



EGI-Engage

EPOS requirements analysis and outline of pilot use cases

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Abstract

The EPOS Competence Centre of the EGI-Engage project drives collaboration between EGI and the European Plate Observing System (EPOS) service developers and providers in order to collect, analyse and compare Earth Science community needs with EGI technical offerings based on specific use cases that are selected as drivers for the work. This document is the first milestone of this effort. It describes selected use cases from the EPOS community which could benefit from EGI services, it provides an initial analysis of the e-infrastructure requirements derived from these use cases, and defines a roadmap to implement these use cases within the EPOS infrastructure, with the use of EGI services.



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TERMINOLOGY

A complete project glossary is provided at the following page: <http://www.egi.eu/about/glossary/>

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Executive summary

The EPOS Competence Centre¹ of the EGI-Engage project drives collaboration between EGI and the European Plate Observing System (EPOS)² service developers and providers in order to collect, analyse and compare the needs of Earth Science community with EGI technical offerings.

During the first 12 months of the EGI-Engage project a team of experts from EGI and EPOS collaborated on identifying infrastructure and scientific use cases that the two organisations could support collaboratively during the next 18 months. The identified use cases are the following:

- AAI use case: EGI offered to EPOS its expertise and knowledge on authentication and authorisation processes to design the EPOS AAI architecture. As outcome of this activity, a first model of the EPOS AAI has been drafted, it will be implemented as pilot during the second year of the project. Integration with the EGI AAI infrastructure has been also taken into account to exploit the distributed resources offered by its infrastructure
- Earthquake simulation use case: this activity aims at improving the back-end services of an existing application, MISFIT, in the field of Computational Seismology. The use case will integrate software previously developed by the VERCE project with the computing services of the EGI Federated Cloud, using data from EIDA / ORFEUS organization via EUDAT data preservation services.
- Satellite Data use case: it is related to the services that will be offered by the EPOS satellite data TCS to the wide range of EPOS users. This TCS deal with the processing of the Earth Observation datasets collected by various satellites, including the Sentinels of the Copernicus programme to address several societal challenges. Aim of this use case is putting together expertise of ICT experts and platforms operators with advanced knowledge on Earth Observation systems with EGI infrastructure expertise to create an environment where new added value services could be easily developed and integrated in the Satellite Data TCS offer. This work is linked to the integration of the Geohazard ESA Thematic Exploitation Platform (TEP) with the EGI FedCloud is currently running under the EGI-Engage task SA1.3.

After this first year devoted to the analysis work, the EPOS CC is starting now the implementation of the envisaged pilots. The main technical issues of each use case have been identified and work plans and roadmaps have been defined. The outcome of the pilots will be the ground basis to depict the outlines of the collaboration between EPOS and EGI in the coming years.

¹ https://wiki.egi.eu/wiki/EGI-Engage:Competence_centre_EPOS

² <https://www.epos-ip.org/>

1 Introduction

The European Plate Observing System (EPOS) is a research infrastructure that foresees the integration of national and transnational Research Infrastructures for solid Earth science in Europe to provide seamless access to data, services and facilities. By improving access to data and data products, together with tools for their use in analysis and modelling, EPOS will transform the European research landscape, driving discovery and developing solutions to the geo-hazards and geo-resources challenges facing European society. The innovation potential of the EPOS infrastructure involves facilitating the integration and use of solid Earth science data, data products, services and facilities, based on distributed national research infrastructures across Europe for the benefit of scientific user community, governmental organizations, industry and general public.

The EPOS Competence Centre of the EGI-Engage project evaluates, adopts and promotes technologies and resources from the EGI infrastructure towards the wider EPOS research community. This is achieved with an iterative approach:

1. Bringing together designated earth science experts from EPOS and technical experts from EGI's collaboration.
2. Identify earth science use cases, which could benefit from the EGI services and could make big impact on EPOS and EGI communities. Analyse their e-infrastructure requirements, especially with respect to the use of services and technologies adopted within the EGI infrastructure.
3. Implement selected earth science use cases based on EGI. Collaborate on the implementation with EGI's and EPOS's partner e-infrastructures, primarily EUDAT.
4. Evaluate the implementations and disseminate the experiences gained with the use cases and with the EGI services towards EPOS, EGI and other relevant communities.

This document is a milestone after stage 2 of this process. The document was written by earth science and e-infrastructure experts from EPOS and EGI, who were brought together within the competence centre. The document captures scientific use cases, derived requirements and envisaged implementation roadmap based on EGI services. Contributors of the report were:

Name	Role in EPOS/EGI	Contribution to the report
Daniele Bailo	EPOS – CC Coordinator	Definition of AAI use case, overall coherency
Michele Manunta	EPOS Satellite Data working group	Definition of the satellite data use case
Francesco Casu	EPOS Satellite Data working group	Definition of the satellite data use case
Diego	EGI Technical Outreach	Definition of the scientific use cases

Scardaci	expert	
Peter Solagna	EGI Senior Operations Manager	Definition of AAI use case
Gergely Sipos	EGI Technical Outreach manager	Overall coherency and supervision
Mariusz Sterzel	CYFRONET Technical Manager	Contribution to technical aspects of AAI use case

2 Scientific use cases

This section provides information about the use cases that have been identified by the Competence Centre. These use cases represent both infrastructure and scientific workflow, spanning from mechanisms to guarantee a seamless access to the EPOS infrastructure to the various kind of end-users to scientific use cases that could benefit of the EGI resources and services, including VREs as the ESA Thematic Exploitation platforms. Each of the use cases are described from three perspectives:

1. Scientific
2. E-infrastructure
3. Impact

These aspects together provide a comprehensive view on the use cases and help the Competence Centre focus its limited effort on those cases that would offer the best value vs. implementation and operational cost.

2.1 AAI Use Case

Introduction

EPOS is by definition a distributed Research Infrastructure where Data, Data Products, Software and Services (DDSS) are provided by different community in the domain of the solid Earth sciences. In this framework, EPOS envisages the construction of a central hub called “Integrated Core Services” (ICS) which aggregates all DDSS from the various disciplines³. From the technical viewpoint, DDSS are provided by a distributed network of endpoints (Thematic Core Services, TCSs) which use heterogeneous authorization mechanisms. Users access to the ICS querying for some data/dataproducts/software/service, and ICS are delegated to fetch the resources on behalf of the user.

The purpose of this use case is to provide a framework, to be used in the ICS hub, which enable any user to access to the ICS with one type of authorization mechanism (e.g. OAuth, eduGAIN, X509 certificates etc.) and delegate ICS to fetch resources at the various endpoints which may implement heterogeneous authorization mechanisms.

³ EPOS-IP WP6 & WP7 teams. (2015). ICS-TCS Integration Guidelines - Handbook for TCS integration: Level-2. Zenodo. 10.5281/zenodo.34666

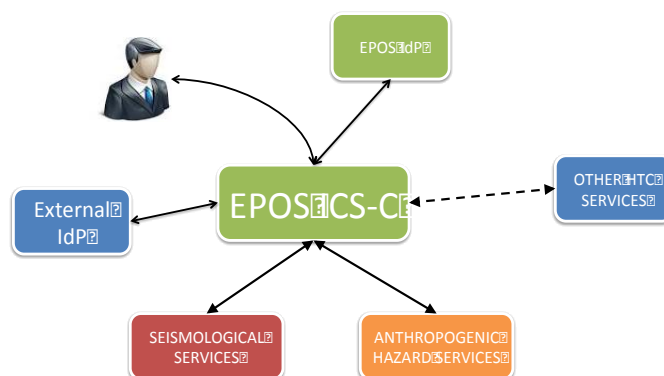


Figure 1. The EPOS AAI architecture

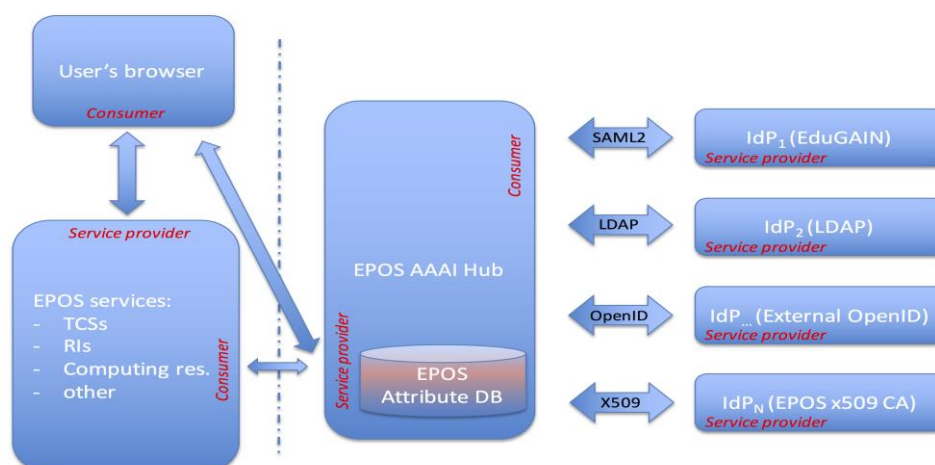


Figure 2. EPOS AAI architecture. Interactions between the different components.

Scientific use case description

<p>User Story</p>	<ol style="list-style-type: none"> 1. The user access to ICS-C portal for the first time, therefore s/he registers to EPOS ICS-C user database. 2. The user logs in with his/her credentials (different technologies IdP enabled, for instance X509 certificates, OpenIdConnect, eduGAIN) 3. User does some simple but multidisciplinary data discovery (i.e. accessing to at least two types of data from different domain and TCSs, say seismological waveforms from seismology TCS and events from ANTHROPOGENIC HAZARDS TCS) 4. S/he gets the complete list of results (e.g. data-objects, files in this case)
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	<p>and selects some of them to be downloaded</p> <p>5. S/he obtains the data (e.g. download as zipped/tar format or simply in the native file format).</p>
(Potential) User base	<p>The potential user base is composed by all users interested in the solid earth sciences, and in particular by: a) Data and service providers, b) Scientific user community, c) Governments, d) Private sector, and e) Society.</p> <p>Each of those stakeholder categories can interact with the system in a different way and therefore be identified as:</p> <ul style="list-style-type: none"> • Active users, those actively using the system. The majority of these users will be registered. We estimate this category to be the 20% of the total engaged. • Occasional users, those occasionally using the system in a “lightweight” mode. We estimate this category to be the 40% of the total engaged users in each year. • Sporadic users, those rarely using the system and for no specific purpose (e.g. they are simply curious, etc.). We estimate this category to be the 40% of the total engaged users in each year. <p>As for the number of users for each stakeholder category, a systematic study is being carried on, taking into account that: a) EPOS is a system under development and the ACTIVE user base will be increasing in time and b) the potential number of users can be enormous if we consider as “interested stakeholders” the total amount of participants to huge geological meetings as EGU⁴ (12.500 registered users) or AGU⁵ (20.860 registered users).</p>

E-infrastructure requirements

HW Resources	This use case doesn’t require any specific HW resources for processing. The amount of resources to host the AAI services will be assessed when the AAI architecture will be fully defined.
SW Resources	The use case does not have particular SW requirement from EPOS. The SW requirements depend on the exact solution to be used and offered from EGI.
Cost of delivery	Estimate can be given once the exact solution is chosen.

⁴ <http://www.egu.eu/meetings/general-assembly/>

⁵ <https://meetings.agu.org/>

Operational aspect	<p>The use case is foreseen as proof of concept only. Once integrated within EPOS infrastructure will be operated by EPOS ERIC ICS-C. NGI interested will involve all countries supporting EPOS Infrastructure.</p> <p>SCAI Fraunhofer is also interested as secondary node for the deployment of the AAI use case NGI.</p>
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Impact

Business plan 1	<p>The definition of a business plan, which is a mandatory step in the development and deployment of “production” applications, may be complex to define when dealing with use cases, as in the present scenario of the AAI use case.</p> <p>Its main goals are indeed: a) validate the design of the system to integrate different AAI mechanisms, b) research activities to explore available technologies and their actual usability to solve the issue of credential delegation.</p> <p>Still, in this framework, it is possible to outline a business plan for future developments and usage of the software which will be possibly produced as a consequence of such test case.</p> <p>The user base comprehends all EPOS users. They will indeed have to log in to the online system with their credentials.</p> <p>A considerable additional effort should be added in order to integrate the software into more complex architectural design (as the one of EPOS Integrated Core Services).</p> <p>If such use case will be applied in the scenario of the actual competence center, any revenue is envisaged. The project is indeed EU funded and not commercially oriented. As a side-effect, however, the provision of a full system (EPOS ICS) integrating also the features provided by the AAI use case, will improve the capacity of EPOS to attract additional funding.</p>
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2.2 Earthquake simulation use case (MISFIT)

Introduction

The activity aims at improving the back-end services of an existing VRE⁸ (Virtual Research Environment) in the field of Computational Seismology. The use case enables the processing and the comparison of data resulting from the simulation of seismic wave propagation following a real earthquake and real measurements recorded by seismographs. It will integrate software from the VERCE project⁶, taking advantage of the computing services of the EGI Federated Cloud, using data

⁶ <http://verce.eu/>

from EIDA / ORFEUS organization⁷. The advantage of porting the misfit application to the cloud would be to have more flexibility of exploiting a resources-on-demand model supporting the VERCE data-intensive code, possibly even close to the location where the simulation data and the raw pre-staged data will be.

Scientific use case description

User Story	<ol style="list-style-type: none"> 1. Through the VERCE Science Gateway⁸, user selects for which simulation results he/she would like to download also the observed raw data. 2. User triggers the execution of a download workflow that will pre-stage the observed data in a dedicated storage space. 3. User combines observed data and simulation results and configure a processing pipeline. 4. User triggers the execution of the pipeline workflow which will ingest and process the observed and synthetic data 5. User selects the pre-processing results and specifies the parameters for the misfit analysis 6. User triggers the execution of the misfit processing workflow 7. Progress of the computations can be always monitored and the results and the associated metadata visualised at runtime or offline
(Potential) User base	<p>The current deployment of the platform counts ca. 110 users.</p> <p>Users mostly belong to the seismological community and are typically students, academics and researchers. We recognize that a certain number are also IT experts who are interested in the platform's generics.</p> <p>Potential user base can be reached by training sessions that combine scientific lectures with the acquisition of technical skills aiming at clear research targets.</p>

E-infrastructure requirements

HW Resources	<p>Apart from the existing infrastructure (Gateway, Middleware backend services, VOMS server, iRODS infrastructure) the use-case only requires additional Cloud VMs for carrying out the processing tasks. Of course the requirements for the processing will depend on the amount of jobs and data volume to be processed. We foresee that a low number of VMs (1-10) will be suitable for evaluation purposes.</p>
SW Resources	<p>SW Product: ObsPy</p> <p>Technology Provider: The ObsPy Development Team (devs@obs.py.org)</p> <p>License: GNU Lesser General Public License, Version 3⁹</p>

⁷ <http://www.orfeus-eu.org/eida/eida.html>

⁸ <https://portal.verce.eu/>

⁹ <http://www.gnu.org/copyleft/lesser.html>

	<p>SW Product: Dispel4Py Technology Provider: The Dispel4Py Development Team (rosa.filgueira@ed.ac.uk) License: Apache License, Version 2.0¹⁰</p> <p>SW Product: gUSE (grid and cloud user support environment) Technology Provider: LPDS Sztaki (portalsupport@lpds.sztaki.hu) License: Apache License, Version 2.0</p> <p>SW Product: Globus Toolkit Technology Provider: The Globus Alliance License: Various¹¹</p>
Cost of delivery	<p>Extension of the current VO with FedCloud attributes. Enablement of cloud-friendly submission from WS-PGRADE workflow towards these cloud resources. Contextualisation of generic VMs suitable for the tasks or delivery of full-fledged dedicated VMs. Instances can be used by single users or in pools.</p> <p>The envisaged cost of delivery is estimated in about 20 person-months.</p>
Operational aspect	<p>The existing services (Gateway, Middleware backend services, VOMS server, iRODS infrastructure) are operated by SCAI which is member of NGI-DE.</p> <p>The EGI FedCloud resources to be used are operated by CNRS IPHC whose participation is supported by the French NGI.</p> <p>Until now there have been no further negotiations with NGIs about additional support.</p>

Impact

Business plan	<p>The platform generally aims at facilitating the integration of computational resources adopting standard interfaces towards cloud and HPC. We foresee its adoption within academic seismology courses that would require exposing dedicated seismological applications through a comprehensive tool capable of integrating data and computational resources. Moreover, earthquake-monitoring facilities could take advantage of these services to evaluate the quality of the incoming raw data against the simulated results, improving their quality-control mechanisms.</p> <p>These sorts of educational and institutional adoptions, could be regulated by subscription fees that may produce sufficient income to cover the regular maintenance of the whole platform.</p> <p>The potential rapid uptake of these resources via the VERCE platform, brought by simplicity, could stimulate the competition across the</p>
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¹⁰ <http://www.apache.org/licenses/>

¹¹ <http://toolkit.globus.org/toolkit/docs/5.2/5.2.3/licenses/>

	<p>providers of computational services (SMEs), fostering new partnerships at reduced costs for CPU hours and support. This strategy would reduce the risk of having the platform not scaling to demand because of financial shortcomings or limited possibilities in terms of technical integrations. It could stimulate cooperation for new projects aiming at improving the service with new tools enabling basic research in the field of seismology and beyond.</p>
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2.3 Satellite Data use case

Scientific use case description

This use case is related to the services that will be offered by the EPOS satellite data TCS to the wide range of EPOS users: a) Data and service providers, b) Scientific user community, c) Governments, d) Private sector, and e) Society.

The satellite data TCS services deal with the processing of the Earth Observation datasets collected by various satellites, including the Sentinels of the Copernicus programme to address several societal challenges related to climate, natural hazards and risk assessment and, efficient usage of resources.

Satellites are very extensive and complex sources of information and their exploitation requires advanced knowledge on Earth Observation systems. IT platforms can make access to satellite data possible for a broader research community, and therefore the EPOS satellite data TCS decided to host services on top of some ESA Thematic Exploitation platforms (e.g. Geohazard TEP).

In the context of use case, some pilot EPOS services will be deployed on top of the Geohazard TEP that will be interconnected to the EGI FedCloud to exploit its resources. The work to integrate the Geohazard TEP with the EGI FedCloud is currently running under the EGI-Engage task SA1.3¹².

Scientific use case description

User Story	<ol style="list-style-type: none"> 1. A user accesses the Geohazard TEP to exploit one of the services hosted by the platform. 2. The user requires some data via the selected services. 3. The user's request triggers a computation. 4. The Geohazard TEP create a certain number of VMs into the EGI FedCloud to perform the computation 5. The Geohazard TEP will copy the input data needed for the computation into the EGI FedCloud storage (caching mechanism will be studied to minimise the data transfers) 6. The Geohazard TEP retrieve the output data from the EGI
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¹² The e-Collaboration for Earth Observation (e-CEO) platform: https://wiki.egi.eu/wiki/EGI-Engage:WP5#TASK_SA1.3_Integration.2C_Deployment_of_Grid_and_Cloud_Platforms

	<p>FedCloud</p> <p>7. The Geohazard TEP provides the requested data to the user.</p>
(Potential) User base	<p>The potential user base is composed by all users interested in the solid earth sciences, and in particular by: a) Data and service providers, b) Scientific user community, c) Governments, d) Private sector, and e) Society.</p> <p>See the AAI use case for more details.</p>

E-infrastructure requirements

HW Resources	<p>The amount of needed HW resources strictly depends on the specific pilot we are going to implement. It is notable to mention that applications dealing with satellite data needs big amount of HW resources, in particular storage.</p> <p>As example, the <i>DLR Systematic Processing Pilot case</i>, that will be one the Geohazard TEP pilots that will run in the EGI infrastructure during 2016, requires the following resources:</p> <ul style="list-style-type: none"> • 80 VMs with 8 cores, 32 GB RAM and 200 GB of local disk. • 40 TB of permanent storage
SW Resources	<p>The SW resources needed are the ESA TEPs and related packages setup on top of them.</p>
Cost of delivery	<p>Integration of the ESA TEPs into the EGI FedCloud could be done at different level.</p> <p>The easier one is the “On-Demand” model: TEPs are deployed and operated by external organisation and use the EGI FedCloud to perform computations on demand:</p> <ul style="list-style-type: none"> • create VMs when a new computation should be performed • transfer input data to the EGI FedCloud • retrieve the output data • free all the resources allocated after the output data have been downloaded. <p>This kind of integration requires about 6 person/months.</p> <p>Different types of integration would be examined and assessed in a later stage. For example, we will investigate how to create clone or big cache of the Satellite Data in the EGI infrastructure accessible by all the FedCloud sites to reduce the transfer time.</p>
Operational aspect	<p>The ESA TEPs are currently under developing. ESA TEPs core team will take care to identify the platform operators in a later stage.</p> <p>The effort needed to maintain these services up & running will be assessed when the platform will be ready to move to production.</p>

Impact

<p>Business plan 1</p>	<p>Satellite Data exploitation has the potential to enable many value-added services that can be tailored to specific public or commercial needs, resulting in new business opportunities.</p> <p>The ESA TEPs will act as enabler for this making simple the development of innovative services to address different societal challenges, allowing focusing efforts on the development of innovative solutions instead of deal with specific EO data management issues.</p> <p>The services deployed on top of the ESA TEPs will be proposed to EPOS for the integration in its Research Infrastructure.</p> <p>Another exploitation channel could be the EGI Long Tail of Science platform to provide services to individual consumers.</p> <p>Furthermore, the integrated environment that will be available once the TEPs are properly interfaced with the EGI infrastructure can be further expanded to be offered to SMEs willing to develop and commercialise new EO products.</p>
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3 Implementation roadmap

3.1 Introduction

The whole EPOS roadmap is quite complex and includes a number of interaction with different stakeholders. In such wider framework, the work carried on in the EGI-ENGAGE context supports the development of specific modules that compose the EPOS Integrated Core Services (ICS). ICS is the main system whose role is to integrate data, data products, software and services from different disciplines organized in “TCS data hubs” (Thematic Core Services – basically discipline-oriented, Europe-wide data providers).

Each discipline has its own history, background and technical level of maturity. As a consequence, TCS technologies are heterogeneous, which is particularly true for the aspects related to Authentication and Authorization (AAI). The purpose of the first use case is therefore to provide an “homogenizing layer” which enable users discovering resources from the ICS system, to access to TCS resources in a transparent way, that is to say using their own (heterogeneous) credentials. This entails the implementation of a system to delegate credentials.

Also, EPOS communities need to access computational resources. Some communities already have community processing systems, others relies on external e-Infrastructure providers, or HPC centers. In this context, a system which enables external community to access with a unified interface to EGI processing resources (which are representative of any e-Infrastructure resource provider) is needed. The purpose of the second use case is therefore to use EGI cloud resources to perform misfit analysis in the context of Seismology as a pilot of this scenario.

One of the communities which “natively” use data processing in a consistent way is the Satellite community. Their products are indeed result of processed satellite images. Such processing is done in a programmatic way for certain regions, but on-demand processing is run in case a user wants to access non-processed regions. In this context, EGI cloud resources should be exploited in a simple and interoperable way. In this context, the third use cases deals with the provision of EGI cloud resources by mean of standardized interfaces, to the satellite community on top of thematic platforms that provide solution for common earth observation data management issues.

3.2 Use case implementation roadmaps

AAI use case

The EPOS CC is evaluating different existing solutions to define the EPOS AAI infrastructure. The most promising seems the one implemented by the EGI Long Tail of Science platform (LToS)¹³ that

¹³ https://wiki.egi.eu/wiki/Long-tail_of_science

adopted Unity¹⁴ and special proxies generated by robot certificate (Per-User Sub-Proxies¹⁵). Integration with the EGI AAI infrastructure will be also taking into account to exploit the resources offered by its infrastructure.

In the framework of the AAI use case, the roadmap represents a step by step process where the main goal is to enable credentials delegation over a federation of system using different AAI mechanisms.

Such roadmap includes the following steps:

1. Set up of a level-1 pilot, which includes the main (ICS-like) system where software models adopted by the EGI LToS platform (e.g. Unity) are implemented and a subset (e.g. one) of available AAI mechanisms is accepted.
2. Inclusion of external resources (TCS-like) within the level-1 pilot, delegation is therefore enabled. Transfer of a simple file (e.g. text file) is enabled.
3. Set up of level-2 pilot, where more than one external resources (TCS-like) is included. It requires implementing the credential delegation mechanism to access several resource providers.
4. Set up of a level-3 pilot where the Unity system can integrate more than one Authentication and Authorization system (e.g. OpenIdConnect, EGI SSO, possibly X.509 certificates), and users are able to collect files from several resource providers.

Earthquake Simulation (MISFIT) use case

The roadmap of the MISFIT use case includes the following steps:

1. Extension of the current VERCE VO with EGI FedCloud attributes.
2. Enablement of cloud-friendly submission from WS-PGRADE workflow towards these cloud resources.
3. Contextualisation of generic VMs suitable for the tasks or delivery of full-fledged dedicated VMs. Instances can be used by single users or in pools.
4. Integrate the new cloud-based workflow in the VERCE science gateway.
5. Interconnect the MISFIT workflow to EUDAT services for data retrieval and preservation.

Satellite Data use case

The Satellite Data use case foresees the following main milestones:

1. Interconnect the ESA Geohazard TEP with the EGI FedCloud with the “On-Demand” model;
2. Identify a set of pilot cases and assess the resources needed
3. Integrate the pilot cases in the Geohazard TEP interconnected to the EGI FedCloud
4. Investigate on more complex types of integration between the Geohazard TEP and the FedCloud:

¹⁴ <http://www.unity-idm.eu/>

¹⁵ https://wiki.egi.eu/wiki/Long-tail_of_science#Per-user_sub-proxies

- a. Study caching strategy to keep copies of satellite data in the EGI FedCloud storage.

3.3 Roles in use case development

Use Case	Leaders	Participants
AAI	Daniele Bailo (INGV – EPOS)	Damian Ulbricht (GFZ) Mariusz Sterzel (CYFRONET) Kostas Koumantaros (GRNET) Diego Scardaci (EGI.eu)
Earthquake Simulation (MISFIT)	Alessandro Spinuso (KNMI)	André Gemund, Horst Schwichtenberg (SCAI) Genevieve Romier, Genevieve Moguilny Kostas Koumantaros (GRNET) Damian Ulbricht (GFZ)
Satellite Data	Diego Scardaci (EGI.eu) and Michele Manunta (CNR IREA)	Franesco Casu (CNR IREA) More members to be found
Harmonisation among use cases	Diego Scardaci (EGI.eu)	