NEANIAS
Novel EOSC services for Emerging Atmosphere, Underwater and Space Challenges

Deliverable

Deliverable: 6.3 Core Services Software Release Report

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Core Services Software Release ReportCore Services Software Release Report

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Core Services Software Release ReportCore Services Software Release Report

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Core Services Software Release ReportCore Services Software Release Report

Table of Contents

Tables of Figures & Tables

Abstract

This document reports on the current state of core-services *release*, in particular the software underlying each service. This report, NEANIAS deliverable 6.3, comes out right after the first core-services release, deliverable 6.2.

Services are the way NEANIAS delivers functionalities within its systems architecture, services are decoupled functionalities composed by software and documentation. Services interact with each other in order to exchange data and provide the user some combined, higher-level functionality. Core-services are fundamental functionalities laying the ground for the thematic services. Core-services address functionalities such as user authentication, processing infrastructure, data archives; Services that will be consumed by the thematics which are then able to focus specifically on their role on science products.

A *released* service provides a point-of-access, an *interface* through which nteracts with other services and *documentation* explaining how to use it. Documentation, for instance, of all NEANIAS services is organized under NEANIAS Docs service at https://docs.neanias.eu/.

Services reported here have gone through the first release round, most services have integrated to NEANIAS authentication system service, the documentation workflow, and integrated with GARR infrastructure services. As expected, this first core-services milestone uncovered some gaps in the services deployment stack which are being addressed for the next milestone, where operational cloud prototypes are being deployed.

1. Introduction

1.1. Context

The NEANIAS WP6 "Core Services Foundation and Implementation" establishes generic, cross-community services that amplify the potential of thematic services delivered by WP2-5, enabling Open Science, and facilitating the migration to the EOSC concepts, by streamlining access to cloud resources. [1]☐☐, *Core Services* are divided in four topical groups, C1 (Open Science lifecycle), C2 (EOSC integration), C3 (Artificial Intelligence processing), C4 (Visualization), and are explained in the whole of NEANIAS infrastructure and development strategy. Core services compose the basis for thematic services to integrate in the cloud environment and provide thematic services with the fundamental layer for processing, data access, data publication and instantiation within the EOSC environment.This deliverable presents the release process of a NEANIAS Service and reports on the overall status, regarding the state of the software towards EOSC integration and the corresponding documentation under NEANIAS docs portal: https://docs.neanias.eu/.

1.2. Content and rationale

The concept of a *service* is largely intuitive to us, as is the concept of *software*, although in NEANIAS we use both terms almost as synonyms and in many discussions, interchangeably. For the purposes of this report – *services release* – it is nevertheless important to distinguish between these concepts.

A service is composed by one or more software components in order to provide well define *active resources* – I.e. resources that answer to user requests. Services are specialists in their role meaning that they are responsible for doing one – typically complex – task only though providing a simple interface to prospective users. The software underpinning a service is *abstracted* from the user, which only experiences its functionality.

Services are seen by the user through their *documentation* and their *interface* exposing functionality in customised ways. In a distributed architecture, as is typically with cloud computing, interfaces are often provided by URLs. Documentation is where users learn about service capabilities and how to effectively deploy them.

The *release* of a service is a point in its lifecycle when software and documentation satisfy a set of pre-defined goals and can be deployed for production. In general, a first release happens when a minimal set of features are functional and stable, and documentation is complete enough to cover them, thus rendering the service deployable by end users. In NEANIAS/EOSC, services are built on top of TRL6 [2] software – software fully functional in their original domain – and evolve the software towards TRL8 – in our context, fully operational in a cloud environment. This first release aims at deploying the software in the context of the NEANIAS infrastructure [1], using cloud infrastructure and services provided by GARR, and integrate relevant documentation, to be used as a test run for uncovering major obstacles across the NEANIAS collaboration. In the next milestones MS4 and MS5, as presented in Section 9 of D6.1 [1], services will go through cloud prototyping and stabilization (TRL7).

1.3. Structure of the document

This document is organized as follows. In chapter 2, we present a general view of the NEANIAS release process and a summary of released services. Chapter 3 provides short descriptions of each service release until the date of this document. Finally, in Chapter 4 we conclude this report with summary of achievements, major issues and future steps.

6.3 Core Services Software Release Report

This document is part of a series of documents to be released during NEANIAS development as the services develop and go through major releases. Each release milestone will get a separate report like this one. Until the next release this document may get updates, as often as needed, to reflect major improvements of core services.

Core Services Software Release ReportCore Services Software Release Report

2.   Release overview

2.1.   Release definition

Simply put, a release is the distribution of software to consumers. As previously said, in NEANIAS we talk about *services*, with <u>users</u> being their respective consumers; Nevertheless, the idea of *release* is analogous to that of the software industry: when the service is ready to be used it can be *released* to the public. The question that needs to be addressed then is: *when is a service ready to be used*?

To answer this question the details of *software* release processes are first presented, then we translate these into concrete NEANIAS services.

A release process is a series of steps along a software project to guarantee a reliable development process, where each step of the process is meant to guarantee a stable software version at the end – when it is released. The process is structured and managed carefully to guarantee a smooth deployment to all users consuming from it. Figure 1 depicts the steps the software in a service will go through during its development and eventual release.

NEANIAS services extend the step of *deploying* the software with that of *publishing* to the services catalogue and consequently appearing in the EOSC marketplace. *Testing* and *documentation* combine together into the *validation* of a service capabilities. Whereas the steps of adapting the software to accomplish EOSC/NEANIAS cloud environment are grouped as *development* stage.

Figure 1: Release process steps

From the surrounding infrastructure – users and other services –, a released service is defined mainly by two aspects: its documentation and the interface, and its access endpoint, I.e. the point through which it is accessible. The way a service is provided – its interface to the prospective users – varies; Some services collect information from others (e.g., Log aggregation), others answer to queries (e.g., NEANIAS AAI, Spatial Data Store), yet other services are less dynamic, openly providing data content or guidelines (e.g, Web Toolkit).

Regardless of the nature of a service or its interface, the documentation is of fundamental importance, even for internal, core services, as it states clearly and persistently how to properly use the service and eventually lists all necessary dependencies on the client side. That is exactly *why*, in the NEANIAS project, a service' documentation is considered as important as the actual functionality. Effectively, in the list of services status report, in section 3, each service reports on its overall implementation and cloud-integration as well as its fulfillment regarding documentation in the context of NEANIAS[1].

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[1] NEANIAS documentation hub: https://docs.neanias.eu/

2.2. Release role and timeline

In parallel with this report, the first round of services' release – D6.2 – is being delivered. This report describes and summarizes the completion of D6.2. The current release is of great importance to the project as it is the first major milestone where most of the participants of the project synchronize at a very practical level, which is fundamental in order to fully appreciate the general workflow within the project. This release is also expected to surface weak (or even faulty) points in the development plan. Such issues – and successes – are important for the project board, management and service leaders, to re-evaluate risks, adjust working groups, fill eventual gaps in the infrastructure plan, and also design and plan personal training.

The NEANIAS services infrastructure is conceptually split in two major groups: *core* and *thematic* services [1]. Core services form the basis for thematic services, which are responsible for the scientific communities data processing, supported by their data, users, and processing management mechanisms.

Section 9 from D6.1 [1] presents the time plan for core-services splitting the development path in four milestones. This first milestone, as planned, is where all the services deploy basic functionalities in the context of a cloud environment, particularly on the aspects of *integration*. From here, we go to **M14** (MS4 Expectation), NEANIAS Core-services' next milestone, when services have worked out basic issues and effectively are deployed under stable integration workflows, including documentation, logging and monitoring.

2.3. Release services summary

Table 2.1: Software released

Short name	Sector[1]	Lead[2]	TRL Level[3]	Version[4]	Core Integration[5]	Documentation Status[6]	Testing Status[7]	EOSC Registration Status[8]
Zenodo	C1	NKUA	TRL9		n/a	Complete	Complete	n/a
DVS	C1	NKUA	TRL6	1.0.0	AAI	Draft	In progress	no
Catalogue Service	C1	ATHENA	TRL6	1.0rc	AAI	Draft	In progress	no
NEANIAS AAI	C2	CITE	TRL7	1.1.0	None	Complete	Complete	n/a
Configuration Service	C2	CITE	TRL7	1.0.0	None	Complete	In progress	n/a
Service Instance Registry	C2	CITE	TRL6	1.0.0	None	Complete	In progress	n/a

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[1] C1/C2/C3/C4/S1/S2/S3/U1/U2/U3/A1/A2/A3

[2] Organisation leading implementation

[3] TRL level at release. All services start from TRL6.

[4] Version according to service issuer

[5] Integration level w.r.t. core NEANIAS services (AAI, Accounting, Monitoring, FAIRness support …)

[6] Level of documentation status: draft, under-update, complete, validated

[7] Testing status: mention the status w.r.t. unit, integration, user acceptance testing (N/A, in progress, complete, failed)

[8] Is service listed in Neanias and EOSC catalogue? (yes, in progress, no, n/a)

6.3 Core Services Software Release Report

Core Services Software Release ReportCore Services Software Release Report

Logging	C2	CITE	TRL7	1.0.0	None	Complete	In progress	n/a
Notifications	C2	CITE	TRL7	1.0.0	AAI	Complete	In progress	n/a
Data Transfer	C2	SZTAKI	TRL6	1.0.0	None	Complete	N/A	no
MiCADO	C2	SZTAKI	TRL6	1.0.0	None	Complete	N/A	no
Data Exploration	C2	MEEO	TRL8	1.0.0	AAI	Complete	Complete	no
C3.1-AI-Gateway	C3	SZTAKI	TRL6	1.0.0	AAI	Draft	N/A	no
C3.2-Model-Serving	C3	ALTEC	TRL6	1.0.0	None	Draft	N/A	no
C3.3-Horovod-Cluster	C3	SZTAKI	TRL6	1.0.0	None	Draft	N/A	no
C3.4-Spark-Cluster	C3	UNIMIB	TRL6	1.0.0	None	Draft	N/A	no
C4.1- Visual Discovery Framework	C4	INAF/UoP/CORONIS	TRL6	1.0.0	None	Complete	In progress	no
C4.2-Visualization Gateway	C4	INAF	TRL6	1.0.0	AAI	Draft	N/A	no
C4.3- Toolkit for Cross Realities	C4	ALTEC	TRL6	1.0.0	None	Complete	In progress	no
C4.4-Spatial Data Stores	C4	JACOBS	TRL6	1.0.0	AAI	Draft	Complete	n/a

3. Services

3.1. C1 – Open Science Lifecycle Support

3.1.1. NEANIAS Catalogue Service

Short name	Lead partner	Contributors
Catalogue Service	ATHENA	NKUA

Service Status	Preliminary beta release of API methods to support NEANIAS internal project's needs for programmatically modelling and managing services and publishing these services into EOSC portal. This release includes the following integrations with NEANIAS Services • NEANIAS AAI (C2-Neanias AAI) No integration with EOSC services are currently implemented
Service Endpoints	Beta release: http://catalogue.neanias.eu/developers Documentation: http://catalogue.neanias.eu/openapi Sample Service API Endpoint: http://catalogue.neanias.eu/api/service/DEV.neanias_service_catalogue
Software information	Web service built with JAVAEE and PostgreSQL offering a list of REST methods for managing a catalogue of EOSC compliant services. Based on FOSS https://github.com/eInfraCentral.

3.1.2. NEANIAS Research Product Catalogue

Short name	Lead partner	Contributors
Zenodo	NKUA	ATHENA

Service Status	This is an external service that is running in production.
Service Endpoints	Web interface is at: https://zenodo.org

	Developer documentation is at: https://developers.zenodo.org
Software information	For details please visit: https://about.zenodo.org

3.1.3. Data Validation Service

Short name	Lead partner	Contributors
DVS	NKUA	

Service Status	Preliminary release of the service, with an operational REST API to allow integration with other services. This release includes the following integrations with NEANIAS Services • NEANIAS AAI (C2-Neanias AAI)
Service Endpoints	Documentation resides at: https://docs.neanias.eu/projects/data-validation-service Service root endpoint: https://dvs.dev.neanias.eu/v1.0/ Service API visualization and interaction url: https://dvs.dev.neanias.eu/v1.0/ui/
Software information	API is designed with OpenAPI (swagger), implementaion using Python, database is Postgresql. All the above are open source tools. The repository for this service is at: https://gitlab.neanias.eu/data-validation-service/dvs

3.1.4. Common User Interface Components

Short name	Lead partner	Contributors
NEANIAS Web Toolkit	CITE	INAF

Service Status	The service provides coloring and logo design guidelines for the thematic services as well as web UI templates (utilizing HTML5/JS/CSS technologies) including the coloring guidelines, texts, html elements, proposals for menus, generic icons and widgets for consistently exposing some backend services features.

Core Services Software Release ReportCore Services Software Release Report

Service Endpoints	• Coloring and logo design guideline availble on the NEANIAS SharePoint. • Landing page mockup available on the NEANIAS SharePoint.
Software information	The Web UI templates source code is available on the NEANIAS GitLab at: https://gitlab.neanias.eu/c1-services/common-ui-components

3.1.5. NEANIAS Access Gate

Short name	Lead partner	Contributors
Catalogue Portal (C1.1)	ATHENA	NKUA

Service Status	Preliminary beta release NEANIAS Catalogue Portal to support NEANIAS internal project's needs for modelling and managing services. This release includes the following integrations with NEANIAS Services • NEANIAS AAI (C2-Neanias AAI) No integration with EOSC services are currently implemented
Service Endpoints	Beta release: http://catalogue.neanias.eu Documentation: https://docs.neanias.eu/projects/catalogue-service Sample Service Page: http://catalogue.neanias.eu/service/DEV.neanias_service_catalogue
Software information	Web portal built with AngularJS for offering uniform access to Neanias catalogue of services. It integrates with EOSC AAI for authentication and it communicates with the catalogue service with rest api. Based on FOSS https://github.com/eInfraCentral.

3.1.6. OpenDMP / Argos

Short name	Lead partner	Contributors
OpenDMP	CITE	ATHENA, OpenAIRE

Service Status	This is an external service that is running in production. NEANIAS adopts the service for Data Management Planning and validates its use in its context. No implementation is currently performed by NEANIAS team.
Service Endpoints	Web interface is at: https://argos.openaire.eu/splash/ Developer documentation is at: https://gitlab.eudat.eu/dmp/OpenAIRE-EUDAT-DMP-service-pilot
Software information	For details please visit: https://argos.openaire.eu/splash/

3.1.7. Data Publishing Service

Short name	Lead partner	Contributors
Zenodo	NKUA	ATHENA

Service Status	This is an external service that is running in production.
Service Endpoints	Web interface is at: https://zenodo.org Developer documentation is at: https://developers.zenodo.org
Software information	For details please visit: https://about.zenodo.org

Core Services Software Release ReportCore Services Software Release Report

3.1.8. Persistent Identifier Service

Short name	Lead partner	Contributors
Zenodo	ATHENA	NKUA

Service Status	This is an external service that is running in production.
Service Endpoints	Web interface is at: https://zenodo.org Developer documentation is at: https://developers.zenodo.org
Software information	For details please visit: https://about.zenodo.org

3.2. C2 - EOSC hub, RIs and cloud integration enabling

3.2.1. NEANIAS Authentication & Authorization Infrastructure Service

Short name	Lead partner	Contributors
NEANIAS AAI	CITE	CITE

Service Status	First release of the NEANIAS AAI Service offering horizontal solution for authenticated access (across users and service), centralized user management and authorization policy definition as well as identity federation. The service is deployed, operational and already supports integrations with a number of NEANIAS services.
Service Endpoints	Service documentation is available at https://docs.neanias.eu/projects/aai-service/ Service deployed at https://sso.neanias.eu/
Software information	The NEANIAS AAI Service is backed by the open source Keycloak application: https://www.keycloak.org/ Service packaging for NEANIAS is available at https://gitlab.neanias.eu/aai-service/server

6

Core Services Software Release ReportCore Services Software Release Report

3.2.2. Configuration Management Service

Short name	Lead partner	Contributors
Configuration Service	CITE	CITE

Service Status	Preliminary release of the NEANIAS Configuration Management Service providing key value storage for storing NEANIAS service configurations allowing integration at bootstrap and runtime. The service is deployed for testing and integration purposes while development and configuration is ongoing. No graphical user interface is available.
Service Endpoints	Service documentation is available at https://docs.neanias.eu/projects/configuration-service Service deployed at configuration.dev.neanias.eu
Software information	The Configuration Management Service is backed by Apache Zookeer: https://zookeeper.apache.org/ Service packaging for NEANIAS is available at https://gitlab.neanias.eu/configuration-service/server

3.2.3. Service Instance Registry

Short name	Lead partner	Contributors
Service Registry	CITE	CITE

Service Status	Preliminary release of the NEANIAS Service Instance Registry providing dynamic registration and service discovery along with location and health status. Allows integration at bootstrap and runtime. The service is deployed for testing and integration purposes while development and configuration is ongoing. No graphical user interface is available.
Service Endpoints	Service documentation is available at https://docs.neanias.eu/projects/instance-registry-service

Core Services Software Release ReportCore Services Software Release Report

	Service deployed at registry.dev.neanias.eu
Software information	The Service Instance Registry is backed by Apache Zookeer: https://zookeeper.apache.org/ Service packaging for NEANIAS is available at https://gitlab.neanias.eu/instance-registry-service/server

3.2.4. Log Aggregation Service

Short name	Lead partner	Contributors
Logging	CITE	CITE

Service Status	Initial release of the Log Aggregation Service providing seamless integration and transport, log aggregation, transformation, field extraction, indexing browsing and visualization. The service is deployed for testing and integration purposes while development and configuration is ongoing. Access is controlled and restricted while authorization policies are evaluated
Service Endpoints	Service documentation is available at https://docs.neanias.eu/projects/logging-service Service deployed at logging.dev.neanias.eu
Software information	The Service Instance Registry is backed by an ELK stack: • ElasticSearch (https://www.elastic.co/elasticsearch/) index backend that stores data and makes them searchable • Logstash (https://www.elastic.co/logstash/) that facilitates the transformation of log entries extraction of additional metadata and homogenization of logged entries • Kibana (https://www.elastic.co/kibana) that offers visualization, aggregation and filtering graphical user interface over the indexed entries • Beats (https://www.elastic.co/beats/) that facilitate data shipping and seamless log aggregation Service packaging for NEANIAS is available at https://gitlab.neanias.eu/logging-service/server

3.2.5. Accounting Service

Short name	Lead partner	Contributors

Core Services Software Release ReportCore Services Software Release Report

Accounting	CITE	CITE

Service Status	Service delivery depends on logging service, concepts (I.e. accounted assets) and policies to be presented by Thematic Sector services.
Service Endpoints	N/A (to be released)
Software information	N/A (to be released)

3.2.6. Notification Service

Short name	Lead partner	Contributors
Notifications	CITE	CITE

Service Status	Preliminary release of the NEANIAS Notification Service providing generic configuration and parametrization of notification templates, ad-hoc message authoring, give configuration options for selected notification channels to users and allow easy integration with other services that want to use its functionality. The service is deployed for testing and integration purposes while development and configuration is ongoing. Integrated with NEANIAS AAI. No graphical user interface is available. Current API bindings offered are limited to Message Queue based.
Service Endpoints	Service documentation is available at https://docs.neanias.eu/projects/notification-service Service deployed at notification.dev.neanias.eu
Software information	The Service Instance Registry is backed by an ASP.NET Core web application: https://code.cite.gr/git/cite/templates/aspnetcore-pomolo-notification Service packaging for NEANIAS is available at https://gitlab.neanias.eu/notification-service/server

Core Services Software Release ReportCore Services Software Release Report

3.2.7. Data Depositing service

Short name	Lead partner	Contributors
GARR Cloud Platform Object Store	GARR	-

Service Status	The GARR Cloud Platform Object Store is currently providing object storage services in the Palermo geographical region of the GARR Cloud infrastructure. It is based on Ceph RADOS object store, currently deployed at the Luminous release.
Service Endpoints	Documentation is available at https://cloud.garr.it/support/kb/openstack/rclone_quick_tutorial/ and https://docs.openstack.org/python-openstackclient/stein/cli/command-objects/object.html The service can be accessed from the OpenStack Dashboard at https://dashboard.cloud.garr.it or via command line interface (CLI)
Software information	The Ceph source code, which includes the RADOS object store is available at https://github.com/ceph/ceph under the LGPL, BSD-like and GPL licenses.

3.2.8. Data Sharing service

Short name	Lead partner	Contributors
DaShaS	NKUA	

Service Status	After deliberation with the partners on the use-cases and requirements for this component, we decided to establish a working group to further research different technologies than the ones listed in D6.1, such as ownCloud and Nextcloud. We will update this deliverable once a specific technology is deployed.
Service Endpoints	

Core Services Software Release ReportCore Services Software Release Report

Software information	

3.2.9. Data Transfer service

Short name	Lead partner	Contributors
C2-DataAvenue	SZTAKI	

Service Status	Data Avenue is a file transfer service. It has been deployed and operated on the GARR cloud by SZTAKI. The current service is the initial Neanias release. At the current phase Data Avenue is not yet integrated to Neanias or EOSC services.
Service Endpoints	The service documentation can be found at https://docs.neanias.eu/projects/c2-dataavenue/en/latest/ . The documentation contains the basic information on the service and its usage. The endpoint of the Neanias service instance is also defined in the documentation.
Software information	The service is realised by the Data Avenue software developed by SZTAKI. It is maintained at the https://github.com/SZTAKI-LPDS/data-avenue repository, where a description can also be found. It is published under the Apache 2.0 license.

3.2.10. Data exploration service

Short name	Lead partner	Contributors
Data Exploration	MEEO	JACOBSUNI

Service Status	Data exploration service enables data discovery, visualization and access services for geospatial data; detailed description of services is available in deliverable D6.1.
	The service is deployed in the MEEO Cloud, that is collocated in two sites, at the University of Ferrara and at the Ferrara Datacenter, interconnected to the 1Gbps high-speed backbone GARR network. An OpenNebula instance manages the MEEO Data Center virtualization resources. Kubernets is used for different purposes, e.g. for balancing discovery and access requests. The datasets and

Core Services Software Release ReportCore Services Software Release Report

	products metadata are archived in a catalogue, original products are archived in physical volumes as described for the C4.4 Data Storage Service. The NEANIAS core services (e.g. AAI) have been succesfully integrated.
Service Endpoints	Documentation is available at: https://docs.neanias.eu/projects/c2-dataexploration/en/latest/
Software information	OpenNebula documentation: https://opennebula.io/docs/ The source code of Kubernets is available at https://github.com/kubernetes/kubernetes under the Apache 2.0 License. Others components use proprietary software and they are in compliance with the required OGC standard.

3.2.11. GARR Cloud Platform Service

Short name	Lead partner	Contributors
GARR Cloud Platform Service	GARR	-

Service Status	The GARR Cloud Platform is providing IaaS services in three geographical regions (Palermo, Catania, Napoli). It is based on OpenStack and has been upgraded in M8 and M9 to the "Stein" release.
Service Endpoints	Documentation is available at: https://cloud.garr.it/compute/ and https://docs.openstack.org/stein/ The service can be accessed from the OpenStack Dashboard at https://dashboard.cloud.garr.it or via command line interface (CLI)
Software information	The GARR Cloud Platform is based on Canonical's distribution of OpenStack, available as a Juju bundle: https://jaas.ai/openstack-base/bundle/ The source code of OpenStack Stein is available at https://releases.openstack.org/stein/ under the Apache License 2.0.

Core Services Software Release ReportCore Services Software Release Report

3.2.12.   GARR Container Platform Service

Short name	Lead partner	Contributors
GARR Container Platform Service	GARR	-

Service Status	The GARR Container Platform is providing a PaaS environment which allows the deployment of scalable containerized services. It is based on Kubernetes. The main cluster is running version 1.13. A secondary Kubernetes cluster has been deployed at M9 through GARR DaaS and is actually running version 1.16.13.
Service Endpoints	Documentation is available at https://cloud.garr.it/containers/ and https://kubernetes.io/docs/home/ The main cluster can be accessed through the dashboard at https://k8s.cloud.garr.it and through command line interface (CLI).
Software information	The GARR Container Platform is based on Canonical's distribution of Kubernetes, available in the Juju store: https://jaas.ai/charmed-kubernetes/bundle The source code of Kubernetes is available at https://github.com/kubernetes/kubernetes under the Apache 2.0 License.

Core Services Software Release ReportCore Services Software Release Report

3.2.13.   GARR Deployment as a Service

Short name	Lead partner	Contributors
GARR DaaS	GARR	-

Service Status	The GARR DaaS allows users to deploy on the GARR Cloud Platform applications from the Juju store at https://jaas.ai . It is currently available for the Palermo and Catania geographical regions of the GARR Cloud Platform. It is based on Juju version 2.6.9. GAAR DaaS has been used to deploy a secondary Kubernetes cluster for NEANIAS and is currently used to operate and maintain it.
Service Endpoints	Documentation is available at https://cloud.garr.it/apps/daas/ and https://juju.is/docs The service is available at https://daas-ct.cloud.garr.it/ and https://daas-pa.cloud.garr.it/ and through command line interface (CLI).
Software information	GARR DaaS is based on Canonical's Juju, whose source code is available at https://github.com/juju/juju/ under the GNU Affero General Public License v3.0.

3.2.14.   MiCADO autoscaling framework

Short name	Lead partner	Contributors
C2-MiCADO	SZTAKI	

Service Status	MiCADO is an autoscaling framework for Kubernetes Deployments in the Cloud. The current version is considered to be used as a private service, the user deploys and uses it exclusively. It can be deployed in any cloud by using its client python library or by hand. The current version is the initial Neanias release. At the current phase, MiCADO is not yet integrated to Neanias or EOSC services.
Service Endpoints	Documentation can be found at https://docs.neanias.eu/projects/c2-micado/en/latest/ . The documentation contains the basic information on the service and its usage.

Core Services Software Release ReportCore Services Software Release Report

Software information	The MiCADO software is documented at https://micado-scale.readthedocs.io/en/latest/ . It is maintained at the https://github.com/micado-scale repository. It is published under the Apache 2.0 license.

3.3. C3 – Artificial Intelligence

3.3.1. AI Science Gateway: service for Development of Machine Learning Model using Jupyter Hub

Short name	Lead partner	Contributors
C31-AI-Gateway	SZTAKI	

Service Status	Neanias AI Science Gateway is a Jupyter Hub service for development of Machine Learning Models. It has been deployed and operated on the GARR container platform by SZTAKI. The current service is the initial Neanias release. At the current phase, the Neanias AAI authentication service is integrated, but integration to EOSC services is not yet performed.
Service Endpoints	The service documentation can be found at https://docs.neanias.eu/projects/c3-1-ai-gateway/en/latest/ . The documentation contains the basic information on the service and its usage. The endpoint of the Neanias service instance is also defined in the documentation.
Software information	The service is realised by the Zero to JupyterHub with Kubernetes software documented at https://zero-to-jupyterhub.readthedocs.io/en/latest/ extended with preinstalled ML libraries and Neanias SSO authentication. JupyterHub is open-source software released under the modified BSD license.

3.3.2. Serving trained ML models

Short name	Lead partner	Contributors
C32-Model-Serving	ALTEC	SZTAKI, UNIMIB, INAF

Service Status	BentoML is the software of choiche for ML models. This software doesn't provide an authorization system but only authentication, it's necessary to extend this platform in order to guarantee authentication with EOSC services (by implementing a new functionality or using an external component to replicate the backend service for any teams) .
Service Endpoints	The service documentation can be found at https://docs.neanias.eu/projects/c3-2-modelserving/en/latest/. The documentation contains the basic information on the service and its usage. The endpoint of the NEANIAS service instance is also defined in the documentation.
Software information	The service is based on BentoML framework described in https://github.com/bentoml/BentoML

3.3.3. Distributed Multi-GPU training of large ML models using Horovod

Short name	Lead partner	Contributors
C33-Horovod-Cluster	SZTAKI	INAF, UNIMIB

Service Status	NEANIAS Distributed Multi GPU training cluster is a Horovod cluster for training large ML models in a distributed environment. It has been deployed and operated on the GARR Cloud platform by SZTAKI. The current service is the initial NEANIAS release. At the current phase, the Horovod cluster is not yet integrated to NEANIAS or EOSC services.
Service Endpoints	The service documentation can be found at https://docs.neanias.eu/projects/c3-3-horovod/en/latest/ . The documentation contains the basic information on the service and its usage. The endpoint of the NEANIAS service instance is also defined in the documentation.
Software information	The service is based on the Horovod framework, which is documented at https://horovod.readthedocs.io/en/stable/index.html . The framework is extended with a JupyterLab component for code

	execution and cluster management. Horovod is open-source software released under the Apache License 2.0.

3.3.4. Distributed Machine Learning using SparkML

Short name	Lead partner	Contributors
C34-Spark-Cluster	UNIMIB	SZTAKI

Service Status	NEANIAS Distributed Machine Learning using SparkML consist of using kubernetes as a resource manager for Spark applications. From version 2.4 Spark supports Kubernetes deployment in experimental mode. Recently, version 3.0.0 of Spark was released and the K8S deployment is currently experimental.
	Different approaches to the deployment of a Spark cluster on K8S in the GARR cloud have been investigated (internal documentation is available here: https://gitlab.neanias.eu/c3-services/c3-4/c3-4service).
	Currently a pod configured with Jupyter and Spark is deployed on GARR Cloud platform. This pod is capable to spawn spark executors to execute parallel distribuited job. In near future, however, the common way to use spark could change by using K8S Operators.
	The Spark service is not yet integrated to NEANIAS or EOSC services, and it is to be considered as a proof of concept deployment.
Service Endpoints	The service documentation can be found at https://docs.neanias.eu/projects/c3-4-spark/en/latest/. The documentation includes the basic information on the service and its usage. The endpoint of the NEANIAS service instance is also defined in the documentation.
Software information	The service is based on Apache Spark (https://spark.apache.org/), an open source unified analytics engine for large-scale data processing, also supporting distributed execution of machine learning algorithms. The documentation of the latest version of this software is available here (https://spark.apache.org/docs/latest/), although for the current deployment we are using an older version (https://spark.apache.org/docs/2.4.6/).

Core Services Software Release ReportCore Services Software Release Report

3.4. C4 – Visualization

3.4.1. Visual Discovery Framework - VisIVO

Short name	Lead partner	Contributors
VD-VisIVO	INAF	UoP

Service Status	The service has been released as a Docker container. The VD-VisIVO Docker container software implementation has been managed using the NEANIAS GitLab at https://gitlab.neanias.eu/c4-service/vd-visivo and it has been delivered from the container image registry.
Service Endpoints	• Documentation: https://docs.neanias.eu/projects/c4-services/en/latest/services/vd.html • Docker Container Registry: gitlab.neanias.eu:5050/c4-service/vd-visivo
Software information	The source code of VisIVO is freely available on GitHub at: https://github.com/inaf-oact-VisIVO/VisIVOServer and it is licensed under GNU GENERAL PUBLIC LICENSE Version 2. The VisIVO user manuals are stored within the same repository of the source code.

3.4.2. Visual Discovery Framework - Splotch

Short name	Lead partner	Contributors
VD-Splotch	UoP	INAF, SZTAKI

Service Status	The service is released as a Docker container. The VD-Splotch Docker container software implementation is being managed using the NEANIAS GitLab at https://gitlab.neanias.eu/c4-service/vd-splotch and it will be delivered to end users via the NEANIAS container image registry.
Service Endpoints	• Documentation: https://docs.neanias.eu/projects/c4-services/en/latest/services/vd.html • Docker Container Registry: https:// gitlab.neanias.eu:5050/c4-service/vd-splotch

Core Services Software Release ReportCore Services Software Release Report

Software information	The source code of Splotch is freely available on GitHub at: https://github.com/splotchviz/splotch and it is licensed under GNU general public licence. Splotch documentation and scientific publications based on Splotch are stored with the source code in the same repository.

3.4.3. Visual Discovery Framework - 2D/3D Tiling and Maps

Short name	Lead partner	Contributors
VD-Maps	CORONIS	JACOBS

Service Status	As proposed in D6.1, the tools required for building tiled maps have been released as a Docker container. Two additional containers for both serving and visualizing the generated maps have also been provided for testing/development purposes. The code and instructions to build these containers are available through Neanias' GitLab, the docker images are available in the registry, and a first version of the documentation is provided.

Service Endpoints	• Main repository (Neanias' GitLab): https://gitlab.neanias.eu/c4-service/vd-maps
	 • Documentation: https://docs.neanias.eu/projects/c4-services/en/latest/services/vd.html#vd-maps
	 • Docker Container Registry:
	   o gitlab.neanias.eu:5050/c4-service/vd-maps/tiler
	   o gitlab.neanias.eu:5050/c4-service/vd-maps/tile_server
	   o gitlab.neanias.eu:5050/c4-service/vd-maps/viewer

Software information	VD-Maps builds upon the following libraries: • Cesium Terrain Builder (https://github.com/geo-data/cesium-terrain-builder - Apache License, Version 2.0) • EMODnet Quantized Mesh Generator for Cesium (https://github.com/coronis-computing/emodnet_qmgc - GNU General Public License v3.0)

3.4.4. Visualization Gateway

Short name	Lead partner	Contributors
VG	INAF	JACOBS, UoP

Core Services Software Release ReportCore Services Software Release Report

Service Status	The service enables access to a web-based environment for processing and evaluating complex, scalable visualisation scenario solutions based on the services implemented in the Visual Discovery Framework.
Service Endpoints	The service is actually accessed from the C3 AI Gateway, based on Jupyther Hub, to enable efficient visualisation of complex visualisation tasks (including AI models) with outcomes being seamlessly integrated in the overall scientific workflows.
Software information	Software information has been provided for the C31- AI-Gateway. See the related section.

3.4.5. Toolkit for Cross Realities

Short name	Lead partner	Contributors
XR	ALTEC	UoP

Service Status	The PMS service (part of XR toolkit) is based on the SPICE toolkit which provides a series of functions, through the use of the Spice Kernels, for the retrive of space-time information on celestial bodies.
	The SPICE toolkit includes a large collection of APIs in multiple languages and a small set of ready-built utility application.
Service Endpoints	• Documentation: https://docs.neanias.eu/projects/c4-services/en/latest/services/xr.html
Software information	The service source code is available from the NEANIAS GitLab at: https://gitlab.neanias.eu/c4-service/xr

3.4.6. Spatial Data Store

Short name	Lead partner	Contributors
DS	JACOBS	MEEO, INAF

6.3 Core Services Software Release Report

Core Services Software Release ReportCore Services Software Release Report

Service Status	MEEO Cloud provides storage resources to host atmospheric and planetary science data. The access interfaces are described in the C2 Data Exploration Service section
Service Endpoints	The access to the storage layer is implemented through C2 Data exploration service for the NAS. • Documentation: https://docs.neanias.eu/projects/c4-services/en/latest/services/ds.html • Also available through Amazon catalogue service: https://meeo-s5p.s3.amazonaws.com/index.html?t=catalogs • https://docs.aws.amazon.com/AmazonS3/latest/dev/Introduction.html
Software information	Software information has been provided for the C2 Data Exploration Service. See the related section.

4. Summary and future steps

In this report we document the current status of NEANIAS core-services regarding the first round of service's software release in the scope of NEANIAS/EOSC. In the components of each service – software and documentation – we note that all services in Table 2.1 have the corresponding software deployed either in the GARR platform as a virtual machine in NEANIAS's OpenStack dedicated cloud resources, or as Docker containers through the NEANIAS Gitlab Container Registry instance. Also summarized in Table 2.1, and explicitly hyper-linked across section 3, all services have integrated some level of documentation into NEANIAS Documentation infrastructure though only approximately half of them are considered complete currently.

In the next period C1-4 services are going to progress their software towards TRL7 level [2], as a working cloud-compatible prototype [1]. Concurrently, and in a few months from now, thematic services will undergo through their first release which will also pose demands on core-services and should thus contribute to improving not only the specific services but also their overall release workflows.

References

[1
]   NEANIAS collaboration, "D6.1 - Core Services Architecture, Design Principles and Specifications," 2020.

[2
]   E. Comission, "Technology Readiness Levels," 2017. [Online]. Available: https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016_2017/annexes/h2020-wp1617-annex-g-trl_en.pdf.

Core Services Software Release ReportCore Services Software Release Report

List of acronyms

Acronym	Description
DS	Data Store
VD	Visual Discovery
VG	Visualization Gateway
XR	Cross Realities