



# EGI-InSPIRE

## OPERATIONS PORTAL ROADMAP

### EU MILESTONE: MS705

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#### Abstract

This document defines the roadmap for the Operations Portal taking into account the regionalisation of the present Operations Portal and the key operational tools, and new resource types being used on the infrastructure



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## II. DELIVERY SLIP

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## 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.

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## VI. TERMINOLOGY

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



## VII. 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.

## VIII. EXECUTIVE SUMMARY

The Operations Portal is based on the “actor’s view” principle where each actor of the community has an access to information from an operational point of view according to his role in the project such as grid operator who daily monitors the status of resources and grid services, regular grid user and VO, site or NGI/ROC managers.

Complementary to this informative goal, the portal also fosters communication between different actors, through channels like broadcast notification, and downtime notification mechanisms and has set-up procedures to address their interaction needs.

The Operations Portal is currently divided into two instances:

- The historical Portal [R1]: the **CIC Operations Portal** that provides operational information related to VO, and deals with information related to sites and Regional Organization.
- The new portal [R2]: **Operations Portal** based on the framework Symphony [R3].

The objectives for the coming year are the following:

- The achievement of the new portal and the decommission of the historical Portal
- Regular updates/ improvements on the Regional Package of the Portal
- Improvements and extended features on the Programmatic Interface
- The interoperability with GOC DB [R4]
- Provide a dashboard for the security team
- Different improvements on the existing features to improve the efficiency of the application

The different timelines are summarized in the conclusion of this document (section 5).

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## 1 INTRODUCTION

This document is the work plan of the Operations Portal for the second year.

The section 3 is dedicated to the assessment of the work plan of the first year to establish what has been achieved so far, why some objectives have been reviewed, what are the initial tasks to take into account also in the second year.

It will be completed by the new developments agreed in the JRA1 activity in section 4 and a roadmap summarizing the timelines in section 5. A process of global registration of requirements has been established within the JRA1 activity.

These requirements are reviewed following this process:

The JRA1 team periodically reviews the tickets and accepts those that can be easily implemented and don't need discussion or prioritization. If the requirements affect the roadmap it will be discussed in OTAG session and the workplan will be updated accordingly.

The part concerning new requirements (section 4 and 5.1.2) is the reflection of the workplan with the requirements registered in the beginning of May, 2011 and examined in the JRA1 or OTAG sessions.



## 2 CONTEXT

The historical CIC Portal has been built as an integration platform, allowing for strong interaction among existing tools with similar scope but also filling up gaps wherever functionality has been lacking. Moreover some features implement numerous work flows derived from procedures put in place during the EGEE project. These features came out of requirements expressed by end users or administrators of Virtual Organizations (VO), Regional Operations Centres (ROCs) or Resources Centres and Operations Coordination Centre (OCC) of EGEE.

The information on display is retrieved from several distributed static and dynamic sources – databases, Grid Information System, Web Services, etc. – and gathered within the portal. This has resulted in numerous tools that have become critical to sites like the User Tracking feature (to contact unknown users out of their DN in case of observed grid misuse for example) or the Alarm Notification feature (to subscribe to alerts upon monitoring failures). Linking this information in the portal has enabled us to display relevant and high added-value views of static and dynamic information of the production grid infrastructure.

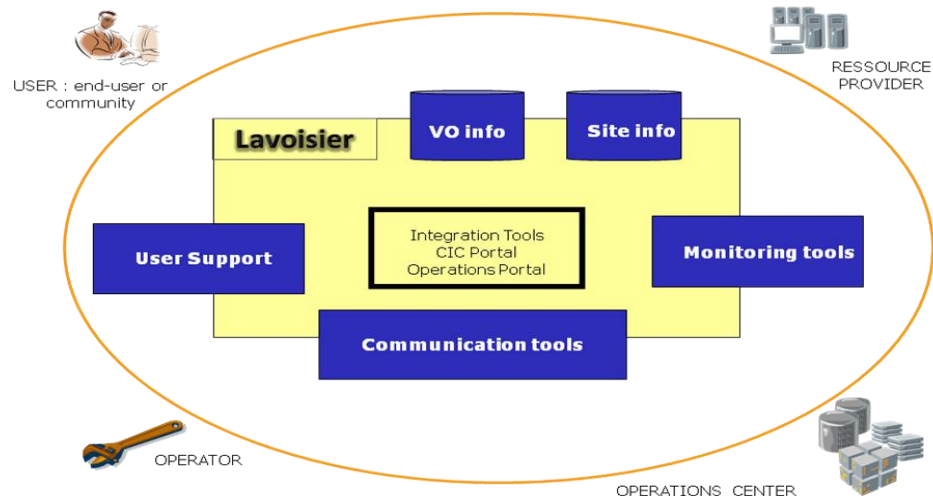
Authentication and authorization is based on user's roles associated to the user's certificate like site administrator, regional operator or VO Manager for example.

Complementary to the goal of securely processing information and workflows, the portal also fosters communication between different actors of the project, through channels such as the Broadcast and Downtime Notification mechanisms.

The architecture is the same for the both versions of the portal and is composed of three modules:

- A database – to store information related to the users or the VO
- A web module – graphical user interface– which is currently integrated into the Symfony framework
- A Data Aggregation and Unification Service named Lavoisier [R5]

## EGEE Operations Portal purpose



**Figure 1- Operations portal an integration Platform based on Lavoisier**

Lavoisier is the component used to store, consolidate and “feed” data into the web application. It provides information from various sources without the portal being directly dependent on those information sources thanks to a caching mechanism. This indeed protects the application from intermittent failures of information sources.

Since the beginning of EGI an important effort has been done to migrate from the historical CIC Portal to the Operations Portal. These developments are integrated into a new framework: Symphony.

We apply the framework approach for the new developments or the improvement of the features in the historical operations portal. The benefits we have seen until now are three-fold

- An increase in the efficiency of the Operations Portal application in terms of response time to end-user requests.
- A decrease in the time spent on software maintenance.
- An increase in the robustness of the application by developing independent modules.

**Figure 1** depicts how the two instances of the Operations Portal (CIC Operations Portal and the new Operations Portal) are integration platforms for several heterogeneous information sources. These instances rely heavily upon Lavoisier to provide information and interfaces to users –being end-users, operators, resource centres or NGI/ROC.



## 3 ASSESSMENT OF THE INITIAL WORKPLAN

### 3.1 *Amendment to the initial roadmap*

Different information and timelines were given in project milestone MS701 [R6], but the initial scheduled release had to be modified during the first project year because of various reasons, among them:

- The Validation /discussion about the VO ID card developments with the User Community Support Team(UCST) took longer than expected due to the many interaction cycles needed with the user support community which is the main user of the tool
- The time spent on the support for the Regional packages was underestimated
- New tasks and big requirements have been introduced during the year, i.e important changes on the dashboard for the Central Operators and the preliminary work for the security dashboard.

So sections 3.2, 3.3, 3.4 and 3.5 will describe the different ongoing or remaining tasks coming from the initial roadmap.

### 3.2 *Migration from CIC Portal to Operations Portal*

The first big task registered in the initial roadmap was the migration of the key features of the historical Portal to the Operations Portal in a new framework (described in Section 4 of MS701).

This task has been achieved for the broadcast tool and the VO ID card.

The validation and the discussion about the VO ID card developments with UCST took longer than expected, causing this work to last until May 2011, as well as explaining the delay in some tasks coming from the previous workplan.

The remaining features to be migrated are:

- The downtime notification system
- The User tracking Tool

Once these 2 last developments are achieved (July 2011) the decommission of the CIC Portal will be announced.

#### 3.2.1 *The Downtime notification system*

This mechanism provided is based on the "supply and demand" rule. A site manager registers a downtime (supply) and grid users request to be notified or not (demand) via a subscription through the Operations Portal.



When a site or region manager decides to register a downtime, it is done through the GOCDB web interface. The relevant person fills an electronic form and specifies which services are concerned, the time lines for the downtime (start and end dates), and the reasons for the expected downtime. This information is stored in the GOCDB databases. All downtime announcements are then collected by an asynchronous mechanism by the Operations Portal and corresponding notifications are sent to all grid users who subscribed to receive downtime notifications according to their settings.

Subscriptions are done on a voluntary basis: every registered grid user is entitled to specify his/her downtime notifications settings via email, RSS feed or Ical feeds. A given user can create, modify and delete his subscriptions. When assigned a managerial role (i.e. ROC/NGI, RC, or VO manager) of a specific entity in the infrastructure (i.e. region/country, site, VO), a grid user can create, modify and delete subscriptions for the given entity in their scope.

A subscription also consists of one or more filtering rules. You can filter your subscription per scope: region, site, node, service, VO and all combinations of these parameters.

### **3.2.2 The User tracking Tool**

The user tracking tool is a module which can contact an end-user without having their email address, through his DN certificate. Indeed, the tool queries the VOMS servers listed in the VO ID card, in agreement with the security policies, in order to collect all users email address.

This tool was initially foreseen to be integrated into the broadcast module but it has been decided to integrate it afterwards in a specific module to avoid confusing the users.

## **3.3 The regional Instance**

### **3.3.1 Architecture and synchronization**

The application is composed of:

- a web service named Lavoisier configured to handle Nagios notifications [R7]., store and providedata cache from GOCDB and GGUS [R8].and to generate metrics reports about the use of the dashboard (alarms raised, tickets handled ...)
- a PHP web application to provide a user interface based on Symfony framework;
- a database generated automatically with the web application during the installation.

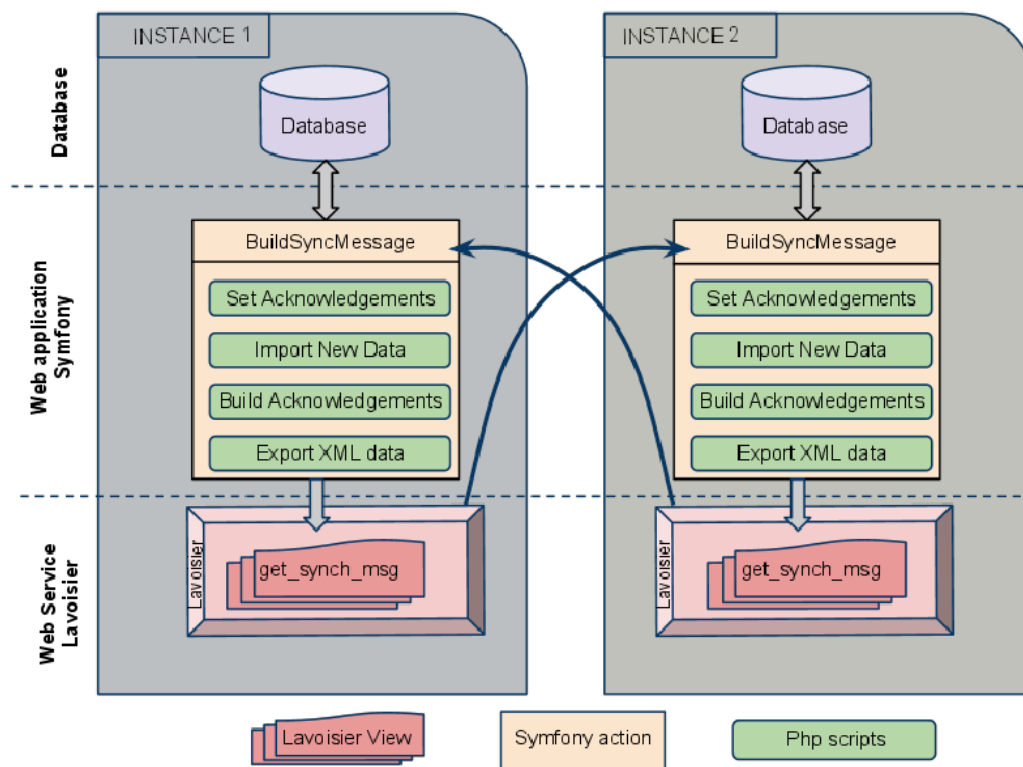
The regional instance is linked with the central instance of Lavoisier; creation, update and deletion of records are synchronized so as not to disrupt global oversight operations. Synchronisation is achieved through REST and SOAP and records are synchronized every 10 minutes by using php scripts. Any problem detected during the synchronisation is reported in a mail sent to the webmasters.

The central and the regional instances (Instances 1 and 2 on the schema below) have been built on the same model in order to behave in the same way and to be easily interoperable. All regions or NGIs are able to opt for either the central or the regional instance.

As shown on the schema (Figure 22), the architecture is exactly the same on a NGI and central instance.

The distributed components are the same, just the configuration changes:

- with PHP code in the application that permits to distinguish a regional instance from a central one
- on the Lavoisier side to filter information and to keep only data relevant to the NGI.



**Figure 2 - Synchronization process**



### 3.3.2 Status

The regional package has been deployed in production in 4 NGI:

- NGI\_CZ
- NGI\_GRNET
- NGI\_IBERGRID
- NGI\_BY

3 upgrades have been done on the package since the first version of June 2010.

The package and the documentation are available through a SVN server [R9].

### 3.3.3 Roadmap

The current work is a refactoring of the package and is focused on:

- The automatization of the generation of the package
- The SVN repository organization and the management of the old packages
- The improvement of the synchronization between the central and the regional instances.

The acknowledgements of the synchronization records have been reviewed to avoid blocking the synchronization process, the data have been also encapsulated to avoid problems with special characters.

The package including these improvements will be released in the end of May 2011.

An upgrade of the regional package will be proposed after each major release on the central Instance.

Finally, the use-cases and the different requirements considered useful for the NGIs will be discussed with the EGI Regionalisation Task Force.

## 3.4 *The standard access to information*

### 3.4.1 Description

The initial task was described as “provide a systematic standard access to all information handled by the Operations Portal. Make the information available through standard format like xml for download or through API “(Section from MS701).

To achieve this goal the architecture of the portal has been built in order to easily extend the number of data sources, and to provide standard access to information. The core of the data gathering system is the web service facility called Lavoisier. In case of known technologies new



views may be added by using an existing plug-in out of the wide-range already available, while for new providers new plug-ins have to be developed in order for the portal to be able to retrieve information. Lavoisier's flexibility allows the Operations Portal to be ready to integrate almost any kind of new information if needed.

Moreover in addition to this model a programmatic interface based on the Web service of Lavoisier has been developed. The idea is to provide the whole set of information in the Portal using standard formats.

The current interface [R10] provides information related to NGI and VO in a XML format. This solution will be extended with :

- supported query languages are XPath, XSLT, XQuery and STX.
- supported formats for query results are XML, JSON and YAMLS.
- supported communication protocols are SOAP, REST and messaging protocols (STOMP, OpenWire).

### **3.4.2 Roadmap**

In order to achieve this model a new major release of the Lavoisier system (v2.0) [R11] is foreseen to be completed in July 2011 . This work is described in the previous roadmap and described in the section 5.2 of MS701

The integration step will last from July to December and the PI will be enhanced step by step with the use of new possibilities offered in this version.

## **3.5 GOC DB Harmonization**

### **3.5.1 Description**

Another complex task required by the DoW is the integration of the Operations Portal and GOCDB under a common interoperable toolkit for Grid operations, which can be split into the following two main directions:

- Integration of a common central human interface allowing users to access both central services through a single entry point.
- Integration of interoperable back ends for distribution to NGIs as a single package if possible.

The study of different solutions has been done during the first year of the project.

And this section describes the conclusion and main lines of this study.

Such development will require effort at data representation level as well as at interface and data transfer level. Both Operation Portal and GOCDDB development teams aim at providing a common web interface to handle information coming from both tools, being transparent to the user. The preferred vision of the development teams is to have “independent tools working together” rather than “one single tool”, keeping the integration transparent to end users that should not care about how this is done in the backend. To the end users, the solution will be seen as “one single tool”.

The following guidelines should drive the implementation:

- Keep modularity – avoiding to create a bulk monolithic tool
- Allow one part of the system to be installed and operated without the other
- Reuse the legacy wherever possible (not enough resources to redo everything)
- Consider the different backends: Oracle vsmySQL
- DB schema and principles are different (use of PROM for GOCDDB [R12])

Two solutions were considered in the implementation study:

- (A) Merged front-ends and separated but interconnected back-ends. Back-ends will interact with one another on joint information through cross-querying services and VOs. This solution has the benefit to reuse legacy databases still providing a single top level interface and maintaining great modularity: the deployment of both tools will not be required. A drawback is the complex failover solutions that are needed to achieve a fault tolerant, high availability tool.
- (B) Fully merged front-ends and back-ends. This solution implies a complete redesign of the database model integrating data currently handled by both GOCDDB and CICDB (Figure 2) and the development of a new interface to this database as a single front-end. Benefits are a less complex failover strategy and an easier implementation of cross queries. Drawbacks for this solution are that the resulting tool will be more complex and hence more difficult to maintain, with less modularity, it also implies a complete redesign of the legacy.

### 3.5.2 Proposed solution and roadmap

The current situation relationship between GOCDDB and Operations Portal components is shown in Figure 3 while the proposed solution A is depicted in figure 4. At the moment of writing solution B seems to be very complex and requires a huge amount of work that is probably beyond the possibility of the GOCDDB and Operations Portal product teams, given the effort that they currently dedicate to JRA1. The solution envisioned has been RAL hosting the GOCDDB database and the Operations Portal in Lyon providing interfaces in the Symfony framework.

The work will begin in January 2012, unless higher priority requirements are approved by the OTAG.

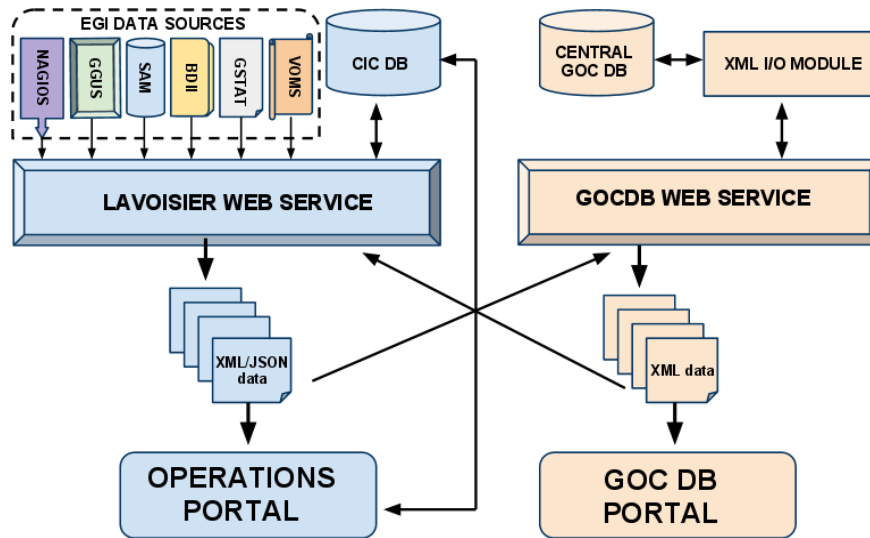


Figure 3 - Current relationship between Operations Portal and GOCDB components

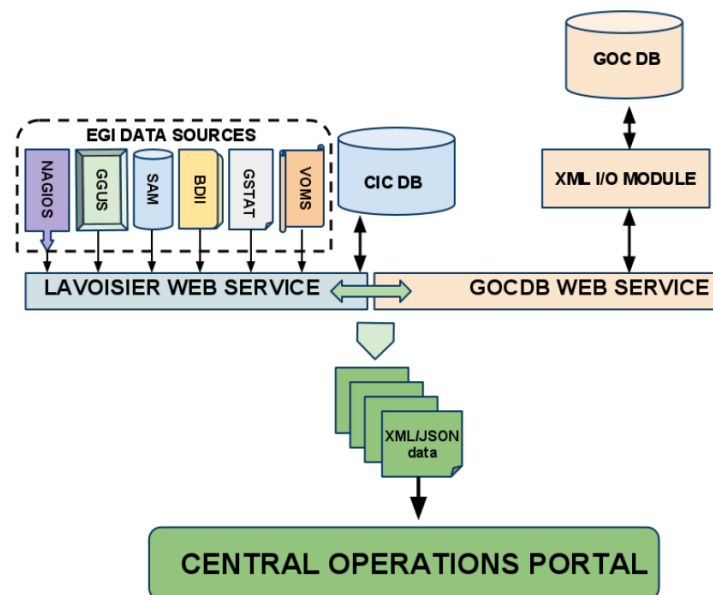


Figure 4 - Operations Portal and GOCDB harmonization envisaged solution.



## 4 NEW DEVELOPMENTS FOR THE SECOND YEAR

### 4.1 Security dashboard

#### 4.1.1 Context

The security team of EGI - CSIRT [R13] - operates several monitoring services that collect different information from the sites and provide an overview of the infrastructure in terms of operational security. Currently two services are in production: the EGI security Nagios box, launching security-related probes, and Pakiti system, evaluating the patching status of the computing resources. Other services may be deployed in the future.

These monitoring services provide their own interfaces to access results, which is obviously not suitable for routine operations. The goal of the EGI security dashboard is to aggregate data produced by the EGI security monitoring and provides ways of manipulating with the data. The dashboard will be linked to the EGI information services (namely GOC DB) and other operation tools (ticketing system) so that the EGI security people could have a single interface to view the data and handle them.

Using the security Dashboard extensions the operations people could handle security issues as part of the standard procedures (while keeping in mind the sensitivity of information communicated).

#### 4.1.2 Use-cases

Incident resolution – when an incident is detected, the EGI CSIRT tries to collect as much information as possible about the affected sites. The data involves status of security patches (current state and history), results of the common security probes as well as other incidents that appeared on the site in the past. The security dashboard should provide this information at a single place, together with an easy way of filing tickets against the sites when necessary.

Vulnerability chases – whenever the EGI CSIRT comes across a serious vulnerability that may seriously impact the infrastructure, it sends alerts to the sites about the issue. For extremely serious vulnerabilities, the EGI CSIRT asks the sites for actions within a short time-frame (usually a week). The subsequent process of following up with sites and monitoring their actual state requires a lot of manual work and is time-consuming for the operators. The security dashboard should assist in obtaining information needed (e.g., based on a template), contacting the sites (directly using the GOC DB contacts and/or via the ticketing system) and in easier handling of the tickets raised against the sites.





Report compiling – since the first “Pakiti challenge” the EGI CSIRT has seen a continuous trend of improving the responsiveness of the sites and their quality. Such achievements as well as cases where communications failed are very important to follow and present to both the sites and management/NGIs. The security dashboard should collect enough information to be able to produce such reports, long-term statistics and follow the trends.

#### 4.1.3 Basic functions of the dashboard

- Collecting results from Pakiti and Nagios
- Displaying a NGI view based on the relevant sites e.g sites with identified problems
- Transmitting results so as to prevent leakage.
- Combining the results between Nagios and Pakiti e.g which site is failing the CVE “xx” an the Nagios probe “yy”
- Providing a view of a site/NGI/EGI
- Applying proper access control.
- Filtering/sorting of the results based on defined criteria, etc.
- Dispatching alerts when needed ideally based on configurable rules
- Having operations functions – links to GOC DB, EGI RT, templates for filing RT tickets, bulk manipulations with them, etc.
- Having report functions – generation on demand and automatically on regular basis
- Computing security metrics based on the numbers gathered

#### 4.1.4 Roadmap

- Define/adapt/implement/ the XML (CSV,...) format of the reports for Nagios and Pakiti and



make them available for Dashboard

- Define and implement the mechanism of passing this information to the Dashboard.
- Extend the dashboard with the capability of displaying the information in the site view
- Make sure proper authorization is applied (based on GOC DB and EGI SSO); make sure that EGI CSIRT/operations people can access all the data collected.
- Create Tickets into RT system with a specific template

A first prototype will be delivered in July 2011 with all features except the creation of ticket into RT system. This feature will be integrated into the official release in October 2011.

After the development of the prototype a discussion will take place between CSIRT team and the operators to be sure that the solution fits the needs. The definitive architecture will be designed with this feedback.

## **4.2 Operations Dashboard**

The dashboard is a tool designed to follow and track problems at sites.

Different parts of the Operations dashboard will be reviewed to increase the efficiency and the standardization:

- Replace the information of VO specific tests coming from the old Programmatic Interface of SAM [R14] by the new one [R15] - June 2011.
- The different notifications coming from Nagios are filtered when they are acknowledged by the Web Service Lavoisier. This mechanism permits to filter the test instances of Nagios, the metrics which are not considered as critical. With the growing number of use cases and exceptions to consider in that filter the complexity of it has also increased and the efficiency of the Web Service has decreased. One solution is to move this filter into the Web application itself and use it asynchronously (every 2 minutes) to increase the efficiency of the Web Service – July 2011.
- The solution used to create tickets since the beginning is still GGUS. We will extend this solution to x-GUS [R16] and to RT system [R17] – August 2011.

## **4.3 VO ID Cards**

The VO ID cards are the static repository for VOs with information such as:

- The VO contact points (VO managers, VO User mailing list, VO representatives, etc.)
- The VO global information (enrolment URL, status, discipline, etc.)
- The Acceptable User Policy of the VO



- The VO's Core Services
- The VOMS information (Groups and roles, certificate details, etc.)
- Any other specified requirements (CPU needed, RAM needed, etc.)

In the first year one big challenge was to adapt this module to EGI and follow the needs of the UCST, which is in charge of the validation of the registration and the updates of the VO ID cards.

In the end the solution chosen was to split the application into 2 modules:

- One for the regular users (VO Managers , Vo Users ) to consult or update information about VO
- One in restricted access for advanced users like UCST to validate the creation or the update of VO ID Cards.

This last module will be improved in the coming year:

- One section will be developed to follow the VO ID cards registered in the past which are not respecting the current rules of registration (security contacts, Home Page correctly registered, AUP not up-to-date). This section will summarize all these problems and UCST will be able to contact the VO Managers to ask him to update the corresponding VO ID Card. – August 2011
- A system of yearly renewal will be put in place with different reminders to ask regularly VO Managers to update information in their Vo ID card.- November 2011

## 5 ROADMAP SUMMARY

### 5.1.1 Tasks inherited from the first year.

Features	Timeline
Downtime Notification System	May 2010
User Tracking	June 2011
Decommission of historical Portal	July 2011
Release of Lavoisier 2.0	July 2011
Integration of Lavoisier 2.0	July –December 2011
Enhancements of Lavoisier Programmatic Interface	July-December 2011
Harmonisation of GOC DB and Operations Portal	January 2012 => May 2012

### 5.1.2 New tasks

Features	Timeline
Replacement of the VO specific tests	June 2011
Security dashboard : prototype	July 2011
Improvements on the filter used in the dashboard	July 2011
Integration of x-GUS and RT system	August 2011
Section with a summary of VOs not respecting the rules	August 2011
Security dashboard : official release	October 2011
Yearly renewal of VO ID cards	November 2011



### 5.1.3 Regional package

Features	Timeline
Automation of the package generation	May 2011
Replacement of the VO specific tests	August 2011
Improvements on the filter used in the dashboard	August 2011
Integration of x-GUS and RT system	October 2011
Integration of Lavoisier 2.0 in the package	December 2011



## 6 CONCLUSION

After different modifications in the roadmap of migration under a new framework is almost achieved and the decommission of the historical portal is close now and we are almost ready to have only one EGI Operations Portal as central access point to most of the information related to operation.

This re-engineering will be enforced by the integration of the new version of Lavoisier that will also make it possible to enhance the information and the formats provided with the Programmatic Interface.

In parallel with this long work we will start an important development with the security dashboard. This development will also help us with the integration of new helpdesks: x-GUS and RT.

And the list of tasks is completed with different improvements on the dashboard and the VO ID cards : filtering improvements, Vo Administration enhancements.

We will finish the year with the implementation of the interoperability with GOC DB.

This work plan is corresponding to the needs expressed by the different actors of the project at one time but it could be affected by different factors: new developments, developments longer than expected. All these aspects will be discussed within JRA1 and OTAG to prioritize the list of developments and try to respect as much as possible the initial roadmap.

## 7 REFERENCES

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R 2	Operations Portal New Home Page : <a href="https://operations-portal.egi.eu">https://operations-portal.egi.eu</a>
R 3	Symfony home page: <a href="http://www.symfony-project.org/">http://www.symfony-project.org/</a>
R 4	GOCD Home Page: <a href="https://goc.egi.eu">https://goc.egi.eu</a>
R 5	Lavoisier Home page : <a href="http://grid.in2p3.fr/lavoisier">http://grid.in2p3.fr/lavoisier</a>
R 6	MS701 – Operations Portal Workplan <a href="https://documents.egi.eu/public/document/39">https://documents.egi.eu/public/document/39</a>
R 7	Nagios <a href="http://nagios.org">http://nagios.org</a>
R 8	GGUS <a href="https://ggus.eu/pages/home.php">https://ggus.eu/pages/home.php</a>
R 9	SVN repository for Operations Portal Regional Package : <a href="https://cvs.in2p3.fr/operations-portal/regional/trunk/">https://cvs.in2p3.fr/operations-portal/regional/trunk/</a>
R 10	Lavoisier Programmatic Interface <a href="http://cclavoisier02.in2p3.fr:9000/LavoisierService/view/PI">http://cclavoisier02.in2p3.fr:9000/LavoisierService/view/PI</a>
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R 12	PROM - Pseudo-Relational Object Model <a href="https://wiki.egi.eu/wiki/GOCD/PROM">https://wiki.egi.eu/wiki/GOCD/PROM</a>
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R 14	Old SAM Programmatic Interface Documentation: <a href="https://twiki.cern.ch/twiki/bin/view/LCG/SamDbQuery">https://twiki.cern.ch/twiki/bin/view/LCG/SamDbQuery</a>
R 15	New SAM Programmatic Interface: <a href="http://grid-monitoring.cern.ch/myegi/sam-pi/">http://grid-monitoring.cern.ch/myegi/sam-pi/</a>
R 16	x-GUS Helpdesk <a href="http://xgus.scc.kit.edu/86.php">http://xgus.scc.kit.edu/86.php</a>
R 17	RT system <a href="https://rt.egi.eu/rt/">https://rt.egi.eu/rt/</a>