H2020-INFRAEOSC-2018-3

NI4OS-Europe

National Initiatives for Open Science in Europe

Deliverable D3.2

First report on pre-production environment

Lead beneficiary(s):	IPB
Author(s):	All partners
Status –Version:	Final version - g
Date:	July 1, 2020
Dissemination Level:	Public

Abstract: Deliverable D3.2 – First report on pre-production environment - defines components (services and tools) of the project's pre-production environment, describes their purpose, and reports the current development status of the pre-production environment.

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Document Revision History

Date	Issue	Author/Editor/Contributor	Summary of main changes
June 06, 2020	a	Dusan Vudragovic	Initial ToC
June 15, 2020	b	Sonja Filipovska, Anastas Mishev, Petar Jovanovic, Emanouil Atanassov, Todor Gurov, Svetlozar Yordanov, Emir Imamagic, Themis Zamani	Input provided by the partners
June 20, 2020	c	Kostas Koumantaros, Dusan Vudragovic	Additional input provided by the partners
June 25, 2020	d	Nicolas Liampotis, Anastas Mishev, Dusan Vudragovic	Additional input provided by the partners, and comments from reviewers
June 30, 2020	e	Dusan Vudragovic	Final draft
July 1, 2020	f	Milutin Radonjic	Internal quality check
July 1, 2020	g	Dusan Vudragovic, Ognjen Prnjat, Eleni Toli	Final version

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List of Acronyms

AAI	Authentication and Authorization Infrastructure
AARC	Authentication and Authorisation for Research and Collaboration
API	Application Program Interface
CMDB	Configuration Management Database
EOSC	European Open Science Cloud
ITIL	Information Technology Infrastructure Library
FitSM	Federated IT Service Management
GOCDB	Grid Operations Configuration Management Database
HPC	High Performance Computing
OTRS	Open Ticket Request System
REFEDS	Research and Education FEDerations group
RT	Request Tracker
SLA	Service Level Agreement
VO	Virtual Organization

Executive summary

What is the focus of this Deliverable?

The main focus of this deliverable is to describe components of the NI4OS-Europe pre-production environment, as well as to present the purpose of each component, and their current development stage.

What is next in the process to deliver the NI4OS-Europe results?

The initial architecture of the NI4OS-Europe pre-production environment was defined in the deliverable D3.1 - "*Best practices for on-boarding and related policies*". Based on this document, we have deployed a set of services and tools, whose detailed description is given here. During the deployment, we examined the on-boarding aspects, requirements, and categorizations presented in the deliverable D5.1 "*Provider landscape analysis and provider categorization*". A reviewed version of this document, based on the experience obtained during the on-boarding of the NI4OS-Europe services, the conclusions of the deliverables D5.2 - "*First report on provider and repository integration*" and D5.3 "*Update of service catalogue*" (type: other, internal catalogue) will be published in the deliverable D3.4 "*Best practices for on-boarding and related policies 2nd version*", as well as in D3.5 "*Final report on pre-production environment*". This deliverable is relevant to user communities' test-cases definition, to be reported in the deliverable D6.3 "*User communities test-cases*".

What are the deliverable contents?

The main five components of the pre-production environment's technical architecture are described as follows:

- Section 2 gives details about the service portfolio/catalogue management system,
- Section 3 presents the specification of the authentication and authorization infrastructure used by the project,
- Section 4 provides details of the monitoring system and its components,
- Section 5 describes the accounting system that analyzes and then provides information about the usage of services,
- Section 6 lists tools within the support system.

The overall purpose of the pre-production environment and scope of each component within the environment is explained in Section 1, while Section 7 presents the deliverable conclusions.

Conclusions and recommendations

The NI4OS-Europe pre-production environment aims to support the integration of regional resources into the EOSC through an environment fully equivalent to the EOSC-Core. Besides its technical aspects, the pre-production environment is essential for the establishment of a community of practice among the resource providers. The pre-production environment was completely deployed in April 2020 (PM8), and resource provider-oriented integration guidelines were published. Practical integration of services with the environment will be preformed during the on-boarding process by resource

providers. Feedback collected in the on-boarding process will directly define further modifications and eventual expansions of the NI4OS-Europe pre-production environment.

1 Introduction

The EOSC is foreseen as a federation of independent organizations and resource providers, and therefore its development follows a system of systems approach. Typically, such an approach understands the deployment of a set of external services and tools that provide the functionality of the federation and access-enabling. Within the EOSC sustainability working group [1], these services and tools are grouped in the EOSC-core layer, which provides the means to discover, share, access, and reuse data and services [2].

A similar and fully compatible set of services and tools within the NI4OS-Europe project [3] is deployed as a part of the pre-production environment. The EOSC-Core and the NI4OS-Europe pre-production environment have the very same function - to enable the federation of distributed resource providers and, in particular, to enable on-boarding of resources, access to resources, composability of resources, and building of a community of practice among the resource providers. During the project preparation, we have seen the establishment of the community of practice for specific technical and quality standards as one of the highest-valued outcomes of the project. Therefore, to accelerate its evolution, during the proposal preparation we considered it essential to deploy a testing environment that will enable resources providers to study and understand the integration abilities of services with the federation tools and to build their technical skills in this way. Hence, such an environment was named the pre-production environment.

The technical architecture of the NI4OS-Europe pre-production environment includes:

- **service portfolio/catalogue management system**, whose role is to give a consistent overview of the project services, which includes information about what services offer, their operational capacities, how they are accessed, etc.
- **authentication and authorization infrastructure (AAI)**, which is responsible for a seamless access to all resources,
- **monitoring system**, which measures the performance of the services in terms of availability and reliability, and ensures continuous status checking and alarms in case of service outages,
- **accounting system**, which measures the performance of the services in terms of utilization,
- **support system**, which consists of tools for providing support to end users and resource providers, including the training.

Each component of the architecture has an additional set of helper tools relevant to their proper functioning. For example, in order to configure the AGORA monitoring engine, a registry that contains information about the topology of NI4OS-Europe resources is required and deployed as the Configuration Management Database, as described in Section 4. Also, our support system, helpdesk, relies on technical documentation and integration guidelines collected within the technical wiki and the training portal, as described in Section 6.

The pre-production environment is deployed as a distributed system so that different components are hosted and maintained by different partners within the consortium. It is important to emphasize that all components of the pre-production environment have been deployed, and initial integration guidelines prepared and published at the project's technical wiki. The majority of them are already integrated with the project's AAI, so the

users can identify and authenticate themselves and use the services via their institute-provided or social credentials. Table 1 lists endpoints of the pre-production environment components and responsible partners.

The integration of a particular service with the pre-production environment will arrive as a part of the on-boarding process. In this process, the resource providers will practically use the developed integration guidelines and propose concrete recommendations for their improvement.

Pre-production component	Endpoint	Responsible partners
Service portfolio/catalogue	https://agora.ni4os-europe.eu/	GRNET
AuthZ and AuthN infrastructure	https://aai.ni4os.eu/	GRNET
Configuration management DB	https://gocdb.ni4os.eu/portal/	UKIM
Monitoring system	https://argo.ni4os.eu/	SRCE, GRNET
Accounting system	https://accounting.ni4os.eu/	IICT
Helpdesk	https://helpdesk.ni4os.eu/	IPB
Technical wiki	https://wiki.ni4os.eu/	IPB
Training portal	https://training.ni4os.eu/	UKIM

Table 1: Endpoints of the NI4OS-Europe pre-production environment services/tools

2 Resource management

In order to be compatible with the developments in EOSC, NI4OS-Europe follows the developments of the EOSC Portal and the EOSC Interoperability Framework closely as they are begin developed, maintained, and operated by the EC Projects EOSC-Enhance [4] and EOSC-Hub [5]. Similarly, NI4OS-Europe has adopted to use the Resource Management Tool Agora [6] as it is currently being developed by GRNET for the EOSC-Hub project, with NI4OS-Europe specific customizations.

2.1 Brief Description of Profiles 3.0

EOSC Profiles are specifications that define common data models for EOSC entities (Providers, Resources, etc.) and related taxonomies. They contribute to the unified framework for describing and offering EOSC Resources to end-users in a harmonized way, guaranteeing the interoperability of resources metadata with open APIs. Their aim is to fully describe and classify Providers and the Resources they offer, so that they are easily on-boarded to EOSC. In parallel, the Profiles guide the providers to define the necessary policies and procedures and to allocate the necessary stuff, so that they can offer mature and stable resources to EOSC. Version 3.00 of the EOSC Profiles include two profiles, each addressing a different entity and a different phase of the on-boarding, update, maintenance and monitoring processes of a Resource by a Provider: the Provider Profile and the Resource Profile. The EOSC Profiles include also Provider and Resource Code lists, Taxonomies, Classifications that have been developed to provide a structured classification of Resources and a harmonized way for the description of various attributes. They also constitute the basis for the structure and the filtering functions of an EOSC Catalogue.

2.1.1 EOSC Providers Profile

We call EOSC Provider any EOSC System User responsible for the provisioning of one or more Resources to the EOSC. EOSC Providers are organizations, a part of an organization or a federation that manages and delivers Resources to End-Users. EOSC Providers can be: Resource Providers, Service Providers, Data (Source) Providers, Service Developers, Research Infrastructures, Distributes Research Infrastructures, Resource Aggregators, Thematic Clouds, Regional Clouds, etc.

An EOSC Profile is the detailed description of the providers and is divided into the following sections:

- Provider Profile,
- Basic Information,
- Marketing Information,
- Classification Information,
- Location Information,
- Contact Information,
- Maturity Information,
- Other Information.

2.1.2 EOSC Resources Profile

EOSC Resource might be any asset made available by means of the EOSC system and according to the EOSC Rules of Participation to EOSC End-Users to perform a process useful to deliver value in the context of the EOSC. EOSC Resource Profiles aim to describe and classify these resources in much detail and they are divided in the following sections:

- Basic Information,
- Marketing Information,
- Classification Information,
- Geographical and Language Availability Information,
- Resource Location Information,
- Contact Information,
- Maturity Information,
- Dependencies Information,
- Attribution Information,
- Management Information,
- Access and Order Information,
- Financial Information.

2.2 Agora – Resource Portfolio Management Tool

The Resource Portfolio Management Tool (Agora) is a tool aimed at facilitating service management in IT service provision, including federated scenarios. Agora represents a complete list of the Resource managed by a Resource provider. Agora was recently upgraded to add support for the EOSC Resource Profiles described in the previous paragraph.
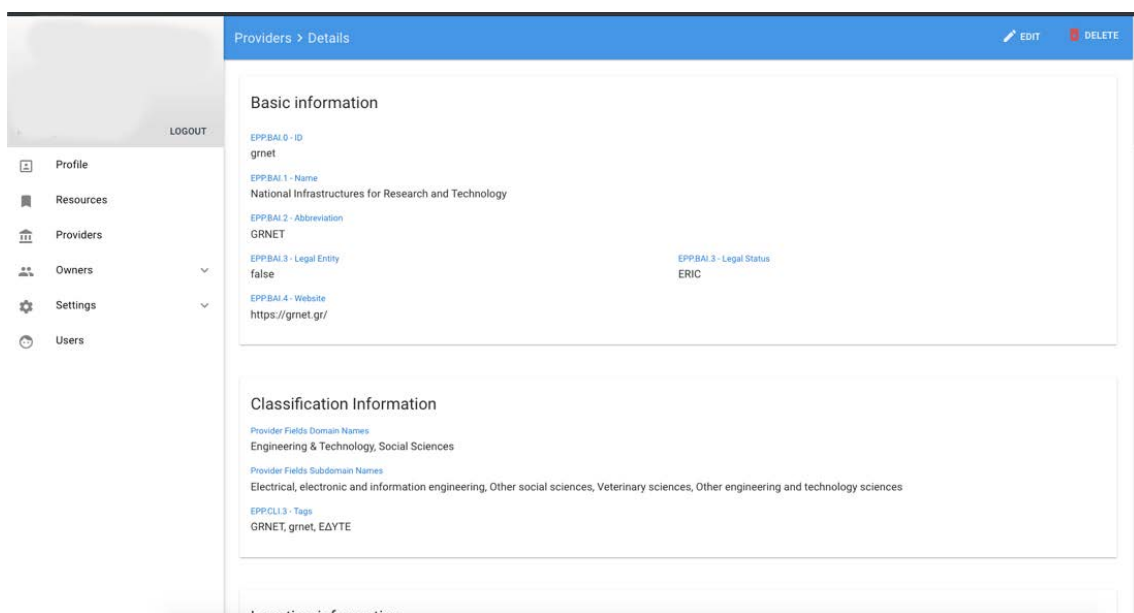

Figure 1: NI4OS-Europe Agora instance

In order to add a resource to NI4OS-Europe Resource Catalogue to be validated and exposed EOSC portal, one needs to register as a provider in Agora and to register his/her resources by filling the required information such as a) The Description, b) Classification and Maturity level and c) contact info. Agora will then assist the curation of the services to be validated and published directly to the EOSC Portal Catalogue via a standardized API that will be offered by EOSC.

The Agora instance for NI4OS-Europe is available at https://agora.ni4os.eu/ and its front page is illustrated in Figure 1. Guidelines on how to use it are available at the https://wiki.ni4os.eu/.

3 Authentication and authorization infrastructure

The NI4OS Login service is the Authentication and Authorization Infrastructure (AAI) for the NI4OS-Europe infrastructure. NI4OS Login enables the integration of external Identity Providers (from eduGAIN [7] and individual organizations) with the services and resources offered through NI4OS-Europe. This allows users to access the NI4OS-Europe services and resources (web and non-web-based) using existing credentials from their home organizations. The implementation of the AARC Blueprint Architecture [8] guidelines and the adoption of open technologies, including SAML 2.0 [9] and OpenID Connect [10] facilitates interoperability and integration with the existing AAIs of other eInfrastructures and research communities. To this end, NI4OS Login has been published in eduGAIN as a Service Provider. Through eduGAIN, the services connected to NI4OS Login can become available to more than 3,700 Universities and Institutes from the 68 eduGAIN Federations with little or no administrative involvement. Compliance with the REFEDS Research and Scholarship (R&S) entity category [11], the GÉANT EU/EEA Data Protection Code of Conduct [12], and the Sirtfi framework [13] ensure sufficient attribute release, as well as operational security, incident response, and traceability. Complementary to this, users without an account on a federated Identity Provider are still able to use social media or other external authentication providers for accessing NI4OS-Europe services and resources that do not require a substantial level of assurance. NI4OS Login enables users to manage their accounts from a single interface, to link multiple accounts/identities together, and to access the connected services based on their roles and Virtual Organization (VO) membership rights. VO managers are provided with an intuitive interface for managing their users and their respective roles and group rights.
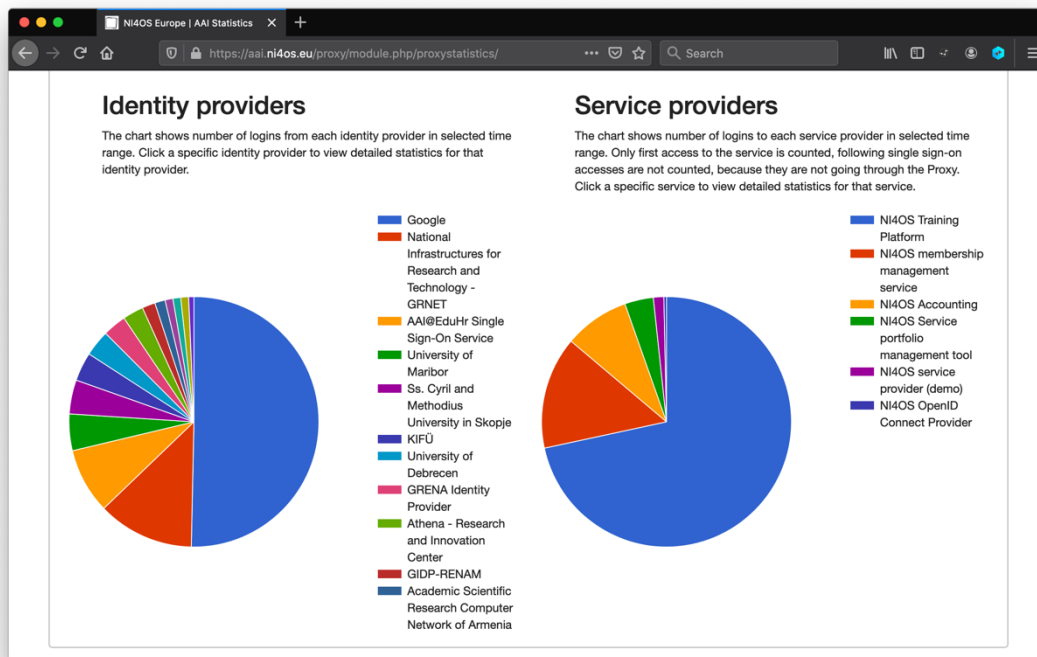

Figure 2: NI4OS Login usage statistics dashboard

The pre-production instance of NI4OS Login is available at https://aai.ni4os.eu/. Usage statistics are available at https://aai.ni4os.eu/proxy/statistics, and illustrated in Figure 2.

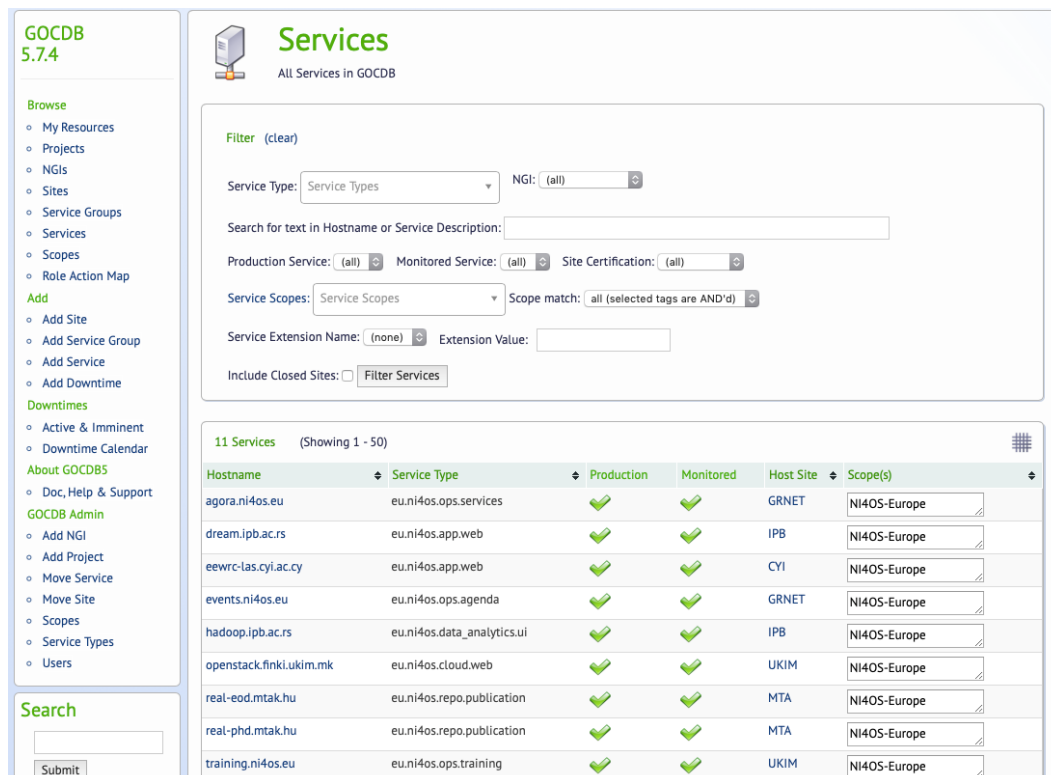The publicly accessible NI4OS Login statistics page includes different charts providing the following information:

- Number of logins per day in a given time range.
- Distribution of logins across identity providers in a given time range. A detailed statistics view for each identity provider is also available for showing the distribution of logins to service providers from a specific identity provider.
- Distribution of logins across service providers in a given time range. A detailed statistics view for each service provider is also available for showing the distribution of logins to a specific service provider.

4 Monitoring system

The monitoring system is responsible for continuous status checking of on-boarded NI4OS-Europe services, availability and reliability reporting, and alarming in case of service outages. Foundations of monitoring systems are sources of truth - registries containing information about what should be monitored and how the monitoring should be performed. Configuration Management Database is a registry that contains information about the topology of NI4OS-Europe - entities such as sites, service endpoints, entity organization (groups, hierarchies), and contact information of users responsible for operations. ARGO Monitoring Service consists of a registry of tests for monitoring different on-boarding services and framework for status checking, reporting, and alerting.

4.1 Configuration Management Database

The configuration management database to be used for the purposes of monitoring in the NI4OS-Europe pre-production environment is based on the well-matured and widely accepted GOCDB platform [14]. It maintains a central registry for e-Infrastructure topology. GOCDB contains a detailed description of service endpoints with custom attributes, tagging, and additional sub-endpoints. Services belong to resources centers, which are grouped in operations centers. It also enables the definition of contact points and declaration of downtimes for individual services endpoints or resource centers. The front page of the NI4OS-Europe GOCDB instance is illustrated in Figure 3.

Figure 3: NI4OS-Europe GOCDB instance

The topology information that GOCDB provides to the monitoring service includes the following information:

- the **monitored service(s)**,
- the **service types** they are running,
- the **service endpoints** of the service,
- the **way they are organized**,
- the **service actors** such as owners, admins, contact points.

It also contains binary attributes that the monitoring system relies on, such as:

- Production Level (Is this service in production?):
  - Y = monitored on production & development infrastructure.
  - N = monitored only on development infrastructure.
- Monitored (Is this service monitored?)
  - must be set to Y for the monitoring system to start monitoring it.
- Notifications (Do you wish to receive notifications about this service?)
  - set to Y if you wish to receive alerts on this service.

Currently, the database contains the service types listed in Table 2. The service types list will be extended when additional services types are identified and on-boarded.

Name	Description
eu.ni4os.app.api	API based thematic service.
eu.ni4os.app.web	Web based thematic services.
eu.ni4os.cloud.api	Cloud service API interface.
eu.ni4os.cloud.web	Cloud service web interface.
eu.ni4os.data_analytics.ui	UI to the analytics generic service.
eu.ni4os.hpc.ui	HPC User Interface (login, gateway node) machine.
eu.ni4os.ops.aai	The AAI service type.
eu.ni4os.ops.agenda	Agenda system.
eu.ni4os.ops.code	Source code repository.
eu.ni4os.ops.gocdb	GOC DB Service.
eu.ni4os.ops.mon.ARGO	ARGO monitoring instance.
eu.ni4os.ops.mon.ARGO.api	ARGO API.
eu.ni4os.ops.mon.ARGO.webui	ARGO Web UI.
eu.ni4os.ops.services	Service Catalogue service.
eu.ni4os.ops.support	Support/helpdesk service.
eu.ni4os.ops.training	Training platform.
eu.ni4os.ops.web	Project web site.
eu.ni4os.ops.wiki	Project wiki pages.
eu.ni4os.repo.data	Data repository.
eu.ni4os.repo.publication	Publication repository.

Table 2: List of NI4OS-Europe service types

4.2 ARGO Monitoring Engine

The ARGO Monitoring Service [15] provides a flexible and scalable framework for monitoring status, availability, and reliability of a wide range of services provided by infrastructures with medium to high complexity. ARGO generates reports using customer-defined profiles (e.g. for SLA management, operations, etc.). During the report generation, ARGO takes into account custom factors such as the importance of a specific service endpoint and scheduled or unscheduled downtimes.

ARGO Monitoring Service for NI4OS-Europe consists of production and development infrastructure. Production infrastructure is deployed in a redundant manner and is used for generating reports and raising alarms for production-grade on-boarded services. Development infrastructure is used for testing and integration of new services and probes. Web user interface is illustrated in Figure 4 and can be found at the following addresses:

- Production: https://argo.ni4os.eu/
- Development: https://argo-devel.ni4os.eu/

Procedure for on-boarding new services in ARGO Monitoring Service was defined as follows. The first step is adding the service to the Configuration Management Database. If services of the same type already exist in the Configuration Management Database, ARGO will automatically start monitoring the service. Otherwise, procedure for adding a new service type to Configuration Management Database has to be followed. Once a new service type is added, service provider checks in the ARGO registry (https://poem.ni4os.eu/ui/public_probes and https://poem.ni4os.eu/ui/public_metrics) if existing metrics can be used for monitoring service. If metrics exist, the ARGO team updates relevant profiles and starts monitoring the service.
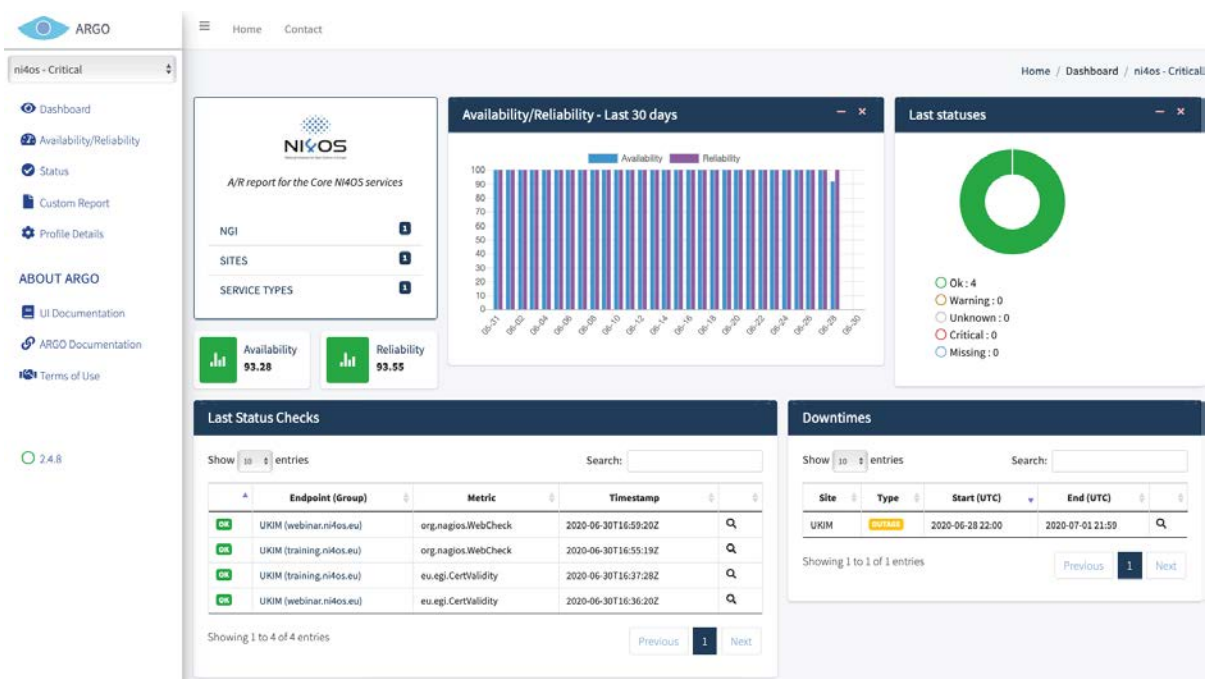

Figure 4: NI4OS-Europe ARGO instance

If new metrics are needed, probe development process is followed:

- Service provider discusses with ARGO team what to monitor.
- Service provider develops probe following Probe development guidelines [16].

ARGO team updates relevant profiles and starts monitoring the service, first on development and then on production infrastructure.

5 Accounting system

The accounting service collects, analyzes, and then provides information about the usage of services, for example, HPC usage, storage data, virtual machines data, and repositories. The service provides information only related to NI4OS-Europe services and is available to the project management team and the service administrators. The user is able to login using his NI4OS credentials by using the NI4OS Login button. In order words, the accounting system is fully integrated with the project's authentication and authorization infrastructure, which is illustrated in Figure 5.

Figure 5: Login screen of the NI4OS-Europe accounting system

Accounting data can be submitted by using the resource key, associated with the partner's resource. One can use either the web-site's interface, the APIs that are provided by the accounting service, or download and install the API clients, which upload data to the accounting service automatically. As an example, the instruction for reporting storage use via API is given in Figure 6.

Figure 6: Instruction for reporting storage use via APIs

Further information on how to do that is accessible at the site's wiki - https://wiki.ni4os.eu/index.php/Accounting and the accounting portal as well. Also, it is always possible to provide accounting information about past usage in order to fill any

gaps and to achieve accurate overall data. It is important to note that there are provisions for the data to be filtered before submission, so that only data that is relevant to the project is uploaded, while data about local or national users that are not required are filtered out.

Once logged in, the user is diverted to the accounting dashboard (Figure 7), where he or she is able to browse the accounting information. The main types of information that the site provides are:

- Jobs (for HPC) – number of jobs, CPU time, elapsed time.
- Storage – amount of storage provided.
- Virtual machines - number of virtual machines and total virtual machines' hours.
- Repositories – number of queries.
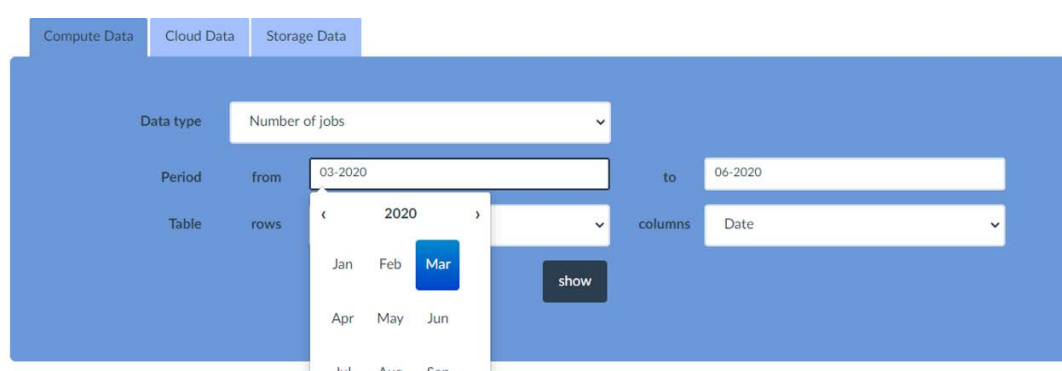
Figure 7: NI4OS-Europe accounting data dashboard

All the information can be grouped by country, date, year, resource name, the research community, and application. The information displayed on the site is mainly on a monthly basis. The accounting data is also presented as tables (which can be filtered and sorted), charts, and graphs. Figure 8 illustrates the graph that shows the distribution of storage usage between different communities.
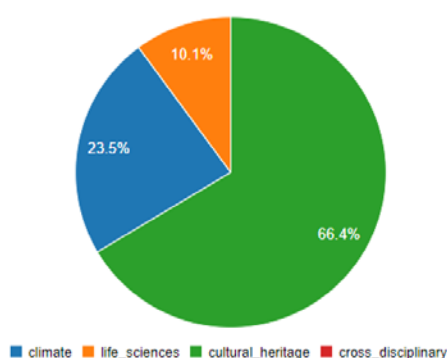
Figure 8: Storage usage by Virtual Research Community

6 Support system

In this section, we give an overview of tools that delivers the NI4OS-Europe support system. The central tool is the Helpdesk system, which is an entry point for users to submit an incident, report on issues or problems for the project's resources. Besides the helpdesk, there is also the technical wiki that collects various integration guidelines and technical documentation, as well as the training platform that provides important information for both prospective service providers and end-users of already on-boarded services.

6.1 Helpdesk

NI4OS-Europe helpdesk service is based on Request-Tracker [17] by Best Practical Solutions. The instance is hosted at the Institute of Physics Belgrade, and its front page is illustrated in Figure 9.

The helpdesk platform is extensible by Perl language scripts and has a strong community with a number of contributed extensions, e.g., AAI integration, different notification methods, data export, etc. Tickets are organized into queues, which are the support channels that group tickets on related subjects. The queues are in a flat structure, i.e., there is no hierarchy or other relations between them. However, the system users (support staff) can be organized into groups, and those groups can contain subgroups, which can define responsibilities and access hierarchically.

Figure 9: Front page of the NI4OS-Europe helpdesk system

System users can submit tickets on any queue after they sign in. Tickets can also be accepted from external (non-registered) users by email, and the communication between support staff and the users is managed and recorded by the system. There is also a command-line interface and API that can be used to implement external user-facing forms for ticket submission.

Custom workflows can be defined to control a ticket's lifecycle as it enters the system and transitions various states in the course of its resolution. Events in the lifecycle automatically trigger scripts that take appropriate actions. These scripts can implement complex behaviors, for example, to ensure the SLAs in response time to issues.

The system also supports creating relations between tickets, such as dependency or parent-child relations. Tickets also have settings for reminders and due dates, control of ticket ownership, and merging of tickets. However, the tickets cannot be moved across queues. All operations on a particular ticket are recorded and shown in the ticket's history.

Although the RT platform has shown great flexibility and meets most of the functional requirements for the NI4OS-Europe project, it may be replaced by the OTRS ticketing system [18] to ensure compatibility with other EOSC-related projects. During the EOSC-Hub week 2020 [19], OTRS was presented as a future helpdesk system, which will be used by EOSC-Hub [5] and EOSC-Enhanced [4] projects. Within these projects, the OTRS test prototype will be deployed by the end of this year, while the full transition to the OTRS will happen during the year 2021. Besides the modern and user-friendly interface, multiple communication channels, and chatting options, it allows easy integration with AAI, CMDB, Jira (issue tracking product developed by Atlassian), and other helpdesk systems, and it is ITIL/FitSM compliant and process-oriented. Therefore, in the next couple of months and before September 2020, we will try to replace our RT platform with the OTRS ticketing system. We do not expect any significant issues related to this transition since the significant usage of the helpdesk system is expected after an initial on-boarding of resources took place (September 2020).

6.2 Technical wiki

The NI4OS-Europe technical wiki is a service for documenting all technical aspects of the project. It is based on the MediaWiki platform [20], which powers Wikipedia and many other documentation sites. NI4OS-Europe technical wiki is illustrated in Figure 10 and can be accessed at https://wiki.ni4os.eu/.

The documentation is presented on interlinked pages, which can contain rich text format and multimedia contents. The history of edits for each page is kept, and users can discuss changes and roll them back if necessary. Editing of text is performed in the MediaWiki markup language, which is one of the most widely used standards for writing online documentation.

Currently, the documentation available at the NI4OS-Europe technical wiki contains information on the pre-production environment, service on-boarding process, WP4 related-tools, as well as policy documents and templates. The pre-production section covers the service portfolio management tool, configuration management database, AAI, monitoring and training, and integration guidelines. The resource on-boarding section contains details about the service on-boarding team, their names, contact information,

and area of responsibility. The service on-boarding procedure can also be found in this section. Via technical wiki, we are also collecting COVID-19 related open-access data and tools, as well as computational resources offered by the project for these purposes.

Although the NI4OS-Europe technical wiki was recently deployed, it already has 25 registered users, 30 pages, and 295 page edits.

Figure 10: Front page of the NI4OS-Europe technical wiki

6.3 Training platform

As a supporting system to the pre-production environment, the Training platform provides the necessary information for both prospective service providers and end-users of already on-boarded services.

All training material available on the platform is organized into training courses on a given topic that belongs to different training categories. The publicly available materials on the training platform are accessible in a Guest mode, which does not require user account. The training platform is integrated with the NI4OS-Europe AAI and supports on-the-fly user creation, thus providing a customized user experience to prospective service end-users that would like to track their training progress. All training material is tagged with keywords that enable fast search of relevant materials. In addition, the training platform

has an integrated calendar that shows planned events such as webinars and workshops and an online forum for discussions on training topics.

Initially, the main goal of the training platform is to enable service providers to find necessary training information related to the process of preparation for service on-boarding. For these purposes, the training platform offers several training possibilities to prospective service providers:

- online self-paced courses on the topics of EOSC concepts and FAIR principles, as well as service management and its related processes;
- targeted capacity building training materials which are related to the national capacity building training events organized by all NI4OS-Europe partners;
- access to public training materials produced during the train-the-trainer NI4OS-Europe events and related training materials harvested from other projects and sources.

The most relevant training materials that are related to the support of the on-boarding process include the Service on-boarding train-the-trainer event that was held as a webinar series on the 3rd and 4th of June 2020, the IT Service Management train-the-trainer event scheduled for September 2020 and the FitSM online self-paced course (Figure 11) available since March 2020. Starting from September 2020, the second wave of training events will start within the project targeting stakeholders related to capacity building, thus including prospective service providers. This will enable the service providers with access to additional training material provided in their local language.
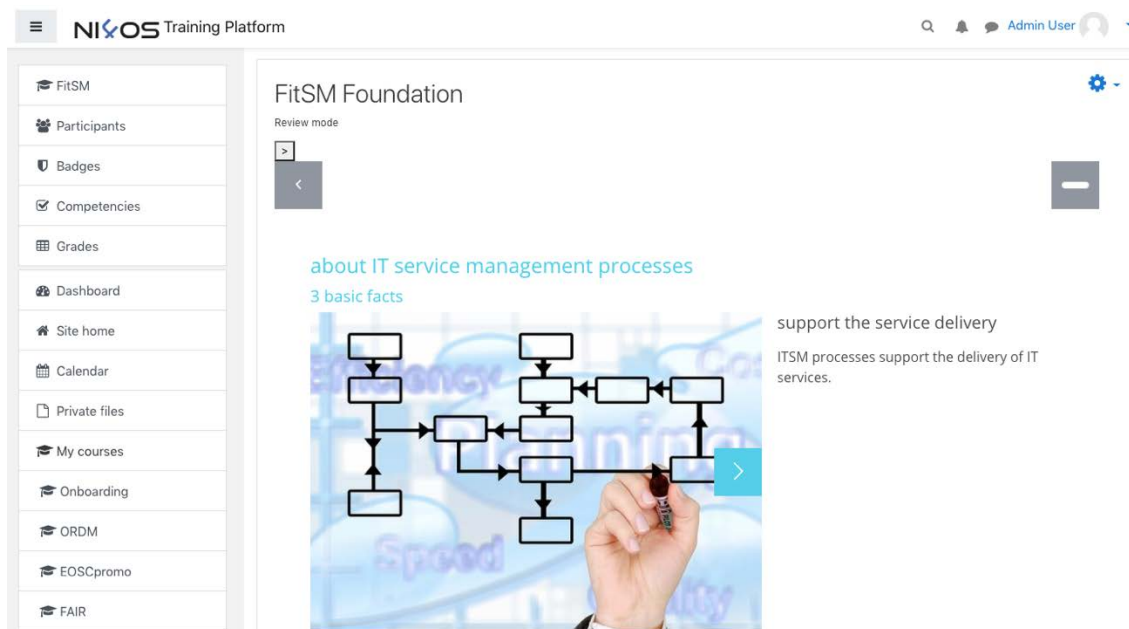
Figure 11: Online self-paced course on FitSM Foundation available on the training platform

As the process of service on-boarding starts and service providers on-board their services to the pre-production environment, the training platform will be used to host the training materials related to the on-boarded services. According to the rules and procedures for

on-boarding as defined by WP3, for each service that is to be on-boarded, the service provider needs to provide training materials for the service. These training materials (Figure 12) can be in the form of an online self-paced course, a training video, examples and use-cases description document, scheduled webinars, or a combination of multiple training materials format. The goal of the training materials is to provide additional practical support to service end-users via a set of examples that will showcase how to use the service and its expected benefits. The training materials should augment the mandatory user guide for the service that is part of the technical documentation for the service. For each on-boarded service, a separate training course will be created on the training platform with representatives from the service provider as managers of the course content. All training materials for the service will be provided within this course. The course and materials will be tagged with the provider and service name as well as other descriptive keywords that will facilitate the search of relevant materials on the training platform. In addition, the location of the training materials on the training platform will also be stored in the corresponding training category in the service catalogue.
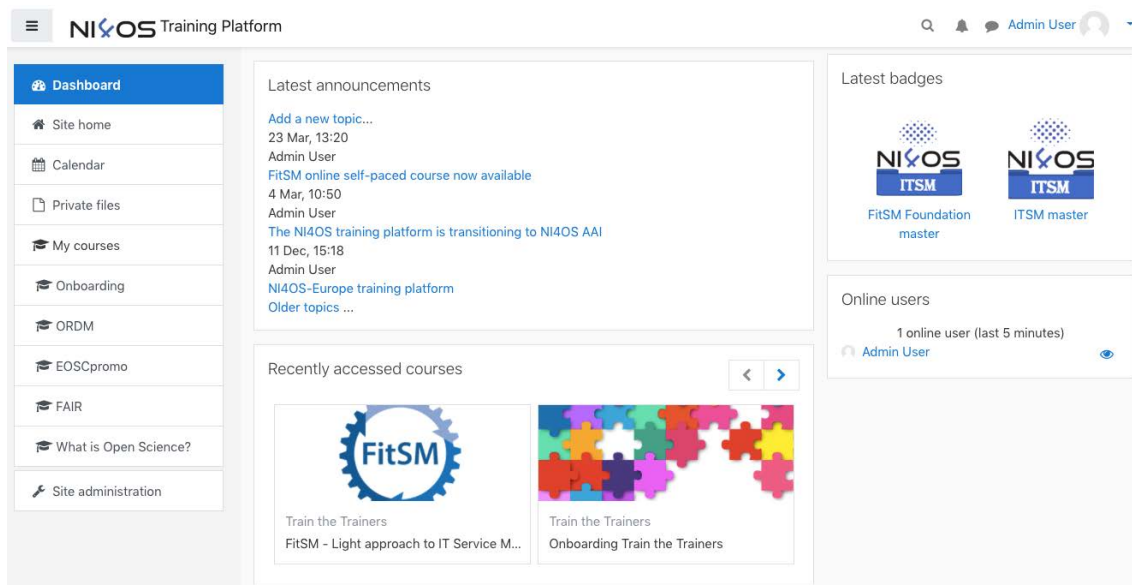
Figure 12: End-user view of training platforms, events, materials and badges

All training materials for each on-boarded service will be publicly available and will require no individual user accounts on the training platform, so that users can access them as transparently as possible. The service training course managers on the training platform will be available via an online forum within the training course that can be used by the end-users in case they have further questions about the provided training materials. The open forum can also be used by the end-users as a means for communication and knowledge exchange, thus providing the possibility to build a community of users around the service.

7 Conclusions

One of the main goals of the NI4OS-Europe project is the identification of regional resources and their on-boarding to the EOSC catalogue. To better assess the maturity of regional resources, as well as to help them raise their integration level within the ecosystem, a pre-production environment has been established and hosted by the project partners. The positive experiences learned from previous regional projects, such as VI-SEEM [21], are built upon to deploy this environment. The environment itself has been designed to be compatible with the EOSC-Core of the Minimum Viable EOSC [2]. The goal of the Minimum Viable EOSC is to enable the federation of the existing and planned research data infrastructures. The main functions of the EOSC-Core include means to discover, share, access, and reuse data and services. It will not by itself store, transport, and process data but it is planned to be widely used by all EOSC users.

In line with this, the NI4OS-Europe pre-production environment is primarily focused to support the integration of regional services through an environment fully equivalent to the EOSC-Core of the Minimum Viable EOSC. It represents a crucial tool for the providers to prepare their operational policies and functionalities so as to be mature enough for EOSC integration. As such, it provides a community of practice among the resource providers. The environment provides essential building blocks to support the smooth integration of regional services to the EOSC. At the moment, the technical architecture of the pre-production environment includes five main components: service portfolio/catalogue management system, authentication and authorization infrastructure, monitoring system, accounting system, and support system. This initial set of services will be extended, if necessary, based on the experiences and resource providers' feedback during the on-boarding process.

The pre-production environment is fully deployed as a distributed system and the initial set of integration guidelines are published on the project's technical wiki. The majority of pre-production services and tools are already integrated with the project's AAI, and the rest will achieve this by September 2020. During the on-boarding process, all components will be practically tested by resource providers and their feedback will directly define further modifications and eventual expansions of the NI4OS-Europe pre-production environment.