



SIMDAT

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

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



Deliverable

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1 Introduction

1.1 Executive Summary

This document summarizes the work done within WP7.1 "Integration of Analysis Services" during project months PM13-18. During this period the task of WP7 was to keep up communication with the users of the first reference implementation described in D7.1.2 and to collect feedback and new requirements from other application areas.

The document starts with a brief introduction, a description of the scope and a review of the state-of-the-art outside SIMDAT. It will then describe the feedback and new requirements derived from the application areas.

1.2 Purpose

Analysis services, for example mesh generation tools, tools for the prediction of the structure of modules, or data mining services, are the basis of virtual product development in many different industries. Such Analysis Services are to an increasing extent being integrated into complex problem solving environments to allow engineers to easily drive the whole development process in an integrated environment. To meet the challenges of geographically and logically distributed development processes, Analysis Services have to be Grid-enabled and integrated into Grid-enabled problem solving environments.

The document is intended mainly for the architects and implementers of Grid-enabled problem solving environments, specifically those who have to deal with the integration of Analysis Services.

1.3 Scope

The Technology Area "Integration of Analysis Services" will provide three major outcomes. First, the requirements of the four SIMDAT application areas Automotive, Pharma, Aerospace and Meteorology regarding Analysis Services had to be collected and consolidated. Second, based on the consolidated requirements, existing standards and technologies had to be evaluated and recommendations for the integration of Analysis Services had to be given. These two outcomes have been discussed in Document D7.1.1.

Third, reference implementation templates for Analysis Services have to be provided and maintained to allow embedding existing simulation codes into application area prototypes quickly. The first reference implementation of a generic MSC Nastran service has been covered by D7.1.2.

The combined Document D7.1.3/D7.1.4 describes feedback and new requirements from the application areas.

1.4 State of the Art

Today's state-of-the-art regarding Analysis Services is that the underlying standards like Web Services, and related technologies such as XML, SOAP, WSDL, UDDI, WS-Security, etc. [1], are relatively advanced and mature. Initial work has been done on casting simulation codes into Analysis Services using Web Services technologies.

However, the focus is still on computational Grid aspects in a research environment, which does not sufficiently consider the industrial requirements such as appropriate security measures, protection of intellectual property right or Service Level Agreements to describe extent and quality of the offered services.

There is still a great need for standardization for grid enabled services. WSRF has made some progress here. GT4 (Globus) and GPE (Intel) are based on it and an upcoming release of the GRIA toolkit used by most of the application areas will support a subset of WSRF. On the other hand there are still ongoing and partly controversial discussions about the usefulness and completeness of WSRF for use in industrial and B2B environments.

Another area where standardization is needed is the field of service registries. Registry standards for Web Services (e.g. UDDI) alone do not satisfy the needs of client systems querying the availability of a certain kind of service (e.g. a meshing service suitable for use in structural analysis workflow in the Aero sector). Some kind of semantic component is needed for this. It is also not yet completely defined what kind of information about a service should be delivered from a service registry. Some time has been spent to look into JSDL and possibly extending it. The initial outcome is that JSDL is to low level for the purpose and would need extension. This is work in progress. An initial services registry for Analysis and Data services is planned for the PM24 timeframe. This will likely be based on components of the upcoming new GRIA release from IT-Innovation.

1.5 Acronyms and Abbreviations

1.5.1 Acronyms

- GRIA: Grid Toolkit developed by IT-Innovation[3]
- MSC.Nastran: Finite element based simulation software developed by MSC.
- MSC.SimManager: name of software product from MSC, which is the basis of simulation data and process management systems like CAE-Bench.

1.5.2 Abbreviations

- AS: Analysis Service[1]
- B2B: Business to Business
- DMZ: Demilitarized Zone – safe place between Internet and Intranet
- GPE: Grid Programming Environment (<http://gpe4gtk.sourceforge.net>)
- GT4: Globus Toolkit (<http://www-unix.globus.org/toolkit>)
- HPC: High Performance Computing
- OGSA: Open Grid Services Architecture (<http://www.globus.org/ogsa>)
- PSE: Problem Solving Environment, for example SRS, CAE-Bench or the CAE Design Lab
- WS: Web Services (<http://www.w3.org/2002/ws/>)
- WS-I: Web Services Interoperability (<http://www.ws-i-org>)
- WSRF: Web Services Resource Framework (<http://www.globus.org/wsrf/>)

1.6 References

- [1] Martin Knoblauch. Consolidated Evaluation and Comparison Documentation for Recommended Implementation Plan for Integration of Analysis Services. SIMDAT deliverable D7.1.1. Munich, 4 May 2005.

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- [2] Mike Boniface. Consolidated requirements report, roadmap and SIMDAT infrastructure design. SIMDAT deliverable D2.1.1. Southampton, 10 February 2005.
 - [3] GRIA: Grid for Industrial Applications <http://www.gria.org/>.
 - [4] IST-2002-511438 SIMDAT – Annex I, vers. FINAL – Approved by EC on 04/06/2004
 - [5] IST-2002-511438 SIMDAT – D17.1.1.2: Initial version of the application scenario demonstrating connectivity and the operation of the model problem.
 - [6] Martin Knoblauch: First Reference Implementation of Analysis Services for Evaluation in Selected Application Area. SIMDAT Deliverable D7.1.2, Munich, November 4th 2005
 - [7] Mike Surridge and Mike Boniface: Industrial Grid Profile Analysis Report SIMDAT R01 V1.0, IT-Innovation Centre, 18 February 2006

2 Improving the Nastran Reference Service

2.1 Infrastructure

So far the only user of the Nastran reference service has been the Auto-2 prototype from LMS/Noesis. The service has been used more or less frequently over the whole period. During this time only small problems have shown up, mainly related to the handling of the CACert certificate revocation list (CRL). These have been resolved and stability has been increased.

Another problem has arisen recently when trying to support multiple certificate authorities. This will be necessary for the Aero Structural Service described below. Due to time constraints this issue has not been resolved. The likely solution is trivial, but needs testing.

2.2 Structural Service for Aero

In a meeting between WP7 and representatives from the Aero activity it was decided that MSC will implement a Structural Service suitable for the Aero prototype.

The prototype will provide Catia geometry, thickness, material and loadcase. The structural service will then perform the following tasks:

- Generate a mesh using Patran
- Assemble mesh and loadcase into a Nastran model
- Use Nastran to do a simple stress analysis
- Extract a key result (like maximum stress) and deliver it back to the Aero prototype

The work will be completed by MSC and tested from the Aero Prototype by PM24.

3 Evaluation and Feedback from the Application Areas

All application areas will deploy Analysis Services in their PM24 prototypes in some form. When requesting feedback and suggestions for new requirements some common pattern becomes obvious.

- **Standards**

All Application Areas are looking into WSRF as a standard for Grid/Analysis Services. IT-Innovation has developed an analysis [7] showing that WSRF is lacking for use in Enterprise B2B applications. This is still under critical discussion and the final outcome is not clear yet.

GRIA will nevertheless support a certain set of base WSRF features in the upcoming 5.0 release.

- **Registry Service**

All Application Areas are asking for a Registry for Analysis and Data services. Due to the complex nature of the requests to the Registry, some kind of semantic component is needed for the necessary translations. GRIA 5.0 will provide a Semantic Service Registry based on UDDI and OWL-S as presented at the March 2006 Grid technology days. A taskforce lead by Aero will meet in April to define usage scenarios for this Registry. So far the - still incomplete - list of required information from the Registry includes:

- Type of service offered (e.g. Meshing, Assembly, Structural Analysis, ...)
- Which “Grid Protocol” is needed to use the Service (GT4, GRIA, SimManager Public-API, etc.)? Until a common global Grid Service standard is in wide use, this information is necessary
- Underlying Application Code (e.g. PamCrash, NASTRAN, ...)
- Underlying Application Code Version
- Description of input files and parameters (type, required/optional, ...)
- Description of service results
- Data Life-Cycle information (access, lifetime, ...)
- Resource management
- Information about needed Licenses (-> cost)
- Information about possible workflow execution

In parallel some effort has been spent by BAE and EADS on looking into JSDL to describe Analysis Services. JSDL is a language for describing the submission requirements of individual jobs. It does not attempt to address the entire lifecycle of a job or the relationship between individual jobs. It is therefore anticipated that, when managing and running jobs that were described and submitted using JSDL, particularly in a Grid environment, a number of other languages and protocols are also required. The initial outcome of the GAP analysis is that JSDL is too low-level for the purpose of describing Analysis Services.

The following paragraphs describe feedback and new requirements for each application area.

3.1 Aero

The Aero prototype is successfully using Analysis Services based on GRIA in the current prototype. To refine the prototype Meshing/Assembly/Solving services for of the “Structural Analysis” part are needed. These will be provided by MSC for PM24.

Other than that a strong need for a Registry and well defined services descriptions has been articulated.

3.2 Auto

Besides the common requirement for standards and Registry functionality, there has been feedback from two parts of the Auto activity.

3.2.1 ESI/Renault/Idestyle

This part of the Auto prototype is using GRIA for Analysis Services. Some GRIA specific feedback has been provided and forwarded to IT-Innovation:

- Needs to run the DMP Version of PamCrash. This requires writing a Host-/Cluster-File “on the fly”.
- Gria Resource Manager should not fail if nodes are unavailable at request time.
- Remote execution of interactive services is desired. This is likely outside the scope of SIMDAT

3.2.2 Knowledge Services (SCAI/MSC)

A data-mining scenario will be implemented for PM24/Review. The aim of this demonstrator is to implement a first step on the way to the application of distributed knowledge discovery algorithms into the automotive distributed problem solving environments. The knowledge use case of the PM 24 automotive knowledge demonstrator is to investigate the impact of design changes on the NVH behavior of the SAMD prototype.

A client application/portal will extract meta-data for WEKA from a SimManager System by invoking the SCAI-Disassembling Tool. This needs the deployment and use of Data- and Analysis services. These will be developed by MSC. The client will be done by SCAI with support from MSC.

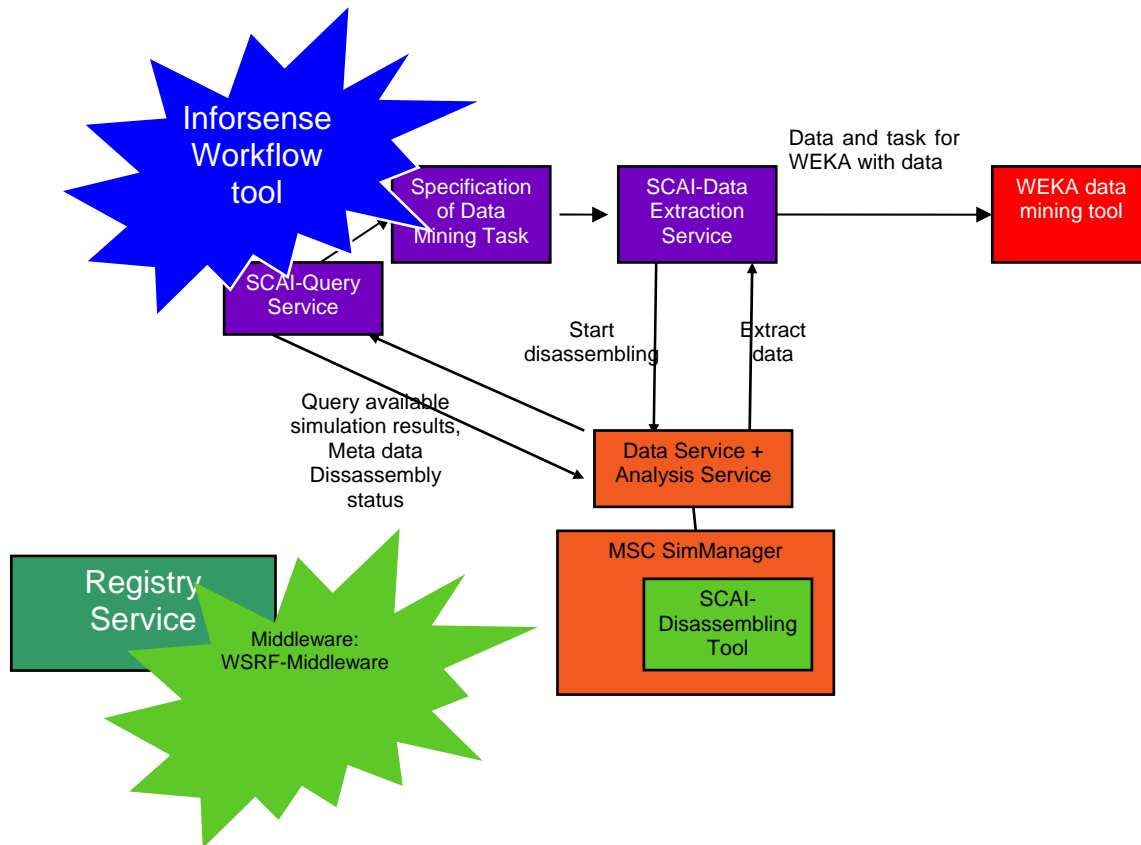


Figure 1: Knowledge Service Scenario for Auto Prototype

While the data services will be implemented using OGSA-DAI based on the GT4 toolkit, the final decision on what toolkit/framework to use for the Analysis services has not been made. The choices are to wrap the SimManager “Public API” into either a thin WSRF or GRIA layer, or to use the “Public API” directly. Deciding factors will be the complexity of the task and the available resources for a PM24 implementation.

The uncertainty on this important detail defines one requirement for the Registry service. As part of the information about a specific Analysis service, the Registry needs to know the “protocol” that the service is using. With this information a client can on-the-fly choose the appropriate interface for invoking the service.

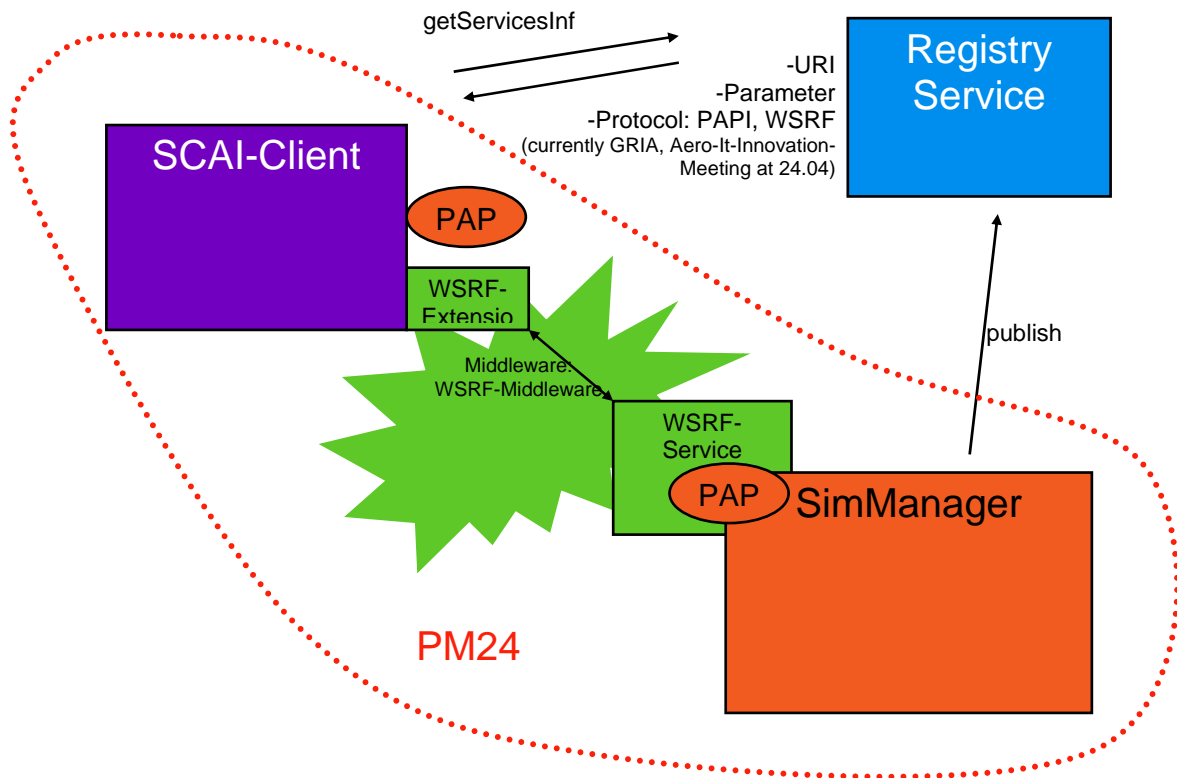


Figure 2: Registry Service for Auto prototype

3.3 Meteo

Meteo is looking into using WSRF (GT4) based Analysis Services. Besides the desire for standardization, no new requirements have been defined.

3.4 Pharma

The Pharma activity is looking into the integration of GRIA into SRS. They are also evaluating “Genostar iogma” (bioinformatics platform for exploratory genomics), a commercial development of a bioinformatics analysis environment integrating workflow concepts

In addition, some new requirements for the deployment of Analysis Services have been specified:

- Functionality: Analysis Services as part of larger transactional services (e.g. distributed BLAST job)
- Security: removal of temporary files as part of QOS attributes
- Performance: no more than 5% overhead for long running jobs. 30% overhead is acceptable for short jobs.

4 Conclusion

All application areas are using Analysis Services in some form, proving the usefulness of the concept. The availability of GRIA for SimDat has been beneficial for the project by providing a framework for the quick integration of analysis codes.

Common to all application areas is the desire for agreed upon standards. WSRF is getting more support, but there are still issues that need to be resolved.

Another common wish is the availability of a Registry service for Analysis and Data Services. Until PM24 work will be done to have a sample implementation ready for demonstration. This will likely be based on components of the upcoming 5.x GRIA release. The driving force for this will be the AERO activity.

Communication between the application areas that use Analysis Services, especially AERO and AUTO (ESI/Renault/Idestyle) will be improved for the remaining project time. The goal is to come up with a more general useable reference implementation/template.