



EGI-InSPIRE

OPERATIONAL TOOLS: ACCOUNTING WORK PLAN

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Abstract

This document defines the work plan for the Accounting activities in relation to the accounting of additional resource types. This version is for year 2 of the project, the initial year for this strand of work.



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II. DELIVERY SLIP

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III. DOCUMENT LOG

Issue	Date	Comment	Author/Partner
1	16/05/2011	Table of Contents	John Gordon, STFC
2	30/05/2011	First combined draft	John Gordon, STFC
3	06/06/2011	Second Draft for internal review	John Gordon, STFC
4	14/06/2011	Third Draft	John Gordon, STFC
5	07/07/2011	Fifth Draft incorporating comments from SH	John Gordon, STFC
6	03/08/2011	Final for AMB	John Gordon, STFC

IV. APPLICATION AREA

This document is a formal deliverable for the European Commission, applicable to all members of the EGI-InSPIRE project, beneficiaries and JRU 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/>.



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

There are two main threads to the work planned for the EGI Accounting Service over the next couple of years.

Firstly, the core APEL service is being redesigned to use messaging for more of its data flows. This redesigned repository will be deployable as a national repository by NGIs who wish to have their own accounting store also holding data for their local VOs.

Secondly, the repository will be expanded to collect data on more types of resources (e.g. storage, data usage, virtualised services, applications). The EGI accounting infrastructure, as it exists today and as modified above, is capable of handling multiple types of accounting records. The Accounting Portal is also flexible enough to report on multiple types of resource accounting.

Requirement capture is at very different levels of maturity for these different resource types. Though a new storage accounting record has been proposed to OGF and is planned to be implemented by EMI, some of the others have no formal statement of requirements. Work to gather these statements will be a focus in the short-term.



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1 INTRODUCTION

EGI has a production infrastructure (APEL) [R1] for accounting CPU used by jobs running in a LRMS or batch system. This infrastructure collects accounting records from all VOs running on the gLite [R2] infrastructure and, in addition, collects records for the LHC VOs from other infrastructures, thus acting as a worldwide single repository for LHC accounting. Summaries of this CPU data are then passed to the EGI Accounting Portal [R3] where a variety of dynamic queries can be run to visualise the data in a variety of views and functions. There are views tailored for a number of roles (e.g. VO member, VO manager, system administrator) and a number of standard reports are generated (e.g. LHC Tier2s grouped by Federation).

The intention of JRA1 is to work on extending this infrastructure to collect accounting records of a wider range of resources. The plan for this forms the core of this report.



2 CONTEXT

EGI is one of a number of grid infrastructures. For effective accounting across more than one infrastructure, a VO needs EITHER a method to query multiple accounting repositories and combine the results; OR a method of combining the data in one place for querying. The present architecture represents the latter case. It was chosen in the past EGEE project series taking into account VO requirements and in particular the High Energy Physics (HEP) ones. Past experience has shown that it is easier to transform data on exchange to cope with small differences in the data schemas than to support the same set of queries directly on different databases and maintain consistency and completeness. In particular, the EGEE-EGI repository includes LHC data from other grids to achieve this single accumulation of data.

This existing infrastructure can be extended to handle different types of accounting records. The prerequisites are an agreement on the structure of the record and the development of the relevant middleware components to create and publish such records. The portal could be extended to visualise other types of accounting records using the same structures with the added benefit of views and reports combining different types of data.

The possibility of federated accounting conflicts with developing an EGI solution and suggests either formal standards via bodies such as OGF [R4], or an informal collaboration with known interested parties. Stakeholders include existing and potential VOs, NGIs, other Grid Infrastructures and middleware providers.



3 EXISTING ACCOUNTING INFRASTRUCTURE

3.1 Current Status

The APEL repository holds data on over one billion jobs dating back to 2004. These data were collected from:

- APEL clients running at EGI gLite sites.
- Sites with their own accounting systems who republished data from their grid jobs to the APEL repository.
- NGIs and regions with their own accounting infrastructures (e.g. Italy, NorduGrid).
- Other infrastructures outside EGI (e.g. Open Science Grid).

3.1.1 Repository

The APEL repository collects job records from APEL clients over a private ActiveMQ [R5] message broker and summary records from other clients and infrastructures via direct database inserts. The current APEL client is a component of gLite; the EMI-1 [R6] version has recently been released but not yet deployed. This release of the publisher allows selective publishing of VOs and mapping between local groups to VOs.

3.1.2 Portal

The Accounting Portal takes summary data from the APEL Repository by a remote database query and combines it with a variety of information on VO membership (from VOMS [R7]), WLCG pledges (from REBUS [R8]), and topological structure (from GOCDB [R9]) to produce a plethora of reports and views.

3.2 Developments in Progress

There are some developments from year 1 of EGI-InSPIRE that are not yet complete. When they are finished, the production infrastructure will be in a suitable state easily to be extended to accommodate accounting for new resource types as discussed in section 4.

3.2.1 Repository

The repository is being refactored to make it suitable for distribution as a ‘regionalised’ repository for NGIs who wish to run their own repository. The NGI APEL repositories would republish summary information to the central one. The publisher-consumer required to do this will also be deployable by the other infrastructures who publish summaries. This new version will use STOMP [R10] on ActiveMQ as recommended by the EMI Messaging Group. It will run on the EGI production message bus alongside EGI Nagios monitoring. Messages will be signed by the publishing host for authorisation and provenance and encrypted for the protection of user data.

Other developments in hand include conditional publishing by VO so that NGIs can keep their national VOs within their NGI and only publish data for international VOs, which need to be gathered centrally for an EGI-wide view. This development for use by the regional repository matches that in the emi-apel client that provides the same functionality at a site (i.e to keep some VOs local).

3.2.2 Roadmap

The accounting repository roadmap is detailed in MS707 [R12]. The headlines are shown below:



- M1. Database redesign and new message format comprising Job Records (JR); Summary Job Records¹ (SJR); and Sync Records (SR²) for calculating Nagios APEL-sync tests.
- M2. SJR Consumer in Pre-Production for testing by developers of other accounting systems.
- M3. SJR Consumer and new APEL Central database in Production.
- M4. JR Consumer deployed.
- M5. Backend record processing completed.
- M6. New Database accepting updates from legacy AMQ.
- M7. APEL Publisher modified and released.
- M8. Deployment of new EMI-APEL.
- M9. Regional Accounting Server packaged and released.
- M10. Deployment and migration completed.

3.2.3 Portal

The portal will receive its summary data through the messaging model outlined above. A regionalised version of the portal will be deployed local to a regional accounting repository to visualise all data collected locally.

The general direction of the Accounting Portal development is to improve the current code, replace the central Accounting registry connector by a message system and implement the new features requested by the NGIs [R23] and NA3. New production releases will be available every 6 months, but any change will be discussed within JRA1 and the Operational Tools Advisory Group (OTAG) [R11] prior to development. The scheduled roadmap for the next 18 months will be available as a DocDB space linked to from the Accounting Portal web page [R3].

Of the requirements in [R3] the following issues have been accepted into the workplan. Further discussion may result in more of them being accepted and additional requirements will doubtless be received.

Requirements Accepted:

- XML data endpoints for NA3 VO Dashboard
- Foreign user calculation
- Roles in Site Admin view
- New ActiveMQ connector with repository
- New record types from accounting repository
- MPI Job support
- Regionalization

3.2.4 Roadmap:

- 10/31/11 Accounting Portal v4.0 (Canopus):

¹ A Summary Job Record is a usage record, which contains data for more than one job. The CPU time and other variable data are summed over all jobs summarised. The selection of jobs to be summarised is done by other fields in the usage record. For example, an SJR may contain a summary of all jobs run by one VO at one site, in one month. Summary information is how data are transferred between infrastructures just now. Standardising an SJR is required for moving such data over a messaging infrastructure.

² Sync Records compare the data collected by a site with that published to the central APEL repository. This is then used by a Nagios test on the site to highlight differences.



- New charts based on pChart framework.
 - ActiveMQ connector.
- 04/30/12 Accounting Portal v4.1 (Deneb):
 - VO scope views v1.
 - Regional Accounting portal.
 - Custom XML endpoint for NA3.
- 10/31/12 Accounting Portal v4.2 (Electra):
 - Contributed CPUs view.
 - Parallel Job accounting.

3.3 Extensibility of Existing Infrastructure

The developments currently in hand will provide an infrastructure in 2011 with a producer/consumer architecture for job and summary accounting records based on the production EGI messaging infrastructure and using STOMP and Python in common with other EGI operational tools. Messages (not usage records) can be signed for proof of origin and optionally encrypted (where policy requires it). The repositories can have different workflows for different types of messages.

This infrastructure will thus have a good foundation into which to receive additional new types of accounting records and process them using different workflows. Initially, such new workflows could simply be implemented on existing servers with scalability handled by deploying additional instances of the consumer and/or database later, configured to handle only certain types of records.

Similarly, the portal architecture [R19] has shown itself capable of easy extension by its reuse as the EGI Metrics Portal.

4 ACCOUNTING OF ADDITIONAL RESOURCES

All of the resource types mentioned below have been raised as possibilities for accounting in EGI and elsewhere but in most cases there has been no formal requirements capture. This must inevitably form the first part of the roadmap.

4.1 Resources Foreseen in the Proposal

4.1.1 Storage

This is the most developed resource type. WLCG built a prototype harvester, which collected data from the relevant parts of the GLUE 1 Schema [R13]. This collected a lot of data but only highlighted the issues in aggregating many, possibly overlapping measurements.

This early work informed a later WLCG work item to collect information on the capacity installed and available to VOs at sites across the Grid. The driver for this work was the requirement to compare the actual capacity deployed at a site with commitments made through ‘pledges’ by national funding bodies to WLCG. Since any measurement of capacity is accompanied in GLUE by a measurement of the amount of used and free space in the corresponding unit of storage, this work made possible a form of remote storage accounting. A WLCG profile for the use of the GLUE schema for storage by WLCG sites [R20] defined a framework for clustering storage by VO. The information providers of all the main storage solutions were modified to publish to this specification and a new tool, GStat [R21], was developed to harvest this information and present it in various views (by site, country, grid, etc.). Although GStat only keeps a current view, it would be possible for it periodically to create accounting records.

In 2010, at OGF28 and OGF30, the Usage Record (UR) Working Group started a new thread on storage accounting. One proposal was to account at every stage in the life cycle of an individual file, cutting local accounting records, which could be aggregated and summarised to give a site-wide view of storage resource usage. While this would give a complete and detailed picture, it did not gather much support as it was generally felt that instrumenting every possible interaction with a file was not practical. The alternative approach of taking regular snapshots at a coarser level (e.g. filesystem, server, cluster) was felt to have greater promise.

EMI has taken the lead on this definition, though EGI and NGI representatives took an active part in OGF and EMI meetings. A draft record format based on the OGF UR has been proposed to the OGF UR WG. The storage middleware suppliers who are part of EMI (StoRM, dCache, DPM) have committed to cut such records.

All work so far has been around the topic of accounting for space taken up on disk or tape, not for access to the data.

There are four roles for EGI in this area:

1. Provide an infrastructure to collect and manage the storage records cut by the storage middleware suppliers.
2. Ensure that all EGI sites have access to a storage solution that can produce storage accounting records. This may be by negotiating with non-EMI suppliers (e.g. Castor), or by developing a remote method of gathering the information and cutting records (see the discussion on GStat above).
3. Provide a means of displaying higher-level views of the storage accounting data (site, VO, country, etc.) as done by the accounting portal for CPU data.

4. Define a profile for EGI use of the accounting storage record for an infrastructure-wide agreement on the semantics and options for how the record should be filled. This should include negotiating with EMI so that the EGI profile is simply configured.

4.1.2 Clouds

There has been wide interest in cloud accounting from both NGI Cloud projects and wider projects like StratusLab [R14], ECEE [R15], and SIENA [R16], but there was little common work until the EGI User Virtualisation Workshop in May 2011 [R17-18]. Relevant conclusions from that workshop included:

1. Accounting for work done by users inside a virtual machine should be done by traditional methods. i.e. traditional jobs running on worker nodes in a cloud do not need a separate accounting infrastructure.
2. Cloud Accounting should be for the use of a VM instance by the person who instantiates it. If they wish to carry out more granular accounting within the VM for recharging that is their prerogative.
3. Storage Accounting *Elastic Storage* in a VM is required. *Persistent Storage* does not need a separate cloud implementation. Cloud and Grid Storage should cut the same standard accounting record.
4. Network Accounting - Some network use can be accounted to the VM, but aspects such as virtual switches do not fit there.
5. The lifecycle of a VM has many similarities with that of a job. It has a defined lifetime and most of the resources you would account for (e.g. CPU, memory, I/O, networking), were foreseen in the OGF UR.

Work to be done (not just by EGI) includes:

1. Requirements capture.
2. Proposing a UR definition with extensions, if required.
3. Seeking agreement that the UR definition meets the use cases.
4. Investigating whether the required data can be collected from the common Virtual Machine Management systems (VMM).
5. Promoting development of software to collect and publish.
6. Providing infrastructure to receive such accounting records.
7. Provide a means of displaying higher-level views of the cloud accounting data (site, VO, country, etc.) as done by the accounting portal for CPU data.

The workshop called for volunteer NGIs to collaborate on the overall efforts of virtualisation implementation, which will include accounting planning as well.

4.1.3 Applications

A general requirement has been stated by some user communities to know more about the use of particular applications across the e-Infrastructure. This is partly driven by the curiosity and desire to know what support skills are required, but sites and users are also interested in issues around billing and licensing, both directly to users and as measurement for software suppliers to understand the level of take-up of their products and hence the justification of grid-wide licensing deals.

Initial suggestions during the project proposal were around adding the binary name executed to the CPU UR and then summarising this in the portal. After further discussion, a conclusion was reached that this would not yield uniform results across sites and would be too susceptible to differences in installation of the applications at different sites. An alternative under consideration is a VOMS group within each relevant VO dedicated to the use of an application. This has the advantage that the VOMS group could also be used to control access to the application and so ensure that accounting was



complete. However, for an application used by many VOs there would be a lot of setting up required by VOs. This would be likely to happen for an application of great importance to the VO but may be less likely for an application only sporadically used by a few users within a VO.

Further investigation is required. A proposal or set of options will be presented to the user communities in the coming months.

4.1.4 Enhancements to CPU

A number of enhancements are in preparation or planned for the existing CPU accounting:

1. Filtering of VOs to be published: This will enable sites and/or NGIs to decide which VOs have their accounting data forwarded to the NGI or EGI.
2. Local jobs: Some sites run significant amounts of work from local users which do not go through the grid interface, therefore does not get accounted by APEL. Since much of this work is for VOs for which central accounting is recorded, there is a requirement to be able to display local work alongside grid work in accounting reports.
3. MPI jobs: An extension of the APEL UR to include the number of cores assigned to a job and bring it line with the OGF standard.
4. MPI: Part of a general review of the CPU UR being carried out within EMI. Any changes agreed will result in modified apel-parsers from the CE product teams in EMI.

4.2 Requirements Verification

Insufficient stakeholder engagement has been an issue for these new areas of accounting so the first few months of year 2 will be devoted to identifying all stakeholders prepared to work with EGI and make outline proposals to them before the Technical Forum (TF). An accounting workshop has been planned for the TF where many of the ideas in this document will be developed and some signed off [R22].

4.3 Requirements for Additional Resource Types

4.3.1 Requirements Capture

In the same work plan as 4.2, the stakeholders will also be surveyed about further resource types that are possibilities for year three.



5 BILLING AND SUSTAINABILITY

When accounting is discussed in general forums, the discussion usually moves quickly onto billing. The work of this task to date has been on meticulous recording of resource usage data. From the point of view of accounting software, billing is straightforward, it is just the application of a function to the recorded data to result in a financial bill.

A good analogy is a phone provider. The provider logs all calls made and then applies a function to achieve a bill. This function can be very complex involving time of day, day of week, duration of call, total level of calls, prepayment contracts, discounted rates, included minutes, and many more. What EGI has achieved so far is logging the calls.

Agreeing on a model for charging and a framework for the subsequent agreements to pay are to be considered policy work and therefore outside the scope of JRA1.

6 ROADMAP SUMMARY

6.1.1 Tasks inherited from the first year

Including those already scheduled for year 2.

Features	Timeline
M1. Database redesign and new message format comprising: Job Records (JR); Summary Job Records (SJR); and Sync Records (SR) for calculating Nagios APEL-sync tests.	End of year 1 - Completed.
M2. SJR Consumer in Pre-Production.	June 2011
M3. SJR Consumer and new APEL Central database in Production.	September 2011 (blocked by M6)
M4. JR Consumer deployed.	June 2011
M5. Backend record processing completed.	August 2011
M6. New Database accepting updates from legacy AMQ.	September 2011
M7. APEL Publisher modified and released (EMI).	September 2011
M8. Deployment of new EMI-APEL (SA1)	When certified
M9. Regional Accounting Server packaged and released.	December 2011
M10. Deployment and migration completed	March 2012

6.1.2 New tasks

Features	Timeline
N1 Engagement with potential stakeholders for new resource types.	July 2011
N2 Agree priority of new types of accounting.	October 2011
N3 Work with EMI on a review of the CPU version of the OGF UR. This work may include any changes required for MPI if the requirements are specified in time. The review is being led by EMI; this milestone represents the EGI involvement necessary for integrated accounting. When complete this will generate further milestones to accept new records into the repository.	August 2011
N4 Work with EMI on a common messaging infrastructure for accounting. EMI have a milestone for their clients. This milestone represents the EGI involvement necessary for integrated accounting.	From June 2011. End date will depend on the outcomes from EMI.



N5 Outline Proposals: a. Storage b. Clouds c. Applications	a. May 2011 b. EGI TF 2011 c. EGI TF 2011
N6 Prototype infrastructure in place to receive new accounting record types for testing.	December 2011
N7 Prototype publishing of new records: a. Storage b. Clouds	February 2011 onwards a. EMI-2 code for testing December 2011 b. First VMM prototype October 2011



7 CONCLUSION

EGI has an accounting infrastructure which when the work of the first year is completed will be flexible enough to handle multiple types of accounting record. The first new types are likely to be storage and virtualised services.

Accounting cuts across many areas of EGI-Inspire and other projects. There is a requirement for some forum where all stakeholders can be engaged/consulted on accounting. We recommend that the EGI-Inspire Technical Coordination Board, as the body where the maximum number of stakeholders are already represented, instigates a task force on accounting to bring together as many strands of accounting work as possible.

8 REFERENCES

R1	APEL: the EGI Accounting Repository https://wiki.egi.eu/wiki/APEL
R2	The gLite Middleware Stack: http://glite.cern.ch/introduction
R3	The EGI Accounting Portal: http://www3.egee.cesga.es/gridsite/accounting/CESGA/egee_view.php
R4	The Open Grid Forum: http://www.ogf.org/
R5	The Apache ActiveMQ Project: http://activemq.apache.org/
R6	The European Middleware Initiative: http://www.eu-emi.eu/
R7	The Virtual Organisation Management Service: http://www.globus.org/grid_software/security/voms.php
R8	REBUS The WLCG REsource Balance and USage: http://wlcg-rebus.cern.ch/apps/pledges/summary/
R9	GOCDDB: The EGI official repository for storing and presenting topology and resources information http://goc.egi.eu/
R10	The STOMP Project: Streaming Text Orientated Messaging Protocol http://stomp.codehaus.org/
R11	Operational Tools Advisory Group: https://wiki.egi.eu/wiki/OTAG
R12	The Roadmap for the Operational Tools: https://documents.egi.eu/document/50
R13	The OGF GLUE Working Group: http://forge.gridforum.org/sf/projects/glue-wg
R14	StratusLab: http://www.stratuslab.org
R15	ECEE: Enabling Clouds for E-science http://www.scientific-cloud.org/
R16	SIENA: http://test.sienainitiative.eu/
R17	EGI User Virtualisation Workshop: go.egi.eu/uvw1
R18	1st User Virtualisation Workshop - Summary Report: https://documents.egi.eu/document/559
R19	<i>Rey, P., Lopez, J., Fernandez, C., Kant, D., Gordon, J.: The Accounting Infrastructure in EGEE. In: Proc. of the 1st Iberian Grid Infrastructure Conference, Santiago de Compostela, Spain (2007)</i>
R20	Usage of Glue Schema v1.3 for WLCG Installed Capacity information https://twiki.cern.ch/twiki/pub/LCG/WLCGCommonComputingReadinessChallenges/WLCG_GlueSchemaUsage-1.8.pdf
R21	Gstat http://gstat-prod.cern.ch/gstat/about
R22	Accounting Workshop at EGI Technical Forum 2011 https://www.egi.eu/indico/sessionDisplay.py?sessionId=39&confId=452#all
R23	https://wiki.egi.eu/wiki/Track_Operations_Requirements