EGI-InSPIRE

ROADMAP FOR THE MAINTENANCE AND DEVELOPMENT OF THE DEPLOYED OPERATIONAL TOOLS

EU MILESTONE: MS711

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Abstract

This milestone document records the planned technical changes for the operational tools and the use cases they are designed to support.

I. COPYRIGHT NOTICE

II. DELIVERY SLIP

		Name	Partner/Activity	Date
From		Helmut Dres	KIT/JRA1	29/01/14
Reviewed by		**Moderator:** Malgorzata Krakowian **Reviewer:** Christos Kanellopoulos	EGI.eu/JRA1 GRNET/SA4	19/02/14
Approved by		**AMB and PMB**		14/03/14

III. DOCUMENT LOG

Issue	Date	Comment	Author/Partner
	09/01/14	ToC	D. Scardaci / INFN
	20/01/14	Added input from the PTs	H. Dres / KIT
	25/01/14	General review. Added Executive summary, introduction, conclusion and references	D. Scardaci / INFN
	29/01/14	Internal review	D. Scardaci / INFN
	19/02/14	External review	D. Scardaci / INFN
	27/02/14	Update based on input from T. Ferrari (EGI.eu) and submission to AMB	D. Scardaci / INFN

IV. APPLICATION AREA

This document is a formal deliverable for the European Commission, applicable to all members of the EGI-InSPIRE project, beneficiaries and Joint Research Unit members, as well as its collaborating projects.

V. DOCUMENT AMENDMENT PROCEDURE

Amendments, comments and suggestions should be sent to the authors. The procedures documented in the EGI-InSPIRE "Document Management Procedure" will be followed: https://wiki.egi.eu/wiki/Procedures

VI. TERMINOLOGY

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

PROJECT SUMMARY

To support science and innovation, a lasting operational model for e-Science is needed – both for coordinating the infrastructure and for delivering integrated services that cross national borders.

The EGI-InSPIRE project will support the transition from a project-based system to a sustainable pan-European e-Infrastructure, by supporting 'grids' of high-performance computing (HPC) and high-throughput computing (HTC) resources. EGI-InSPIRE will also be ideally placed to integrate new Distributed Computing Infrastructures (DCIs) such as clouds, supercomputing networks and desktop grids, to benefit user communities within the European Research Area.

EGI-InSPIRE will collect user requirements and provide support for the current and potential new user communities, for example within the ESFRI projects. Additional support will also be given to the current heavy users of the infrastructure, such as high energy physics, computational chemistry and life sciences, as they move their critical services and tools from a centralised support model to one driven by their own individual communities.

The objectives of the project are:

1. The continued operation and expansion of today's production infrastructure by transitioning to a governance model and operational infrastructure that can be increasingly sustained outside of specific project funding.
2. The continued support of researchers within Europe and their international collaborators that are using the current production infrastructure.
3. The support for current heavy users of the infrastructure in earth science, astronomy and astrophysics, fusion, computational chemistry and materials science technology, life sciences and high energy physics as they move to sustainable support models for their own communities.
4. Interfaces that expand access to new user communities including new potential heavy users of the infrastructure from the ESFRI projects.
5. Mechanisms to integrate existing infrastructure providers in Europe and around the world into the production infrastructure, so as to provide transparent access to all authorised users.
6. Establish processes and procedures to allow the integration of new DCI technologies (e.g. clouds, volunteer desktop grids) and heterogeneous resources (e.g. HTC and HPC) into a seamless production infrastructure as they mature and demonstrate value to the EGI community.

The EGI community is a federation of independent national and community resource providers, whose resources support specific research communities and international collaborators both within Europe and worldwide. EGI.eu, coordinator of EGI-InSPIRE, brings together partner institutions

established within the community to provide a set of essential human and technical services that enable secure integrated access to distributed resources on behalf of the community.

The production infrastructure supports Virtual Research Communities (VRCs) – structured international user communities – that are grouped into specific research domains. VRCs are formally represented within EGI at both a technical and strategic level.

VII. EXECUTIVE SUMMARY

The development of the deployed operational tools is an on-going activity that concerns the common tools that are currently used to support e-Infrastructure operations. This work ensures:

- The continuing and correct functionality and interoperation of the tools with the deployed middleware;
- The developing of new features in response to the new scenarios that arise in a so dynamic world like e-Infrastructure;
- The developing of new features to satisfy the new requirements coming from its users, primarily the NGI/EIRO Operation Centres and the EGI.eu Operations Team.

The first activity is fundamental to avoid a degradation of tools capabilities that could decrease the quality of the services offered by EGI. The other two activities allow us to provide EGI community with up-to-date tools able to satisfy a growing numbers of end-users requirements and the most recent use-cases increasing the ability of EGI to keep and attract users. User requirements and new scenarios are collected and prioritised by the Operational Tools Advisory Group (OTAG). OTAG provides a forum to discuss the future evolution of the operations tools and to agree tool roadmaps that meet the expressed needs of the EGI community. It has representation from the tool users, and the software product teams located within or external to the project. Additionally a dedicated advisory board has been created to discuss the GGUS requirements. It is composed of representative from user communities, NGIs, EGI, technology providers and the new GGUS requirements will be discussed there before reaching the OTAG

To monitor this work there is a series of milestones labelled "Roadmap for the maintenance and development of the deployed operation tools". One is planned for the beginning of each project year. The aim of the milestone is to give an overview of the plans for the developments for the operational tools in the following months, describing the general direction of the development and give estimations of the timeframe for these developments.

During PY4 the main driving themes for JRA1 activity have been the support of the operational needs of the EGI federated cloud, the extension of the operational tools to integrate new middleware types, the whole refactoring of the Operations Portal to improve its look and feel and performance, the GOCDB v5 release that remove the dependency from Oracle and the deployment of the last SAM update integrating the EMI probes

The JRA1 activity ends in PY4, after that the software maintenance will be supported as EGI core activity through EGI Council fees and NGI in-kind contributions. Additionally the JRA2 activity, that will start in PY5, will deal with the continuation of software development for a subset of tools that require further improvements. The roadmap presented in this document includes developments that will be carried out during 2014 by all these activities.

This is the last milestone of the series and the plans described here cover the interval between now and the end of the project.

The tools in the scope of the milestone are:

- Operations Portal
- GGUS
- GOCDB
- Accounting Repository
- Accounting Portal
- Service Availability Monitoring (including support for messaging)

- Metrics Portal

For each of these tools the current status, highlighting the features developed in the last year and their dependencies to other tools, are described. The deviations from the roadmap planned in the previous milestones of the series will be listed and motivated. This is meant to provide the background on which the new developments and plans will be realised.

All development teams have detailed plans for the last project year and beyond. Nevertheless it is important that the respective advisory body (OTAG and GGUS advisory board) steers and monitors this activity. The requirements coming from the users of the various tools need to be channelled and prioritised by this group and discussed with the developers, to make sure that changes could be well harmonized in all the tools preserving the integrity of the interplay between them.

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1 INTRODUCTION

As described in last year's milestone MS 710 [R 1] this document summarises the current status of implementation and the development plans of critical operational tools till the end of the EGI-InSPIRE project in December 2014. These operational tools are essential to achieve the objective of providing a large scale and resilient pan-European distributed computing infrastructure supporting a diverse range of scientific disciplines.

The JRA1 activity will end at PM48, after that the software maintenance will be supported as EGI core activity [R 2] through EGI Council fees and NGI in-kind contributions. Additionally the JRA2 activity that will start in PY5, will deal with the continuation of software development for a subset of tools that require further improvements. The roadmap presented in this document includes developments that will be carried out during 2014 by all these activities: JRA1 (until April 2014), EGI core activities (May-December 2014) and JRA2 (May-December 2014).

Section 2 sequentially looks at the current status of each of the operational tools highlighting the features developed in PY4 and the contingent deviations from the roadmap planned in MS 710. It also lists the functional dependencies of that tool on other operational tools and on specific data sources and reviews the status of regionalisation.

Section 3 outlines the development plans and each tool development team presents a roadmap summary for 2014.

2   EGI OPERATIONAL TOOLS - STATUS AND DEPENDENCIES

2.1   *Operations Portal*

The Operations Portal [R 3] is providing information to various actors (NGI Operations Centers, VO managers, etc.) along with related facilities, such as the VO administration tool and the VO management module, the different dashboards (Operations dashboard, security dashboard, VO Operations dashboard) and different communication tools : broadcast tool and downtime system announcement.

2.1.1   Current Status

The Operations Portal is described in detail in the EGI-InSPIRE milestone document MS705 [R 4]. In this section we describe the main developments performed during PY4.

2.1.1.1   Refactoring of the whole portal

To improve the look and feel and the ergonomics of the portal a complete review of the portal has been initiated. Currently the refactoring is almost completed and the new Operations portal release (3.0) will be deployed in pre-production in February 2014 and we will move it to production in March 2014. The benefits of this refactoring will be:

- New portal look and feel with a homogenization of the display
- Improvements on efficiency, on reactivity and visibility
- The replacement of the heterogeneous JavaScript libraries by the use of a standard one: jQuery. [R 5]
- Readiness for mobile phones and tablets
- The use of the last web technologies to improve the efficiency and the usability
- Upgrade of php version

Different improvements have been added to access more easily to the information:

- Filters on the long table
- Possibility to export information (json, csv)
- Auto completion on large list

This work has been done step by step and module per module:

- Refactoring of the VO ID cards - achieved
- Refactoring of the VO Administration Module - achieved
- Refactoring of the Broadcast - achieved
- Refactoring of the ROD Dashboard – achieved
- Refactoring of the VO Dashboard – achieved
- Refactoring of the COD Dashboard – on going
- Decommission of CIC_HELPDESK and integration of Operations Portal with standard GGUS Helpdesk - on going

2.1.1.2   Migration to Lavoisier 2.0

In parallel with the refactoring of the portal Lavoisier [R 6] has been migrated to a new version.

This version is more flexible and provides new features like:

- Complete support of path and xpath
- More rendering formats: csv, json, txt, xml, yml, gzip , html, chart, etc
- The support of java scripts libraries and css framework

The main work was to translate the different views from the old version to the new one but also to increase the efficiency by using as much as possible the xpath queries.

2.1.1.3 VO security contact list

The EGI CSIRT community [R 7] expressed some requirements related to the availability of the VO security contact information. These requirements are described in an EGI document [R 8] and translated by JRA1 in RT requirements (RT 6107 and RT 6108).

To satisfy the CSIRT's requirements, a new page has been created summarizing the list of VO security contacts and the possibility to export it. Moreover a new branch has been added into the broadcast to contact these different contacts in one click. The remaining task is to provide an API to the EGI mailman system to concatenate all these contacts in one mailing list.

2.1.1.4 VO Users

- It has been added the possibility to export the list of users and robot certificates registered in our user's database extracted from the different VOMS servers. To get the list of users use[1],
- To get the list of robot certificates[2].

Moreover, the users accounting has been improved by using the new VOMS API. The results are currently visible only on the Lavoisier Interface[3].

2.1.1.5 Tasks described in MS710

Task	Status	Comments
Refactoring of the different dashboards	Done except for the COD dashboard	Will be delivered with release 3.0
Continuous integration	Done	Will be delivered with release 3.0
Availabilities and reliabilities report system	Done	In production
Package	Low priority task	No demand from NGI

2.1.2 Dependencies

Directly dependent on	Comments
GGUS	Display, create and update tickets via SOAP calls
Indirectly dependent on	
GOCDB	Use of information: user, ngi, site, downtimes, services Views in cache in Lavoisier
SAM PI	Use of information: Availabilities and reliabilities raw data

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[1] https://operations-portal.egi.eu/vo/downloadVoUsers
[2] https://operations-portal.egi.eu/vo/downloadVoUsers?robot=true
[3] https://cclavoisier02.in2p3.fr:8080/lavoisier/voms_users?accept=html

	Views in cache in Lavoisier
ActiveMQ broker network Regional Nagios Services	Use of information: Nagios results The use of virtual queues ensure the persistence of the information
GSTAT	Use of metrics about storage and CPU Views in cache in Lavoisier
BDII	All dynamic information about services Views in cache in Lavoisier
Pakiti	Use of information: security vulnerabilities Views in cache in Lavoisier
The security Nagios Box	Use of information: security vulnerabilities Import stored into our DB
The EGI SSO system	User list - used to refined the authentication mechanism Views in cache in Lavoisier
VOMS servers	Users and vo information Views in cache in Lavoisier
Tools which are dependent on the Operations Portal	
Accounting Portal	List of VO and discipline
AppDB	List of VO and the associated information
GOCDB	The downtime visualisation tool.

2.1.3 Regionalisation

As announced in MS710 regionalization is supported by providing central customized views for each Operations Centre of the Operations Portal facilities. During PY4 different views in the portal were created depending on the role of the users registered into GOC DB and associated to their certificates, so that access to information is restricted to the authorized operators only.

2.2 GGUS

The EGI helpdesk also known as GGUS (Global Grid User Support) is described in detail in MS410 [R 9].

2.2.1 Current Status

The implementation of the Report Generator and all the other requested features were completed. The high availability solution was brought forward a big step. The whole infrastructure was moved to two independent stacks of virtual machines in different locations. The manual switching mechanisms was implemented. The VOMS synchronization for user authentication was restructured to improve reliability. This is fundamental for the alarm ticket process used to send urgent notifications to the supporters in case of critical errors.

Alternative access to GGUS and xGUS using an AAI infrastructure was prepared and will be completed early 2014. For MAPPER project a dedicated xGUS instance was set up [R 10].

2.2.1.1   Tasks described in MS710

Task	Status	Comments
Integration of the last remaining NGI (Russia)	Cancelled	Never got any response. Currently we have the Russian helpdesk connected to GGUS via an e-mail interface.
New interfaces to MAPPER	Done	New xGUS instance for Mapper
Specific work flows for CSIRT/Security	Cancelled	
Restructure VOMS GGUS synchronization	Done	
GGUS Report Generator (final version depends on external requirements)	Done	
Adapt interface to GOC DB/Doctrine	Done	
Implementation of alarm processes for EGI tools	In progress (March 2014)	
High availability for GGUS components (switching between stacks)	Done	
Disaster recovery plan[4]	Rejected	Beyond GGUS responsibility
Additional authentication through shibboleth	In progress (April 2014)	

2.2.2 Dependencies

Directly dependent on	For
GOCDB	Site names, email contacts, downtime information
OIM (OSG Information Management System)	Site names, email contacts
VOMS	Rights for Team/Alarm tickets
Two way dependency	
xGUS instances NGI Helpdesks based on xGUS (NGI_AEGIS,	Same server infrastructure as GGUS

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[4] The disaster recovery plan is the set of processes, policies and procedures related to preparing for recovery or continuation of GGUS after a natural or human-induced disaster. The responsibility of such a plan is on KIT facilities like medical unit or fire brigade and, then, is beyond the product team responsibility. The lack of this plan has a minimal impact on GGUS availability considered that the whole infrastructure was moved to two independent st acks of virtual machines in different locations.

NGI_CH, NGI_DE, NGI_SI, Africa ROC, China ROC)	
Helpdesks interfacing with GGUS	Synchronisation of ticket data
Tools which are dependent on GGUS	
Operations Portal	Display, create and update tickets via SOAP calls
Accounting Repository	GGUS ticket data
Metrics Portal	GGUS ticket data
LHCOPN helpdesk	Dedicated view on tickets in GGUS

2.2.3 Regionalisation

Already in PY3 all the remaining NGI helpdesk instances could be integrated in GGUS, so the regionalisation task for GGUS can be considered as finalised. The NGI can choose to set up an xGUS instance, to use GGUS directly or to set up an interface to their local helpdesk. Currently we have 6 NGIs using an xGUS instance (ngi_aegis, ngi_africa, ngi_ch, ngi_china, ngi_de and ngi_si) and 7 NGIs/ROCs connected via an interface to GGUS (NGI_France, NGI_CZ, NGI_GRNET, NGI_IBERGRID, NGI_PL, ROC_CERN, ROC_RUSSIA, OSG). All other NGIs are using GGUS directly.

2.3 GOCDB

GOCDB is an information system for recording Grid topology data such as service endpoints, sites, downtimes and users. GOCDB v5 supports multiple projects and is used to manage the relationships between different entities (Grid, Cloud, etc.) using a well constrained relational schema. It includes a comprehensive role-based permissions model project specific business rules.

A detailed description of GOCDB and its features is provided at the following link:

https://wiki.egi.eu/w/images/d/d3/GOCDB5_Grid_Topology_Information_System.pdf

2.3.1 Current Status

GOCDB v5.1 is the current production release. The GOCDB service is hosted at STFC RAL with a nightly tape backup. The service has a primary failover instance installed offsite at STFC Darsebury Lab. The primary failover is updated with an hourly download of the production data. A secondary failover instance is hosted in Germany.

Table 1: Production and failovers GOCDB instances.

GOCDB instances	URL
Production instance	https://goc.egi.eu/portal/
Primary failover instance	https://goc.dl.ac.uk/portal/
Secondary failover instance	https://goc.itwm.fraunhofer.de/portal/

The main developments of PY4 focused on development of GOCDB v5. This version replaces the now deprecated v4.x series, which was based on a proprietary PROM database that was strongly tied to Oracle. In contrast, v5 is based on de-facto Object Relational Mapping libraries (Doctrine ORM) [R 11] that can support different RDBMS, and is a major re-write from v4. V5 was necessary in order to

simplify the code base, improve performance and to develop new features that were not possible with v4.

The main features developed during PY4 include:

- Support for different RDMBS with out-of-box support for Oracle and MySQL. Other DBs such as Postgres could be supported with few changes.
- Extensions to the scoping mechanism to allow different operational entities (Sites, Services, ServiceGroups) to be tagged by one or more scope-tags. The scope extensions allow the creation of flexible resource categories akin to a tag-cloud. Fine-grained resource selection and filtering is supported in the programmatic interface (PI) with the 'scope' and 'scope_match' parameters.
- An admin Interface was developed to simplify and speed-up daily operational tasks for GOCDB administrators.
- A powerful extensibility mechanism was developed based on the GLUE2 extensibility mechanism. This allows users to associate custom key-value pairs to Sites, Services, and ServiceGroups so that this information is published following the Open Grid Forum standard. Support in the Programmatic Interface (PI) is provided with newly the added 'extension' parameter, which allows queries to perform fine-grained resource filtering based on custom properties. This feature has been released on the GOCDB test instance and is currently undergoing acceptance testing prior to a production release.
- Support for multiple projects hosted within a single GOCDB instance. A new 'Project' entity was added with supporting project-level user roles and business rules.
- The GLUE2 XML rendering was completed and published by OGF [R 12]. The GOCDB development team contributed to the accomplishment of this milestone.

The work completed during PY4 largely followed the MS710 planned tasks. Three of the four core tasks were delivered and some deviation occurred:

- The GLUE2 XML rendering task is being carried over as it was important to finalize the OGF specification before focussing on a GOCDB implementation with new PI methods.

Additional developments were also undertaken that were not recorded in MS710, including prototyping multiple service endpoints and providing operational assistance to EUDAT.

2.3.1.1 Tasks described in MS710

Task	Status	Comments
GOCDB v5	Completed	Released Oct 2013
Extending Scoping	Completed	Released as part of v5
Extensibility Mechanism	Completed, released to gocdb-test for acceptance testing	Planned release ~end Jan 2014
Glue2 XML Rendering and add Glue2 Downtime	Carried over.	Specification published by OGF Dec 2013.

2.3.2 Dependencies

As a primary source of information GOCDB doesn't depend on any other tool.

Tools which are dependent on GOCDB and corresponding Technology Provider
Operations Portal and Operations Dashboard (IN2P3)
ATP (CERN)
Top-BDII config generator (CERN)
MyEGI
NCG (SRCE)
Regional Nagios (CERN)
GGUS (KIT)
GSTAT (ASGC)
APEL (STFC)
Accounting Portal (CESGA)
Metrics Portal (CESGA)
e-GRANT (Cyfronet)

The list is not exhaustive. Some VO specific tools are using the GOCDB programmatic interface (e.g. to feed downtime calendars), and the information may also be used by regional tools (local monitoring, local helpdesks etc.).

2.3.3 Regionalisation

Since the start of PY3 regionalisation of GOCDB is implemented through scoping and the implementation of scoped views of the entities registered. See MS710 [R 1] for details.

2.4 Accounting Repository

The EGI accounting repository (APEL) [R 13] stores information relating to the usage of resources within the EGI production infrastructure. It receives data on individual jobs and summaries of collections of jobs records from information providers, sites and other infrastructures, and exports accounting information to consumers of usage records.

2.4.1 Current Status

2.4.1.1 CPU Accounting

A new EMI-APEL client was released as part of EMI 3 [R 14]. It includes support for local jobs and MPI accounting [R 15]. The EMI 2 and EMI 3 APEL Accounting systems have successfully run in parallel with one set of daily summaries retrieved by the Accounting Portal. The APEL team has worked with APEL client sites to migrate them to running EMI APEL 3. There are now 50 sites sending data to the new repository.

A regional version of the APEL Accounting Repository has been released for testing. It is in testing by the South African NGI (NGI-ZA).

Moreover, the APEL team have worked with sites and developers running alternative accounting clients to use Secure Stomp Messenger (SSM) [R 16] to send their records to the Accounting Repository. There are now sites in production sending accounting data from ARC [R 17], QCG [R 18] and EDGI Desktop Grid [R 19]. Globus [R 20] and Unicore [R 21] have successfully tested but have not started publishing in production.

2.4.1.2   Other Types of Accounting

- Cloud Accounting – a new version using SSM 2.0 has been implemented and is currently in use. Summary data is sent to Accounting Portal daily using SSM via the EGI Message Broker network. 17 sites have sent data, 9 are sending regularly.
- Storage Accounting – a new test database, Implemented using SSM 2.0, is in place. Now contains data from over 50 sites. Accounting portal have a dump of this data and have produced a prototype view.

2.4.1.3   Tasks described in MS710

Task	Status	Comments
EMI-APEL 3 Client released	Complete	In use at 50 sites
Regional APEL Server released	Complete	In use by NGI-ZA
Cloud Accounting Summaries to Accounting Portal	Complete	Prototype portal view in use
Application Accounting usage record defined	Running	Prototype parser and database in development. A demonstration will be showed during the next EGI CF 2014.
Storage Accounting Summaries to Accounting Portal	In progress (April 2014)	Prototype portal view in use from database dump
Publishing summaries from Accounting Repository to other sites (OSG/DGAS)	Running	DGAS: In testing by December 2013. OSG: issue with US laws. The current legal advice is that we cannot transfer UserDN data to the USA. Transfer of summarized usage records is being considered.

2.4.2 Dependencies

Directly dependent on	For
EGI Message Broker Network	Transport of data from client to server
Operations Dashboard & Operations Broadcast	Shows APEL client Publication/Synchronisation Status. Service availability/maintenance broadcasts
GGUS	Managing support workflow

BDII	Benchmark data for normalisation used in accounting
GOCDB	Used to identify production APEL sites, for permission to publish and for APEL client Nagios tests.
SAM	Monitors APEL availability
Functional dependency on	
Accounting Portal	Repository provides the accounting summaries which the portal manipulates and visualises

2.4.3 Regionalisation

The regional APEL server software has been released. It is currently in testing by the South African (NGI-ZA) and Greek (NGI-GRNET) NGIs.

2.5 Accounting Portal

The EGI accounting infrastructure is a complex system that involves various sensors in different regions, all publishing data to a central repository [R 13]. The data is processed, summarized and displayed in the Accounting Portal, which acts as a common interface to the different accounting record providers and presents a homogeneous view of the data gathered and a user-friendly access to understanding resource utilisation.

2.5.1 Current Status

The activity in PY4 included an integral core rewrite, inclusion of several types of new accounting (Storage, Cloud, etc.), local job support, great improvements on InterNGI accounting, work on improving the UserDN publishing, the first instance of a regionalized version of the Portal.

Below a list of the main activities achieved during PY4:

- Improved UserDN country classification patterns
- Improvements on usage by country
- GET interface for CSV
- Support for new RFC 2253 UserDNs
- Better support for custom VOs
- UserDN NGI attribution
- Support for local jobs, there are three options, selectable on most views:
    - Only Grid jobs (default)
    - Grid and local jobs (In case there is a corresponding global VO, both are aggregated)
    - Only local jobs
- Moved InterNGI views to production
- New Active Users View
- New query publication percentage views
- Shortened web service URLS
- New XML endpoint for VO activity
- Solved change on myOSG endpoint
- Fixed US OSG views
- Fixed reptier2 for Brazil federation.

- New endpoint for UserDN publication SAM probe
- Updated links section
- Heavy Core refactoring
- OOP migration
- New view aggregating all region charts for InterNGI reports (NGI/COUNTRY)
- Security improvements
- New code for UserDN SAM probe that detects if sites have published CPU/UserDN records on the last 7 days and honors some NGI non publishing policy
- Cloud accounting base code
- Updating of VO Metrics processing
- Base VM to deploy a regional accounting portal instance
- Changes for other types of accounting
- Fist Regionalized instance operative on NGI GR
- Monetary cost computation for cloud view
- Cloud accounting implementation
- Work on summary view
- Installation of new SSM software
- Fix for Unknown Discipline counting on VO Discipline CVS report
- Server work and moving, database maintenance
- Many fixes and optimizations.

2.5.1.1 Tasks described in MS710

Task	Status	Comments
Contributed CPUs by site	Under analysis	Technical issues under investigation
Preliminary support for parallel (MPI) jobs	Done	
Provisioning of Storage accounting	Done	
Provisioning of MPI accounting	In progress (February 2014)	Still needs some view coding
Provisioning of Application accounting	In progress (October 2014)	
EGI User usage accounting	Done	
Provisioning of Cloud Accounting	Done	
Regional portal codebase improvements	Done	
XML endpoints generalization and improvement	In progress (June 2014)	
SSM implementation for normal Accounting	In progress (June 2014)	
EGI Usage VT Report Improvements	Done	
EGI Usage VT Publishing Improvements	Done	

Scientific Disciplines VT Interface Support	Blocked	Depends Ops Portal
Scientific Disciplines VT final Implementation	Blocked	Depends Ops Portal

2.5.2 Dependencies

Directly dependent on	Comments
GOCDB:	List of sites and NGIs in production, list of available services in production.
Operations Portal:	VOMS endpoints and VO list.
Accounting Repository:	Accounting records and summarized accounting data.

2.5.3 Regionalisation

A regionalised version of the portal was developed and deployed during PY4, it is currently in testing in the Greek NGI (NGI_GR). The developer team planned to discuss with the South African NGI (NGI_ZA) to gauge their interest in a regional instance of the Portal.

2.6 Service Availability Monitoring Framework

The Service Availability Monitor (SAM) [R 22] is the system that is used to monitor EGI resources within the production infrastructure. It consists of the following components:

- Probes: implementing the metrics to test the infrastructure. A wide range of existing middleware components and protocols can be tested, e.g. FTS, LFC, CREAM, SRMv2, BDII, etc.
- Submission framework: a test execution framework based on the Nagios open source monitoring tool and Nagios Configuration Generator (NCG)
- Transport layer: a message broker network to distribute monitoring results
- Storage layer: Aggregated Topology Provider (ATP), Profile Management Database (POEM) and Metric Result Store (MRS)
- Visualization layer: MyEGI

2.6.1 Current Status

SAM v. 22 is the current production release [R 23]. This version has introduced EMI probes in SAM framework that was a major milestone necessary to support testing of the EMI middleware. This release was also focused on major repackaging of the SAM distribution and implementation of several MyEGI enhancements. Deployment of the SAM v. 22 also involved several complex coordination tasks, such establishment of the EMI/SAM testbed [R 24] to test newly developed probes, establishment and contribution to the SAM probes WG [R 25] which aimed at analysing the impact of the changes to EGI operations as well as SAM testing campaign where several regions volunteered to participate and help validate the final release.

During the PY4 the SAM team has also contributed to the testing and validation of the GOCDB v5 release and participated in the validation of the *A new approach to Computing A/R reports* mini-project [R 26].

Integration of the EMI probes was a major task in MS710 roadmap and was achieved in full scope by successfully releasing and deploying SAM v. 22 to production in October 2013 [R 23]. A small delay compared to the planned release in September was mostly due to the need of extensive testing and validation.

With respect to the messaging activity progress has been made in the development of failover capabilities for the msg2handler component. In general, the message brokers network is resilient to failure as long as the clients support such a feature and the developments done target towards that direction. However, this task has not yet concluded and the foreseen date for the delivery of the necessary components is February 2014.

One more achievement to be mentioned is the support of APEL clients, which has already been implemented on the production message brokers. APEL clients publish data through the message brokers to which they connect via ssl (x509). Authentication data are updated regularly on the message broker endpoints (source of information is GOCDB) and so far the interoperation with APEL can be considered successful overall.

2.6.1.1   Tasks described in MS710

Task	Status	Comments
Integration of some EMI probes	Done (October 2013)	
Messaging: Implementation of SAM probes failover capabilities	In progress (February 2014)	Slow start in development process

2.6.2 Dependencies

Directly dependent on	Comments
GOCDB	Provides infrastructure topology information for sites, services and downtimes.
BDII	Provides infrastructure topology information to define mapping between services and VOs supported.
GStat	Provides GRID topology information to define mapping between sites and Tiers.
Tools which are dependent on SAM	
Operations portal	Via messaging.
Metrics portal	

2.6.3 Regionalisation

SAM was conceived from the beginning as a fully distributed monitoring system and was one of the first tools to support regionalization. Significant improvements were implemented in SAM v.17 [R 27] enabling distributed profile management and configuration of the service. Right now, almost every NGI is running a regional SAM instance and contributes to the aggregated availability reports published every month.

2.7 Metrics Portal

The Metrics Portal [R 28] displays a set of metrics that will be used to monitor the performance of the infrastructure and the project, and to track their changes over time. The portal automatically collects all the required data and calculates these metrics before displaying them in the portal. The portal aggregates information from different sources such as GOCDB, GGUS, etc.

2.7.1 Current Status

The Metrics Portal has been used for the last year to gather metrics from the project tasks. Depending on changes of the structure and scope of the projects and its tasks and activities, the portal will be updated while keeping the old metrics in their validity periods.

Below a list of the main activities achieved during PY4:

- Access control improvements

- Quarter-dependent activities (for decommission of SA3).

- Quarter-dependent metrics (for decommissioned, replaced and semantic-changing metrics).

- NGI summed metrics for NA2.

- New quarterly views and Excel report.

- New scrolling report layout.

- Internal changes in the authentication system.

- Manual metrics expansion.

- New NGI entity for the EGI.eu organization for management purposes.

- New custom Excel reports.

- Cosmetic fixes for Chrome browsers

- Project Metrics View

- Improved links and navigation in the metrics portal

- GGUS metrics improvement

- Addition of new SA1, SA2 metrics and update of the portal to reflect changes in the activity and project metrics

- Software support metrics moved from SA2 to SA1

- Fixed problem with history view

- Restored SA2 metrics
- Server work.
- Fixes and optimizations.

2.7.1.1 Tasks described in MS710

Task	Status	Comments
GGUS metrics improvement and new A/R metrics	Done	
Access Control improvements	Done	
Manual metrics expansion and refinement	Done	
New customized reports with Excel support	Done	
Views enhancement and optimization	Done	
GGUS metrics improvement and new A/R metrics	Done	

2.7.2 Dependencies

Directly dependent on	Comments
Accounting Portal	To display accounting metrics, most active VOs, Number of submitted jobs, etc.
BDII	Number of CPUs and Cores in production, online and nearline storage, mpi sites.
GGUS	Number of tickets created/closed. Tickets response times, Number of tickets created by priority, etc.
GOCDB	Sites in production, number of countries and NGIs in EGI.
ACE	Availability and reliability metrics.

3 OPERATIONAL TOOLS ROADMAP

3.1 Operations Portal

3.1.1 Operations Portal Plan

3.1.1.1 Operations Portal 3.0

As described previously the Operations Portal team has focused its developments on the refactoring of the application and the web service.

All these improvements will be delivered with the release 3.0 into 2 phases:

- In February for the pre-production part. This phase it is necessary to check with the users that everything is working well.
- The critical bugs identified during the pre-production phase will be fixed before to deploy the new release into production (March 2014).

Then, the Operations Portal team will collect feedback from people from March to May to implement some improvements and bug fixes according to this feedback.

3.1.1.2 A new classification of the VO disciplines

A new classification of the VO disciplines has been recommended by the Scientific Discipline Classification virtual team [R 29] [R 30]. Basically the Operations Portal will move from one level of disciplines to 2 levels and a VO could be present in multiple discipline. The main development tasks and an assessment of the whole activity are showed in Table 2.

Table 2: New classification of the VO disciplines - Tasks and assessment of the activity

Thematics	Tasks
Database	Database refactoring
Database	Modification of the classes
Database	Update of the current VO
VO ID Cards	Integration of multi levels selection
VO ID Cards	Modification of the search tool
VO ID Cards	Modification of the workflows
VO ID Cards	Modification of the interfaces
Metrics and Charts	Integration of multi levels selection
Metrics and Charts	Modification of the metrics per discipline
Metrics and Charts	Modification of the interfaces
Metrics and Charts	Modification of the charts
Evaluation	**2 PM**

3.1.1.3 Support and maintenance

Operations Portal support and maintenance will be guaranteed through the EGI core activities [R 31].

The support is provided through the EGI helpdesk to EGI.eu, VO Managers, EGI CSIRT, Resource Centre, NGI operators for the usage of the various functional modules provided by the tool and to the operators of other depending systems.

The maintenance activity will include:

- core refactoring, bug fixing, proactive maintenance, improvement of the system;
- coordination of software maintenance activities with other technology providers that provide software for the EGI Core Infrastructure or remote systems deployed by integrated and peer infrastructures that interoperate with the Operations Portal;
- maintenance of probes to test the functionality of the service;
- requirements gathering;
- documentation.

3.1.2 Operations Portal Roadmap Summary

Tasks inherited from MS710	Planned completion time
Refactoring of the portal	February : pre-production March : production
Package	September – If this task is still pertinent
New Tasks	Planned completion time
New disciplines classification	April
Collection of the feedback	March - May
Implementation of the feedback	May - June

3.2 GGUS

3.2.1 GGUS plan

Alternative access to GGUS and xGUS using an AAI infrastructure will be completed.

Interfaces to PRACE and XSEDE infrastructures are foreseen. The implementation will start once the partner infrastructures are ready to go with their ticketing systems.

The VO CMS intends to switch from Savannah to the GGUS ticketing system. Therefore some dedicated modifications of GGUS will be implemented to meet the CMS requests.

For the EGI central operations tools an alarm process will be developed and integrated.

The operations portal is currently implemented as a separate application interfacing with GGUS. It will be integrated into GGUS for simplifying processes and workflows.

3.2.1.1 Support and maintenance

GGUS support and maintenance will be guaranteed through the EGI core activities [R 32].

Support will be provided through the EGI helpdesk itself:

- to users and operators of helpdesk systems integrated with GGUS about bugs and incidents affecting the GGUS system itself;

- to the operators of integrated (or to be integrated) helpdesks about GGUS interfaces and testing activities;
- to users of GGUS about the functionality provided by GGUS.

The maintenance activity will include:

- core refactoring, bug fixing, proactive maintenance, improvement of the system;
- coordination of software maintenance activities with other technology providers that provide software for the EGI Core Infrastructure or remote systems deployed by integrated and peer infrastructures that interoperate with the central EGI components of the system;
- requirements gathering;
- documentation.

3.2.2 GGUS Roadmap Summary

Tasks inherited from MS710	Planned completion time
Implementation of alarm processes for EGI tools	March 2014
Additional authentication through shibboleth	March 2014
New interfaces to PRACE and XSEDE	Depend on PRACE and XSEDE
New Tasks	Planned completion time
CMS specific adaptations	March 2014
Merge GGUS and xGUS webfrontends to a common platform	March 2014
Implement a bulk submit feature to enable the notification of many sites at the same time	March 2014

3.3 GOCDB

3.3.1 GOCDB plan

During PY5 new features for GOCDB will be developed outside of EGI as an open source project. Future developments are therefore largely undetermined and are likely to evolve. Nevertheless, continued involvement within the EGI Global Task will help ensure future developments are strategic and interoperable. Support will also be provided in PY5 to provide continued EGI operational support, service hosting and bug-fixing. The major developments for GOCDB are likely to include multiple service endpoints and further GLUE2 support.

- Multiple endpoints: A requirement has emerged during PY4 to cater for multiple endpoints per service. This would allow different service-interfaces to be registered and published for a single service. In addition, selected endpoints of a service could be put into downtime rather than the service as a whole. Prototyping for this work has been carried out in PY4 and is a likely development for PY5. Interoperability and future support from dependent tools would be needed to consume the multiple endpoints, e.g. with downtime notifications for selected service endpoints and monitoring of selected service endpoints.

- GLUE2 support: It is envisaged that a range of new GLUE2 attributes will be added to the GOCDB data model including support for the recently evolving GLUE2 cloud extensions. New PI methods will be added to render the GOCDB data in the GLUE2 XSD standard.

3.3.1.1 Support and maintenance

GOCDB support and maintenance will be guaranteed through the EGI core activities [R 33].

The support will be done through the EGI helpdesk to users of GOCDB and to the operators of other depending systems.

The maintenance activity will include:

- core refactoring, bug fixing, proactive maintenance, improvement of the system;
- coordination of software maintenance activities with other technology providers that provide software for the EGI Core Infrastructure or remote systems deployed by integrated and peer infrastructures that interoperate with the central EGI components of the system;
- requirements gathering;
- documentation.

3.3.2 GOCDB Roadmap Summary

Tasks inherited from MS710	Planned completion time
GLUE2 XML rendering of GOCDB data	Aug/Sept 2014
Writable PI method to submit downtimes	~June 2014
New Tasks	Planned completion time
Multiple Service Endpoints	~May 2014
Extend data model and add more GLUE2 attributes (e.g. GLUE2 cloud extensions)	~July 2014
Web portal interface enhancements	To be defined[5]

3.4 Accounting Repository

3.4.1 Accounting Repository Plan

The APEL team will work with sites in testing and the message broker team to move our test infrastructure to use the production message broker network.

After discussion with other sites, publishing summaries from Accounting Repository to other sites (OSG, DGAS) will be implemented. Work will continue with sites to migrate their CPU accounting systems from EMI2 to EMI3 and with sites running SSM 1.2 to migrate them to SSM 2.0. The MPI data will be sent from the new repository to the accounting portal. This requires extensive work to

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[5] This task will be executed outside EGI-InSPIRE project and EGI.eu Core Activities. The timeline is not yet available.

re-route the data flow of the existing repository backend. Further work will be to set up database replication to improve the reliability and availability of the service.

Work will start to move the Federated Cloud sites to production. The APEL team will work with developers and sites to finalise the cloud data schema. Then, the necessary systems for the cloud accounting in production will be installed, configured and monitored.

A specific activity will be performed to ensure that storage accounting data received from the different storage clients is comparable across sites. Once this is established, work will continue to define the summaries of storage accounting data. The APEL team will collaborate with the accounting portal team to visualise the summaries after which we can begin receiving storage accounting data in production.

A prototype application accounting system will be developed to be presented at the EGI Community Forum 2014 [R 34]. Collaborating sites will be selected to install an application accounting repository for testing.

Accounting repository activities will continue during PY5 in the context of the JRA2 activity. The PY5 plan foresees the following tasks:

- support of new resource types as the GPGPU;
- evolution of the cloud accounting towards a production system;
- improvement of CPU, parallel jobs and storage accounting;
- improvement of the cloud accounting to cover storage accounting for transient cloud storage and data usage accounting by the virtual machines;
- adoption the OGF Usage Record v2;
- support to implement Pay-for-Use proof of concept.

3.4.1.1 Support and maintenance

Accounting repository support and maintenance will be guaranteed through the EGI core activities [R 35].

The support will be done through the EGI helpdesk about the accounting records publishing process in the production infrastructure and is provided:

- to the operators of those infrastructures that publish or need to publish usage records into the EGI central accounting databases (Resource Centres, NGIs and other integrated and peer infrastructures);
- to the operators of other depending systems.

The maintenance activity will include:

- core refactoring, bug fixing, proactive maintenance, improvement of the system;
- coordination of software maintenance activities with other technology providers that provide software for the EGI Core Infrastructure or the accounting systems deployed by integrated and peer infrastructures;
- maintenance of probes to test the functionality of the service;
- requirements gathering;
- documentation.

3.4.2 Accounting Repository Roadmap Summary

Tasks inherited from MS710	Planned completion time
Application Accounting usage record finalised	September 2014
Storage Accounting Summaries to Accounting Portal	April 2014
Publishing summaries from Accounting Repository to other sites (OSG/DGAS)	September 2014
New Tasks	**Planned completion time**
Application accounting prototype	June 2014
Cloud Accounting to production	April 2014
Migrate sites from SSM1.2 to SSM2	December 2014
Confirm Storage Accounting schema	March 2014
Storage Accounting in production	December 2014
Send MPI data to portal	April 2014
Send all accounting data (including MPI data) to portal in production using the new schema	September 2014
GPGPU accounting prototype	December 2014
Improvement of the cloud accounting to cover storage accounting for transient cloud storage and data usage accounting by the virtual machines	December 2014
Adoption the OGF Usage Record v2	December 2014
Support to implement Pay-for-Use proof of concept	December 2014

3.5 Accounting Portal

3.5.1 Accounting Portal Plan

The general direction of the Accounting Portal development is to improve the current code and implement the new features requested by the NGIs, VOs, PMB and OMB. The refactoring in the last period has improved the extendibility of the code and will be phased in production gradually. The regional portal in production in NGI_GR will be updated and deployed on other NGIs if requested. The views concerning storage, MPI and application accounting views are partly implemented in different degrees and will be completed during the next months.

The scientific disciplines development is dependent on the Operations Portal implementation.

Accounting Portal activities will continue during PY5 in the context of the JRA2 activity. The PY5 plan foresees the following tasks:

- portal extension to include GPGPU usage information

- evolutions on the visualization of cloud accounting information to include the new features introduced in the accounting repository
- evolutions on the visualization of storage accounting information
- evolutions on the visualization of parallel jobs information
- adoption the OGF Usage Record v2
- support to implement Pay-for-Use proof of concept

3.5.1.1 Support and maintenance

Accounting Portal support and maintenance will be guaranteed through the EGI core activities [R 36].

The support, done through the EGI helpdesk, will be provided:
- to users of the portal about the data displayed and the views provided.
- to the operators of other depending systems.

The maintenance activity will include:
- core refactoring, bug fixing, proactive maintenance, improvement of the system;
- coordination of software maintenance activities with other technology providers that provide software for the EGI Core Infrastructure or remote systems deployed by integrated and peer infrastructures that interoperate with the central EGI components of the system;
- maintenance of probes to test the functionality of the service;
- requirements gathering;
- documentation.

3.5.2 Accounting Portal Roadmap Summary

Tasks inherited from MS710	Planned completion time
Provisioning of Application accounting (DB implementation)	Oct 2014
Provisioning of Application accounting (View implementation)	Oct 2014
Provisioning of MPI accounting (View Implementation)	Feb 2014
XML endpoints generalization and improvement	Jun 2014
SSM implementation for CPU Accounting	Jun 2014
Scientific Disciplines VT Interface Support	Oct 2014
Scientific Disciplines VT final Implementation	Oct 2014
New Tasks	Planned completion time
Regional Portal Implantation in other NGIs	Dec 2014
Improvements Storage View	Dec 2014
Improvements Cloud View	Dec 2014

Improvements MPI View	Dec 2014
General Improvements	Dec 2014
Portal extensions to include GPGPU usage information	Dec 2014
Adoption the OGF Usage Record v2	Oct 2014
Support to implement Pay-for-Use proof of concept	Nov 2014

3.6 Service Availability Monitoring Framework

3.6.1 Service Availability Monitoring Framework plan

A general direction of the development will focus on the maintenance and bug fixing of the existing components. Work started on SAM v. 22.1 with primary aim to fix various issues identified during the deployment of SAM v. 22 and during the extended validation phase.

As SAM services operated by CERN will be discontinued as of 01 May (CERN did not participate to the bidding for providing the services after PY4), the main task for the forthcoming period is to support migration of SAM central services to a new consortium of partners (CNRS, SRCE and GRNET). This will involve developing a detailed time plan, writing technical documentation necessary for the migration of SAM central services, providing technical support to the consortium as well as organizing SAM migration meetings and workshops to follow up on the transition process and make sure it is implemented in time and within its scope. In addition, documentation will be written in order to finalize monitoring of the local NGI services.

With respect to the message brokers the plan is to have a transparent migration (one that will not affect the clients, i.e. SAM and APEL) in the upcoming months. As the new set of brokers will be built upon a newer version of the ActiveMQ software (5.8) tests are already underway to evaluate and assess whether the newer version can interoperate with the current one used in production (5.5). As long as the results of these tests are successful the new broker endpoints (two (2) that will be hosted by GRNET and SRCE respectively) will be added to the current production network by mid-March 2014 so that the removal of the current 4 endpoints can proceed until the end of April 2014. If the tests are unsuccessful then GRNET and SRCE will proceed with the provisioning of a new set of brokers that will rely upon the 5.5 version of ActiveMQ, so that the transparent removal of the currently four (4) broker endpoints in production can proceed.

Development of the SAM product will continue during PY5 in the context of the JRA2 activity. The consortium composed by CNRS, GRNET and SRCE will lead the developments. The main objective of SAM developments in PY5 is the evolution of the framework towards a more lightweight and open source project that will better address the evolving requirements of EGI for testing and benchmarking its capabilities in terms of resilience and service continuity and potentially of other interested Research Infrastructures. The work will rely on the outcome of the mini project *A new approach to Computing A/R reports* [R 26] executed during project year 4.

The PY5 plan foresees the following tasks:

- development of a new web user interface, replacing MyEGI, based on the Lavosier service
- the extension of the WebAPI delivered by [R 26] in order to support also status and metric results as well the aggregation factors
- the extension of the Sync Components in order to store also the raw data of the metric results

- the creation of a lean monitoring instance that will be supported in a easier way
- the removal of the Oracle database dependency for large scale central installations

3.6.1.1 Support and maintenance

SAM and the Message Broker network support and maintenance will be guaranteed by the CNRS, GRNET and SRCE consortium through the EGI core activities [R 37] [R 38].

Second and third level of support will be provided through the EGI helpdesk

- to SAM users and operators about SAM functionality , SAM installation, upgrade and configuration issues, MyEGI views and support to other SAM components, re-computations of monitoring results and of availability/reliability reports
- to the operators of other depending systems
- to the operators of systems that rely of the EGI Message Broker Network capability

The maintenance activity will include:

- core refactoring, bug fixing, proactive maintenance, improvement of the system
- maintenance of probes to test the functionality of the service
- integration (configuration and packaging) of new probes into SAM
- coordination of software maintenance activities with other technology providers that provide software for the EGI Core Infrastructure or remote systems deployed by integrated and peer infrastructures that interoperate with the central EGI components of the system.
- maintenance of probes to test the functionality of the service
- requirements gathering
- documentation.

3.6.2 SAM Roadmap Summary

Tasks inherited from MS710	Planned completion time
Messaging: Implementation of SAM probes failover capabilities	February 2014
New Tasks	Planned completion time
SAM to monitor services and sites not in GOCDB (RT2791)	April 2014
Support for migration of central services	April 2014
Addition of new (2) broker endpoints	February 2014
Removal of current (4) broker endpoints	April 2014
Development of a new web user interface replacing MyEGI[6]	December 2014
Extension of the WebAPI delivered by [R 26]	December 2014
The extension of the Sync Components	December 2014
Creation of a leaner monitoring instance[7]	December 2014
Removal of the Oracle database dependency	December 2014

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[6] Needed to remove the Oracle database dependency and reduce the maintenance cost.
[7] A lean monitoring instance could be supported in an easier way reducing the maintenance cost.

3.7 Metrics Portal

3.7.1 Metrics Portal plan

Currently the portal is in a stable state, further changes on metrics are dependent on any remaining evolution of the EGI project itself.

3.7.1.1 Support and maintenance

Support and maintenance will be guaranteed in best effort way.

3.7.2 Metrics Portal Roadmap Summary

Tasks inherited from MS710	Planned completion time
Manual metrics expansion and refinement Manual metrics are metrics that are introduced manually by the users, as opposed to automatic metrics, which are estimated and then validated or corrected by the users.	April 2014
Views enhancement and optimization The enhancement refers to the improvement and refinement of the presentation of the editing, reporting and charting views, their presentation on multiple devices, including several browsers and mobile versions. This includes changes to the HTML and CSS coding and templates, tabulation, layout, new fields, colour scheme, search engine ranking and corporate identity.	April 2014
New Tasks	Planned completion time
N.A.	

4 SUMMARY

This document presents the current status of the operation tools and describes how the PY4 roadmap showed in MS710 [R 1] has been implemented.

As a general consideration the operational tools is continuing the transformation process, started with the EGI-InSPIRE project, that is modifying the old Grid operations used during the EGEE projects in a more general solution, independent from the underlying technologies, applicable to the grid platform as well as to the EGI federated cloud platform, and able to serve different projects and Research Infrastructures. This is proved by the adoption of some of our tools in EUDAT [R 40] and Mapper project [R 41]. Interest in join development of these tools evolving them into open source projects is being discussed with e-Infrastructure and research infrastructure representatives.

Moreover, advanced fail over mechanisms have been introduced to make sure that the availability and reliability of the tools can be maximised.

The JRA1 activity ends in PY4, however, the operational tools development will carry on in different manners. Support and maintenance will be guaranteed by the core EGI activities funded with the EGI Council fees and NGI in-kind contributions. New developments and evolutions will be delivered by the JRA2 activity and open source projects.

The coordination of software maintenance and development activities and requirement analysis will be driven by EGI.eu also in the future in the context of the core EGI activities. This is fundamental to safeguard the EGI infrastructure operation considering the strong interconnections between the EGI.eu operational tools, described in Section 2, and the dependency of other infrastructure components on the operational tools.

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