SIMDAT

Data Grids for Process and Product Development using Numerical Simulation and Knowledge Discovery

Project no.: 511438

Grid-based Systems for solving complex problems – IST Call 2

Integrated project

SIMDAT

Deliverable - Draft

D.15.4.4 Evaluation report on Airbus Acoustic Workflow Demonstrator by end-user

Start date of project: 1 September 2004 Duration: 48 months

Due date of deliverable: 2008/09/30
Actual submission date: 2008/10/31

Lead contractor for this deliverable: EADS
Revision: 1.0

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	
PP	Restricted to other programme participant (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)	X

Revision history

Date	Version	Author	Modification
29/10/08	0.1	G. Alleon	Initial version after preliminary discussions with customer (end user).
7/11/08	1.0	G. Alleon	Correction according to remarks from reviewers

Copyright

Table of contents

1 Definitions, Acronyms and Abbreviations

1.1 Acronyms

EADS	European Aeronautic Defence and Space company
MOD	Ministry of Defence
CAD	Computer Aided Design
CAA	Computational Aero Acoustics
COTS	Commercial Off The Shelf
R&D	Research and Development
LAN	Local Area Network
HPC	High Performance Computing
GRIA	Grid Resources for Industrial Applications
API	Application Programming Interface
UI	User Interface
IT	Information Technology
PKI	Public Key Infrastructure
URL	Uniform Resource Locator

2 Executive Summary

This document describes the acoustic workflow deployment demonstrator of SIMDAT technologies done by EADS for Airbus. The process of digital simulation of a product's performance in the preliminary design phase of the product's life-cycle is used to demonstrate the technologies. The design of innovative solution for noise reduction is one aspect of the work performed at Airbus France and using SIMDAT distributed workflow technologies is undertaken using simulation services and computing facilities deployed by EADS Innovation Works in Toulouse and Singapore. This demonstrator was a success in demonstrating the added value of SIMDAT outcome and showed very promising results that will be complemented through an internal project.

3 Introduction

This report describes the Airbus demonstrator using SIMDAT technologies. Airbus is an aircraft manufacturing subsidiary of EADS, a European aerospace company. Based in Toulouse, France, and with significant activity across Europe, the company produces around half of the world's jet airliners. This demonstrator involves both part of EADS:

- Airbus which is solely responsible for the design of its aircraft. More precisely Airbus/EEA6, which is responsible for the acoustic design of nacelle and cockpit is part of the demonstrator,

- EADS Innovation Works which is responsible for producing some of the advanced numerical software used throughout the design of various aerospace products.

The major objective of the demonstrator is to showcase new ways of working especially in the way simulation software and data are accessed in order to reduce errors and further reduce development time. The Airbus acoustic team will use novel tools to express their simulation process and access software and computing platform located at EADS Innovation Works.

4 Demonstrator Scenario

4.1 Aircraft noise

Roadway noise and aircraft noise are the most pervasive sources of environmental noise worldwide, and remarkably little change has been effected in source control in these areas since the start of the problem, a possible exception being the development of the hybrid vehicle. Aircraft noise is defined as sound produced by any aircraft or its components, during various phases of a flight, on the ground while parked such as auxiliary power units, while taxiing, on run-up from propeller and jet exhaust, during takeoff, underneath and lateral to departure and arrival paths, over-flying while en route or during landing.

During take-off some aircraft may generate sound levels in excess of 100 decibels at ground level, with approach and landing creating lower levels. Since aircraft landing in inner-city airports are often lower than 60 meters (200 ft) above roof level, a sound level above 100 dBA can be realized.

Back in 1966, after a number of lawsuits in the United States and a public outcry in Europe, the major commercial aviation authorities called an international conference on aircraft noise to establish rules for aircraft. After much politicking and delay, the U.S. Federal Aviation Administration (FAA) decided to implement its own rules in Federal Aviation Regulations (FAR) Part 36, in 1971. FAR Part 36 established limits on the maximum noise that could be produced at an airport at three points—two on either end of the runway beneath takeoff and landing paths and one at the middle and sides of the runway. It also established a sliding scale for allowable noise versus takeoff weight for large aircraft (in other words, bigger aircraft could be noisier).

Although it is easier to design quieter engines from scratch than to try and quiet an existing design, there is a substantial market for aircraft "hushkits" to reduce the noise on current aircraft. These hushkits include some of the same technological approaches first explored in the 1960s by aircraft designers. As the number of commercial airplanes flying increases, local communities around airports complain more and this leads to calls for even greater regulation of airplane noise. As a result, aircraft designers are constantly looking for ways to make their aircraft quieter.

During the late 1960s, several countries were trying to develop a supersonic transport, or SST, a plane that would fly faster than the speed of sound. There were numerous hurdles for the designers to overcome, including both engine noise and sonic booms. Ultimately, the United States abandoned its effort for various reasons, including concerns over excessive noise pollution. The British and French jointly developed the Concorde, but its use was restricted to only a few airports due to noise concerns. Noise remains a major challenge for any future large, fast aircraft.

Since the Concorde, noise reduction has always been a major concern in all the new aircraft design leading to an exceptionally quieter Airbus A380. The Airbus A380 operating from Sydney Airport is more than six decibels quieter on departure than Boeing's 747-400, noise monitoring data shows. At noise monitors about 1.7 kilometers north of Sydney Airport, the A380 was between 4.4 and 6.7 decibels quieter than the 747-400 on departure, the recordings show. About five kilometers to the north, the Airbus was between 3.9 and 5.5 decibels quieter. On arrival, the A380 is between 2.1 and 3.7 decibels quieter than the 747-400.

`

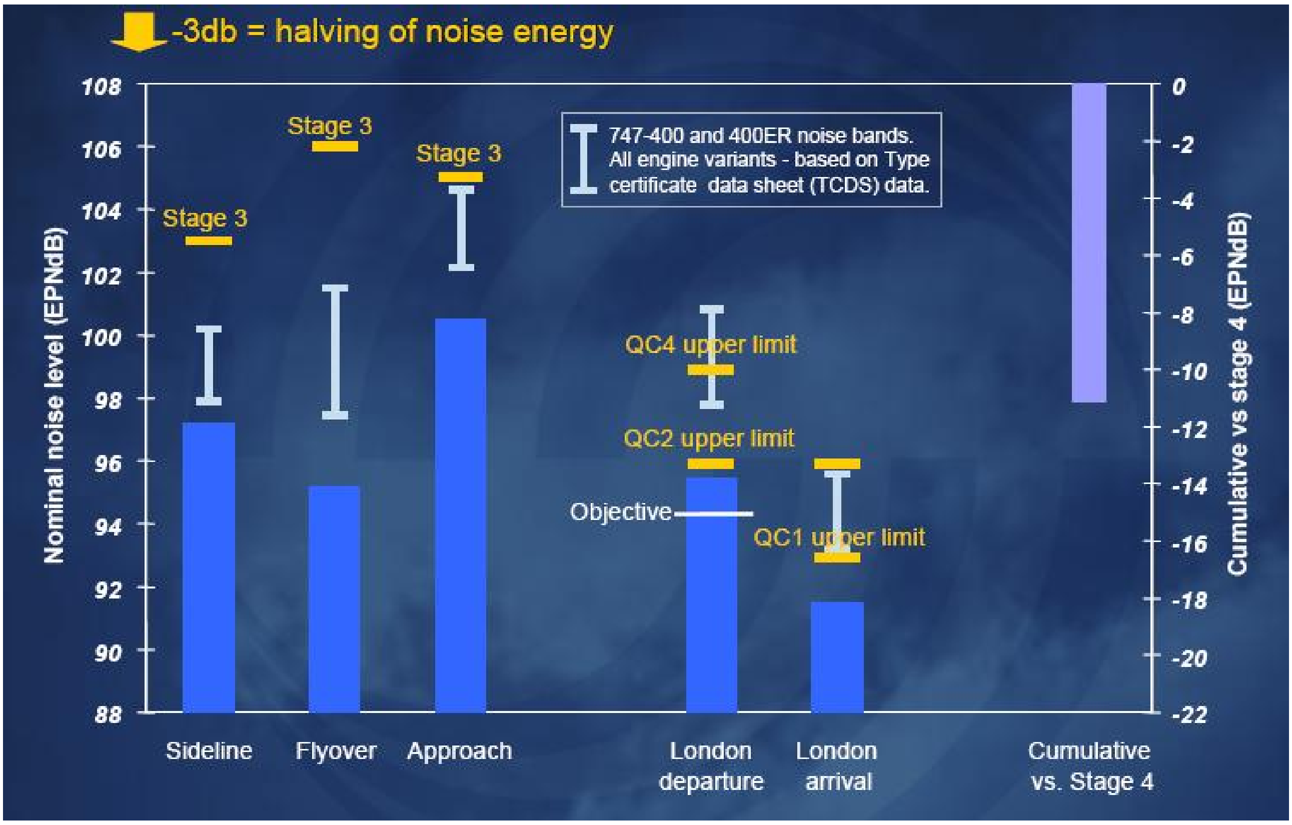

Figure 1: Noise level of A380 in comparison with regulation levels (QC)

This has been made possible by the availability of new simulations tools used in complex simulations processes.

4.2 Noise evaluation process

Exterior noise can be reduced by different factors. One major factor is the design of the nacelle especially looking at the intake and exhaust and applying appropriate coatings. The second one is to study the installation effects and use shielding by other parts of the structure. This process is described in figure 2 in seven different steps:

1. CAD healing to remove every detail that is not interesting for CFD and/or acoustics
2. Meshing for the CFD
3. CFD computation that give acoustic source terms
4. Interpolation of the results
5. Acoustic simulation computing the radiation patterns of the sources
6. Coupling tools (assembling aircraft and engine)
7. Coupled acoustic solver

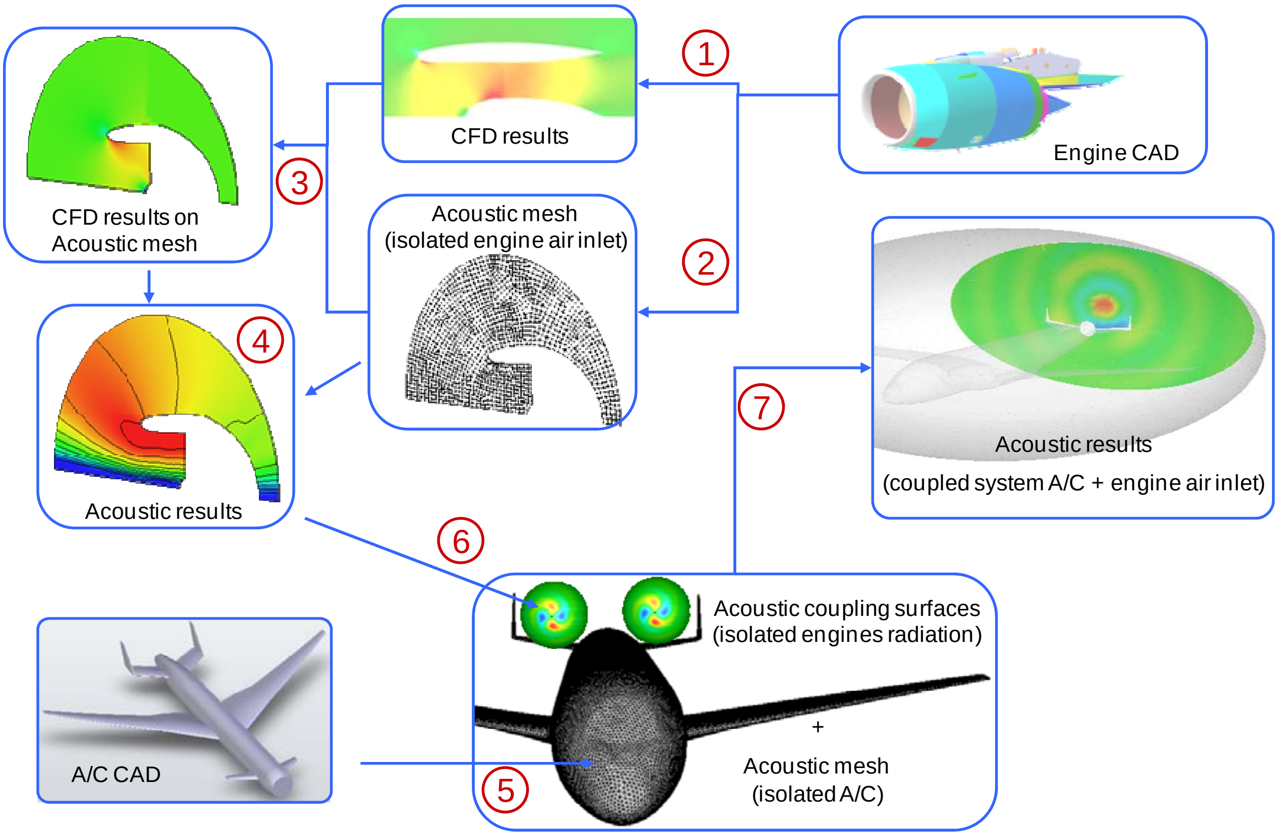

Figure 2: the overall acoustic simulation process

Currently this is being modelled with a number of COTS tools such as CATIA/PAAM for geometry generation, FLUENT for CFD analysis and internal acoustic solvers. Running such a process is currently done manually which requires a good knowledge of the business, the applications used and the underlying IT infrastructure. Obviously working is such a complex environment can lead to some errors that slow down and reduce the number of simulations. Airbus is therefore willing to get some knowledge capture tool that could represent their simulation processes and possibly optimize their execution on various hosts.

EADS Innovation Works has expertise in a number of areas including computational acoustics (CAA) and GRID computing. It will therefore deploy key parts of the SIMDAT portfolio and a number of analysis services on a number of internal resources located on an EADS restricted LAN. These services will then be offered for use to Airbus and at a later stage to a number of business units within the group. The business units will be able to evaluate this new way of working without a costly deployment in house and they will additionally gain access to new computing resources.

The demonstrator will focus on a simple workflow involving both a windows machine and unix resources including a cluster for the parallel code.

5 Requirements Capture and Evaluation Criteria

Airbus EEA has the requirement to study novel design configurations on aircrafts and this is done through complex workflows. In order to pursue this goal, it needs to access various simulation software deployed on various IT hardware resources.

Since software are complex to tune and the underlying hardware is changing on regular basis, engineers should focus on "engineering" issues and "play" with few of the design parameters through an appropriate integration layer.

The requirements capture for Airbus acoustic team highlighted the following.

Top priority requirements:

1. Need to model complex workflows.
2. Require access to simulation code data.
3. The users don't want to worry about software localisation.
4. The proposed solution should be integrated in the existing IT infrastructure
5. The proposed solution should have a simple interface and be easy to use.
6. Users should be able to obtain information on the status of a job while the job is running.

Lower priority requirements:

1. Require access to high performance computing. There is a desire to make best use of parallel computing architectures to reduce digital simulation design and analysis timeframes.
2. The team don't want to worry about managing IT infrastructure and especially high-performance computing clusters.
3. Inter business units collaboration should be possible. Especially Airbus should be able to submit jobs on the EADS Innovation Works cluster infrastructure.
4. Simulation results can be shared with members of a team, access should be restricted to team members

The end-user evaluation criteria are:

1. Users should be able to start and stop workflows and not just single jobs.
2. Users should have access to simulation data. The user should be able to download the output of a workflow and post-process the data on their own computer.
3. The users should not worry about software localisation.
4. The system should integrate with the existing IT environment, no specific action should be required for accessing remote resources.
5. There must be access restrictions on the jobs and data.

6 SIMDAT Components

The main component that will be used is the GRIA middleware. More specifically, we will used the GRIA Basic Application Services package which provides the core functionality for job and data management. It consists of:

A Data Service

> This allows remote users to upload and download data files to the service provider, and to transfer data between Data Services hosted by different service providers. The Data Service also supports management of access rights (for read or read-write access) granted to other users or service providers.

A Job Service

> This allows remote users to start, monitor or kill computational jobs, executed by the service provider. The Job Service will fetch input from and write output to a local Data Service. The Job Service can be configured to support multiple applications, which are chosen by the service provider.

The application services will be configured to be unmanaged (free)

The second component that will be used is the iSIGHT-FD plug-in for GRIA which will be adapted to be used with Kepler (an other workflow tool). Kepler has been chosen because it is an active open source software that can be deployed for testing very easily and without incurring costs.

7 Architecture

The end-user requirements led to the decision to have two components in the architecture:

1. A workflow designer used by the business integrator,
2. A web based portal to access the required analysis services.

The standalone workflow designer gives the user flexibility to model its process while the portal can be accessed from everywhere meeting most of the user requirements.

The portal was developed in collaboration with BAE using the GRAILS framework which was already demonstrated (at a smaller scale) for the monitoring framework. This framework has a number of advantages:

- Ability to access any Java API directly through the Groovy scripting language. Since GRIA is developed in Java, this is an important driver.
- Independence to the back-end storage solution (database) through the use of Hibernate.
- Existing Security frameworks.
- Rapid development infrastructure – no need to compile anything. Convention over configuration approach.

- Independence to the hosting servers. A GRAILS application ends-up being a web application that can be deployed in any Java container (IBM WebSphere, JBoss, Tomcat)

The architecture of the server side is shown below in figures 3 & 4. This architecture is generic and complements the one used by BAe (Leary, 2008) which can support any GRIA service. None of these architectures is application or domain dependant.

This has been integrated into EADS Innovation Works environment. It runs on the EADS intranet so is only available to EADS employees providing an extra layer of security.

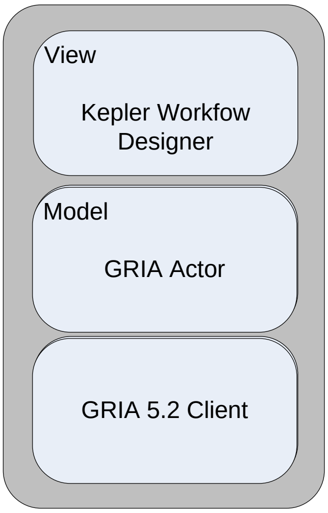

Figure 3: Workflow designer architecture

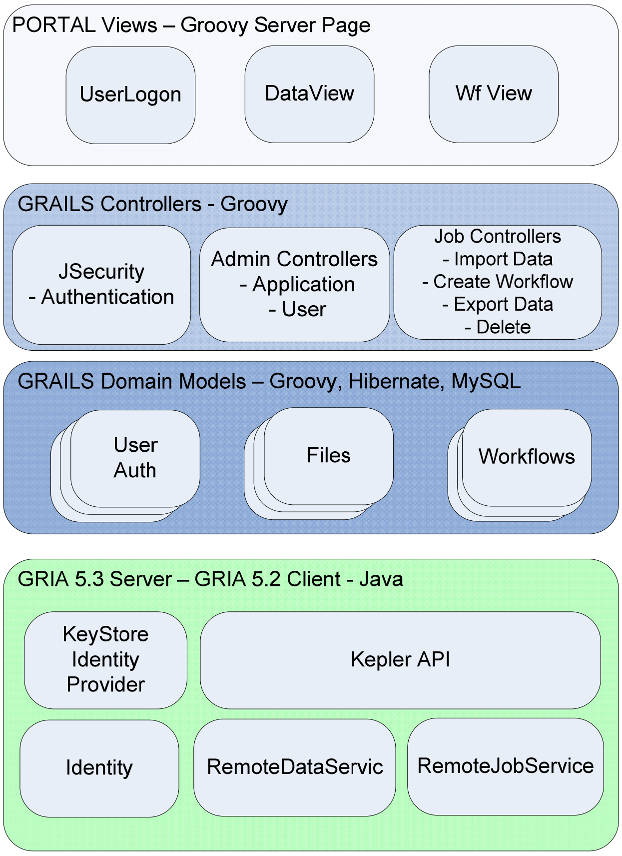

Figure 4: Server Architecture.

7.1 Workflow design tool

Kepler (Jones, 2008) was chosen as workflow tool because it is open source and therefore easy to deploy. The GRIA plug-in from iSIGHT-FD was adapted to this workflow design tool. Figure shows the editor in action with the acoustic workflow.

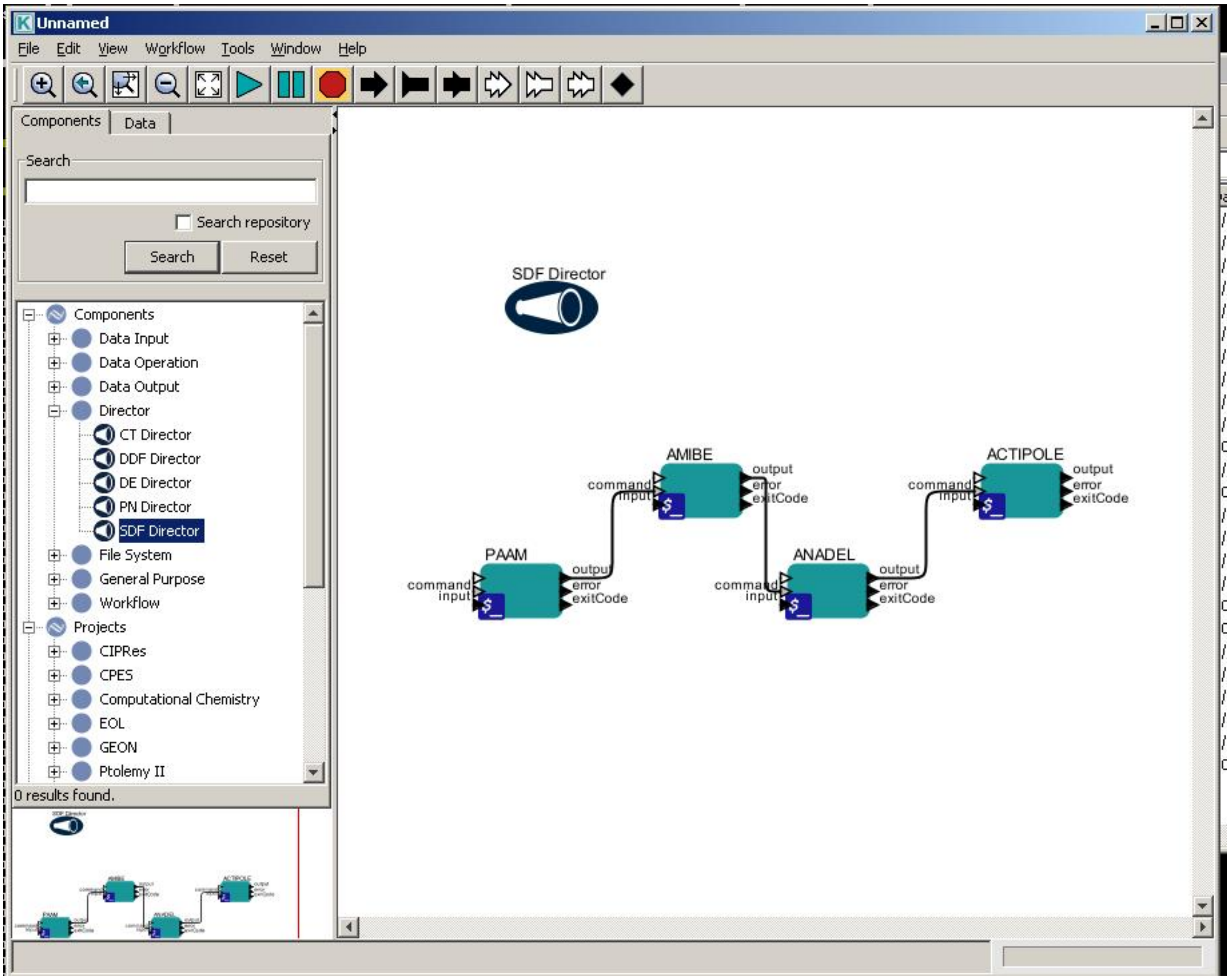

Figure 5: The Kepler workflow editor

7.2 Authentication Framework

Authentication is done using the JSecurity module available with GRAILS. This means that authentication is currently done against the internal GRAILS database. When a user connects for the first time to the system the appropriate keystore required for GRIA is created.

This process is described with details in (Leary, 2008).

While the authentication is not yet fully in line with the company policy (i.e Active Directory or LDAP), it is easy to do since JSecurity comes with an LDAP real template.

7.3 User Management and Workflow Publishing

To deploy a new workflow application the following steps should be taken:

- Launch Kepler
- Create new workflow using the GRIA actor (see Figure 6)
- Save the workflow as a MoML file or a KAR archive

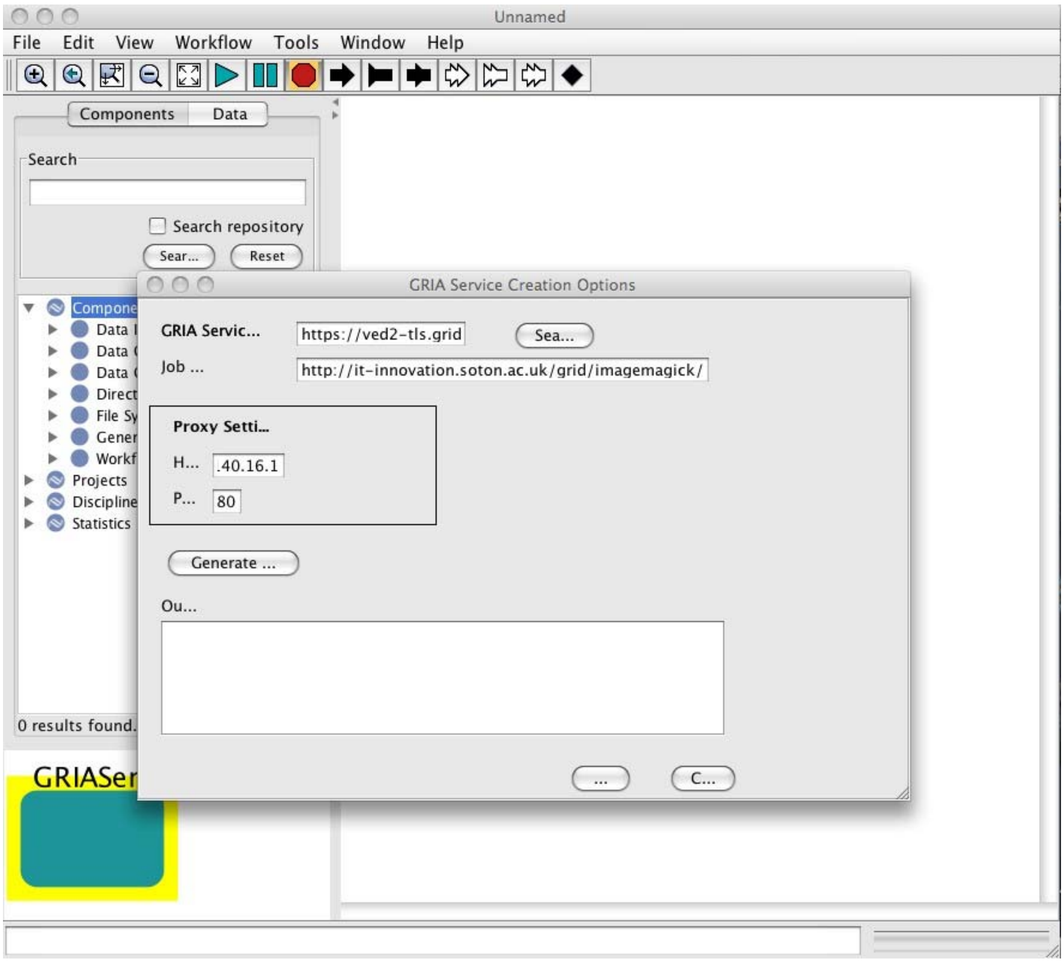

Figure 6: GRIA Actor settings

The workflow can now be deployed to the portal.

Administrators do not see exactly the same functionality when they connect to the portal. Figure 7 shows the administrator panel which can be used to create new user and grant them permissions. Permissions that can be granted are:

- Permission to manage users (create, modify and delete users)
- Permission to manage projects (create, modify and delete workflows)

- Permission to manage users in a project (add delete users from a project)

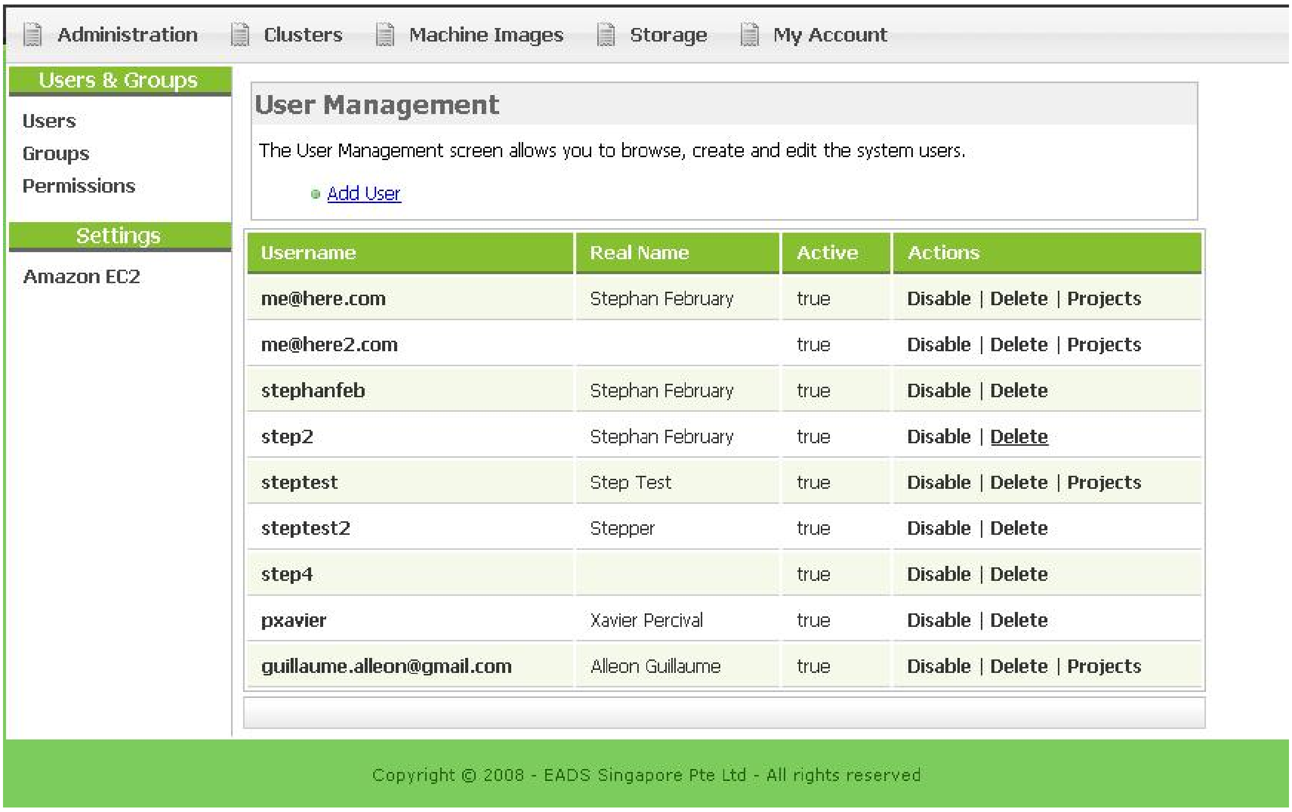

Figure 7: Administrator panel

8 The Portal and Simulation Results: User Perspective

Once the workflows have been deployed in the portal, every member of the project can instantiate a workflow. Instantiating such a workflow lead to a form which is automatically generated from the XML description of the workflow.

The user can then upload the appropriate input files and run the workflow.

9 The acoustic workflow

Due to some integration problem with PAAM, the implemented workflow consists of only two components PAAM & amibe. PAAM is a modeller working on top of Dassault Systeme CATIA and Amibe is a surface mesher used in the aerospace scenario.

Each of the tools has been deployed on an EADS internal GRIA server following the following architecture (Figure 8).

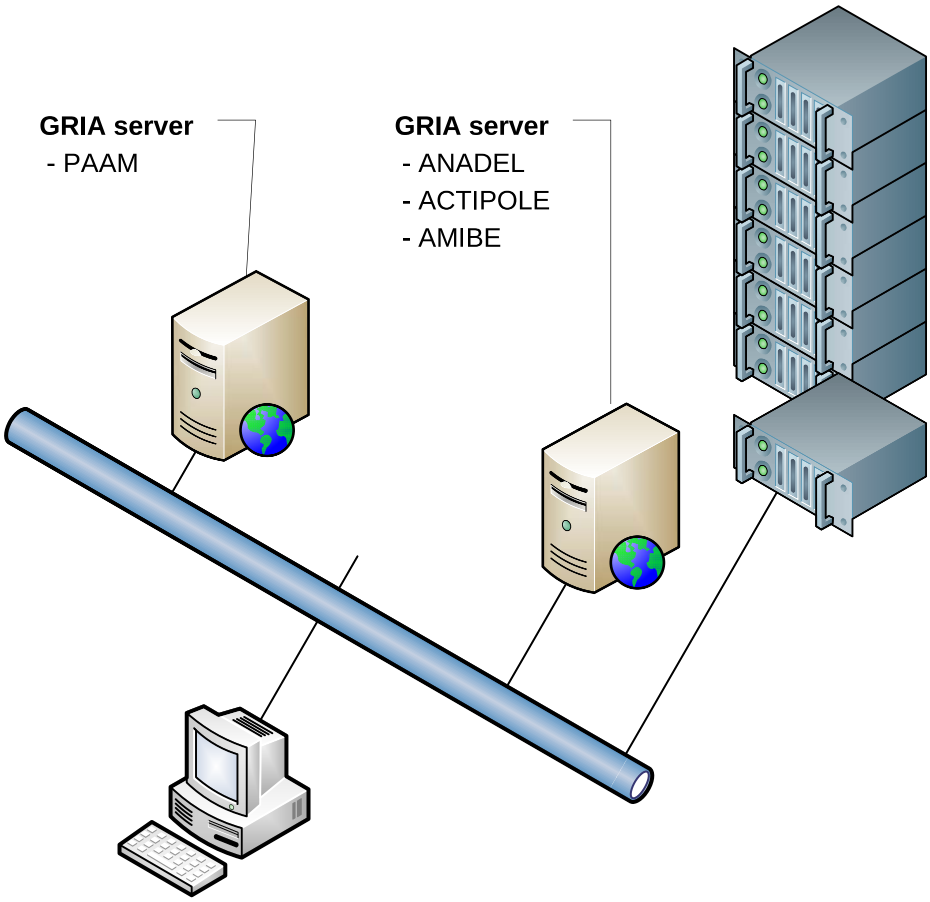

Figure 8: Infrastructure used for deployment

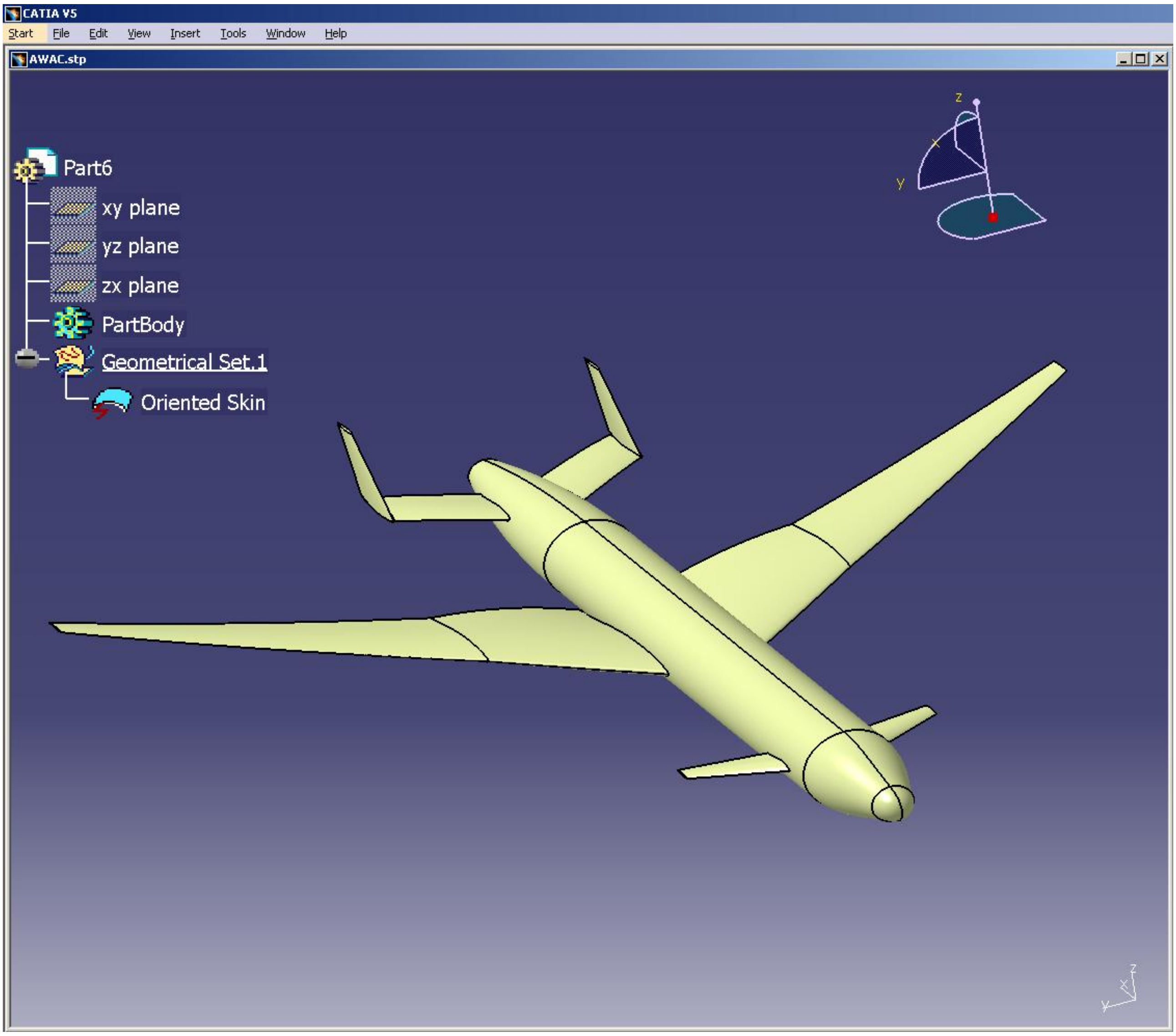

Figure 9: Output of the PAAM component

10 Customer Feedback

From an Airbus point of view, this demonstrator is a success and shows the added value of the SIMDAT technologies. Some integration problems where met due to the fact that the PAAM application was quite sensitive to the underlying windows platform and not intended to be used in batch mode ; these problems were long to diagnose and solve. Once this integration problem was solved, the integration of the other SIMDAT component was quite straightforward. Despite these minor glitches, the demonstrator was proved a success since it demonstrates a new way of working that would permit the end-users to concentrate on their business without being stuck by IT problems. It lead to two new technologies that were developed:

1. The GRIA Kepler plugin

2. The web portal to deploy and execute workflows

The strengths and weaknesses mentioned by the users were the following:

+++	Workflows as Russian dolls: once a workflow has been designed it can be used as a single service in order to create new and more complex workflows.
+++	Workflow modeller user-friendly even if not available as a thin client
+++	Standard execution across discipline facilitate exchange and reuse
----	File transfer are managed with http – might not be suitable for large data sets
---	Full workflow capabilities (loops, branching, ...) were not demonstrated

We take the two last remarks as new requirements that will be fully developed in an internal project.

11 Conclusions

Despite some integration difficulties, the demonstrator was found to be a big step forward in the virtualization of applications. The SIMDAT technologies were perceived are quite mature for industrial deployment as this part of the demonstrator run quite smoothly as compared to the integration.

This demonstrator will be continued in the EADS internal project VED (Virtual Engineering Demonstrator) which already embed Astrium Satellite – another EADS business unit. In the frame of this internal project, a specific effort will be put in developing the following aspect:

- Portal access (including visualisation and workflow modelling)
- Brokering and load optimization (based not only on technical requirements)
- Virtualization using cloud computing (research topic)

12 Bibliography

Leary, S. (2008). *D.15.4.5 Evaluation Report on BAE Systems Internal Deployment and Assessment by End-User*. BAe & SIMDAT Consortium.

End of Document