EELA-2

INFRASTRUCTURE ASSESSMENT REPORT

EU DELIVERABLE: DSA1.4

Document Full name	**EELA-2-DSA1.4-v1.4**
Date	**04/04/2009**
Activity	**SA1**
Lead Partner	**UFRJ**
Document status	**APPROVED**
Classification Attribute	**PU (PUBLIC)**
Document link	http://documents.eu-eela.eu

Abstract: The goal of DSA1.4 "Infrastructure Assessment Report" is to describe the status of the organisation put in place to manage the production e-infrastructure deployed in the context of the EELA-2 Project and to provide metrics to help evaluating quality and functionality of the infrastructure available at M12.

Delivery Slip

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From				
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Document Log

Issue	Date	Comment	Author
0-0	23/03/09	First draft	Alexandre Duarte
0-1	27/03/09	Internal Review	Alexandre Duarte, Diego Carvalho, Ramon Diacovo
0-2	30/03/2009	Some comments and corrections throughout the whole document	Roberto Barbera
0-3	30/03/2009	Incorporation of Roberto's comments	Ramon Diacovo, Diego Carvalho
0-4	30/03/2009	Minor corrections	Ramon Diacovo, Diego Carvalho
1-4	04/04/2009	Final corrections and approval	Bernard Marechal

Document Change Record

Issue	Item	Reason for Change

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1.1. PURPOSE OF THE DOCUMENT

The goal of DSA1.4 "Infrastructure Assessment Report" is to describe the status of the organisation put in place to manage the production e-infrastructure deployed in the context of the EELA-2 Project and to provide metrics to help evaluating quality and functionality of the infrastructure available at M12.

1.2. DOCUMENT ORGANISATION

The executive summary in Section 2 is an overview of the first year achievements of the SA1 activity of the EELA-2 project, describing the structures and procedures and also presenting the main issues arisen so far.

Section 3 describes the SA1 Activity and its effectiveness. This description is divided into two main parts. Initially, there is a description of the internal organisation of the SA1 Activity, presenting the Operator Teams and their operational duties, focused on maintaining the infrastructure services running smoothly and on providing first level support to users, application developers and site administrators. Later, there is a description of the SA1 participation in the working groups crossing the borders of the Activity domain.

Section 4 presents the operation assets put in place to support the infrastructure functionalities. It describes the operations tools, procedures and bodies deployed within the project. Section 5 describes the status of the infrastructure currently deployed at M12 and present metrics to show its evolution during the first year of the project. This section describes also the infrastructure availability from the EELA-2 Virtual Organisations (VO) point of view. Further details about the operation and status of the infrastructure are available in the quarterly reports provided by the activity.

Finally, Section 6 presents the main conclusions in terms of achievements and pending issues.

1.3. APPLICATION AREA

This document is intended for readers both internal and external to the project, with its aim being to summarise achievements and issues in managing production operations and to reference all established procedures.

1.4. DOCUMENT AMENDMENT PROCEDURE

Any Project Member can request amendments to this document via the Project Coordinator or the Project Office.

1.5. TERMINOLOGY

Glossary

BDII	Berkley Database Information Index
CIC	Core Information Centre

DoW	Description of Work
EELA	E-infrastructure Shared Between Europe and Latin America
EELA-2	E-Science Grid Facility for Europe and Latin America
EELA-CS-LA	Latin America Core Service Centre
EGEE	Enabling Grid for E-Science
EOC	EELA-2 Operations Centre
EOCDB	EELA-2 Operations Centre Database
GIIS	Grid Information Index System
JRA1	Joint Research Activity 1
LA-PKI	Latin American Public Key Infrastructure
NA1	Network Activity 1
NA3	Network Activity 3
OOD	Operator-On-Duty
RC	Resource Centre
SA1	Service Activity 1
SAM	Service Availability Monitoring
VO	Virtual Organisation
VOMS	Virtual Organisation Management System
VPN	Virtual Privative Network
WBS	Work breakdown structure

2. EXECUTIVE SUMMARY

This document starts by presenting the SA1 organisation through its objectives, functional components and three main bodies, the EOC (EELA-2 Operations Centre), the Production Infrastructure and the Certification Infrastructure.

The EOC, responsible for the central coordination between all activities, ensures that proper tools and communication channels are deployed according to SA1 needs. The Production Infrastructure only operates the Core Services in Europe and in Latin America and works with sites that have demonstrated to have an adequate maturity level in par with what is expected from a production environment. The Certification Infrastructure focuses on the induction of new Resource Centres. Operating a controlled environment, local site administrators can learn operational procedures without the burden of keeping a production level service available at all times.

The report moves then to describing the SA1 work breakdown structure (WBS) and the necessary human effort to accomplish its objectives (54 persons).

During the reporting period, SA1 got involved in several collaborations, interacting with other project activities in order to fulfil the project objectives. The most notable example of such interactions is the so-called Crash Programme. By November 2008, EELA-2 was facing a problematic scenario: few Resource Centres (RC) composed the production infrastructure, because even sites that were a part of the first phase of EELA (Testbed) had not configured the new Virtual Organisation (VO) yet. As for the usage, very few applications were submitting jobs to this new infrastructure, being mainly the High Energy Physics (HEP) ones. The Project Management decided then to implement the Crash Programme. SA1 took part on it by gathering a small group, composed by SA1 management, Core Services and some RC administrators. It was decided that this group would handle the infrastructure operations until 12 RCs were available on EELA-2. The Crash Programme surpassed its goals, integrating 20 sites into the new infrastructure. After that, the knowledge gained from this period was used to revise the Operator-On-Duty (OOD) training[1], what was done at Bogota in February 2009. Then, the OOD teams took back the responsibility of operating the infrastructure.

The document assesses the current status of infrastructure with graphs containing the number of CPUs and executed jobs, for example. It should be noticed that every site supports the EELA-2 production VO and, according to institutions' interests, may support other VOs, such as LHCb, Alice, CMS and Biomed. The entire infrastructure amounts to over 5,800 cores, from which approximately 18% of them are exclusively dedicated to the EELA-2 production VO.

A lower bound analysis showed that at least 980,000 jobs were executed in the EELA-2 infrastructure (accounting jobs ran on both Production and Testbed infrastructures) in the first 12 months of the project. This results on an average of more than 80,000 jobs per month, what surpassed all initial expectations.

[1] SA1 Technical Meeting - http://indico.eu-eela.eu/conferenceDisplay.py?confId=187

3. SA1 ORGANISATION

The EELA-2 work plan is split into activities[2]. Amongst them, the Grid Infrastructure Service Activity (SA1) is in charge of the operation of a production quality Grid empowered infrastructure, which makes computing and storage resources from partners across the Latin American and European areas accessible to EELA-2 e-Science communities. Moreover, this activity consolidates the prospective work done by the previous EELA project, undertaken in both geographical areas, also fostering the creation of basic organisational structures, protocols and procedures required for a long-term operation of an interoperable infrastructure in Europe and Latin America.

3.1. SA1 OBJECTIVES

The complexity of the long-term operation of this infrastructure imposed a careful design of its organisational structure by means of its objectives that are:

- **Grid Management and Coordination**: to coordinate the fulfilment of the project objectives by every SA1 task; to manage the relationships with resource centres, core service providers, network, research activities and communities;
- **Deployment of Ancillary Services**: to support and complement grid related services, supporting the management of the activity and its daily operations;
- **Knowledge Consolidation**: to consolidate knowledge through operations protocols, cookbooks and any other specific documents needed for the long-term operation of this grid empowered infrastructure;
- **Latin America Public Key Infrastructure (LA-PKI) and Security Coordination**: to coordinate and support the continuity of the LA-PKI and the handling of security issues through an incident response team, according to well defined policies and protocols;
- **Core Infrastructure Services**: to deploy, support and maintain a grid core service infrastructure by means of a defined set of essential services, such as information services, workload management systems, file catalogues, logging and bookkeeping systems, etc;
- **Virtual Organisation Operation**: to operate virtual organisation framework services for the communities participating in the project;
- **Monitoring and Accounting Operation**: to monitor the operational state of the grid infrastructure and its performance, through proactive procedures and protocols, notifying all agents of any operational issue;
- **Resource Centre and User Support**: to diagnose and correct grid problems related both to resource centres and users; to build a comprehensive knowledge database to be used as a reference guide for any user or newcomer in the future;
- **Grid Deployment and Induction**: to deploy, provide assistance and certificate new resource centres, providing the necessary help to bring them to a level of maturity required for a production infrastructure;
- **Middleware and Application Deployment**: to deploy and validate new or customised middleware offerings from JRA1 and community applications by NA3 on a controlled environment.

[2] EELA-2 Description of Work, available upon request: mb@eu-eela.eu.

3.2. SA1 FUNCTIONAL COMPONENTS

Figure 1 depicts the main functional components needed to achieve the objectives stated above. This division is based on the experience learned from EELA and other European projects, such as EGEE.

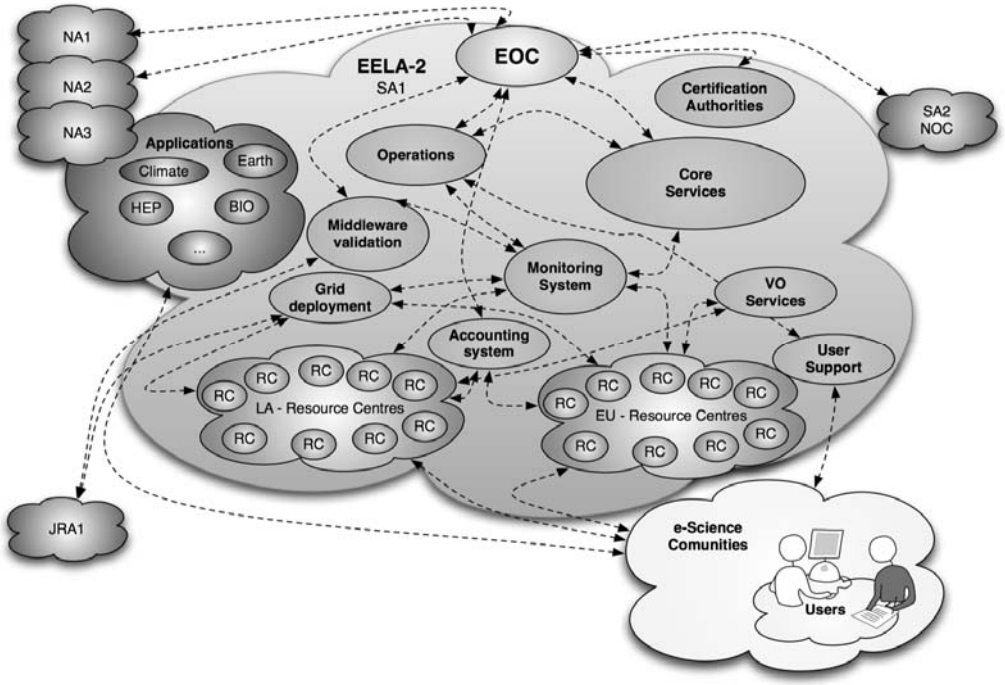


Figure 1: SA1 Operational Structure

The list of SA1 components includes:

- EOC (EELA-2 Operations Centre) – to manage and administer the EELA-2 grid;
- Operations – to carry on the resource centres and users tasks (such as help-desk);
- Public grid infrastructure co-ordination – to co-ordinate the operations of Latin American Certification Authorities and the international accreditation bodies;
- Grid deployment – to promote the integration of new resource centres and to carry on resource centres under certification procedure.
- Middleware validation – to certify the correctness of new middleware versions or customizations;
- User support – to provide support to communities;
- VO services – to provide special virtual organisation services;
- Accounting subsystem – to account for resource usage;
- Core services – information systems, workload management systems, etc;
- Monitoring subsystem – to monitor the state and the performance of the grid;
- Documentation – to facilitate the knowledge consolidation.

Looking from the highest possible level of abstraction, SA1 was designed to treat EELA-2 four basic demands by diverse and adequate means:

1. All operation-related activities must have strong coordination through a centralised management unit, so that all efforts are spent on the same direction; a coherent and complete documentation set must be produced to serve as legacy after the end of the project so the infrastructure is able to sustain itself properly;
2. Users need to have access to a stable and mature infrastructure so they can concentrate on performing research and not on circumventing instability problems derived from immature or poorly managed resources;
3. New resource integrators must have a place to get acquainted with the technology and absorb the techniques necessary to bring their resource centre to a maturity level that is comparable to the well-established sites before being accept for production use;
4. New middleware and application offerings must also be well tested before being widely deployed to every site.

These four basic demands are directly mapped to the three main SA1 bodies[3]: The EOC (EELA-2 Operations Centre), the Production Infrastructure and the Certification Infrastructure.

The EOC[4] is responsible for the central coordination between all activities, ensuring that proper tools and communication channels are deployed according to SA1 needs, and to serve as the gathering and quality assurance point for all documentation artefacts produced by the Activity.

The Production Infrastructure only operates the Core Services in Europe and in Latin America, and work with sites that have demonstrated to have an adequate maturity level in par with what is expected from a production environment. Moreover, the performance of the Production Infrastructure is tracked by teams of "operators on duty", which are the seeds for the creation of future regional operations centres in LA, able to interoperate with worldwide initiatives. This body also maintains the virtual organisation services.

The Certification Infrastructure focuses on the induction of new Resource Centres. Operating a controlled environment, local site administrators can learn operational procedures without the burden of keeping a production level service available at all times. This controlled environment is based on the use of pre-configured middleware deployment kits, as the INFN distribution[5]. Once the resource centres reach the adequate maturity level, they are taken into the Grid Production infrastructure, using a full set of the deployed middleware.

Giving that EELA-2 is intended to be a general-purpose e-Infrastructure where every integrated resource centre supports the EELA-2 VOs[6], a fair share (first come, first served) allocation of computing resources was implemented by the underlying middleware and by operations policies. However, the SA1 team has at its disposal two mechanisms to overcome shortage conditions.

The first mechanism uses the concept of "in reserve" resources, where a percentage of all available computational resources are engaged into the execution queues when a special condition arises: resource centre failure, network failure, computing resource shortage, etc. The second mechanism is to

[3] D. Carvalho, et al. DSA1.2 - Activity Execution Plan Grid Infrastructure Service Activity Deliverable. EELA-2 Consortium, 2008. Available at: http://documents.eu-eela.org/record/1024/files/.

[4] EELA-2 Operations Centre website. Retrieved January 20th 2009, from http://eoc.eu-eela.eu.

[5] http://igrelease.forge.cnaf.infn.it/doku.php?id=doc:guides:start

[6] B. M. Marechal, et al. DNA1.2 – Acceptable Use Policy Report. EELA-2 Consortium, 2008. Available at: http://documents.eu-eela.org/record/1016/files/.

put in place Data Challenges where a pre-allocation of resource centres and specific resources is made when an application envisages using more than a certain percentage of the total amount of resources.

3.3. SA1 STRUCTURE

Figure 2 depicts the work breakdown structure (WBS) of SA1.

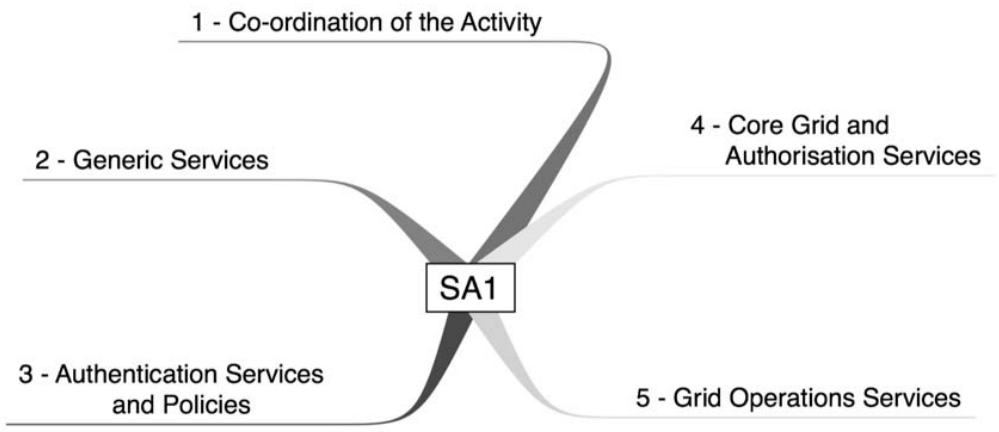


Figure 2: SA1 Work Breakdown Structure

Five tasks compose the Activity and they map the components presented on the previous section, as follows. TSA1.1 - Co-ordination of the Activity, TSA1.2 - Generic Services, TSA1.3 - Authentication Services and Policies, TSA1.4 - Core Grid and Authorisation Services, TSA1.5 - Grid Operations Services. The three high level bodies presented above can be mapped to SA1 Tasks as follows: the EELA-2 Operations Centre is under direct supervision of Tasks TSA1.1, TSA1.3, TSA1.4 and TSA1.5; the Production and Certification Infrastructures are under direct supervision of Tasks TSA1.4 and TSA1.5.

The next sections present each task and its components, providing an overview of each SA1 action.

3.3.1. TSA1.1 – Co-ordination of the Activity

The purpose of the Co-ordination Activity Task is to take care of all aspects related to the administration of SA1, including all necessary effort related to the inter-task co-ordination and the liaison with the other activities of the project.

Amongst other daily activities, such as co-ordination, infrastructure assessment and monitoring the performance of the activity, the SA1 management participates in standardisation bodies and related committees in order to maximise the actual interoperability of the infrastructure on all levels. Furthermore, the SA1 management directly works on SA1 dissemination efforts related to the adhesion and induction of new resource centres. Moreover, this task organises regular meetings in order to evaluate the maturity and quality level of the infrastructure.

3.3.2. TSA1.2 – Generic Services

The purpose of the Generic Services Task is to provide support ancillary services i.e. not directly related to the grid itself, to the other activity tasks, helping to ensure proper coordination and management between the different tasks.

Amongst the services deployed by this activity, one can cite:

- A document, source code and software repository, to collect everything on a central point;
- A Wiki, to foster collaboration between activity participants;
- The EELA-2 Operations Centre website and the operations dashboard;
- EELA-2 Operations database and BDII configurations[7];
- The SA1 Mailing lists;
- The Ticket Support System.

3.3.3. TSA1.3 – Authentication Services and Policies

The purpose of the Authentication Services and Policies Task is to take care of all aspects related to the management of Security related services within SA1. This includes the management of the Latin America Public Key Infrastructure deployed by EELA, and of security related issues[8].

3.3.4. TSA1.4 – Core Grid and Authorisation Services

The purpose of the Core Grid and Authorisation Services Task is to take care of all aspects of the production services that are not directly deployed on partners that commit resources to the project. These include the operation and support of the essential core grid services, VO specific services, the accounting and the monitoring subsystems, both from managerial and operational points of view. This task deploys and operates services for two different environments, serving different needs:

- A Production environment, where mature, already ported and validated applications can be used by their respective e-Science communities on production runs in a high-quality environment;
- A Certification environment where new resources committed by partners are tested to ensure they are ready to be integrated with the production quality environment.

[7]EELA-2 Operations Centre Grid Database site. Retrieved January 20th, 2009, from: http://eu-eela.eu/eocdb

[8]D. Carvalho, et al. DSA1.1 – New Certification Authority Selection report. EELA-2 Consortium, 2008. Available at http://documents.eu-eela.org/record/1019/files/

In order to achieve a production-level status, the Core Grid Services are replicated in two Core Service Centres (CSC), one in Latin America and one in Europe. Services deployed on these centres include:

- Information System Servers;
- Workload Management Systems;
- Logging and Bookkeeping servers;
- Logical File catalogues and metadata catalogues;
- File Transfer Services;
- VO-related Services.

3.3.5. TSA1.5 – Grid Operations Service

The purpose of the Grid Operations Service Task is to take care of the monitoring and administration support of computing and storage resources deployed locally on partners that commit resources to the project, in order to minimise downtime and maximise availability of resources to end users.

3.4. HUMAN EFFORT

Table 1 depicts the human effort available for SA1 on the current reporting period.

Table 1: SA1 Human effort

Name	***Role***	***Institution***	***Type of Contribution***
Diego Carvalho	SA1 Manager TSA1.1 Task Leader TSA1.4 Task Leader	CEFET-RJ	Unfunded
Alexandre Duarte	SA1 Deputy Manager TSA1.5 Task Leader	UFCG	Funded
Ramon Diacovo	TSA1.2 Task Leader	CEFET-RJ/UFRJ	Funded
Vinod Rebello	TSA1.3 Task Leader	UFF	Unfunded
Jacques Alves da Silva	CA Manager	UFF	Funded
Daniel Marques	Security Officer ICPEDU liaison	UFF	Unfunded
Carolina Cunha	Grid SOC Coordinator	UFF	Funded
Eduardo Ramos	Grid SOC Team	UFF	Funded
Sean Crammond	Grid SOC Team	UFF	Funded
Manuel Cotallo	Core Services Manager	CETA-CIEMAT	Funded
Raul Priego	Core Services Manager	CETA-CIEMAT	Funded
Bruno Rodrigues Silva	Core Services Manager	UFRJ	Funded
Frederico de Oliveira	Core Services Manager Site Administrator	UFRJ	Parc. Funded
Gilberto Diaz	Operator on Duty	ULA	Funded

	Site Administrator		
Daniel Stevens	Operator on Duty	UFRJ	Funded
Daniel Burbano	Operator on Duty Site Administrator	UNIANDES	Funded
Michael Perez	Operator on Duty Site Administrator	UNIANDES	Funded
Tomás Soares	Operator on Duty Site Administrator	UFCG	Funded
Ruben Diez	Site Administrator	CESGA	Unfunded
Rolando Navarro	Site Administrator	CIP	Unfunded
Esther Montes	Site Administrator	CIEMAT	Unfunded
Antonio J. Rubio	Site Administrator	CIEMAT	Unfunded
Henry Garcia	Site Administrator	CUBAENERGIA	Unfunded
Andres Barbieri	Site Administrator	IFLP/UNLP-CONICET	Unfunded
Marcos Antonio Gutierrez	Site Administrator	INCOR	Unfunded
Marcos Yamaguti	Site Administrator	INCOR	Unfunded
Giuseppe Platania	Site Administrator	INFN-Catania	Unfunded
Antonio Roberto Mury	Site Administrator	LNCC	Unfunded
Tadeu Gomes	Site Administrator	LNCC	Unfunded
Francisco Eijó	Site Administrator	LSC/UBA	Unfunded
Oscar Barriga	Site Administrator	PUCP	Unfunded
Richard Miguel	Site Administrator	SENAMHI	Unfunded
Rogério Iope	Site Administrator	UNESP	Unfunded
Luís Alves	Site Administrator	UAVEIRO	Unfunded
Rui Ramos	Site Administrator	UPORTO	Unfunded
Valvanuz Quiruelas	Site Administrator	UC	Unfunded
Daniel Lombraña	Site Administrator	UEX	Unfunded
Rafael Silva	Site Administrator	UFCG	Unfunded
Gustavo Miranda Teixeira	Site Administrator	UFJF	Unfunded
Ricardo Campos	Site Administrator	UFJF	Unfunded
Erick Meneses	Site Administrator	UIS	Unfunded
Denise Stringhini	Site Administrator	UMACKENZIE	Unfunded
Romualdo Zayas-Lagunas	Site Administrator	UNAM-CCG	Unfunded
Eduardo Murieta	Site Administrator	UNAM-IBT	Unfunded
Luciano Diaz	Site Administrator	UNAM-ICN	Unfunded
Tulio Silva	Site Administrator	UNB	Unfunded
Danilo Riccken	Site Administrator	UNB	Unfunded
Andres Holguin	Site Administrator	UNIANDES	Unfunded

Marcus Carneiro	Site Administrator	UNILASALLE	Unfunded
Miguel Caballer	Site Administrator	UPV	Unfunded
Jesus de Oliveira	Site Administrator	USB	Unfunded
Cesar Porras	Site Administrator	USMP	Unfunded
Yuri Ivanov	Site Administrator	UTFSM	Unfunded
Susana Arias	Site Administrator	UTPL	Unfunded

3.5. JOINT WORKING GROUPS

3.5.1. SA1 - NA3: Crash Programme

By November 2008, EELA-2 was facing a problematic scenario: few RCs composed the production infrastructure, because even sites that were a part of the first phase of EELA (testbed) had not configured the new VO yet. As for the usage, very few applications were submitting jobs to this new infrastructure, most of them being mainly HEP ones. The Project Management then decided to implement the Crash Programme. SA1 took part on it by gathering a small group, composed by SA1 management, Core Services and some RC administrators. It was decided that this group would handle the infrastructure operations until 12 RCs were available on EELA-2.

The Crash Programme surpassed its goals, integrating 20 sites into the new infrastructure and contributing to the impressive number of about 5,800 CPU cores currently integrated and at the disposal of EELA-2 users. After that, the knowledge gained from this period was used to revise the OOD training, what was done at Bogota in February 2009. Then, the OOD team took back the responsibility of operating the infrastructure.

SA1 second Crash Programme target was to investigate users' issues on the use of the infrastructure. NA3 and SA1 decided to sequentially pick some applications to "babysit", greatly improving and speeding up their gridification processes, as described in DNA3.4[9].

3.5.2. SA1 - CESGA: Accounting

Accounting deployment for EELA-2 is ongoing. Our schedule aims to have an accounting portal ready by May 2009 but a preliminary version is already running. This effort is being made in conjunction with CESGA - Spain. EELA-2 is going to profit from the EGEE existing structure. Meanwhile, it is possible to roughly estimate the infrastructure usage per application based on a tool developed by NA3 in conjunction with SA1. By monitoring Proxies creation, information on which users are engaging on the infrastructure usage becomes available.

3.5.3. SA1 - CCIN2P3: CIC Portal

SA1 and CCIN2P3 are cooperating on an effort to deploy an EELA-2 instance of the CIC portal[10], which will provide a comprehensive dashboard, integrating the EELA-2 Operation Tools, described in the next section, by August 2009.

[9] http://documents.eu-eela.org/record/1271/files/
[10] http://cic.in2p3.fr/

4. INFRASTRUCTURE OPERATIONS

The EELA-2 project is operating a production quality grid infrastructure, which provides computing and storage resources, from selected partners across the Latin American and European areas, accessible to several e-Science communities. Moreover, this infrastructure consolidates the prospective work done by the previous EELA project undertaken in both areas, also fostering the creation of basic organisational structures, protocols and procedures required for the long-term operation of an European-Latin American interoperable infrastructure.

This section presents the operation tools already deployed and being used to keep the infrastructure running within the expected levels of availability and summarises the operation procedures conceived and adopted in the EELA-2 project. It also describes the role of the Operator-on-Duty teams in keeping the infrastructure right on rail.

4.1. MONITORING AND OPERATION TOOLS

Monitoring and operation tools are mandatory in a grid environment where the responsibility for keeping the infrastructure running is shared amongst several sites spanning multiple time zones across several institutional domains. Moreover, they provide the various statistics on job execution characteristics, which are the basic input data to evaluate the efficiency and performance of the infrastructure in particular and of the project in general.

The driving idea of the deployment of these tools is to use, whenever possible, the tools already provided by other projects and to adapt them if/when necessary. This section describes the monitoring and operation tools currently used by EELA-2 resource centre administrators and operations teams for finding, diagnosing and dealing with problems in the infrastructure.

4.1.1. Service Availability Monitoring – SAM

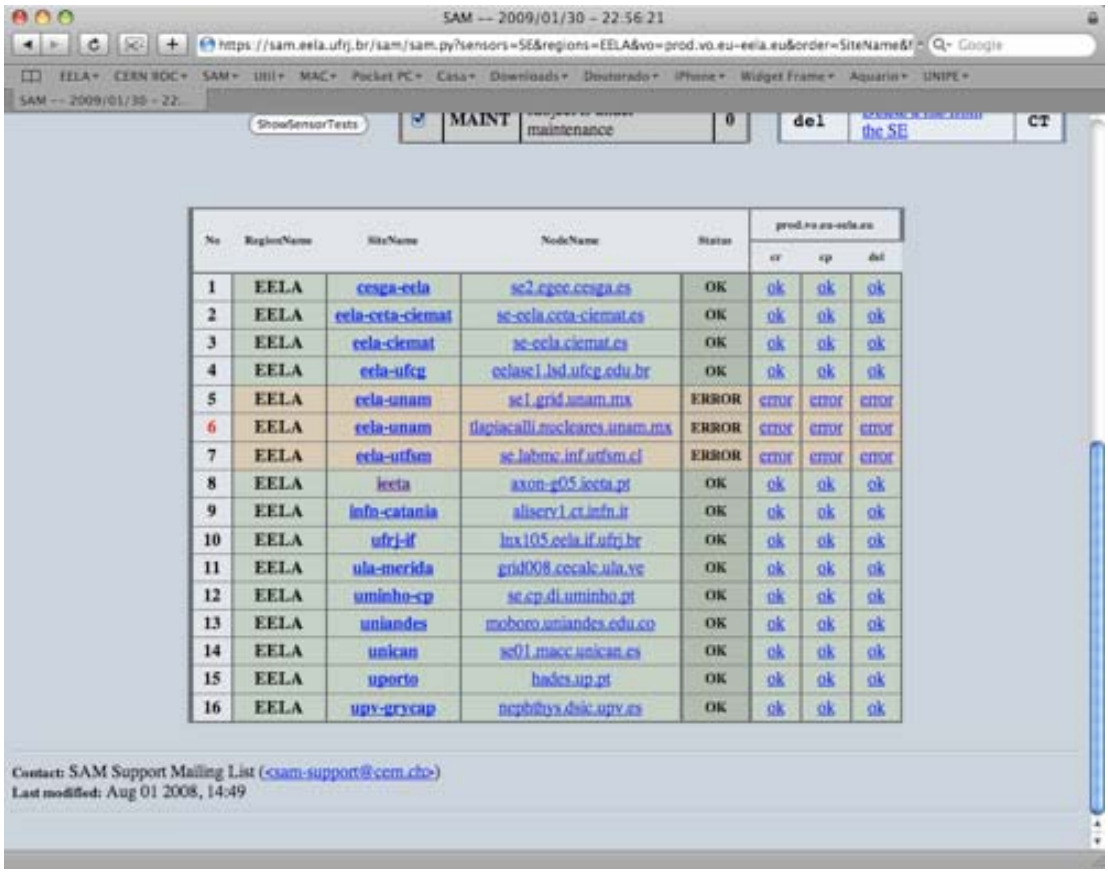
SAM[11] is a framework that uses acceptance-like tests to help diagnose failures on the grid. This framework deals with the grid services as single components that should produce an expected output to a pre-defined input. For example, to monitor a Computing Element SAM submits some grid jobs to the CE, waits for the end of the execution and then compares the results of the test execution with the results obtained from a previously correct execution.

The current SAM version is able to test most of the gLite Grid Services, including Computing Elements, Storage Elements, File Catalogues, File Transfer Services and Workload Management Systems.

It is the main monitoring tool used in EELA-2 because it provides a user level view of the infrastructure, helping to detect problems that can actually happen when the users try to use the infrastructure.

Figure 3 shows SAM web interface with the test results for all Storage Elements in the EELA-2 infrastructure. Selecting any of the error test results the site administrator receives detailed information about the problem and can use this information to fix it.

[11] https://sam.eela.ufrj.br



No	RegionName	SiteName	NodeName	Status	prod.vo.eu-eela.eu		
					cr	cp	del
1	EELA	cesga-eela	se2.egee.cesga.es	OK	ok	ok	ok
2	EELA	eela-ceta-ciemat	se-eela.ceta-ciemat.es	OK	ok	ok	ok
3	EELA	eela-ciemat	se-eela.ciemat.es	OK	ok	ok	ok
4	EELA	eela-ufcg	eelase1.lsd.ufcg.edu.br	OK	ok	ok	ok
5	EELA	eela-unam	se1.grid.unam.mx	ERROR	error	error	error
6	EELA	eela-unam	flapiacalli.nuclecares.unam.mx	ERROR	error	error	error
7	EELA	eela-utfsm	se.labmc.inf.utfsm.cl	ERROR	error	error	error
8	EELA	ieeta	axon-g05.ieeta.pt	OK	ok	ok	ok
9	EELA	infn-catania	aliserv1.ct.infn.it	OK	ok	ok	ok
10	EELA	ufrj-if	lnx105.eela.if.ufrj.br	OK	ok	ok	ok
11	EELA	ula-merida	grid008.cecalc.ula.ve	OK	ok	ok	ok
12	EELA	uminho-cp	se.cp.di.uminho.pt	OK	ok	ok	ok
13	EELA	uniandes	moboro.uniandes.edu.co	OK	ok	ok	ok
14	EELA	unican	se01.macc.unican.es	OK	ok	ok	ok
15	EELA	uporto	hades.up.pt	OK	ok	ok	ok
16	EELA	upv-grycap	nephthys.dsic.upv.es	OK	ok	ok	ok

Figure 3: The SAM user interface

During the operation of the EELA-2 infrastructure a drawback of the current SAM user interface was detected. It organizes the test results by service type but not by site. So, using the SAM interface it is possible to see the results for all Computing Elements in the infrastructure but it is not possible to see the results for all services of a given site. To overcome this limitation, it was developed within SA1 a dashboard[12] that provides an overview of the availability of the resource centres in the EELA-2 Infrastructure. This dashboard is shown on Figure 4.

[12] http://eoc.eu-eela.eu/doku.php?id=e-infrastructure_status

Figure 4: The EELA-2 Operations Dashboard

4.1.2. The Eventum Issue System

The Issue-based Support System Eventum[13] is the EELA-2 main facility for users to report problems experienced during the utilisation of the infrastructure. It is also important for the Operations Team to communicate possible local malfunctions to the resource centres managers.

The EELA-2 Eventum instance is split in support units or departments, each with an assigned team of professionals who are responsible for answering tickets belonging to their respective areas of competence. At the time of this writing, there are 10 departments, divided into internal sub departments, as shown in Table 2.

[13] http://eventum.eu-eela.eu

Table 2: The EELA-2 Support Departments

Department	*Sub department(s)*
Applications & Gridification Support	General support GILDA support
Certification Authorities	-
Grid Site Deployment	New resource centre Certification infrastructure
JRA1 Services	OurGrid Grid2Win
Middleware	gLite ourGrid Additional services Application-oriented services
NA1 Management	-
Network	-
Operations	Ancillary services Information system servers Logging and bookkeeping servers Logical file and metadata catalogues File transfer services VO-related services Accounting system Monitoring system Management
Resource Providers	one for each resource centre
Training and Dissemination	GILDA training Dissemination

The two-level hierarchy serves more than one purpose. First, it helps simplifying the system usage, since issues are submitted with only the top-level department filled out. Also, the existence of a more specific level makes the issue routing more efficient, as this auxiliary label makes it possible to deliver the issues directly to the person in charge of responding them. Setting the sub department label for every issue is one of the responsibilities of the operations team.

The issues follow a workflow through various statuses until they are closed. On the meantime, it is possible to track responses, emails, etc., allowing their progress to be monitored. Even after the issues are closed, it is still possible to access them, since a history record is kept in order to build a constantly growing knowledge database. With every fixed issue (and its respective solutions) stored on the system, the support team can quickly respond to common, renitent issues.

When necessary, reports can be generated to support management decisions or to keep track of the issue distribution over the infrastructure.

4.1.3. The EELA-2 Operations Centre Database

There is a fair amount of information regarding the resource centres that is worth keeping at hand. Technical contacts, and supported VOs are some examples. Thus, it was decided to create a central database to aggregate this information, namely the EELA-2 Operations Centre Database (EOCDB)[14].

It is not in the scope of this document to enumerate and explain every bit of information stored on the EOCDB, but there are some of them that deserve special attention:

- Site GIIS URL: in addition to being used by the BDII, the EOCDB automatically fetches some data from the sites' GIIS via the LDAP protocol;
- Scheduled downtimes: when any given resource centre is on downtime, it is automatically removed from the top-level BDII, to prevent jobs from being sent there;
- Tags: it is possible for users to find out which sites support a given application or development library by searching this field.

Besides serving as a database, a great feature of the EOCDB is that it turns the complex topology configuration of the infrastructure into a simple and quick task. Figure 5 shows the EOCDB administration backend. By configuring the checkboxes, sites are instantly added or removed from the respective infrastructures. The process is not complicated: the checkboxes control the generation of a configuration file, which is published on the web. Every infrastructure' BDII is configured to read the site list from this very file, yielding the desired result.

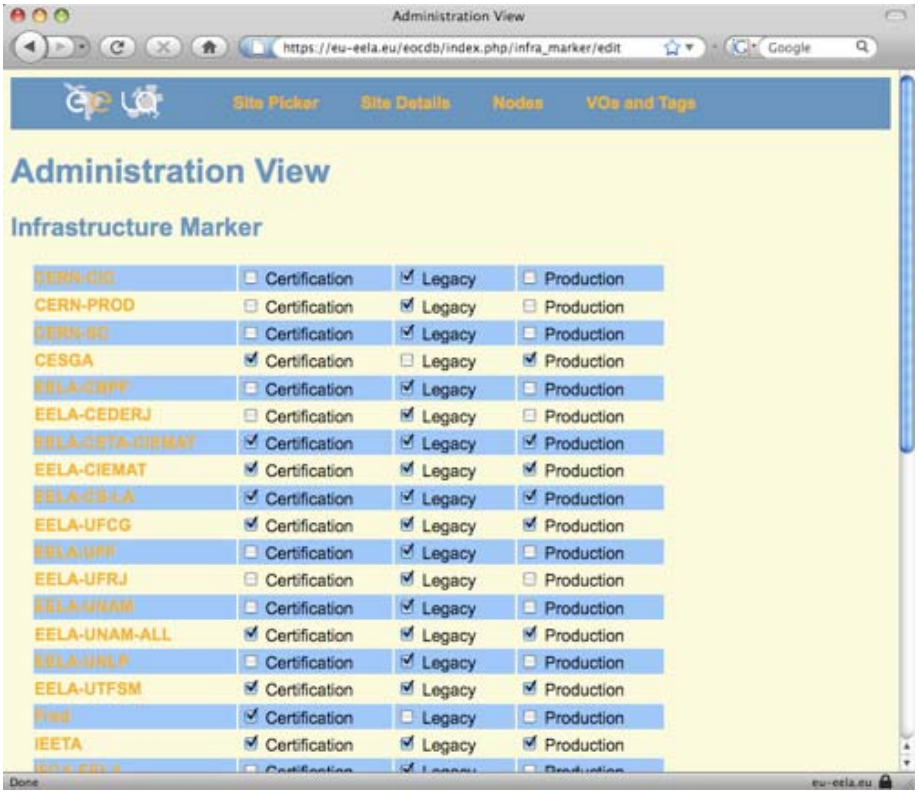


Figure 5: The EOC Database

[14] https://eu-eela.eu/eocdb/

4.2. OPERATION PROCEDURES

The mandate of the Operator-on-Duty teams can be formalised through the definition of Operation Procedures. With this objective SA1 defined a set of procedures describing in details how the OODs should act in order to fulfil their duties and to maintain the quality expected from a production infrastructure. This section summarises the main operation procedures. A detailed description of these procedures is available in an internal document published in the EELA-2 Operation Centre Web site[15].

4.2.1. Resource Centre Creation

This procedure illustrates the necessary steps for the initial acceptance and creation of a new Resource Centre, up to the point where the site is ready to begin the installation. A relevant step is the formalisation of the Site Candidature with SA1 Management. After that first step, the site administrator is requested to provide all the necessary information to register the site in the internal EELA-2 tools.

4.2.2. Resource Centre Certification

This procedure shows the necessary steps for the certification of a new Resource Centre, up to the point where the site is ready to be integrated in the Production Service. The main purpose of this procedure is to make sure that a broken site will not be integrated in the infrastructure, what may cause severe disturbances in the running services. To reach this objective, the candidate site is put in the Certification Infrastructure, where it is evaluated using the available monitoring tools in order to identify any potential problem with its services.

4.2.3. Resource Centre Integration

This procedure details the necessary steps for the integration of a Resource Centre that has finished the certification procedure. It describes how the site should be registered in the EELA-2 Information Systems and operation tools.

4.2.4. Continuous Testing Monitoring

This procedure describes the main OOD day-by-day work. It provides details on how to use the monitoring tools to continuously track the status of the resource centres in the production infrastructure. Once a problem is detected in any services, immediate actions must be taken in order to fix the problem or to isolate the broken service from the infrastructure.

4.2.5. Issue Creation

This procedure explains how resource centre administrators should be notified about problems in the services provided by their site. It describes the process to create and submit tickets using the Eventum Issue System described before.

[15] http://eoc.eu-eela.eu

4.2.6. Escalation Procedure

This procedure depicts how open tickets should be followed-up in order to ensure proper and quick fix of the notified problems. It describes also how to deal with unresponsive sites, providing deadlines for acknowledges from the site administrators and, when problems are not dealt properly, describing how to problem should be escalated to higher hierarchical levels in the project until it arrives in the Technical Board, that may decide to remove the site from the project.

4.3. OPERATOR ON DUTY: OOD

To achieve the goal of providing a production quality infrastructure for the e-Science community in Europe and Latin America the SA1 Management create four Operator-on-Duty teams using member institution manpower.

The OOD teams are responsible for the continuous monitoring and support of the resource centre fabric for prompt detection, diagnostic and resolution of operational problems.

Another responsibility of the OOD teams is the documentation of problems encountered on the diverse resource centres, for the authoring of resource centre management cookbooks and best practice documents by the project.

The mandate of the OOD teams can be summarised as follows:

- Ensure that EELA-2 Resource Centres and Core Grid Services are operating as expected by using the selected monitoring tool to detect and diagnose problems;
- Notify the appropriate personnel about detected problems and help them in the solving process;
- Conduct grid site administrators in the process of project, deployment and certification of new grid resource centres;
- Provide first level support to users either by fixing the problem themselves or by forwarding the request to the appropriate personnel able to solve it;
- Create Shift Reports describing the problems encountered during your shift as grid operator and how they were solved;
- Help in the consolidation of the Shift Reports to create a Grid Operator Cookbook.

The EELA-2 project deployed four OOD Teams in places where grid technology is widespread (one in Venezuela, one in Colombia, and two in Brazil). The SA1 Management decided to deploy the four OOD Teams in Latin American in order to disseminate the operation knowledge in the region since there are already plenty of teams in Europe carrying the same function in the context of other Grid projects while in Latin America there is a lack of qualified human resources in the field.

Furthermore, these teams are going to be the first step in order to create regional operating centres in Latin America able to interoperate with other grid initiatives and to support the creation of a Latin American Grid Initiative.

Each OOD team follows a procedure described below.

1. SA1 management implemented a weekly rotation shift whose planning is available at http://eoc.eu-eela.eu/doku.php?id=ood_shift_rota;
2. Operators use a set of tools available at http://eoc.eu-eela.eu/doku.php?id=i_m_a_member_of_the_operation_teams;
3. Depending on alarms, detailed symptoms and diagnosis help tool, operators follow a specific procedure to address the different problems they encounter, available at

http://documents.eu-eela.org/record/640/files/.
This document describes in details the operation procedures summarised in the previous section and is under constant evolution according to the feedback of the Operator-On-Duty teams;

4. At the beginning of the following shift they proceed to a hand-over procedure during a weekly operations meeting. This is used to benefit from the Operator-On-Duty feedback. Handover reports are available at
http://eoc.eu-eela.eu/doku.php?id=ood_shift_rota.

5. INFRASTRUCTURE EXPLOITATION

During the design phase of the EELA-2 infrastructure, 40 institutions pledged computing and storage resources and this projected infrastructure can be seen at Figure 6. It is foreseen in the Description of Work that the complete EELA-2 infrastructure is going to be composed by more that 3000 job slots and around 700 TB of disk storage.

Figure 6: EELA-2 Projected Infrastructure

This section provides details on the status of the integration of resource in the infrastructure, related to resource centres and core services, statistics on their usage, availability metrics, and numbers reflecting the User Support efforts related to the usage of the Ticket Systems.

5.1. RESOURCE CENTRE STATUS

The first EELA project deployed and maintained a grid testbed to disseminate the Grid usability and usefulness among scientific communities in the beneficiary countries. In spite of not being a production quality infrastructure, this testbed provided a very useful and important service.

The EELA-2 project decided to profit from the existence of the testbed and continued to support it until the operation tools, protocols, and, most important, human resources, needed to operate a production infrastructure, were put in place. This event was tracked by a milestone in EELA-2 Description of Work that was successfully attained at M07. The graph in Figure 7 shows the evolution of the EELA-2 infrastructure during the first year of the project.

In the first seven months of the project, SA1 supported the operations of the previous testbed, with about 10 resource centres. At M07, as foreseen in the EELA-2 DoW, the Production Quality Infrastructure started to be put in place with the deployment of the Operator-on-Duty teams.

While the support of the previous testbed was being discontinued, the engagement of new resource centres started very slowly, reaching the worrying mark of only 5 resource centres available at M08. At this point, as mentioned in Section 3.5.1, the Management of the Project decided to start a Crash Programme, which speeded up drastically the RCs integration process. The number of integrated RCs increased by a factor 4 in three months, jumping from 5 (M09) to 22 (M12).

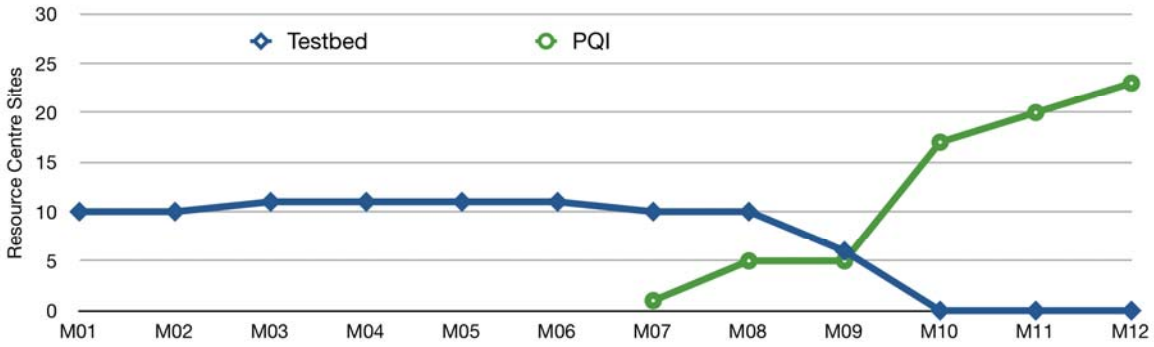


Figure 7: The EELA-2 Resource Centres Evolution

Figure 8 shows the evolution of available jobs slots over time.

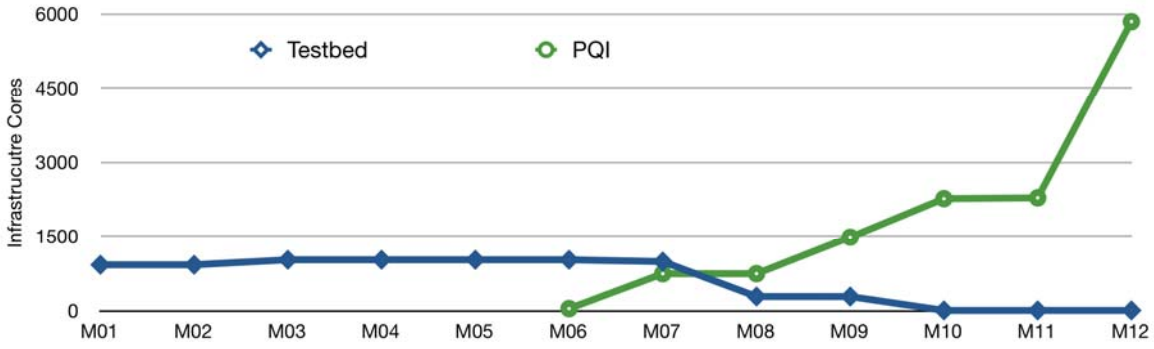


Figure 8: Job Slots Evolution

Table 3 depicts the current infrastructure status, presenting the number of job slots and terabytes of storage per site. Some of them are still in process of integration or certification. It should be noticed that every site supports the EELA-2 production VO and may, according to the respective institutions interests, support other VOs, such as LHCb, Alice, CMS and Biomed. The entire infrastructure amounts to over 5,800 cores, from which approximately 18% of them are exclusively dedicated to the EELA-2 production VO.

The current infrastructure (M12) already provides almost two times the amount of job slots foreseen to be available by the end of the project. However, it is important to notice that the current amount of storage is less that a third of what should be available at M12. This is the result of an agreement made with some project partners that concentrate most of the disk space in the infrastructure. They agreed to immediately make a portion of the pledged storage available and to delay the deployment of the outstanding according to the demand. So, more disk space will be available when required and the amount of storage currently available is considered to be enough to cope with the current supported applications demands.

Table 3: Infrastructure status

Site Name	*Infrastructure Cores*	*Storage (TB)*
CCIN2P3[16]	3563	100
CESGA	356	1.54
CETA-CIEMAT	126	0.06
CIEMAT	100	1.87
csTCDie	772	43.71
IEETA	12	0.16
INFN	530	39.51
UFCG	6	0.05
UFRJ-BIOF[16]	16	-
UFRJ-IF[17]	60	0.78
ULA	24	1.01
UMINHO-CP	15	0.1
CCG-UNAM[16]	2	-
FESC-UNAM[16]	8	-
IBT-UNAM[16]	25	-
ICN-UNAM	2	0.87
SUPER-UNAM[16]	2	0.62
UNIANDES	100	0.4
UNICAN	67	0
UPORTO	15	0.89
UPV	22	0.7
UTFSM	40	0.51
Total	**5863**	**192.78**

[16] Being integrated

[17] 224 more cores to be integrated soon

5.2. CORE SERVICES STATUS

The current configuration of the core services deployed to support the infrastructure presented previously is depicted in

Figure 9. This configuration is made up of one centre in Europe and another one in Latin America. Both centres run information system, workload management, file catalogue, and logging and bookkeeping servers. Furthermore, they also run replicated VOMS servers connected by a secure VPN.

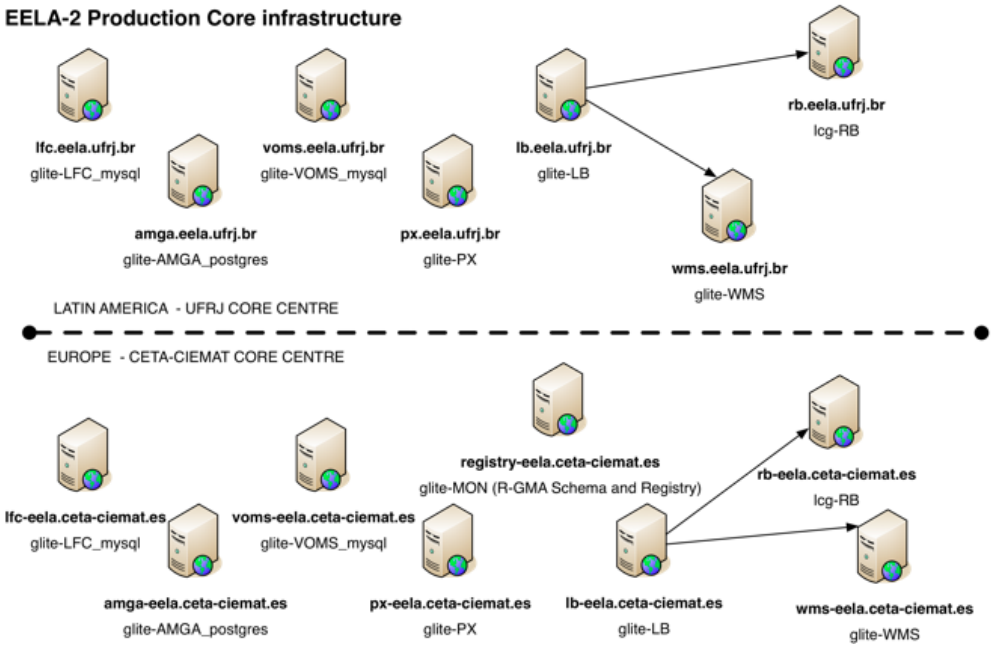


Figure 9: EELA-2 Core Services Map

5.3. UTILISATION METRICS

The information provided by the EELA-2 accounting system, still under development, is not accurate enough and, in order to correctly estimate the use of the infrastructure, one had to use logs from the bookkeeping system. This information was then analysed and it was discovered that at least 980,000 jobs were executed at the EELA-2 infrastructure (accounting jobs ran on both Production and Testbed infrastructures) in the first 12 months of the project. This results on an average of more than 80,000 jobs per month.

Figure 10 shows the job breakdown for all VOs supported by the EELA-2 RCs during the first project year. It is worth to mention that jobs executed until M07 were submitted using the testbed infrastructure and only from then job submission began on the production infrastructure. It is also important to mention that the steep curve from M09 shows that the Crash Programme had a positive effect on the use and the increase of the installed capacity.

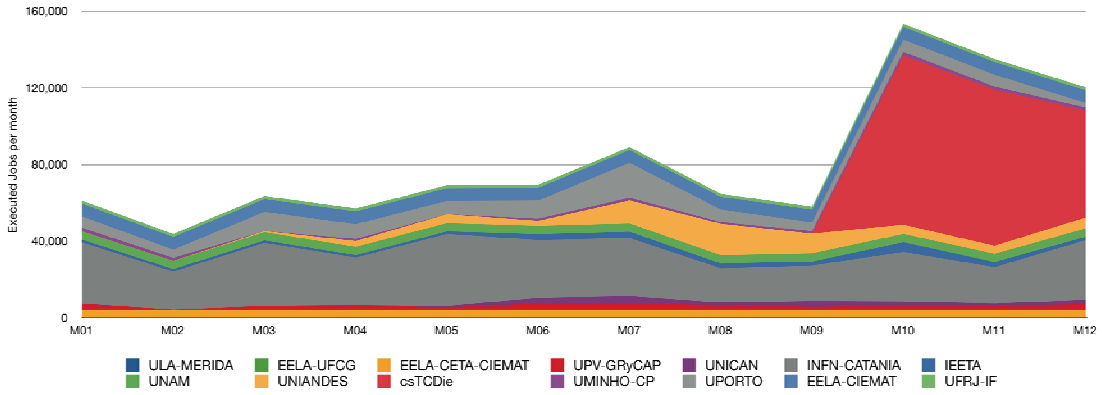


Figure 10: Job Breakdown for All VOs

Figure 11 is structured in the same way, but jobs are now restricted to the ones executed under the EELA-2 VO. Again, this is a lower bound and the graph shows a total of almost 50,000 jobs executed during the first project year, resulting in more than 4,000 jobs per month. The crash programme had an important role on the job volume increase from M09, due to the accelerated deployment of EELA-2 applications it promoted.

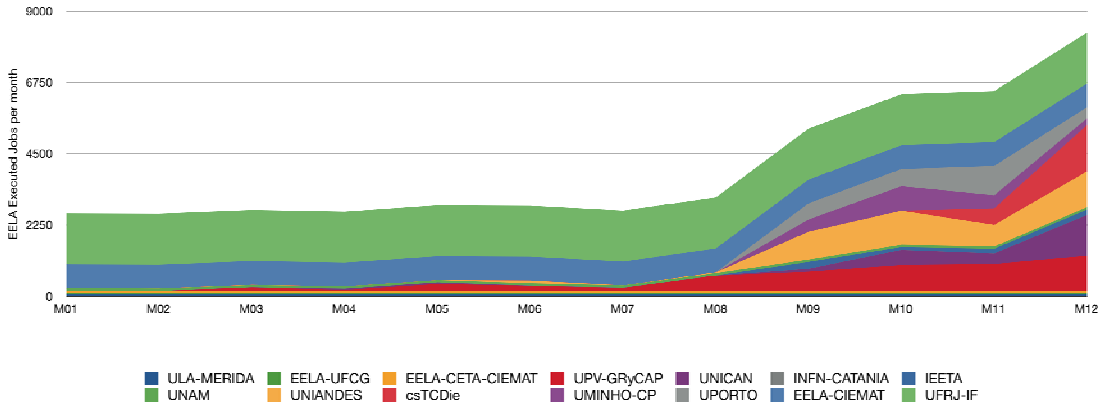


Figure 11: Job Executed under the EELA-2 VOs

5.4. AVAILABILITY METRICS

Figure 12 shows the average availability of the services provided by each of the 22 RCs and the Latin American Core Services Centre (EELA-CS-LA). The majority (17/23) of the resource providers has been available for more than 95% of time – since they were deployed – and just 5 of them have been available for less than 90% of the time. Most of the partners presenting lower availability are improving their network access, and thus increasing their availability. Even so, these are acceptable values when dealing with grid services, known for its highly heterogeneous and dynamic nature, where resources might become online and offline at any time.

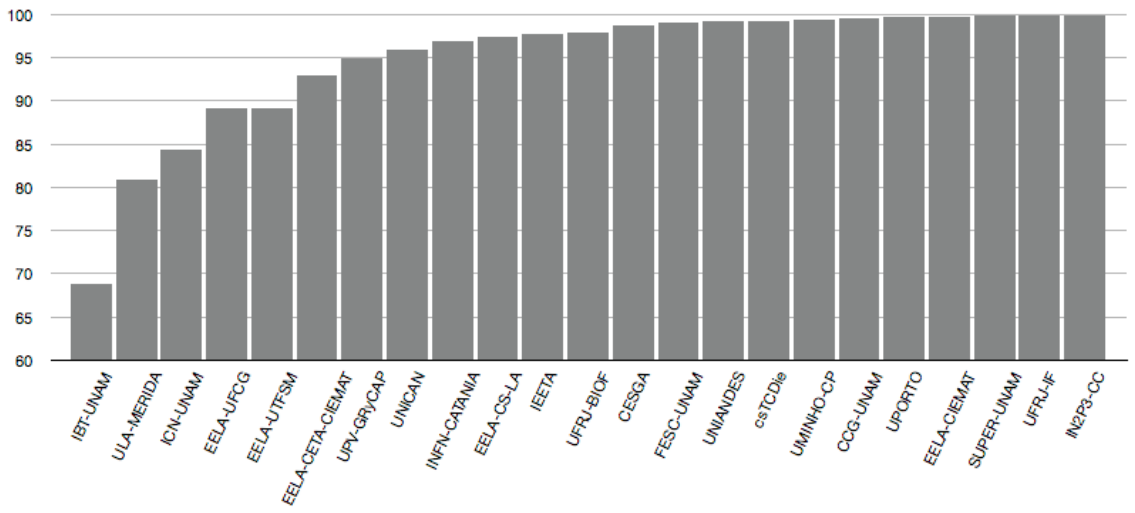


Figure 12: Resource Centre Availability

5.5. USER SUPPORT

As described in Section 4.1.2, EELA-2 adopted Eventum as its support system. This section summarises the support system activity in the first 12 months of the project and provides a breakdown of the opened tickets by category.

Figure 13 shows the evolution of the activity in the support system over the first project year. The support system was commissioned at M04 (July, 2008) and during the first 5 months of operation it received of 12 new tickets per month on average. At M08, the Crash Programme, mentioned in Section 3.5.1, started to mobilise a larger number of application developers, users and resource providers. In the context of SA1, one of the actions was to close the support system, re-evaluating its functionalities and adequacy. This is the reason why no activity is shown during M09 and M10. At M11, the support system was reopened and, after an OOD training update, all pending issues were solved. M12 shows a higher activity in the support system, with 48 new tickets. This happened due to an increase in the number of active users in the infrastructure, one of the outcomes of the Crash Programme.

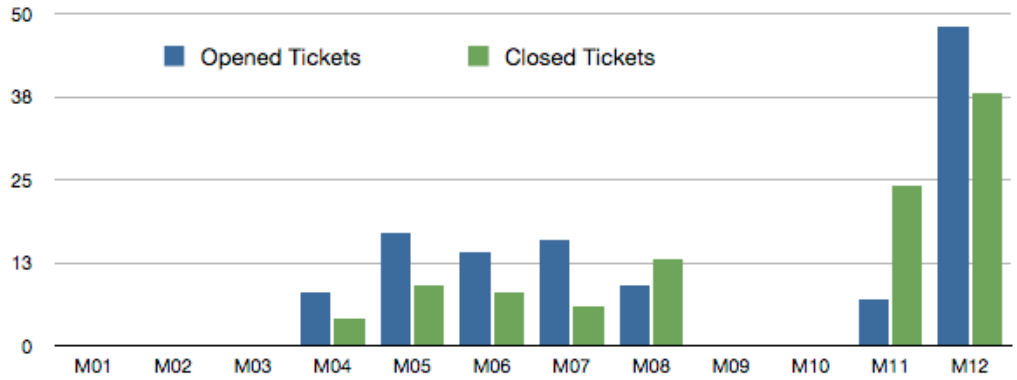


Figure 13: Support System Activity during the first Project year

Figure 14 shows the ticket breakdown per category[18] in the first 12 months of the project. The majority (77%) of the tickets were related to Resource Providers (43%) and to Operations (34%). The former group is related to problems localised in a single RC, usually triggered when users have trouble running their applications, or by OOD in response to monitoring alarms. The latter encompasses all tickets related to the Ancillary Services, Core Grid Services, Monitoring and Operation Tools and Virtual Organisation Management. Only 8% percent of the tickets were submitted as "Uncategorised", which means that they are related to *ad hoc* not foreseen problems types, or simply that the submitter could not identify the correct category to assign the ticket to. The remaining 15% of the tickets were almost equally divided among the remaining categories, with a lower incidence of tickets related to network problems.

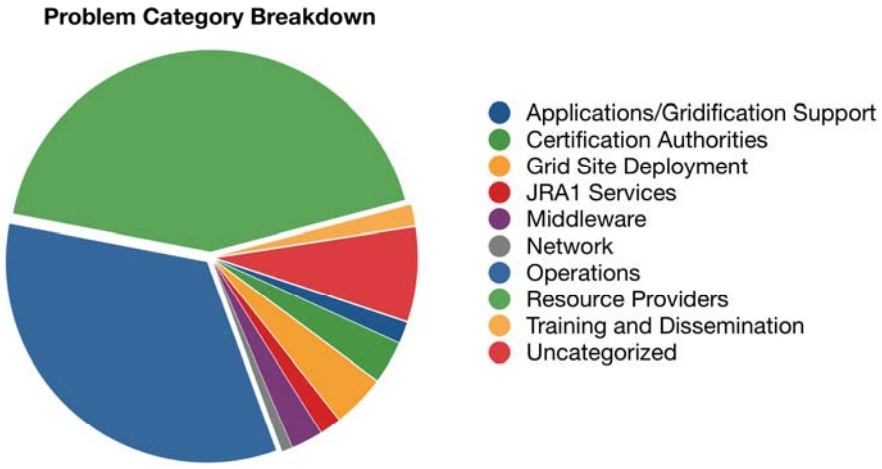


Figure 14: Ticket Breakdown

5.6. AUTHENTICATION AND AUTHORISATION OPERATIONS

5.6.1. Authentication

The current status of the Public Key Infrastructure in Latin America is depicted in Figure 15. Argentina, Brazil, Chile and Mexico operate TAGPMA accredited Certification Authorities. Peru and Venezuela are undertaking the accreditation processes, and all unaccredited countries request certificates on the catch-all Latin America and Caribbean Certification Authority (UFF LACGrid CA).

[18] The categories are described in Table 2, on page 20

Figure 15: Public Key Infrastructure in Latin America

5.6.2. Authorization

The EELA-2 VO currently includes 56 distinct users. Figure 16 shows their proxy requests issued by the EELA-2 Production VOMS server after the Crash Programme (Section 3.5.1). The average over the period is about 13 proxies per day, but it is expected that this average increases to 30 requests during the next year of operation.

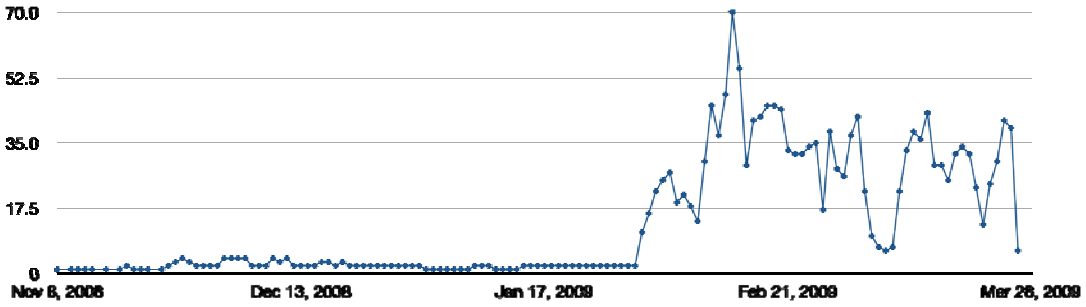


Figure 16: EELA-2 Production VOMS Server Proxies

6. CONCLUSIONS

The existing infrastructure at M12 already provides almost two times the amount of jobs slots promised to be made available by the end of the project. Currently, there are 22 Resource Centres in operation, from the 40 promised in the Description of Work.

It is not possible right now to precise the amount of jobs executed so far in the infrastructure. As described in section 3.5.2, the accounting system is still being developed. But, analysing the logs of the bookkeeping system, it is possible to say that at least 980,000 user jobs were already executed on the infrastructure.

The availability metrics presented in section 5.4 show that the EELA-2 infrastructure evolved from the testbed deployed in the context of the previous project to a full fledge production quality infrastructure, able to support the emerging e-Science communities in Latin America and existing ones in Europe.

All ancillary services, operation tools, protocols and personnel are put in place, fully operational and being used on a daily basis by users, application developers and support personnel. Four Operator-on-Duty teams were trained and deployed in three Latin American countries and can be the roots to the creation of regional operations centres in the region to support the creation of a Latin American Grid Initiative.

It is important, however, to keep the good momentum created by the Crash Programme, avoiding any slowness in the integration of the remaining resource centres.

One actual concern of the SA1 management is that there are no SLAs (Service Level Agreement) accepted and singed by any resource centre. It is important to have such documents in place to establish what levels of support must be provided by the several entities involved in the operation of such a production quality Grid infrastructure. The SA1 management already created a Service Level Description and it will be submitted soon for appreciation to the project members.

One peculiarity of the project is that there are several partners in Latin America that want to participate in the infrastructure and deploy a resource centre but do not have a significant amount of computational resources to justify the effort needed to support them from a pure operational point of view. In some cases, they don't even have the minimum amount of resources need to deploy the required grid services. As one of the objectives of the project is to foment and integrate the e-Science communities in the region, SA1 and JRA1 are studying together a mechanism based on the usage of the OurGrid[19] middleware to facilitate the integration of these partners in the infrastructure.

[19] http://www.ourgrid.org