



Project Number: 101058432

Start Date of Project:
01/06/2022

Duration: 36 months

Deliverable 3.2

Report in the form of the half-yearly digest on EOSC technical activities following the ETCC

Authors	Ilire Hasani-Mavriqi (TU Graz), Marthe Bierens (TU Graz), Teodor Ivanoaica (EOSC-A), Kaori Otsu (CREAF), Miguel Rey Mazon (TU Graz), Diego Scardaci (EGI)
Contributors	Edith Euan Diaz (EOSC-A), James Tierney (EOSC-A)
Work Package	WP 3 SRIA up-to-date and Technical Development
Reviewed by	Ute Gunsenheimer (EOSC Focus Project Coordinator), Sara Garavelli (EOSC-A Director), Friederike Schröder-Pander (Belnet), Franciska de Jong (CLARIN), EOSC Focus Management Board
Due Date of Deliverable	31/10/2023, M17
Actual Submission Date	22/11/2023, M18
Dissemination Level	PU
Approval Status	Submitted to EC
Version	V1.0

Deliverable Abstract

This deliverable is a report on the technical collaboration with and between Horizon Europe EOSC-related projects. The aim of this deliverable is to demonstrate the cross-project alignment on technical developments (design, architecture, implementation, roadmaps and deliverables) within Horizon Europe EOSC-related projects, as an essential prerequisite for efficient and coherent development of EOSC.

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DOCUMENT LOG

Issue	Date	Comment	Author	ORCID ID
v.1.0	29/092023	Final version	Ilire Hasani-Mavriqi Marthe Bierens Teodor Ivanoaica Kaori Otsu Miguel Rey Mazon Diego Scardaci	https://orcid.org/0000-0003-0758-0805 https://orcid.org/0009-0005-2544-4833 https://orcid.org/0000-0003-0611-6365s https://orcid.org/0000-0001-7835-0949 https://orcid.org/0000-0003-3116-1926 https://orcid.org/0009-0007-7492-3616

TERMINOLOGY

Terminology/Acronym	Definition
CREAF	Centre for Research on Ecology and Forestry Applications
DG RTD	European Commission Directorate-General for Research & Innovation
EC	European Commission
EGI Foundation	EGI: Advanced Computing for Research
EOSC	European Open Science Cloud
EOSC-A	European Open Science Cloud Association
EOSC Partnership	The European Commission's Co-Programmed European Partnership for EOSC
FAIR	Findable, Accessible, Interoperable, Reusable (data)
H2020	Horizon 2020
HE	Horizon Europe
HE EOSC-related projects	Horizon Europe INFRAEOSC and related projects supporting EOSC
INFRAEOSC projects	Destination INFRAEOSC projects within the EU's research and innovation funding programme
MAR	EOSC Partnership Multi-Annual Roadmap
Macro-Roadmap	The Macro-Roadmap for the implementation of EOSC - a visual mapping of the results of EU projects developing EOSC and the in-kind contributions of EOSC Association member organisations.
REA	European Research Executive Agency

SRIA	EOSC Partnership Strategic Research and Innovation Agenda
SRIA Action Areas	SRIA 1.1. Action Areas: Implementation challenges and Boundary Conditions
TF	EOSC-A Task Force
TU Graz	Graz University of Technology

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Executive Summary

The EOSC Focus project's Work Package 3 aims to ensure alignment and cooperation on the technical developments across projects awarded under the Destination INFRAEOSC calls of the Horizon Europe (HE) framework programme. The present deliverable (D3.2) describes the work carried out in EOSC Focus Task 3.2 – “EC-funded EOSC projects and technical developments” – by the EOSC Focus consortium, coordinated by the EOSC Association (EOSC-A). The INFRAEOSC projects are awarded within the context of the European Commission's Co-Programmed European Partnership for EOSC (EOSC Partnership), a Partnership between EOSC-A and the EC that is guided by the objectives of its Strategic Research and Innovation Agenda (SRIA).

In September 2022, the EOSC Association laid out guidelines for collaboration within the EOSC Partnership that have served as the basis for the major initiative of Task 3.2, the Horizon Europe (HE) Technology Group. These guidelines, published as, *Vademecum - A Handbook for Effective Collaboration within the EOSC co-programmed Partnership*, describe the voluntary framework for collaboration between the HE EOSC-related projects and the EOSC Partnership (primarily via EOSC-A's coordination of the EOSC Focus project) within five specific areas of cooperation, including technical developments [R6]. D3.2 - *Report in the form of the half-yearly digest on EOSC technical activities following the ETCC* describes the results of this voluntary collaboration one year after the publication of the *Vademecum*. It addresses the successes and limitations of this collaboration and makes recommendations to overcome the latter.

In service of the alignment and cooperation of the INFRAEOSC and related projects supporting EOSC (collectively referred to hereafter as the HE EOSC-related projects), and in support of the overall objectives of the EOSC Partnership, EOSC Focus established the HE Technology Group to enable the projects to actively engage, collaborate and coordinate not only between one another, but with the larger movements of EOSC-A and the Partnership. The two major activities of this group, aside from monthly meetings, are the EOSC Technical Coordinators' Cockpit (ETCC) and the forthcoming “Winter School” (29 January-01 February 2024).

In the broader picture, the EOSC Association's inclusion of the projects in the 2023 consultation for the EOSC Partnership's Multi-Annual Roadmap (MAR) 2025-2027, chapter 8 of the SRIA, has additionally served as a mechanism for technical alignment.

As described in this deliverable, Task 3.2 is on the path to achieve some critical outcomes. These include structured technical collaborations between some projects and the wide scale cross-pollination between all HE EOSC-related projects, the EOSC-A Task Forces and the EOSC-A Board of Directors that is anticipated in the Winter School. However, a key outcome of Task 3.2 to-date is the observation that the *Vademecum*, the further evolution of the HE Technology Group, and the potential of EOSC Focus to steer true technical collaboration between projects have already begun to run up against their limits. Additional pressure on this voluntary framework will be exerted by the inclusion of the INFRAEOSC projects coming online in 2024.

The legal framework of the EOSC Partnership does include guidance relative to coordination with the INFRAEOSC projects, which are “*expected to participate in concertation activities in the framework of the EOSC Partnership*”¹. This “expectation” has unfortunately proven to be too weak a mechanism for coordination, and has in practice served to exclude the possibility of EOSC Focus and the EOSC Association from actively coordinating the HE EOSC-related projects. This lack of a mandate has in turn created a void in leadership and guidance that threatens the objectives of EOSC, and is complicating the overall implementation of EOSC.

EOSC Focus is nonetheless moving forward with initiatives of support and assistance to enable each project’s success, and by providing them with a powerful platform from which to demonstrate impact and return on investment.

The deliverable (D3.2) begins with an introduction, background information and an overview of the collaboration involving HE EOSC-related projects in the realm of EOSC technical developments (sections 1 and 2). Sections 3 and 4 offer an in-depth overview of the various activities and outcomes resulting from this collaborative framework. The deliverable concludes with lessons learned, identified challenges and opportunities and future plans (section 5).

¹ Quoted text from the project conditions and clauses

1 Introduction

The strength of the EOSC ecosystem lies in its size, the multitude of stakeholders, and its diverse composition. In recent years, significant financial funding from the European Union has played a crucial role in engaging the community, raising essential awareness about EOSC and its objectives, and undoubtedly accelerating EOSC development and implementation.

Numerous projects have received funding from EC programmes, initially in the form of a €350 million investment from Horizon 2020, and currently a planned half a billion euro investment through Horizon Europe’s Destination INFRAEOSC and related calls. The operational landscape for the HE INFRAEOSC projects differs significantly from that of the Horizon 2020 projects. The HE INFRAEOSC projects have been initiated within the context of the EOSC Partnership, and are the financial investment of the European Commission into the Partnership. They are designed to achieve the ambitious objectives of the Partnership which are laid down in the SRIA.

The HE INFRAEOSC projects run in parallel and contribute to the establishment of EOSC in different areas, in some cases advancing the adoption of FAIR data practices, in other cases producing standards, services and tools to support the implementation of a sustainable and federated infrastructure for Open Science. This approach is not only generating a wealth of knowledge and enabling a wide range of stakeholders to participate in the development of EOSC, but has also sparked and sensitised the community's interest in EOSC. Unfortunately, the lack of alignment and coordination of activities between projects that characterised Horizon 2020 EOSC-related projects has bled through to Horizon Europe, despite Partnership. This can be attributed to the fact that there is no formal structure or mandate to facilitate collaboration between projects funded under EC funding programmes. There has never been a central point of contact in place to guide and coordinate EOSC-related projects.

This lack of a coordinated effort was one of the main issues identified by the EOSC Association when, in 2021, it co-signed with the EC the Memorandum of Understanding that established the EOSC Partnership [R2, R7]. In response, the EOSC-A Coordination & Support Action, EOSC Focus, was funded with the purpose, among other tasks, of promoting alignment and collaboration on technical developments undertaken by its fellow HE INFRAEOSC projects.

Capitalising on the fact that all HE projects funded under Destination INFRAEOSC are “*expected to participate in concertation activities in the framework of the EOSC Partnership*”² in order to coordinate and align their activities, the EOSC Association, as coordinator of EOSC Focus, set out to provide a set of guidelines for this concertation of activities. Three months into the EOSC Focus project, the Association, in consultation with DG RTD, DG CNECT and the European Research Executive Agency (REA), published these guidelines as, *Vademecum – A Handbook for Effective Collaboration within the EOSC co-programmed Partnership*. It is on the basis of the Technical Developments area of the *Vademecum* that the HE Technical Group, the EOSC Technical Coordinators’ Cockpit and the Winter School were initiated.

² Quoted text from the project conditions and clauses

However, the Goliath-scale of the massive undertaking that is HE INFRAEOSC does not coincide with the David-scale of EOSC Focus, which in the end was given no mandate for coordination. The language of the co-programmed EOSC Partnership reserves this mandate for the Commission, though EOSC Focus is perhaps the closest the Commission has come to structuring any cross-project coordination. The resulting looseness of the relationship between EOSC Focus and the HE EOSC-related projects has produced a sort of “coalition of the willing” – a voluntary framework that has led to uneven levels of engagement. This leaves the overall objectives of EOSC Focus in a relatively vulnerable position.

While most participants in the HE Technology Group recognise the importance of the collaboration, and the opportunity it gives them to sustainably integrate their technical developments into EOSC, it has proven difficult for the HE EOSC-related projects to prioritise activities external to their specific EC-driven mandates. To accommodate as many projects as possible, this has necessitated that the HE Technology Group function as a looser network than is actually needed for it to achieve all of its worthwhile objectives. A secondary but related concern is that the alignment and cooperation that the HE Technology Group fora have established could be further diluted by the addition of the INFRAEOSC projects coming online in 2024. As the project count continues to rise, the static allocation of resources poses a challenge in maintaining the robustness of alignment and cooperation.

Task 3.2 nonetheless presses on, still managing to achieve results within the constraints of EOSC Focus.

1.1 Vademecum – A Handbook for Effective Collaboration within the EOSC co-programmed Partnership

To collaborate on technical development, the HE Technology Group was established in accordance with the Vademecum. This report describes the results of this voluntary collaboration one year after the publication of the Vademecum. It addresses the successes and limitations of this collaboration and makes recommendations to overcome the latter.

The Vademecum was developed jointly by EOSC-A and EOSC Focus under the guidance and input from the EC’s DG RTD Open Science Unit, with the purpose to effectively align high-level objectives of the EOSC Partnership with current developments at the operational level. First introduced to the HE EOSC-related projects at the coordination meeting organised by the EC on 30 September 2022, the Vademecum outlines specific actions and their underlying rationales across five key areas of cooperation: Governance, Administration, Communication & Stakeholder Management, Impact, and Technical Developments.

To ensure that the outcomes from the projects complement and harmonise with each other, the Vademecum will provide valuable assistance to the projects by [R6, R7]:

- Facilitating the sustainable integration of project results into the EOSC ecosystem;
- Mapping the complementary activities of the projects to prevent duplicated efforts;
- Fostering mutual learning and inspiration among the projects; and
- Maximising the impact of project results through effective communication.

1.2 Technical Developments (as defined in the Vademecum)

The Vademecum describes specific actions to ensure cross-project alignment on technical developments (design, architecture, implementation, roadmaps and deliverables) within HE EOSC-related projects, as an essential prerequisite for efficient and coherent development of EOSC. The actions include:

- Close cooperation through well-established and open communication channels;
- Alignment of the project outcomes with the policy objectives of the EOSC Partnership, so that they can be integrated into future developments;
- EOSC Technical Coordinators' Cockpit meetings; and
- Inclusion of EOSC-A representatives in technical project meetings.

Alignment of technical project results is essential for efficient integration of contributions into the EOSC ecosystem and for clear assessment of the impact of project results on the EOSC landscape. Collaboration between projects is therefore key to efficient EOSC development and to ensuring maximum return on investment for EC funding programs.

Indeed, the need for technical alignment and collaboration between all the initiatives contributing to EOSC clearly emerged during Horizon 2020, which highlighted the need to improve the compatibility between solutions, prevent the development of multiple implementations of similar capabilities, and increase coordination to support scientific use cases, among others.

The subsequent sections provide an overview of the collaboration on EOSC technical developments involving HE EOSC-related projects. This also encompasses a discussion of the activities and outcomes derived from the collaborative framework.

2 Collaborating on EOSC Technical Development

Expanding upon the goals and scope outlined in the Vademecum, which offers a complimentary collaboration framework for the HE EOSC-related projects, the process of collaborating on EOSC Technical Development has been structured into three phases throughout the duration of the EOSC Focus project (see Figure 1):

1. The initial phase of the collaboration on EOSC technical developments is aimed at *mapping developments, activities, and results* by projects into the Framework of EOSC Partnership. This is done by (i) establishing a comprehensive understanding of the status of the HE EOSC-related projects, (ii) identifying the technical challenges they tackle and their Key Exploitable Results and (iii) connecting the technical developments of projects to SRIA challenges. This phase also explores the shared topics and technical challenges faced by projects that would benefit from collaboration.
2. The upcoming phase, which focuses on *planning contributions to address challenges and achieve success*, will identify tangible aspects of technical developments and promote synergies between projects working in overlapping areas. These shared topics and technical challenges have been named Opportunity Areas. Projects collaborating in Opportunity Areas

and operating in related domains, will structurally work towards the jointly agreed outcomes and leverage the synergies. This phase will frame the inter-project collaboration that allows seamless onboarding of future projects (2023 onwards).

- The final phase of the collaboration on EOSC technical developments is about *consolidating technical alignment* and putting into action the results achieved in the Opportunity Areas. The goal is to ensure that collaborative efforts and technical advances increase the potential of the HE EOSC-related projects to deliver sustainable results that benefit the ESOC deployment and thereby maximise project impact. Additionally, it is crucial to acknowledge and consider the insights and feedback gained in this phase in shaping future EOSC planning, particularly with a view to addressing identified gaps in strategies beyond the year 2027.

With more projects from the upcoming INFRAEOSC calls joining (some as early as January 2024), the phases described above can run in parallel.

In the following, we provide an overview of the HE Technology Group, which serves as the principal catalyst for fostering collaboration on EOSC technical developments with HE EOSC-related projects. This group plays a pivotal role in harnessing input from various sources within the EOSC ecosystem, particularly within the EOSC Partnership framework. As illustrated in Figure 1, the HE Technology Group operates at the intersection of diverse activities and developments, ensuring that it effectively incorporates insights and contributions from these different sources to drive the collaborative efforts in EOSC's technical domain.

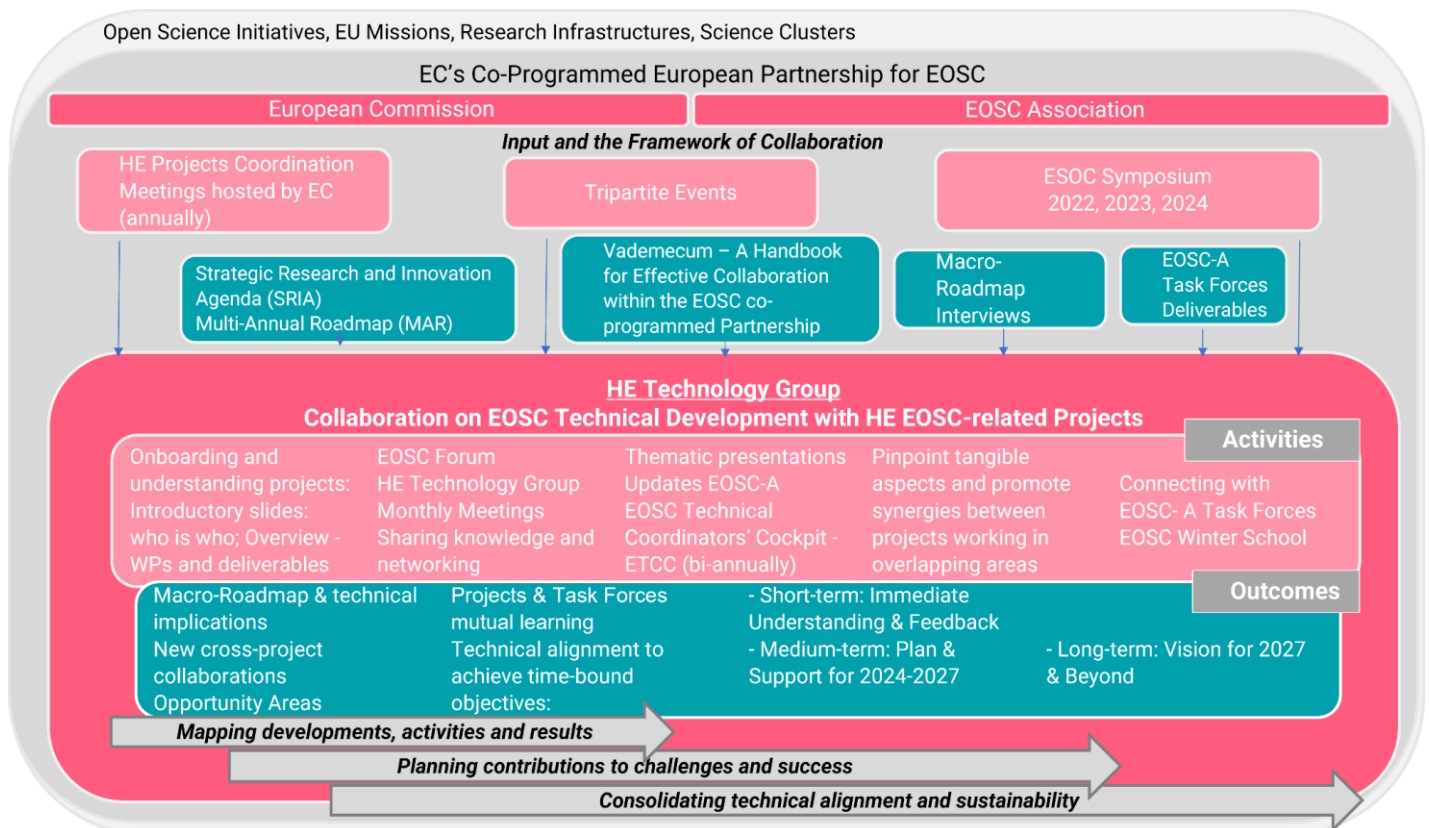


Figure 1 - Overview of collaboration on EOSC technical development with HE EOSC-related projects: sources, activities and main outcomes

2.1 HE Technology Group

The HE Technology Group was introduced as part of the actions resulting from the Vademecum, with the aim of being a platform for technical coordination among all HE EOSC-related projects. The group invited first the projects awarded under the 2021 INFRAEOSC call, as well as other projects related to EOSC from different calls to join this group on a voluntary basis, stressing the importance of collaboration and alignment. Since then, the group has grown steadily by incorporating projects awarded in more recent Horizon Europe calls and will continue to do so in the future. A current overview of all projects involved in the HE Technology Group can be found in Appendix 1. The collaboration on technical developments in the HE Technology Group serves three important goals:

- Cross-project alignment on EOSC technical developments (design, architecture, implementation, roadmaps and deliverables) is essential to the efficient and coherent development of EOSC, to maximise the impact of the project outputs, and to ensure their integration in an operational EOSC platform and increase long-term sustainability of EOSC.
- Collaboration on technical developments aims to support projects that experience difficulties in their progress by providing support from EOSC-A and other EOSC-related projects, and by bringing projects together to inspire and learn from each other. Together, the group provides an expert base where projects can troubleshoot their technical challenges. Communicating the challenges faced to EOSC-A experts and to the other projects will facilitate finding solutions for technical issues and hiccups in the process.
- Cross-project collaboration aims to create synergies between the projects and avoids duplication of effort. Exploiting the synergies and joining efforts in related topics will create a combined greater effect: projects will not just develop next to each other, but also *with* each other.

2.1.1 Participants

The HE Technology Group is formed by the Technical Coordinators of all HE EOSC-related projects, together with EOSC-A's Technology Officer, and members of the EOSC Focus consortium (TU Graz, EGI Foundation, and CREAM) as part of the activities of Task 3.2 (Figure 2).

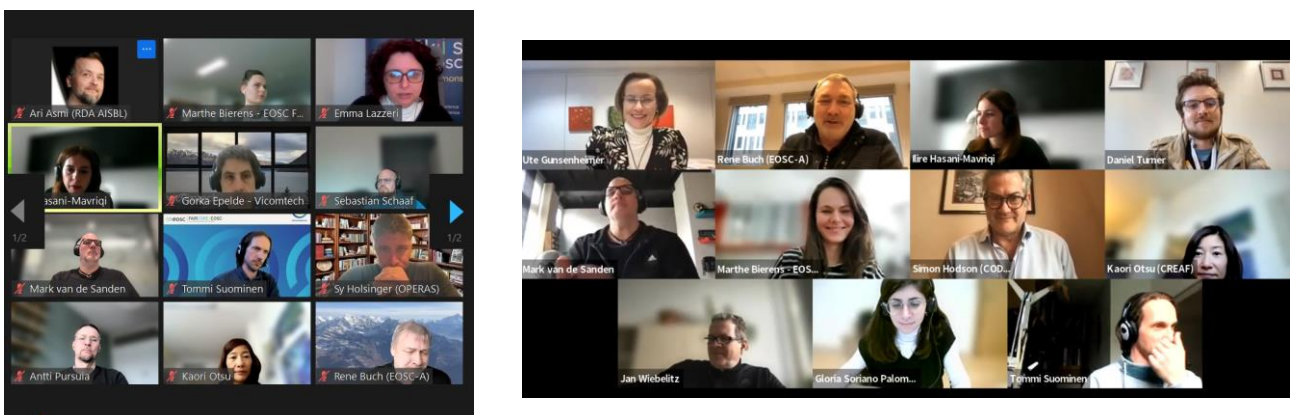


Figure 2 - Photos of HE Technology Group participants

3 HE Technology Group Activities

In this section, we provide an in-depth exploration of the HE Technology Group's multifaceted activities.

3.1 Onboarding and Understanding Projects

The first projects were onboarded in the HE Technology Group following the process established by EOSC Focus in the “Onboarding Guidelines - HE Technology Group”, first completed in March 2023. The document (and correspondingly the process) has since been refined and extended with relevant information gathered in the group meetings. As a “living” document, it will be updated in the future as required. Projects were officially onboarded during the first meetings of the group, in which an introduction to the Vademecum was provided, and the scope and objectives of the subsequent meetings were defined. The onboarding guidelines will be used by EOSC Focus partners to onboard new project members. The guidelines contain information on:

- the objectives of the HE Technology Group
- background to the collaboration in the Group
- practical information on meetings
- an introduction to EOSC Forum and the EOSC Forum page of HE Technology Group
- practical information on the shared Google doc space

To gain a deeper insight of project activities, two further “living” documents were created and shared with projects during their respective onboarding processes. It should be emphasised here that, in accordance with the approach adopted by EOSC Focus and ultimately EOSC-A, projects are invited and moreover *encouraged* to contribute to both documents; but participation in these activities remains, just as in the HE Technology Group, *voluntary*:

1. A “who is who” slide deck: All HE Technology Groups are asked to introduce their projects, project members and other important information (e.g. top technical priorities, key focus areas and specific activities in 2023).
2. A spreadsheet containing information on the work packages and tasks: The projects are asked to populate this spreadsheet and share it with the other Group members in order to provide a stronger understanding of the similarities in work and developments, and to facilitate the identification of synergies between projects. This is done on a voluntary basis but highly encouraged. Some projects need to seek agreement from the consortium before they are able to share this information.

3.2 EOSC Forum

The EOSC Forum serves as the primary form of communication between projects and takes the role of the interactive platform for collaboration on EOSC Technical Developments. Here, invited project members can share relevant information, post events and developments, store documents, and have personal conversations in a chat. The HE Technology Group has its own workspace on EOSC Forum³. This workspace is used to share agendas for upcoming meetings, to store important documents of previous meetings, and to allow project members to communicate among themselves and with EOSC

³ <https://forum.eosc.eu/group/he-technology/timeline>. The content is only visible to group members.

Focus outside of the meetings (Figure 3). All important messages relating to the HE Technology Group are posted there. On top of that, the EOSC Forum also serves as a platform to disseminate achievements of the HE Technology Group.

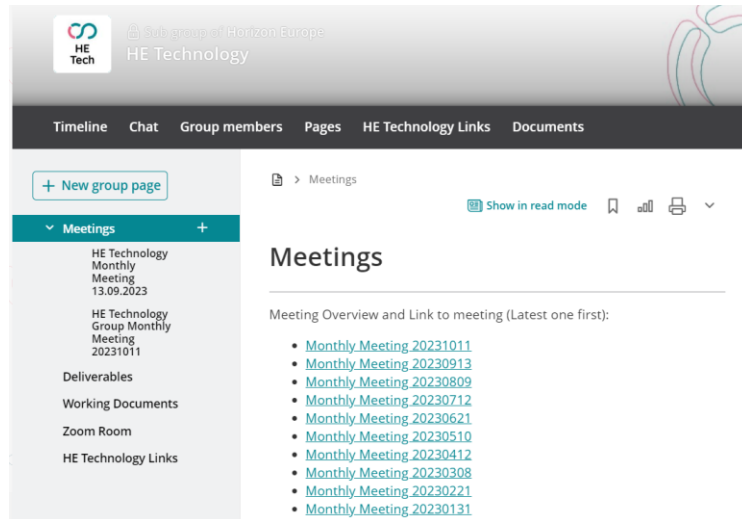


Figure 3 - HE Technology Group EOSC Forum page

3.2 First Coordination Meeting Hosted by the European Commission

The projects were introduced to the Vademecum and collaboration activities on Technical Development (section E in the Vademecum) during the first coordination meeting held in Brussels on 30 September 2022 under the title “Horizon Europe projects coordination meeting in the context of the EOSC European Partnership”, hosted by the European Commission’s Directorate-General for Research & Innovation (DG RTD)⁴. Representatives from 12 Horizon Europe (HE) EOSC-related projects, DG RTD, and EC’s Research Executive Agency (REA), the EOSC Focus project as well as EOSC-A, met to discuss how to efficiently and effectively organise the cooperation to the best advantage of the EOSC Partnership’s objectives. A first public version of the *Vademecum* was distributed to the projects and was discussed during the meeting.

3.3 HE Technology Group Kick-off Meeting

Following the face-to-face meetings in Brussels and Prague (this one during the EOSC Symposium in November 2022), the HE Technology Group kicked-off officially on 23 November in 2022 with an online meeting via Zoom. 15 participants gathered, representing EOSC-A, EOSC Focus and the majority of HE EOSC-related projects. The introduction to the projects emphasised that the HE Technology Group is dedicated to the EOSC technical developments as described in Area E of the Vademecum. The main discussion focused on the expectations from the participant projects. It became evident that there is a need for strategic coordination, as well as more immediate practical cooperation, to identify overlaps and gaps between project:

- whether work is being duplicated
- what kind of templates to use for architecture

⁴ <https://eosc.eu/news/coordination-meeting-eosc-related-horizon-europe-projects>

- open source communities & scalability
- whether components implemented by projects are fit for community purposes

Regarding the frequency of meetings, the participants expressed their interest and need for regular meetings on monthly basis, in addition to the biannual meeting as EOSC Technical Coordinators' Cockpit (section 3.6) proposed by EOSC Focus.

3.4 HE Technology Group Monthly Meetings

The monthly meetings of the HE Technology Group, initiated in January 2023, serve as a platform for facilitating collaboration and addressing significant technical challenges. These gatherings are integral to sustaining the momentum of the group's growth and are shaped by a specific methodology. The methodology involves tackling general topics that cut across all projects, including discussions on the technical architecture and specifications, as well as topics on discipline-specific solutions. This is facilitated by thematic presentations of the projects, contributions from EOSC-A and EOSC Focus and the collection of feedback.

An effort was made early on to include and leverage the experiences and lessons learned from H2020 projects such as EOSC Future in an initial thematic presentation. The role of EOSC Procurement in introducing the EOSC EU Node concept was also outlined.

In terms of the FAIRCORE4EOSC project, discussions revolved around crafting the essential components needed to foster a FAIR EOSC ecosystem, with a keen focus on user requirements and technical specifications. The FAIR-IMPACT team shed light on their strategy for implementing FAIR-enabling practices, tools, and services across diverse scientific communities, research outputs, and various levels. The RAISE project presented current technical developments and use cases.

In addition, the EuroScienceGateway team and the Galaxy project delved into the exploration of Virtual Research Environments (VRE).

In terms of discipline-specific endeavours, two notable initiatives were highlighted:

- Blue-Cloud 2026: This project is dedicated to uncovering and showcasing the capabilities of Open Science in promoting ocean sustainability.
- FAIR-EASE Galaxy for the Earth system and biodiversity: A project that's actively working towards achieving FAIR principles for Earth system and biodiversity research within the Galaxy platform.

3.5. Second Coordination Meeting Hosted by the European Commission

With the inclusion of seven new projects from the 2022 INFRAEOSC calls, representatives from 19 HE EOSC-related projects gathered in Brussels on 15-16 June 2023 to deepen collaboration with the EC and the EOSC-A, exchange expertise among them, and provide project updates⁵. EOSC Focus presented the design for an online, interactive "Macro-Roadmap" (see section 4.2) to demonstrate the implementation of EOSC over time via the projects' contributions to the objectives of the SRIA. While it was acknowledged that numerous tasks lie ahead, the meeting served to reinforce the EOSC Partnership's common priority to demonstrate the added value of EOSC. Several follow-up activities were identified, including the organisation of a "Winter School" (see section 3.7) to be held in January 2024, to work on project's common technical challenges and establish more in-depth, hands-on,

⁵ <https://eosc.eu/news/breadth-eosc-partnership-full-display-he-projects-coordination-meeting>

technical cooperation. Detailed information about the second coordination meeting and main outcomes can be found in the European Commission meeting report, released 22 September 2023⁶.

3.6 EOSC Technical Coordinators’ Cockpit - ETCC

The EOSC Technical Coordinators’ Cockpit (ETCC) meeting takes place bi-yearly organised by EOSC Focus. The ETCC is an interactive and focused session with a longer duration, so the Technical Coordinators of the projects are able to have a deeper discussion on the most faced or future challenges, sharing successes, discussing use cases that show new important insights and a chance to network with other projects.

The first EOSC Technical Coordinators Cockpit (ETCC)

The first EOSC Technical Coordinators’ Cockpit (ETCC) meeting took place online on the 10th of May 2023. The ETCC-meeting replaced the HE Technology May meeting, with the focus placed on providing space for in depth-discussions on technical developments and challenges encountered by projects. Because of the limited time of the meeting, FAIRCORE4EOSC and BlueCloud-2026, who contribute developments across many technical SRIA Action Areas (as determined by the Macro-Roadmap interviews), were asked to present their projects (Figure 4). The two projects presented themselves and their expected results, with a focus on the technical developments. Both presentations were followed with a question and discussion round.

The concept of the first ETCC was positively received in the HE Technology Group, which resulted in requests of other projects to present their project during the meetings to share their results and challenges with the other projects. The thematic presentations of several projects were therefore included in the meetings that followed, leading to better alignment between projects and to the start of the collaboration between EuroScienceGateway and FAIR-EASE on the integration of the Earth Lab developed by FAIR-EASE in the Galaxy infrastructure (EuroScienceGateway) (details are provided in section 4.1).

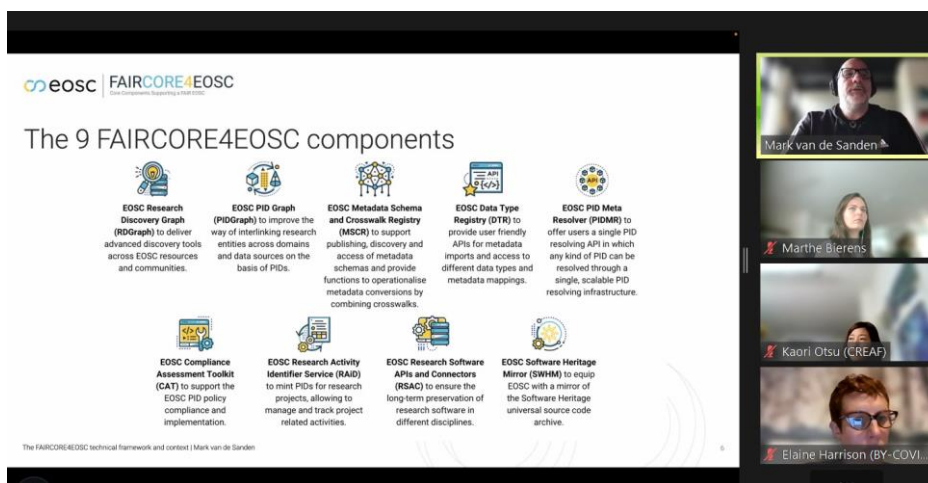


Figure 4 - First ETCC meeting

⁶ European Commission meeting report, released 22 September 2023 <https://eosc.eu/wp-content/uploads/2023/10/202320coordination20meeting20of20eosc-related20projects-KI0423769ENN.pdf>

The second EOSC Technical Coordinators Cockpit (ETCC)

The second ETCC took place in Madrid in person on September 22, 2023, as a side event of the EOSC 2023 Symposium. This first face-to-face encounter brought together around 40 Technical Coordinators and other members from 16 projects, as well as EOSC-A Board members and members of the EOSC-A Secretariat.

The meeting started with a plenary part, where Ute Gunsenheimer, Secretary General of the EOSC Association, welcomed us and mentioned the importance of this collaboration. She also announced the Programme Committee for the Winter School, the next in person event to tackle the technical challenges in EOSC in a shared setting. This announcement was followed by a shared session led by Diego Scardaci from the EGI Foundation (EOSC Focus/EOSC Future) and Bob Jones of the EOSC-A Board of Directors on the “EOSC nodes” and “EOSC EU node” concepts as the first example of how such nodes that will form the “EOSC Federation” could look like. The Q&A that followed the presentation helped to clarify some points, to the extent allowed by the information currently available on the nodes. The EOSC node-concept will be further developed in the coming year(s).

The representatives of EOSC-A’s Board of Directors Marialuisa Lavitrano and Ignacio Blanquer provided the view from the Task Forces of EOSC-A: they have proven the engagement of the community in the development of EOSC and deserve to be thanked for their effort. The participation of TF members in the INFRAEOSC projects should make it possible for the projects to uptake the results from the TF’s work.

One of the objectives of ETCC was to support Technical Coordinators to build a systematic approach towards sharing their current work and concerns, fostering collaborations between projects. In doing so, Opportunity Areas were determined with connected challenges. The full process of arriving at the Opportunity Areas as selected is described in section 4.3. These Opportunity Areas and challenges laid the base of the second /interactive part of the ETCC.

The second part of the meeting, organised in four breakout sessions, was dedicated to begin with the preparations of the EOSC Winter School that will take place in Thessaloniki (Greece) from 29th of January till 2nd of February 2024, co-organised by EOSC Focus, the HE EOSC-related projects, and members of the RAISE consortium as local organisers. The ETCC members of the different breakout sessions worked together to identify three top priorities (sub-topics), tangible outcomes /goals and key contributors that could help create the content and activities for the Winter School. Below we provide a short summary of the discussions that took place in each of the breakout sessions (illustrated in Figure 5):

1. PIDs - the group discussed shared challenges among projects related to Persistent Identifiers (PIDs) and outlined three key priorities. First, the focus is on standardising and integrating the PID graph, with an emphasis on defining criteria for a PID policy that are measurable and community-endorsed. Second, the group highlighted the need to expand and improve the standardisation and integration of the PID graph by identifying gaps and ensuring accurate provenance information for new PIDs. Lastly, it suggested the creation of a working group to address the trustworthiness of nodes and in the PID graph. These priorities aim to enhance PID compliance, community requirements, and the overall PID ecosystem.

2. Metadata, ontologies & interoperability - the group has identified following priorities: The first priority is the importance of metadata crosswalks for data and metadata sharing, emphasising the need for standardised metadata schemas to facilitate interoperability and the development of federated search engines. The second priority is ontology interoperability, ensuring that ontologies used in different communities can interoperate effectively. The third priority is semantic interoperability and services, which should be core services in EOSC and require user onboarding and training. The tangible result for this Opportunity Area is to organise hackathon-like sessions during the Winter School to build demonstrators and accelerate technical collaborations, supporting the development of new use cases and validating technical interoperability.
3. User & resource environments - The focus of this breakout session was placed on providing a common description on three shared challenges / priorities that will unify the different VREs in the EOSC Landscape: (1) design: mapping requirements & gaps in current VREs, to create an overview of the current VRE frameworks, (2) implementation: collecting mechanisms/services for easy data access inside current VREs as a handbook for future VREs, and (3) interoperability: an inventory of options for orchestrating analytics to deploy VREs.
4. The discussion on Skills, training, rewards, recognition, and upscaling revolved around following priorities. One crucial aspect was incentivizing the participation of various stakeholders in EOSC. This involved the discussion on developing a research-assessment framework, forming policies, and convincing policymakers. The discussion stressed a comprehensive approach, considering open science practices in career paths and evaluating concrete steps for implementation. Digital skills at different levels, both internationally and nationally, were highlighted, with an emphasis on recognizing varying levels of maturity among countries. The shared priorities in this context include creating a knowledge base and community of practice, enhancing competence development, and generating tangible outcomes like summaries of project approaches to skills and competences, along with a collection of training materials and best practices for stakeholder engagement.

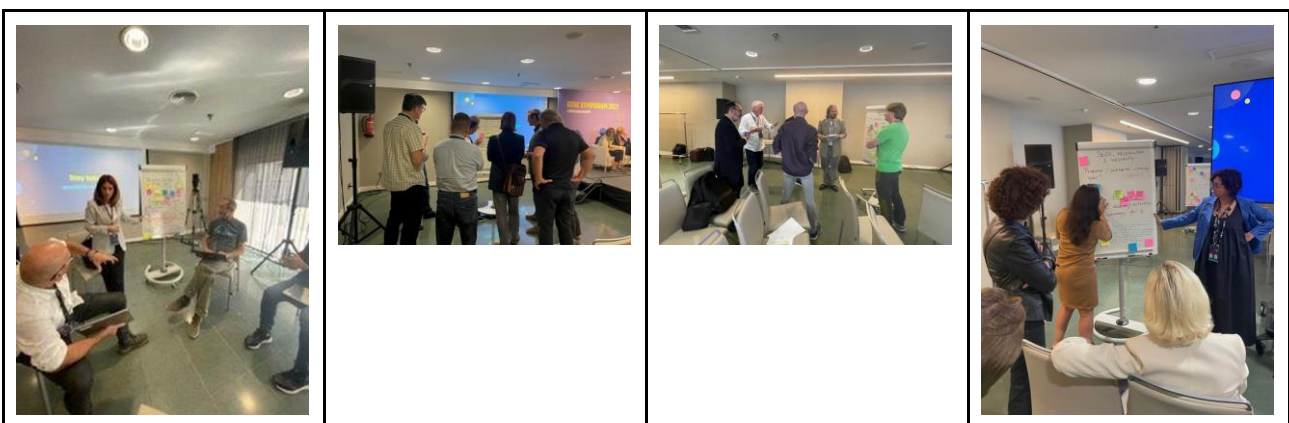


Figure 5: Breakout session ETCC (22.09.2023)

The ETCC represents the attempt to align and streamline the efforts of the technical teams of the EOSC-related projects to create a consistent and systematic approach to the challenges identified in the SRIA as key for the development of EOSC. Through this approach, the community of technical experts, represented by the project Technical Coordinators, will acquire a full view of the entire EOSC's

landscape, and will thus be able to aggregate and integrate results from the projects to create a working and sustainable EOSC.

3.7 EOSC Winter School

Following the proposal put forth during the second coordination meeting organised by the European Commission in June 2023 in Brussels, the 19 HE EOSC-related projects have commenced preparations for the upcoming Winter School. The specified dates have been finalised: from January 29th to February 2nd, 2024, these projects will convene for the first EOSC Winter School event in Thessaloniki, Greece (the initial planning is shown in Figure 6b).

The primary objective of the EOSC Winter School is to assemble all participating projects, EOSC-A Board members, Task Force Co-Chairs, and representatives from the European Commission. Its purpose is to foster dialogue, facilitate the exchange of ideas, and build lasting connections among the participants. The Winter School provides a dedicated time and space for projects to strengthen their cooperation on common technical challenges and engage with EOSC-A Task Forces to learn about their accomplishments and outcomes. This is outlined in the short-term, mid-term and long term objectives.

- Short-term objectives:
 - Hand-over results of EOSC-A TFs to HE EOSC-related projects
 - Establish structured collaborations between the newly mandated EOSC-A TFs and the projects
 - Hands-on technical collaboration in the six identified Opportunity Areas to establish closer technical collaboration between the projects for the remainder of their duration
- Mid-term objectives:
 - To frame inter-project collaboration that allows seamless onboarding of future projects (2023 onwards)
 - Contribute to shaping the vision of SRIA 2.0
- Long-term objectives:
 - Increase the potential of the HE EOSC-related projects to deliver sustainable results that benefit the ESOC deployment and thereby maximise project impact

The significance of this event is underscored by its potential to bring together a diverse range of perspectives, offering a rich blend of insights and experiences. The program will be thoughtfully designed to include sessions on specific vertical topics like Opportunity Areas and technical implementation challenges, as well as horizontal topics encompassing impact, engagement, and dissemination (as depicted in Figure 6a).

The event is jointly organised by EOSC-A, EOSC Focus, the HE EOSC-related projects, and local organisers from the RAISE consortium. A programme committee, chaired by the EOSC-A Secretary General, six sub-programme committees corresponding to Opportunity Areas and an organising committee, led by RAISE, will be working in the upcoming months to develop a comprehensive program for the Winter School and make all necessary logistical arrangements for the event (as indicated in Figure 6c).

Sub-committees consist of at least two representatives from the projects, 1-2 Task Force Co-Chairs, and one representative from the EOSC-A Board. These sub-committees will follow the outlined plan in

Figure 6c to design hands-on technical collaboration within the six identified Opportunity Areas, promoting closer technical cooperation among the projects for the remainder of their duration.

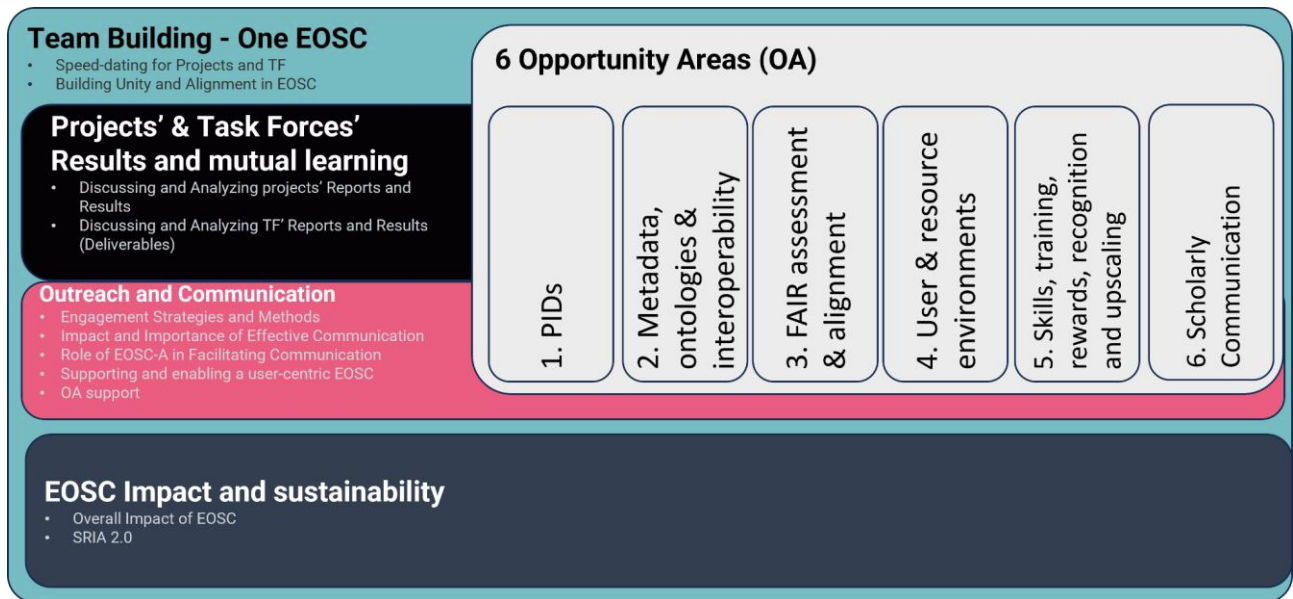


Figure 6 a - Winter School Identified Themes and Sub-Topics

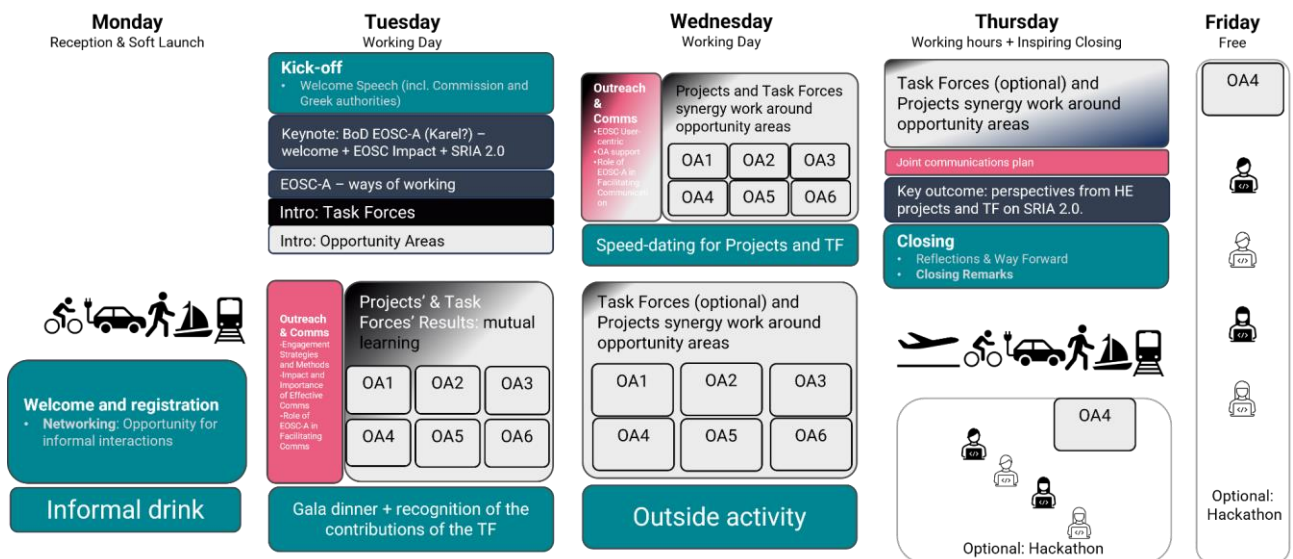


Figure 6 b - Winter School Initial Planning

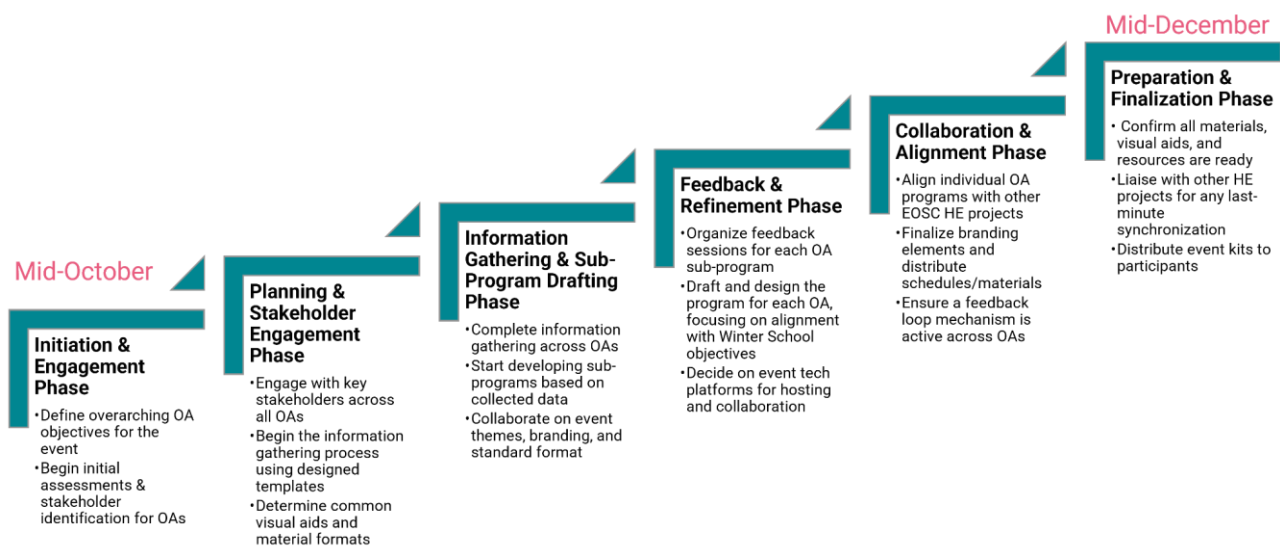


Figure 6 c - Winter School Sub-Committee Plan

4 HE Technology Group Outcomes

This section serves as a comprehensive overview of the HE Technology Group's key outcomes, some of which have already been alluded to in earlier chapters, to provide a foundational context for the collaborative activities described. Here, we elaborate on the specific outcomes that have emerged from the dedicated efforts of the group.

4.1 Cross-Project Collaboration

As stated in the call description, the ultimate goal of the INFRAEOSC projects is “[to enable] an operational, open and FAIR EOSC ecosystem”⁷, to be achieved by contributions from each project as well as collective synergies among projects. In the following, we present cross-project collaborations initiated through HE Technology Group activities.

EuroScienceGateway and FAIR-EASE: exploring the extension of the Galaxy platform

Several projects in the EOSC Landscape are developing Virtual Research Environments (VREs), i.e. platforms that enable the access of scientists to tools and services to perform data analysis. Generally, VREs are discipline-dependent, and the extension to different communities is not straightforward. The collaboration between EuroScienceGateway, a project centred in the biomedical sciences, and FAIR-EASE, which deals with environmental and biodiversity data, to extend the FAIR data analysis enabled by the Galaxy platform to a broader group of scientific disciplines, is therefore important for the progress of EOSC. The collaboration was announced in a joint publication in February 2023⁸ that highlighted the benefits it is expected to have for both projects.

⁷ See e.g. <https://bit.ly/3PLei6q>

⁸ <https://fairease.eu/news/stronger-together-fair-ease-and-eurosciencegateway-join-forces>

EuroScienceGateway and FAIR-EASE had the first joint workshop on the Galaxy platform in May 2023, and will continue on a close collaboration over the next three years. The goal is to create cross-discipline workflows between climate science, biodiversity studies and the earth sciences—creating, sharing and re-using tools and workflows in a single platform. It is envisioned that other projects that use or develop VREs, such as Blue-Cloud 2026, AqualNFRA, and EOSC4Cancer (by providing a use case on sensitive data), will further become involved in other similar collaborations.

On 21 June 2023 EuroScienceGateway provided a tour of the Galaxy platform, including its infrastructure, and described several examples of how Galaxy is used in practice by its many communities. This was followed by a presentation by FAIR-EASE on the Earth Analytical Lab (EAL), an easy-to-use tool to visualise, analyse and process environmental data on demand (see Figure 8). The EAL relies on a Data Lake to improve data access both in terms of data harmonisation and technical efficiency, using the federated Data Discovery and Access Service (DD&AS)⁹ created in the Blue-Cloud project. Finally, the architecture proposed for the EAL was presented: it will build on top of existing solutions and open standards in compliance with FAIR principles for data discovery, access, processing, mining, scaling, and visualising.



Figure 7 – FAIR-EASE Earth Analytic Lab for FAIR tools in Galaxy as a virtual environment

FAIR-IMPACT and RAISE: deriving measurable and community endorsed criteria for the PID policy

This collaboration effort is driven by FAIR-IMPACT (in collaboration with FAIRCORE4EOSC). HE EOSC-related projects are invited to propose use cases and new PIDs to be evaluated against the PID policy. A collaboration on this particular topic has a mutual effect:

- projects get feedback on their PID compliance
- FAIR-IMPACT (and FAIRCORE4EOSC) get feedback / input on the community requirements for the PID policy (is it broader enough)

A first project to start the collaboration with is the RAISE project.

⁹ <https://data.blue-cloud.org/>

Skills4EOSC and EOSC4Cancer: collaborating on training

Skills4EOSC and EOSC4Cancer have forged a strategic collaboration aimed at enhancing training initiatives in the field of cancer research and data management.

The collaboration between these two projects opens up exciting possibilities for the development of specialised training modules, equipping cancer researchers with the tools and knowledge they need to leverage resources effectively. EOSC4Cancer will have a domain specific pilot in Skills4EOSC for the portfolio: pilot in training approaches and the increase of training interoperability approaches. This collaborative effort represents a significant step forward in bridging the gap between domain-specific research needs and the broader EOSC ecosystem.

EOSC4Cancer and SciLake: first discussions on OpenAIRE Graph

EOSC4Cancer and SciLake recently embarked on their first collaborative discussion, focusing on the OpenAIRE Graph. This initial discussion marks the beginning of their efforts to harness the potential of OpenAIRE's rich data resources and infrastructure to advance cancer research and scientific knowledge in general. The discussion involved exploring opportunities for data sharing, integration, and leveraging the OpenAIRE Graph's capabilities for enhancing cancer-related research within the broader scientific context.

RDA Tiger and FAIR-IMPACT: a working group on PID provenance

Through a collaborative effort between RDA Tiger and FAIR-IMPACT, a working group focused on the provenance of Persistent Identifiers (PIDs) will be initiated. A concept for a PID working group funded by RDA Tiger will be defined during the Winter School. The aim is to involve the broader community in the topic of provenance / trustworthiness of nodes in PID Graph.

4.2 Macro-Roadmap Interviews and Technical Implications

Between March and September 2023, EOSC Focus worked on the collection of project results and the underlying relationships in the EOSC Landscape through the interviews for the EOSC Partnership Macro-Roadmap¹⁰ [R15]. This has shown how the outcomes of the HE EOSC-related projects contribute to the EOSC implementation and fulfil the objectives of the EOSC Partnership over time.

The Macro-Roadmap gives a visual representation of the relations between the projects and their results, and shows how each project adds value to the overall goal of achieving “one EOSC” (a preview is shown in Figure 9). By mapping the expected project results against the Action Areas described in the SRIA [R4], it provides an overview of what is being developed in what area, where projects align with other developments in the EOSC landscape (previous projects, current projects and Task Forces, key partners, etc.), and shows where possible new collaboration between projects lie, and where the risk of gaps is high because of missing components. The Macro-Roadmap interviews were a collective effort between T2.3 and WP6 and are captured in EOSC Focus Deliverable 2.1: Successful engagement enabled and future planning, due 30th November 2023. This deliverable is classified as sensitive. For that reason, a description of the methodology of the interviews is captured in Appendix 3.

¹⁰ <https://eosc.eu/roadmap>



Figure 8 - Visualisation of the Macro-Roadmap as presented on the EOSC-A Website, <https://eosc.eu/roadmap>

Macro-Roadmap Interviews and HE Technology Group

The HE Technology Group was continuously informed of the development of the Macro-Roadmap interviews and provided important feedback on the design and interview process. To achieve this, the Macro-Roadmap was regularly discussed in the HE Technology Group monthly meetings. The Technical Coordinators were specifically invited to provide their input during the interviews on the technical developments in all projects. In return, and because of the discussions that took place in them, the interviews suggested topics for the group meetings. In fact, some connections between projects were made during the interviews which resulted in new collaborations.

The information collected in the Macro-Roadmap interviews has been analysed in the scope of the collaboration on EOSC Technical Developments and the outcomes are described in the next section.

4.3 Opportunity Areas

In the previous sections, Opportunity Areas were mentioned as the main mechanism for current and future collaboration in the HE Technology Group. Here we provide detailed information about the process we followed in deriving these Opportunity Areas, their structure, the technical challenges they encompass, and the projects that show interest in and engage with specific Opportunity Areas.

A very important part of the activities of the EOSC Focus is to identify technical challenges faced by the projects, and to devise the means to support them to achieve their maximum capacity, in particular by fostering collaborations between them. Thanks to the effort invested in documenting and communicating the projects' results published in the Macro-Roadmap, the Technical Coordinators have begun to see the benefits of sharing the challenges each of them faces, as well as the results of the activities they carry out. This common understanding arising in the HE Technology Group has enabled it to develop a systematic approach for the technical challenges surrounding EOSC, after identifying new collaboration and information in shared Opportunity Areas. The Opportunity Areas condense the systems and services developed directly within each of the projects, but also present

the areas in which a project team is interested in contributing to calibrate and improve the services and tools provided to the scientific community, This can happen either directly or indirectly, by which it is meant when projects contribute to additional developments that help the entire EOSC ecosystem to evolve harmoniously.

Data from the Macro-Roadmap interviews has been analysed into the scope of HE Technology Group by collecting and comparing the technical results of the projects and the challenges they face. The overlapping technical challenges discovered through the analysis of the Macro-Roadmap interviews provide opportunities for close collaboration, tackling the challenge with the expertise and different views of multiple projects, and therefore were named as Opportunity Areas (the overview can be found in Table 1).

Opportunity Area	Overlapping challenges
PIDs	Standardising and integrating the PID graph
	New PID technologies
	PID policy and implementation
Metadata, ontologies & interoperability	Access for thematic communities (sensitive data, new to open science, data sharing in times of crisis etc.)
	Develop services that exploit all the advantages of community metadata registries and schemas
	Interoperability between use cases
	Federated search engine in EOSC
	Semantic Interoperability
FAIR assessment & alignment	Aligning FAIR assessment models/frameworks
	Compliance of tools, services and digital objects with FAIR metrics
User & resource environments	Mapping of user requirements, usability and good user experience for EOSC service development
	Development and integration of VREs
	Data Discovery Access platforms
	Data transfer (apart from Data Discovery Access)
	Orchestrating data analytics in heterogeneous IT infrastructures (Cloud, HPC, access to storage system, etc.)
	Technical interoperability between services (APIs, protocols, etc)
Skills, training, rewards, recognition and upscaling	(Technical) Skills and Competences development
	Incentivise engagement of 'new' stakeholders (global, national, private sector, thematic communities)

	Research assessment framework development: technical solutions
Scholarly Communication	Technical development & uniformizing Open Access
	Scientific Knowledge Graphs advancement and interoperability
	Research Assessment

Table 1 – An overview of the Opportunity Areas and related challenges

The Opportunity Areas form a collection of activities, developments, and challenges derived from the SRIA Action Areas. At the same time, they intend to support the SRIA Action Areas in that they indicate the topics shared among various projects so that it becomes easier for them to share the developments in their core services and objectives, and thus increase the chance of establishing a collaboration (Figure 10). With a strong focus on capturing all auxiliary efforts and interests of stakeholders of the projects, Opportunity Areas have the potential to align efforts between current projects, facilitate future collaborations by identifying new key exploitable results and point out opportunities between different project teams and communities.

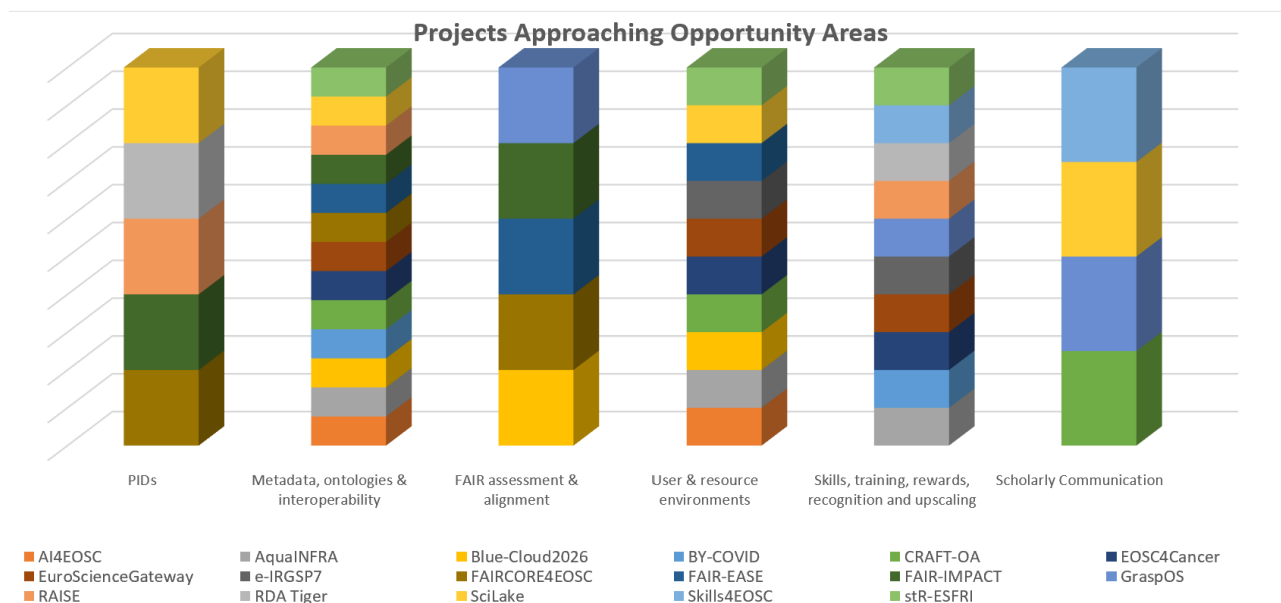


Figure 9 - Projects involvement in defined Opportunity Areas

The Opportunity Areas will be further developed in expert groups, made of project members that are part of the HE Technology Group. For their development, they will lean on the expertise of the projects, who will lead the agenda. Each Opportunity Area will be supported by a member of EOSC Focus that will collect the input provided at the meetings. The input collected per Opportunity Area will be streamlined in the collective HE Technology meetings and discussed within EOSC Focus, to guide the projects in the selection of the most relevant Opportunity Areas. The first milestone in the collaboration around the Opportunity Areas will be at the upcoming Winter School in January, where they will facilitate technical working sessions on each topic.

4.4 HE EOSC-related Projects and EOSC-A Task Forces - Mutual Learning

The Macro-Roadmap interview results also mapped if and how projects are contributing to EOSC-A Task Forces (TFs)¹¹. Most projects collaborate directly through project members involved in some of them. Some, like FAIR-IMPACT, also actively contribute to and review TF deliverables.

The alignment between projects and TFs is of value and is becoming more important through the introduction of the Opportunity Areas. As these are based on the SRIA Action Areas, the challenges they present can be linked back to the TFs that deal with technical topics. The alignment and collaboration between projects and TFs are therefore a priority for work on the collaboration on EOSC Technical Developments in the upcoming months. Keeping in mind that the mandate of the Task Forces ends at the end of 2023, connecting their contributions to the Opportunity Areas of the projects also secures the work of Task Forces not being lost but integrated back into the work of the projects through the collaboration. An overview of the Opportunity Areas and challenges and related TFs can be found in Appendix 4.

To strengthen the relationship between projects and TFs, HE Technology Group members have been asked through several channels and on several occasions to review the deliverables from the TFs, according to their expertise. This has been well-received by the projects since they are aware of the importance of the Task Forces for the development of EOSC. Besides, becoming members of a TF also gives projects the chance of stepping outside their initial involvement, familiarise with the work the Task Forces do, and play an active role by providing feedback.

For the Opportunity Areas, a good understanding of the work and discussions in the related TFs is the essence to prevent overlapping discussions and results. The TFs provide important guidance from EOSC stakeholders, while the Opportunity Area groups are tasked to translate this into technical solutions fitting to the challenges. The HE Technology collaboration sees it therefore as an important development to bring the progress within the HE Technology Group and the Opportunity Areas closer to the TFs, and to establish a close connection and collaboration between them. To achieve this, a high-level time plan was made which can be found in Figure 11. In an effort to multiply the opportunity,

¹¹ EOSC-A Task Forces. <https://eosc.eu/eosc-task-forces>

the EOSC-A Task Force Co-Chairs will attend and help to prepare the EOSC Winter School.

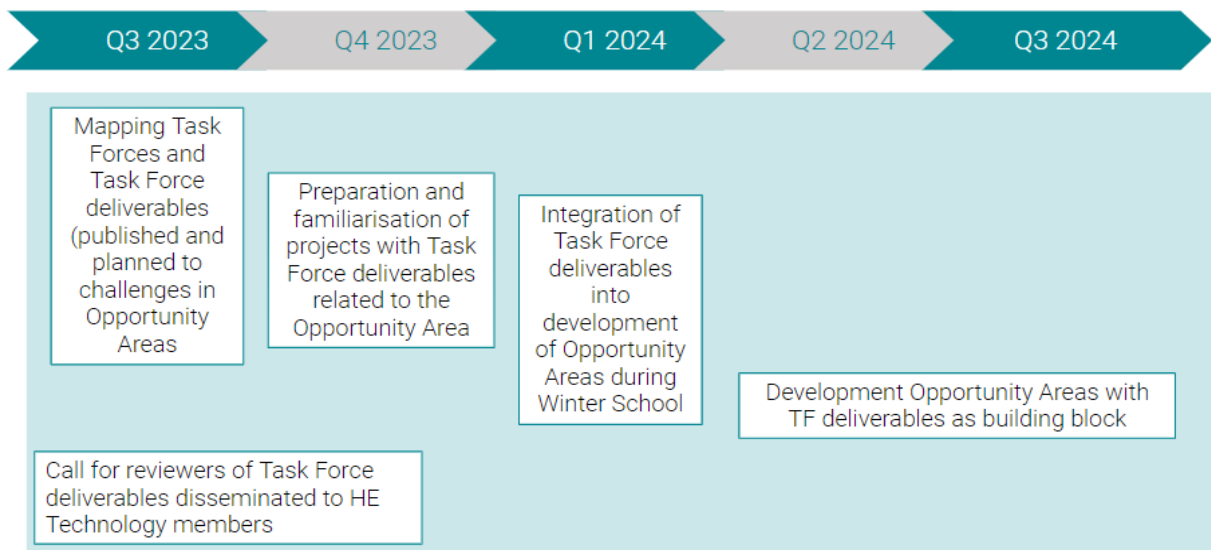


Figure 10 - Timeline integration of TF deliverables into Opportunity Areas

5 Lessons Learned and Outlook

Starting the HE Technology Group, based on the framework of the Vademecum, has set the cornerstone to form a community of technology experts working together towards developing the EOSC.. The collaboration in its current form has made it possible to *map the developments, activities and results* of the projects towards SRIA.

As suggested by some of the Technical Projects Coordinators, a stronger coordination and collaboration would be useful to deepen the results and move into the *planning and consolidating the technical alignment and sustainability*. This will create new opportunities for new collaborations between projects that can establish powerful solutions for research integrating their services.

The Macro-Roadmap interviews and first results were overall very positively received by the EOSC community and the projects themselves. Multiple projects indicated their appreciation for the efforts of EOSC Focus in relation to the Macro-Roadmap and first reactions to the first results have been positive. This was mimicked by other stakeholders, like the European Commission. It is therefore safe to say that the effort that went into developing the interviews, conducting them, transcribing them and translating them, paid off.

5.1 Identified challenges and opportunities

The interaction and engagement established with the HE EOSC-related projects that work directly to address the challenges of the SRIA Key Action Areas, has allowed the EOSC Focus team to gain a better understanding of the technical complexity of the technical systems required to support EOSC. This allowed to reveal several dependencies between the parts of the overall system, as well as

identify how the outputs of the EOSC/related projects need to be connected to each other to develop a sustainable and optimal system that satisfies the needs of EOSC users.

Our approach consisted in trying to capture these common challenges in a coordinated manner within the scope of the voluntary collaboration framework - the *Vademecum*, by consolidating the Opportunity Areas. With a continuously evolving environment, consolidating the Opportunity Areas will streamline collaborations and facilitate the establishment of a community of technology experts to support the implementation of EOSC. The Task Forces have a relevant role in this collaboration providing important input on the SRIA Action Areas related to the Opportunity Areas.

The establishment of the HE Technology Group and the potential of the collaboration in its current form has its limits. Being set in a voluntary framework, the amount of engagement and interaction from both EOSC Focus and the joined projects are relatively vulnerable. Even though most members recognise the importance of the collaboration to ensure alignment and with that increasing the chance of their results becoming a more sustainable integration into the EOSC, the prioritising of this collaboration remains a struggle because of the voluntary character. This means that the engagement and inclusion need to be as accessible as possible, providing a work method that works for different members of different projects. In addition, the number of projects captured in the collaboration framework will grow even further with the upcoming calls.

The effort required for coordination and support cannot be sustained by the EOSC Focus project in the long run. In the near future, efforts will be dedicated to exploring a viable solution for this challenge. Consequently, there is a need to facilitate the collaboration between the procurement and the already funded projects. This coordination mechanism is imperative to address the evolving needs of the EOSC ecosystem effectively.

5.2 Conclusion and Future Steps

After one year of collaboration, it can be concluded that building a collaboration among HE EOSC-related projects, despite its many conceptual and practical challenges, has proven to bring benefits that will reflect on EOSC as a whole. In this environment, projects have the possibility to present the solutions they develop to other Technical Coordinators and receive valuable feedback. The efforts in the HE Technology Group have already resulted in multiple collaborations between projects (see Section 4.1: EuroScienceGateway and FAIR-EASE, EuroScienceGateway and Blue-Cloud 2026, EuroScienceGateway and AqualNFRA, EuroScienceGateway and EOSC4Cancer, FAIR-IMPACT and RAISE, Skills4EOSC and EOSC4Cancer, EOSC4Cancer and SciLake, RDA Tiger and FAIR-IMPACT). Based on interactions with the projects and the question to create more opportunities for exploring the collaborations outside of the HE Technology meetings, it can be concluded that these benefits are widely recognized by the projects.

Furthermore, the consolidation of the Opportunity Areas and the identification and definition of overlapping challenges has led to collaboration between the projects to work together on formulating solutions for shared technical challenges, not just for the current projects, but also for the future projects who will become part of EOSC. Several projects have expressed appreciation for the support provided by the HE Technology Group and acknowledged the added value achieved through enhanced collaboration facilitation. The EOSC Focus project is planning to expand on these first positive results,

diving deeper into the opportunities brought by the collaborations to improve their work in the Opportunity Areas, and planning other events in the spirit of the Winter School.

The introduction of the Opportunity Areas will not only lead to the formulation of solutions for shared technical challenges for current and future challenges, it will also provide an opportunity to support the development of sustainability plans for the results that are developed by projects related to these challenges. Apart from that, because of its origins in the Macro-Roadmap, which was based in the SRIA Action Areas, the integration of these developments in the SRIA 2.0 is facilitated in its concept, making the Opportunity Areas also a growing ground for technical input in the strategic documents of EOSC.

Building on the achievements of the first year of the EOSC collaboration on technical development has therefore been anything but pointless, which is recognized through the involved parties. However we have hopes for the collaboration to go even further and tackle the following challenges:

- avoiding duplication of effort, and speeding up the creation of new capabilities by providing a clear picture of the capabilities already available and promoting their reuse to facilitate the development of new solutions for research;
- ensuring interoperability, i.e. promote collaboration between EOSC projects to make their services interoperable;
- facilitating the integration of capabilities delivered by multiple initiatives, i.e. promote the joint support of scientific use cases with the adoption of capabilities delivered by multiple projects;
- improving the links between EOSC-A TFs and EOSC projects through regular presentations and meetings that allow mutual better knowledge of the respective main achievements;
- clarifying EOSC's implementation status: map the projects' outputs to the EOSC Strategic Objectives to have a regularly updated view on the EOSC implementation status.

So far, the EOSC technical collaboration has been based on voluntary effort highlighting the need for an official collaboration framework. To reach the full potential of HE Technology and a collaboration on technical development, tracking the full impact of developed results for EOSC, the collaboration needs to become a priority. The only way to achieve this is to place it in the right official structure. We therefore encourage the EC to facilitate the collaboration between the procurement and the already funded projects.

6 References

No	Description/Link
R1	Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC), Version 1.0 https://eosc.eu/wp-content/uploads/2023/08/SRIA-1.0.pdf
R2	MoU for the Co-programmed European Partnership on the European Open Science Cloud: https://eosc.eu/sites/default/files/20210215_EOSC_MoU_FinalDraft.pdf
R3	Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC), Version 1.1 https://eosc.eu/wp-content/uploads/2023/08/SRIA-1.1-final.pdf
R4	The Strategic Research & Innovation Agenda (SRIA) and its Multi-Annual Roadmap (MAR) https://eosc.eu/sria-mar
R5	Horizon Europe Work Programme 2021-2022. https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-3-research-infrastructures_horizon-2021-2022_en.pdf
R6	Vademecum – A handbook for effective collaboration within the EOSC co-programmed Partnership https://bit.ly/EOSCVademecum22
R7	EOSC Focus Deliverable 6.1 (formerly combined D2.1/6.1) Rolling Engagement and Communication Plan
R8	HE Technology Forum page (The content is only visible to group members) https://forum.eosc.eu/group/he-technology/timeline
R9	News Article - Coordination meeting for EOSC-related Horizon Europe projects https://eosc.eu/news/coordination-meeting-eosc-related-horizon-europe-projects
R10	News Article - Breadth of EOSC Partnership on full display at HE projects coordination meeting https://eosc.eu/news/breadth-eosc-partnership-full-display-he-projects-coordination-meeting
R11	HE INFRAEOSC: Enabling an operational, open and FAIR EOSC ecosystem https://bit.ly/3PLei6q
R12	Technical Bridging Team https://faircore4eosc.eu/technical-bridging-team
R13	News Article - Stronger together: FAIR-EASE and EuroScienceGateway join forces https://fairease.eu/news/stronger-together-fair-ease-and-eurosciencegateway-join-forces
R14	Data Discovery and Access Service (DD&AS) https://data.blue-cloud.org/

R15	The Macro-Roadmap for the implementation of EOSC is a visual mapping of the results of EU projects developing EOSC and the in-kind contributions of EOSC Association member organisations. https://eosc.eu/roadmap
R16	EOSC-A Task Forces. https://eosc.eu/eosc-task-forces

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Appendix 1- List of HE INFRAEOSC and other related projects in HE Technology Group

Horizon Europe INFRAEOSC 2021 (total:10)

Project	Project Coordinator	Call
Skills4EOSC	Consortium GARR	HORIZON-INFRA-2021-EOSC-01-01 - Supporting an EOSC-ready digitally skilled workforce
EOSC Focus	EOSC Association	HORIZON-INFRA-2021-EOSC-01-02 - Supporting the development and coordination of activities of the EOSC Partnership
FAIRCORE4EOSC	CSC-IT Centre for Science	HORIZON-INFRA-2021-EOSC-01-03 - Deploying EOSC-Core components for FAIR
FAIR-EASE	The French National Centre for Scientific Research (CNRS)	HORIZON-INFRA-2021-EOSC-01-04 - Innovative and customizable services for EOSC
EuroScienceGateway	University of Freiburg	HORIZON-INFRA-2021-EOSC-01-04 - Innovative and customizable services for EOSC
RAISE	Aristotle University of Thessaloniki	HORIZON-INFRA-2021-EOSC-01-04 - Innovative and customizable services for EOSC
AI4EOSC	The Spanish National Research Council (CSIC)	HORIZON-INFRA-2021-EOSC-01-04 - Innovative and customizable services for EOSC
Scilake	Athena Research Center (RC)	HORIZON-INFRA-2021-EOSC-01-04 - Innovative and customizable services for EOSC
FAIR-IMPACT	Dutch national centre of expertise and repository for research data (DANS)	HORIZON-INFRA-2021-EOSC-01-05 - Enabling discovery and interoperability of federated research objects across scientific communities
EOSC4Cancer	Barcelona Supercomputing Center (BSC)	HORIZON-INFRA-2021-EOSC-01-06 - FAIR and open data sharing in support of cancer research

Horizon Europe INFRAEOSC 2022 (total: 5)

Project	Project Coordinator	Call
GraspOS	Athena Research Center (RC)	HORIZON-INFRA-2022-EOSC-01-01 - Services and tools to underpin a research assessment system that incentivises open science practices
CRAFT-OA	University of Göttingen	HORIZON-INFRA-2022-EOSC-01-02 - Improving and coordinating technical infrastructure for institutional open access publishing across Europe

Blue-Cloud 2026	National Research Council (Cnr)	HORIZON-INFRA-2022-EOSC-01-03 - FAIR and open data sharing in support of healthy oceans, seas, coastal and inland waters
AquaINFRA	Aalborg University	HORIZON-INFRA-2022-EOSC-01-03 - FAIR and open data sharing in support of healthy oceans, seas, coastal and inland waters
RDA TIGER	Research Data Alliance Association	HORIZON-INFRA-2022-EOSC-01-04 - Support for initiatives helping to generate global standards, specifications and recommendations for open sharing of FAIR research data, publications and software

EOSC-related projects (total:3)

Project	Project Coordinator	Call
WorldFAIR	CODATA	HORIZON-WIDERA-2021-ERA-01-41 - Global cooperation on FAIR data policy and practice
e-IRGsp7	INNOV-ACTS LIMITED	HORIZON-INFRA-2021-DEV-01-05 - Support to the e-Infrastructure Reflection Group (e-IRG)
Str-ESFRI3	ATHENA Research and Innovation Centre	HORIZON-INFRA-2021-DEV-01-01 - Support to the European Strategy Forum on Research Infrastructures

Appendix 2 - HE Technology Group Monthly Meetings

Date (dd/mm/yyyy)	No. of participants	Presentation and discussion topic	Projects involved
31/01/2023	20	The EOSC Platform	EOSC Future
31/01/2023	20	C4 Model as a common methodology to describe EOSC Architecture	EOSC Future
21/02/2023	17	Introduction to the EC EOSC Procurement	EOSC Future
08/03/2023	23	EOSC Focus Macro-Roadmap in line with SRIA action areas and interviews	EOSC Focus
12/04/2023	25	Introduction to Key Focus Areas and Key Exploitable Results in Task Forces and HE Technology Group	EOSC Focus
10/05/2023	29	Technical specifications for the FAIRCORE4EOSC components	FAIRCORE4EOSC
10/05/2023	29	Blue-Cloud 2026: Exploring and demonstrating the potential of Open Science for ocean sustainability	Blue-Cloud 2026
21/06/2023	19	Galaxy project - EuroScienceGateway	EuroScienceGateway
21/06/2023	19	Galaxy for the earth system and biodiversity	FAIR-EASE
12/07/2023	18	RAISE Project technical developments and use cases	EOSC-RAISE
09/08/2023	11	Opportunity Areas for EOSC Technical Coordinators' Cockpit meeting and EOSC Winter School	EOSC Focus
13/09/2023	25	EOSC Symposium and ETCC	EOSC Focus
11/10/2023	27	FAIR-IMPACT Overview and Technical WPs	FAIR-IMPACT

Appendix 3 - Methodology of Interviews for the Macro-Roadmap

Introduction

In an effort to capture the results developed by the HE EOSC-related projects, align them and place them in the landscape of EOSC, the Macro-Roadmap interviews were developed. The goal of the interviews was to develop a Macro-Roadmap illustrating how project outcomes align with EOSC objectives, identify synergies and technical challenges, and showcase project contributions to EOSC-related impact. We conducted interviews with representatives from each project consortium, analysed the results, used the information gathered to develop the graphic, reviewing and refining it through several iterations, and updated it regularly to reflect changes in the projects. The result is a visual depiction of the relationships between the INFRAEOSC projects and their outcomes that shows how each project contributes to the overall goals of achieving “one EOSC”.

Timeline: EOSC Focus started developing the Macro-Roadmap interviews in March 2023. Between the last week of April and the last week of May all projects were interviewed. The preliminary results of the interview were presented during the second Coordination Meeting organised by the EC in Brussels on 15-16 June 2023. The first result, the visualisation of the Macro-Roadmap was presented during the EOSC Symposium 2023. Further analysis will be carried out in T2.3 Engaging Projects: Supporting the Alignment of the EOSC Partnership with Projects of EOSC Focus.

Methodology

Participants: A total of 18 interviews were conducted with 18 different projects. The projects joining the interviews were the projects represented in the HE groups. In the invitation to the interviews, the projects were asked to invite max. 3 project members, preferably the project coordinator, technical coordinator and communication officer to be able to cover all aspects of their project. On two occasions an exception was made where projects joined in with 4 participants after a specific request by the project.

The projects were facilitated by a preparation document, containing the questions of the interview to prepare with their consortium beforehand. Some projects decided to prepare the interview and provide input beforehand the interview, so the conversation could be more focused. This was not obligatory.

All projects signed a consent form for the documentation of their interviews and the inclusion of their results in the Macro-Roadmap.

Approach: The interview was designed to be semi-structured, containing semi-standardized questions. Important vocal points in the development of the interview were that the collected data that could be analysed in a structured manner to build a dataset that could be expanded by future projects, but at the same time leaving enough room in the interviews to expand on topics that were brought up during the interview.

Before starting the interviews, a short desk study was done by the moderators of the interview, collecting the material on the projects that was available online.

All projects followed the same format of questions that consisted of standardised questions followed by an open question for explanation. The questions were developed in collaboration with the EOSC-Association. Here follows a description of the interview:

The interview was developed in two different parts. The first part focused on aligning project outcomes with EOSC objectives. The framework of the interview therefore follows the Action Areas of the Strategic Research and Innovation Agenda (SRIA) and aligning the project results accordingly. The SRIA Action Areas are displayed in Figure 12.

Implementation challenges

Persistent Identifiers
Metadata and Ontologies
FAIR Metrics & Certification
AAI (Authentication and Authorisation Infrastructure)
User Environments/ Resource Provider Environments
EOSC Interoperability Framework

Boundary conditions

Rules of Participation
Landscape Monitoring
Skills and Training & Rewards and Recognition
Widening to Public and Private Sectors & Going Global (international engagement and alignment)

Figure 11 - SRIA Action Areas

Projects were asked to point out the Action Areas they contribute to the most, selecting three Action Areas. For each of these selection Action Areas, the project was asked to answer the following questions:

- What concrete result(s) are you contributing to the Action Area? (short description, type of result (deliverable, report, model, prototype, product, service, etc.)
- How will it contribute to the development of EOSC? (What problem is addressed by the result? Who is the target group? How does it add value?)
- When can the result(s) be expected to be delivered? e.g. Q4 2023 (Is the result ready to use by the end of the project? In which TRL, if applicable?)

The second part of the interview concentrated on mapping connections and relations. The questions followed went into detail with the projects on the following topics:

- Alignment and relationships with previous (H2020) and current projects (INFRAEOSC and related)
- Alignment with EOSC-A Task Forces
- Adding value to EOSC (collecting case studies, good practices, best practices or use cases)
- Sustainability plans of the project
- Gaps and obstacles foreseen by the project in the EOSC landscape and the role of EOSC-A in this

The interviews were captured by documenting the answers and recording them. The recordings were transcribed after the interviews.

Analysis

The first step in the analysis was to transcribe the recordings and merge them with the data that was collected in the Excel sheets. The projects were asked to validate the transcriptions, adding in information or clearing up comments that were unclear after the transcription.

At the same time the visualisation of the webtool of the Macro-Roadmap was developed with designers for the website. Based on the transcriptions and the possibilities of the webtool, a format was created. The transcriptions of the interview fed into the format, providing the input for the visual Macro-Roadmap. The projects were asked to validate this input for the visualisation.

The translation of the data and the design of the analysis was not just validated by EOSC Focus and the projects, also the European Commission was actively involved in the translation of the data collected by the interviews, indicating the importance of the overview to them.

The data collected by the interviews is more excessive than displayed on the visualisation, making it therefore the first result of the Macro-Roadmap interviews. Further analysis of the remaining data is still to be done. The next step will be to anonymise the data so it can be further analysed and complies with the consent form signed by the projects. Afterwards, a deeper analysis of the transcriptions and second part of the interview will be done.

Another next step is to make the webtool of the Macro-Roadmap interactive so that the projects will be able to update existing results or add new results to the overview.

And finally, there will also be the development of the interviews for future projects that will join the EOSC-realm; results of new projects will feed into the Macro-Roadmap.

First reactions to the Macro-Roadmap

The Macro-Roadmap interviews and first results were overall very positively received by the EOSC community and the projects themselves. The up to date overview of project results that was facilitated and visualised on the website was introduced at the EOSC Symposium.

All projects joined the interview within the given timespan and acknowledged the importance of their inclusion in the Macro-Roadmap. On top of that, multiple projects indicated their appreciation for the efforts of EOSC Focus in relation to the Macro-Roadmap and first reactions to the first results have been positive. This was mimicked by other stakeholders, like the European Commission. It is therefore safe to say that the effort that went into developing the interviews, conducting them, transcribing them and translating them, paid off.

Appendix 4 - Opportunity Areas, Related Challenges and EOSC- A Task Forces

Opportunity Area	Challenges per Opportunity Area	Task Force related to challenge
PIDs	Standardising and integrating the PID graph	PID Policy and Implementation Long-Term Data Preservation
	New PID technologies	PID Policy and Implementation Long-Term Data Preservation
	PID policy and implementation	PID Policy and Implementation Long-Term Data Preservation
Metadata, ontologies & interoperability	Access for thematic communities (sensitive data, new to open science, datasharing in times of crisis etc.)	Semantic Interoperability
	Develop services that exploit all the advantages of community metadata registries and schemas	Semantic Interoperability
	Interoperability between use cases	Technical Interoperability of Data and Services Semantic Interoperability
	Federated search engine in EOSC	Technical Interoperability of Data and Services
	Semantic Interoperability	Semantic Interoperability
FAIR assessment & alignment	Aligning FAIR assessment models/frameworks	FAIR Metrics and Data Quality
	Compliance of tools, services and digital objects with FAIR metrics	FAIR Metrics and Data Quality
User & resource environments	Mapping of user requirements, usability and good user experience for EOSC service development	Researcher Engagement & Adoption
	Development and integration of VREs	Technical Interoperability of Data and Services
	Data Discovery Access platforms	Technical Interoperability of Data and Services
	Data transfer (apart from Data Discovery Access)	Technical Interoperability of Data and Services

	Orchestrating data analytics in heterogeneous IT infrastructures (Cloud, HPC, access to storage system, etc.)	Technical Interoperability of Data and Services Infrastructures for Quality Research Software
	Technical interoperability between services (APIs, protocols, etc)	Technical Interoperability of Data and Services Authentication and Authorization Infrastructure Architecture
Skills, training, rewards, recognition and upscaling	(Technical) Skills and Competences development	Data Stewardship, Curricula and Career Paths Upskilling Countries to Engage in EOSC
	Incentivise engagement of 'new' stakeholders (global, national, private sector, thematic communities)	Upskilling Countries to Engage in EOSC Researcher Engagement & Adoption
	Research assessment framework development: technical solutions	Research Careers, Recognition and Credit Researcher Engagement & Adoption
Scholarly Communication	Technical development & uniformizing Open Access	PIDs Technical Interoperability of Data and Services Research careers, recognition and credit
	Scientific Knowledge Graphs advancement and interoperability	FAIR metrics and Data Quality Technical Interoperability of Data and Services Semantic Interoperability Research careers, recognition and credit
	Research Assessment	Research careers, recognition and credit Data stewardship, curricula and career paths Researcher Engagement & Adoption