



omii europe
open middleware infrastructure institute



EU project: RI031844-OMII-Europe

Project no: **RI031844-OMII-Europe**

Project acronym: **OMII-Europe**

Project title: **Open Middleware Infrastructure Institute for Europe**

Instrument: **Integrated Infrastructure Initiative**

Thematic Priority: **Communication network development**

D:SA2.0 – Initial Specification of OMII-Europe QA procedure, tools, policies and practices

April 2007

Start date of project: **1 May 2006**

Duration: **2 years**

University of Southampton

Revision [v0.7]

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document Control Sheet

Document	Title: Quality Assurance tools, policies, practices and procedures within OMII-Europe	
	ID: D:SA2.0v2	
	Version: 0.7	Status: Draft
	Available at: http://omii-europe.org	
	Software Tool: Microsoft Word 2003	
	File(s): DSA2.0.doc, DSA2.0.pdf	
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	Approved by:	Technical Committee

Document Status Sheet

Version	Date	Status	Comments
0.1	03 November 2006	Draft	Skeleton
0.2	18 th January 2007	Draft	Fairly complete and ready for comments.
0.3	19 th January 2007	Draft	Some minor corrections (DV/UEDIN)
0.4	31 st January 2007	Draft	Resolution of comments from AD & DV.
0.5	8 th February 2007	Draft	Restructured as requested by AD.
0,6	4 th March 2007	Draft	Further restructuring to push content out to milestone documents at AD's request.
0.6.1	14 th March 2007	Draft	Minor typos addressed. (Michael Russell, PSNC)
0.7	31 st May 2007	Draft	M12 Updates
0.8	1 st June 2007	Draft	Post EPCC/KTH Reviews

Executive Summary

This document describes the Quality Assurance activity within the OMII-Europe project and, specifically, the SA2 work package. It provides details of the quality assurance process as defined by the description of work, the various tests (functionality, standards compliance, performance, coverage, etc.) that are used to review the quality of a particular software project, the framework and tools used to manage and deliver the test reports, and the expected software packaging. This activity is put into context with other activities within OMII-Europe that together will inform users of the software in the OMII-Europe repository as to its performance, its compliance with established standards to ensure inter-operability, and its portability across a set of defined platforms and environments. Software will be contributed into the repository by the development teams, but not made available for public download until its quality has been assessed and graded.

This document makes extensive reference to the milestone documents (M:SA2.1, M:SA2.2, M:SA2.3, and M:SA2.4) which are available from the OMII-Europe website. These documents describe the state of the SA2 activity at month 6 and will be updated at regularly during the course of the project. Together they provide supporting information relating to the tools, procedures, policies and practices used with the project. It is not seen to be within the current scope of the SA2 activity to develop a complete quality assurance process – such as ISO certification. It is also outside the scope of the SA2 activity to define quality assurance processes for the individual JRA1 activities. These tests will be used to derive a rating for a software release and to determine its suitability for public use.

By February 2007 we have identified the testing framework (ETICS and Metronome), written a compliance test suite for job submission and job monitoring, and deployed the ETICS and Metronome frameworks. This work has been used at SuperComputing 06 to validate the compliance of web service endpoints implementing the High Performance Computing Profile specification from the Open Grid Forum. Effectively a basic prototype quality assurance environment has been defined for assessing the compliance of job submission and job monitoring web service with draft standards from the Open Grid Forum using the Metronome framework. Future work will involve the deployment of ETICS and the integration of the compliance test suite, followed by the integration and automated build and deployment of a job submission service.

Table of Contents

Executive Summary	3
Table of Contents	4
Glossary	5
1 Overview	6
2 Integrating Scenario	7
2.1 Phase 1	7
2.2 Phase 2	7
2.3 Phase 3	7
2.4 Phase 4	7
2.5 Phase 5	7
3 Compliance Testing	8
3.1 Job Submission and Job Monitoring	8
3.2 Accounting	9
3.3 Virtual Organisation Management	9
3.4 Database Access	9
4 Test & Review	10
4.1 Test	10
4.2 Review	10
5 Build and Test Facility	11
6 Quality Assurance Process	12
7 Packaging	13
8 Summary	14

Glossary

QA: Quality Assurance.

VCS: Version Control System.

CVS: Concurrent Versioning System – an open-source VCS widely used in open-source software projects.

Unit test: A test for a small, independent unit, such as a class or a component.

NSF: National Science Foundation.

NMI: NSF Middleware Initiative.

Metronome: Official name of the NMI Build and Test infrastructure that is built upon Condor.

OGF: Open Grid Forum.

OGSA: Open Grid Services Architecture. A web service based architecture of Grid services being defined within the OGF.

BES: Basic Execution Service. A job submission and job management specification that has been developed within the OGF.

JSDL: Job Submission Description Language. A recommended standard from the OGF.

HPCP: High Performance Computing Profile. A profile of the BES and JSDL specifications to support simple HPC job submission.

ETICS: eInfrastructure for Testing Integration and Configuration of Software, an EU project being led by CERN.

Component: Used within ETICS to define an individual (atomic) package, e.g. an XML parser.

Subsystem: Used by ETICS to refer to a collection of components, e.g. an authorisation web service that could include an XML parser.

Project: Used by ETICS to define a collection of software components or subsystems that provides a complete system, e.g. an authorisation system such as VOMS that could include web services, web applications and other supporting software.

1 Overview

This report describes the activity that has taken place within SA2 Quality Assurance activity within OMII-Europe project over the first 9 months of the project. The overall objectives of this activity are to ensure that the software components available from the OMII-Europe repository function correctly and are of good quality. Therefore the goal within this activity is that each software component is assessed for:

- Interoperability through Standards Compliance. A clear goal is that all repository components will be interoperable within reason by following standards;
- Quality Assurance. The ability of the software to perform as described including standards compliance, functional operation across different platforms and performance.

The presentation of these assessments is the responsibility of the SA1 'Repository' activity and outside the scope of this report. Nor is it the goal of this activity to define a complete software engineering or quality assurance process for the individual JRA1 activities that could gain ISO like accreditation. OMII-Europe has not been resourced to support that activity.

In order to achieve these objectives, activity is defined within the project by the description of work which focuses effort in the following areas (in order of overall allocated unfunded and funded effort):

- Compliance Testing
- Test and Review
- Quality Assurance Process
- Build and Test Facility
- Packaging

The compliance testing activity revolves around the ensuring that the services being re-engineered within JRA1 (primarily job submission, accounting, data access and virtual organisation management) comply with the appropriate community specifications. To ensure functional operation across the different platforms, and to identify and resolve any associated performance issues, the contributed software services will be built, deployed and run across critical environments. The interaction of these activities with work taking place in other OMII-Europe activities is identified through the tools, policies, practices and procedures that define the 'Quality Assurance' process. Underpinning this process will be an automated build and test facility. At a high-level this uses ETICS (eInfrastructure for Testing, Integration and Configuration of Software) and provides a framework for defining the environment for building and testing software components. The actual low-level building and testing of the software components uses the mature Metronome framework built upon Condor.

This document describes in greater detail the OMII-Europe Quality Assurance process than the overview provided in the description of work. It provides details on the policies, testing process, compliance tests and testing interfaces (software) adopted by OMII-Europe within the scope of this activity and provides information to groups wanting to adopt this process.

2 Integrating Scenario

It was decided early on in the SA2 activity to use an integrating scenario to drive the development and deployment of activities within the work package. Job submission and job monitoring web services would be used for the initial testing scenario as this was a mature area – both in terms of standards activity within the Open Grid Forum and software development activity within JRA1. Once the quality assurance activities had been established for one domain the testing will be expanded to include other services and their associated test suites. The current plan, as detailed below in the following phases, will expand the compliance testing to other JRA1 activities as they mature – both in terms of implementations and defined consumption of standards.

2.1 Phase 1

The initial phase involved in writing a compliance test suite around the High Performance Computing Profile being developed within the Open Grid Forum. This test suite was integrated into the Metronome framework and demonstrated at SuperComputing 2006 in November 2006. These two activities have been captured in the milestone documents M:SA2.3 and M:SA2.4. This phase can be considered complete at PM9.

2.2 Phase 2

Having integrated the compliance testing into the low-level Metronome framework we will deploy the ETICS system at Southampton and use the test plug-in mechanism to run the compliance test suite within ETICS. This will provide a source of test data and a local ETICS infrastructure to start integration of ETICS test results into the OMII-Europe repository being developed by SA1. It is expected that this work will be completed at PM12.

2.3 Phase 3

The OMII-Europe repository (from SA1) is expected to be deployed by PM12 and be available to the JRA1 participants for them to upload releases. With JRA1 source code in the repository, a basic integration of the repository and the ETICS service can be undertaken by SA1 and is due for completion at PM15. This will enable SA2 to work on integrating the functional test suite provided by JRA1 into the ETICS system. By running functional and compliance test suites through ETICS there will be ‘live’ test data that can be presented through the SA1 repository. It is expected that this will be complete around PM15.

2.4 Phase 4

Taking place at the latest by PM18, and concurrently with other activities after PM12, this phase will integrate work from JRA4 relating to benchmarking of deployed systems. These benchmarking tests will be integrated into the ETICS framework to enable performance metrics to be collected and presented through the repository interface.

2.5 Phase 5

Taking place after PM12, additional compliance test suites will be written to verify the compliance of the other re-engineered software emerging from JRA1. At this moment it is not clear when services will be delivered and the maturity of their associated specifications. Integration into the framework will take place as the software becomes available.

3 Compliance Testing

The OMII-Europe project has engineering activities to provide interoperable job submission and job monitoring, accounting, virtual organisation management and database access services where interoperability is vital. The portal and component exchange with CNGrid will not necessarily fall into this category are currently considered a lower priority for the purposes of compliance testing.

The description of work makes extensive reference to OGSA (Open Grid Services Architecture) compliance which at the time of writing was the primary architectural model – specifically complying with its profiles and service interfaces. Considerable work has taken place within the OGF and the wider web service community. The WSRF (Web Services Resource Framework) model, which once exclusively underpinned the OGSA activities, is now just one activity. A ‘plain web services’ model has recently found traction within many OGF participants and longer-term, the community will move away from WSRF to a WS-RT family of specifications that will have broader cross-industry support.

SA2 activity at SOTON has developed a series of compliance tests for job submission and job monitoring around specifications coming out of OGF. This is the most mature, in terms of standards development, of the services being re-engineered within OMII-Europe. The initial compliance test suite for job submission and job monitoring is described in detail in (M:SA2.3) and summarised below.

3.1 Job Submission and Job Monitoring

The High Performance Computing Profile (HPCP) is currently (November 2006) the primary standards activity within the Open Grid Forum (OGF) for Job Submission and Job Monitoring. The profile uses the OGSA Basic Execution Service (OGSA-BES) and Job Submission Description Languages (JSDL) specifications. A very simple authentication mechanism was defined as part of the early HPCP specification – this has now been revised prior to submission into the OGF review process. For Supercomputing 2006 this was combined with an interim authentication solution to enable interoperability testing to take place amongst a dozen groups.

The current test suite is run from within the NMI test infrastructure. Work is ongoing at this time to integrate the execution of these tests from within the ETICS framework. Currently, these tests verify pre-defined end-points. Part of the ETICS integration will include the dynamic deployment of the service, from ETICS build binaries onto one machine in the build pool, and the execution of the test from another machine in the build pool. This form of distributed client and server testing has already been demonstrated through direct use of the NMI software.

The tests currently verify the correct behaviour of the following operations of the OGSA-BES interface. These represent the majority of the operations defined within the High Performance Computing Profile (HPCP) that is being defined within the Open Grid Forum. The specifications are entering public comment (February 2007) at which point the compliance test suite developed for SuperComputing 2006 as part of the HPCP interoperation activity will be updated and released to the project. Detailed information relating to the testing scenarios will be in the release documentation for the compliance tests.

Tests around these operations need to be expanded to cover failure as well as successful cases. To help with error tracking in the test suite and the service addition checks are made to ensure that:

- Returned documents are well-formed XML and validate against the relevant schemas.
- That the incorrect username/password combination has not been used.
- Requests have not been malformed and being rejected immediately by the service
- The submitted JSDL has not been malformed.

- Valid but unusual SOAP headers (WS-Addressing, WS-Security, others?) have not been used.
- Requests have not been made for invalid/non-existent job information.

Expansion of this test suite and its use, within the ETICS system, with several different compliant services represents an ongoing activity within SA2.

3.2 Accounting

The accounting activity within OMII-Europe uses the Usage Records (UR) and Resource Usage Service (RUS) specifications from the OGF. Early activity with JRA1 has identified areas where these specifications need to be enhanced to meet the needs of the broader Grid community – primarily the expansion of the UR specification to include the distinguished name of the service/user and the support of aggregate accounting within the RUS interface. As this work is still ongoing work has not started on the development of a compliance test suite, but this will be the next priority. There are also several implementations of the RUS interface by OMII-Europe partners that may be compliant with the current draft specification.

3.3 Virtual Organisation Management

The definition of the specifications that will be used within the Virtual Organisation Management services, and the overall OMII-Europe security architecture is still ongoing. The development of compliance tests will commence when these activities have stabilised.

3.4 Database Access

The database access service will be based around the OGSA-DAI software from the University of Edinburgh and implement the WS-DAI family of specifications. The porting of this software to the middleware platforms is currently underway, as is work on the compliance of OGSA-DAI with the WS-DAI specifications. It is expected that a release, which can be tested to the WS-DAI specifications, will be available for Summer 2007 and this when work on these compliance tests will be considered.

4 Test & Review

4.1 Test

Tests are needed by the SA2 activity to determine the ‘Quality Assurance’ of the contributed software. This is defined in the objectives of the activity as standards compliance, functional operation and performance across different platforms. A platform is defined as a combination of hardware, operating system, hosting environment (if a web service) and software environment. Clearly, some of these tests will produce a simple pass or fail and be constant across a set of platforms, while others (e.g. performance) may vary greatly from one platform to another.

The ETICS, Metronome and Condor tools provide the supporting framework for running cross-platform tests within the SA2 activity and are described in detail in M:SA2.2. To assess the software in the OMII-Europe repository it is our policy that the software will be tested for standards compliance, performance, portability on different platforms and the coverage of these tests will also be assessed.

4.2 Review

Earlier sections have described the tests (quality metrics) that will be used as the basis of the quality assessments within the OMII-Europe repository. To ensure that the software components ultimately stored in the OMII-Europe repository are robust, standards compliant and high performing it is important that these metrics are monitored and feedback provided to the relevant development teams. This will identify issues that will improve the individual metrics or if the selected metrics are not proving effective measures of the software quality, to improve the set of metrics being used to measure the software quality.

ETICS provides the mechanism for collating these metrics and the OMII-Europe repository the presentation mechanism for displaying the metrics. Developers will of course be able to interact with the ETICS system directly if they wish to obtain their own test reports. The functional tests provided with the contributed software will be reviewed for completeness by SA2 if a functional specification is provided by the development team. Advice will be provided to the JRA1 teams if no functional specification is available as to how a functional specification could be developed.

Effort to systematically review the test results will come from SA2 and will typically include:

- Identification platform portability issues across functional tests.
- Failed compliance tests due to service deployment in different environments.
- Performance issues taking place on different environments on a single machine.

Analysing the coverage of these test suites will identify areas where the test suite may need to be improved by providing feedback to JRA1 software developers, the development of new benchmarks in JRA4 and the compliance test suite developers from SA2.

5 Build and Test Facility

Parallel deployments of Build and Test facilities are taking place at BU, CERN, and SOTON. This involves the deployment of Condor, Metronome and ETICS. Further information on Metronome (<http://nmi.cs.wisc.edu>) and ETICS (<http://etics.web.cern.ch/etics/>) can be found on their respective websites. More information on ETICS is provided at the end of this document. The Condor and Metronome deployments are being activity supported by UWISC and have taken place at CERN and SOTON.

Work is ongoing on deploying ETICS at SOTON using the deployment at CERN as a reference installation. Maintenance of these infrastructures is the primary activity within this task – providing feedback to the development teams as appropriate. The use of this integrated framework to support the execution of compliance tests for job submission is described in M:SA2.4 (Initial integration of test suites into the NMI Test and Build Facility).

6 Quality Assurance Process

The Quality Assurance process within SA2 provides information relating to the software contributed into the OMII-Europe repository on standards compliance, functional behaviour and performance across different platforms. The OMII-Europe repository, underpinned by the ETICS framework, is the main point of interaction that the various users will have with the quality assurance process. To support the process there needs to be an infrastructure and a procedure for using it. M:SA2.1 provides a description of the procedure for the various actors within the quality assurance process:

- Software Developer: A developer within a project that is using the OMII-Europe repository, e.g. a JRA1 software engineer
- Software Consumer: An end-user browsing the OMII-Europe repository
- Project Administrator: A role given to an individual within the OMII-Europe repository to co-ordinate activity between a development project (e.g. JRA1 task) and the repository.
- Test Engineer: Member(s) of SA2 who have the responsibility of driving the OMII-Europe quality assurance activity, as opposed to developing and integrating the infrastructure.

Aspects that need to be examined and reported through the OMII-Europe repository – in order to provide information to the user as to its quality – are its documentation, adherence to standards, ease of use, reliability, resilience and robustness. Some of these aspects cannot be measured through automated tests alone and require manual review and assessment. Automated tests will be executed through the ETICS and Metronome frameworks – both the tests and the frameworks are described elsewhere in this document. Manual assessment of the remaining items will be undertaken by SA2 (the Test Engineer) as part of the review process described elsewhere in this document.

Activity to date relating to the presenting of information in the overall OMII-Repository has been restricted by progress in SA1, but vital work has been done in developing compliance tests and familiarization with the ETICS test framework.

7 Packaging

The individual JRA1 software activities will have different mechanisms for packaging their source code and binary outputs. Source code may be defined by a specific tag in a source code repository, a tar ball or distributed as a source RPM. Binary packages again may come in many formats such as RPMs, tarballs, or GPT.

The quality assurance process and its supporting frameworks have the flexibility to work with any defined packaging systems. It is important the packaging system is defined – an OMII-UK example is provided here (<http://www.omii.ac.uk/dissemination/IntegrationSpecification.pdf>) and there is an experiences VDT. The testing service will need to deploy individual services instead of complete systems and this may require a specific binary packaging model.

This has not been a priority during the early phase of the project for the funded resources.

8 Summary

At project month 9 (February 2007) phase 1 of the integrating scenarios has been completed.

The Metronome software (previously the NMI Build and Test Framework) has been deployed, and is being maintained across a diverse set of platforms at SOTON as part of the OMII-UK testing pool and CERN as part of the ETICS pool. An initial test suite for verifying compliance with early versions of the High Performance Computing Profile (HPCP), as used for the interoperation demonstration at SuperComputing06, has been developed and is being prepared for download as part of the planned milestone (M:SA2.3). This test suite, which verifies service compliance with the Basic Execution Service (BES) specification and Job Submission Description Language (JSDL) as used in the HPCP specification, has been run from within the Metronome framework. It can also be used as a standalone test suite through the JUnit framework.

In the run up to the PM12 activity described in Phase 2 of the integrating scenarios will continue. The HPCP test suite will be expanded and updated once the HPCP specification enters public comment – due February 2007. The test suite will also be integrated into the ETICS environment at SOTON. This will involve the deployment of the first formal release of the ETICS framework and will provide a defined base from which to base the integration of new test suites from software contributed into the OMII-Europe repository. Linkage with the SA1 OMII-Europe repository activity will be developed to include the presentation of test reports held within ETICS through the repository. Consideration will then be given as to which service should be used as the target for the next compliance test suite.