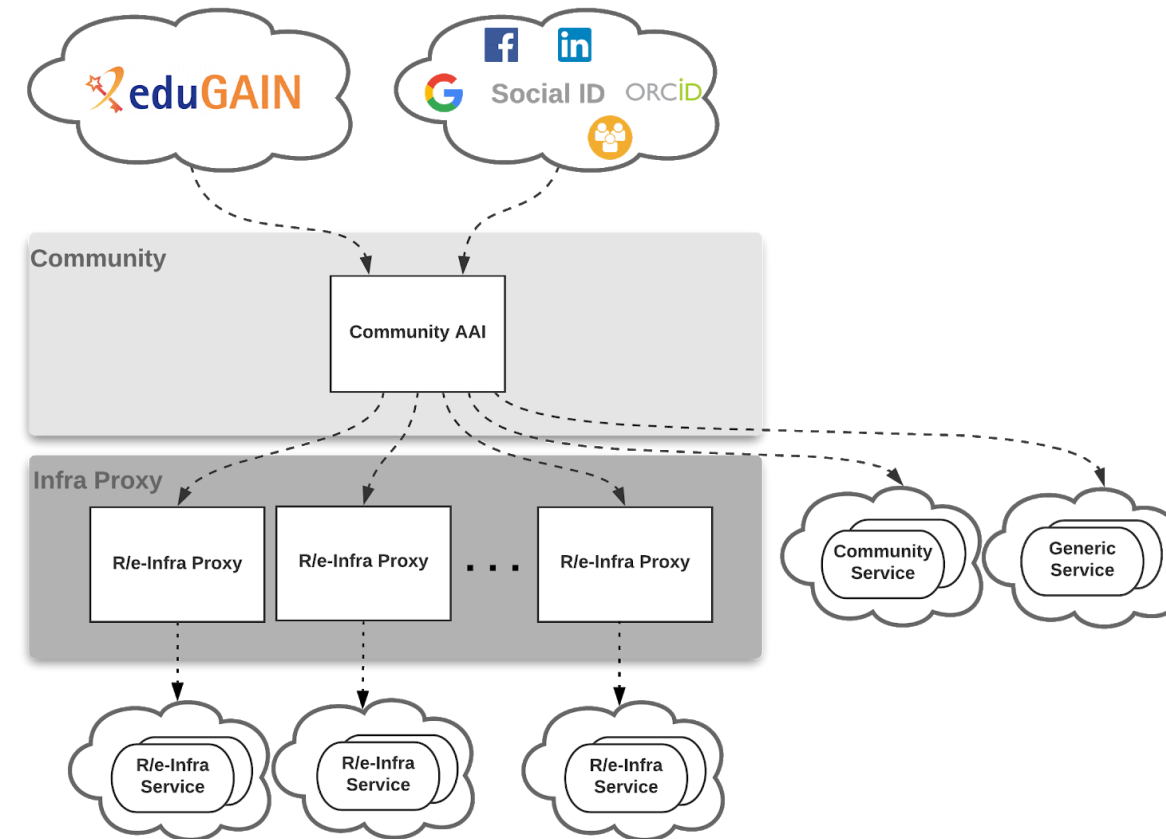
Hub Portfolio
AAI
Helpdesk
Accounting
CMDB
Monitoring
Order Management

Hub Portfolio
EOSC Portal
Operations portal
Service Portfolio Management Tool
Collaboration software & platforms
Messaging
Security Monitoring

Standard	Short description	References
Security Assertion Markup Language (SAML) 2.0	OASIS standard for exchanging authentication and authorisation data between parties.	https://www.oasis-open.org/standards#samlv2.0
OAuth 2.0	Standard for authorisation that enables delegated access to server resources on behalf of a resource owner	"The OAuth 2.0 Authorization Framework", RFC 6749, https://www.rfc-editor.org/info/rfc6749
OpenID Connect 1.0	Identity layer on top of the OAuth 2.0 protocol. It enables Clients to verify the ...	"OpenID Connect Core 1.0", https://openid.net/specs/openid-connect-core-1.0.html
X.509	ITU-T standard for a public key infrastructure (PKI), also known as PKIX (PKI X509)	https://www.rfc-editor.org/info/rfc5280 https://www.rfc-editor.org/info/rfc3820
Lightweight Directory Access Protocol (LDAP)	Provides access to distributed directory services that act in accordance with X.500 data and service models.	https://tools.ietf.org/html/rfc4511

Federation services – Technical Specification

An example: AAI (1/3)



High-level Service Architecture

An example: AAI (2/3)

- Technical interoperability guidelines (an extract)
 - The attributes used to express user information should follow the REFEDS R&S attribute bundle, as defined in [[REFEDS-R&S](#)]
 - VO/group membership and role information should be expressed according to [[AARC-G002](#)]
 - Capabilities, which define the resources or child-resources a user is allowed to access, should be expressed according to [[AARC-G027](#)]
 - ...
- Policy interoperability guidelines (an extract)
 - For the EOSC AAI, compliance with the GÉANT Data Protection Code of Conduct version 1 (DPCoCo-v1) [[DPCoCo-v1](#)] is implicit...
 - The entities of the EOSC AAI registered with eduGAIN should meet the Sirtfi [[Sirtfi-v1.0](#)] requirements and express Sirtfi compliance
 - EOSC AAI services should adopt the WISE Baseline AUP model [[WISE-AUP](#)].

An example: AAI (3/3)

Solutions compliant with this specification

AAI Services
<u>B2ACCESS</u>
<u>Check-in</u>
<u>eduTEAMS</u>
<u>INDIGO-IAM</u>

Identity and Access Management
<u>Perun</u>
<u>Comanage</u>
<u>HEXAA</u>

Token Translation Services
<u>WaTTS</u>
<u>MasterPortal</u>
<u>RCauth.eu</u>

Common Services

- A macro-feature in the Common Services block is a **technical function that**
 - **offer added value on top of the EOSC resources**
 - can be adopted by multiple thematic services
- Examples of macro-features
 - IaaS VM/Container management, Cloud Orchestration, metadata management, making scientific artefacts FAIR, etc.
 - A macro-feature can be offered by one or more generic services
- Number of relevant macro-features in Common Services can be huge
 - Different technical areas
 - Need to prioritise
 - Starting from the most relevant for users → use cases requirements

- Split the work leveraging on technical areas
 - EOSC-hub technical areas

Technical Areas
HTC/HPC Compute
Cloud Compute (inc Containerisation and orchestration)
PaaS Solutions
Workflow management and user interfaces and Data analytics

Technical Areas
Data Platforms for Processing
Data Publishing and Open Data
Data Preservation/Curation/Provenance
Metadata Management and Data Discovery

- Other tech areas suggested by other initiatives
 - E.g. OpenAIRE suggested to add Scholarly Communication



Thematic services

Scholarly
Communication

Workflow
Management

Common services

Compute

Data
Management

Data/Compute/Storage Resources

EOSC Portal

Other Portals and Marketplace

Federated Discovery and Brokerin./supporting (Federated AAI)



Thematic services

Std interfaces

Feature 5

Scholarly
Communication

Std interfaces

Feature 6

Std interfaces

Feature 7

Workflow
Management

Std interfaces

Feature 8

Common services

Std interfaces

Feature 1

Comp

Std interfaces

Feature 2

Std interfaces

Feature 4

Data
Management

Std interfaces

Feature 3

Data/Compute/Storage **Resources**

Federations tools

AAI, Accounting, monitoring, Helpdesk, etc.


Macro-features per technical area

Technical Area	Macro Features
HTC/HPC Compute	<ul style="list-style-type: none">• Multitenant job submission• Multitenant container based job submission• HTC / HPC clusters on demand
Cloud Compute (inc Containerisation and orchestration)	<ul style="list-style-type: none">• IaaS: VM Management• IaaS: Orchestration• IaaS: Containers
PaaS Solutions	<ul style="list-style-type: none">• Abstract the IaaS resources• Manage the provisioning, configuration and scaling of the cloud resources• Support Hybrid deployments• Advanced Scheduling capabilities• Support for data orchestration and movements• Provide solution stack as a Service• Provide on-demand application deployment• Provide function as a service

Macro-features per technical area

Technical Area	Macro Features
Data Platforms for Processing	<ul style="list-style-type: none">• Transparent data processing using POSIX in distributed and hybrid cloud environment including Dockers and Kubernetes and Jupiter• Data Ingesting and movement for processing in hybrid cloud environment• Metadata Management in processing workflows• QoS based data access optimization and tight integration with preservation services• Authorization based on attributes from IdP• Results sharing and experiment repeatability• Distribution of software for the processing tasks
Data Publishing and Open Data	<ul style="list-style-type: none">• Data Repository
Data Preservation/Curation/Provenance	<ul style="list-style-type: none">• Data Preservation• Tracking of provenance metadata• Data Curation
Metadata Management and Data Discovery	<ul style="list-style-type: none">• Data Discovery and Access• Metadata cataloguing and indexing• Annotation service

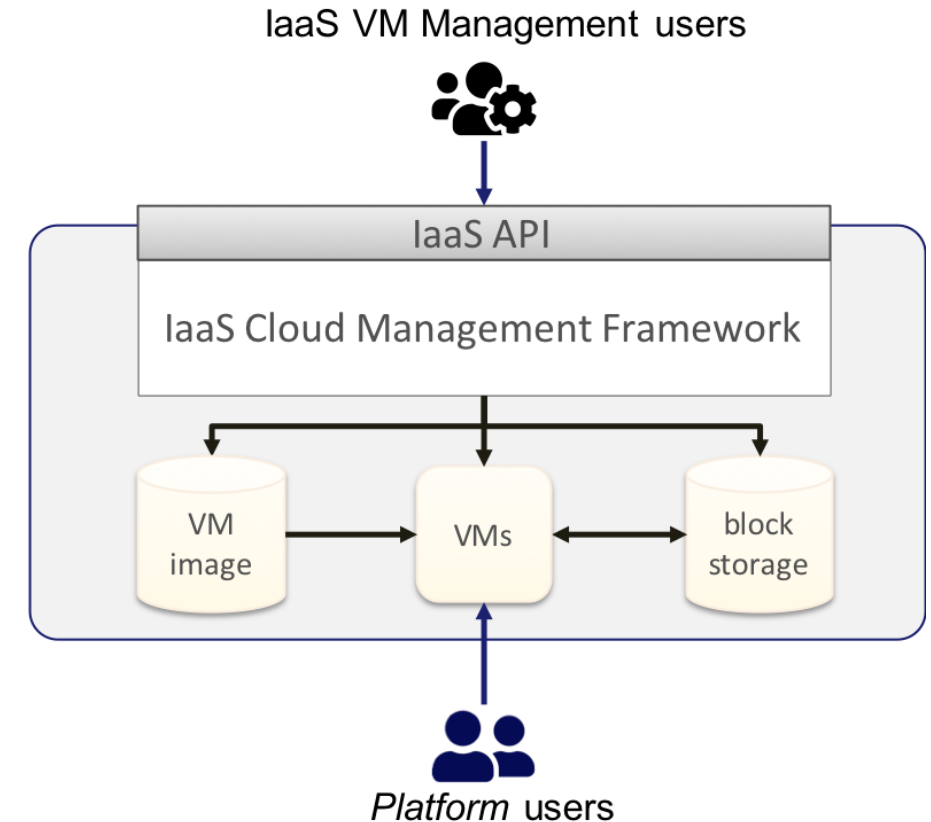
Macro-features per technical area

Technical Area	Macro Features
Workflow management and user interfaces and Data analytics	<ul style="list-style-type: none">• Portals• Big data analytics• ML/DL analytics services• Cloud based IoT Platforms interoperability
Scholarly Communication 	<ul style="list-style-type: none">• Data Management Plans• Digital Preservation• Overlay platforms: Peer-review• Anonymization• Aggregator• Broker• Entity Registry• Metadata validation• Annotation• Usage stats• VRE: RI Services for experiments

An example: Cloud IAAS VM Management

Standards & API

Standard	Short description	References
Open Virtualization Format (OVF)	Packaging format for software solutions based on virtual systems (VM image format)	OVF 2.1.1
OpenStack	OpenStack is an Open Source cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter...	OpenStack API
Amazon EC2/EBS/VPS & AWS VPN	Provide management of Virtual Machines and associated block storage and network features	AWS EC2 API
Azure Virtual Machines/Disks/Vnet	IaaS VM management services from Microsoft Azure	Azure Virtual Machines API
Google Cloud Compute Engine	IaaS VM management service from Google Cloud Platform	Google Cloud Compute Engine API
OGF OCCl	Open community-lead specifications delivered through the OGF	OCCI Specification
DMTF CIMI	Model and protocol for management interactions between a cloud Infrastructure as a Service (IaaS) provider and the consumers	CIMI 2.0.0



High-level Service Architecture

An example: Cloud IAAS VM Management

- Interoperability guidelines:
 - API access for on-demand management of VMs and associated resources must be provided
 - Open and/or Standard APIs are preferred
 - Services that provide the capability to manage VMs through graphical dashboards but limit API access to users cannot be considered interoperable

An example: Cloud IAAS VM Management

- AAI interoperability
 - Services should provide access to users authenticated with one of the EOSC AAI federated identity protocols (OpenID Connect and/or SAML)
- Orchestration interoperability
 - Services should expose APIs that are supported by IaaS Orchestrator services of EOSC
- Federation interoperability:
 - Services in this category that need to be federated into a cloud federation should provide API-based access to:
 - Management of VM images, i.e. allow to create (upload) and delete VM images from which VMs can be instantiated
 - Access usage information of individual VMs and block storage so accounting records can be generated for integration into the EOSC central services

An example: Cloud IAAS VM Management

Solutions compliant with this specification



Cloud Compute

Run virtual machines on demand with complete control over computing resources



Cloud Container Compute BETA

Run Docker containers in a lightweight virtualised environment



openstack®



Thematic services

APIs and std interfaces
**Workflow
Management**
APIs and std interfaces
APIs and std interfaces
**Big Data
Analytics**
APIs and std interfaces
APIs and std interfaces
**Data
Annotation**
APIs and std interfaces
APIs and std interfaces
**Making science
products FAIR**
APIs and std interfaces

Common services

APIs and std interfaces
Cloud IaaS
APIs and std interfaces
APIs and std interfaces
**Cloud
Orchestrator**
APIs and std interfaces
APIs and std interfaces
Data Discovery
APIs and std interfaces
APIs and std interfaces
**Metadata
management**
APIs and std interfaces
Data/Compute/Storage Resources
EOSC Portal
Other Portals and Marketplace

Federated Discovery and Brokerin./supporting (Federated AAI)



AAI, Accounting, monitoring, Helpdesk, etc.

Federations tools

Thematic services

APIs and std interfaces

Workflow Management

APIs and std interface

APIs and std interfaces

Big Data Analytics

APIs and std interfaces

APIs and std interfaces

Data Annotation

APIs and std interfaces

APIs and std interfaces

Making science products FAIR

APIs and std interfaces

Common services

APIs and std interfaces

Cloud IaaS

APIs and std interfaces

APIs and std interfaces

Cloud Orchestrator

APIs and std interfaces

APIs and std interfaces

Data Discovery

APIs and std interfaces

APIs and std interfaces

Metadata management

APIs and std interfaces

Data/Compute/Storage Resources

Thematic Services

- The same process to identify macro-feature can be also applied to Thematic services
- A macro-feature in the Thematic Services block is a **technical function** that
 - is **discipline oriented**
 - can be re-used in multiple thematic services
- Discipline oriented macro features need to be identified and specified by experts of disciplines
- EOSC-hub will start this effort with communities participating to the project
 - Community oriented projects need to be involved (e.g. Cluster projects)

Thematic services

APIs and std interfaces
**Discipline
feature 1**
APIs and std interfaces
APIs and std interfaces
**Discipline
feature 2**
APIs and std interfaces
APIs and std interfaces
**Discipline
feature 3**
APIs and std interfaces
APIs and std interfaces
**Discipline
feature 4**
APIs and std interfaces

Generic services

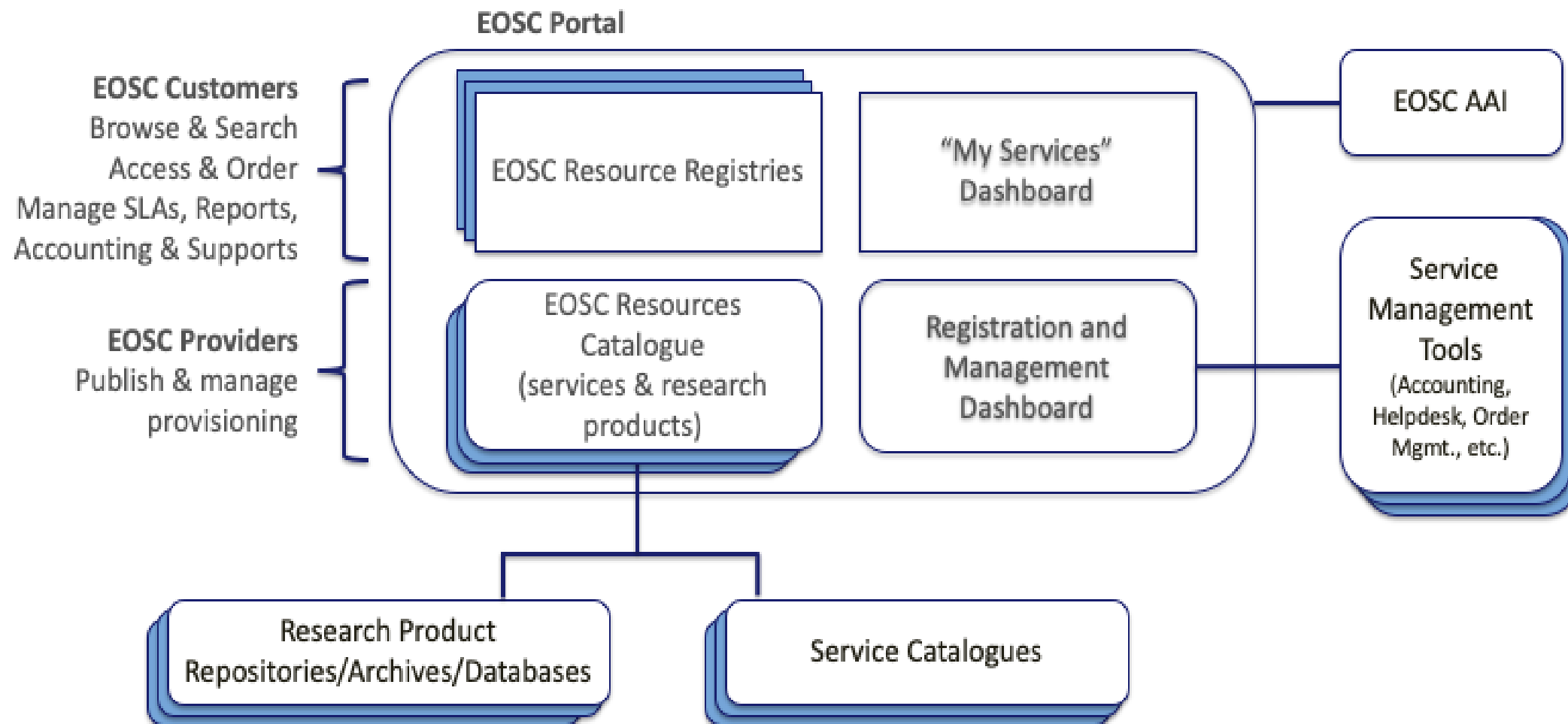
APIs and std interfaces
Cloud IaaS
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APIs and std interfaces
APIs and std interfaces
**Metadata
management**
APIs and std interfaces
Data/Compute/Storage Resources
Federations tools

AAI, Accounting, monitoring, Helpdesk, etc.

EOSC Portal



- EOSC Portal has been jointly designed and developed by EOSC-hub, OpenAIRE Advance & eInfraCentral
- EOSC Portal Concept paper
 - <https://wiki.eosc-hub.eu/display/EOSC/EOSC+Portal>





- **EOSC Portal Collaboration agreement** (to Dec 2020)
 - Involving EOSC-hub, OpenAIRE Advance & key tech partners from eIC
 - 4 Joint activities
 - Operations: The EOSC Portal will be operated according to the EOSC Service Management System (SMS) being developed by EOSC-hub
 - Interoperability Framework: updates the EOSC Portal Catalogue Framework (ECF) and the Open Application Programming Interfaces (APIs)
 - Technical Integration:
 - Develop a single portal (WUI) and entry point (API interface) for Service Providers to register and maintain service descriptions and for the discovery of scientific products
 - Optimise the integration of the current EOSC Portal, Service Catalogue and Marketplace
 - Content provisioning
- Project funded under call INFRAEOSC-06 from January 2020
 - EOSC Enhance proposal (EOSC-hub, eIC, OpenAIRE, GEANT, Clusters projects)

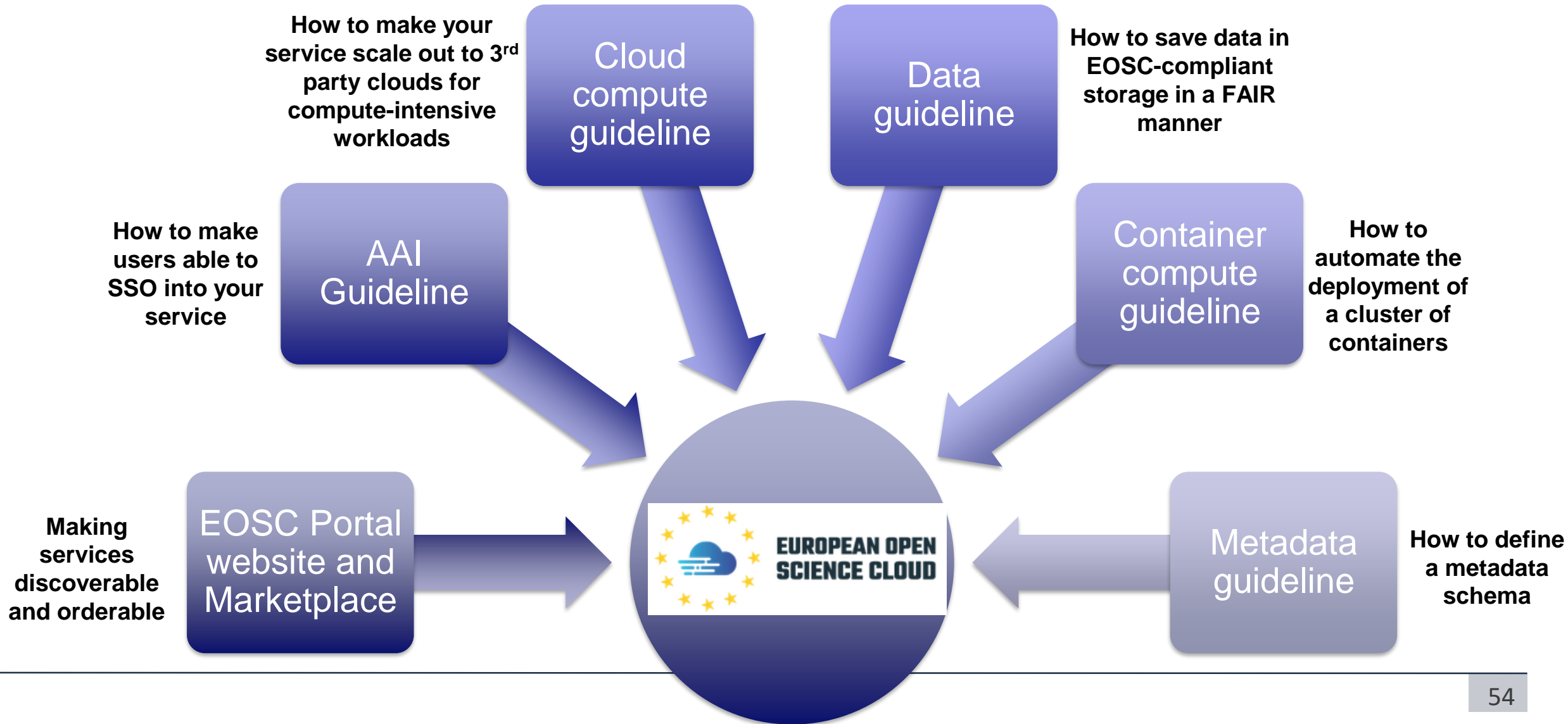
EOSC Use Cases Analysis

User requirements

EOSC Pilot Scientific Demonstrators
EOSC-hub Thematic Services
EOSC-hub Competence Centers

- EOSC-Pilot scientific demonstrators
 - [D5.6 Evaluation Report of service pilots](#)
- EOSC-hub Thematic Services
 - [D7.2 First report on Thematic Service architecture and software integration](#)
- EOSC-hub Competence Centers
 - [D8.1 Report on progress, achievements and plans of the Competence Centres](#)
- EOSC-hub Community Requirements Database
 - <https://wiki.eosc-hub.eu/display/EOSC/Community+requirements+DB>
- A sub-set of communities taken into account:
 - PanCancer, EPOS, Photon & Neutron, DODAS, ENES, ELIXIR, EISCAT-3D, CLARIN, WeNMR, OpenCOASTs, FUSION, LOFAR, ICOS, etc.

EOSC-hub Reference architectures, interfaces and interoperability guidelines



Defining the EOSC Technical Architecture

Conclusion & Next steps

Mapping with the EOSC Architecture WG objectives
An open approach

EOSC Architecture WG objectives

1. EOSC core services and their interfaces
2. EOSC open source APIs for reuse by thematic services
3. EOSC portal components and federated catalogues of service offerings
4. the EOSC data description standards
5. Standards and best practices necessary to ensure the evolution of EOSC and the widening of its user base to the industry and the public sectors.

Objectives of this work

Definition of the EOSC Access Enabling and Federation services and interfaces

Interoperability guidelines for Common services (interfaces)

Interoperability guidelines for Discipline specific services (interfaces)

EOSC Portal and EOSC service portfolios

EOSC-hub proposal for the EOSC technical architecture – An open approach

- June 2019: [Technical WS in Amsterdam](#) with participation of the main e-infrastructures (EGI, EUDAT, GEANT, OpenAIRE)
 - Expected output: EOSC-hub/OpenAIRE-Advance/GEANT recommendation for the EOSC technical architecture, reference architecture, guidelines and principles

DONE
- Summer /Autumn 2019: [First technical specification for Access Enabling, Federation and Common services ready](#)
 - Public consultation

ON GOING
- Summer/Autumn 2019: [Collecting feedback and suggestions](#)
 - Sharing the documents with a broader set of stakeholders (e.g. RIs, Clusters, EOSC service providers and implementation projects)
 - Organise webinars to present the proposal and to gather feedback
 - Sharing the approach and the first results with the EOSC Architecture WG

ON GOING

EOSC-hub proposal for the EOSC technical architecture – An open approach

PLANNED

- Autumn 2019:
 - [EOSC Architecture Workshop](#): an open event co-organised by EOSC-hub in collaboration with the EOSC Architecture Working Group
 - Expected output: a proposal for the EOSC tech architecture as outcome of the consultations with the largest expected EOSC user groups.

PLANNED

- By end of 2019:
 - Consolidated proposal for the EOSC technical architecture shared with the EOSC architecture WG

Thank you for your attention!

Questions?



EOOSC-hub

Contact

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