Deliverable D3.1

Initial architecture plan on the integration of CDI Operation and Collaboration Tools in EOSC

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Abstract:	First report on the initial design of the integration architecture. The main focus is on the planned integration activities of the Collaborative Data Infrastructure (CDI) Operation and Collaboration tools with the EOSC-Core services.
Keyword List:	integration, CDI operation and collaboration tools, EOSC, EOSC-Core, apis, messaging, EUDAT
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Table of Contents

The DICE project has received funding from the European Union's Horizon 2020 project call H2020-INFRAEOSC-2018-2020 under Grant Agreement no. 101017207.

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Terms and abbreviations

AAI	Authentication and Authorisation Infrastructure
AGORA	Service Portfolio Management Tool (SPMT)
AMS	Ardo Messaging Service
API	Application Programming Interface
CDI	Collaborative Data Infrastructure
DoA	Description of Action
DPMT	Data Project Management Tool
EC	European Commission
EIF	EOSC Interoperability Framework
EOSC	European Open Science Cloud
EU	European Union
EUDAT ltd	EUDAT ltd
IdP	Identity Provider
GA	Grant Agreement to the project
GRNET	National Infrastructures for research and technology
KIT	Karlsruher Institut für Technologie
MVE	Minimum Viable EOSC
RI	Research Infrastructure
RoP	Rules of Participation
RT	Request Tracker
SPMT	Service Portfolio Management Tool
VA	Virtual Access
WG	Working Group
WP	Work Package
SPMT	Service Portfolio Management Tool

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Executive Summary

DICE relies on the independently operated Collaborative Data Infrastructure (CDI) that was developed in the course of the EUDAT and EOSC-hub projects. To enable efficient service and resource provisioning through DICE, the integration activities described in this document focus on the further integration of the CDI Operation and Collaboration tools with the EOSC-Core services.

The first aim of this activity is to adapt to the EOSC-Core services evolution/updates the relevant support services (e.g helpdesk, accounting, monitoring) and to support the resource provisioning through the EOSC Platform (e.g. service onboarding, resource accounting, monitoring). The second aim is to connect the user-facing data services with EOSC-Core services making them available via the EOSC Platform. In summary, the objectives are 1) to strengthen the CDI Operation and Collaboration Tools to remain interoperable with the relevant components of the EOSC ecosystem and 2) to facilitate a consistent service onboarding and efficient resource provisioning process through EOSC.

The Integration of the services we are referring to, have to do with the end-user while navigating in the Portal and searching for services. EUDAT CDI Helpdesk will be integrated to support the users requests, and DPMT (Data Project Management Tool) to support the ordering process of the users. At the same time AGORA (SPMT) will play an important role in the onboarding process for the DICE services by integrating with the EOSC Platform. The EUDAT Monitoring, and EUDAT Accounting service integration will support the resource provisioning of the services to the EOSC ecosystem based on the requirements set. The integration and operation of the services follow the FitSM[1] standard, with standard procedures and responsibilities clearly defined to guarantee the quality of the service.

The CDI Operation and Collaboration tools are already in operation and follow the main guidelines to be compatible with the EOSC-Core since their integration began in the course of the EOSC-hub project and other collaborating projects (e.g. OpenAIRE Advance, EOSC-Enhance). Therefore, minor and non disruptive requirements are anticipated for publishing monitoring and usage statistics via EOSC Platform dashboards. While the EOSC ecosystem and its requirements are constantly evolving, their related developments, particularly for the guidelines on EOSC Rules of Participation (RoP[2]) , will be actively monitored and the CDI Operation and Collaboration Tools will be adapted accordingly. The main interoperability aspects[3] that will be addressed by DICE are: a) comply with the rules of participation that regulate the onboarding of services, and b) provide feedback on and comply with the EOSC-Core interoperability and integration guidelines produced via the EOSC Future project.

[1] https://apmg-international.com/product/fitsm
[2] https://repository.eoscsecretariat.eu/index.php/s/QWd7tZ7xSWJsesn#pdfviewer
[3] EOSC Interoperability Framework - https://www.eoscsecretariat.eu/sites/default/files/eosc-interoperability-framework-v1.0.pdf

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1 Introduction

This document provides a first approach on the integration of the CDI Operation and Collaboration Tools in EOSC. It presents the current status of the EOSC ecosystem, the CDI Operation and Collaboration Tools and the steps needed to achieve the integration. Work Package 3 (WP3) focuses on providing the necessary integrated set of tools that enable the onboarding of user-facing services to EOSC and their integration with the EOSC-Core services. The interoperability guidelines will evolve (updates will follow in related projects like the EOSC Future) and will be used as baseline for the interoperability specifications so as to guide the CDI Operation and Collaboration Tools when designing and implementing the architectural plan.

1.1 About this deliverable

CDI Operation and Collaboration Tools cover the whole life-cycle of services, from planning to delivery and include a subset of services that are common with EOSC-Core services and that need to be fully compatible with the EOSC. At the same time, the user-facing data services - such as those provided through the DICE project - should be as much as possible integrated with EOSC-Core services and made available through the EOSC Platform, to be then provided through WP6 and used by service providers part of the WP7 Virtual Access work package. Our objective is to evolve the CDI Operation and Collaboration Tools to play an important role in the EOSC ecosystem.

1.2 Document structure

Chapter 2 presents / identifies the current EOSC-Core landscape, the work achieved until time of writing (June 2021) about Interoperability / integration in the EOSC environment whilst at the same time the CDI Operation and Collaboration Tools are presented. Each tool is separately described with a summary of its main features. This work also helped the team to acknowledge the integrations needed for each tool and to identify the additional work needed.

Chapter 3 presents the initial plan of the architecture to integrate the CDI Operation and Collaboration Tools in EOSC. By analyzing and extracting insights from all these different tools helped us discover service's data insights (ex. structured data, common vocabularies) and ways (ex. apis, messaging service) to support interoperability (technical, semantic). The role of each tool is identified and the work needed to support the internal integration (between CDI services) and of course the integration with EOSC-Core services .

Chapter 4 introduces the internal integration needed via the Collaboration Tools.

Finally Chapter 5 concludes with the current status of the integrations, the obstacles that we expect to face and the next steps.

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2 Interoperability / integration introduced by EOSC environment

2.1 EOSC Environment

The European Open Science Cloud (EOSC) is the European Commission initiative aiming at developing a federated infrastructure providing its users with services promoting Open Science practices. This infrastructure is built by aggregating services provided by several providers following a system of systems approach.

EOSC aims at underpinning Open Science, turning FAIR principles into reality across Europe, building a web of FAIR data, enabling the core functions and service layers of an operational EOSC ecosystem, linking the development with other major initiatives and gradually expanding the offer to public and private sectors. EOSC aims to give the EU a global lead in research data management and ensure that European scientists enjoy the full benefits of data-driven science. EOSC governance coordinates the development of EOSC, and in order to ensure full implementation of its structure, it created five working groups (WGs). One of this WG is the Architecture WG, and it works on the technical framework required to enable and sustain an evolving EOSC federation of systems.

The Architecture WG defined the following grouping for the EOSC services: a) **EOSC-Core**: the set of enabling services required to operate the EOSC, b) **EOSC-Exchange**: the set of federated services registered in EOSC by Research Infrastructures (RIs) and clusters to serve the needs of research communities and the widening to the general public and private sector, c) **EOSC Federation**: the set of scientific services provided by RIs and Clusters to the respective communities. The Architecture WG defined **The Minimum Viable EOSC (MVE)** as a dynamic set of EOSC resources like i) The subset of EOSC resources necessary for forming the added-value and opportunities considered essential to be provided by the EOSC and ii) The subset of EOSC-Core components/services required to operate and deliver such resources.

The EOSC-Core is the simplest set of services and interfaces that are required for EOSC to function. The services that are part of the EOSC-Core are the following:

- **EOSC portal (website)**: The EOSC Portal is the universal access channel to EOSC services and resources.
- **EOSC Service Catalogue and orders**: advertise, order services and resources, compliant with the needs of the European research community.
- **Federated AAI**: A distributed federated AAI infrastructure which allows for sharing of login and access to services and data across EOSC.
- **Helpdesk**: Basic helpdesk to cover incidents for the portal and for the core services.
- **Monitoring** of service use for services, to report on their availability in various ways.
- **Accounting**: Delivery of accounting data by services.

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The EOSC Architecture WG initiated a task to identify the MVE in function level. This WG developed an architectural diagram[4] describing a functional overview of the EOSC and has identified concrete frameworks of the EOSC Interoperability Framework (EIF) and functions to be included in the MVE, with a focus on the essential functions of the EOSC-Core. All the functions which are in the FAIR lady[5], EOSC-Hub interoperability guidelines[6], and OpenAIRE guidelines[7] are considered in this deliverable. These functions focus mainly on EOSC-Core services and they are trying to create the functional overview of EOSC. This list of functions is a priority for DICE and the members of this WP want to enable it in the DICE environment to support the integration with EOSC.

2.2 DICE in EOSC Environment

The DICE consortium brings together a network of computing and data centres, and research infrastructures for the purpose to enable a European storage and data management infrastructure for EOSC, providing generic services and building blocks to store, find, access and process data in a consistent and persistent way. All services provided via DICE will be offered through the EOSC Portal and interoperable with EOSC-Core via a lean interoperability layer to allow efficient resource provisioning from the very beginning of the project. In order to support that, DICE has included this dedicated work package to integrate the services offered through DICE with the EOSC-Core and Exchange.

DICE, relying on EUDAT tools, offers a set of services - common with many of the EOSC-Core services - that helps providers enhance their own services from the operational perspective. The services can, for example, simplify how users access the service federated authentication (AAI), improve service reliability (monitoring), provide details on capacity consumption by users (accounting), or simplify user interaction via a helpdesk (helpdesk).

Considering this, the EOSC-Core and DICE have a set of common functions (like the ones mentioned in Architecture WG and MVE) to enable the federation of distributed resource providers and, in particular, to enable on-boarding of resources, access to resources, composability of resources, ordering, monitoring, accounting of the resources. This set of functions are part of the DICE CDI Operation and Collaboration tools and are the following:

- B2ACCESS authentication and authorization infrastructure (AAI), which is responsible for a seamless access to all resources.
- AGORA Service Catalogue (SPMT): the service portfolio management tool which includes standardized information based on the EOSC profiles (now version 3.0) about the providers and the resources available from this project.
- DPMT: The EUDAT Data Project Management Tool, the registry for providers, services, pledged and allocated resources, for customers and their projects (service orders), and for the management of scheduled downtimes.

[4] EOSC architecture working group view on the minimum viable EOSC Report from the EOSC Executive Board, https://op.europa.eu/en/publication-detail/-/publication/91fc0324-6b50-11eb-aeb5-01aa75ed71a1/language-en
[5] A FAIR Lady (olim Iron Lady) report from the EOSC Sustainability Working Group, https://op.europa.eu/en/publication-detail/-/publication/581d82a4-2ed6-11eb-b27b-01aa75ed71a1/language-en/format-PDF/source-175468053
[6] Interoperability Guidelines https://www.eosc-hub.eu/technical-documentation
[7] OpenAIRE Guidelines - https://guidelines.openaire.eu/en/latest/

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- Monitoring: EUDAT service for monitoring status and performance data, the availability and reliability of the services.
- Accounting (ACCT): The EUDAT accounting service for collecting information about the usage of resources and services (this can be the number of data objects, the used volume of a storage or the number of users that are registered on a service).
- EUDAT Helpdesk: which consists of tools for providing support to end users and resource providers.

Integration of most of the EUDAT Operational and Collaboration Tools has already begun in the EOSC-hub project and other related projects (like EOSC-Enhance) to deliver services under the EOSC. Most of the tools are mature and follow in general the main guidelines to be compatible with the EOSC.

To enable efficient service and resource provisioning through DICE, the integration activities will focus on the further integration of the CDI Operation and Collaboration tools with the EOSC-Core services. The first aim of this activity is to adapt the relevant support services to EOSC-Core services and to support the resource provisioning through the EOSC portal (service onboarding, ordering, resource accounting, monitoring). The second aim is to connect the user-facing data services with EOSC-Core services making them available via the EOSC portal (federated AAI, helpdesk).

2.2.1 Integration guidelines and Collaboration with other projects

In order to support this integration process we have established a team within the WP3 with wide-ranging expertise and experience to cover all aspects. Moreover, DICE partners are actively engaged with the other EOSC initiatives and projects running in parallel to find complementarities, and to capitalize on synergies, to avoid duplication of effort and increasing seamless integration of the services and resources. At the same time, the team is closely following the developments of the EOSC Portal and the EOSC Interoperability Framework as they are developed, maintained, and operated by EC Projects EOSC-Enhance and EOSC Future (started in EOSC-Hub). Collaboration with EOSC Future is foreseen as part of connecting the federating core services with the EOSC-Core and in aligning with the requirements of integrated, composable and reliable services.

The main points that have been identified to be aligned[8] in the DICE project are a) the comprehensive and coherent set of rules of participation (RoP[9]) to onboard services and make them discoverable and accessible through the EOSC Platform and b) the interoperability and Integration guidelines[10], defining the high-level architecture for basic EOSC technical functions, c) the interoperability guidelines - technical specifications for AAI, Accounting, Monitoring , Helpdesk that were created during the EOSC-Hub project.

The Integration of the services we are referring to, has to do with the end-user while navigating in the EOSC Portal and searching for services. In order to support that, the EUDAT Helpdesk should be integrated with the EOSC Helpdesk, as we know that the current EOSC Helpdesk is planned to change. At the same time, the EUDAT Order management must be aligned with the

[8] EOSC Interoperability Framework - https://www.eoscsecretariat.eu/sites/default/files/eosc-interoperability-framework-v1.0.pdf
[9] https://repository.eoscsecretariat.eu/index.php/s/QWd7tZ7xSWJsesn#pdfviewer
[10] Interoperability guidelines https://confluence.egi.eu/pages/viewpage.action?pageId=52598376

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EOSC Order management to support the users' orders. Moreover, AGORA will play an important role in the onboarding process for the DICE services by integrating with the EOSC Platform. The EUDAT Monitoring, and EUDAT Accounting service integration will support the resource provisioning of the services to the EOSC ecosystem based on the requirements set.

The interoperability guidelines will evolve (updates will follow in related projects like EOSC Future) and will be used as baseline for the interoperability specifications so as to guide the CDI Operation and Collaboration Tools when designing and implementing the architectural plan.

In the following sections, the work achieved until now about Interoperability / integration in the EOSC environment from various projects will be presented along with the corresponding CDI Operation and Collaboration tools and their functions.

2.2.2 EOSC Federated AAI

B2ACCESS was part of the EOSC-Hub project and participated in the creation of technical specifications and interoperability guidelines for the AAI service[11]. In these guidelines it was agreed to follow the AARC blueprint architecture for research infrastructure AAIs. In this architecture, the AAI is a proxy Identity Provider (IdP) which allows user authentication with a set of upstream IdPs. This lowers the barriers for users to use services from a research infrastructure already known by another one. Beside the architecture, the interoperability guidelines contain a set of AARC guidelines which was agreed to and shall harmonize the attribute exchange between the services, and creates a reliable set of attributes which are available to the services. The contained policy guidelines lowers the barriers for users because they need only to accept the policies at the first AAI where they enter the EOSC AAI federation and do not repeat this on every further AAI they pass on the way to access a service. The team is also monitoring the final report on the EOSC Authentication and Authorization Infrastructure (AAI)[12], produced by the EOSC AAI Task Force (TF) released by the EOSC Architecture Working Group. Members of the team have also applied to the AAI Architecture Working Group.

B2ACCESS - Authentication and authorisation services

B2ACCESS is EUDAT's Authentication and Authorization Infrastructure (AAI). It is based on Unity Identity Management (IdM) and follows the AARC blueprint architecture[13] for research infrastructure AAIs. It offers the users a wide variety of authentication mechanisms and protocols. B2ACCESS participates in the SAML-based interfederation service EduGAIN, which allows users from all over the world to authenticate with the accounts of their home organisation. Beside of this, B2ACCESS is connected to social IdPs like Google or Facebook and author IdPs like ORCID using OAuth2/OIDC. Additionally, it offers authentication with X.509 certificates. For users, who have none of these accounts or do not want to use them for authentication at EUDAT services, B2ACCESS offers local accounts as well. The user-facing and some of the EUDAT services are connected to B2ACCESS using SAML and OAuth2/OIDC protocols. B2ACCESS can translate the authentication between those protocols, so users are not limited in the usage of services by the type of authentication they use.

[11] https://wiki.eosc-hub.eu/display/EOSCDOC/AAI

[12] EOSC Authentication and Authorization Infrastructure (AAI) Report from the EOSC Executive Board Working Group (WG) Architecture AAI Task Force (TF)
https://op.europa.eu/en/publication-detail/-/publication/d1bc3702-61e5-11eb-aeb5-01aa75ed71a1/language-en/format-PDF/source-188566729

[13] AARC blueprint architecture - https://aarc-project.eu/architecture/

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In the past B2ACCESS was already connected to EGI CheckIn, GEANT eduTEAMS and Indigo IAM, so services behind these AAIs can be used with authentication through B2ACCESS and EUDAT services can be used by users who authenticated by one of those AAIs.

Beside the account management of single users, B2ACCESS offers the management of research groups/communities who do not have the possibilities on other infrastructures. For this, a dedicated view is usable to create and maintain the group structure including subgroups and inviting or deleting group members. The membership information, which might be used for authorisation, is released in the common attribute set of each user.

2.2.3 Helpdesk

The EOSC Helpdesk interoperability guidelines are published in: "Technical specifications Federation Services Helpdesk" (https://wiki.eosc-hub.eu/display/EOSCDOC/Helpdesk). The document describes three possible integration methods for a generic Helpdesk with the EOSC Helpdesk service:

1. Direct usage, for services which have no helpdesk system and want to adopt the EOSC one;
2. Ticket redirection, for services with a fully independent Helpdesk tool, which need EOSC helpdesk to forward the tickets to their system; and
3. Full Integration, for services with a fully interoperable Helpdesk service, able to synchronize the information of the EOSC ticketing system with its own.

A service provider can decide the Helpdesk integration method with EOSC during the on-boarding phase. However, the EUDAT Helpdesk has been one of the EOSC-hub demonstrators for the fully integrated method.

An interface was developed during the EOSC-hub project to provide the connection between the Core service and the EUDAT Helpdesk. The protocol adopted follows the SOAP standard framework. The structure and the semantic of the XML messages interchanged by the EOSC and the integrated ticketing systems is published in the wiki page: https://wiki.egi.eu/wiki/GGUS:SOAP_Interface_FAQ.

The synchronization of the two ticketing systems has been proven to work during the EOSC-hub project. Any evolution of the EOSC Helpdesk service affecting the API connecting the services has to be followed in order to maintain the full functionality for the users, and keep the fulfilment of the interoperability requirements for the EOSC services.

EUDAT CDI Helpdesk

The EUDAT CDI Helpdesk is a service based on the Request Tracker (RT) ticketing system software.

The higher level architecture of the current EUDAT service is represented in the graph below.

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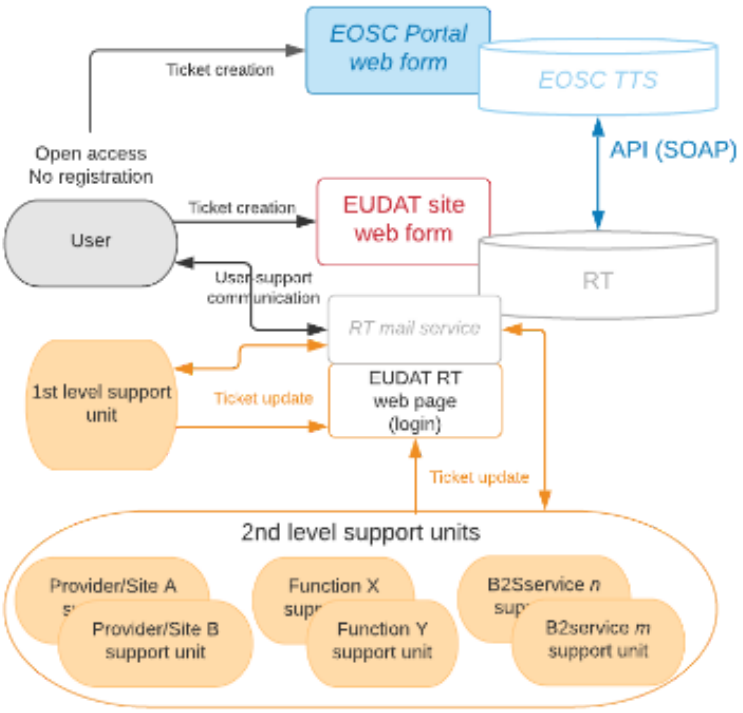

User interaction with the EUDAT Helpdesk. There are three possible ways to create a ticket for reporting an issue, asking for support or requesting a service.

- A generic user, without need of registration, can fill the form with the request at the EUDAT site web form (https://eudat.eu/contact-support-request). The form submission automatically creates an entry in the EUDAT RT system.
- The system is directly accessible from the web page https://helpdesk.eudat.eu/ (login required) by registered members of EUDAT Support Units, and it allows the registered users to create new tickets.
- The EOSC Platform allows users to create tickets for EUDAT services from the portal web form: https://eosc-portal.eu/helpdesk. The integration of the two TTSs (Trouble Ticketing System) permits to create new tickets and synchronize the status of EUDAT tickets registered in the EOSC systems through the API interface.

User and Support communications All communications between the support members and the user are through the email system of the RT TTS. The email communication is direct between user and support, and the content of the mails is saved in the ticket history.

The users support organization is based on support units. The first level support unit members receive the notification of a new ticket created in the system by email, to promptly revise the ticket content and assign the ticket to the more proper second level support unit. Second level support units are organized in subgroups specifically addressing issues regarding a provider site, a specific EUDAT service or function. A third level of support is formed by service developers. The internal organization follows the FitSM standard, with standard procedures and responsibilities clearly defined to guarantee the quality of the service.

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2.2.4 Marketplace - Catalogue

Marketplace

EOSC marketplace is where users are searching, finding and requesting services. The searching and finding rely on the onboarding of the services in the EOSC catalogue as described below, while the request of the service is managed by the ordering process. How the orders are being managed by EOSC and the service providers is set by the providers in the onboarding phase:

- open access: the user is redirected to the service web page where the service can be used without authorisation from the provider
- provider managed: the provider is directly taking care of the requests which are forwarded to the indicated address
- EOSC managed: the requests are checked by the EOSC order management team which clarifies questions or asks for missing information and then forwards the requests to the provider(s).

In DICE all three types of services will be onboarded and the requests will be managed accordingly. For the third category of services and as much as possible for the second one the requests are registered and managed via the Data Project Management Tool (DPMT).

Data Project Management Tool (DPMT)

DPMT (https://dp.eudat.eu) is EUDAT's coordination tool. Information about providers and customers as well as the projects that they are engaged in are documented in DPMT. EUDAT is currently running services, service components and resources provided through them are registered with the DPMT. DPMT is a web-based portal application designed to allow new and existing data projects to be enabled, managed and monitored with the help of the partners of the EUDAT CDI. Machine agents can gather information about all EUDAT services, service components and resources through an API that is compatible with the GOCDB API (see above). A central deployment of the DPMT serves the entire EUDAT CDI reducing the maintenance costs. Through multiple, taylormade interfaces it supports easy and effective interoperability with EOSC's operational tools.

EOSC Catalogue

The EOSC Platform aims to become a key component of the European Open Science Cloud (EOSC) by providing an access point for resources for Europe's research sector. It is composed of two main components: the Marketplace (Demand - End User Portal) and the Providers Portal. The EOSC Platform is build upon specifications that define common data models for EOSC entities (Providers, Resources, etc), referred as the EOSC Profiles[14].

DICE operates its own Service Portfolio Management Tool (Agora) which is based upon the EOSC Profiles as well. At the time of writing, the EOSC Enhance Project, which is currently responsible for the operation of the EOSC Platform, is working to produce a preliminary process in order to integrate regional or thematic portals such as Agora with the central EOSC Platform. This process assumes that each associated portal adheres to the Rules of Participation[15] and has in place similar processes for the validation of Providers and Resource Profiles.

[14] https://eosc-portal.eu/providers-documentation
[15] https://op.europa.eu/s/pemm

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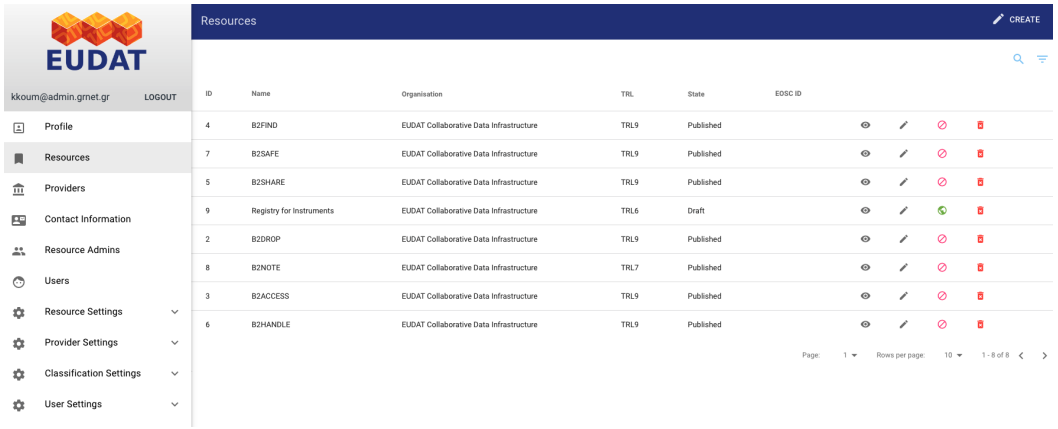
AGORA / Service Portfolio Management Tool (SPMT)

Agora (https://eudat.agora.grnet.gr/) is the service portfolio management tool (SPMT) of the project which includes standardized information based on the EOSC profiles 3.0 about the providers and the resources available from this project. Agora is a web application created with Django framework, it uses a mysql database and has a public API that facilitates the data feed for extensions such as agora-catalogue or agora-metrics. Agora allows Provider administrators to enter the necessary information (e.g. classification, availability, maturity, policies, management, dependencies etc) in order to describe their organisation. Similarly resource administrators enter into Agora the corresponding information for their services. The portfolio managers curate these descriptions according to the EOSC Rules of Participation and validate the Resources to be published either to DICE Catalogue or to the EOSC Platform.

Agora plays an important role in the onboarding process for DICE as it enables the following processes

- Resource Admins are able to describe their Resources according to Profiles 3.0 and to submit them for Validation.
- Provider Admins are able to describe their organisations according to Profiles 3.0 and to submit and curate Resource profiles for the services/resources of their organisation.
- Portfolio Managers are able to validate Resource and Provider Profiles and then publish them either to DICE catalogue, EUDAT catalogue or EOSC Platform.



2.2.5 Monitoring and Accounting

Monitoring

As already mentioned, to support the seamless operation of services in the future European Open Science Cloud, EOSC-hub has proposed a number of technical specifications and interoperability guidelines covering both common and federation services. Among these guidelines, a guideline related to monitoring was created (https://wiki.eosc-hub.eu/display/EOSCDOC/Monitoring). The monitoring specification details the main features, the high-level architecture and the deployment models of the service in EOSC and defines interoperability guidelines that enable various integration paths to allow any EOSC service provider to use the service.

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The interoperability document describes the high-level service architecture for an EOSC Monitoring service and presents the main integration and usage use cases for monitoring in EOSC. It proposes interfaces as guidelines to be followed to achieve the interoperability between monitoring systems in EOSC for three envisaged use cases: (1) combine Results of one or more infrastructures in EOSC in a unified UI, (2) add a Service Provider/Infrastructure to EOSC Monitoring and (3) Third-party services exploiting EOSC Monitoring data. The interoperability guidelines will be updated by the EOSC Future project and other related projects in the EOSC ecosystem.

EUDAT Monitoring

The EUDAT CDI Monitoring service (https://avail.eudat.eu) is based on ARGO Monitoring and is an infrastructure availability/reliability monitoring service designed for Service Level Monitoring, for medium and large electronic infrastructures.

The Monitoring Service monitors services by emulating typical user scenarios which allows them to infer the quality of service the actual user gets. It mimic's the actual end user behaviour without requiring special privileges or special configurations from the service provider side. As a result it offers near real-time status updates which allow both end-users and site admins to have an overview of the service offered at any given point in time. The major objective of the monitoring system is to quickly identify and correlate problems before they affect end-users and ultimately the productivity of the services, the infrastructure and finally the organization.

It monitors the status, availability and reliability of services provided by electronic infrastructures with moderate to high complexity. It is a flexible and scalable framework for monitoring status, availability and reliability of services provided by infrastructures with medium to high complexity. It can generate multiple reports using customer defined profiles (e.g. for SLA management, operations etc.) and has built in multi-tenant support in the core framework. It supports flexible deployment models and its modular design enables the monitoring service to integrate with external systems (such as CMDBs, Service Catalogues etc.). During the report generation, the monitoring service can take into account custom factors such as the importance of a specific service endpoint, scheduled or unscheduled downtimes etc. It relies on a modular architecture as shown in Figure below.

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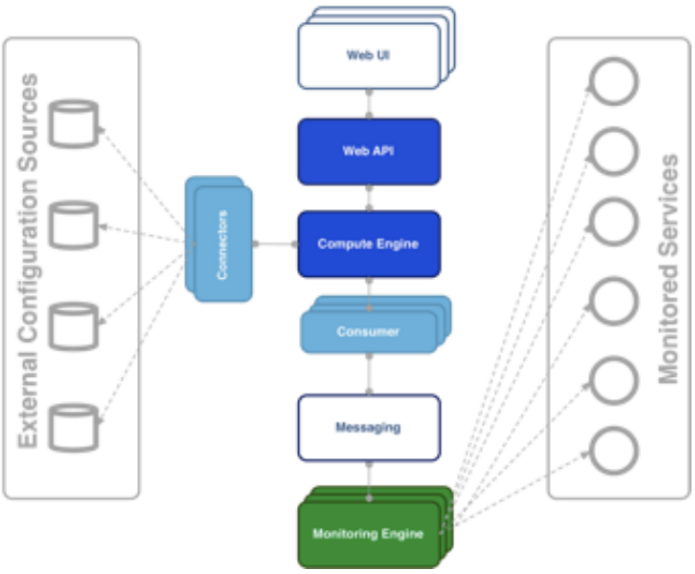

By embracing a modular, pluggable architecture, ARGO Monitoring can easily support a wide range of integrations and be part of another architecture (System of Systems). ARGO monitoring follows the state of the art as is defined in EOSC association working groups and is planning to have close collaboration with EOSC Future which just started. ARGO Monitoring will maintain compatibility with the developments of the EOSC Monitoring Interoperability Framework and the evolution-development of the EOSC Ecosystem in general.

Accounting

The EUDAT accounting (ACCT) is the service for collecting information about the usage of resources and services (this can be the number of data objects, the used volume of a storage or the number of users that are registered on a service). The accounting system comprises the central database server (https://accounting.eudat.eu) that periodically receives accounting records from distributed accounting agents that collect the metrics from the resources. Each accounting record has a unique resource identifier that is issued by the DPMT when a new resource is registered. Compute, storage and other resource metrics can be accounted for via specific accounting agents that operate on installations that are hosting the resources.

The accounting service is designed to be simple, generic and flexible. Any set of key/value pairs can be submitted as a payload of an accounting record from any resource.

The interoperability document[16] describes the high-level service architecture for an EOSC Accounting service and presents the main integration and usage use cases. It proposes interfaces as guidelines to be followed to achieve interoperability. This is the first document describing the process. The interoperability guidelines will be updated by the EOSC Future project and other related projects in the EOSC ecosystem.

[16] EOSC Technical specification document https://wiki.eosc-hub.eu/display/EOSCDOC/Accounting

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2.2.6 Other services of the federated core

This Work package also deals with all supportive operational and collaborative tools that help onboard services based on technology trends and technologies with integration patterns that are based on events and asynchronous messaging and with technologies that support the continuous delivery of the service.

The Messaging service will try to collect relevant data models, and metadata and take the role of a single point of reference when needed. GITLAB, SVMON, CDI repository are the main CDI services that facilitate the management of software projects and delivery cycles for the on-boarded services. These tools will support the internal integration of all DICE services. They will then be validated and be prepared to on-board on EOSC.

Messaging

The ARGO Messaging Service (AMS) is a Publish/Subscribe Service, which implements the Google PubSub protocol. Instead of focusing on a single Messaging API specification for handling the logic of publishing/subscribing to the broker network the API focuses on creating nodes of Publishers and Subscribers as a Service. It provides an HTTP API that enables Users/Systems to implement message oriented service using the Publish/Subscribe Model over plain HTTP.

The ARGO Messaging Service could play a key role in this new ecosystem by filling the gap to the end to end interconnection between services, enforcing the adoption of common standards and becoming the main transport layer between CDI Services and the EOSC ecosystem.

The caching mechanism that it supports in accordance with the pull/push functionality with extended features can easily be a solution for services that need to exchange information. The AMS pull/push functionality may easily support the automatic collection and exchange of information related to services (ex. service updates). At the same time, the Schema Support, as an on demand mechanism that enables the definition of the expected payload schema, the definition of the expected set of attributes and values and the validation for each message could enable the definition of validations or sanitizations on the data exchanged with the EOSC-Core services.

Gitlab

GitLab is a web-based platform, operated under the open-source license which provides an integrated environment for software development including Git-repository, issue tracking system, wiki, continuous integration module etc. GitLab is used as an integrated solution for a full software development cycle and provides rich APIs for integration with other services. Fully automated workflows for software testing and deployment implemented in GitLab can be used for efficient release and deployment management for EOSC-hub distributed services.

Federated access to the GitLab deployed at KIT (https://gitlab.eudat.eu) is provided by the EUDAT AAI solution B2ACCESS, thus GitLab resources and Git-repositories are available for many research communities and scientific organisations.

Docker Registry

Docker Registry is an open source server-side application for storing and distributing Docker images. Providing a self-hosted Docker Registry allows project members to control where

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Docker images are stored, customize the distribution pipeline, and integrate Docker images with the current setup of Gitlab and Mattermost. Independence from Dockerhub, the *de facto* standard storage location for Docker images, enables compliance with general European data protection legislation.

The Docker Registry is hosted at KIT (available at https://containers.eudat.eu) and can be used via token-based authentication generated by the Gitlab instance mentioned above. Currently, the service is running in a test environment and access is limited to a closed group of internal users. The combination of Gitlab and Docker Registry allows users to set up their own Continuous Integration and Continuous Delivery routines which run entirely on European servers.

Mattermost

Mattermost is an open source self-hosted communication service, which enables team communication, messaging, data sharing. It's fully integrated with GitLab and facilitates the software development cycle.

Mattermost service is hosted by KIT (https://chat.eudat.eu) and can be accessed via EUDAT B2ACCESS AAI. It provides one-to-one or group messaging, unlimited search history. Mattermost offers a wide array of integrations based on the access to Mattermost server REST APIs.

SVMON

The software version monitoring framework SVMON collects the information on software versions of EUDAT services and their components installed in EUDAT CDI. The framework allows the monitoring of the following information:

- Software versions of the service or service component,
- Operating system flavour and version of the endpoint where the service or service component is running,
- Any service software version installed on the endpoint if needed.

The software version monitoring framework consists of the web-based central portal which collects the information on software versions, stores it in the database and displays it in a compact overview table and the agent software running on the service instance.

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3 Architecture plan on the integration of the CDI Operation and Collaboration Tools in EOSC

3.1 Introduction

This WP focuses on the interconnection and data exchange between the CDI Operation and Collaboration Tools and the EOSC-Core services. There's more than one approach for integrating applications and of course a number of criteria that must be taken under consideration.

In order to support the integration (technical interoperability) with the EOSC-Core services, a number of common integration concepts, styles or patterns should be identified like a) the well-defined API style for services that support it and/or b) the messaging integration style where structured data needs to be exchanged.

Apart from the integration concept which totally depends on the methods supported by the EOSC-core service the data-format should be also checked (semantic interoperability). The services must agree on the format of the data they exchange, or must have an intermediate translator to unify applications that insist on different data formats.

In the preparatory phase of the project, as well as in these initial months, lots of effort was made on the identification of the integrations needed. The relevant policies and rules of participation for the services that need to be followed were acknowledged as described in the previous sections. This step represents the basics for the additional detailed work needed to be done in the next integration phases.

External dependencies though like other projects (EOSC Future) prevented the completion of all the integration plans needed, and this report will have to be reviewed in the next deliverable. The requirements that will come from the work of these projects will help us update/ follow / finalise the required integration steps with EOSC-Core.

3.2 Preparation of services to integrate with EOSC

The main focus of the DICE consortium is to provide capacity in the realm of data services to the EOSC. All services provided via DICE will be offered through the EOSC Platform and interoperable with EOSC-Core via a lean interoperability layer to allow efficient resource provisioning from the very beginning of the project. These services will be integrated with the EOSC ones as part of this work package activities by integrating the CDI Operation and Collaboration Tools. In order to ensure that services are accessible under VA immediately at project's starttime and that new service requests can be met from the beginning, DICE relies on the coordinated operations and established support tools of the EUDAT CDI. These have been maintained and further integrated in the course of the EOSC-hub project.

The different installations of the DICE consortium are provided by the different DICE providers. This requires the coordinated management of the DICE service portfolio, the coordination of DICE service and resource providers, consistent support and the access requests and service orders have to be dispatched to the DICE providers.

These different types of actions that are mainly done by CDI Operation and Collaboration Tools have been already described in the previous Chapter and are depicted in the image below. DICE services might use, connect to the following services whenever possible.

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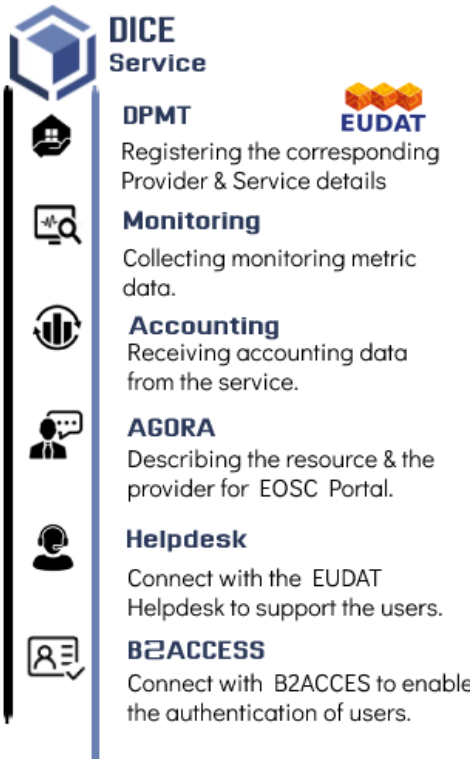

DPMT: The EUDAT Data Project Management Tool, the registry for providers, services, pledged and allocated resources, for customers and their projects (service orders), and for the management of scheduled downtimes.

Monitoring: EUDAT service for monitoring status and performance data, the availability and reliability of the services.

Accounting (ACCT): The EUDAT accounting service for collecting information about the usage of resources and services (this can be the number of data objects, the used volume of a storage or the number of users that are registered on a service).

AGORA: The EUDAT Service Portfolio Management Tool (Agora) that is used to document and to track the status of (DICE) service feature requests, maintenance and further developments and to publish the service to EOSC catalogue.

Whilst the previous services are mandatory there are also two integration services that are offered and can be used when needed and is applicable by all DICE services to support their users in the following two ways:

- **EUDAT Helpdesk**: The central point where Users can ask for technical support, training and advice for DICE services.
- **B2ACCESS**: Enable authentication and authorization of users

By the time DICE providers have followed the required steps , all these user-facing data services will be ready to be onboarded to EOSC and make them available via the EOSC Platform. At the same time the resource provisioning through the EOSC Platform (service onboarding, resource accounting, monitoring) will automatically be supported.

3.3 Status of the integration with EOSC

In the following sections, you may find information about the work done until the time of writing and the status of integration with respect to the work planned in DICE for each of the Operation and Collaboration tools is The status of the work in progress in DICE is also depicted in the following figure while associating the corresponding EOSC-Core services.

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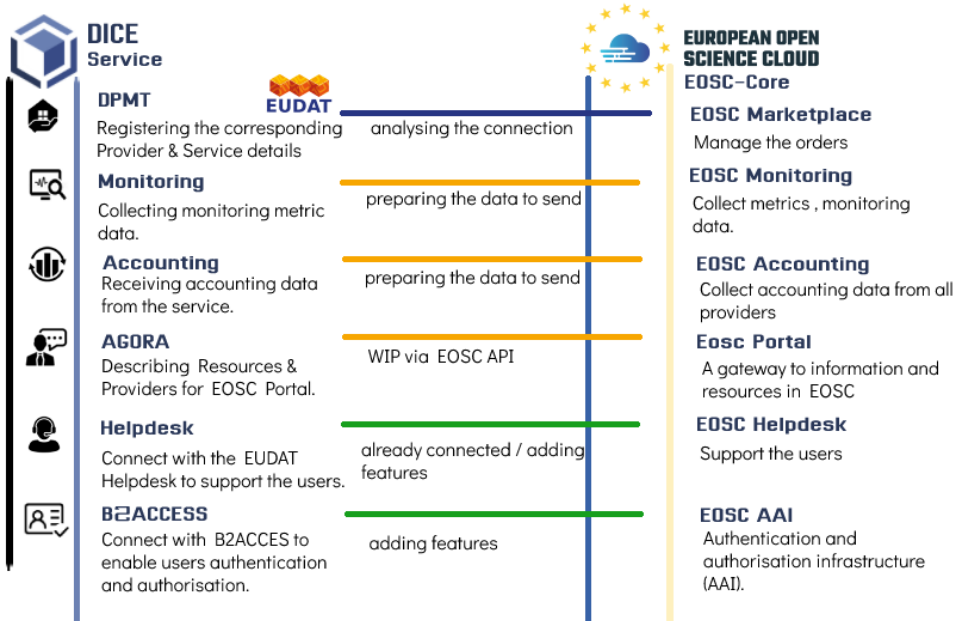

As it is mentioned in each tool, although the integration work has already started we are reporting on some blocking parameters. In fact, this integration work is a moving target since the EOSC ecosystem is constantly evolving, and it should be adapted in an agile manner - through a set of iterative steps. We believe that the plan of the integration will be finalised in the next deliverable based on the work from other projects (like EOSC Future, EOSC-Enhance).

3.3.1 B2ACCESS - Authentication and authorisation service

Beside the maintenance of the connection to EOSC Platform and other research infrastructures, participating EOSC, which was enabled in previous projects, we work on the connection to further research infrastructures and communities. We will follow the developments of the EOSC AAI in the EOSC future project and adjust the connection and our AAI service to the outcome from this project. Additionally, we are going to review new and renewed AARC guidelines to harmonise the user and user data exchange with other research infrastructures and services providers in EOSC. Although the interconnection and data exchange with other tools and EOSC service is the main focus, we want to improve the usability to users with new features and lower barriers.

Because of external dependencies we created generic tasks which will be extended by concrete subtasks if they come up. The tasks are:

- **B2ACCESS enhancement:** general enhancement of the service itself. Based on user feedback, gathered information from operation and upcoming changes about optimising and extending the integration with other AAIs and services.
- **Update requested attributes to R&S2 set:** The recommended set of requested attributes, the Research and Scholarship (R&S) by REFEDS, is under revision at the moment and it is going to be changed at the identifier level. If the new set is published we will adjust the requested attributes.
- **Join EOSC AAI federation:** At the moment B2ACCESS is already part of the mesh created in the EOSC-Hub project. Within the EOSC Architecture working group AAI a federation was planned. B2ACCESS will participate in the planned EOSC AAI federation.

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For this the start of the AAI federation and the publication of the integration flow is needed.

- **General update of supported guidelines:** B2ACCESS implements a set of AARC, wise or other guidelines for operating an AAI and interacting with other AAIs. Those guidelines are continuously reviewed and new guidelines come up. If those guidelines are published and they are relevant to B2ACCESS, they will be implemented in B2ACCESS.

Status: At the moment, on most tasks we have external blocking factors. The R&S2 set is not yet published. The EOSC AAI federation is still in preparation and has not yet started. AARC guidelines are in preparation right now, but not yet finished. Some general enhancements are in preparation. At the moment, we are working on huge improvements of the group management which will reduce the work of group administrators to invite users and manage their groups. Another enhancement we are working on is the support of different singing methods in the SAML exchange messages.

3.3.2 Agora - Service Portfolio Management Tool

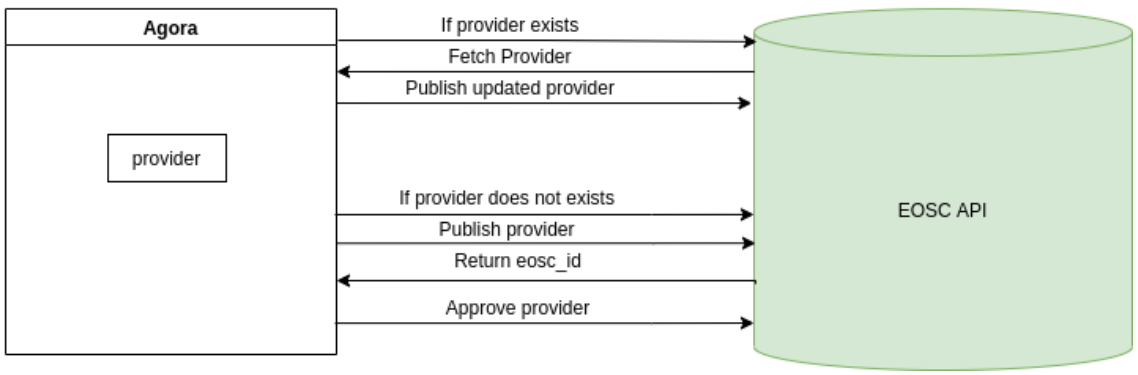
In collaboration with the EOSC Enhance project, that is currently developing the EOSC Platform, GRNET started the integration of the Agora catalogue with the EOSC Platform. This is a **work in progress.** Our Main goal in this process is to be able to Onboard to EOSC Platform multiple providers and resources/services registered in AGORA and to synchronise controlled vocabularies between the portals. In this process the following basic assumptions apply:

- The EOSC Platform provides a unique ID (EOSC_ID) for Providers Profiles which is used as a reference for all actions.
- The EOSC Platform provides a unique ID (EOSC_ID) for Resource Profiles which is used as a reference for all actions.
- The EOSC Platform is the authoritative source for all the controlled vocabularies.
- The EOSC Platform and Agora use the same model which is EOSC Profiles 3.0.

In order to integrate with the EOSC Platform Agora uses the API offered by the EOSC Platform and implements the workflows below.

Onboard Provider Profiles Workflow

The image below demonstrates the workflow to onboard a provider in the EOSC Platform via the EOSC API.



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1. In order to onboard a **Providers Profile** to EOSC, one needs to *Check* if the provider is onboarded on the EOSC Portal from a different source. If it exists, AGORA will fetch its contents and the Provider Administrator may update them. if it does not exist the Provider Administrator creates a Provider profile in Agora and fills in the necessary information;

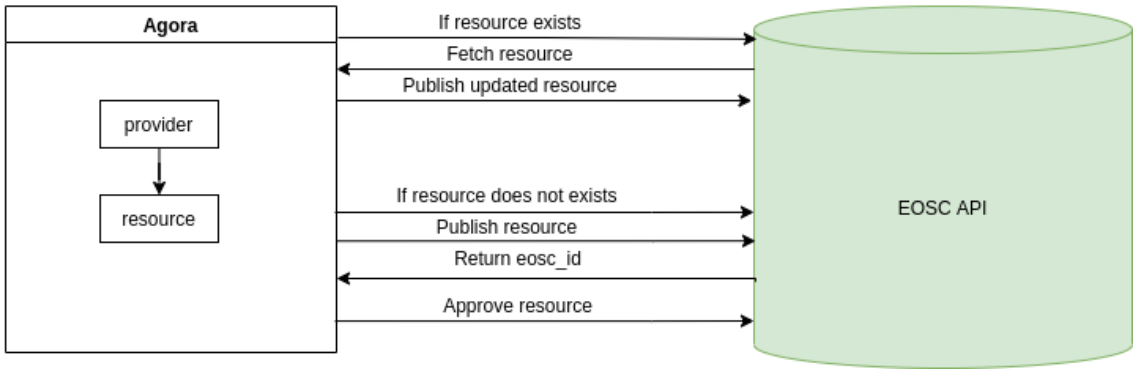
2. Once the providers profile is ready ask the Portfolio Manager to *Validate* it and *Publish* it to EOSC Platform;

3. Once the profile is valid the Portfolio Managers *Publishes* it into the EOSC Platform and the publication date and EOSC_ID is recorded in the profile.

Status: We are currently working on the publishing of Providers profiles that do not exist in the EOSC Portal. We are waiting for the system-to-system authentication to be completed from EOSC API and the agreement between DICE and EOSC Portal.

Onboard Resource Profiles Workflow

The image below demonstrates the workflow to onboard a resource in the EOSC Platform via the EOSC API.



1. In order to onboard a **Resource Profile** to EOSC the corresponding Provider profile must be onboarded already.

2. *Check* if the resource is onboarded on the EOSC Portal from a different source. If it exists, AGORA will fetch its contents and the Resource Administrator may update them. if it does not exist the Resource Administrator creates a Resource profile in AGORA and fills in the necessary information.

3. Once the resource profile is ready ask the Portfolio Manager to *Validate* it and publish it to EOSC Platform.

4. Once the profile is valid the Portfolio Managers *Publishes* it into the EOSC Platform and the publication date and EOSC_ID is recorded in the profile.

Status: We are currently working on the publishing of Resources profiles that do not exist in the EOSC-Portal. This integration is nearly ready in the development instance. We are waiting for the system-to-system authentication to be completed from EOSC API and the agreement between DICE and EOSC Portal.

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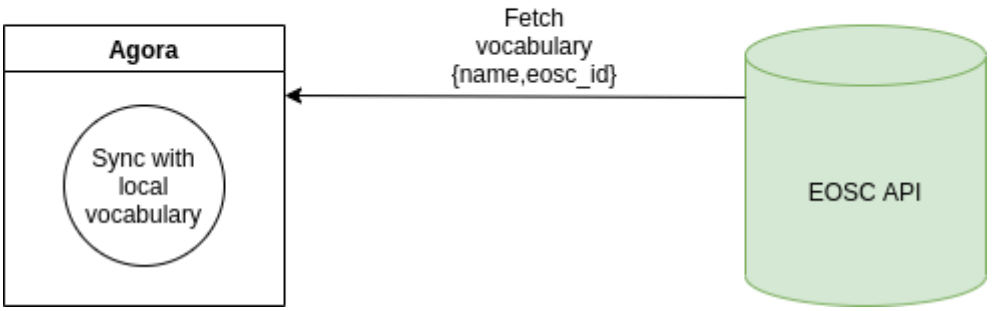
Synchronization of controlled Vocabularies

The main issue we faced at the beginning of the integration was the vocabularies. Both AGORA and EOSC API started using the vocabularies defined in the Profile 3.0. During the evolution and development of the EOSC API there were some changes (additions, removals) of the entries. That was an obstacle to integrating the AGORA instance with the EOSC Platform. So we had to use the same vocabulary.



The steps followed are described:

1. In order to be able to integrate with EOSC API we needed to use the same vocabulary.
2. Check if an entry in agora vocabulary matches a specific word from the EOSC vocabulary. For example a standard MERIL category.
3. Once we find the matching entry from AGORA we get it's eosc_id from the vocabulary and append it to the entry model. As a result we saved the eosc_id in the object of the vocabulary entry as follows {name: <Vocabulary entry>, eosc_id: <entry_id>}
4. After the synchronisation we sanitized the data by removing duplicates and entries without an eosc_id.

Status: One of the main issues we are currently facing is the authorisation of the AGORA instance with the EOSC API. Due to the lack of agreed authorisation policies that define who has the authority to administer each Resource or Providers profiles the current implementation allows only to onboard Providers and Resources that are not onboarded already from a different source. One more issue is the need for an agreement between DICE and the EOSC Platform Operator which will describe who has the authority on which Resource and Providers profiles so that the appropriate access rights are given to AGORA to manage them. DICE team is working on having this included in the collaboration agreement under preparation with the EOSC Future project.

3.3.3 Helpdesk, user support

EOSC Platform Users can ask for technical support, training and advice for DICE services, including the operations related to the data services marketplace and services composition. EUDAT Helpdesk (RT) is a mature service and the integration will be maintained along EOSC integration guidelines as the EOSC Platform evolves. A model will also be designed for EOSC users to ask for help and receive technical support and advice for (composed) data services.

Not all services provided through DICE are already supported via the EUDAT Helpdesk and thus appropriate support units must be defined. The effectiveness of the solution will be essential to guarantee the quality and the accessibility of the EOSC services and the growth of the EOSC users' community.

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- ***Integration with EOSC Helpdesk / maintenance***

At the moment EUDAT Helpdesk is fully integrated with the xGUS ticketing system developed in the context of the EOSC-hub project. The helpdesk system integration will be maintained until a new system by the EOSC Future project will be released.
Status: Ongoing
Dependencies: EOSC Future Helpdesk

- ***Integration with EOSC Helpdesk / update***

The connection between the EUDAT helpdesk and the EOSC helpdesk will be updated according to the changes made by EOSC Future. The first step consists of establishing a technical communication channel with the EOSC Helpdesk developers.
Status: EOSC Future contact established. Update of the system: blocked.
Dependencies: EOSC Future Helpdesk update.

- **Integration with EOSC Helpdesk / enhancement**

The Helpdesk service will follow the evolution of the requirements established by EOSC Rules of Participation. It will include actions not only for the EUDAT services, but also the helpdesk service of the DICE services not included in the EUDAT services portfolio.
Status: Enhancement of the system: blocked.
Dependencies: EOSC Rules of Participation update.

- **EUDAT Helpdesk service / update**

We expect an increase in the number of tickets from the DICE and EOSC users in the next months. The EUDAT Helpdesk will be updated to respond to the needs of the project and the user's requests. The support units definition, with the corresponding queues, as well as the technical functionalities will be updated whenever necessary to guarantee the efficient tickets management.
Status: Update of the service: stand-by.
Dependencies: DICE and EOSC users feedback.

3.3.4 DPMT and Marketplace

Order requests coming via the Marketplace are forwarded to the EUDAT helpdesk and then, when checked by the order management team, they are recorded into DPMT. At present, there are no other requirements for further integrations to be needed, but the evolution of the order processing in EOSC Future will be monitored to identify any new opportunity.

3.3.5 ARGO Monitoring

The monitoring service is not integrated with the EOSC Monitoring. As described in the previous chapters it supports and describes the monitoring data in the predefined format as mentioned in the interoperability guidelines. The main tasks that we are currently working are the following.

Monitor the different services in DICE

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In cooperation with WP6 - Operations we are working on guidelines to help the service owners to understand who they can prepare their services to be monitored by the Monitoring Service. In service monitoring, we start by checking the health status of the service. Based on the type of the service a few core checks (ex. http, tcp, certificate) are used. Apart from this traditional status monitoring, the monitoring service focuses on monitoring a service from the end users perspective. That means that the services have to be monitored in the same way regardless of who the service providers are and where they are located.

We have to report here that most of the services (EUDAT B2 Services, CDI Operation and Collaboration Tools) are already monitored and other new metrics are going to be added during the project. New service instances (B2SAFE) and new Services offered from partners is a task that we are currently working on.

Status: Ongoing.
Dependencies: None

Prepare the monitoring data

Based on the Interoperability guidelines the main data needed in order to integrate with the EOSC Monitoring are the following:

- **Topology**: The way the services are organised.
- **Metric Data**: metric data comes in the form of avro file and contains timestamped status information about the hostname, service and specific checks (metrics) that are being monitored.
- **Metric Profile**: Services and associated metrics are grouped into profiles that instruct monitoring instances what kind of tests to execute for all and for a given service.
- **Aggregation profile**: This profile defines how monitored items are grouped and form hierarchies.

All these different sources of truth (topology, profiles) are ready but they need to be validated by the latest version of the interoperability guidelines of EOSC Monitoring.

Status: Blocked.
Dependencies: Waiting for EOSC Future to validate the monitoring data to expose.
Expose the monitoring data

One of the main advantages of the CDI Monitoring service is the way it exposes the data it uses. It uses well defined messages and technologies that can easily and quickly support the integration needed.

One of the core components of the monitoring Service is the argo-web-api . It’s implemented as a RESTful HTTP API service. The argo-web-api, is the central source of truth and orchestrator for all components of the argo monitoring system. It provides the Serving Layer of ARGO. It consists of a high performance and scalable datastore and a multi-tenant REST HTTP API, which is the actual source of truth of all other monitoring components.

At the same time the messaging service is another core component the Monitoring service uses to exchange the predefined messages from one component to another.

It is not yet decided which way will be used to integrate with EOSC Monitoring . Either a number of well defined API endpoints will be used to integrate with the EOSC Monitoring or

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the use of messaging service to publish the prerequisite data and forward them to the EOSC Monitoring.

For both solutions the ARGO monitoring service will have to be extended to integrate with the EOSC monitoring. This extension will maintain compatibility with the developments of the EOSC Monitoring Interoperability Framework and the evolution-development of the EOSC Ecosystem in general.

Status: Blocked.
Dependencies: Waiting for EOSC Future to validate the interoperability guidelines and the ways to expose the data.

4 Additional integration for operational tools

4.1 Introduction

Apart from the integration of the CDI Operation and Collaboration tools with EOSC-Core, EUDAT has a number of other supporting tools used in project DICE that could enable the internal integration.

This list contains all the supportive operational and collaborative tools that help onboard services based on technology trends and technologies that are most used for the service development, operations and support. They actually advance the automation, integration and interoperability of the tools supporting the service operations, service development lifecycle and project management.

Messaging is a service based on the idea of one integration style out of many, used for connecting various applications in a loosely coupled, asynchronous manner. It decouples the applications from data transferring, so that applications can concentrate on data and related logic while the messaging system handles the transferring of data.

GitLab as mentioned in Chapter 2, is the web-based platform which provides an integrated environment for a full software development cycle and provides rich APIs for integration with other services.

The software version monitoring framework SVMON collects the information on software versions of service and service components and populates the SVMON database and provides it via API to further services.

Finally, Mattermost collaboration platform has as an initial integration plan the implementation of notifications of any change for all CDI services. The planned integrations described below would facilitate operations and change management in the infrastructure, accurately plan the migrations of the services and allow service providers and users to easily subscribe or unsubscribe to the desired service channels.

4.2 Messaging

The ARGO Messaging Service (AMS) is a real-time messaging service that allows the user to send and receive messages between independent applications. It is implemented as a Publish/Subscribe Service. As already mentioned it can play a key role in this new integration

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ecosystem by filling the gap to the end to end interconnection between services, enforcing the adoption of common standards and becoming the main transport layer between CDI services.

It is actually a messaging service where the senders of messages are decoupled from the receivers of messages. It could be used for both push and pull message delivery. In push delivery, the Messaging Service initiates requests to your subscriber application to deliver messages. In pull delivery, your subscription application initiates requests to the server to retrieve messages.The Messaging service is investigated to play the following roles:

- as a library of common used data (ex. minimal set of values of providers)
- as the main transport layer of data in between the operational tools (ex. send alerts from the monitoring service to mattermost to inform everyone)
- as the main transport layer of data between the CDI Operation and Collaboration tools and the EOSC.

Can act as an abstraction layer so that services can use it to pull and push information to EOSC-Core. At the same time, the caching mechanism that AMS supports in accordance with the pull/push functionality with extended features can easily be a solution for services that need to exchange information. The AMS pull/push functionality may easily support the automatic collection and exchange of information related to services.

In order to support the use of AMS the Messaging Service also maintains a number of extra tools to help third parties to easily use and extend the functionalities of the service:

- **Argo-ams-library**: A simple library to interact with the ARGO Messaging Service.

- **Argo-AuthN**: Argo-authn is an Authentication Service. This service provides the ability to different services to use alternative authentication mechanisms without having to store additional user info or implement new functionalities.The AUTH service holds various information about a service's users, hosts, API urls, etc, and leverages them to provide its functionality.

The initial plans for AMS:

- To use it In the ARGO Monitoring Service for the exchange of data in its components
- Investigating the use of AMS for the exchange of Providers data between DPMT and AGORA (SPMT)
- integration of Other Elements of the federated core like SVMON, Mattermost and Monitoring to exchange information.

4.3 Gitlab

GitLab is the web-based platform which provides an integrated environment for a full software development cycle. The purpose of this internal integration helps us automate not only CI/CD but also the creation of production services used in DICE for development and testing. As the use of these tools push towards more and more automation, the number of errors that used to arise earlier out of the repetitive steps will vanish. This lets developers channel their time and efforts towards more critical tasks like product development as there aren't many code changes to make now. Another distinguished advantage of having CI/CD in your pipeline is that it enhances test reliability. As the system gets more fault sensitive, more accurate tests can be conducted, delivering full-proof results and insights.

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The GitLab service hosted at KIT is currently running as a production service and delivers the central software repositories for EUDAT software developers as well as it offers repositories for all EOSC related scientific communities and researchers.

The initial plans for GitLab can be summarized as follows:

- Extend currently allocated 100 GB depending on usage.
- Provide VMs at KIT for deployment of runners and increase the number of private runners based on the requests coming from EUDAT CDI developers for EUDAT core services.
- Implement workflows which allow the build, test and deploy projects from Docker images hosted on the EUDAT container registry containers.eudat.eu. Run the CI/CD jobs in Docker containers for the main CDI core services .

4.4 Mattermost

Mattermost is a production service hosted by KIT. The initial integration plans for the service consider the implementation of notifications of any change for all CDI services. This implementation will be performed based on the requirements of WP6 to facilitate distributed operations of the infrastructure and will include the following steps:

- For each service a dedicated channel will be created
- Mattermost will integrate different already available notification methods like rss feeds for services, e-mail alerts etc.

We also plan as next step the integration of Mattermost with ARGO monitoring system via messaging service which will allow the ARGO system to send the alerts to the service channels in Mattermost.

The planned integrations described above would facilitate operations and change management in the infrastructure, accurately plan the migrations of the distributed services and allow service providers and users to easily subscribe or unsubscribe to the desired service channels.

4.5 Containers.eudat.eu

Currently the Docker registry is running in a test environment. After thorough performance and scalability tests the registry will be integrated with the gitlab production instance and will become available for the GitLab users and software developers.

The registry will be connected to the KIT Large Scale Data Facility (LSDF), a central KIT storage system for research data and data-intensive scientific projects. The initial planned storage allocation will be 5 TB with possibility for extension depending on the usage trends.

4.6 SVMON

The current plans for SVMON are focused on three main areas:

- Further enhancement of frontend of the service
- Further enhancement of backend of the service
- Connection of the further services and their components with SVMON.

Currently SVMON frontend is being migrated from Angular to React.js and from Angular to React.js. Several performance improvements will take effect in the frontend and also support

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for mobile devices will take effect. Although the main source of topology for SVMON is DPMT, we plan also to enreach the front-end dashboard and enable manual update of services, components with additional information, when this is needed. It should be stressed that the DPMT data objects will not be updated or modified in SVMON and the integrity of the information will be kept. The dashboards in the SVMON will be improved to provide different views on the service and components, enabling filtering and sorting by different key parameters.

The backend will be migrated from Java to Node.js framework. The migration has been started according to the roadmap of the service. The database architecture will be updated according to the scheme proposed[17]. New API Version will be released to add api Swagger Documentation.

The SVMON will be integrated with the Argo Messaging System (AMS) to enable easy integration with other systems which would require the information provided by SVMON.

The SVMON client will be enhanced to include more supported services, simplify its installation at the target nodes across the infrastructure. The coverage of the SVMON will be extended.

We also consider the possibility of integration of SVMON with the EUDAT accounting client, but there are no clear plans so far or any agreed plans to proceed. The results of this discussion and feasibility of this integration will be provided in further deliverables.

[17] http://zenodo.org/record/4040865

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5 Conclusions

The Data Infrastructure Capacities for EOSC (DICE) consortium brings together a network of computing and data centres, and research infrastructures for the purpose to enable a European storage and data management infrastructure for EOSC, providing generic services and building blocks to store, find, access and process data in a consistent and persistent way.

CDI Operation and Collaboration Tools are a set of services that cover the whole life-cycle of services, from planning to delivery and include a set of services that implement common functions with EOSC-Core services and that need to be fully compatible with the EOSC. All the CDI Operation and Collaboration Tools have been designed to be compatible with the EOSC-Core of the Minimum Viable EOSC. The goal of the Minimum Viable EOSC is to enable the federation of the existing and planned research data infrastructures. The main functions of the EOSC-core include means to discover, share, access, and reuse data and services.

DICE via CDI Operation and Collaboration Tools offers a set of services that help Service Providers enhance their services from the operational perspective. The services can, for example, simplify how users access the service federated authentication (AAI), improve service reliability (monitoring), provide details on capacity consumption by users (accounting), or simplify user interaction via a helpdesk (helpdesk).

The CDI Operation and Collaboration Tools are fully deployed and the integration for most of them has already begun in the EOSC-hub project and other related projects (like EOSC-Enhance). Although in some of the tools the integration plans are set, most of the integrations are blocked due to the fact that the integration guidelines will be updated within the duration of the EOSC Future which started with a four months delay on the 1/4/2021. The work on the new version of the guidelines is an obstacle to finalising the integration plan at this point but the DICE team will be actively monitoring the evolution of the guidelines and anticipate any possible activity in the integration.

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