# e-IRG White Paper 2022

# Realisation and enhancement of coordination and collaboration in the e-Infrastructure landscape covering the full spectrum of e-Infrastructures (networking, computing, data) and related services

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# Foreword

Dear Reader,

The e-IRG White Paper 2022 deals with the "Realisation and enhancement of coordination and collaboration in the e-Infrastructure landscape" **at European level**. It follows up on its previous White Paper 2021 that presented "Good practices of coordination within and across e-Infrastructures and thematic Research Infrastructures" *at institutional, national and regional levels.*

Both e-IRG White Papers respond to the 2018 Council Conclusions on EOSC that called for the e-IRG expertise, and also to the 2020 Council Conclusions on the new ERA, which encouraged the EC and the Member States/Associated Countries "*to increase the level of national and European coordination, in particular on research infrastructures and e-infrastructures*". The more recent Council Recommendation on a Pact for Research and Innovation in Europe (2021) called for the "*connection of existing and new European and national research infrastructures, including e-infrastructures*", while the related Council Conclusions on the future governance of the European Research Area (ERA), in its ERA Policy Agenda action 8 on Research Infrastructures called for "*increased cooperation between RIs, e-infrastructures and stakeholders, including through EOSC*". In the very recent Council Conclusions on Research Infrastructures further coordination among major European policy bodies, such as ESFRI and the EOSC Steering Board was recommended at European level.

In the current White Paper 2022, in order to achieve a recognised role of the e-Infrastructures, it is recommended to **move from the current ad-hoc coordination among European e-Infrastructures towards a committed regular, well-framed and high-level coordination at strategy level**, which would be beneficial for the ecosystem, as it would ensure a steady dialogue and flow of information and common understanding across all actors.

With this actual e-IRG White Paper 2022 e-IRG is following its vision "*to facilitate integration in the area of European e-Infrastructures and connected services*" and is now providing an analysis and recommendations towards the coordination and collaboration among the European e-Infrastructures.

The current White Paper is an outcome of an iterative process with all major European e-Infrastructure initiatives, namely EGI, EUDAT, GEANT, OpenAIRE and PRACE, the European Commission, as well as the EOSC Steering Board and EOSC Association, who have all contributed to the creation of this policy document through the participation in e-IRG workshops and meetings and answered the related e-IRG questionnaire. We would thus like to thank all the contributors for their time and efforts and are looking forward to a continued cooperation, with better coordination among e-Infrastructures.

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Paolo Budroni        Stefan Hanslik
e-IRG Chair 2020-2022      e-IRG Chair 2023-2025

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# 1. Executive Summary

Since the introduction of the *e-Infrastructure Commons* in the e-IRG Roadmap 2012, some progress has been made towards an integrated e-Infrastructure landscape[1], most notably with the implementation of the European Open Science Cloud (EOSC) and the federation of generic (horizontal) and thematic (vertical) services from e-Infrastructures and Research Infrastructures accordingly. Still, progress is slow given the complex European research ecosystem spanning institutional, national regional and European components, at different maturity levels and speeds. The current cooperation and coordination among European e-Infrastructure initiatives and related organisations under the EOSC undertaking or other efforts, is ad-hoc and not properly framed. e-IRG sees a clear need to enhance the coordination and cooperation among major European e-Infrastructure initiatives, which are an indispensable part of EOSC. This will eventually benefit the end users who will gradually enjoy well-coordinated, joint, integrated user-friendly services, easing their work, so that they can focus on their (cross-)disciplinary research, and not the infrastructures and tools.

The objective of this e-IRG White Paper 2022 is to provide recommendations to the different stakeholders to strengthen the communication between e-Infrastructure providers at European level and their cooperation towards an enhanced and coordinated strategy setting. The need for better coordination across national and European levels has also been emphasised by the European Competitiveness Council on several of their Conclusions and Recommendations in the last years, calling for an increased cooperation between research infrastructures, e-Infrastructures and stakeholders, including through EOSC. With its White Paper 2022, e-IRG thus aims to bridge the identified gaps in terms of cooperation and coordination across the major European e-Infrastructure components, reflecting on the identified issues and providing concrete proposals.

Although exchanges between the major European e-Infrastructures actors are already taking place at project-based or other ad-hoc levels, e-IRG believes that a regular, well-framed and high-level coordination at strategy level would be beneficial for the ecosystem, as it would ensure a steady dialogue and flow of information and common understanding across all actors.

An umbrella e-Infrastructure Forum as already recommended in the e-IRG White Paper 2013 and e-IRG Roadmap 2016 (or other lightweight structure) with representatives of the major e-Infrastructure initiatives will enable the above mentioned flow of information, steady dialogue and common understanding and be able to foresee and proactively resolve issues and frictions among e-Infrastructures. The e-Infrastructure Forum or Assembly should facilitate high-level strategy-setting, community building, and coordination of the entire e-Infrastructure landscape. Some form of representation of users is also favoured in the Forum, possibly advisory and domain-agnostic/neutral, such as via ESFRI Clusters that covers all thematic domains or other structures.

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[1] e-IRG Vision: e-IRG is a strategic body to facilitate integration in the area of European e-Infrastructures and connected services, within and between member states, at the European level and globally. (https://e-irg.eu/mission-and-vision/)

Besides EOSC, EuroHPC is the other major recent undertaking building a set of word-class High Performance Computing (HPC) systems across Europe, which already yielded impressive results as several EuroHPC systems have already been inaugurated and are featuring in the first places of the Top500 and Green500 benchmarks. e-IRG sees that coordination between EuroHPC, EOSC and related e-Infrastructures would be required in the near future. Interoperability between the EOSC and EuroHPC federations would also provide strong benefits for the end users of computing and data services. It is thus recommended to invite EuroHPC to join the envisaged coordination and collaboration structure(s) in the near future.

Furthermore, e-IRG emphasised the importance of having transparent funding streams, costs and business models of each e-Infrastructure provider to facilitate their long-term sustainability.

In the preparation of this document, e-IRG, as an independent body of representatives from European countries, has initiated the discussion between all stakeholders and is aiming at liaising as a neutral platform with the corresponding bodies, offering its expertise and high-level advice for the alleviation of fragmentation towards the envisaged integrated and holistic e-Infrastructure environment, facilitating such a cooperation and coordination framework.

# 2. Coordination of EU e-Infrastructures

## 2.1 Introduction

Besides the networking layer that was already rather advanced since more than 10 years ago, considerable progress has been achieved in the electronic Infrastructures (e-Infrastructures[2]) in the last 5-7 years across all layers and in particular in the computing and data layer. Furthermore, two significant initiatives have been launched which by now are well underway towards implementation, namely the European Open Science Cloud (EOSC) and the EuroHPC one.

EOSC is aiming towards a federated environment for hosting and processing research data via the appropriate tools and services to support EU science[3]. In terms of e-Infrastructures, it builds on the High Throughput Computing (HTC) EU infrastructures mainly federated in the EGI infrastructure[4], and the research data management infrastructure EUDAT[5] (https://www.eudat.eu) and the scholarly communication infrastructure in OpenAIRE[6] (https://www.openaire.eu). These e-Infrastructures are based on national or regional components and support structures[7], and are contributing towards the realisation of EOSC as a system of systems. The process to create the EOSC was initiated by the European Commission in 2015 and its first phase was concluded at the end of 2020. EOSC is now in its second phase in an effort to consolidate national[8][2], regional and European components, as well as both generic (discipline-agnostic) and thematic (disciplinary) ones, along with related policies and strategies, ultimately aiming at easing researchers in their data-driven cross-disciplinary research. In terms of governance in its current phase, EOSC has been organised as a co-programmed European Partnership[9], between the EC and the newly formed EOSC Association[10]. The Partnership Board includes representatives of the Member States (MS) and Associated Countries (AC) in a Steering Board, in essence forming a tripartite collaboration[11] among the EU represented by the Commission, the EOSC Association, and the MS/ACs to guarantee resources and support to EOSC.

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[2] A proper definition of e-Infrastructures needs to be agreed; still, it should be clear that e-Infrastructures are cross-cutting, digital infrastructures comprising information and communication technology based resources and integrated services. e-Infrastructures consist of communication networks, high-throughput and high-performance computing facilities, data infrastructures and all related middleware, software and services. Thus, e-Infrastructures include (generic) data infrastructures.

[3] European Open Science Cloud (EOSC) | European Commission (europa.eu)
[4] https://www.egi.eu/
[5] https://www.eudat.eu/
[6] https://www.openaire.eu/
[7] These national and regional components have been analysed by e-IRG in its 2019 policy document "National Nodes - Getting organised; how far are we?" (https://zenodo.org/record/3608075) and the e-IRG White Paper 2021 (https://zenodo.org/record/5741971)
[8] In several countries National Open Science Clouds (NOSCs) initiatives are well underway
[9] Partnership | EOSC Association
[10] Association | EOSC Association
[11] Tripartite Collaboration | EOSC Association

On the other hand, EuroHPC is building a set of word-class High Performance Computing (HPC) systems across Europe. These are organised at multi-country level with an agreed location for each of the systems, and in some cases national components. In terms of organisation a Joint Undertaking (EuroHPC JU[12]) has been established to lead this effort and the majority of European countries have joined the EuroHPC initiative as members. In this way, the EU (50% in cash via the EC) and participating countries (50% in cash or in kind) pool their resources together to deploy these petascale, pre-exascale or even exascale supercomputers and related technologies/applications. The EuroHPC systems are also in the process of implementation, with the majority of the systems having been procured, working towards operation or already operational. EuroHPC JU systems have made it to high-ranked positions in the Top500 and Green500 ones, given the increasing importance of energy efficiency and green approaches. Respective policies for the access and use of the systems are also being developed with a first set already being agreed[13]. It is important to note that EuroHPC is also aiming to serve industrial users, and this makes it a particular case compared to the other e-Infrastructures that focus on the mainstream of research and academia, although they are able to serve industrial research.

Furthermore, the Partnership for Advanced Computing in Europe (PRACE[14]) has been working to facilitate access to supercomputing and data management resources of its hosting countries for a series of years and corresponding projects. This is done via a peer review process, while in the last years more flexible and fast access schemes have been introduced, with lightweight peer-review evaluation (e.g. for AI usage) but also limited resources. PRACE is also negotiating with EuroHPC in its role for providing peer-review access to the EuroHPC systems. Additionally PRACE provides a rich set of training activities for the users of supercomputers.

In parallel, GEANT[15] has been steadily providing high-speed and high-quality connectivity and related services interconnecting the vast majority of European National Research and Education Networks (NRENs) around Europe and beyond, expanding towards all continents around the world. Besides the operational services offered at production level, new and innovative services are continuously being introduced and gradually moving in production. GEANT has been for more than 20 years providing the "glue" between the EU NRENs, who in turn interconnect their research and academic institutions completing the chain of campus-national (sometimes regional) and European research networking ecosystem. GEANT, besides offering advanced middleware services (such as Authentication and Authorisation Infrastructure – AAI), has also expanded towards the computing layer, offering for example cloud services[16] via an integrated pan-European framework agreement program. GEANT has become a vital trust aggregator in the EOSC ecosystem.

*Besides the progress made in each individual area in these major EU e-Infrastructures (networking, computing, data and scholarly communications), there is still a lot to be*

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[12] https://eurohpc-ju.europa.eu/
[13] EuroHPC JU Documents
[14] https://prace-ri.eu/
[15] https://geant.org/
[16] https://clouds.geant.org/

*done in terms of cooperation and coordination across these major infrastructures, especially towards providing integrated user-friendly services easing the work of researchers and providing to them added value. In particular, cooperation and coordination between EOSC and EuroHPC is still in early stages of discussions and of position statements formulations, while work in this area is being planned as part of the EC Work Programmes for 2021-2022 and the next one (2023-2024) recently published.* Although GEANT is transparently offering its services to its users with high professionalism, the example of the high-speed interconnection of the EuroHPC systems, required deliberations between the EuroHPC JU and its members, as well as with GEANT and the NRENs with regards to possible interconnection solutions. *Thus, proper planning for cooperation and coordination, looking ahead is required among all these major stakeholders.*

## 2.2 Policy Area and Goal

The need for coordination across e-Infrastructures is confirmed at the highest political level, the EU Competitiveness Council, with top-down initiatives and statements for many years now, resonating and complementing the bottom-up requirement from the e-Infrastructure community for integrated services. In particular, in its conclusions on the New European Research Area (ERA)[17] in the December 2020 Council "encourages the Commission and Member States **to increase the level of national and European coordination**, in particular on research infrastructures and e-infrastructures". A similar message is part of the Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe *to develop better "connection of existing and new European and national research infrastructures, including e-infrastructures"* and on the Future governance of the ERA[18], with its new ERA Policy Agenda and ERA Actions. In particular, under ERA Action 8 on Research Infrastructures, there is a clear call for *"increased cooperation between research infrastructures, e-infrastructures and stakeholders, including through EOSC".* In the ERAC meeting in September 2022[19], as part of the discussion on the Digital Transition of European Research Infrastructures, the Members States and EC affirmed the required coordination among EOSC and ESFRI and also with other e-Infrastructures such as GEANT and EuroHPC.

**The e-IRG White Paper 2022 aims at bridging the identified cooperation and coordination gaps across the major e-Infrastructure components, reflecting on the above issues and providing concrete advice and recommendations to all related stakeholders**. Relevant e-Infrastructure stakeholders are GEANT, EOSC and the underlying e-Infrastructures EGI, EUDAT, OpenAIRE, as well as PRACE and EuroHPC mainly dealing with "Horizon Europe", "Digital Europe" and "Connecting Europe Facility" programs. The multiple EU funding streams, along with relevant national funding streams (either coming from the EU or from national sources), constitute a quite complex and challenging environment, and coordination across both e-Infrastructures and funding streams is more eminent. The exclusion of the Switzerlands and the United

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[17] https://data.consilium.europa.eu/doc/document/ST-13567-2020-INIT/en/pdf
[18] https://data.consilium.europa.eu/doc/document/ST-14308-2021-INIT/en/pdf
[19] https://era.gv.at/public/documents/4775/WK_13550_2022_INIT.pdf

Kingdom, who are crucial partners in European research and science, from several funding programs, makes this environment even more complicated and coordination imperative.

**e-IRG, as an independent body of representatives from European countries, aims at liaising as a neutral platform with the corresponding bodies, offering its expertise and high-level advice towards the alleviation of fragmentation and the envisaged integrated and holistic e-Infrastructure environment, facilitating the introduction of such a cooperation and coordination framework**.

The goal is to analyse and discuss coordination between e-Infrastructure providers and related initiatives to facilitate easy and transparent access and enhanced use for the benefit of the user communities, to enforce and support the policy development and give advice where necessary or needed. Ultimate goal is the secured funding, coordination and sustainability of pan-European initiatives, distributing the inherent risk of the different undertakings. Practical benefits of such joint activities include the need to overcome the fragmentation, avoid duplication of efforts and promote innovation via federated environments, covering in particular the envisaged EOSC and EuroHPC undertakings and the relations between the two. The implementation of such links would address important strategic objectives of the new European Research Area to become inclusive, collaborative, seamless and connected, inspiring and open.

Besides the ERA, there is now a trend of several e-Infrastructure providers across Europe to expand to other "universes" (beyond the ERA), such as health, the public sector and digital governance, as well as the private sector. This also implies different funding programmes besides the Horizon Europe one, such as Digital Europe Programme and Connecting Europe Facility2, including the national Resilience and Recovery Funding instruments, the Structural Funds, etc. This involves also the interconnection with Digital Hubs, Startups/SMEs, expanding Open Science towards citizens and the general public and promoting Open Innovation and connections with Industry. "Cross-programme, cross-"universe" use of e-Infrastructures will require advice on such policies, identifying good practices, practical solutions, etc. **Still, the primary focus of this paper is on Research and Science**.

## 2.3 Process and past papers

e-IRG organises two open workshops every year, and four closed meetings among its delegates nominated by (research-related) ministries, each under the auspices of the corresponding EU presidency. In line with its vision ("to facilitate integration in the area of EU e-Infrastructures and connected services, within and between Member States, at the EU level and globally") and mission ("to support related policy-making"), the topic of coordination at institutional, national, regional and European level has been a steady topic in its past policy papers:

- e-IRG stressed the need for e-Infrastructure coordination at the national level and strong national building blocks, enabling coherent and efficient participation in European efforts in the **e-IRG Roadmap 2016[20]**

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[20] e-IRG Roadmap 2019 https://zenodo.org/record/4048805#.Y7x6pS9Xa3U

- The role of National Nodes in the implementation of the e-Infrastructure Commons and its instantiation as the European Open Science Cloud is also highlighted in the e-IRG policy document **"National Nodes - Getting organised; How far are we?**" (2019)[21]
- Good practices of coordination within and across e-Infrastructures and thematic Research Infrastructures are presented at institutional, national and regional levels in the **e-IRG White Paper 2021**[22]

The topic of coordination at **European level** has been initiated in the e-IRG Roadmap 2012[23] and detailed in the **e-IRG White Paper 2013**[24]. e-IRG has recommended the **creation of a Forum of e-Infrastructure providers at EU level** almost since a decade ago as part of its vision towards 2020 and beyond both in White Paper 2013 and **e-IRG Roadmap 2016**[25]. Its current White Paper 2022 is coming back to this topic, as there have been several developments in the e-Infrastructure landscape and discussions are maturing. For example, as part of EOSC, a framework for the federation of both generic (horizontal) but also thematic (vertical) e-Infrastructure services has been established and is being implemented. The e-IRG White Paper is initially focused at the EU level, but it goes without saying, that it is also strongly linked to the national/regional levels, and also to community and thematic levels, as highlighted in the e-IRG past documents.

## 2.3.1 The White Paper 2022 creation process

The main steps taken to come up with the White Paper 2022 are summarised below:

- Established of informal link with EOSC Steering Board, September 2021
- Dedicated meeting with EC (DG Connect and DG R&I) in December 2021
- Organised related sessions at May 2022 e-IRG workshop (French EU Presidency)
  - Session I: Towards a sustainable EOSC - The role of e-Infrastructures
  - Session III: Cross-e-Infrastructure collaboration and coordination
- Prepared a questionnaire for all major e-Infra stakeholders – June-July 2002
- Internal feedback from e-IRG delegations - July and August 2022
- Questionnaire sent to e-Infrastructures in August 2022
- First batch of answers to the questionnaire received in September 2022
- Analysis of answers presented at the EGI Conference 2022, in September 2022
  - At the EGI conference (closing plenary) EGI, EUDAT, GEANT and OpenAIRE expressed their willingness to pursue a more structured cooperation
- Second batch of answers to the questionnaire received in November 2022
- Updated analysis of answers presented at the EOSC Symposium, in November 2022
- Answers received from:
    - EGI, EOSC Association, EOSC Steering Board, EUDAT, GEANT, OpenAIRE, PRACE.

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[21] National Nodes - Getting organised; How far are we? https://zenodo.org/record/3608075#.Y7x7By9Xa3U

[22] e-IRG White Paper 2021 https://zenodo.org/record/5741971#.Y7x7aS9Xa3U

[23] e-IRG Roadmap 2012 https://zenodo.org/record/4049560#.Y7x6Ti9Xa3U

[24] e-IRG White Paper 2013 https://zenodo.org/record/4049675#.Y7wWni9Xbq0

[25] e-IRG Roadmap 2016 https://zenodo.org/record/4048805#.Y7wXky9Xbq0

- Draft White Paper 2022 prepared early December 2022 (later than envisaged) and presented at e-IRG Workshop under the Czech EU presidency in Prague. The inputs were discussed during the e-IRG workshop among all stakeholders who answered the questionnaire.
- A closed meeting of the stakeholders who answered the questionnaire, plus ESFRI, took place immediately after the e-IRG workshop.

A few more details on the above steps are included below:

e-IRG organised a **dedicated meeting with the EC services** on this topic of e-Infrastructure coordination in its December 2021 meeting with representatives from both DG Connect and DG R&I.

**In the e-IRG open workshop under French EU presidency in May 2022, one of its sessions was dedicated to e-Infrastructures cooperation and coordination**[26]. An additional session was jointly organised between e-IRG and the EOSC SB on common EOSC policy areas and gaps[27]. All these efforts are in line with the 2018 Competitiveness Council Conclusions on EOSC referring among others to "*e-Infrastructures and RIs to get organised so as to prepare them for connection to the EOSC",* calling for the EC to make optimal use of initiatives such as ESFRI and e-IRG[28].

The e-IRG support project then prepared a **questionnaire for major e-Infrastructure-related initiatives** (**see [Annex 1](#)**). The questionnaire was discussed within e-IRG and all comments provided by the e-IRG delegations were integrated.

The questionnaire was then **distributed to the major e-Infrastructure-related initiatives in August 2022**. It should be noted that not all initiatives contacted own e-Infrastructure resources. Still, they play a major role in the federation of resources, the development of policies and/or are linked with corresponding e-Infrastructure communities and users. As such, the EOSC Association and the EOSC Steering Board, with which e-IRG has established informal links, have been contacted.

A first (preliminary) analysis of the answers was performed for the purpose of the EGI 2022 conference closing session, where the e-IRG White Paper 2022 draft was first presented. In the closing session major e-Infrastructure initiatives were invited, namely EUDAT, EuroHPC, GEANT, OpenAIRE and EGI. The main outcome of the session is that GEANT, EGI, EUDAT and OpenAIRE expressed their willingness to move from the current ad-hoc cooperation and coordination to a more structured cooperation and coordination framework as foreseen already in the White Paper 2013.

A second batch of answers to the questionnaire was received only late in November 2022, just in time for the updated e-IRG White Paper 2022 presentation at the EOSC Symposium. Positive feedback to e-IRG presentation was also received during the

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[26] e-IRG Workshop under French EU Presidency: Cross-e-Infrastructure collaboration and coordination
[27] e-IRG Workshop under French EU Presidency: Towards a sustainable EOSC - The role of e-Infras
[28] https://data.consilium.europa.eu/doc/document/ST-9029-2018-INIT/en/pdf

EOSC Symposium, this time coming from the EOSC community, as the session where the presentation was given was in the area of Researcher Engagement in EOSC.

At the end answers have been received from all the invited stakeholders, namely EGI, EOSC Association, EOSC Steering Board, EUDAT, GEANT, OpenAIRE, PRACE, besides EuroHPC, who stated that they are working on their answers. The draft e-IRG White Paper 2022 was thus prepared only in December 2022 (i.e. later than envisaged, given the very busy schedule with multiple trips from the e-IRG secretariat and also the late feedback from some e-Infrastructures). The e-IRG White Paper 2022 was then presented at e-IRG Workshop under the Czech EU Presidency in Prague, and valuable input was received during the related session, but also during a follow-up closed meeting among the above stakeholders, plus ESFRI.

## 2.4 Questionnaires analysis

The analysis is given per area of the questionnaire (see Annex I)

### 2.4.1 Respondents

As identified already, answers have been received by the following e-Infrastructure related organisations:

a. EGI, EOSC Association, EOSC Steering Board (SB), EUDAT, GEANT, OpenAIRE and PRACE

### 2.4.2 Governance of EU e-Infrastructures/e-Infra Forum

a. A main point in this area was the question on the ***e-Infrastructure umbrella Forum for community building, high-level strategy setting and coordination for the entire e-Infrastructure landscape,*** which was recommended already in the e-IRG White Paper 2013. This umbrella Forum is not a separate organisation, but a forum in which the representatives of the strategy and coordination bodies and user communities for the different parts of the European e-Infrastructure work on a common strategy based on common understanding among each other.

   i. *How does the European e-Infrastructure organisation/initiative you represent perceive this idea? Is your organisation/Initiative willing to discuss the framework for such a Forum?*
   **The majority of answers received so far is positive** (covering all e-Infrastructures, including open scholarly communications) but clear definition of roles and coordination with existing bodies is required. On the other hand, the EOSC SB proposes existing channels, such as the EOSC Association, ESFRI Stakeholders Forum or the upcoming joint ESFRI-EOSC structure, in line with ERAC recommendations.

   ii. *Which generic (horizontal) European e-Infrastructure bodies would you like to see in such a Forum? (keeping in mind that the e-Infrastructure landscape is spanning networking, computing, data components and related services). Do you believe that EU e-Infrastructure stakeholders from all layers should participate?*

**Most answers advocate for the Forum to be inclusive.** So, the participation of all consolidated publicly-funded e-Infrastructures of pan-European relevance is welcomed. Although the EOSC Association is not an e-Infrastructure, it is a stakeholder strongly connected with e-Infrastructures. Thus, it is interested in following the activities of the Forum.

iii. *Besides generic (horizontal) e-Infrastructure providers in this Forum do you also envisage some form of user/thematic communities representation? And what about EU funding agencies or policy makers? Comment on the potential roles of each of these.*
**Some form of representation of users is also favoured,** possibly advisory and domain-agnostic/neutral, such as via ESFRI Clusters that cover all thematic domains or via an ESFRI-EOSC joint group currently planned or via the EOSC governance bodies. Some answers indicate that funding agencies and policy makers should also be invited. The representation of national and industrial relevant stakeholders can also be discussed. In addition, other models could be studied to identify good practices that can be applied in the e-Infrastructure Forum.

iv. *e-IRG can facilitate the process for the establishment of such a Forum as a neutral body/platform. How does your organisation perceive this idea?*
**Mixed answers have been received on the facilitating role of e-IRG**, some are positive, some neutral and some negative. So, this should be discussed by the Forum members.

v. *[optional] Do you believe that besides a strategy / governance forum a technical / operational forum across all e-Infrastructures would be beneficial?*
**Mixed answers have been received on the creation of a technical forum. A gradual approach seems to be favoured.** So, some high-level technical/operational points could be included in the main strategy Forum.

vi. *What is the expected impact on your governance due to increased coordination between e-Infrastructures?*
Some answers indicate that i**nternal steering via such a Forum could be achieved, without impacting so much the organisation governance**. Input to such a Forum may be provided by internal organisation WG.

b. *Other points/ideas you would like to raise on the topic of governance.*
Some answers indicate preference of a **lightweight and pragmatic approach to such a Forum**. Also, given the ad-hoc nature of coordination (e.g. as part of projects such as EOSC Future, EOSC tripartite governance or organisations such as EOSC Association), structured coordination can have a positive effect overall.

Some answers favour the role of e-IRG as a think tank to discuss new ideas, new services and news entities, rather than having a role as an implementation body.

## 2.4.3 Compatible policies/interoperable services/operational aspects

a. *In the last years the EOSC stakeholders have been working on rules of participation, common or compatible policies and interoperable services in EOSC to enable the federation of e-Infrastructures providers and their services (e.g. EGI, EUDAT, OpenAIRE) and thus facilitate data-driven science. EOSC is working towards the development of an ecosystem of portals at EU/regional/national and in some cases institutional levels to provide added-value services to end users, facilitating also cross-disciplinary research/science, which is required to address the scientific and societal challenges. Work is also underway towards a personalised and smart (AI-based) dashboard for researchers/scientists that will include relevant data/services/workflows/software and other artefacts to ease their work. EuroHPC has been doing similar work to federate the EuroHPC centres and define the rules of participation and sharing of resources among its members.*

   i. *Do you believe that the **EOSC and EuroHPC** (federation and sharing) paradigms should be expanded to federate data/services across all major European e-Infrastructures?*

Mixed answers have been received on this point. Although **EOSC and EuroHPC coordination is important** and should happen, this may have to be **planned in a next phase** (next few years). Note, that several answers may have misunderstood this question (which is about EOSC and EuroHPC coordination) and reflected on federation and sharing approaches within their areas (e.g. EOSC).

   ii. *Federation of all e-Infrastructures would require **compatible policies and interoperable services,** so that they can be integrated in a federated portal and ultimately in the personalised dashboards of end users. Do you believe that this can be done in the coming years or should priority be given first to each of the areas, e.g. EOSC and EuroHPC, before attempting to work together at such (technical) level?*

Again mixed answers have been received on this point. Still, **priority on each of the two areas (EOSC and EuroHPC) should be given first**, **before attempting to work together.** A discussion about interoperable federations between EOSC and EuroHPC appears to be premature.

   iii. *[optional] Authentication and Authorisation Infrastructures (AAI), including blueprint architectures, have been developed (e.g. GEANT and EGI) and there has been significant effort to make them interoperable and use them across horizontal and thematic e-Infrastructures. Do you find this as an example of collaborative operational work and interoperable policies that can be expanded to other e-Infrastructures and more communities?*

**Answers are rather positive**, showing that in this area quite some progress has been achieved, spanning both the EOSC and EuroHPC ecosystems. On the other hand, there are multiple providers and in some cases slow progress. Still quite some work to make it more user friendly and transparent, especially when using services across different service providers.

*iv.* ***Resource access models and policies differ between HPC*** *(more based on call for proposals with peer-review evaluation committees for longer time, e.g. 1 year)* ***and HTC*** *(faster process and cycles based on policies and more opportunistic, e.g. policy-based access to support national access to EU thematic collaborations such as ESFRI projects or ERICs). Furthermore, resource ownership models are different, e.g. EuroHPC owns up to 50% of the EU access capacity of EuroHPC systems, while in HTC the vast majority of resources and their access are national. The above may hinder interoperability and cross e-Infrastructure usage (i.e. HTC-HPC). Do you see space for cooperation/coordination in this area? If this is the case, which of your organisation's policies need to be adapted.*

Most answers confirm the gap between resource access models in HPC and HTC, and **room for cooperation in this area**. There is already some work done by PRACE trying to bridge these models, such as a lightweight peer-review evaluation for Artificial Intelligence resources that is still for limited resources, while EGI mentions that implementation of a compute continuum federating HTC-HPC-Cloud facilities in Europe and beyond is part of the EGI Federation strategy. On the contrary, there are answers questioning the need for such HPC-HTC interoperability as they are aimed for different use cases and are differently funded.

*v. There is a plan to update the EU Charter of Access to Research Infrastructures (including e-Infrastructures). Do you see a role of the future e-Infrastructure Forum at strategy or technical levels in this update?*

All answers indicate that the **Charter of Access to RIs could benefit from a coordinated input from horizontal e-Infrastructures**.

*vi. What about coordination with similar industrial efforts (e.g. GAIA-X) and industrial e-Infrastructure/service providers (EU and non-EU) or other thematic data spaces in the super portal mentioned above? Do you see this as a priority for the coming years?*

***Mixed answers have been received on the coordination with relevant industrial efforts.*** *The area is important, however this may become a priority after consolidating the user base from the research community by 2024 (i.e.. in EOSC in 2025-2027). The Common European Data Spaces support different business models with a range of services. Recommendations on both areas (industry and data spaces) would be valuable, including input on the area of Technology Infrastructures under Action 12 of the ERA Policy Agenda.*

*vii. Are there in your opinion other important operational aspects that need to be harmonised to facilitate a well-coordinated federated European e-Infrastructure?*

Some answers indicated the **need for a cross e-Infrastructure helpdesk for technical support to the e-Infrastructure users, as well as joint training capacity planning and delivery.** Other areas include standardisation of APIs to

allow interoperability of front end portals with various levels of middleware provided by e-Infrastructures (GEANT), resolution of software licensing access in the different service providers, workflow harmonisation for automation (machine-to-machine) (PRACE), the EOSC Interoperability Framework and architecture aspects (e.g. on the emerging SIMPL middleware for data spaces and interoperability with EOSC), practices and tools for sensitive data, data security aspects (including authorisation for who has access to what and when), certification of trusted repositories/data sources, and last but not least business models both for services but also for data (OpenAIRE), harmonisation on the access to the e-Infrastructures (EOSC Association).

*viii.*　*What is the **expected impact on operational aspects** due to increased coordination between e-Infrastructures?*

Increased usage, better solution based service offerings to the users, lower costs as a result of focus on core competences (EUDAT), easier communication and alignment of operations between the compute, data and network service providers (PRACE), a shorter time to scientific discovery thanks to fast adoption of innovative IT solutions (EGI), seamlessly composing multiple services and integrating multiple FAIR data sets into new, innovative workflows (EOSC SB), facilitation of the provision of resources (EOSC Association). Beyond operational aspects, cultural and strategic aspects of coordination between e-Infrastructures may also need to be reflected upon (GEANT).

## 2.4.4 Cost and Business Models, Funding/Sustainability

a. *Understanding costs and having business models for e-Infrastructures is important for planning their operation and their sustained funding, including renewing (procuring) the actual infrastructure over the years. A joint group between the EOSC Steering Board and e-IRG have identified a gap in this area that needs to be developed in the future, especially given the transition of EOSC Core and part of EOSC Exchange towards an operationalised framework (based on procurement vs. short lived projects).*

i. *Does your infrastructure have a **cost model and methodology** to track its costs? If federated, is there a common cost model/methodology across the national components?*

**Mixed answers** have been received on this point, as in several cases resources and related services are distributed at national or institutional level, which makes it quite complicated. Some e-Infrastructures can cope with such distribution, others not, depending on the scale, while others have not progressed. This question is also not directly applicable for the EOSC Association and EOSC Steering Board.

ii. *If not, do you see the need for an **establishment of lightweight methodologies and cost models** for the different layers (networking, computing, data) for better understanding the costs of e-Infrastructures (both CAPEX and OPEX), across EU e-Infrastructures and also across national entities? See as an example the e-FISCAL methodology/model for computing costs.*

**Mixed answers**, depending also on the answer to the previous question. **Understanding the cost of each e-Infrastructure provider is very important for their future sustainability and business models**. E.g. understanding first the cost of operating EOSC is crucial and then sustainability methodologies need to be defined.

Relevant work of the EOSC Focus was also brought up to develop and test cost models and future business models for a lasting long-term sustainability framework for the EOSC platform and of the EOSC TF on Defining Funding Models for EOSC.

iii. *Do you believe that collecting and **sharing different approaches** (around methodologies and cost models) across Europe could provide value to the EU or national actors?*

**Answers are very positive on sharing practices around cost models and methodologies.** This may help new actors to understand the cost models, as well as **provide transparency** and **increased understanding by funders** on the particularities of e-infrastructure costs. Sharing good practices and experience, including in the area of virtual access and transnational access funding, since the current experience (e.g. EOSC-hub) demonstrated that the level of maturity of cost analysis varies greatly in publicly-funded providers with different cost recovery models. It can be an instrumental activity to support the definition of the European transnational access model to national infrastructures participating in e-Infrastructures.

iv. *Does the e-Infrastructure you represent have a **business model and sustained funding** to facilitate a sustained operation?*

Most answers indicate that they are **working in this direction** of sustained funding and related business models. Still, they may be at different maturity levels.

v. *What is the **expected impact on your funding/business model due to increased coordination** between e-Infrastructures?*

Some answers indicate no envisaged change to their funding models in the short term due to the increased cooperation, while others **can't foresee the outcome**. Other answers indicate that increased coordination can help in **reducing costs at the providers side by joint services and avoiding duplication of efforts**.

## 2.4.5 Other

a. *Any other topics or points in this area of e-Infra cooperation/coordination that you would like to discuss in a potential future Forum or any comments.*

   i. *What are the **main or potential obstacles for the end users to conduct cross e-Infrastructure research** activities that you are aware of? Lack of awareness (of services availability), administrative burden, ease of use and added value, fragmented environment (multiple e-Infras, multiple EU funding programmes, coordination among EU and national*

*players), different priorities, different policies (access, resource usage, etc). How can the identified or potential obstacles be overcome?*

*Several of the above and many more have been raised, including:*
- *Different legal/funding environments, dependencies on projects*
- *Administrative barriers rooted in the funding of resources that govern their usage*
- *Fragmented environment (many e-Infrastructures and services), different types of actors (from network, to hard core computing, to scholarly communication), different priorities/policies, lack of long term technical support and funding for customization of existing solutions*
- *Different or lack of common/coordinated business models*

ii. *e-IRG has recommended increasing coordination efforts between the e-Infrastructures for a long time now, what would be the business **areas mostly affected from such increased coordination** in your e-Infrastructure organisation?*
*Key areas are **joint or integrated easy to use services towards the end users** and **increased speed and breadth of adoption of services** (due to technical support and compatible policies)**. Other areas that can benefit from increased coordination are **cost savings**, **outreach efforts, joint research and development programmes** across e-Infrastructure for the introduction of innovative services.*
*A common challenge for all e-Infrastructures include **talent shortage**, keeping high-talented personnel (lower salaries compared to industry).*

## 2.5 Feedback during the e-IRG sessions

The draft e-IRG White Paper 2022 was presented at the first session of the [e-IRG Workshop on Monday, 12th of December in Prague](#) (hybrid event). All e-Infrastructure stakeholders, who responded to the questionnaire were present, plus a representation of the EC and also ESFRI. A closed meeting among the stakeholders present took place after the end of the session. The main points from the e-IRG events are summarised below.

There is agreement that moving from the current ad-hoc (mostly project-based) coordination and collaboration, to a regular, well-framed and high-level coordination at strategy level would be beneficial. This would ensure a steady dialogue, constant flow of information and common understanding across all actors. The exact form of the coordination still needs to be decided, but e-Infrastructures agree that it should be lightweight & progressive.

**Key points raised by the e-Infrastructures representatives** regarding the need for coordination during the Prague meeting were among others on the following:

1. **Laying out each of their (e-Infrastructure) visions**, as well as interconnecting and coordinating their visions, as well as evolving their visions over time given the ongoing developments.

2. Going beyond coordination towards working together and paving the way towards having "**interdependencies**".
3. **Sharing experiences and building views,** and in general facilitating the strategic discussions via means such as joint position papers for funders to inform policy making based on the practical experience of servicing research, or joint contributions to major European initiatives, such as EOSC (e.g. EOSC SRIA and MAR), ESFRI (e.g. Charter of Access), Data Spaces, EuroHPC, etc.
4. Synergies, connections and **joint communication and dissemination efforts** towards the communities.
5. Organising **joint R&D projects for the introduction of their next generation services**
6. The coordination should ultimately **benefit their end users, with high-level harmonisation of service delivery for communities** that require integrated and seamless access (this can also include training and technical support), simplifying the complex research ecosystem. This means that **a combination of the top-down strategy setting approach with the bottom-up user needs is needed**. Regarding the user representation in the coordination structure, this needs further discussion.

Although there was considerable progress in the areas of coordination, the exact areas need to be further discussed and agreed.

Regarding the form of the cooperation, e-Infrastructures prefer a consensus-based, lightweight and agile structure, without much overhead, which is open to e-Infrastructures and transparent to the community, having an advisory role to their e-Infrastructures governance. The coordination structure should start working very soon, without many formalities. If the coordination is appreciated, then it can go deeper.

The EuroHPC view as a major stakeholder in the ecosystem would be greatly appreciated.

## 2.6 Proposed approach

*After analysing the contributions from the EC and the e-Infrastructures, some key proposed directions are presented in this section.*

Coordination across e-Infrastructure providers will promote the digital transformation and the crucial role of e-Infrastructures in the new ERA and beyond, given also the foreseen pillars on open science, open innovation and grand challenges including health, digital and industry, climate, etc. So there is a need for closer cooperation and coordination across the different e-Infrastructure and data providers, including cooperation between thematic research infrastructures (e.g. clusters, RI projects) and horizontal (generic) e-Infrastructure providers (network, computing, data) within and across GEANT, EOSC and related e-Infrastructures, and EuroHPC.

**Although significant exchanges between the major European e-Infrastructures actors are already taking place ad-hoc,** one way or another, **e-IRG believes that a regular, well-framed and high-level coordination at strategy level would be beneficial for the ecosystem, as it would ensure a steady dialogue and flow of information and common understanding across all actors.**

Based on the analysis of the answers from major e-Infrastructures, the following approaches and steps are proposed:

1. **An umbrella e-Infrastructure Forum, Assembly or other lightweight structure (exact name and form needs to be agreed) with representatives of the major e-Infrastructure initiatives to facilitate the above mentioned flow of information, steady dialogue and common understanding and be able to foresee and proactively resolve issues and frictions among e-Infrastructures is proposed. The Forum can be used for high-level strategy-setting, community building, and coordination of the entire e-Infrastructure landscape.**
   a. The idea of the Forum was well received by both the e-Infrastructure providers (EGI Conference closing plenary in September 2022, e-IRG workshop December 2022 and related closed sessions on both events) and also the users (EOSC Symposium in November 2022).
   b. **The exact representation and form (including hosting entity) of the Forum is to be decided among the e-Infrastructures themselves**, however from the discussions at the e-IRG workshop, all components should be represented, while clear definition of roles and coordination with existing bodies are required. **A lightweight and progressive approach is also favoured.**
   c. The **EOSC Association** is interested to have observer status in the Forum, and it is proposed that its role in the Forum is agreed with the other stakeholders. The EOSC Steering Board would be welcome to reflect on their participation.
   d. **EuroHPC** has not yet officially answered the e-IRG questionnaire, although it has provided feedback during the May 2022 e-IRG workshop and September 2022 EGI Conference. On the other hand, **PRACE's answer** indicates the initial willingness to join the Forum. The Forum can be initiated by the collaboration among GEANT, the EOSC major related e-Infrastructures (EGI, EUDAT and OpenAIRE) and PRACE, also followed by the EOSC Association. It is proposed to be expanded to EuroHPC (if favoured by the EuroHPC governance) in the near future.
   e. **Representation of the thematic / user communities is important**, with an advisory role, however given the high number of communities and stakeholders, an appropriate representation is challenging. A domain-agnostic and neutral representation would be favourable. Such representation can possibly be achieved by ESFRI clusters (e.g. via a rotating representation) that cover all thematic domains or via another entity (or entities) such as the foreseen ESFRI-EOSC joint group. Other approaches, as in other high-level bodies can be examined.
   f. An additional **technical / operational forum** across all e-Infrastructures got mixed reviews, and it is proposed that some high-level technical/operational aspects can be included in the agenda of the strategy-setting Forum.
   g. **e-IRG**, as a neutral body, offered a facilitating (only) role in this Forum. However, as mixed answers have been received, it should be left to the Forum members to make a decision.

h. Regarding the **topics** on cooperation and coordination of the Forum, the list is quite long and needs to be prioritised as part of the Forum itself, during the first preparatory meetings. An initial list has been presented in section 2.5, requiring a combination of the top-down strategy-setting approach with the bottom-up user needs, which is further processed and proposed below:

    i. Presentation, reflection upon, and coordination of the different e-Infrastructure visions.

    ii. Sharing experiences, building views and in general facilitating strategic discussions in all e-Infrastructure-related matters (can also take the form of joint position papers or contributions to major European initiatives). Examples include some of the areas of the questionnaire such as strategies, policies, business models, cost aspects including energy, sustainability.

    iii. Joint work on high-level harmonisation of service delivery for communities/users that require integrated and seamless access and support, including a joint technical support/helpdesk and coordination on training delivery.

    iv. Synergies, connections and joint communication and dissemination efforts towards the communities.

    v. Organising joint R&D projects for the introduction of next generation services.

2. The **interoperability between the EOSC and EuroHPC federations** appears to be premature and thus it is proposed to take place at a next phase. Priority within each of the two areas (EOSC and EuroHPC) should be given first, before attempting to work together.

a. The **AAI paradigm** is however an exception and already a cross-cutting success story spanning all of the GEANT, EOSC and EuroHPC federations. Still, there are multiple providers and in some cases there is slow progress. So, it is proposed that more work should take place to make it more user friendly and transparent, especially when users use services across different service providers and the Forum can possibly reflect on some strategic (non-technical) issues.

b. The **gap between the resource access models in HPC and HTC** has been confirmed, although there is already some work to bridge this gap, such as a lightweight peer-review evaluation for limited resources, and create a compute continuum federating HTC-HPC-Cloud facilities in Europe (e.g. by EGI and PRACE). Other views however, indicate the two models are for different use cases and question the necessity to bridge the gap. So, there is no clear proposed approach in this case. The topic may be discussed at the Forum from the strategic point of view.

c. On the upcoming update of the **Charter of Access to RIs** that will be undertaken by ESFRI, all answers favoured coordinated input from horizontal e-Infrastructures. The input to such a document can be coordinated by the Forum.

d. On the coordination with **industry** (similar industrial efforts such as GAIA-X) and onboarding of industrial e-Infrastructure/service providers services) it is recognised by the e-Infrastructures that this area is very

important. However, in some cases such as EOSC, this may become a priority after consolidating the user base from the research community by 2024 (i.e. in EOSC in 2025-2027). Inputs from the Forum on Industry and the area of Technology Infrastructures under Action 12 of the ERA Policy Agenda would be beneficial.

    e. With regards to other thematic **data spaces** reflections from the Forum members are needed on the optimal coordination with EOSC and interoperability with the proposed data spaces middleware.

    f. Topics proposed by e-Infrastructures in this area are listed below, however some of the topics may be technical and not appropriate for the Forum.

        i. A joint e-Infrastructure helpdesk for technical support to the e-Infrastructure users

        ii. Coordination across training and skills development, including capacity planning and delivery.

        iii. Standardisation of APIs to allow interoperability of front end portals with various levels of middleware provided by e-Infrastructures

        iv. Resolution of software licensing access in the different service providers

        v. Workflow harmonisation for automation (machine-to-machine)

        vi. Architectural aspects and relevance to the EOSC Interoperability Framework (e.g. on the emerging SIMPL middleware for data spaces and interoperability with EOSC),

        vii. Practices and tools for sensitive data

        viii. Data security aspects (including authorisation for who has access to what and when)

        ix. Certification of trusted repositories/data sources

        x. Business models both for services but also for data

        xi. Harmonisation on the access to the e-Infrastructures.

    g. Expected impacts on operational aspects due to increased coordination between e-Infrastructures can be:

        i. Better tailored service offerings to the users and increased usage

        ii. Lower costs as a result of focus on core competences from each e-Infrastructure, avoiding duplication of activities.

        iii. Easier communication and alignment of operations between the compute, data and network service providers

        iv. Shorter time to scientific discovery thanks to fast adoption of innovative IT solutions

        v. Seamlessly composing multiple services and integrating multiple FAIR data sets into new, innovative workflows

        vi. Facilitation of the provision of resources

3. In the area of **costs, business models, funding and sustainability,** a first major point is that **understanding the costs of each e-Infrastructure provider is very important for their future sustainability and business models.** For example, understanding the costs of EOSC Core and especially EOSC Exchange is vital. So, the following areas are proposed:

a.  **Sharing different approaches** around methodologies and cost models across Europe could provide value to the EU and national actors. This may help new actors to understand the cost models, provide transparency and increased understanding by funders on the particularities of e-infrastructure costs. This is also valid in specific areas such as virtual access and transnational access funding. The definition of a European transnational access model to national infrastructures participating in e-Infrastructures could be a major success story in this area.

b.  Most e-Infrastructure-related organisations are working towards **sustained funding and business models** for a sustained operation, however, they are at different maturity levels. This area is already identified and proposed in the list in previous areas.

c.  The expected impact on e-Infrastructures' funding/business models due to increased coordination among e-Infrastructures may be reduced costs at the providers side by joint services and avoidance of duplication of efforts.

4.  The main **challenges and potential obstacles** for the end users to conduct cross e-Infrastructure research activities identified can also be discussed in the Forum, and were the following:

    a.  Different legal, administrative barriers and funding environments across countries and providers, and dependencies on projects, in particular the funding provisions of resources that govern their usage in each country.

    b.  Fragmented environment (many e-Infrastructures and services), different types of actors (from network, to computing, and scholarly communications),

    c.  Different priorities/policies

    d.  Different or lack of common/coordinated business models

    e.  Lack of skills and talent shortage.

5.  Overall, the areas that can be positively affected from such increased coordination in e-Infrastructure organisations include joint/integrated services towards the end users and increased adoption of services, cost savings, improved community outreach efforts, joint research and development programmes across e-Infrastructure for the introduction of innovative services.

6.  It is finally proposed that e-Infrastructures go beyond the vested interests and comfort zones, shifting the discussions towards more integrated and joint services. Ultimately, this will benefit the end users.

## 2.6 Recommendations

*This section provides distilled material from the previous section in the form of concise text referring also to the different actors that need to perform the actions.*

To enhance the coordination and cooperation among European e-Infrastructures recommendations are provided addressing the different related stakeholders. The objective is to have a Forum in place facilitating cooperation and enabling coordination on high-level strategy alignment of e-Infrastructures, taking into account the needs and demands of the end users. The ultimate goal is a political, technological, and

administrative framework for an easy and cost-effective shared use of distributed electronic resources across Europe, envisaged by e-IRG as e-Infrastructure Commons.

### *European and national e-Infrastructure providers*

*Appropriate coordination among all stakeholders is required through a coordination platform, implementing a distributed multi-stakeholder model of cooperation and coordination. The coordination platform should allow a staged and gradual approach at the e-Infrastructure landscape, moving towards more integrated and joint services.*

*e-IRG recommends to the e-Infrastructure providers to form a Forum or Assembly, the exact form of which and the umbrella under which it should go, should primarily be discussed among them. e-IRG is willing to have a facilitating role, if found appropriate, and not a steering one.*

*It is also recommended that the e-Infrastructures agree on a lightweight structure, and also a lightweight means to monitor/report the progress of the cooperation activities.*

*e-IRG recommends regular gatherings of the Forum to keep the discussion going and establish some form of open documentation to provide transparent progress monitoring.*

### *European Commission*

*Appropriate support for the European strategy setting and coordination bodies and their umbrella forum or other lightweight structure is required;*

*e-IRG recommends that in future Work Programmes the EC provides strong incentives for cross platform innovations, thereby further supporting the need for coordination and consolidation of e-Infrastructure service development and provisioning at the national and the European level. Dedicated support for the e-Infrastructure Forum or Assembly, depending on the exact implementation model is also recommended.*

*e-IRG recommends to recognise the importance of e-Infrastructures in the realisation of the European Open Science Cloud, and provide a clear definition of EOSC with its e-Infrastructure components and corresponding boundaries.*

### *Thematic infrastructures, communities, users*

*e-IRG recommends to the thematic infrastructures and representatives of communities to actively follow the discussions of the e-Infrastructure Forum or Assembly, and to agree on some rotating representation in the Forum, inline with the Forum views. This will allow the provision of needs from the user side and balance the top-down with bottom-up approaches.*

# Colophon

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# Annex I Guiding Questions to e-Infrastructure organisations

# e-IRG White Paper 2022

Realisation and enhancement of coordination and collaboration in the e-Infrastructure landscape covering the full spectrum of e-Infrastructures (networking, computing, data) and related services

## GUIDING QUESTIONS TO E-INFRASTRUCTURE ORGANISATIONS

### Aim and short introduction (see extended version at the bottom)

**The e-IRG White Paper 2022 aims at contributing towards bridging the cooperation and coordination gaps across the major e-Infrastructure components**, reflecting on several policy areas of cooperation (including governance, access and other policies, sustainability, etc.) and providing concrete advice and recommendations to all related stakeholders. Relevant e-Infrastructure stakeholders are GEANT, EOSC and the underlying e-Infrastructures EGI, EUDAT, OpenAIRE, as well as PRACE and EuroHPC mainly dealing with 'Horizon Europe', 'Digital Europe' and 'Connecting Europe Facility' programs.

Although significant exchanges between the major European e-Infrastructures actors are already taking place one way or another, e-IRG believes that a regular, well-framed and high-level coordination at strategy level would be beneficial for the ecosystem, as it would ensure a steady dialogue and flow of information and common understanding across all actors.

e-IRG, as an independent body of representatives from Member State and Associated Countries, aims at liaising as a neutral platform with the corresponding bodies, offering its expertise and high-level advice towards the alleviation of fragmentation and the envisaged integrated and holistic e-Infrastructure environment, facilitating the introduction of such a cooperation and coordination framework.

e-IRG organised a dedicated meeting on this specific topic of e-Infrastructure coordination with the EC services in its December 2021 meeting with representatives

from both DG Connect and DG RTD. In the recent e-IRG open workshop under French EU presidency in May 2022, one of its sessions was dedicated to e-Infrastructures cooperation and coordination[29]. An additional session at the e-IRG workshop was jointly organised between e-IRG and the EOSC Steering Board on common EOSC policy areas and gaps[30]. As a follow up to its May workshop, e-IRG provides a set of guiding questions (in the form of an open-ended questionnaire guiding the required input) for e-Infrastructures to provide their feedback in an effort to find common ground and establish a cooperation framework.

e-IRG has recommended the creation of a Forum of e-Infrastructure providers at EU level almost since a decade ago as part of its vision towards 2020 and beyond (both in White Paper 2013 and Roadmap 2016), and with its current White Paper 2022 is coming back to this topic, as there have been several developments in the e-Infrastructure landscape and discussions are maturing. For example, as part of EOSC, a framework for the federation of both generic (horizontal) but also thematic (vertical) e-Infrastructure services has been established and is being implemented. The e-IRG White Paper is initially focused at the EU level, but it goes without saying, that it is also strongly linked at the national/regional levels, and also at community and thematic levels, as highlighted in the e-IRG past documents.

e-IRG is aware that Data Spaces as part of the European e-Infrastructure landscape are currently being built up and identified also for these components the need for coordination and cooperation. e-IRG considers addressing this topic later.

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### e-IRG White Paper 2013[31]

**Proposed approach**

*"In the 2020 vision, providers have the freedom to innovate, and users enjoy the freedom to choose the services they need from a mix of public e-Infrastructure and commercial services. In order to enable this vision, we need an ecosystem of different organisations, at the national and international levels, each with their own focus but also **with effective coordination between them**."*

*e-IRG believes this challenge can be met by maintaining a clear separation between the three core functions:*

*1. Community building, **high-level strategy and coordination in Europe**: for each type of e-Infrastructure service, a single coordinating*

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[29] e-IRG Workshop under French EU Presidency: Cross-e-Infrastructure collaboration and coordination

[30] e-IRG Workshop under French EU Presidency: Towards a sustainable EOSC - The role of e-Infras

[31] e-IRG White Paper 2013 - https://zenodo.org/record/4049675

*organisation with a central role for user communities. **These bodies**, in turn, **will need a forum for coordination between them across the different e-Infrastructure types.***

*2. Service provision: flexible, open, and competitive approach to national, European, and global service provision; with advanced collaboration among the interested public and commercial service providers.*

*3. Innovation: Implementation of major innovation projects through the best consortia including e-Infrastructure suppliers, industry, users and academia with a dedicated management structure comprising the partners per project.*

***The e-IRG sees a clear need for a single e-Infrastructure umbrella forum for community building, high-level strategy setting and coordination for the entire e-Infrastructure. This umbrella forum is not a separate organisation, but a forum in which the user communities and the strategy and coordination bodies for the different parts of the European e-Infrastructure work on a common strategy.***

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**e-IRG Roadmap 2016**[32]

"*..an emphatic co-operation among all main stakeholders is required: the providers (the e-Infrastructure developers and operators), the users (the scientific communities, both big users including Research Infrastructures and the long tail), and the funders (the EC and the national governments and their agencies). A joint EU e-Infrastructure ERIC still seems to be far away, and thus the only way forward is good coordination through a formal coordination platform among all stakeholders in-line with the Commons, implementing a distributed multistakeholder model of governance*".

***Recommendations***

*7.2.2 (European and national) e-Infrastructure providers*

*.. "One of the steps forward is assurance of a good coordination through a formal coordination platform among all stakeholders inline with the Commons, implementing a distributed multi-stakeholder model of governance. It may allow a staged approach towards a common ERIC.*

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[32] e-IRG Roadmap 2016 - https://zenodo.org/record/4048805

> ***e-IRG concludes that a coordination platform among all stakeholders inline with the Commons, along with a distributed multi-stakeholder model of governance is needed.*** *One of the proposed solutions and step forward could be the introduction of interoperable service of catalogues. Only then users may be able to enjoy a single point of access and as widely as possible common access and security policies, as well as long-term sustainable services.*
>
> *7.2.4 European Commission*
>
> *.. **"Provide input for the European strategy setting and coordination bodies and their umbrella forum"**;*
>
> *"**e-IRG recommends that in future Work Programmes the EC provides strong incentives for cross platform innovations, thereby further supporting the need for coordination and consolidation of e-Infrastructure service development and provisioning on the national and the European level**"*

# Guiding Questions
(GÉANT, EGI, PRACE, OpenAIRE, EUDAT, EOSC (A&SB), European Commission)

1. **Administrative**
   Name of your organisation:
   Contact details (name, email):

2. **Topic: Governance of European e-Infrastructures**
   a. e-IRG recommended ***an e-Infrastructure umbrella Forum for community building, high-level strategy setting and coordination for the entire e-Infrastructure landscape.*** *This umbrella Forum is not a separate organisation, but a forum in which the user communities and the strategy and coordination bodies for the different parts of the European e-Infrastructure work on a common strategy based on common understanding among each other. The ultimate beneficiary of this effort will be the end users providing integrated user-friendly services easing the work of researchers and providing to them added value.*

      i. *How does the European e-Infrastructure organisation/initiative you represent perceive this idea? Is your organisation/Initiative willing to discuss the framework for such a Forum?*

      ii. *Which generic (horizontal) European e-Infrastructure bodies would you like to see in such a Forum? (keeping in mind that the e-Infrastructure landscape is spanning networking, computing, data components and*

*related services). Do you believe that EU e-Infrastructure stakeholders from all layers should participate? Note that in the e-IRG terminology the term electronic (or digital) Infrastructure (e-Infrastructure) includes data infrastructures, although there has been some confusion in some documents in the recent years). Please justify your answer.*

    *iii.    Besides generic (horizontal) e-Infrastructure providers in this Forum do you also envisage some form of user/thematic communities representation? And what about EU funding agencies or policy makers? Comment on the potential roles of each of these.*

    *iv.    e-IRG can facilitate the process for the establishment of such a Forum as a neutral body/platform. How does your organisation perceive this idea?*

    *v.    [optional] Do you believe that besides a strategy / governance forum a technical / operational forum across all e-Infrastructures would be beneficial?*

    *vi.    What is the expected impact on your governance due to increased coordination between e-Infrastructures?*

  b.  Other points/ideas you would like to raise on the topic of governance.

3.  **Topic: Compatible policies/interoperable services/operational aspects**
  *a.  In the last years the EOSC stakeholders have been working on rules of participation, common or compatible policies and interoperable services in EOSC to enable the federation of e-Infrastructures providers and their services (e.g. EGI, EUDAT, OpenAIRE) and thus facilitate data-driven science. EOSC is working towards the development of an ecosystem of portals at EU/regional/national and in some cases institutional levels to provide added-value services to end users, facilitating also cross-disciplinary research/science, which is required to address the scientific and societal challenges. Work is also underway towards a personalised and smart (AI-based) dashboard for researchers/scientists that will include relevant data/services/workflows/software and other artefacts to ease their work. EuroHPC has been doing similar work to federate the EuroHPC centres and define the rules of participation and sharing of resources among its members.*

    *i.    Do you believe that the EOSC and EuroHPC (federation and sharing) paradigms should be expanded to federate data/services across all major European e-Infrastructures?*
    *Note: This does not mean that one of them should integrate the other, rather coordinate their strategies and harmonise their policies (as peers) to be able to federate and share the data/services/software etc. for the benefit of the users.*

    *ii.    Federation of all e-Infrastructures would require compatible policies and interoperable services, so that they can be integrated in a federated*

*portal and ultimately in the personalised dashboards of end users. Do you believe that this can be done in the coming years or should priority be given first to each of the areas, e.g. EOSC and EuroHPC, before attempting to work together at such (technical) level?*

iii. *[optional] Authentication and Authorisation Infrastructures (AAI), including blueprint architectures, have been developed (e.g. GEANT and EGI) and there has been significant effort to make them interoperable and use them across horizontal and thematic e-Infrastructures. Do you find this as an example of collaborative operational work and interoperable policies that can be expanded to other e-Infrastructures and more communities?*

iv. *Resource access models and policies differ between HPC (more based on call for proposals with peer-review evaluation committees for longer time, e.g. 1 year) and HTC (faster process and cycles based on policies and more opportunistic, e.g. policy-based access to support national access to EU thematic collaborations such as ESFRI projects or ERICs). Furthermore, resource ownership models are different, e.g. EuroHPC owns up to 50% of the EU access capacity of EuroHPC systems, while in HTC the vast majority of resources and their access are national. The above may hinder interoperability and cross e-Infrastructure usage (i.e. HTC-HPC). Do you see space for cooperation/coordination in this area? If this is the case, which of your organisation's policies need to be adapted.*

v. *There is a plan to update the EU Charter of Access to Research Infrastructures (including e-Infrastructures). Do you see a role of the future e-Infrastructure Forum at strategy or technical levels in this update? s*

vi. *What about coordination with similar industrial efforts (e.g. GAIA-X) and industrial e-Infrastructure/service providers (EU and non-EU) or other thematic data spaces in the super portal mentioned above? There are ongoing efforts in some of these, such as the integration of commercial services/resources, in-line with the e-IRG vision of 2013 so that "users enjoy the freedom to choose the services they need from a mix of public e-Infrastructure and commercial services". Do you see this as a priority for the coming years?*

vii. *Are there in your opinion other important operational aspects that need to be harmonised to facilitate a well-coordinated federated European e-Infrastructure?*

viii. *What is the expected impact on operational aspects due to increased coordination between e-Infrastructures?*

4. **Topic: Cost and Business Models, Funding/Sustainability**

a. Understanding costs and having business models for e-Infrastructures is important for planning their operation and their sustained funding, including renewing (procuring) the actual infrastructure over the years. A joint group between the EOSC Steering Board and e-IRG have identified a gap in this area that needs to be developed in the future, especially given the transition of EOSC Core and part of EOSC Exchange towards an operationalised framework (based on procurement vs. short lived projects).

   i. Does your infrastructure have a cost model and methodology to track its costs? If federated, is there a common cost model/methodology across the national components?

   ii. If not, do you see the need for an establishment of lightweight methodologies and cost models for the different layers (networking, computing, data) for better understanding the costs of e-Infrastructures (both CAPEX and OPEX), across EU e-Infrastructures and also across national entities? See as an example the e-FISCAL methodology/model[33] for computing costs.

   iii. Do you believe that collecting and sharing different approaches (around methodologies and cost models) across Europe could provide value to the EU or national actors?

   iv. Does the e-Infrastructure you represent have a business model and sustained funding to facilitate a sustained operation?

   v. *What is the expected impact on your funding/business model due to increased coordination between e-Infrastructures?*

5. **Topic: Other**
   a. Any other topics or points in this area of e-Infra cooperation/coordination that you would like to discuss in a potential future Forum or any comments.

   i. What are the main or potential obstacles for the end users to conduct cross e-Infrastructure research activities that you are aware of? Lack of awareness (of services availability), administrative burden, ease of use and added value, fragmented environment (multiple e-Infras, multiple EU funding programmes, coordination among EU and national players), different priorities, different policies (access, resource usage, etc). How can the identified or potential obstacles be overcome?

   ii. e-IRG has recommended increasing coordination efforts between the e-Infrastructures for a long time now, what would be the business areas mostly affected from such increased coordination in your e-Infrastructure organisation?

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[33] Methodology | e-FISCAL project (efiscal.eu)

# Background

*(from e-IRG White Paper 2022 introduction)*

Besides the networking layer that was already rather advanced since more than 10 years ago, considerable progress has been achieved in the electronic Infrastructures (e-Infrastructures) in the last 5-7 years across all layers and in particular in the computing and data layer. Two significant initiatives have been launched and by now are well underway towards implementation, namely the European Open Science Cloud (EOSC) and the EuroHPC one.

EOSC is aiming towards a federated environment for hosting and processing research data via the appropriate tools and services to support EU science[34]. In terms of e-Infrastructures, it builds on the High Throughput Computing (HTC) EU infrastructures mainly federated in the EGI infrastructure ([https://www.egi.eu](https://www.egi.eu)) and the data and scholarly communication infrastructures accordingly mainly federated in EUDAT ([https://www.eudat.eu](https://www.eudat.eu)) and OpenAIRE ([https://www.openaire.eu](https://www.openaire.eu)). These e-Infrastructures are based on national or regional components and support structures and are contributing towards the realisation of EOSC as a system of systems. The process to create the EOSC was initiated by the European Commission in 2015 and its first phase was concluded at the end of 2020. EOSC is now in its second phase in an effort to consolidate national[35][2], regional and European components, as well as both generic (discipline-agnostic) and thematic (disciplinary) ones, along with related policies and strategies, ultimately aiming at easing researchers in their data-driven cross-disciplinary research. In terms of governance in its current phase, EOSC has been organised as a co-programmed European Partnership[36], between the EC and the newly formed EOSC Association[37]. The Partnership Board includes representatives of the Member States (MS) and Associated Countries (AC) in a Steering Board, in essence forming a tripartite collaboration[38] among the EU represented by the Commission, the EOSC Association, and the MS/ACs to guarantee resources and support to EOSC.

On the other hand, EuroHPC is building a set of word-class High Performance Computing (HPC) systems across Europe. These are organised at multi-country level with an agreed location for each of the systems, and in some cases national components. In terms of organisation a Joint Undertaking (EuroHPC JU[39]) has been established to lead this effort and the majority of European countries have joined the EuroHPC initiative as members. In this way, the EU (50% in cash via the EC) and participating countries (50% in cash or in kind) pool their resources together to deploy these petascale or even exascale supercomputers and related technologies/applications. The EuroHPC systems are also in the process of implementation, with the majority of the systems having been procured and working

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[34] [European Open Science Cloud (EOSC) | European Commission (europa.eu)](#)
[35] In several countries [National Open Science Clouds](#) (NOSCs) initiatives are well underway
[36] [Partnership | EOSC Association](#)
[37] [Association | EOSC Association](#)
[38] [Tripartite Collaboration | EOSC Association](#)
[39] [https://eurohpc-ju.europa.eu/](https://eurohpc-ju.europa.eu/)

towards operation. EuroHPC JU systems have made it to high-ranked positions in the Top500 and Green500 ones, given the increasing importance of energy efficiency and green approaches. Respective policies for the access and use of the systems are also being developed with a first set already being agreed[40]. It is important to note that EuroHPC is also aiming to serve industrial users, and this makes it a particular case compared to the other e-Infrastructures that focus on the mainstream of research and academia, although they are able to serve industrial research.

In parallel, GEANT https://geant.org/ has been steadily providing high-speed and high-quality connectivity and related services interconnecting the vast majority of European National Research and Education Networks (NRENs) around Europe and beyond, expanding towards all continents around the world. Besides the operational services offered at production level, new and innovative services are continuously being introduced and gradually moving in production. GEANT has been for more than 20 years providing the "glue" between the EU NRENs, who in turn interconnect their research and academic institution, completing the chain of campus-national (sometimes regional) and European research networking ecosystem. GEANT, besides offering advanced middleware services (such as Authentication and Authorisation Infrastructure – AAI), has also expanded towards the computing layer, offering for example cloud services via an integrated pan-European framework agreement program (https://clouds.geant.org).

*Besides the progress made in each individual area in these major EU infrastructures (networking, computing, and data), there is still a lot to be done in terms of cooperation and coordination across these major infrastructures, especially towards providing integrated user-friendly services easing the work of researchers and providing to them added value. In particular, cooperation and coordination between EOSC and EuroHPC is still in very early stages of discussions and of position statements formulations, while work in this area is being planned as part of the EC Work Programmes for 2021-2022 and the next one (2023-2024) currently being consolidated.* Although GEANT is transparently offering its services to its users without any major issues, the example of the high-speed interconnection of the EuroHPC systems and related procurement, caused demanding discussions between the EuroHPC JU and its members (and corresponding NRENs) with regards to the participation of NRENs in the interconnection solution. *Thus, proper planning for cooperation and coordination, looking ahead is required among all these major stakeholders.*

The need for coordination across e-Infrastructures is also confirmed at the highest political level, the EU Competitiveness Council, with top-down initiatives and statements for many years now, resonating and complementing the bottom-up requirement from the e-Infrastructure community for integrated services. In particular, in its conclusions on the New European Research Area (ERA)[41] in the December 2020 Council "encourages the Commission and Member States **to increase the level of national and European coordination**, in particular on research infrastructures and e-infrastructures". A similar message is part of the Council Recommendation (EU) 2021/2122 of 26 November 2021

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[40] https://data.consilium.europa.eu/doc/document/ST-13567-2020-INIT/en/pdf EuroHPC JU Documents
[41] https://data.consilium.europa.eu/doc/document/ST-13567-2020-INIT/en/pdf

on a Pact for Research and Innovation in Europe *to develop better "connection of existing and new European and national research infrastructures, including e-infrastructures"* and on the Future governance of the ERA[42], with its new ERA Policy Agenda and ERA Actions. In particular, under ERA Action 8 on Research Infrastructures, there is a clear call for ***"increased cooperation between research infrastructures, e-infrastructures and stakeholders, including through EOSC"***.

**The e-IRG White Paper 2022 aims at contributing towards bridging the above cooperation and coordination gaps across the major e-Infrastructure components, reflecting on the above issues and providing concrete advice and recommendations to all related stakeholders**. This covers GEANT, EOSC and the underlying e-Infrastructures EGI, EUDAT, OpenAIRE, PRACE? and EuroHPC mainly dealing with "Horizon Europe" and 'Digital Europe'. **e-IRG, as an independent body of representatives from Member State and Associated Countries, aims at liaising as a neutral platform with the corresponding bodies, offering its expertise and high-level advice towards the alleviation of fragmentation and the envisaged integrated and holistic e-Infrastructure environment, facilitating the introduction of such a cooperation and coordination framework**.

e-IRG organised a dedicated meeting on this specific topic of e-Infrastructure coordination with the EC services in its December 2021 meeting with representatives from both DG Connect and DG RTD. **In the recent e-IRG open workshop under French EU presidency in May 2022, one of its sessions was dedicated to e-Infrastructures cooperation and coordination**[43]. An additional session was jointly organised between e-IRG and the EOSC SB on common EOSC policy areas and gaps[44]. All these efforts are in line with the 2018 Competitiveness Council Conclusions on EOSC referring among others to *"e-Infrastructures and RIs to get organised so as to prepare them for connection to the EOSC",* calling for the EC to make optimal use of initiatives such as ESFRI and e-IRG.[45]

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[42] https://data.consilium.europa.eu/doc/document/ST-14308-2021-INIT/en/pdf
[43] e-IRG Workshop under French EU Presidency: Cross-e-Infrastructure collaboration and coordination
[44] e-IRG Workshop under French EU Presidency: Towards a sustainable EOSC - The role of e-Infras
[45] https://data.consilium.europa.eu/doc/document/ST-9029-2018-INIT/en/pdf

# Annex II Contributions from e-Infrastructure organisations

*The contributions from e-Infrastructure organisations are published separately in Zenodo, provided that a corresponding confirmation from the e-Infrastructure-related organisation has been received.*

EGI
EOSC Association
EOSC Steering Board
EUDAT
GÉANT
OpenAIRE
PRACE