EGI-Engage

Final release of the accounting and operational tools

D3.17

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Abstract

This deliverable describes the final release of the EGI Accounting and Operational Tools during EGI-Engage project, including the developments made during the third year of the project for the Operations Portal, ARGO, Messaging, GOCDB, Security Monitoring, Accounting Repository and Portal. The evolution of these tools has been driven by the need to support new technologies (e.g. cloud) and to satisfy new requirements emerging from service providers and user communities, in particular from the Research Infrastructures contributing to EGI-Engage via the EGI Competence Centres (CCs) and the Resource Providers (RPs) who contribute infrastructure services to the federation. The development roadmap has been reviewed and updated according to a requirement gathering process, which has been accomplished in collaboration with the other EGI Engage WPs in charge of the communication with users and key stakeholders.

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TERMINOLOGY

A complete project glossary and acronyms are provided at the following pages:

- https://wiki.egi.eu/wiki/Glossary
- https://wiki.egi.eu/wiki/Acronyms

Contents

Executive summary

This deliverable describes the final release of the EGI Accounting and Operational Tools during EGI-Engage project, including the developments made during the third year of the project for the Operations Portal, ARGO, Messaging, GOCDB, Security Monitoring, Accounting Repository and Portal. The evolution of these tools has been driven by the need to support new technologies (e.g. cloud) and to satisfy new requirements emerging from service providers and user communities, in particular from the Research Infrastructures contributing to EGI-Engage via the EGI Competence Centres (CCs) and the Resource Providers (RPs) who contribute infrastructure services to the federation. The development roadmap has been reviewed and updated according to a requirement gathering process, which has been accomplished in collaboration with the other EGI Engage WPs in charge of the communication with users and key stakeholders.

The Operations Portal team implemented a new metric view for the VOs merging data collected from both the Accounting system and the AppDB. The tool now supports the new EGI AAI based on the CheckIn service[1] and improvements were applied to the VO ID Card. The VAPOR module provides now a summary of the CPU and storage capacities by countries, resource or operations centres, and geographical maps with a global view of all the resource providers with a VO filter.

Several new features are now available in the ARGO Monitoring system. The Compute Engine was enhanced to support stream processing in real time. The introduction of this new feature enables the development of new functionalities that go beyond the infrastructure monitoring, as for example an alerting system. The support for probe management in the POEM component greatly simplifies the addition of new probes in the system. In addition, ARGO now only uses GOCDB as a source of topology information, new probes were developed and the UI was enhanced with new reports and updates on existing views.

Final tests to move the new Messaging Service into production are running. It provides an HTTP API that enables users/systems to implement a service-oriented messaging system using the Publish/Subscribe Model over plain HTTP. Work to migrate the ARGO monitoring system, the Operations Portal and the accounting system to the new Messaging Service is progressing well and will be completed shortly.

To meet requirements of communities, including WLCG, the write API of the GOCDB was extended to allow the programmatic creation, update, and deletion of service endpoints and updates to the details of services. This update allows changes to key entities within GOCDB, programmatically, and represents a significant evolution in the way in which GOCDB works, allowing for much greater automated interaction with the information managed by GOCDB.

Work on Security Monitoring is progressing and Secant, the framework to detect security vulnerabilities in images of virtual machines, will be integrated with AppDB in the coming months to support the assessment of the virtual appliances during the endorsement process.

[1] https://wiki.egi.eu/wiki/AAI

Finally, the accounting system has added storage systems as a source of accounting data and support for long running virtual machines was included in cloud accounting. The Accounting Portal has been enhanced with the introduction of new views and metrics.

1 Operations Portal

1.1 Introduction

Tool name	Operations Portal
Tool url	http://operations-portal.egi.eu
Tool wiki page	https://wiki.egi.eu/wiki/Operations_Portal
Description	The Operations Portal provides VO management functions and other capabilities, which support the EGI daily operations. It is a central portal for the operations community that offers a bundle of different capabilities, such as the broadcast tool, VO management facilities, a security dashboard and an operations dashboard that is used to display information about failing monitoring probes and to open tickets to the affected Resource Centres. The dashboard also supports the central grid oversight activities. It is fully interfaced with the EGI Helpdesk and the monitoring system through messaging. It is a critical component as it is used by all EGI Operations Centres to provide support to the respective Resource Centres. The Operations Portal provides tools supporting the daily running of operations of the entire infrastructure: grid oversight, security operations, VO management, broadcast, VO metrics. VAPOR: the Vo Administration and Operations Portal, is a generic tool to assist community managers and support teams in performing their daily activities. The application provides resources status indicators, statistical reports, data management tools. It gathers resource information from the BDII and displays them in an ordered way, replacing the features previously offered by GSTAT. The amount of resources and the resources themselves are shown in different views that group information per Operations Centres, Countries and VOs.
Value proposition	New features offered by the Operations Portals allow its customers to better monitor and browse the infrastructure and, then, adapting their workflows according to the exact status of the computing and storage resources (e.g. moving some computation from one provider to another since the latter is working better).

Customer of the tool	EGI; NGI; RI; Resource Provider; Research Communities
User of the service	Site admins; Operations Managers; VO Manager; VO users;
User Documentation	https://forge.in2p3.fr/projects/opsportaluser/wiki/Main_Features_of_the_dashboard http://operations-portal.egi.eu/vapor/globalHelp
Technical Documentation	https://forge.in2p3.fr/projects/opsportaluser/wiki/Main_Features_of_the_dashboard
Product team	IN2P3/CNRS
License	Apache 2.0
Source code	https://gitlab.in2p3.fr/groups/opsportal

1.2 Service architecture

1.2.1 High-Level Service architecture

The high-level service architecture of the Operations Portal is described in section 1 of D3.10[2].

1.2.2 Integration and dependencies

Operations Portal dependencies have been already described in section 1 of D3.10[3]. They are not changed in this release.

1.3 Release notes

Refer to section 1 of D3.10 for release notes of older version.

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1.3.1 Operations Portal 4.2

This version is foreseen for August and is focused on:

- Integration of complementary metrics for the VO: accounting data and AppDB changes;
- Improvements on the VO ID Card;
- The support of the new EGI AAI based on the CheckIn service (IdP/SP Proxy).

[2] https://documents.egi.eu/document/3018
[3] https://documents.egi.eu/document/3018

- A backend for the monitoring
    - Exploration of logs (Apache , symfony, access)
    - Status of the Lavoisier servers and views
    - Status of some tables of the DB
    - The use of ARGO messaging system to collect Nagios notifications
-

1.3.2 VAPOR 2.2

This release has been delivered in February 2017.

For this release, the Operations Portal team has worked closely with the EGI Operations to consolidate the different queries to the Top BDII and the different extracted figures. The results are the following:

- A summary of the CPU and storage capacities by countries, sites or Operations Centres;
- A geographical map with the distribution of sites with a VO filter;
- Some additions in the faulty publications: bad HEPSPEC, mismatches between the different benchmarks, negative values for jobs.

This release has been also focused on the documentation of the different features and the access to the API.

1.3.3 VAPOR 2.3

This release is currently in the test phase and will be delivered in August 2017.

Once again this release is the results of multiple exchanges with EGI Operations team to enhance the current features. We have worked on different improvements:

- Upgrade of the different JavaScript libraries to improve the performances.
- Identify the duplicated values published by the sites.
- A map has been added with a global view of all the sites.
- A summary of the figures is now available for each site.
- The global storage capacity computation has been improved.
- One new metric has been added in agreement with EGI Operations team : “the Computation power”

1.4 Feedback on satisfaction

Prioritization and testing has been done by dedicated Operations Portal Advisory and Testing Board (OPAnTG)[4] coordinated by EGI Operations team. Furthermore, the Operations Portal team

[4] https://wiki.egi.eu/wiki/OTAG#Operations_Portal_Advisory_and_Testing_Board

has worked on the automation of tests. Unit and acceptance tests are now done through Docker piloted by GitLab Continuous Integration server.

If tests are failing, new features are not propagated to the test infrastructure. This allows performing a first bug filter before manually tests are executed. Complementary to these tests, the team also adopted a SonarQBE instance to inspect the quality of code.

The architecture of the Operations Portal automatic test suite is described below.

As a result, a minor number of bugs have been identified by the testing team in the most recent releases.

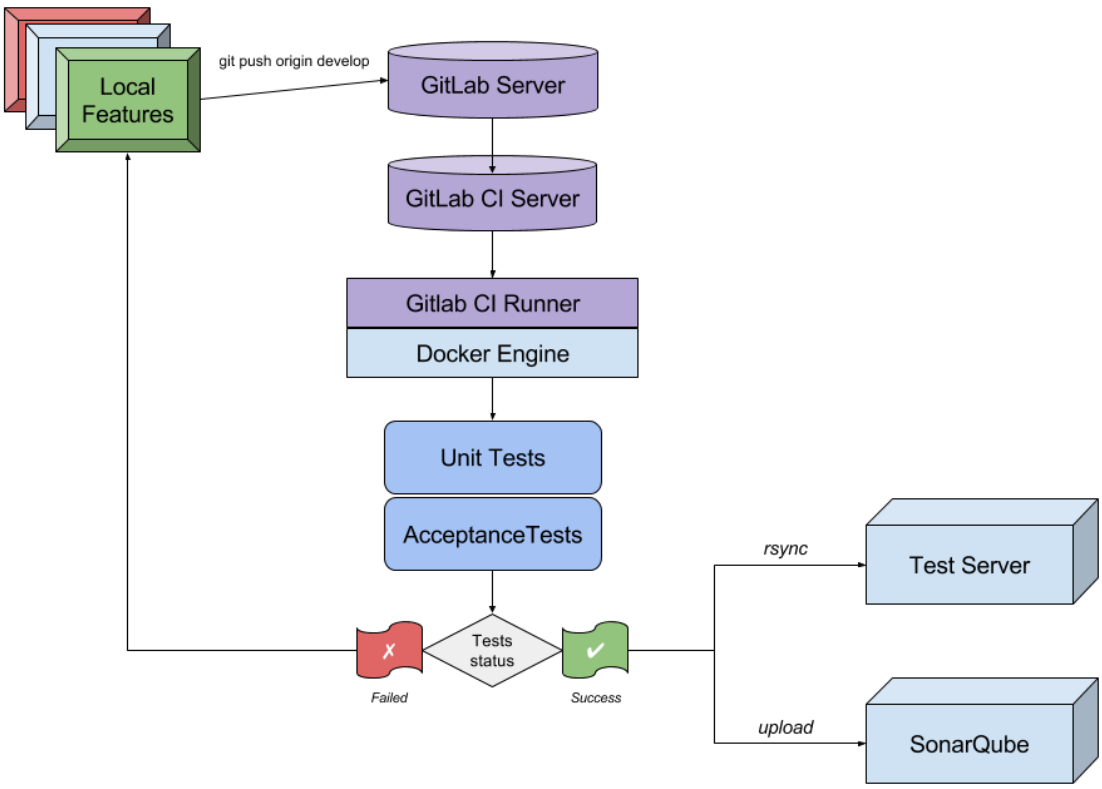


Figure 1. Operations Portal - Automatic test suite.

1.5 Plan for Exploitation and Dissemination

Name of the result	Operation Portal
DEFINITION	

Category of result	Software & service innovation
Description of the result	Software enhancement: integrate the VO Administration and operations PORtal (VAPOR) into the Operations Portal and enhance the monitor infrastructure resources including the most relevant features currently offered by GSTAT.
EXPLOITATION	
Target group(s)	Users, NGIs, Resource centres, RIs
Needs	Monitor / browse / Evaluate the resources for VO, sites, Operations Centres
How the target groups will use the result?	• Exploit the new features in the daily operations of the EGI infrastructure • Exploit the advanced metrics to better promote the EGI infrastructure
Benefits	• Ease the daily administration of the resources • Have an overview of the resources and their status • Be more efficient in the daily job submission
How will you protect the results?	Apache 2 License
Actions for exploitation	The result is accessible through the web site and the code is hosted on a GitLab.
URL to project result	http://operations-portal/vapor https://gitlab.in2p3.fr/opsportal/
Success criteria	The deployment in production and the use by end users.
DISSEMINATION	
Key messages	Browse and evaluate your resources
Channels	EGI Broadcast tool, EGI Meetings
Actions for dissemination	EGI conferences, publications, participation to workshops organised by potential users.
Cost	
Evaluation	The number of requests and the feedback given by users

1.6 Future plans

Future plans cover following aspects:

- VAPOR
  - Enhance the historical scripts, especially the 'JobMonitor' Tool;
  - Consolidation / coherency of the data:

        - Data issued from site publications with incoherencies:
        - Detect and propose corrections:
    - Extend the current features with user feedback.
- Operations Portal
    - integration of complementary metrics for the VO;
    - Add more genericity in the VO Id cards;
    - Extend the current features with user feedback;
    - Adapt the current tools to the new communities;
    - Define a new module for the SLA/OLA management including:
        - workflows to automatic service activations;
        - on-demand generation of reports on resource usage.

2 ARGO

2.1 Introduction

Tool name	ARGO
Tool url	http://argo.egi.eu
Tool wiki page	https://wiki.egi.eu/wiki/ARGO
Description	ARGO is a flexible and scalable framework for monitoring status, availability and reliability
Value proposition	Improved portal design that allows new and easier way to access and visualise data for the final users. Third parties can now gather monitoring data from the system through a complete API. A central deployment of the ARGO monitoring engine can serve a large infrastructure reducing the maintenance costs.
Customer of the tool	EGI; NGI; RI; Resource Provider; Research Communities
User of the service	Site admins; Operations Managers; large research group
User Documentation	http://argoeu.github.io; http://argo.egi.eu
Technical Documentation	http://argoeu.github.io
Product team	GRNET, SRCE, CNRS
License	Apache License Version 2.0
Source code	https://github.com/ARGOeu/

2.2 Service architecture

2.2.1 High-Level Service architecture

The high-level service architecture of ARGO is described in section 2 of D3.10[5].

2.2.2 Integration and dependencies

ARGO dependencies are not changed in this release. Refer to D3.10 for more information.

[5] https://documents.egi.eu/document/3018

2.3 Release notes

2.3.1 Requirements covered in the release

As already mentioned ARGO is not just single software, but a suite of software components, each one managed independently. During the third year of the project, there have been a number of releases of the ARGO components that covered the following requirements:

ARGO Compute Engine & Web API

- Streaming processing;
- Alerting mechanism;
- Separation of A/R and Metric stores:
- APIv2;
- Stability and performance improvements.

ARGO Monitoring Engine

- Migration of ops probes from opsmon.egi.eu to the central monitoring instances argo-mon/2.egi.eu and decommissioning of opsmon.egi.eu;
- Deployment of three new ARGO Monitoring Services:
    - Testing instance (argo-mon-test) used for testing new ARGO Monitoring Service releases and deployment of new probes and updates of existing probes; instance is constantly monitoring subset of EGI infrastructure and list of sites and service endpoints is extended on demand;
    - Uncertified instance (argo-mon-uncert) used for monitoring uncertified sites which fully relies on information provided by sites in GOCDB;
    - Internal instance used for monitoring all internal ARGO components by using ARGO probes and NRPE;
- New probes and updates of existing probes:
    - New probe for decommissioning of dCache 2.10 and dCache 2.13;
    - New probes for OneData services;
    - New probes for AAI CheckIn service;
    - New probe for NGI Argus service;
    - New probe for WebDAV service;
    - Improved probes for FTS3, gsisshd and VOMS services;
    - Improved probes for CREAM-CE;

    - Analysis and deployment of new ARC-CE probes;
    - Scripts provided for handling UNICORE probes configuration;
- Prototype version of ARGO Monitoring Service for biomed VO;
- AMS Publisher: is a new component acting as bridge from Nagios to ARGO Messaging system. It is integral part of software stack running on ARGO monitoring instance and is responsible for forming and dispatching messages that are results of Nagios tests. Successfully running on the development infrastructure for more than a month;
- Support for GOCDB as a single source of topology:
    - Step 1: Randomly check service endpoint;
- Stability and performance improvements.

ARGO EGI Consumer and Connectors

- Use of ARGO nagios AMS-publisher;
    - Ready on development infrastructure;
- Use of the messaging API for Connectors component;
    - Ready on development infrastructure;
- Stability and performance improvements.

ARGO EGI Web UI

- New Uncertified report;
- New FedCloud Report;
- UI Enhancements;
    - New pdf report;
    - Updates to ELIXIR report;
    - Updates to admin list;
    - Updates to links to reports.

ARGO POEM

- Finalize support for probe management;
- Initial steps for the connection to the EGI IdP/SP Proxy;
- Stability and performance improvements.

2.3.1.1 Changelog

- **25/06/2017**

- ARGO Monitoring Plugin - AMS publisher [Version 0.2.0-1] https://github.com/ARGOeu/argo-nagios-ams-publisher/releases/tag/v0.2.0-1
- ARGO-Monitoring Engine [Version 0.4.0-1] https://github.com/ARGOeu/argo-ncg/releases/tag/v0.4.0-1

- **20/06/2017**
  - ARGO-Poem [Version 1.0.5-1] https://github.com/ARGOeu/poem/releases/tag/v1.0.5-1
- **24/05/2017**
  - ARGO-Connectros [Version 1.5.9-1] https://github.com/ARGOeu/argo-egi-connectors/releases/tag/v1.5.9
  - ARGO-Monitoring Engine [Version 0.3.4-1] https://github.com/ARGOeu/argo-ncg/releases/tag/0.3.4-1
- **06/05/2017**
  - ARGO-Poem [Version 1.0.4-1] https://github.com/ARGOeu/poem/releases/tag/v1.0.4-1
  - ARGO Web UI [Version 1.3.6-2] https://github.com/ARGOeu/argo-egi-web/releases/tag/V1.3.6-2
- **04/05/2017**
  - ARGO-Monitoring Engine [Version 0.3.3-1] https://github.com/ARGOeu/argo-ncg/releases/tag/0.3.3-1
- **03/04/2017**
  - ARGO-Monitoring Engine [Version 0.3.2-1] https://github.com/ARGOeu/argo-ncg/releases/tag/0.3.2-1
- **03/04/2017**
  - ARGO-Connectros [Version 1.5.8-1] https://github.com/ARGOeu/argo-egi-connectors/releases/tag/v1.5.8
- **17/03/2017**
  - ARGO-Connectros [Version 1.5.6-1] https://github.com/ARGOeu/argo-egi-connectors/releases/tag/v1.5.6
- **06/03/2017**
  - ARGO-Connectros [Version 1.5.4-1] https://github.com/ARGOeu/argo-egi-connectors/releases/tag/V1.5.4-1
- **03/03/2017**
  - ARGO-Monitoring Engine [Version 0.3.1-1] https://github.com/ARGOeu/argo-ncg/releases/tag/0.3.1-1
- **16/02/2017**
  - ARGO-Monitoring Engine [Version 0.3.0-1] https://github.com/ARGOeu/argo-

ncg/releases/tag/0.3.0-1

- **09/02/2017**
  - ARGO Web UI [Version 1.3.6-1] https://github.com/ARGOeu/argo-egi-web/releases/tag/v1.3.6-1
- **30/01/2017**
  - ARGO Web UI [Version 1.3.5-1] https://github.com/ARGOeu/argo-egi-web/releases/tag/v1.3.5-1
- **17/01/2017**
  - ARGO Compute Engine [Version 1.6.9-1] https://github.com/ARGOeu/argo-compute-engine/releases/tag/v1.6.9-1
- **10/01/2017**
  - ARGO-Poem [Version 1.0.3-1] https://github.com/ARGOeu/poem/releases/tag/v1.0.3-1

2.4 Feedback on satisfaction

The ARGO product team uses a development process based around GitHub, which includes procedures that guarantee a high quality of software releases. For details of the ARGO development process, see Appendix I.

2.5 Plan for Exploitation and Dissemination

Name of the result	ARGO
DEFINITION	
Category of result	Software & service innovation
Description of the result	Software enhancement: improve the portal designing new and easier way to access and visualise data for the final users and exposing a complete API allowing third parties to gather accounting data from the system. Stability and performance improvements of the central ARGO Monitoring Service. NGI instances were decommissioned or kept for NGI's internal purposes. In addition, specific monitoring instances like opsmon.egi.eu were decommissioned and all probes were integrated into central ARGO Monitoring Service. A/R calculations are performed solely by using results from the central ARGO Monitoring Service. Uncertified instances are also monitored via the centralized ARGO Monitoring Service. Two additional centralized ARGO Monitoring Services were deployed for testing and verification of new probes and for monitoring internal ARGO components.

	Centralized ARGO Monitoring Service poses a risk if only one instance is deployed. In case of failure of that instance, the whole infrastructure will not be monitored. Therefore, a high availability setup is used. The reorganization of the Compute Engine to support stream processing in real time is one of the key new factors. A new streaming layer has been introduced. Monitoring results flow through the AMS to the streaming layer (in parallel to the HDFS). The streaming layer is used in order to push raw metric results to the metric result store and to compute status results and push them to the status store in real-time. The streaming and batch job for the status results is running in the development infrastructure producing the same results as the production infrastructure. At the same time, the new AMS publisher has been introduced. It is a new component acting as bridge from Nagios to the new ARGO Messaging system. It is successfully running on the development infrastructure for a while producing the same results as on production. It is integral part of the software stack running on ARGO monitoring instance and is responsible for forming and dispatching messages that are results of Nagios tests. Thanks to the new real-time Streaming processing layer, we are now able to introduce new functionality to the ARGO Monitoring Service that goes beyond infrastructure monitoring, as, for example, the alerting. We are working on a new component on top of the streaming engine. This component will analyse the monitoring results and send notification based on a set of rules. The minimum set of rules support should mimic the Nagios behaviour.
EXPLOITATION	
Target group(s)	RIs, Service providers, Users, NGIs, Resource centres
Needs	• Used for the Availability and Reliability monitoring • Provide complete API allowing third parties to gather data from the system. • Used as a source of alerts for resource centres administrators through the Operations Portal Dashboard • Used for middleware versions monitoring and upgrade campaigns
How the target groups will use the result?	The ARGO Availability and Reliability Monitoring Framework is used by the ARGO Monitoring Service that is operated by EGI for the monitoring of the availability and reliability of the EGI infrastructure. The ARGO Monitoring Service can be provided also to research communities and other infrastructures as a service in order to monitor the status, availability and reliability of their services.
Benefits	The developments during this period, allowed EGI to replace the older implementation of the SAM Nagios Monitoring Engine, which required one monitoring engine per NGI, with a new implementation using the ARGO Monitoring Engine, which provided a monitoring engine that could deliver monitoring probe scheduling and execution as a service for all the NGI and communities. Central ARGO requires less maintenance effort and enables faster

	and streamlined deployment of new tests or update of existing tests. This leads to improvements in the performance, robustness and reliability of the ARGO Monitoring Service. Furthermore, real-time computations give the ability to take immediate action for urgent issues. The goal is to obtain the insight required to act prudently at the right time - which increasingly means immediately.
How will you protect the results?	The ARGO Monitoring Framework is released under the Apache 2.0 license.
Actions for exploitation	The new version of the ARGO Monitoring Framework has already been adopted by the production ARGO Monitoring Service. In order to further exploit the results, we should promote the service also to research communities and other infrastructures that can benefit of its features.
URL to project result	http://argo.egi.eu/ https://github.com/ARGOeu/
Success criteria	The deployment of the results to the production EGI infrastructure. The usage of the service to monitor third party services.
DISSEMINATION	
Key messages	Offer a guaranteed quality of services.
Channels	EGI Broadcast tool, EGI Meetings.
Actions for dissemination	EGI conferences, publications, participation to workshops organised by potential users
Cost	
Evaluation	The number of requests for information is the main way to evaluate the impact of the dissemination actions.

2.6 Future plans

Future plans cover following aspects:

ARGO Compute Engine

- Streaming processing;
- Alerting mechanism;
- Separation of A/R and Metric stores;
- Stability and performance improvements.

ARGO Monitoring Engine

- Finalize support for GOCDB as a single support of topology;
- Integration with probe management feature in POEM;
- Use of the messaging API on production;
- Fedcloud probes updates;
- Stability and performance improvements.

ARGO Web UI

- UI Enhancements.

ARGO EGI Consumers and Connectors

- Decommission of Consumer and use ARGO nagios AMS-publisher instead;
- Finalize the use of the messaging API for Connectors component on production;
- Stability and performance improvements.

ARGO POEM

- Finalize the probe management feature;
- Connect to the EGI IdP/SP Proxy;
- Stability and performance improvements.

3 Messaging Service

3.1 Introduction

Tool name	ARGO Messaging Service
Tool url	http://argoeu.github.io
Tool wiki page	https://wiki.egi.eu/wiki/Message_brokers
Description	The Messaging service enables reliable asynchronous messaging for the EGI infrastructure.
Value proposition	e-Infrastructures and research communities are building distributed services and workflows in order to satisfy their operational and research requirements. Synchronization between services, gathering of telemetry, monitoring and accounting data, and any secure messages exchange are core requirements in any type of distributed services. The Messaging Service provides an easy to use and reliable transport layer for the secure exchange of messages between services such as accounting data, monitoring data, event notifications, etc.
Customer of the tool	EGI; NGI; RI; Resource Provider; Research Communities
User of the service	Site admins; Operations Managers; Large research group
User Documentation	http://argoeu.github.io;
Technical Documentation	http://argoeu.github.io
Product team	GRNET, SRCE
License	Apache License Version 2.0
Source code	https://github.com/ARGOeu/

3.2 Service architecture

3.2.1 High-Level Service architecture

The high-level service architecture of the Messaging service is described in section 3 of D3.10[6].

[6] https://documents.egi.eu/document/3018

3.2.1.1 AMS Metrics

The AMS Pub/Sub API exports usage metrics that can be monitored programmatically. The list of available metrics is the following:

- Memory usage per AMS instance: percentage value that displays the Memory usage of AMS service in the specific node;
- CPU usage per AMS instance: percentage value that displays the CPU usage of AMS service in the specific node;
- Messages published per topic/project/user:
    - Counter that displays the number of messages published to the specific topic (per project and per user);
- Messages delivered per topic/subscription/project/user:
    - Counter that displays the number of messages delivered to the specific subscription (per project, per user and per topic);
- Bytes in/out per topic/subscription/project/user:
    - Counter that displays the total size of data (in bytes) published to the specific topic;
    - Counter that displays the total size of data (in bytes) consumed from the specific subscription;
- Topics per project/user:
    - Counter that displays the number of topics belonging to the specific project;
    - Counter that displays the number of topics belonging to the specific user;
- Subscriptions per project/topic/user:
    - Counter that displays the number of subscriptions belonging to the specific project:
    - Counter that displays the number of subscriptions that a user has access to the specific project:
    - Counter that displays the number of subscriptions belonging to the specific topic;
    - Counter that displays the number of subscriptions belonging to the specific user.

3.2.1.2 Operational Metrics[7]

The Operational Metrics mainly include metrics related to the CPU or memory usage of the AMS nodes. The list of operational metrics is the following:

- Memory usage per AMS instance;
- CPU usage per AMS instance;
- Messages published per topic/project/user;
- Messages delivered per topic/subscription/project/user;
- Bytes in/out per topic/subscription/project/user;
- Topics per project/user;
- Subscriptions per project/topic/user.

3.2.1.3 Accounting

The list of accounting metrics is the following:

- Number of messages published per topic/project/user;
- Number of messages delivered per topic/subscription/project/user;
- Number of topics per project/user;
- Number of subscriptions per project/topic/user.

3.2.1.4 AMS - Library[8]

It is a simple Python library for interacting with the ARGO Messaging Service.

The Messaging Service is implemented as a Publish/Subscribe service. Instead of focusing on a single Messaging API specification for handling the logic of publishing/subscribing to the broker network, the API focuses on creating nodes of Publishers and Subscribers as a Service.

In the Publish/Subscribe paradigm, Publishers are users/systems that can send messages to named-channels called Topics. Subscribers are users/systems that create Subscriptions to specific topics and receive messages.

You may find more information in the ARGO Messaging Service documentation[9].

3.2.2 Integration and dependencies

The Messaging Service does not have any dependencies to other services now.

[7] http://argoeu-devel.github.io/messaging/v1/api_metrics/
[8] https://github.com/ARGOeu/argo-ams-library
[9] http://argoeu.github.io/messaging/v1/

3.3 Release notes

3.3.1 Requirements covered in the release

- APIv1 test implementation;
- APIv1 final implementation;
- APIv1 final specification;
- Support APEL to use Messaging Service;
- Support AppDB to use Messaging Service;
- Support Operational Portal to use Messaging Service;
- Message Service Accounting: Metrics for Messaging Service;
- Operational statistics;
- Usage Statistics;
- Stability and performance improvements.

3.3.2 Changelog

- **28/06/2017**
  - **AMS Library [Version 0.3.0-1]** https://github.com/ARGOeu/argo-ams-library/releases/tag/v0.3.0-1
- **08/06/2017**
  - **AMS Library [Version 0.2.0-1]** https://github.com/ARGOeu/argo-ams-library/releases/tag/v0.2.0-1
  -

3.4 Feedback on satisfaction

The ARGO product team uses a development process based around GitHub, which includes procedures that guarantee a high quality of software releases. For details of the ARGO development process, see Appendix I.

3.5 Plan for Exploitation and Dissemination

Name of the result	ARGO Messaging Service
DEFINITION	
Category of result	Software & service innovation
Description of	In the new version of the Messaging Service, the STOMP interface has been

the result	replaced with an HTTP interface, which makes the implementation of new clients easier and the implementation more robust. This new ARGO Messaging Service is a real-time messaging service that allows services to asynchronously send and receive messages using the Publish/Subscribe model.
EXPLOITATION	
Target group(s)	RIs, Service providers, Users, NGIs, Resource centres, EGI Accounting service and the Operations Portal
Needs	e-Infrastructures and research communities are building distributed services and workflows in order to satisfy their operational and research requirements. Synchronization between services, gathering of telemetry, monitoring and accounting data, and any secure messages exchange are core requirements in any type of distributed services. The Messaging Service provides an easy to use and reliable transport layer for the secure exchange of messages between services such as accounting data, monitoring data, event notifications, etc.
How the target groups will use the result?	Infrastructure architects that need to design distributed architectures that require a robust and easy to use messaging backbone, which can scale to billions of messages.
Benefits	The ARGO Messaging service offers the following features: • Simple HTTP API for client access; • An easy to use python library; • Operations & usage metrics ; • Transparent scalability & high availability; • Access controls implemented at the API layer; • Multi-tenant support; • Performance robustness.
How will you protect the results?	The ARGO Messaging service is released under the Apache 2.0 license.
Actions for exploitation	• Promote the service to other research communities and infrastructures that can benefit of its features. • Provide the necessary documentation (all, for a publisher, or for a subscriber) • Create test accounts per target group to publish messages to topics, or to consume messages as subscribers from a topic.
URL to project result	http://argo.egi.eu/ https://github.com/ARGOeu/
Success criteria	• The ARGO Messaging Service should be operated as a production EGI service. • All the EGI tools services should have migrated from the old Messaging Broker service to the new ARGO Messaging service.

DISSEMINATION	
Key messages	Interconnect your distributed services in a ease and efficient manner.
Channels	• Dissemination through the EGI conferences • Article featured in the EGI newsletter
Actions for dissemination	EGI conferences, publications, participation to workshops organised by potential users
Cost	
Evaluation	The number of requests for information, and/or accounts (either test or production) is the main way to evaluate the impact of the dissemination actions.

3.6 Future plans

Future plans cover following aspects:

- Move to production
- Stability and performance improvements

4 GOCDB

4.1 Introduction

Tool name	GOCDB
Tool url	https://goc.egi.eu
Tool wiki page	https://wiki.egi.eu/wiki/GOCDB
Description	GOCDB is a central registry to record information about the topology of an e-Infrastructure. This includes entities such as resource centers (sites), services, service-endpoints and their downtimes, contact information and roles of users responsible for operations at different levels. The service enforces a number of business rules and defines different grouping mechanisms including object-tagging for the purposes of fine-grained resource filtering.
Value proposition	The Extensions to the write API will greatly increase the ability for external tools to interact in a programmatic way with GOCDB. This will make GOCDB more viable for the future and reduce the need for other information systems.
Customer of the tool	EGI Operations and WLCG
User of the service	Site/service admins, NGI managers and Security teams.
User Documentation	https://wiki.egi.eu/wiki/GOCDB
Technical Documentation	https://wiki.egi.eu/wiki/GOCDB
Product team	STFC
License	Apache 2
Source code	https://github.com/GOCDB/gocdb

4.2 Service architecture

4.2.1 High-Level Service architecture

Details about the high-level service architecture of the GOCDB are available in D3.10[10].

[10] https://documents.egi.eu/document/3018

The previous release, introduced a new dependency on the EGI CheckIn service in order to provide federated access to GOCDB for users without client certificates. However, for users with certificates there continues to be no dependencies on other operational tools. Other than the extensions to the capability to the write API, this release brings no major alterations to the architecture.

4.2.2 Integration and dependencies

GOCDB newly depends on the EGI CheckIn service to provide federated authentication and access without client certificates. When accessed using a client certificate, GOCDB continues to depend on no other tool.

4.3 Release notes

4.3.1 Requirements covered in the release

By August the Write API will have been extended to meet requirements of WLCG[11]. This will allow programmatic:

- Creation, update, and deletion of service endpoints
- Update of details of services

There will be no changes to the way authentication and authorisation for the write API since the previous release. Building upon the previous release, these updates allow changes to key entities within GOCDB programmatically. This represents a significant change in the way in which GOCDB works, allowing for much greater automated interaction with the information managed by GOCDB. This will help secure GOCDBs future in an evolving information space.

A number of smaller bugs[12] will also have been addressed.

4.4 Feedback on satisfaction

Before every production release, GOCDB development is frozen and a period of testing is announced that lasts for approximately two weeks to one month using the GOCDB test instance[13]. This testing phase is widely disseminated using the relevant mail lists, and all operational tools and users are invited to perform tests against this instance. Recent GOCDB releases successfully passed this stage.

The GOCDB development process is described in Appendix II.

[11] https://rt.egi.eu/rt/Ticket/Display.html?id=11020
[12] from the GitHub bug list: https://github.com/GOCDB/gocdb/issues
[13] https://gocdb-test.esc.rl.ac.uk

4.5 Plan for Exploitation and Dissemination

Name of the result	GOCDB
DEFINITION	
Category of result	Software & service innovation
Description of the result	• Extension of the write API.
EXPLOITATION	
Target group(s)	WLCG tool developers, ARGO service, Resource/service provider admins and NGI managers
Needs	The extension to the Write API will enable communities (e.g. WLCG) to further automate their interactions with the GOCDDB and move away from other information sources.
How the target groups will use the result?	The results are integrated into the production instance of GOCDB, on which much of the target group's infrastructure relies.
Benefits	The result will improve the efficiency of target group's use of the GOCDB service, as well as ensure its continuing fitness to serve them.
How will you protect the results?	Apache 2 licence
Actions for exploitation	The code needs to be integrated into the production instance of the GOCDB in order to provide the described functionality. The full source code will be available for use (under the Apache 2 licence) at https://github.com/GOCDB/gocdb
URL to project result	https://github.com/GOCDB/gocdb/releases/tag/5.8[14] https://goc.egi.eu/
Success criteria	Regular use of the write API extension by at least one tool.
DISSEMINATION	
Key messages	The Write API has now been extended to have greater functionality.
Channels	WP3 meetings, EGI OMB meetings, WLCG Information Systems Evolution Task Force
Actions for	Announcement emails to multiple EGI mailing lists and WLCG information

[14] Link will not be live until release in August

dissemination	system evolution mailing list. Description of new features to EGI Conference (May 2017: https://indico.egi.eu/indico/event/3249/session/32/contribution/31.
Cost	
Evaluation	Uptake of use of new features.

4.6 Future plans

Future plans cover following aspects:

- Data freshness check[15];
- Replacement of the GOCDB UI with a modern Web framework;
- Extending GOCDB in the info-service space supporting dynamic attributes;
- Improve change logging.

[15] https://rt.egi.eu/rt/Ticket/Display.html?id=8240

5 Security Monitoring

5.1 Introduction

Tool name	Secant
Tool url	https://github.com/CESNET/secant
Tool wiki page	https://wiki.egi.eu/wiki/Tools
Description	Secant is a framework to detect security vulnerabilities in images of virtual machines. It tries to detect the most common security issues that often lead to incidents and prevent them from appearing in the context of EGI cloud facilities.
Value proposition	Security incidents may cause significant problems for users, service providers and infrastructure operators. Secant was designed to detect common weakness in virtual appliances so that these can be fixed before they threaten a production infrastructure.
Customer of the tool	Cloud providers, VA owners, EGI operations, the EGI CSIRT
User of the service	Administrators, operators, security staff
User Documentation	https://github.com/CESNET/secant
Technical Documentation	https://github.com/CESNET/secant
Product team	CESNET
License	Apache License Version 2.0
Source code	https://github.com/CESNET/secant

5.2 Service architecture

5.2.1 High-Level Service architecture

The high-level service architecture of Secant is described in section 5 of D3.10[16].

5.2.2 Integration and dependencies

Secant needs to integrate support of a cloud management framework, which enables to both manage virtual machines and maintain the list of images to assess. The current implementation

[16] https://documents.egi.eu/document/3018

supports OpenNebula for the management of virtual machine and uses the EGI CloudKeeper[17] to maintain the list of images and templates in the cloud repository.

In order to facilitate integration with existing infrastructure services, support for a messaging has been introduced recently. Secant uses the ARGO messaging to consume information about available images and to deliver assessment reports once assessment has been finished.

5.3 Release notes

5.3.1 Requirements covered in the release

Following the principles of continuous delivery, Secant does not have fixed releases. The outcomes of recent development are always available from the pilot installation deployed at CESNET. The features introduced recently involve integration of the EGI Messaging, support of CloudKeeper, and integration work aiming at utilization of Secant for the Application Database and EGI endorsement of virtual appliances.

5.4 Feedback on satisfaction

Secant runs in a piloting environment established at CESNET and its MetaCloud site. The development follows expectations of the EGI CSIRT team and the service was presented to the team several times. Since the integration works are on-going, assessment tests can only be executed manually. So far, several dozens of virtual appliances underwent testing by Secant and findings were incorporated by the developers.

5.5 Plan for Exploitation and Dissemination

Name of the result	**Secant**
DEFINITION	
Category of result	Software & service innovation
Description of the result	Secant is a framework to detect security vulnerabilities in images of virtual machines. It tries to detect the most common security issues that often lead to incidents and prevent them from appearing in the context of EGI cloud facilities.
EXPLOITATION	
Target group(s)	Users, RIs, Resource centres, NGIs, security teams, VA endorsers.
Needs	Prevent from security incidents that misuse common vulnerabilities exposed

[17] https://appdb.egi.eu/store/software/cloudkeeper

	by servers connected to the Internet.
How the target groups will use the result?	The tools will facilitate the endorsement process and will help the endorsers detect common weaknesses. The tools will also be available to users preparing their images or installations on the top of running virtual machines.
Benefits	Achieving a common security bottom line of virtual machines in clouds, based on shared knowledge and tooling.
How will you protect the results?	The tool is released under a standard open-source license.
Actions for exploitation	Secant will be freely available and its utilization documented.
URL to project result	https://github.com/CESNET/secant
Success criteria	Availability of the tool for performing assessments.
DISSEMINATION	
Key messages	Secant help identify common security vulnerabilities in virtual appliances.
Channels	EGI Conferences, meetings with cloud experts.
Actions for dissemination	Integration with AppDB will facilitate the introduction of the assessment in the endorsement process.
Cost	
Evaluation	Utilization of Secant in endorsement process.

5.6 Future plans

After Secant has been fully integrated with AppDB, it will be necessary to overview the endorsement process to support the assessment. We will need to take into account emerging technologies (like containers) to examine their impact on the assessment process.

6 Accounting Repository

6.1 Introduction

The EGI Accounting Repository is an accounting tool that collects resource usage data from sites participating in the EGI and WLCG infrastructures as well as from sites belonging to other e-infrastructures and organisations that are collaborating with EGI, including OSG and NorduGrid. The Repository uses software from the APEL project run by the STFC.

The accounting information is gathered from different sensors into a central Accounting Repository where it is processed to generate statistical summaries that are available through the EGI Accounting Portal. Statistics are available for view at different levels of detail by users, VO managers, resource provider administrators, and anonymous users according to well-defined access rights. Table 1 provides a summary of the tool covered in this release.

Table 1. APEL tool summary.

Tool name	APEL
Tool URL	http://apel.github.io/
Tool wiki page	https://wiki.egi.eu/wiki/Accounting_Repository
Description	EGI Core Service – The Accounting Repository collects and stores user accounting records from various services offered by EGI.
Value proposition	Improved information about the usage of the cloud resources within the EGI infrastructure. Added storage systems as a source of accounting data
Customer of the tool	e-Infrastructures, research infrastructures and, in general, distributed infrastructures.
User of the service	Resource providers, NGI admins, EGI operations, end users.
User Documentation	https://wiki.egi.eu/wiki/APEL
Technical Documentation	https://wiki.egi.eu/wiki/APEL
Product team	STFC
License	Apache License, Version 2.0
Source code	https://github.com/apel/apel https://github.com/apel/ssm

This section provides a short introduction to the components provided by the APEL project as part of the EGI Accounting Repository. Then, the high-level architecture of the tool and its components are described, along with the integrations and dependencies it has. Release notes and the results of testing for this release are then provided. Finally, plans for exploitation, dissemination, and future work are shown.

6.2 Service architecture

6.2.1 High-Level Service architecture

Figure 2 shows how the latest APEL client, EGI developed collectors, central APEL server and the EGI Accounting Portal interact. For a detailed description of the interactions, see section 6.2.1 of deliverable D3.10[18].

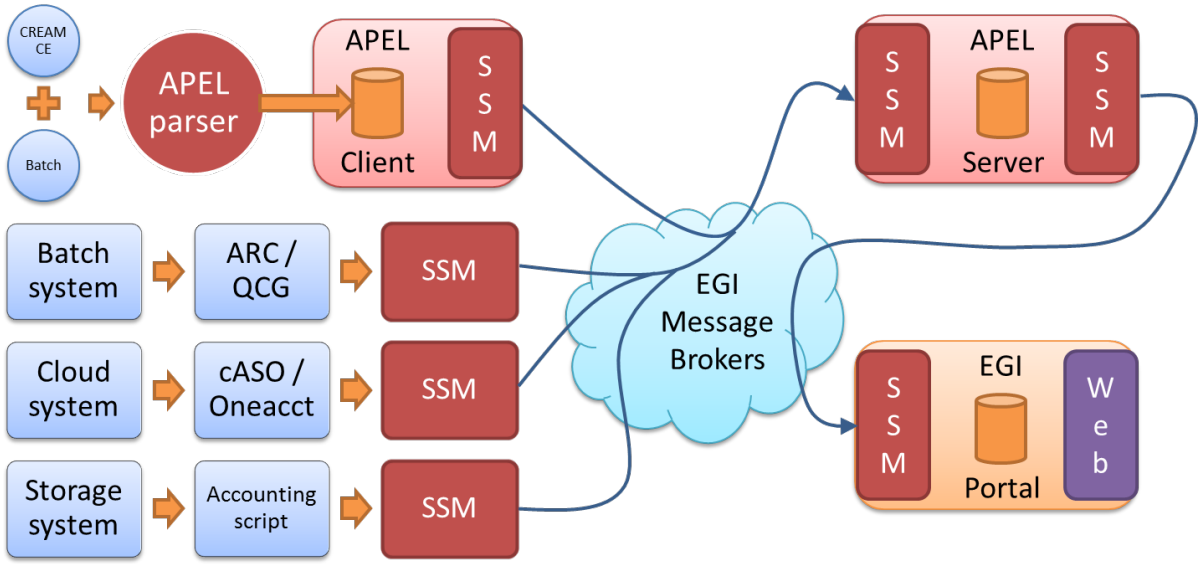


Figure 2. APEL components and their interactions. Components in red are provided by the APEL project.

This release has added storage systems as a source of accounting data. Much like cloud accounting, the storage accounting collectors have been developed by EGI partners who are experts in the underlying storage system.

6.2.2 Integration and dependencies

See deliverable D3.10[19] for the details of dependencies. There are no changes to the dependencies in this release.

[18] https://documents.egi.eu/document/3018
[19] https://documents.egi.eu/document/3018

6.3 Release notes

6.3.1 Requirements covered in the release

These are the changes included in this release of the APEL software, version 1.7.0, since the previous Accounting Repository Release in EGI-Engage:

- Added support for long running virtual machines in cloud accounting.
- Advanced storage accounting to production level.
- Added support for version 10 of the LSF batch system.
- Documentation of a method to extract APEL format records from non-APEL SQL databases.
- Developed a draft GPGPU usage schema for cloud accounting to enable accelerator usage to be accounted for.
- Added support for more operating systems so that the software can be used in a wider variety of infrastructures.
- Added more unit tests to improve the quality of the code and streamline quality assurance activities.
- Developed many minor bug fixes and tweaks to improve the overall quality of the software.

6.4 Feedback on satisfaction

The APEL project uses a development process based around GitHub, which includes a semi-automatic testing procedure used to assess the quality of software releases. For details of the testing procedure used, see Appendix III. This process is also detailed in the APEL Development Process document[20]. Table 2 summarises the results of testing this release.

Once these automatic and manual checks were passed, the server-side software was rolled out to a pre-production system for testing and feedback from users, and the client-side software was submitted though the EGI release process so that feedback could be collected on that part of the software. Neither feedback process raised any issues with the software so it was put into production.

Table 2. APEL software testing results.

	Result	***Link***
Unit tests	Build passed	https://travis-ci.org/apel/apel/builds/242356858
Coverage	No reduction in coverage	https://coveralls.io/builds/12374751

[20] https://documents.egi.eu/document/2739

6.5 Plan for Exploitation and Dissemination

Name of the result	Accounting Repository
DEFINITION	
Category of result	Software and service innovation
Description of the result	Update to the software that provides the EGI Accounting Repository including a number of small fixes and improvements as well as support for a new cloud accounting usage record schema and storage accounting.
EXPLOITATION	
Target group(s)	RIs, international research collaborations, service providers, Funding agencies and decision/policy makers
Needs	Usage accounting data that can aid in ensuring resources are used as expected.
How the target groups will use the result?	Service providers update client installations. Extra metrics collected in the repository will be presented in the Portal for various uses.
Benefits	Support for different version of batch system and packages now available for EL7 based systems.
How will you protect the results?	Open source license (Apache License, Version 2.0)
Actions for exploitation	Roll out update to production server infrastructure and package the software for use at the client end. Work with Accounting Portal to update views.
URL to project result	https://github.com/apel/apel/releases/latest
Success criteria	Smooth roll out and any issues resolved quickly
DISSEMINATION	
Key messages	New version of the accounting software available that support extra metrics for cloud and storage accounting
Channels	EGI OMB, WP3 meetings
Actions for dissemination	Announce at an OMB and WP3 meeting

Cost	Low
Evaluation	Installation of new release and feedback on new features

6.6 Future plans

Although this is the final release of the EGI Accounting Repository under EGI-Engage, the repository will likely be developed further under follow-on projects. Areas that are a natural extension of work done under EGI-Engage include: applying the research done on big data tools to a new prototype accounting repository, extending support for GPGPU accounting if it becomes available in grid batch systems, and producing a production level dataset accounting service.

7 Accounting Portal

7.1 Introduction

Tool name	Accounting Portal
Tool url	https://accounting.egi.eu
Tool wiki page	https://wiki.egi.eu/wiki/Accounting_Portal
Description	The Accounting Portal provides data accounting views for users, VO Managers, NGI operations and the general public.
Value proposition	Improved look & feel. New views that allow to aggregate data in different ways. Improved support for scientific disciplines.
Customer of the tool	Infrastructure users, VO Managers, Operations Centres, Sites and the general public.
User of the service	Infrastructure users, VO Managers, Operations Centres, Sites and the general public.
User Documentation	https://documents.egi.eu/public/ShowDocument?docid=2789
Technical Documentation	https://documents.egi.eu/public/ShowDocument?docid=2545
Product team	CESGA, CSIC
License	Apache
Source code	https://github.com/cesga-egi/accounting

7.2 Service architecture

7.2.1 High-Level Service architecture

The Accounting Portal is a web application based on Apache and MySQL, which has as its primary function to provide users with customized accounting reports, containing tables and graphs, as web pages. It also offers RESTful web services to allow external entities to gather accounting data.

The basic architecture of the Portal consists on:

1. A backend, which aggregates both data and metadata in a MySQL database, using the APEL SSM messaging system[21] to interact with the Accounting Repository and several scripts, which periodically gather the data and metadata described below;

[21] https://wiki.egi.eu/wiki/APEL/SSM

2. A Model represented by the database schemas, both external and internal, which defines database tables for several types of accounting (HTC, Cloud, Storage, user statistics etc.) and metadata (topology, geographical data, Resource Centre status, nodes, VO users and admins, Resource Centre admins etc.), and a series of parametrised queries;

3. A set of views that exposes the data to the user. These views contain a form to set the parameters and metric of the report, a number of tables showing the data parametrised by two selectable dimensions and filtered by several parameters, a line graph showing the table data, and pie charts showing the percentage distribution on each dimension.

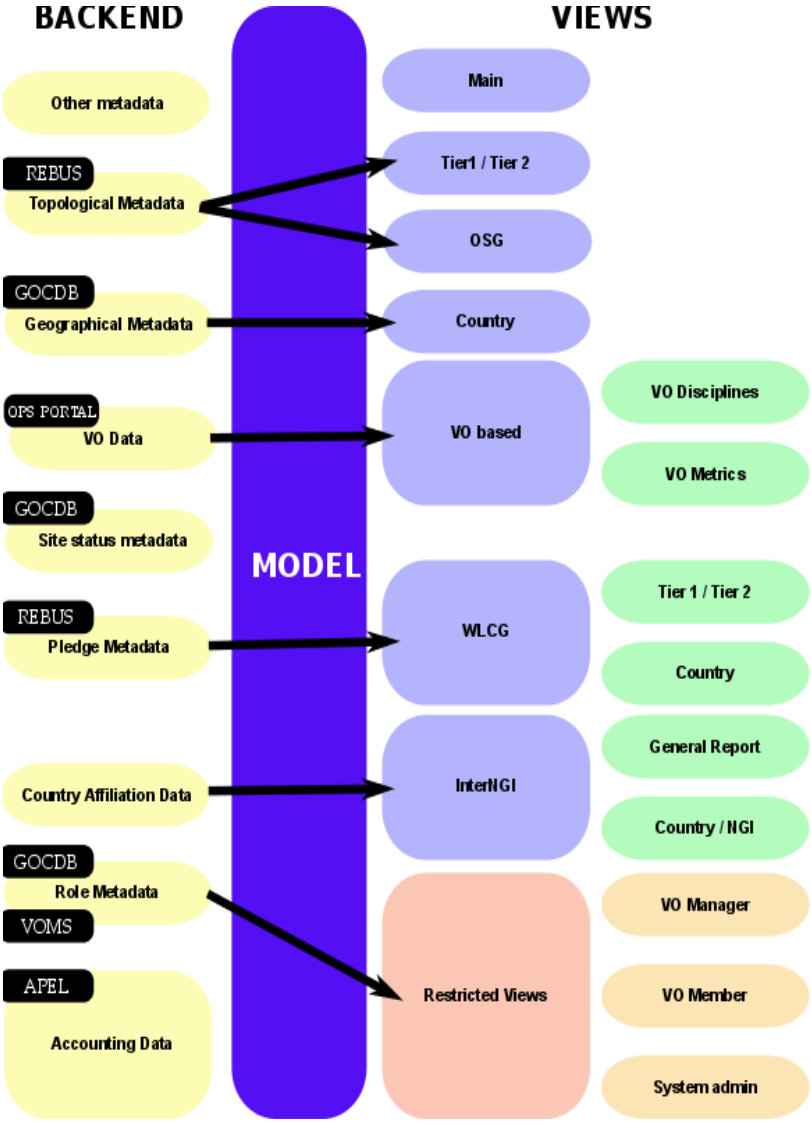


Figure 3. Accounting Portal architecture.

A graphical representation of these components is depicted on **Error! Reference source not found.**

7.2.1.1 Backend

The Accounting Portal backend is a varied collection of messaging systems and scripts that gather accounting data and metadata from several external sources like GOCDB, the Operations Portal or WLCG REBUS for the portal consumption.

The accounting data are sent by each Resource Centre to the central APEL Accounting Repository, processed and made into summaries using internal processes by APEL. Data is organised to enable the ease implementation of optimised queries. Metadata is a category of data, which complement that raw data and allows the portal to organize, categorize and impart new meaning to it.

7.2.1.2 Model

The model in the portal is designed to interchange data with the Accounting Repository and other operational tools. The queries are parametrized to avoid SQL injections (SQL attack vectors based on malicious code on SQL input parameters).

Since there is a large number of possible queries, and the accounting data have many reads but are only written on updates from the repository, the portal can be very aggressive with database indexes, and there are periodic optimizations of these queries.

The queries have a common structure derived from the views:

- **Metric**: It is the number we want to use for the accounting, it varies from view to view (e.g. Number of VMs on cloud), but we usually have:
  - Number of jobs: The number of jobs run, regardless the CPU or the time used.
  - CPU time: The time used by CPU core in hours while executing jobs.
  - Normalised CPU Time: The time used by CPU core multiplied by a corrective factor depending on a benchmark run on the machines. This benchmark is usually HEPSPEC06.
  - Elapsed Time: The wall time, or real time spent in executing jobs, this should be greater than the CPU time since it also includes I/O and SO time.
  - Normalised Elapsed Time: Wall time normalised in the same way that the CPU time.
  - Efficiency: Wall time divided by CPU time. This indicated the percentage of time used doing calculation instead of doing I/O or servicing other tasks. This is important for pledges and VO admins.

- Monetary Cost: An estimation of the equivalent monetary cost of the accounted work, this is only an indicative value.

- **Time period**: All queries are limited to a time period expressed in months, and which can go from January 2004 to the present.
- **Dimensions:** All data shown in the portal is parametrized by two dimensions (the "rows" and "columns" of the tables), these include, but are not limited to:
  - Date: The month of the accounting data.
  - Region: The Operation Centre or federation in which it was accounted.
  - Country: The country that the data was accounted for.
  - VO: The VO that the jobs were run as.
  - Resource Centre: The Resource Centre the data was accounted for.
  - Number of processors: The number of cores used by the job.
- **VO Group**: The VOs that appear in the accounting:
  - LHC: The VOs directly associated with the Large Hadron Collider in Geneva, comprises "alice", "atlas", "cms" and "lhcb".
  - TOP10: The top 10 VOs in the selected range in raw CPU consumption.
  - ALL: All available VOs.
  - Custom: It shows all VOs available in the range so the user can select which to display.
- **dteam VO**: It excludes the "dteam" and "ops" VOs that are only used for admin and test purposes.
- **Local Jobs**: Some Resource Centres can account jobs that have been processed locally on Resource Centre bypassing the infrastructure middleware. The available options are "Infrastructure Jobs only", "Infrastructure and local jobs" and "Local Jobs only".

There are customized reports and views, which use other inputs, but in general those are the usual inputs of the common queries.

7.2.1.3 SSM and Messaging

The Accounting Portal has to refresh its database periodically with data from the Accounting Repository to assure their freshness. The system uses the EGI Messaging System, a queue messaging system based on ActiveMQ, which is also used for the communications between Resource Centres and the Accounting Repository. Since the repository uses it internally for all

communications, it is also needed to gather the accounting data from them. The SSM system is composed by:

- A SSM loader for each accounting source (multicore, cloud, storage, etc…). This daemon waits for messages arriving on a queue and authenticates it with a DN and certificate. If the message is deemed valid, it is saved to a spool directory for further processing.
- A DB loader, this daemon monitors the spool directory and if there are messages these are introduced in the DB in order. This introduction at present does not delete the previous data in the tables, it only overwrites it, then manual intervention is needed for stale data.

7.2.2 Integration and dependencies

There are dependencies on other tools and components that provide metadata used in the portal. This metadata includes:

- **Geographical Metadata**: Resource providers' country and Operation Centre affiliation. Generally, this follows current borders, but there are important exceptions. This is gathered from GOCDB using its XML-based API.
- **Topological Metadata**: Resource providers are presented in trees, there are Country and Operation Centre trees that correspond to geographical classifications, but there are also trees based on topological classifications like Tier1 and Tier2 Resource Centres, OSG Resource Centres and uncategorised Resource Centres. Inside Tier2 Resource Centres, the federation they belong to is also important and can trigger special code in some cases. Gathered from several sources, including OSG and WLCG databases.
- **Role Metadata**: VO members and managers, and Resource Centre admin records. This metadata controls the access to restricted views. Information is gathered from GOCDB and individual VOMS servers constructing a list of individual VOMSes and querying them with the VOMS API.
- **Country affiliation data**: Each user record contains a user identifier that has his/her user name, institution and sometimes country. Scripts in the backend map each user with the country of the institution which issues their certificate. These data are used in anonymised statistics per country on: how many resources from other countries are used by given country and the distribution of its resources used by other countries.
- **VO Data**: To make possible VO selection in the user interface, the portal stores lists of VOs. They are also used to filter incorrect VO names, provide access to VO managers, and arrange accounting by VO discipline (such as "High Energy Physics", "Biomedicine", "Earth Sciences", etc.). Information is gathered from the Operations Portal using its XML based APIs.

- **Resource Centre status metadata**: Resource Centres must be filtered to exclude those that are not in production (because not certified yet, suspended, closed or being in test mode). There must be also metadata to aggregate the accounting history of Resource Centres whose name has been changed. Information is gathered from GOCDB using its XML tables and internal tables compiled as part of EGI PROC 15[22].
- **Pledge metadata**: The WLCG reports have to contain only those Resource Centres where MoUs or other pledges between VOs and Resource Centres are honoured, so the validity date and pledged hours are needed. Information is gathered from WLCG using the REBUS service.
- ***Other metadata:*** There are also other metadata like local privileges, SpecInt calculations, publication status, VO activities and more. Some of these metadata is calculated internally using other types of metadata and published for other EGI operational tools, like VO activity data and Resource Centre UserDN publishing.

7.3 Release notes

7.3.1 Requirements covered in the release

- Implementation of the Storage Accounting views
- Added geographical JSON encoding options
- Add day, month, quarter, half-year and year scaling to hour based units
- Processors and initial Flavor variable support on cloud accounting
- Added “number of processors” and “elapsed time * processors” to cloud views
- Improved Scientific Discipline report
- Solved filtering of valid cloud Discipline classifications
- Metric Unit field changes to cosmetic one option select on non-hourly metrics
- Fixed unit definition matrix on WLCG pages
- REST API implementation (JSON + CSV output)
- Simplifying URLs and separating CSV + JSON links
- REST API documentation on a detailed wiki form
- Mass mailing notification support for VO Managers and Resource Centre Admins
- Bug fixing

[22] https://wiki.egi.eu/wiki/PROC15_Resource_Center_renaming

7.4 Feedback on satisfaction

Several tests were executed in collaboration with the EGI UCST and Operations Team. User communities were involved in the testing phase and the portal was updated according to the gathered requirements.

Feedback collected on the final release by all the stakeholders involved in the testing phase was very positive.

7.5 Plan for Exploitation and Dissemination

Name of the result	Accounting Portal
DEFINITION	
Category of result	Software & service innovation
Description of the result	Completed refactored portal with a modern and more attractive look & feel and several new features such as new home page, a WLCG specific sub-portal, new EGI reports, improved scientific discipline support, reorganized menus, contextualised help inline, improved CSV support, reimplemented VO metrics.
EXPLOITATION	
Target group(s)	Infrastructure users, VO Managers, Operations Centres, Resource providers and the general public.
Needs	Modern look & feel, new ways to access data, new reports.
How the target groups will use the result?	Reporting activities, problem solving, MoU estimation.
Benefits	Better reports, better problem solving, better MoU estimation.
How will you protect the results?	Attribution via open source license
Actions for exploitation	The result is published in a public web page, immediately exploitable.
URL to project result	http://accounting.egi.eu
Success criteria	Continued use.

DISSEMINATION	
Key messages	A modern accounting portal with several new features is now available.
Channels	• Dissemination through the EGI conferences • Article featured in the EGI newsletter
Actions for dissemination	EGI conferences, publications, participation to workshops organised by potential users
Cost	
Evaluation	Number of accesses.

7.6 Future plans

Future plans cover following aspects:

- Additional options to aggregate data.
- Reports for spotting increasing/decreasing VO usage.
- Accounting data analytics.
- Dynamic pie charts.
- Change type of graph dynamically
- Support GPGPU Accounting.
- Support Data Accounting.
- Bug fixing.

Appendix I. ARGO development process

The following text is a copy of the "ARGO Development Process" document. The latest version of the document can be found here:

https://docs.google.com/document/d/1W0pT-zcBHG1E_hfftW67DH01LBZC7zMKLlIgJTlsFh8/edit#

Open development

We follow an open development process. All the repositories of ARGO are hosted on GitHub under the ARGOeu organization. Each component that can be standalone, is hosted in its own repository in the ARGOeu organization.

Each component should have a CONTRIBUTING guidelines document, describing how contributions can be made. There will be a general CONTRIBUTING guidelines document. Components that are maintained in their own repositories can should link to the general CONTRIBUTING guidelines document or have their own set of guidelines if required.

- https://github.com/ARGOeu

Forked repositories

Following the spirit of DVCS, each of us forks the repositories from GitHub to her/his own account. We can work on new or on-going features on our own forks and when we feel it is ready or whenever we want feedback from the rest of the team, and then we can open a pull request towards the respective ARGO repository.

Useful information:

- https://help.github.com/articles/fork-a-repo
- https://help.github.com/articles/syncing-a-fork

Pull requests & core team

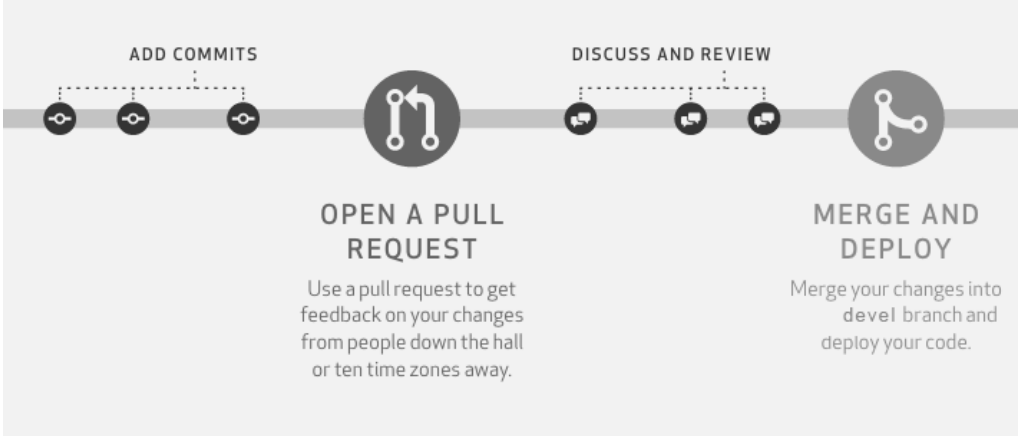
All of the members of the core team should be able to merge pull requests in the ARGO repositories. The person who opens a pull request never merges it {her,him}self, but asks/expects another core team member to review it and merge it. The idea behind this is that at least two people (the committer and the reviewer) will be involved for each new feature that we develop.

Advices for a committer:

- Do commit early and often
- Do make useful commit messages (they will be used for the release CHANGELOG). Creating insightful and descriptive commit messages is one of the best things you can do for others who use the repository. It lets people quickly understand changes without having to read

code. When doing "history archaeology" to answer some question, good commit messages become very important.

- Format of a commit message:
    - Title: [Jira issue ID] - descriptive title
    - Description: summary of your job with enough information so that a can understand the context and the intention of the change.



The person who opens a pull request should make sure that {s}he includes enough information so that the reviewer can understand the context and the intention of the changes proposed in the pull request. A member can use the PULL_REQUEST_TEMPLATE that is supported by GitHub since earlier this year. https://github.com/blog/2111-issue-and-pull-request-templates. It is strongly encouraged that we open pull requests as soon as possible in the developer process in order to trigger prompt feedback.

1 pull request should refer to 1 feature, task, bug. Pull requests that are not ready to be merged should be marked as Work-In-Progress (WIP). Having the pull request open, means that each commit is visible to the ARGO CI, which can then build the component, run all the unit tests and attempt to package the component and at the end provide status feedback within the pull request.

Useful information:

- https://help.github.com/articles/creating-a-pull-request
- https://help.github.com/articles/checking-out-pull-requests-locally
- https://help.github.com/articles/creating-a-pull-request
- https://help.github.com/articles/merging-a-pull-request
- https://quickleft.com/blog/pull-request-templates-make-code-review-easier
- https://help.github.com/articles/merging-a-pull-request

Pull request review process

When a feature is ready, the developer removes the WIP mark from the pull request. Removing the WIP mark effectively signals the rest of the team that the pull request can be peer reviewed. At least one team member (other than the committer) has to act as the reviewer of the pull request. During the peer review process, the reviewer has to check the feature implemented, the code quality, the unit test coverage as computed, the existence of proper documentation and whether the component can be packaged successfully. If all these checks pass, then the reviewer can accept the pull request in order to be merged in the devel branch.

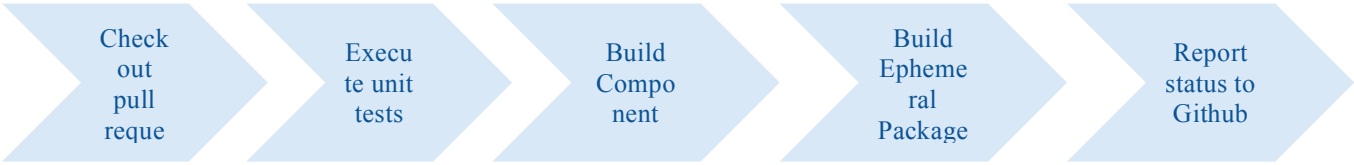
Branches and builds

Each repository should have at least 2 long-term branches:

- the devel branch, which should always be deployable
- the master branch, which should always be releasable

Pull requests

Pull requests for new features should be opened initially against the devel branch. For every pull request that is opened, the ARGO CI will execute the following workflow



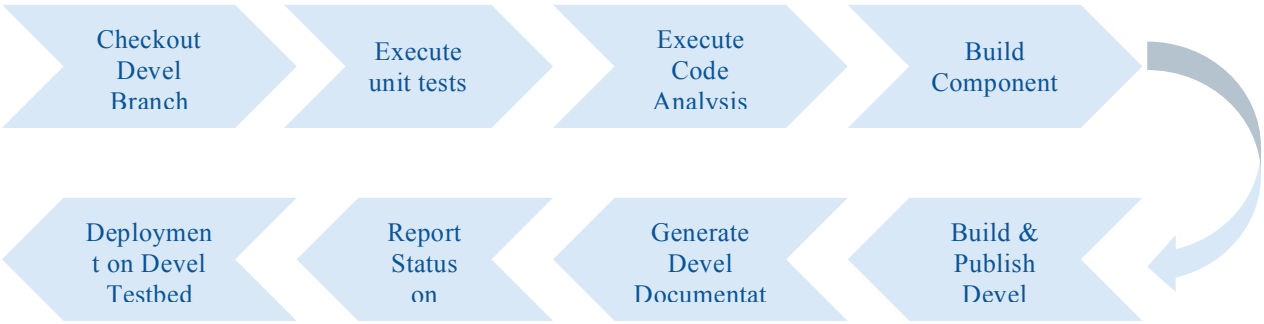
Before a pull request can be merged in the devel branch, a member of the development team (other than the original committer) has to review the pull request and check the following according to the "Definition of Done":

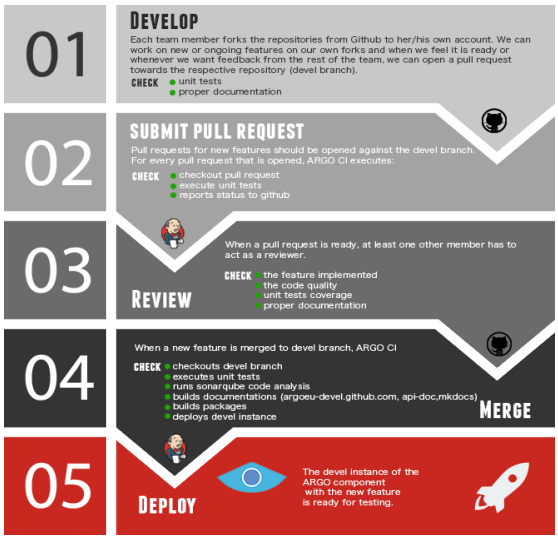
#	Check	Status
1	Quality of Code	
2	Passes acceptance criteria automatic Unit tests for non-UI (80% or greater code coverage for business logic tier for new code)	
3	CI build job is up-to-date and compiles, tests, and analyses the existing & newly added code	
4	DB migration script for DB Schema tasks	

5	Sufficient documentation: • APIs + Interfaces (public) • Manuals (where applicable) • Changelog / Release Notes • Inline comments where 'complex' code	
6	Ability to be properly packaged	

Devel branches

When new code is merged on the devel branch of each component, the CI system (a) picks it up, (b) builds the codebase, (c) runs again the unit tests, (d) runs the sonarqube code analysis suite and publishes the results on the ARGO sonarqube instance, (e) builds the devel packages and publishes them on the ARGO devel RPM repository, (f) extracts, builds the documentation and publishes it on the devel website and (g) reports the status of the CI on Github. New RPMs published on the devel RPM repository are automatically installed on the devel testbed.





The devel testbed is using actual production data and is being operationally monitoring by the same monitoring probes that are used to monitor also the production instance. Furthermore at the end of each sprint, the product team performs the sprint review ceremony in which the important features are presented to the ARGO stakeholders and live tested on the devel testbed. After the successful completion of the sprint review, the new code base is merged on each component's master branch.

In case more than one developer is working on the same component or a developer is working in

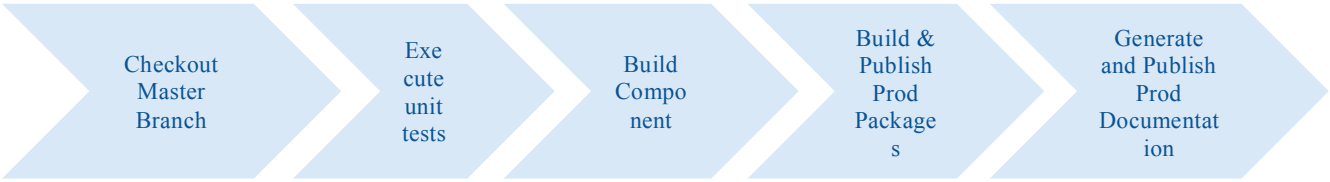
parallel in more than one feature for the same component, the use of feature branches is advised.

The Devel branch is considered to be the main branch where the source code of HEAD always reflects a state with the latest delivered development changes for the next release. Some would call this the **"integration branch".** This is where automatic builds are built from.

When the source code in the develop branch reaches a stable point and is ready to be released, all of the changes should be merged back into master somehow and then tagged with a release number.

Master Branches

When new code is merged in the master branch of each component, the CI system picks it up and execute the follow workflow: (a) builds the codebase, (b) runs the unit tests again, (c) builds the production packages, (d) publishes them on the ARGO production RPM repository and (e) extracts & builds the documentation and publishes it on the ARGO website.



Each time changes are merged back into master; this ***is a new production release by definition***.

Useful information:

- http://martinfowler.com/bliki/FeatureBranch.html

Releases

The release follows the process when new code is merged in the master branch of each component. Some prerequisites for a helpful release:

- **Spec files** should follow the correct release number shown in the following table. Spec files (%changelog) should not contain information about features or fixes, but information about changes in the package[23]. Do NOT put software's changelog at here. This changelog is for RPM itself. If the package has no changes, the description should say "New RPM package release".
- **Release**: New release is created in the component repository. (Go to releases → Draft new release) The release contains the release number and detailed information. The information is created via the PR descriptions, so the PRs should have descriptive titles and messages. The release description should have the following sections:

[23] https://docs.fedoraproject.org/en-US/Fedora_Draft_Documentation/0.1/html/Packagers_Guide/sect-Packagers_Guide-Creating_a_Basic_Spec_File.html

```
# New features/Enhancements

# Fixes

# Documentation updates
```

Release numbers

v1.0.**[1]**	Patch release. A new minor release typically including just backwards-compatible bug fixes. No new functionality is added.
v1.**[1]**.1	Feature release. MINOR version when you add new functionality in a backwards-compatible manner.
v**[1]**.1.1	Major release. Significant changes in the functionality. Mandatory if the changes are breaking backward compatibility.

A todo list of a release is described in this document.

Releases process

Planning: On every **first meeting** of the month we plan the new features, functionalities (jira tasks) of the components. It is not obligatory to have new features, functionalities, fixes for all components. For the planning process a Jira Sprint will be used, with the selected jira tasks. It will be nice to comment and update the status of each Jira task.

Testing: All the new features, functionalities and fixes must be tested for 2 weeks at least in the devel infrastructure. This effectively means that, in the next release, only the features that are ready to be tested in the middle of the month will be included.

Release: All tested features, functionalities and fixes will be deployed to the production infrastructure at the beginning of the next month. If a feature, functionality, fix is not properly tested or requires more development it will be added to the next release.

Process based on proc23

	Responsible	**Action**	**Notes**

1	**Service Provider team**	**Once release is ready the team opens a GGUS ticket to Operations with the following information:** • **Name of the tool** • **Date of release** • **Release notes** • **Suggested deployment date** • **Testing instance url and testing instructions** • **Names of testers if testing is manual (if not defined Development team may ask to appoint testers)**	**This refers only to monitoring boxes and WEB UI**
2	**Operations Team**	• **Inform the Noc-Managers about the upcoming release, asking if there is anyone else interested in performing the tests** • **can add further people for performing the tests** • **The suggested duration of the test phase is two weeks** • **Update the ticket**	
3a	**Operations Team / Noc-Managers**	**Update the ticket with the information on the performed tests and their result**	
3b	**Service Provider team**	**Update the ticket with information about results of the overall testing phase**	
4	**Service Provider team**	**Provide in the ticket the link to updated documentation**	
5	**Service Provider team and Operations team**	**Agree on deployment date and update the ticket**	

6	Operations team	10 days before the upcoming deployment, inform the Noc-Managers. Update the ticket	
7	Service Provider team	Schedule a downtime of the service in case it is needed	
8	Service Provider team	Deploy release and update the ticket	
9	Operations team	Close the GGUS ticket after a week of the deployment only if the release was successful	

Step 1: Example

https://ggus.eu/index.php?mode=ticket_info&ticket_id=129318&come_from=submit

Appendix II. GOCDB development process

Testing:

- The GOCDB source code includes DBUnit and Unit tests for selected core packages. For a data-centric product like GOCDB, emphasis is placed on the DBUnit tests, which are essential to assert expected behaviour on the deployed RDBMS.
- The GOCDB test suite prioritizes quality functional testing of the most critical code-paths rather than achieving high blanket coverage of less meaningful tests.
- As of Jan/2016 this includes 67 DBUnit tests with 668 assertions.
- Coverage reporting is included for selected core packages (DAOs – 55%, Doctrine 35%, Gocdb_Services 17%) and it is acknowledged that a higher coverage should be achieved for these packages.
- Continuous Integration is carried out on all pull requests to GitHub using Travis. This uses the unit tests to check the GOCDB code base against PhP 5.3, 5.4, 5.5, MySQL and SQLite (though not all the tests currently pass for SQLLite).

Approach to Source Control:

- The GOCDB project is hosted in GitHub under the GOCDB organization.
- The main GOCDB repository has two main branches ‘master’ and ‘dev’.
- The master branch is always ‘releasable’.
- The dev branch is always ‘deployable’.
- Developers fork the repository into their own personal repository to work on features using Topic branches.
- When ready, a pull request is opened against the ‘dev’ branch in the main repository for review by other team members.
- After review, the pull request is merged into the ‘dev’ branch.
- When ready, the dev branch is merged into master.
- Tags are subsequently created from the master branch to identify specific releases (v5.5. v5.6 etc).
- Throughout this process, the test suite is continuously executed and any failing tests addressed before creating pull requests and/or merging.
- For certain scenarios, we consider it acceptable to push commits directly to the dev branch rather than always enforcing pull requests which may add unnecessary overhead, such as making documentation changes or small rendering updates.

Appendix III. Accounting Repository dev process

The APEL project produces its own software, which is written in Python and uses MySQL as the database backend. Source code is hosted on GitHub under the APEL organization. As Git is a distributed version control system, all the developers who work on the APEL project have their own copy of the repositories, known as a fork, in their own GitHub accounts. The developers work on local copies of these forks, fixing bugs or creating new features.

When the changes a developer has been working on are ready to be merged back into the parent repository a pull request is opened. The developer should include information about the changes, such as their purpose and whether they address an outstanding issue, so that someone else can understand the context of these changes. Where new features are added, they should be covered by a corresponding unit test. Opening the pull request initiates the execution of a number of checks. The main one is the execution of the test suite using the hosted continuous integration service Travis CI[24]. Code test coverage checking is performed by Coveralls[25] and Python code quality checks. These tools report the result of their checks directly in the pull request for the developers to see. The continuous integration test must pass before the changes can be merged back into the parent and it is highly recommended that the other checks also pass.

The changes are reviewed by at least one other member of the APEL team who did not submit the pull request. This is so that at least two people have seen or worked on the changes that are to be added. After this stage, the reviewer can either approve the changes, or suggest improvements. If approved, then the changes are merged into the parent repository by the team member with the release manager role. If not approved, then the developer can incorporate the suggestions and add more changes to the pull request which leads to the automated checks being made again and then the process can repeat until the reviewer is satisfied with the suitability of the changes.

Both of the main APEL repositories have two branches used to manage the source code: The development branch and the master branch. The development branch (shortened to “dev” in the version control system) is where pull requests are merged to and so contains the latest features as they are completed. Therefore the code in this branch should always be deployable to test systems. The master branch is where the development branch is merged to when preparing the software for a release. Therefore the code in this branch should always be releasable to production systems.

Extra testing can be performed using a test system if it is thought that the changes are not tested comprehensively enough in the unit tests or if there are potential integration issues. The APEL project has a test server where new versions of the software are installed so that external developers can test against them before deploying to production.

[24] https://travis-ci.org/
[25] https://coveralls.io/