MAGIE

Mass of data Applied to Grids: Instrumentation and Experimentations

Abstract

Data and computing grids technologies have now reached a sufficient quality to allow the deployment of large scale production infrastructures such as EGEE, consisting of 12000 processors, 5 PetaBytes shared worldwide among 130 nodes, dealing daily with several thousand jobs. The various scientific fields using EGEE (Astrophysics, Bioinformatics, medicine, particle physics and Earth Science) all share huge needs relative to data storage, data access and data mining. A certain number of blocking problems and bottlenecks have already been identified, linked to the data volume (several PetaBytes) and to the files number (several millions) that will have to be dealt with. The observation and instrumentation of the EGEE production infrastructure, because of its very large user community and its very demanding storage and access requirements, will allow in a unique way to collect very precious information and to propose innovative solutions, in a context where scaling is a immediate necessity, on workflow, databases, mediation systems, mining and learning. The validation through experimental data taken at the relevant data scale is an essential asset of this project. A close and novel collaboration will thus be built on the ground between the various users communities and the computing scientists, as can be seen in the countries were similar initiatives were launched (UK, US). In addition, MAGIE will allow to create a very interesting synergy between EGEE, a production infrastructure, and GRID5000, the French grid research infrastructure. Measurements collected on the former will provide experimental input to the latter, new methods derived from GRID5000 work will be tested on EGEE. A few nodes of the French EGEE grid will have to be equipped with significant storage capacity in order to enable relevant measurements. It is also necessary to allow storage experiments in parallel to the production needs. This hardware investment will complement the very large effort provided by the various EGEE-France partners (CNRS, CEA, Europe, Regions, Departments). The total financial request is 2 M€, 50% to recruit computing scientists, and 50% for storage hardware. Our consortium is made of 18 laboratories representing the user communities and a strong contingent of computing scientists, specialized in data transport, storage, access and mining.

Table

1 OVERVIEW

1.1 Preamble and Partnership

Very large computing and data grids have been recently been set up as production infrastructures, allowing various scientific communities to develop new powerful methods and produce new results in a novel fashion. In Europe, the major project at this scale is EGEE(http://www.eu-egee.org) with vast computing and storage resources (12000 processors, 5 PetaBytes of storage) made available to several hundred users on 24h/24h basis. This new computing object needs to be understood in great detail to make sure it will be able to satisfy the huge future needs. The MAGIE (Mass of data Applied to Grids: Instrumentation, Experimentations) project has been set up to address this goal, concentrating on the most demanding issue of data access, storage, transport and mining. Experienced users, with very demanding data needs and computing scientists with expertise on all the fields mentioned above have decided to join their forces to create the experimental conditions and measurements that will provide a unique testing ground for novel methods proposed by advanced computer science research labs. The MAGIE consortium thus represents a total of 18 laboratories, 75 participants for a total of 24 FTE, equally split between advanced grid user communities involved in four different scientific disciplines: Earth Science, Life science, Astrophysics, High Energy Physics and pioneering computing research in domains related to large data sets. The complete list of the teams with the CVs of the team leaders is given in Appendix A. MAGIE will develop very close ties with several other grid projects or infrastructures in France and internationally, such as the French grid research infrastructure GRID5000. In addition, several laboratories or projects, including industrial partners have expressed their support to MAGIE: they are listed in Appendix B.

Although MAGIE requests a large budget from ANR, this sum represents only a small fraction (10%) of the efforts the various user communities are already investing in grid based activities. In particular, no manpower is requested from ANR neither to operate the grid and produce the experimental results MAGIE relies upon, nor for any computing elements, nor for applications developments.

In summary, MAGIE is a great opportunity to make decisive strides in grid research and to bring together large user communities and advanced computing research, using quantitative measurements and experimentations on a real large scale production grid infrastructure.

1.2 Goals

The goals of this multi-disciplinary project are:

- Fostering interactions between, on one hand computer science on-going basic research and advanced methods in the fields of data access and interpretation, and on the other hand the scientific disciplines which are grid users. This interaction will target the following objectives.
    - Transfer of knowledge and skills: the goal is to provide the advanced functionalities which will allow to scale the current computing practices of the disciplines up to the grid level.
    - Experiment and deploy the computer science research work at a very large scale, being supported by the hardware, software and manpower of the unique European production grid based on clusters.
    - Be the seed of a new scientific community: just as parallel architectures (hardware and software) have co-evolved with high performance numerical applications, the feedback loop between grid infrastructure projects and the final users should include basic computer science research.

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- Contribute to an experimental theory of grids systems through the initiation of a *grid observatory*. Models inspired by extensive observations should provide rationales for engineering design and choices, which are based currently on educated intuition, and should also be subject to elaboration and even refutation with the improvement of acquisition methods.

This project, after completion, will form the basis of an integrated, multi-disciplinary and open national grid data-oriented production infrastructure.

2 PROJECT ORGANIZATION

Given the very large size of the MAGIE project (18 laboratories and ~100 people), it has to be very well structured. MAGIE is structured around a project office, 8 partially overlapping workpackages, a collaboration board, and a resource board. An external advisory committee will be set up to monitor the project activity and to provide external guidance. Short description of these various entities is provided below

2.1 Project management

2.1.1 Project office

The project office has the role to provide global management of the project, monitor its progress, prepare the documents for the various reviews and reporting requests, deal with the financial aspects. It will also be responsible for outreach and dissemination, contact with associated partners from the academic or industrial world. The project office consists of the project coordinator, secretarial help from the coordinating laboratory and the executive board formed by the Work Packages leaders.

2.1.2 Collaboration Board (CB)

The two primary roles of the CB, made up by one representative from each participating lab, is to select the project coordinator and to make sure that the information flows well within the project. The CB meets twice a year to hear a status report, discuss any important issue, decide on new memberships,… A Resource Board (RB) will be formed by a small number of CB members, to monitor the usage of the storage capacities provided by MAGIE to the various users communities, to make sure that they are used to the best interest of the MAGIE project. Its membership consists of the project coordinator, one representative from each user community, and two representatives chosen by the CB. Local resource managers are in attendance.

2.1.3 External Advisory Committee

Three international experts on grid computing will be asked to monitor MAGIE and provide regular guidance to the project Office.

2.2 Workpackages

MAGIE is organized into 11 WP, overlapping as the matrix indicated in the figure below: 5 are related to computing research (WP-CR1-5) themes, 4 to each main applications domain (WP-A1-4) and two to resource deployment and data transport (RD, DT) issues,.

WP CR1	Towards a Grid Observatory
WP CR2	Scientific Data Mining
WP CR3	Data Security
WP CR4	Grid-enabling Data-Intensive Workflows
WP CR5	Querying, Sharing and Integrating Data in grids
WP A1	Earth Science
WP A2	Life Science
WP A3	Particle Physics
WP A4	Astrophysics, Cosmology and Astroparticle Physics
WP RD	Resource Deployment
WP DT	Data Transport

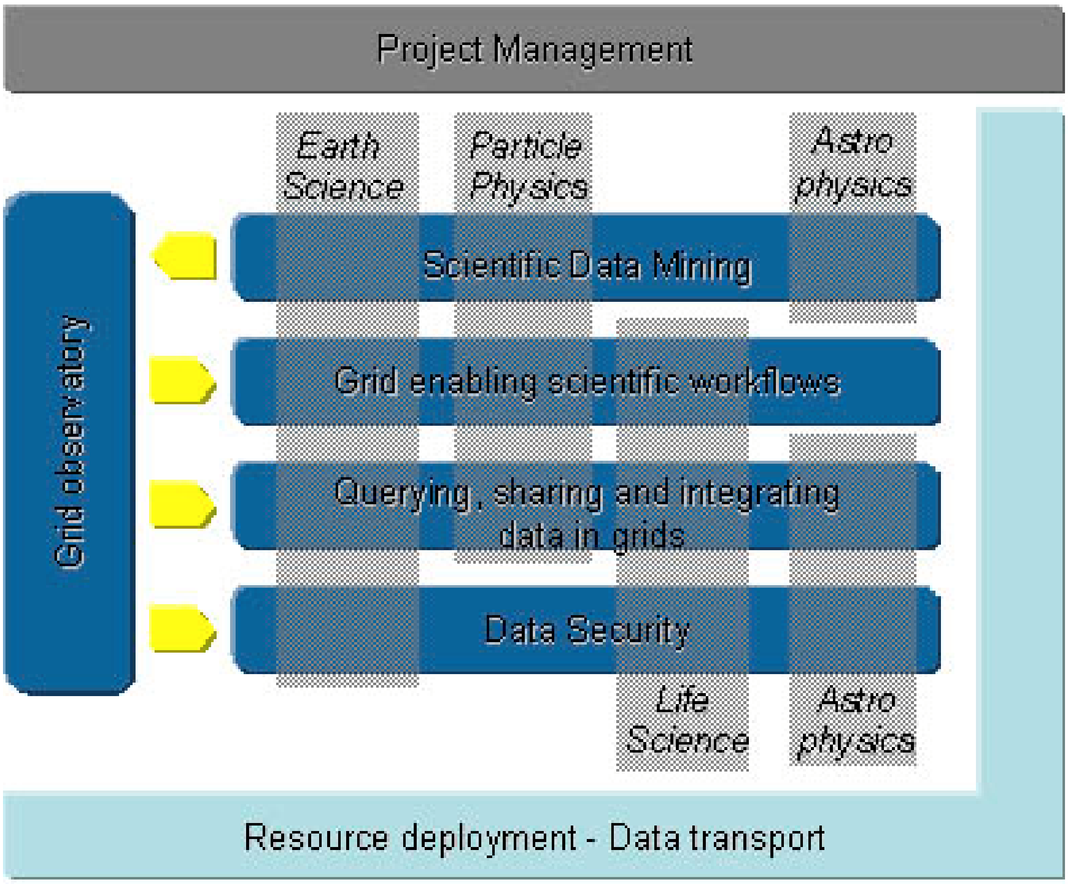

Fig 1. Matrix organization of the 11 Workpackages of the MAGIE project

3 MOTIVATION AND CONTEXTS

Faced with the challenge of new experiments that produce unprecedented data volumes, various scientific fields had decided to turn to grid infrastructure. The degree of implication varies: HEP worldwide has made a definitive choice, thus heavily invested (both in infrastructure and manpower) in the preparation of the use of the grid in a coordinated fashion. Earth Science and biomedical research are in the experimentation phase, with a significant investment. Grid awareness has grown to a high level in the public, which is waiting now for the grid to deliver.

To summarize these expectations, the need is for “real-time” processing, from true real-time alert in the case of major natural catastrophes or the grid information system itself, to acceptable response time in the analysis of the continuous flow of data produced by the LHC; life science applications present both aspects. The major accomplishment of the EGEE project has been to set-up a grid middleware that has been proven scalable to an unprecedented level under the pressure of the most demanding applications. The next step is to provide the grid-enable advanced methods required for organizing, accessing and mining these data, at the same scalability level. This step is probably not less difficult than the previous one, many of the issues being currently computer science research.

3.1 Scientific and societal challenges

3.1.1 Earth Science

Earth Science covers many domains related to the solid Earth, the Ocean, the Atmosphere and their interfaces. The volume and the quality of the observations are increasing due to global and permanent networks as well as satellites. The result is a vast amount of datasets and databases, all distributed among different countries and organizations. The investigation of such data is limited to some sub-sets. As a matter of fact, all those data cannot be explored completely due on one hand to the limitation in local computer and storage power, and on the other hand to the lack of tools adapted to handle, control and analyse efficiently so large sets of data.

Furthermore, many national and international programmes - both research and operational – in different domains aim to develop large-scale frameworks for monitoring and analysis of earth-system interactions in order to better understand and predict prevailing conditions (now casting as well as long term prediction). This kind of application implies the integration of cross-domain scientific data in large-scale simulation modelling that is necessary for example to improve long-range weather and environmental forecasting. They could also imply software platforms including web services. Civil sector applications bring two classes of requirements: the first concerning short-term forecasting of risks (e.g. of pollution, earthquakes, thunderstorms, hurricanes, volcano eruptions), and the second concerning long-term forecasts for climatic trends. Both require fast access to large distributed datasets and high performance computing resources.

Grid technology has started to increase the accessibility to computing resources. Earth Science has explored the grid technology via European projects such as DataGrid and EGEE in different domains to test the possibility to deploy their applications on a larger scale. The next step will be to develop, chain and port more complex applications, which will lead to original results and new computing paradigms. The tools needed are mainly beyond the skill of any ES laboratory; however the tools will surely be the result of collaboration with computer research teams.

3.1.2 Life science

The awareness of grid technologies in the health community has increasingly raised in the past five years. Although there was *a priori* few interest for computing technologies in this community, the needs for large data manipulation and analysis has lead to identify areas where applications can highly benefit from a grid infrastructure. Early in the European DataGrid project (2001-2004, http://www.edg.org/), the biomedical applications have been identified as a pilot area for steering grid development and testing grid infrastructures. In the same time, the international community has been increasingly active in the area of grids for health as demonstrate the multiple conferences (see HealthGrid, http://www.healthgrid.org/, or Biogrid, http://www.cse.uconn.edu/~huang/BioGrid-05/, for examples) and research program appearing (see MEDIGRID, http://www.creatis.insa-lyon.fr/MEDIGRID/, or BIRN, http://www.nbirn.org/, for example).

The biomedical applications area is one of the two pilot application fields considered in the EGEE project. It has demonstrated the relevance of grids for that kind of application with the deployment of more than a dozen of applications in the fields of medical image analysis, bioinformatics and molecular structure analysis in a production environment. In all these fields, the current acquisition devices enable the acquisition of tremendous amount of data. Usually, the data produced are stored locally, on-site, and data exchanges are limited or require a human intervention. In the worst cases, data is just lost by lack of storage resources. The pilots deployed in the EGEE project could benefit from the grid capabilities to distribute, store, share, and process such data.

3.1.3 Particle physics

Since now several years the particle physics community plays a major role in the development of grid computing. The high level motivation of this community is driven by the nearby start-up of the Large Hadron Collider (LHC) at CERN and the data taking of the four associated experiments ALICE, ATLAS, CMS and LHCb. In these experiments, the collision rate will grow from 100 million per second in 2007 up to 1 billion per second in 2010. The highly sophisticated trigger electronics of the experiments will select about 100 events per second of high physics interest. The amount of produced raw data remains nevertheless at a level of 10 to 15 PetaBytes per year which is several levels of magnitude above the one reached in any previous experiment.

In order to overcome the LHC challenge, the particle physicists have decided to join the LHC Computing Grid (LCG) [Hep01] project putting together there computing and storage resources located all over the world in Europe, Asia and America. Since the aim of the LCG project is to deploy the grid infrastructure needed to reconstruct, analyse and simulate the four LHC data, LCG has a strong connection to the Enabling Grid for E-sciencE (EGEE) [Hep02] project. The LCG project strongly participates to the development of the EGEE grid software (middleware) and as a consequence heavily uses the EGEE middleware for its implementations. Similarly to EGEE, the physics collaboration users (physicists and software engineers) are grouped into virtual organisations (V0) which are in charge of the development of the applications needed to treat the detector data.

One should also note de global trend in the whole community to migrate to the grid computing model. In order to profit from this emerging tool, the particle physics collaborations from the BaBar, CDF, D0 and Zeus experiments have decided to adapt their software to the grid.

3.1.4 Astrophysics

Astrophysics and cosmology are currently at one of the major turning points of their long history. Since a few years, experimental evidence (ultra high energy particles, dark matter, dark energy) has leaded to question the standard model of the universe which has been stabilized in the middle of the XXth century; longstanding competing theories (e.g. string theory), could be proved or infirmed in the next decade by ongoing experiments. The conjunction of advances in acquisition devices, mature theory and puzzling partial evidences from previous generation observatories, has led to a massive international effort in funding various observatories whose common goal is to gather significant enough data series (statistics in the physics vocabulary) about these elusive phenomena. The projects are described in more detail in the WP Astrophysics.

These projects gather and process larger and larger data sets, which can easily attain hundred terabytes. The data structures have generally a lower degree of complexity, compared to what is found in particle physics. Most often, the data can be described as one of the following structures:

- Images and pixelised maps, representing emission and absorption intensities over a region
- Time series, with regular and irregular time sampling. The gravitational wave detector (VIRGO) is an example of a large instrument, where most of the data can be represented as time series.
- Catalogues, representing for example various characteristics of celestial sources.

In some astroparticle experiments, such as the cosmic and gamma ray observatories, the data have richer structures which are comparable in some extent to the complexity of the data structures encountered in particle physics.

We have to add to the ancillary data, representing the status of the instrument and its environment, as well as the all the associated data, called some times metadata, needed to describe and manage the scientific data and the various processing steps.

The data accumulated by the various projects must undergo complex and often CPU intensive processing, which produce usually new and large data sets. Simulations and comparison of real and simulated data sets are common practice in the field, increasing the need for powerful data management systems.

In addition, an increasing number of projects have to make the processed data available to a large community. Indeed, the study of many subjects can only be done through a joint analysis of data accumulated with different instruments, operated by various groups.

3.2 Scientific and technical bottlenecks

Research into grid technologies and recent, large-scale deployments of those technologies have resulted in a relative consensus on the basic functional requirements towards grid middleware: grouping of users into Virtual Organizations, transparent execution regardless of location, availability of a global file system, and scheduling based on the required data. Data intensive applications require advanced tools in order to reap the full benefit of the grid. These tools fall into two classes: those related to information access and those related to data analysis.

The complexity of real applications requires the definition of intermediate-level services to provide high-level, efficient solutions for data access. From this point of view two objectives are critical: the services must scale to an unprecedented number of users and sites and, for certain applications, they must guarantee the security and confidentiality of the data. The design of tools in this area touches many fundamental, interrelated research areas.

The analysis of scientific data (from physics, geophysical, and life science research) as well as the data related to the operation of the grid translates into the study of data-mining and statistical inference within the computer science domain. The fundamental link between the scientific and the operational issues is the need to use metadata to represent, interpret, and characterize the data. Fundamental computer science research, in particular from the study of databases, mass storage, and data-mining, has produced methods, algorithms, and environments which have been largely validated scientifically but still need to be stress-tested on a very large scale.

Like the scientific data, the complexity of the grid itself requires advanced analysis. The grid infrastructure consists of a variety of components: processors, storage, network, and grid services, which are, in their own right, complex systems in the technical sense of that term. Such a large distributed system cannot be analytically modelled: its topology and state at any time can only be estimated, and its production usage often results in an uncontrolled and unforeseeable load on the system. As the rules controlling its behaviour are unknown, the grid itself becomes an object for observation and experimental studies, with two objectives:

- To understand in general the dynamics of the use of grid resources and in particular the access related schemes.
- To provide a realistic model of large, highly distributed systems, to drive the study of optimal algorithms for the scheduling of jobs, transfer of data, and the like.

3.3 Related projects

In Europe and in the US, a few large-scale integrated projects involving both computer science research and the above mentioned scientific domains have proposed to go beyond the proof of concept stage to long-term cooperation. Building upon the rich experience of its partners, the ambition of MAGIE is to act as a seed to develop the same synergies, and to offer an equivalent visibility.

3.3.1 US

Describing the relentless effort toward grid computing, starting with the early metacomputing, and currently implemented in a few nationwide projects is outside of the scope of this proposal. We only want to stress here two related points

- The overall trend to integration of the resources (hardware, software, manpower and skills): three major US projects (iVDGL, GriPhyN and PPDG, and the U.S. participants in the LHC experiments ATLAS and CMS), have joined their efforts into the Grid3 project (http://www.ivdgl.org/grid3/). Amongst the principal investigators of Grid3 are Ian Foster and Miron Livny, well-known pioneers of the theory and practice of grid computing; among the computer science research areas are grid monitoring (with MonaLisa and Ganglia), and data interpretation. Grid3 has now evolved to the Open Science Grid consortium (http://www.opensciencegrid.org/)

- The continuous integration of the highest quality computer science research with real-world applications by the means of collaboration in a production system. The following quote coming from the presentation of the PPDG project is a very concise description of this integration.

"The Particle Physics Data Grid Collaboratory Pilot (PPDG) is developing and deploying production Grid systems vertically integrating experiment-specific applications, Grid technologies, Grid and facility computation and storage resources to form effective end-to-end capabilities. PPDG is a collaboration of computer scientists with a strong record in Grid technology, and physicists with leading roles in the software and network infrastructures for major high-energy and nuclear experiments. Our goals and plans are guided by the immediate and medium-term needs of the physics experiments and by the research and development agenda of the computer science groups."

This quote dates from 2001; if we extend "particle physics" to the disciplines that are currently exploring grid usage, and specialize the computer scientist research areas and skills to the area of data access and interpretation, MAGIE could be seen as a contribution towards the emergence of such collaboration at the national level.

With respect to these projects, the originality and potential advance of MAGIE is its strong component in the area of data semantics, as a principal bridge between the operational and interpretation issues.

3.3.2 European initiatives

In Europe, several countries have launched a coordinated grid effort, associating a production grid infrastructure development with computer science research. The leading country is the UK, (the e_science initiative), followed by Italy (Grid.it) and recently Germany (D-Grid). In France, such an initiative has not been taken up yet and MAGIE would represent a large step in this direction.

In addition to these national projects, the EU strongly supports very important Grid programs, both on the production infrastructure side (EGEE (http://www.eu-egee.org) and DEISA (http://www.deisa.org) and on the research side, organized along various networks of excellence. Two of them are especially related to MAGIE:

3.3.2.1 PASCAL (http://www.pascal-network.org/)

The objective of PASCAL is to build a Europe-wide Distributed Institute which will pioneer principled methods of pattern analysis, statistical modelling and computational learning as core enabling technologies for multimodal interfaces that are capable of natural and seamless interaction with and among individual human users. EGEE has recently developed a strong interest in grid-enabling interaction, in collaboration with the former EU CrossGrid project. The LRI partner has pioneered awareness about this issue in EGEE, and is the site manager for Université Paris-Sud in PASCAL. This configuration offers a rare opportunity for cross-fertilization at the institutional level.

3.3.2.2 CoreGrid (http://www.coregrid.net/)

This European Research Laboratory has six virtual institutes mapped to the areas that have been identified in the joint programme of activity as "of strategic importance". Two of them are *knowledge & data management* and *Grid information and monitoring services*, which are the main targets of MAGIE. At the European level, EGEE and CoreGrid have established some collaboration.

3.3.3 National

3.3.3.1 Grid 5000

French researchers have at their disposal unique tools like Grid5000 and Grid Explorer for the study of problems related to large-scale grids. These tools are very complementary to production infrastructures lie EGEE which can bring very valuable and reliable measurements of the real-life behaviour of very large-scale, production grids running diverse applications which analyse huge volumes of data.

3.3.3.2 DEISA and large HPC computing centers

EGEE production infrastructure is quite different from HPC grids such as DEISA and very complementary: only jobs which do not require a high level of parallelism are well adapted to EGEE, whilst such jobs should not run on HPC computers. The storage issues are also quite different. However, it will be useful that MAGIE and DEISA share some results in a regular fashion.

3.3.3.3 Thematic programmes ACI Masses de Données and other ACI

The relevant actions will be described in the *Partners Skills* section.

4 PROJECT DESCRIPTION

4.1 Computing research issues

4.1.1 Modeling very large systems

The complex system constituted by the grid itself on one hand, and the complex systems explored by the applications on the other hand, exhibit similar characteristics and comparable structures.

These systems first share the volume of information to analyze. Complexity has reached new levels, due to the large range of dynamic resources (all kinds of resources like software usage rights, sensors, logical objects, etc.), application workflow improvements, and the interference of VO management and modern resource brokering. To give some idea of this complexity, in EGEE:

- About 30 VOs (virtual organisations of a community of users and resources) access 30 resource brokers launching jobs, sharing computing elements (in general clusters) from more than one hundred computing centres around the world through network connections provided by NRENs and international links. The volume of information generated by the grid itself is also large: very concise data about jobs (logging & bookkeeping system) amounts to 1GB per month.
- High Energy Physics experiments produce 4*40 million events each second (15 PB/year) and the millions of files produced per year must be processed through four levels of computing centres. Moreover, 6000 physicists want immediate (often simultaneous) access to analyse and visualise these data.
- Data for climate studies are shared between multiple organizations. These data must be located and aggregated before and during analysis through metadata describing ontologies, access rights, and access protocols own by each organism.

The second characteristic is that there is no unique exact interpretation that could be used as a reference to calibrate the interpretation methods and analysis algorithms. Thus, the issue is first to define the search space (classes of interpretation, selection of models), the criteria of interest (what is a meaningful interpretation). The second is to define a relevant interaction mode: the question is the tradeoff between the time required to propose solution and the quality of the solution, which allows for a feasible dialogue between the expert and the system; the relevant technical context is the one of *anytime algorithms*.

MAGIE is thus highly innovative in that the modeling functionalities to realize could and should be equally relevant for the grid users (applications) and the grid administrators and even developers.

Related Computing Research WP: Grid Observatory, Scientific Data Mining

Related Applications WP: Astrophysics, Earth science, Particle Physics

4.1.2 Workflows and scientific computing

Workflow management systems (WMS) have a well-established popularity as support tools for business processes. Software tools to generate workflow process definitions from business models exist. The migration between the simple sequential model implemented in batch computing and a broader model encompassing complex workflows scheduling and data dependencies is required in many application areas.

Workflows are currently being studied in three different communities that have identified the need for dealing with complex data flows and chains of processing. It is striking that this same thematic is addressed under different names depending on the community: *workflows* in the industry or the parallel and distributed systems community, *dataflows* in the community of semantic mediation, and *massively parallel problems* in the community of grid users. The different phrasings should not hide a unique need: to efficiently schedule and process a set of dependent processes with temporal and data dependencies.

Recent research efforts aim at integrating access control mechanisms into those tools. Access control is of major importance for such environments, especially if a shared resource is used both in the grid and for internal purposes of the organization.

For life science applications, and especially for medical imaging, scientific workflows need to cope with various types of resources, which are both data and processing procedures. These resources are in essence heterogeneous and distributed. Sharing these data and integrated them over scientific workflows implies the definition of semantic descriptions of these resources in order to better interact with the design of the scientific workflows according to the semantic information carried by all resources composing (i.e. for the processing) or traveling (i.e. for the data) the workflows.

Related Computing Research WP: Grid-enabling Data-intensive Workflows, Data Security

Related Applications WP: Earth science, Life Science, Particle Physics

4.1.3 Security and privacy

In the recent years, much work has been done on the basic tools for security in computational grids, with two main contributions: authentication (so that users can be recognized across institutional boundaries in virtual organizations), and transport security (so that data can be transmitted from one site to another without being disclosed). Authorization is most of the time based on authentication and mapping between global identities and local rights in the distributed system. In EGEE, for instance, VOMS (Virtual Organization Management System) gives attributes to users, these attributes being used to allow or deny access to resources. We believe that this approach does not cover completely the needs of some user communities. Medical applications for instance need more fine grain access control than what is included (or will be in the near future) in EGEE middleware; in some extreme cases, raw data simply cannot be published, and the challenge is to define the meaningful attributes and the appropriate associated operators.

Related Computing Research WP: Data Security, Scientific Data Mining

Related Applications WP: Earth science, Life Science

4.1.4 Data Sharing and Integration

The recent emerging Grid computing raises many challenges in the domain of performance analysis. One of these challenges is how to understand and utilize performance data where the data is diversely collected and no central component manages and provides semantics of the data.

The goal of a Data Integration system is to provide a uniform access to a set of heterogeneous data sources, freeing the user from the knowledge about the data sources themselves. The problem of designing effective data integration systems has been addressed by several research and development projects in the last years. Most of the data integration systems described in the literature (see, e.g., [Ham95, Pap95, Zho95, Wid95, Jar99, Goh99, Ber01]), are based on a unified view of data, called mediated or global schema, and on a software module, called mediator that collects and combines data extracted from the sources, according to the structure of the mediated schema. A crucial aspect in the design and the realization of mediators is the specification of the relation between the sources and the mediated schema. Two basic approaches have been proposed in the literature [Ull97]. The first approach, called global-as-view (or simply GAV), focuses on the elements of the mediated schema, and associates to each of them a view over the sources. On the contrary, in the second approach, called local-as-view (or simply LAV), the focus is on the sources, in the sense that a view over the global schema is associated to each of them. Indeed, most data integration systems adopt the GAV approach.

Existing approaches on performance data sharing and tools integration which mostly focus on building wrapper libraries for directly converting data between different formats, making data available in relational database with specific data schema, or exporting data into XML, have several limitations. For example, building a wrapper requires high cost of implementation and maintenance; wrappers convert data between representations but not always between semantics. Although XML and XML schemas are sufficient for exchanging data between parties that have agreed in advance on definitions, their use and meaning, they mostly are suitable for one-to-one communication and impose no semantic constraints on the meaning of the data. Everyone can create his own XML vocabularies with his own definitions for describing his data. However, such vocabularies and definitions are not sharable and do not establish a common understanding about the data, thus preventing semantic interoperability between various parties which is an important issue that Grid monitoring and measurement tools have to support. Utilizing relational databases to store performance data [Tay00, Tru03] simplifies sharing of data. However, data models represented in relational database are still very tool-specific and inextensible. Notably, XML and relational database schemas do not explicitly express meanings of data they encode. Since all above-mentioned techniques do not provide enough capability to express the semantics of performance or application data and to support tools integration, they might not be applicable in Grids due to the autonomy and diversity of performance monitoring and measurement tools.

The Grid provides us with the ability to create a vastly different model of data integration allowing support for dynamic, late-binding access to distributed, heterogeneous data resources.

Related Computing Research WP: Querying, Sharing and Integrating Data, Scientific Data Mining

Related Application WP: all

4.1.5 Efficient access to data

Query optimization, in any type of database system, is basically to determine, in a considered search space and for a given query, an execution plan close to optimum (or optimum). Optimality of the execution plan among the alternatives is predicted through the estimations produced by the cost model which mostly combines the statistics on the base data and estimations on the runtime information into an overall metric. Availability of the dependable statistics and runtime information become critical issues since optimization is only as good as its cost estimates [Oza 05]. In this perspective, various solutions to the cost estimate problem have been proposed [Ada 96, Du 92, Gar 96, Zhu 03]. Whatever the solution of the cost model is, the statistics stored in the database catalog are subject to obsolescence notably, so, it is very difficult to estimate the processing and communication costs during the compile time in large-scale heterogeneous databases. Hence, in [Ive 04, Ham 02, Ham 04, Kab 98, Kha 00] centralized dynamic optimization methods are proposed in order to react to estimation errors (i.e. variation between the parameters estimated at compile-time and the parameters computed at run-time) and resources unavailability (i.e. data, CPU, memory, networks). In large-scale heterogeneous database, the centralization of dynamic optimization methods generates a bottleneck and produces a relatively significant message passing on the network and prevent the scalability. Therefore, we suggest to leaning on a programming model on base of mobile agents. This theme corresponds to that of the ACI “Masses de données 2004” Gene Medical GRID: architecture for the management and the analysis of gene-medical data on computing GRID (http://liris.cnrs.fr/PROJETS/ggm)

Related Computing Research WP: Qurying, Sharing and Integrating, Scientific Data Mining

Related Application WP: All

4.2 Partners skills and involvement

4.2.1 Computer Science laboratories

4.2.1.1 LIRIS Laboratory

The LIRIS partner is an UMR CNRS (5205), composed of 90 permanent researchers. In the MAGIE proposal, 8 researchers will participate, from three different teams. These teams have a large number of projects funded by European, French and Regional organisms, and the participants are well-known in their communities.

The "Distributed Information Systems" team is involved in Grid Computing since 2001, and focus its activities around Data Management in Grids and Large Scale Distributed Systems. The team participates in the JRA3 activity in the EGEE project related to Security. The group have been funded by the French Ministry for Research for its activity in Grid related area, and more specifically in projects involving Data Management in Grids : ACI Grid Medigrid, ACI Grid Darts, ACI Grid DataGraal, ACI MD GGM. At a regional level, the Rhole Alpes region funded the RagTime project leaded by LIRIS lab. Two permanent researchers (L. Brunie and J-M Pierson) and five PhD students are involved in these activities so far and will participate in the MAGIE project.

The Database, Knowledge Representation and Reasoning group (http://www710.univ-lyon1.fr/~dbkrr) is allso involved in this project. The research of this group deals with (1) the theoretical exploration, (2) the practical implementation, and (3) the convenient utilization, of formalisms and inference techniques capable of improving the level of abstraction, productivity, and reliability in designing advanced information systems. The group is concerned with the integration of knowledge representation formalisms and reasoning techniques for novel applications. The group is currently working on two related projects (ACI Masses de Données “Web Semantique (SemWeb)”, http://www710.univ-lyon1.fr/~semweb/) and the European Project TARCHNA (Towards ARCHaeological Heritage New Accessibility, http://www.tarchna.org/home.htm).

4.2.1.2 IRIT

IRIT laboratory is a common research unit of CNRS (UMR 5505), INPT (Institut National Polytechnique de Toulouse), UPS (Université Paul Sabatier) and UT1 (Université Toulouse 1 Sciences Sociales) composed of 210 researchers and faculty members . Research at IRIT covers all research domains in computer and information science. These programs are structured in seven research themes: information analysis and synthesis; data indexing, retrieval and storage; interaction, autonomy, dialogue, cooperation; reasoning and decision; applied maths, algorithms and high performance computing; architecture, systems and networks; safe software development.

The PYRAMIDE team (leader A. Hameurlain) is connected with the topic “data indexing, retrieval and storage” of IRIT. The team’s research is focused on optimization methods of queries referring to data sources which are heterogeneous and distributed on a large scale. The PYRAMIDE team is strongly involved in national and international initiatives in parallel databases, mobility and grid computing. For example, the team collaborated with the technical university of Vienna (Amadeus program). Nationally, the team is involved in ACI “masse de données” GGM and GRID 5000 projects. On the local plan, the team participated to contracts supported by the regional council and in research contract with the industry (Dassault Data Services).

4.2.1.3 LRI

LRI is a joint laboratory of CNRS (UMR 8623) and University Paris-Sud-11, with more than 140 researchers (permanent and PhD students), and 10 teams in various areas of computer science. The Inference & Learning (I&A) research team in LRI, historically centered on

Machine Learning and Inductive Logic Programming, has been among the world pioneer teams in machine learning since the 80's. It later broadened its scope to knowledge discovery and data mining, motivated by the ever-growing amount of available data and the strategic importance of their exploitation. The Inference & Learning team is headed by Michèle Sebag since 2002, with 7 permanent researchers and 10 non permanent (PhD students and temporary positions). The cross-fertilization of machine learning, knowledge discovery and evolutionary computation is the main motivation for the PCRI TAO project, created in 2003 and including members of the IA group and the INRIA Fractal group

The I&A - TAO group involves six highly coupled research teams / themes. The first two are concerned with the fundamentals of machine learning, knowledge discovery and evolutionary computation. A third one is concerned with inductive logic programming. The last three themes are concerned with applications calling for specific advances in ML/KDD and EC: Text Mining, Inverse Problems (Numerical Engineering), and Robotics.

At the European level, the group is involved in the Network of Excellence FP6 PASCAL (Pattern Analysis, Statistical Modelling and Computational Learning), decribed in the Context section. M. Sebag is the leader of the Paris-Sud section of PASCAL.

At the national level, the group is involved with various projects. Those relevant to MAGIE are the three ACI Nouvelles Interfaces des mathématiques (Mistr, NeuroDyne and Molecular Simulation), and the ACI Masses de Données AGIR (Global Analysis of radiological data – project leader). The group collaborates with IFP, AIRBUS, EADS and SNCF. The group is already involved in a collaboration with EGEE through DEMAIN, a joint project with LAL (university level), and also through AGIR.

4.2.1.4 L2S

The Laboratoire des Signaux et Systèmes is a common research unit of CNRS, the Electrical Engineering school Supélec and the university Paris-Sud, with a staff of about 110 (doctoral students included). It belongs to the STIC Department of CNRS and to the DSPT 9 (with the keywords control theory, signal processing, images, speech and vision; computer aided design, modelling, optimisation, micro-waves. It pertains to sections 61 and 63 of the CNU (National Council of the Universities) and is evaluated by Sections 7 and 8 of the Comité national de la recherche scientifique.

Not counting its numerous visitors, it comprises about 110 persons, including 16 CNRS researchers, 28 professors and assistant professors, a technical and administrative staff of 11, 6 post-doctoral students and 49 doctoral students.

It consists of three components of roughly the same size: the Signal Division, the Systems Division and the Electromagnetism Department. These three components share a system vision based on input-output models which may be black-, grey- or white boxes depending on how much prior information on the system is taken into account. The systems under consideration are usually dynamical, complex systems. Complexity may result from the nonlinear, multivariable, non Gaussian nature of the model, or of the dimension of its parameter vector or state vector. Modelling, parameter or state estimation from experimental data and decision making in an uncertain environment can be found in all of the three components.

4.2.1.5 IRISA

Inria, the University of Rennes 1, Insa-Rennes and the CNRS (UMR 6074) are associated within a research center called Irisa (Institut de Recherche en Informatique et Systèmes Aléatoires) located mainly in Rennes (*Web: http://www.irisa.fr/).* Irisa's scientific activities cover the following domains : Networks and Systems ; Software Engineering and Symbolic Computing ; Man-Machine Interaction ; Image Processing, Data Management, Knowledge

Systems ; Simulation and Optimization of Complex Systems. Irisa has a staff of 550 persons, including more than 250 research scientists and 170 PhD students.

In this French project, IRISA/CNRS represents also the following members of the "Joint Research Unit" IRISA :

- the French National Center for Informatics and Automation (INRIA)
- the University of Rennes 1.

The IRISA project-team concerned by this project is the VisAGeS team (http://www.irisa.fr/visages), This team has just received the recognition as a new research unit from INSERM (French National Institute of Research in Health). Research activities of the VisAGeS team are concerned with the development of new processing algorithms in the field of medical image computing and computer assisted interventions: image fusion (registration and visualization), image segmentation and analysis, and management of image related information.

The participation of the Visages team in the MAGIE project is based on our expertise, from the Neurobase project (http://www.irisa.fr/vista/Themes/Demos/Medical/Neurobase/). This expertise lies in our mature perception of the needs of this application field, our background in medical image processing and in our experience in reconciling heterogeneous data in the neuroimaging field.

4.2.2 Earth Science

The persons involved in this proposal are scientists and engineers belonging to the *Institut Pierre Simon Laplace* (IPSL) and to the *Institut de Physique du Globe de Paris* (IPGP), part of the ES community. They have been involved in Grid projects, DataGrid and EGEE. They have ported applications on Earth Observation by satellite and Seismology. On the Jussieu Campus they have a close collaboration and share the same EGEE node. M. Petitdidier (IPSL) has been the coordinator of Earth Science applications in EGEE.

The **Institut Pierre Simon Laplace** was founded at the beginning of the 1990s with the aim of sharing the skills of several laboratories implicated in terrestrial and planetary sciences in the Paris area. Today, it regroups 5 laboratories and 750 people (280 researchers, 240 engineers, technicians and administrative staff, and 230 thesis students and post-docs). This is about 40% of the national research potential in the field of oceanic and atmospheric science. The largest part of its financial resources comes from the Centre National de la Recherche Scientifique (CNRS), the Université Pierre et Marie Curie and the Université de Versailles Saint Quentin en Yvelines. The institute is also supported by the Commissariat à l'Energie Atomique (CEA), the Institut de Recherche et Development (IRD), the Ecole Normale Supérieure (ENS), the Ecole Polytechnique and the Centre National d'Etudes Spatiales (CNES).

Its main objectives are :

- To understand the dynamic, chemical and biological processes that operate in the oceans and in the atmosphere and to understand how the atmosphere, oceans and biosphere exchange matter and energy;
- To understand the natural climate variability on regional and global scales and to understand past and future trends in climate of our planet;
- To understand the impacts of human activities on the climate and to predict the climate at seasonal and interannual scales(monsoon, ENSO, NAO);
- To understand the physics of the Sun-Earth interactions in the close and distant terrestrial environment, and to use the skills developed in the study of our terrestrial environment to study the environments of other planets.

The Paris Geophysical Institute (or IPGP) is a research institute dedicated to the study of the Earth as a system. The IPGP is in charge of the French national observatories of seismology, volcanology and geomagnetism. Its statute is that of a University since 1990. It is on the protection of the *Ministère de l'Education Nationale* and the *Ministère de la Recherche.*

4.2.3 Particle physics

The particle physics community in EGEE consists of 4 IN2P3 laboratories (LAL Orsay, LAPP Annecy, LPC Clermont-Ferrand and CPPM Marseille) and of DAPNIA/DSM from CEA. These laboratories are the leaders of this field in France and all benefit from an excellent international reputation. They were all partners of the pioneering DATAGRID project which between 2000 and 2004 laid the base for EGEE. They all host, or will host in the future, a Tier center for the LHC program and have thus developed a significant local infrastructure and manpower to run and maintain large computing resources. They are therefore the most natural and effective places to locate the MAGIE storage capacities. They all have developed significant multi-disciplinary partnerships within EGEE and DATAGRID and other projects, such as Hadrontherapy for DAPNIA, LAL, astrophysics and cosmology for LAL and DAPNIA, Life science for LPC Clermont and CPPM.

Some more details are required about the LAL, which plays a major role in this project for two reasons: the project leader (Guy Wormser) belongs to LAL and has a very strong experience in running large projects. LAL is in charge of the task Monitoring and Trace Collection in collaboration with computer science laboratories, of the Astrophysics workpackage and of the Resource deployment workpackage. The LAL is a joint laboratory of CNRS and University Paris-Sud (UMR 8607), with 84 researchers and a 215 technical and administrative staff. The LAL has a history of large project management and technical support; his experienced staff will be of great help for the technical aspects of a fully professional diffusion (from a web site to the capacity of accommodating large meetings in its 200 seats amphitheatre with accompanying organization). The LAL grid group plays a leading role in EGEE, both at the project management level and as chairing the Project Technical Forum.

4.2.4 Life Science

IGBMC, IBCP and Creatis are three leading laboratories in CNRS specialized in Life Science. In MAGIE, the Life Science theme (on the two aspects of medical imaging and bioinformatics) corresponds extremely well to their domain of expertise. IGBMC is a 700-person laboratory in Strasbourg; it includes the largest animalery in Europe and manipulates many large images (up to 600 MB) from biological cells to animals. CREATIS, in Lyon, is specialized in 3D and 4D imaging for heart images. IBCP, also in Lyon, specializes in Bioinformatics and manages an international Web portal for genomic sequences.

4.3 Detailed organization

The following table summarizes the organization of the workpackages.

Workpackage	Leading partners	Sub-Tasks
Towards a grid observatory	LRI	Trace collection
		Grid Models
Scientific Data Mining	LRI	Basic research
		Centre of expertise
Grid-enabling scientific workflows	I3S	Workflow Management
		Assembling Workflows
		Semantic integration in data intensive workflows – Application to Medical Imaging
Data Security	LIRIS	Access Control and Encryption
		Workflow Security
		Privacy Preserving Data Integration and Sharing
Querying, Sharing and Integrating Data in grids	LIRIS, IRIT	Data sharing/integrating
		Query Optimization
Earth Science	IPSL	
Particle Physics	DAPNIA	
Astrophysics	LAL	
Life Science	IBCP	Medical Image Processing
		Bioinformatics
Ressource deployment	LAL	
Data transfer	UREC	

4.3.1 WP CR1. Towards a grid observatory

The grid, as a complex system, has to be extensively observed in order to create meaningful models. This task requires a multi-disciplinary approach, which involves:

- on the data interpretation side, expertise in statistical learning, data mining and stochastic or non-linear optimization, which are at the core of the WP "Scientific data mining"
- on the EGEE side, first the collective expertise of EGEE in collecting and managing very large datasets; second the knowledge of the complexity of the operational issues, which is crucial for deploying new tools.

4.3.1.1 WP CR1.1 Monitoring and trace collection

The aim of this activity is in the gathering of reliable traces on complex applications and very large grids behaviour. These traces will be based on EGEE events recording, fit together for an easy access through a portal and easy comparisons with those provided by monitoring tools available on other grids.

Most part of monitoring tools are generally used in various contexts, like Mapcenter, Ganglia, but they reach their limits on EGEE -due to the number of monitored resources and the volumes to be consider-, and must be adapted to assure tracking of complex application workflows. Other tools, for instance simulators like gangSim, extractors, have their own format. Usage records are less or more standardised and could be very useful, thanks to their large independence vs the context of execution of each job. But new sensors and tools have to be added, to capture information related to data localisation and moving (placing, proximity, replication, transfers, etc.). Resulting records will be usable by statistical analysis and data mining tools. Other instruments can also be added, particularly if GRID5000 experimenters want to test it on a production environment.

EGEE R-GMA (Relational Grid Monitoring Architecture) [Coo05, Byr04, Coo04] has been developed on the GGF's GMA standard to assure acquisition at very large scale of measurement records and will allow deployment of renewed information systems. Therefore, current content of this information system has to be checked, and probably improved to give a more complete foundation for massive data usage measurements on recent very large scale grids. That has to be considered as an opportunity to take into account demands coming from the researchers in information and data management at a very fine grain.

Thanks to this open source instrumentation, portable and sharable, we will have the capability to define systematic experiment plans for data mass oriented benchmarks on EGEE, giving in-vivo results and comparison basis with other environments, typically experimental environments.

This task will actively pursue synergies with the NoE CoreGrid, in particular its *Institute on Grid Information and Monitoring Services.*

4.3.1.2 WPCR1.2. Mining Grid Data

The objective of this task is to contribute to modeling the grid and discovering its properties, by the means of the analysis of the data gathered by the "monitoring and trace collection" task.

The fundamental motivation for an approach based on statistical analysis, computational learning and, to some extent, data mining, is the proved complexity of the individual components of the grid, and the potentialization effect of their interaction. For each hardware/software/human component, properties that characterize complex systems have been exhibited: computer occupation shows heavy-tailed distributions; the load of time-shared computers exhibits multi-modal distributions, long-range correlation, self-similarity and epochal behavior [Din99, Wol00]; similar properties hold for network traffic [Lel93]; some initial evidence of small-world structure has been exhibited in the pattern of reference for large scale collaborations [Iam04]. A better understanding of the properties of these complex systems has been the principled method towards efficient forecasting [Wol99], leading to adaptive management policies [Din2A].

Considering the grid, the first step of this research is to produce a synthetic characterization of the basic parameters for individual components: for instance, in a grid, the access to machines has to be regulated through queuing systems, in order to enforce various fair-share objectives [Dum04]. The load profile could thus be expected to be very different fro the one in uncontrolled cluster studied before. Similarly, the locality profile of data access has to be characterized; new insights on the adequate metrics have recently been proposed in the context of web streams both for temporal [Fon05] and spatial [Cro03] locality. Finally, the access to grid facilities creates networks between the grid users (same analysis program, same files, etc.). These networks have to be characterized as graphs, with all the necessary carefulness about the horizon effects caused by incomplete information [Lak03]. Obviously, these analyses could not be significant without the rich datasets coming from the monitoring of a production grid.

The next step is to go beyond this collection of profiles, by characterizing, and finally explaining, their interactions. We think that a key factor is the integration of the grid new concept of Virtual Organization (VO). Correlated activity (computation, file access, database requests) will be created by the common timelines of related institutions or individuals; these correlations are both temporal (deadlines, "interesting" experimental events) and spatial (the researchers, the data, and the available computing power of a VO are not uniformly distributed over the grid). The perspective is thus the integration of the profiles through the graphs created by the VO structure.

Accurate prediction of availability and performance of grid resources is a precondition for users satisfaction (makespan) and efficient grid utilization. Research has started on the exploitation of this kind of information [Rou04]. While the main objective of this task is in the precondition (grid models), further exploitations of the models will be explored internally, and collaborations will be sought for large-scale experiments, especially with grid 5000.

4.3.2 WP CR 2. Scientific Data Mining

4.3.2.1 Basic research

In collaboration with the Network of Excellence (NoE) PASCAL, this task will explore the impacts of the computation and storage model proposed by the grid on statistical inference and data mining, when considering a) the scaling properties of the classical algorithms b) the new opportunities offered by computational and storage power at unprecedented scale. Advances at the fundamental level will be sought in the following areas:

- Confronting the existing non-asymptotic statistical bounds, which are generally considered as over-conservatives, and the asymptotic ones, which are generally considered as optimistic, with the empirical convergence on very large datasets.
- The parameterization of existing algorithms as a function of the order parameters of the considered problems, such as the volume and data distribution on one hand, and the sensibility and specificity criteria on the other hand; the goal is to select the best algorithms for a given region in the parameter space.
- The theoretical study of the benefits of large-scale distribution for statistical inference and data mining methods: improved bounds might appear when taking into account the pattern of data distribution. An interesting axis is the theory of asynchronous algorithms [Ber86], which will be considered either as a principled way to relax synchronism constraints or in relation with already asynchronous known methods (e.g. belief propagation algorithms [Yed00])

This activity will have a concrete implementation, through the specification of *challenges* for the PASCAL NoE; a challenge is an analysis challenge for which a dataset is provided to the competitors. The same concept is proposed for the first time at SC (Supercomputing) 2005; the experience with the PASCAL challenges will be exploited to apply to SC analysis challenge.

4.3.2.2 The Expertise Centre

Beyond the algorithms answering the problems already identified by the partners, which will be detailed below, MAGIE will seek to provide to the users community a *Centre of Expertise*, taking as a starting point comparable initiatives at the European level. The mission of this Centre will be to effectively direct the users towards the experts and the most adapted approaches in the areas of statistical learning and data mining. It will also support technological surveying and scientific reactivity, by facilitating the detection of the main trends and the evolutions of the applications considered.

More specifically, the methods considered are as follows.

RECOGNITION OF SPATIO-TEMPORAL PATTERNS

The goal is to subsume the raw representation of the data to concise and interpretable representations: identification of relevant patterns, for example stable according to a temporal dimension and a space dimension (antagonistic objectives); identification of scenarios and sequences of patterns; categorization and visualization of the typical scenarios.

A first objective relates to the development of flexible approaches and algorithms, adapted to the types of explicit criteria available (monotone criteria, volume of awaited solutions) and their locality (active zones, zones of rupture of the correlation). An essential aspect is the compromise between the quality and the completeness of the solutions, and the computational resources (*anytime* algorithms [ZIL96]).

The second objective is related to one of the main current challenges of data mining: the “expert in the loop”, and the modeling of his/her preferences. It now clearly appears that no general measure of interest can efficiently capture the preferences of the user, which are both subjective and changing as the mining process goes along. Multi-objective optimization is in our opinion a relevant and expressive framework for formalizing the conflicting criteria of the expert, e.g., simultaneously looking for general and accurate hypotheses.

STOCHASTIC COMPLEXITY AND PHASE TRANSITION.

The theoretical modeling of very large systems will take as a starting point the approaches of stochastic complexity known as *phase transition*: identification of the order parameters (problem size, type and structure of the interaction graph of the components); Modeling of partial subsystems and/or systems related to a specific area of the order parameters; evaluation of the heterogeneity of the subsystems and the confidence; search for phase transition phenomena, pointing the limits of the operating modes of the system.

NONLINEAR BLACKBOX OR GREY-BOX MODELLING

When detailed knowledge-based models are not available, or when simulating them turns out to be too costly, one may try to develop simple nonlinear models of the input-output behavior of systems. Such models are often called black-box models, to stress that they tell nothing about what takes place inside the systems modeled. Once built, black-box models may be used to optimize behaviors while taking into account some requirements on the robustness of the solutions to be obtained. An especially important issue is thus the development of methods making it possible to build simple yet efficient models from as few experiments as possible. The passion for neural networks in this context seems to decrease to the benefit of scientifically more ambitious methods such as Support Vector Machines or more generally reproducing-kernel methods. Kriging provides a probabilistic framework well suited to addressing such crucial problems for kernel methods as the choice of a kernel structure, the estimation of the parameters of this structure and the characterization of the uncertainty on the predictions provided by the model. Recent methodological results obtained at the Laboratoire des Signaux et Systèmes on multivariable problems (i.e., problems where several outputs depend on several factors) are promising and should be put to work. The same holds true for our results on how to take into account prior in formation to get grey-box models from which better performances can be expected than with purely black-box models. Among other things, our participation to this project will allow us to consider the black- or grey-box modeling of the complex system consisting of a grid of computers from the observation of its behavior.

Besides these methods, a prospective axis is the structured metadata describing the scientific process itself. It appears absolutely necessary to us to anticipate the rise, in complexity and not only in volume, of the relevant data in the mass of experiments which will produce or treat a grid. The annotations (calibration, modes of production, software environment) are carried out most naturally in textual form, whatever their later mode of conservation. The use of such annotations largely controls the possibility of the long-term reusability of data. An axis of prospective for the Centre of expertise will thus explore to the junction with the de facto for structured data (XML).

4.3.3 WP CR3. Data Security

This Work Package is split in three parts: DS1 mainly focus on the implementation of access control mechanisms in a real production grid, while DS2 focus on research work in the workflow security. The interest of DS3 is to take into account privacy protection mechanisms for data integration and sharing.

4.3.3.1 WP DS1 : From a tool Grid to a production Grid: Access Control and Encryption in the real world

The most important challenge is that on demand of the middleware data on a Grid may be copied outside the home domain of their owner in order to be stored close to some distant computing resource. To respond to these challenges we propose an access control system that is decentralized and where the owners of some data are in control of the permissions concerning their data. Furthermore, we argue that the access control system must support a delegation of rights that is effective immediately. Grid users also need delegation mechanisms to give rights to processes, which act on their behalf. As these processes may spawn sub processes, multi-step delegation must be possible.

In addition to these usability requirements, the transparent storage and replication mechanisms of Grids make it necessary to implement additional protection mechanisms for confidential data. Attackers having access to the physical storage medium can circumvent access control. We therefore need encrypted storage mechanisms to enhance the protection of data stored on a Grid.

We propose in this work package to study two aspects: the access control on one side, and data encryption on the other side. We also want to offer something integrated, with the two aspects interconnected.

In the last year, an implementation on a tool grid of Sygn, a distributed access control, and Cryptstore, a distributed encrypted data storage have been demonstrated on a tool grid (µGrid), at the LIRIS laboratory. The behavior of the algorithms has not been tested against a large number of users nor on a high number of storage resources: The scalability is then more theoretical than practical, and thus feedback from real users has not been collected.

Integration of this work in a production Grid such as EGEE is of potential high value for the user communities. Unfortunately, these developments have not been included yet in the middleware. Nevertheless, the LIRIS researchers involved in Sygn and Cryptstore already participate (on a voluntary basis) in the EGEE JRA3 (Security part of the EGEE middleware). This group has adopted the principle of Cryptstore, and will implement a slightly different approach in the EGEE middleware. The principle of Sygn is very different from the VOMS approach, but we think that we can have VOMS as a high level management system for fine grain access control of Sygn (Sygn certificates might be considered as attributes of VOMS).

As a conclusion of this sub work package WP DS1, we believe that: the integration of high level data security is mandatory. The existing tools in the production Grids are not sufficient. Our proposal is clearly feasible in a production grid such as EGEE.

4.3.3.2 WP DS2 : Workflow Security

In this WP, we propose to investigate access control for workflow management systems (WMS) in computational environments. In order to make grids an option for wider use, grid resources need to support WMS. Some applications (biomedical, business world) requires confidentiality of certain data, the possibility of accounting for the use of shared resources and control over how and when resources are used. This makes it necessary to integrate access control mechanisms into a business oriented Grid-WMS. The complexity of such an approach is due to the cooperative and decentralized nature of a Grid, which makes it necessary to combine policies from different possibly overlapping, domains in order to arbitrate a multitude of interests and reach unified access control decisions.

The problem of integrating access control mechanisms in a WMS on a Grid raises a considerable number of interesting scientific and technological, but also social issues.

A number of those challenges come from the Grid environment, with its dynamic sets of available resources and/or user community constitution. The cross-organizational structure of a Grid makes it necessary to combine different domains to reach access control decisions.

The workflow management environment is responsible for different challenges, such as the need to base access control decisions on contextual information (e.g. time, current task in the workflow, previous accomplishment of other workflow tasks). Dynamic access constraints need to be enforced (e.g. a person that has created an order may not be the person that approves this order). As workflows involve detailed task descriptions with fine grain resources involved in every step, the access control system must be able to control these resources at the same fine grain level. For example in a health-care scenario when a medical doctor accesses a patient's file, he may only be allowed to work on the parts dealing with his domain and not on other parts of the same file.

Grid access control and workflow access control each for themselves are current areas of scientific interest. Our novel contribution will be to solve the challenges arising from the combination of both. The first challenge is to enforce cross-organizational security policies in a heterogeneous, dynamic resource-sharing environment. The second challenge is the dependence of access control on contextual information, taking into account dynamic constraints and the ability of fine-grained control. Further challenges may arise during the requirements studies in the first phases of the project.

At an international scale, we will cooperate with the KTH at Stockholm on this theme, with who we have already a collaboration (one LIRIS PhD will be in PostDoc there next year – beginning in September 2005).

This sub work package WP DS2 is clearly more exploratory than the first one, and will need more investigation. It will be done in strong cooperation with the applications who will detail first their typical workflows, and their modeling. There will be strong links with the WP Grid-Enabling data-intensive workflows.

4.3.3.3 WP DS3 : Privacy-Preserving Data Integration and Sharing

Data integration and sharing have been a long-standing challenge for the database community. The six white papers on future research directions published by the database community from 1989-2003 acknowledged the growing need for integrating and sharing data from multiple sources. This need has become critical in numerous contexts, including integrating data on the Web and at enterprises, building e-commerce market places, sharing data for scientific research, data exchange at government agencies and monitoring health crises. Unfortunately, data integration and sharing are hampered by legitimate and widespread privacy concerns. Companies could exchange information to boost productivity gains, but are prevented by fear of being exploited by competitors or antitrust concerns. Sharing healthcare data could improve scientific research, but the cost of obtaining consent to use individually identifiable information can be prohibitive. Sharing healthcare and consumer data enables early detection of disease outbreak, but without provable privacy protection it is difficult to extend these surveillance measures nationally or internationally. The continued exponential growth of distributed data in all aspects of our life could further fuel data integration and sharing applications, but may also be stymied by a privacy backlash. It has become critical to develop techniques to enable the integration and sharing of data without losing privacy.

This project brings an integrated research plan to the above problem. We want to achieve the widespread integration and sharing of data, especially in domains of priorities, while allowing the end users to easily and effectively control their privacy. Toward this end, our research goal is to develop a comprehensive framework that handles the fundamental problems underlying privacy-preserving data integration and sharing, then apply and evaluate the above framework in our application domains. It is important to emphasize at the outset that our research is related to, but significantly different from, research on privacy-preserving data mining. Privacy-preserving data mining deals with gaining knowledge after integration problems are solved. We will develop a framework and methods for performing such integration, as well as understanding and managing privacy for a wider range of types of information sharing. *The challenge here is how can we develop a privacy framework for data integration that is flexible and clear to the end users?* This demands understandable and provably consistent definitions for building a privacy policy, as well as standards and mechanisms for enforcement.

This WP will have strong links with the Data Sharing/Integration in Grids task.

4.3.4 WP CR4. Grid-enabling data-intensive workflows

Workflow Management Systems have been developed in various environments for applications with a need for assembling a significant number of dependent tasks together. Less frequently, WMS have addressed problems arising with compute intensive and/or data intensive tasks, which lead to a distribution of the computations and the control of the resulting data flows. In a wide scale environment, the problem of the heterogeneity of the various algorithms composing each task and the accepted data formats is an additional problem. Enabling workflows on grids thus raise both problems: (1) optimal execution of such a workflow taking into account the data to manipulate, and (2) interaction of software components involved in the workflow realization.

4.3.4.1 Task CR4.1 Workflows management

Workflows scheduling has been a very active research topic among the parallel systems and distributed computing community. The solutions developed need to be adapted and integrated on a grid due to the different hypothesis verified on a grid infrastructure. The problem is to migrate from a fine-grain programming model considering data, instructions and tasks, to a large grain batch production model considering files, services and jobs.

In the applications targeted by grids, the workflow manager needs to take into account the data processed and produced as:

- there is often a stronger potential in data parallelism than in control parallelism;
- the applications are data intensive and data transfers between remote nodes are costly.

The mapping of the workflows on the available resources can therefore not been achieved statically taking into account the workflow topology alone. It rather needs to take into account the data to be processed dynamically, at each new execution ordered. The balance between data transfer and computing time needs to be accurately evaluated in order to propose an efficient mapping. The grid monitoring activity (execution and data transfer logging) will help in this respect to get an overview of the grid data exchange capabilities at a given time, and to estimate the computing time from prior executions, without human knowledge. Given the volatile nature of grid resources, the mapping of the workflow on the grid resources also need to take into account the current status of the grid at the submission time. This problem is difficult due to the impossibility to get the whole status of the grid resources at a determined time: again, the monitoring will help in providing as accurate an information on the grid resources as possible.

4.3.4.2 Task CR4.2 Assembling workflows

The Web Services standard is emerging today as the basis of the future standard for describing access to grid services. Originally developed for non-scientific applications, Web Services are simple and poorly designed for dealing with complex workflows and manipulating large data sets. Individual components of a workflow are insufficiently specified in this model that will need to evolve to match the scientific application needs. It should provide efficient computation tasks submission and integrate the call to complex computing tasks with strong code coupling and high performance computing needs due to their high granularity level. The data exchanges need to be minimized as well.

4.3.4.3 Task CR4.3 Semantic integration in data intensive workflows, application to medical imaging

This task is presented here, but will be transversal between this WP, and WP 5 (data sharing). Research in the field of neuroimaging is certainly a field that could benefit from the wide scale deployment of grid infrastructures. Actually, it is really a domain where processing tools and neuroimaging resources (data or programs) need to be shared at a wide scale, in the context of virtual organizations federating several research organizations, pursuing common objectives (such as the BIRN project). Applications may consist of applying a common set of processing tools to a large population of subjects (several hundreds or thousands), gathered from or located at different sites, or build in a flexible way new processing workflows on image data constituted from heterogeneous components available and located in various centers of expertise.

A major difficulty in the creation of such federated systems is related to the heterogeneity of data and processing tools. Actually, the repository of each constituent site was set up independently, according to local needs and views. It follows that the semantics of the data and processing tools cannot be shared successfully, unless some sort of common language is defined and agreed upon by all participants in the federated system. This problem has been addressed in the context of the NeuroBase project, in order to define a shared ontology, highlighting the most salient concepts related to: (1) subjects, (2) neuroimaging data, and (3) data processing. A subset of this ontology was used in a demonstrator, which allows the integration of heterogeneous data available in several sites, thanks to wrappers transforming the specific data structures into a common relational schema, according to a Local as View integration framework.

The work to be done in the context of MAGIE is to assess implementation of similar capabilities (data queries to heterogeneous data in SQL, and execution of workflows/dataflows in a distributed environment) in the context of advanced grid systems, offering services that were not available in the Neurobase demonstrator environment, such as resource identification, security, data caches, etc.

4.3.5 WP CR5. Querying, Sharing and Integrating Data in Grids

4.3.5.1 WP CR5.1 Data sharing and integrating

The Grid provides us with the ability to create a new model of data integration allowing support for dynamic, late-binding access to distributed, heterogeneous data resources. However the opportunities to exploit these new methods of data integration also produce many issues and open questions. One such an issue is the inability to ensure interconnection semantics. Interconnection semantics is the study of the semantics in the interconnection environment for supporting flexible access by meaningfully interconnecting resources in semantic spaces. Interconnection semantics concerns:

- Single Semantic Image: mapping sources into a single common semantic space to enable resource utilization to be independent from their type and location.
- Transformation and Consistency between semantic spaces: classification semantics, layout semantics, logical semantics, and concurrent semantics.
- Realize semantic-based storage and retrieval in scalable large scale-network environment.

This project will develop the technology needed to semantically access large scale distributed databases. While the emphasize will be on general techniques for data sharing, the project will work in the context of diverse but particularly relevant problem domains, including earth science, astrophysics, biomedical and particle physics. Involvement of domain experts from these fields in developing and testing the techniques will ensure impact on areas of international importance.

To address the above problems, we will develop solutions to the following fundamental problems:

Schema matching: To share data, sources must first establish semantic correspondences between schemas. *How can we develop semantic-based schema matching solution?* Making semantics (i.e. metadata and ontologies) explicit can happen in many ways, depending largely on content types and usage environments.

Querying Across Sources: Once semantic correspondences have been established, we can start querying across the sources. *How do we query the sources such that all the relevant results are disclosed?*

Object Matching and Consolidation: Data received from multiple sources may contain duplicates that need to be removed. In many cases it is important to be able to consolidate information about entities (e.g., to construct more comprehensive sets of scientific data). *How can we match entities and consolidate information about them across sources?*

4.3.5.2 WP CR5.2 Query optimization

In heterogeneous databases distributed on a grid, the proposed optimization methods strongly reveal their limits. Indeed, the performance of an execution plan generated by a traditional optimizer can be totally inefficient for three main reasons: i) the centralization of the decisions taken by the optimizer, ii) the inaccuracy of estimates, iii) and the resource unavailability.

The centralization of the optimization methods generates a bottleneck and produces a relatively heavy message passing which can lower performance and prevent the scalability. It becomes thus convenient to make autonomous and auto-adaptable execution of the queries on a GRID.

The problems of optimization due to the inaccuracies of the estimations and to the unavailability of data were extensively and widely studied in a parallel and distributed environment by considering only the models of classical distributed execution such as message passing, the remote procedure call or the remote object invocation. An alternative [Arc 04] consists in making autonomous and auto-adaptable the execution of the queries to limit the communications on the network (i.e. replace remote interactions by local interactions). In this perspective, a new investigated approach consists in leaning on the programming model of mobile agents. The fundamental difference with the classical migration process is mainly the initiator of the migration. While process migration is triggered by a runtime manager, mobility is decided autonomously –proactively- by the agent themselves. Furthermore, the mobile agent-based platforms offer only mechanisms for agent mobility but no policies. It is for this reason that we wish to design and to develop an execution model based on mobile agents and a proactive migration policy.

4.3.6 WP A1 Earth science

4.3.6.1 Application description

In the following part, the needs of Earth Science research will be illustrated with three different applications instead of speaking generally. These applications may be considered as testbeds for new developments.

Application 1) Ozone in polar zone (S. Godin-Beekmann, Service d'Aéronomie/IPSL)

2006 will be the International year of Ozone. One goal is the prediction, in quasi-real time, of the ozone concentration in the polar zone. The same scenario will be used to determine the trend of the ozone concentration, since 1980, in both Arctic and Antarctic zone during winter time, period during which the destruction has taken place.

For each day during winter time since 1980, the computation of ozone concentration will be achieved by running a simulation in both polar areas, Arctic and Antarctic. That simulation is based on a chemical-transport model using the daily meteorological outputs from the ECMWF (European Centre for Medium range Weather Forecasting), ERA40, and the output of another simulation for the initialization.

The result outputs will be the winter daily concentrations of around 10 constituents, involved in the ozone photochemistry. The corresponding files will be stored and compared to the available simultaneous measurements obtained with different satellite instruments.

In order to select the case where the activation of chlorine compounds, responsible for the ozone destruction, is observed on satellite data, data mining on these sets of data will be very useful.

As all the data needed in this application are already available, the simulations and the data mining can be conducted independently. A simulation concerns the whole winter period and a given pole. As a consequence the simulations for the different years and pole areas are independent and can run simultaneously on different CPUs, being a typical application to be deployed on a grid. For the prediction in quasi-real time, the concerned ECMWF and satellite data are to be first searched on external servers.

All the different operations can be ported manually; however the aim is to integrate these complex operations of ozone destruction into a platform that can routinely provide a prediction in quasi-real time.

Application 2) Analysis of oceanic multi-sensor and multi-satellite images (C. Provost, LOCEAN/ IPSL)

Satellite data provide different parameters over the ocean, like sea surface temperature, ocean colour, surface winds, sea surface height with increasing spatial and temporal resolution(i.e. 1 km and 1day)… A variety of studies have been carried out, often limited in the number of addressed cases by the large volume of the files and their number. Some sub-sets have been analysed by data mining using a classification method in order to determine regions with the same characteristics and to observe their evolution as a function of time. Some structures, like large gradient variation, filamental structures have been searched and compared. One difficulty is the presence of clouds that mask or provide erroneous values. Most of the data are available on external servers and can be downloaded via web interface.

The possibility to deploy the data mining on all the satellite data and images available is the challenge. The applications may be divided into different goals:

- Classification in different zones according to a given parameter measured with a given sensor aboard a given satellite,
- Daily, seasonal variations and inter-annual variability;
- Intermittent events;

- Comparison with data provided by another sensor measuring the same parameter with a different method and/or resolution (or in-situ data);
- Comparison with regions obtained with different parameters in order to study their correlation
- Search of structures in time and space (gradients, extreme events, rapid changes, special mesoscale structures like pair of vortices etc.)

The tests or limited studies have pointed out the originality of the research and the potentiality of new results.

Application 3) Seismic hazard analysis (J.-P. Vilotte, IPG Paris)

Integration of physics-based models of Earthquakes within information infrastructures provides enormous benefit for assessing and mitigating earthquake risks through seismic hazards analysis. Modern seismic information system should in a short time locate regional earthquakes, determine the earthquake mechanism and produce preliminary maps of ground shaking and deformations by integrating seismologic, geodetic and geological data. Today earthquakes are routinely recorded in quasi real time all around the Globe by global broadband seismological networks.

For each earthquake of magnitude greater or equal to 6, seismologic records on a selected number of stations have to be automatically retrieved from distributed seismologic data collections and selected based on some quality data analysis. At this stage the seismic hazard analysis must include three interconnected pathways:

- A timely data inversion for locating the regional earthquake and determining the source mechanism. In the inversion procedure, a systemic exploration of some space parameters (source time duration, location in latitude, longitude and depth, focal planes) involves several complex operations.
- In the same time, radar satellite images in a given time window and regional area around the earthquake are retrieved from ESA and stored on the Grid. They must be automatically processed using embarrassingly parallel data processing tools on computational nodes of the Grid. Then interferograms are computed in order to produce maps of the observed ground deformation that are integrated to the results of the previous analysis.
- Finally, a regional earth model for the selected earthquake has to be retrieved from seismologic data bases and automatically meshed.

The aim of the present project is to integrate these complex pathways of seismic hazard analysis into an information system that can routinely process typically between 10-20 earthquakes each year in a short time.

4.3.6.2 Main Issues

Metadata and data

A particular characteristic of ES applications is the need to access both metadata and data. The metadata catalogue permits to select the files corresponding to some given criteria. The RDBS used varies from an application to another. The ones generally used are MySQL, PostgreSQL and Oracle. Recently, metadata base is being developed with geospatial information, like the footprint of satellite orbit, by using MySQL and PostgreSQL. For a given experiment, several metadata catalogues may correspond to the same product, obtained with different instruments or algorithms. This problem has been addressed by separate metadata bases distributed on separate external servers, some of them controlled by OGSA-DAI.

Access controls, restriction and security are needed on both metadata and data. Data may be confidential and/or accessible only for a given group of users and for a given period of time, for example, until publication of some new results. Data access policy varies depending on the origin of the data and time of production. Some products can be made freely available on the web after two years (having informed the data producer and proposed him to be co-author or acknowledged only), while other products may be used free of charge for scientific but with charge for industrial and commercial purposes. Certain types of products, e.g. European satellite data, are only made available to users working on approved projects. In some cases, a personalized accounting has to be set up in order to know the users and make them paying if needed. As a consequence, the ES application community needs secure and restricted access to both metadata and data, although encryption is not required.

It is therefore necessary to be able to define access rules and capabilities at the level of group and subgroup in a virtual organisation, and provide an accounting to know the user and make it paying if needed.

Information system

So far, the metadata, data and algorithms are mainly used by scientists that are experts in the domain. In some larger applications, especially where there is integration of cross-domain scientific data, information system will be useful. Information system will also permit to make decision to choose the right path for an application. The main issues for seismic-hazard information system and in general, for ES applications, are:

Knowledge representation and reasoning techniques: to manage the heterogeneity of the models and to capture the relationships between the physical processes and the algorithms, the algorithms and the simulation, and the simulation and data inversion codes.

Digital library technology with knowledge-based data management tools to access existing various data catalogues, and to incorporate collections of data generated by physics-based simulations.

Interactive knowledge acquisition techniques for the Grid to enable users to configure computational and storage resources; as well as to select and deploy appropriate simulation and data inversion integrating data sets like seismologic, geodetic (GPS, InSAR satellite image) and geologic data sets.

Data mining

The need of efficient Data mining tools is shown in the Ocean application; however it is present in the other applications [Fra05]. It will be useful not only to long term exploration but also to select data for real-time application.

4.3.6.3 Expertise and collaborations

The application “Earth Science” has acquired an expertise and experience about metadata bases using the RDBS, MySQL, on Grid [Fus04]. As a matter of fact, to validate data it is necessary to look for satellite data located in an area around the ground-based sites. 7 years of satellite ozone profiles were produced/or ported on EGEE [Cas03], they represent 38 500 files per algorithm; 2 algorithms being tested completely i.e. 77 000 files, another partially but using a different way to store the data i.e. 78 000 files. The validation has been carried out by selected the satellite ozone profiles located over a given site by queries addressed to the corresponding metadata bases. In DataGrid the databases are first located on a server outside the Grid infrastructure. Then a replica metadata catalogue, part of the middleware, was tested with and without VOMS. In EGEE the metadata bases are located on a server outside EGEE with an access control provided by OGSA-DAI. We have not yet tested the capability of the new version of the middleware, gLite. Recently, Geospatial information have been introduced in the metadata to determine the footprint of the orbits and then to facilitate the search of profiles in a given area.

One of the application "Seismology" involved complex simulation in MPI, that runs from 4 CPUS up to a thousand of CPUs, according its complexity. The other application has been an application on alert when a major earthquake occurs. The Grid provides enough resources to obtain the results in the framework of one day.

Many other ES applications have been run by European scientists belonging to the VO, ESR. The applications in hydrology are typical of what the civil society can expect for prediction. One concerns the coastal Mediterranean aquifers involving Tunisian scientist. The other concerns a complex application made by a cascade of simulations for Danube flood prediction which is carried out by the Informatics Institute, IISAS, in Slovakia. Climate application porting is investigated. All ESR (Earth Science Research) VO partners collaborate to solve technical problems that each application may encounter.

4.3.6.4 Expected results and impact

In order to explore new fields by developing the application at a large scale, ES needs to develop an information structure to facilitate following issues:

- Control access to distributed metadata and data bases created with different RDBS
- Management of large distributed collections of heterogeneous data, coming from measurements and simulation, and update
- Need to associate to the data, detailed information to form an information system: knowledge representation and reasoning, digital library
- Data Mining: on very large and distributed multi-sensor and multi-satellite data sets, the data set being constituted of time series of image or of n-dimension data, like for 4Dimension: altitude, horizontal components and time. The kind of data mining asked for concerns the classification of region in an image, and the search of a given structure, like gradients, region with minimum or maximum values…
- Workflow of integrated application like platform for seismic hazard analysis, or prediction of polar ozone
- Integration of web services

Some of these expected results may lead to use semantic mediation, and create data warehouses.

The applications chosen as testbeds are very generic in ES community. Then the impact of solutions to those blocking points in ES domains will lead to very new results and efficiency to answer relevant questions.

4.3.7 WP A2. Life science

4.3.7.1 Project description

The awareness of grid technologies in the health and bioinformatics communities has increasingly risen in the past five years. Although there was *a priori* few interests for computing technologies in this community, the needs for large data manipulation and analysis has lead to identify areas where applications can highly benefit from a grid infrastructure. Early in the European DataGrid project (2001-2004, http://www.edg.org/), the biomedical applications have been identified has a pilot area for steering grid development and testing grid infrastructures. In the same time, the international community has been increasingly active in the area of grids for health as demonstrate the multiple conferences (see HealthGrid, http://www.healthgrid.org/, or Biogrid, http://www.cse.uconn.edu/~huang/BioGrid-05/, for examples) and research program appearing (see MEDIGRID, http://www.creatis.insa-lyon.fr/MEDIGRID/, GriPPS, http://gripps.ibcp.fr, or BIRN, http://www.nbirn.org/, for example).

The biomedical applications area is one of the two pilot application fields considered in the EGEE project. It has demonstrated the relevance of grids for that kind of application with the deployment of more than a dozen of applications in the fields of medical image analysis, bioinformatics and molecular structure analysis in a production environment. In all these fields, the current acquisition devices enable the acquisition of tremendous amount of data. Usually, the data produced are stored locally, on-site, and data exchanges are limited or require a human intervention. In the worst cases, data is just lost by lack of storage resources. The pilots deployed in the EGEE project could benefit from the grid capabilities to distribute, store, share, and process such data.

4.3.7.2 Applications to medical image analysis

Medical images analysis requires image processing algorithms that are often costly and which complexity usually depends on the size of the processed images. Although the analysis of a couple of medical images is usually tractable on a standard desktop computer today, larger computing needs are expressed by many emerging applications such as statistical studies or epidemiology for which full image databases need to be processed and analyzed, human body modeling, knowledge databases assembling for assisted diagnosis, etc.

Beyond the need for computing power, the medical data management is crucial for many medical applications and raises the most challenging issues. The medical data is distributed by nature overt the various sites participating to its acquisition. It represents tremendous amounts of data: a simple radiological department will produce more than 10 TB of data each year. This leads to a yearly production over the country of more than 1 PB, most of which is simply not archived in a numeric format by lack of storage infrastructure.

The grid infrastructure and the middleware services are expected to ease application development by providing tools suitable for medical data management. It should ensure a coupling between data management and processings, taking into account the complex structure and sensitivity of medical data.

Main Issues

The needs of medical image processing are complex both in terms of processing and data manipulation. Simple batch-oriented systems used for cluster computing are often not flexible enough. Medical applications may deal with a very large number of individually short tasks (for which classical batch computing is inducing a too high overhead), with complex application workflows, with emergency situations, or with interactive applications.

In terms of data management, medical images have to be considered in conjunction with associated medical data (patient related metadata, image acquisition metadata...). A physician cannot produce a medical diagnosis on the base of an image alone: he needs to take into account all the patient folder (context, history...). The medical data structure is very complex and there are few standards for enabling data exchanges, when they are used at all. Enacting indexation and search of medical images are therefore crucial to face the increasing volume of medical image data produced.

Most medical data is sensitive and the identification of persons from whom the data originates should only be possible for a very limited number of accredited end users. Although security enabling techniques may be well known (data encryption, pseudonimisation, ...), the security policies expression and their enactment is a complex problem. On a grid infrastructure, this problem is even more complex due to the distribution of data and (on sites shared by many application areas where site administrators are not necessarily accredited to access medical data) and the wide extension if the users community.

Many medical image analysis applications are require a human supervision with a more or less high degree of interactivity. This introduces specific constraints on the submission procedure as feedback must be fast enough for human users to interact with the running remote processes. Moreover, medical image analysis procedures are often assembled from basic software components by building complex workflows. The easy representation and the efficient execution of such workflows is a key to the success of these applications. Given the size of the data to be manipulated, data transfer are costly and the scheduling of workflow needs to take into account the dependencies on data and data location in order to efficiently user the grid resources.

Community and expertise involved

The medical image analysis user community already deployed a significant number of applications in the framework of the EGEE project, among which can be cited:

- **GATE** (GEANT4 Application to Tomography Emission): a radiotherapy modeling and planing tool. The grid is used for medical data archiving and costly computations involved in the Monte Carlo simulator.
- **CDSS** (Clinical Decision Support System): an expert system based on knowledge extraction from annotated medical databases. The grid is used as a mean to transparently access the data for the distributed community of medical users and for sharing data bases together with data classification engines developed in various areas.
- **Pharmacokinetics**: this is a tool for studying perfusion images in abdominal Magnetic Resonance Images. The grid is used for accessing the complex and large data sets involved in such a medical study, and for performing the costly 3D registration computations.
- **SiMRI3D**: is a Magnetic Resonance Images simulator, which uses a parallel implementation for the calculus of the physical laws involved in the MRI phenomenon.
- **gPTM3D** (*Poste de Traitement Médical 3D*): is a medical data browser and an interactive medical images analysis tool. It has shown how a batch-oriented grid infrastructure can be used to satisfy the need of an application with highly dynamic processes through an application level agent scheduling policy.
- **Bronze standards**: is an application dedicated to validate medical image registration procedures and algorithms thanks to the largest available data sets and using the largest possible number of registration algorithms. The grid is used for accessing the data involved and managing the complex workflow of the application.

The community is composed of application developers with an informatics background, working with medical partners bringing their expert knowledge on the clinical needs. Given the number of projects currently being developed, the expertise level is very high. Some of the application are reaching the point of being put in production and an enlargement of the user community to medical end-users is expected in the coming years in some fields.

4.3.7.3 Application to Bioinformatics

Understanding biological data produced by large-scale discovery project, as complete genome sequencing projects, is one of major challenges in Bioinformatics. These data are published into several international databases. Thus, bioinformaticians need, for most analyses, an efficient access to these updated biological data integrated to relevant algorithms. Today, this integration has been done in several bioinformatics centres with web portal technology. But the size of these data is doubling each year, and scalability problems are now appearing. Grid computing could be a viable solution to distribute and integrate these genomics data and bioinformatics algorithms. But these software programs have different computing behaviours that the grid can suit: access to large data file such as sequence banks, long computation time, part of a workflow, …

Main Issues

Biological data represent huge datasets of different nature, from different sources, with heterogeneous model. They can be protein three-dimensional structure, functional signature, gene expression signal, … And to store and analyzed these data with computing tools, they have to be translated into different type such as (i) alphabetical for genes and proteins, (ii) numerical, for structural data from Xray crystallography or NMR, or (iii) imaging for 2D-gel.

All these data are then analyzed, cross-checked to databanks, used to predict other ones, published into scientific journals (and papers are also cross-linked to biological data), or into world-wide databanks

An important specificity of biological data is that these databanks have to be kept up-to-date periodically. These updates mean that the banks will have a new major or minor release number, but have to be available exactly on the same way than before: under the same filename, under the same index in a DMBS, … Moreover, some data are dependant of others: for example, pattern and profile for sites and functional signatures are built on the multiple alignment of a whole protein family. Then, due to the daily publication of new data, the data link to the new data need also to be updated. For example, the discovery of a new protein belonging to an existing protein family, or the correction of an old one, will modify the sequence alignment of the family, and then the pattern or the profile could be affected by this new data. In the last years, the world-wide databanks like Swiss-Prot,TrEMBL, GenBank or EMBL have doubled the volume of their data each year

The grid infrastructure and the middleware services are expected to ease application development by providing tools suitable for biological data management. It should ensure a coupling between contents and tools integration, taking into account the complex structure and sensitivity of medical data, as in medical imaging.

Community and expertise involved

The bioinformatics user community already deployed a significant number of applications in the framework of the EGEE project, among which can be cited:

- **GPS@** (Grid Protein Sequence Analysis): grid portal devoted to molecular bioinformatics. GPS@ is integrating databases and algorithms for proteins sequence analysis on the EGEE grid The current version is available for experimental dataset analyses on the LCG2 platform. GPSA is a porting experiment of the NPSA (Network Protein Sequence Analysis) portal onto the grid.
- **GridGRAMM** (Molecular Docking web): a simple interface to do molecular docking on the Web. It currently can generate matches between molecules at low or high resolution, both for protein-protein and ligand-receptor pairs. Results include a quality score and various access methods to the 3D structure of the complex (image, coordinates, inmersive Virtual Reality environment).
- **GROCK** (Grid Dock, Mass screenings of molecular interactions web): The goal of GROCK is to provide an easy way to conduct mass screenings of molecular interactions using the Web.Grock will allow users to screen one molecule against a database of known structures.
- **Docking platform for tropical diseases**: high throughput virtual screening platform in the perspective of in silico drug discovery for neglected diseases. First step for the EGEE project is to run several docking software with large compounds databases on malaria and dengue targets.

The community is composed of application developers with an informatics and/or biological background, bringing a very high expertise level. An enlargement of the user community to biologists is expected in the coming years through for example Web portals.

4.3.7.4 Collaboration within the project

The GATE, SiMRI3D, gPTM3D, bronze standard, GPS@ and docking platform applications mentioned above are developed by French partners (LPC, CREATIS, LRI-LAL, I3S and IBCP) already interacting and working together inside the EGEE biomedical applications activity (5 FTEs funded for the whole Biomedical activity). The French federation is leading the biomedical applications activity inside the EGEE project and the experience with grid technologies in this area is very high. Moreover, many thematic research are lead by partners participating to the ACI-GRID or ACI-MD programs such as ACI-GRID MEDIGRID and GriPPS, ACI-MD AGIR and GEDEON

4.3.7.5 Expected results and impact

The aims of the medical image analysis and bioinfomatics communities will be to:

- collect experience among participants regarding medical image and biological data, with associated metadata representation and storage;
- identify applications for deployment and suitable data structures;
- identify data sets that can be shared and distributed taking into account the medical constraints;
- test the data access security provided;
- deploy data-intensive applications on the infrastructure to demonstrate the benefits of grid computing;
- test the workflow engine provided;
- produce scientific results.

Consequently, the expected results are:

- description of data schemata for medical and biological data used by the applications;
- sets of medical image and biological databases on the grid;
- applications running on the infrastructure and producing scientific results (dependent on the application deployed);
- a report on the security achievements and problems encountered;
- a report on the workflow engine.

4.3.8 WP A3. Grid computing applied to particle physics

4.3.8.1 The foreseen computing models

To meet the demands of LHC data analysis, a particular form of hierarchical Grid has been proposed as the appropriate architecture by the computing models [Hep03]. The LHC data are distributed and treated in computing centres, located all over the world and the proposed hierarchy consists of four levels of resources noted from Tier-0 to Tier-3. The Tier-0 facility, localized at CERN, is responsible for the archival and the pre-processing of the raw data coming from the detector event filters. After pre-processing, the data are sent to Tier-1 facilities (from 6 to 10 depending on the experiment) located all around the world and having a mass storage strong enough to store a large fraction of the data. In order to guaranty the raw data archives they are mirrored on tape between Tier-1 facilities. The activities of the Tier-1 facilities will be the reconstruction of the raw data as soon as the required calibration constants become available. The reconstruction software will produce the Event Data Summary (ESD) and the reduced Analysis Oriented Data (AOD). The AOD's are copied to the all Tier-2 facilities localised at a regional level and used by a community of about 20 to 100 physicists to analyse the data. At the same time the Tier-2 facilities are foreseen to produce the simulated events needed to make the analysis tasks and those data are archived at the Tier-1 facilities. Tier-2 facilities will not have any expensive and heavy to operate mass storage equipped with magnetic tapes so all data will stay on disks. Finally, Tier-3 facilities located at the laboratory level will be used in order to make the last analysis steps needed for physic results publication. They could be made of just the physicist laptops or an online analysis cluster.

The organization of computing resources in a Grid hierarchy provides the following important advantages: resources will be presented as part of a unified system, allowing optimal data distribution, scalable growth and efficient network use.

The current LCG grid prototype is mainly used during the data challenge (DC) periods to run the simulations, the reconstruction and more recently the analysis jobs for the four LHC experiments. At each new DC the amount of processed data increases significantly in order to approach more and more the LHC real conditions. Other periods called service challenges (SC) are reserved to tests the throughput of the network and the newly developed data transfer tools. Many steps have been achieved but tests under real conditions of usage of the LCG grid, where all Tier facilities will do their specific jobs at the same time, have not been performed yet. This will need much more resources than existing right now both in storage space and in computing power.

4.3.8.2 Main issues to be addressed

The reconstruction and summarizing of the raw data under the AOD format will reduce the event size by almost a factor 20. Nevertheless disk storage needed in the Tier-2 facility stays very high. A mean Tier-2 facility used by the four LHC experiments will need in 2007 around 400 TB. In 2012, after 5 years of data taking the needed space will grow up to 5.3 Pb. Building such a large disk storage capacity is a real challenge. To achieve the performance optimization of such a device it will be necessary to solve serious and complex software and hardware problems. On the other hand, due to the continuous increasing of the network throughput it will be soon possible to join the resources of geographically close laboratory in order to build easier new Tier-2 facilities. Since in France the efforts have been concentrated on the setup of a Tier-1 centre in Lyon[1], we are rather late and short in terms of Tier-2 facilities and so this opportunity is for us of first importance.

The simulation work in the Tier-2 facilities will not be a problem as long as the network between them and Tier-1 facilities is maintained at the requested level. The work is usually planned in advance and the jobs are mainly computing power consuming. This part of the work together with the data transfer from Tier-0 to Tier-1 will be tested in the next SC3 service challenge.

The analysis work will be much more complicated. There will the coexistence of both chaotic analysis activities induced by the physicist work and more planed analysis work induced by the physics working groups. The analysis work will be based on high level hierarchical data (MetaData) describing the main physics characteristic of the events like missing transverse momentum, isolated lepton Energy-momentum and so on. For certain type of physics analysis (low statistics) the first step of analysis will consist in filtering the data in order to extract a small sub sample containing the interesting events. For other analysis the interesting signal will be large and the whole data set will be accessed by the analysis operations. This later type of analysis will be impossible to realize if the performances of the developed storage elements are not high enough. It is therefore of first importance that the

[1] CCIN2P3, the joint Computing Centre of both the IN2P3 (National Institute of nuclear physics and particle physics) and DAPNIA (CEA Department of Astrophysics, Nuclear physics, particle physics and associated instrumentation staff), located in Lyon is the designed French Tier-1 centre for the LHC.

evaluation of the technical solutions foreseen to realise the Tier-2 storages are tested in real conditions.

As a consequence, the realisation on a efficient large disk storage element for the Tier-2 facilities will be the main issue to be addressed by this project.

4.3.8.3 Expertise and collaborations

Both the LCG and EGEE experts from about 7 French particle physics laboratories and their associated technical staff (software engineers) will bring there knowledge and tools to the realization of this project. At the same time the grid user community in these laboratories is growing very fast due to the close LHC start up. The feedback provided by several hundreds of users will be of first importance for the software experts to understand and improve the efficiency of such a large and complex system.

Due to the specific partnership between the Tier-2 and the Tier-1 facilities, but also because of the relationship between Tier-2 facilities which have to face common problems, the LCG and EGEE collaborations play a central role in this project. In addition to that some partners of this project have already started to work together in order to build common Tier-2 facilities which are located close but physically separated.

In addition to the LCG internal collaboration and based on our specific computing models, we can identify collaboration themes with computing scientists where the volume of our data and variety of treatments like reconstruction, simulation and analysis will be both a challenge for us and an interesting subject of study for them. Some the one we can think of are:

- The localization of data versus job execution (data to job or job to data) and associated mechanisms for data replication and distribution. The analysis job, with chaotic access to data being the worst case.
- The metadata mechanisms that need to be validated at the Grid level for a very large number of users and huge data samples largely distributed.
- Fault tolerance algorithms, specifically for production treatments that implied tens of thousands of jobs to be launched. Mechanisms that will need to be implemented at each level of the job execution path, from metadata and data access, to Grid middleware components and farm processing.
- The log information collect and management for monitoring.

4.3.8.4 Expected results and impact

The main expected result will be the realisation of an efficient and scalable disk storage element for the Tier-2 facilities. It is of first importance for us that the French LCG community fills up its present gap with respect to our close European partners. At the same time we expect that this project, involving researchers in many fields will be fruitful for all of us due to the exchange we could have on many subjects like for example the different data treatment techniques, both at the level of the algorithms and the statistical methods.

4.3.9 WP A4 Astrophysics, Cosmology and Astroparticle physics

4.3.9.1 Project description

In the SGSD-A project (Système de Gestion et Stockage de Données en Astroparticules), partially supported by the Programme Interdisciplinaire d'Astroparticules (CNRS), we carry a comparative study of different data organisation and management systems, using relational data bases, object oriented data bases and files.

In this study, we have tried to construct representative, although simplified data structure scheme and constraints, using some of the projects in the field.

AUGER (http://www.auger.org) is a large international scientific collaboration with the aim of detecting and studying cosmic rays at extreme energies, around and above 10^{19} eV. A very large detector, composed of more than thousand Cherenkov tanks, disseminated over 3000 km^2, and two sets of fluorescence telescopes. This detector represents data processing and simulation challenges which can be tackled using grid infrastructures. A number of grid related activity structured around AUGER have already started (see section partner skills), the most recent being the proposal of the PPF (University project) DEMAIN (Des Données Massives aux Interprétations).

- Planck (http://www.planck.fr) is an ESA space mission dedicated to cosmic microwave background studies. Planck is due for launch in 2007. Planck will scan the whole sky in nine spectral bands (30 GHz - 857 GHz), during its one to two year mission. The raw data is in the form of time lines (~ TB) which will be converted to full sky maps in the different spectral bands through a very complex processing pipeline. The processing pipeline and data products have to be validated using CPU and disk intensive simulations, which can be carried, at list partially on EGEE.
- SNLS (SuperNovae Legacy Survey - http://www.cfht.hawaii.edu/SNLS/) is a large imaging survey at CFHT (Canada-France Hawaii Telescope), and a spectroscopic survey. The imaging survey uses the MEGAPRIME instrument, the largest CCD mosaic ever built, made of 40 2048x4612 pixels CCD, representing a total of 340 millions pixels, and covering a full 1 deg x 1 deg field. SNLS produces few terabytes of data per observation season, both for supernovae search and weak lensing programs.
- EROS (Expérience de Recherche d'Objets Sombres - http://eros.in2p3.fr) searches for dark matter in the form of compact object, through the microlensing effect. EROS-2 has accumulated and processed few 10^6 (millions) 2kx2k CCD frames, during its 8 years operation (1996-2003), representing a total of few terabytes of data. EROS will make its catalogue of around 100 million stars, their light curves and corresponding images available to the community.
- In SGSD-A, we try the test and evaluate the benefits and drawbacks of different approaches, using files, relational data bases (mySQL, ORACLE), OO databases (Objectivity, Versant) or a combination of these systems, both from the mass production side and data subset selection and extraction.

Extending these experimentations to the grid, and measuring the impact of distributed storage and databases will be valuable.

4.3.9.2 Main issues to be addressed

- Assessment of the effects and limitations of using a central data base (relational / object oriented) to manage data sets represented by files distributed over the grid
- Explore and evaluate the grid tools and middleware to access distributed data in a computing intensive applications, using grid infrastructure
- Explore and evaluate available technologies for distributed data bases
- Evaluate and assess the usability of tools for data access right management (a limited form of)

4.3.9.3 Community and expertise involved

The astroparticle, astrophysics and cosmology groups in MAGIE come from three leading laboratories in the fields: LAL Orsay and DAPNIA Saclay (previously described above which in addition to their HEP component, have a strong involvement in Astrophysics, astroparticles and cosmology) and APC. APC (AstroParticles and Cosmology) is a recently created laboratory on the premises of the new Tolbiac campus of University Paris-VII. It is formed by theorists and experimentalists working on astroparticles, astrophysics and cosmology coming from CNRS, CEA, University Paris VII and Observatoire de Paris. This powerful blend positions APC very well in the field.

- Members of AUGER collaboration (LAL) with broad knowledge of data management challenges
- Members of Planck (IAP, APC, LAL) with in depth knowledge of Planck needs
- Members of EROS (LAL, DAPNIA) and SNLS (APC, DAPNIA)
- CC-IN2P3 with expertise in DB and storage systems in grid environments
- Members of SGSDA

4.3.9.4 Expected results and impact, collaboration within the project

The main results will be in the form of documents containing the results of the experimentations and evaluation of implementation of some data organisation schemes, inspired from EROS/SNLS or Planck and AUGER on the grid.

Some of the software components developed for the test might also be made available as building block of data management systems.

We see also a number of possibilities to take advantage of the expertise present in the project, namely, in WP2 (scientific data mining), and WP4 (data security). However, it must be noted that our requirements for access control and encryption are much less demanding than in other fields (e.g. medical applications).

4.3.10 Common activity to WPA1-4 : Resource deployment

This paragraph describes the issues and strategies associated wit the resource deployment. Since the data storage will be pooled between all applications, this is a common activity to all application workpackages. The French resource centers involved in the EGEE production service, the grid used for the in-vivo measurements for MAGIE, permit access via the grid to nearly all of their resources. However the absolute size of the contributed resources varies significantly between the various centers because of many factors. These variations make studying the behaviour of the EGEE infrastructure an excellent complement to simulations of highly-distributed systems. Nevertheless, to satisfy the aims of the project concerning the production, movement, and analysis of large datasets, it is vital that each center have a minimum of resources---from 50 to 100 CPUs and more than 100 TB of disk space. Given the significant size of these resources, the project must find a good balance between the number of sites and the size of those sites. The resource centres involved in MAGIE must have:

- The CPU resources necessary to produce and analyze the datasets,
- Experience managing computing resources in a grid infrastructure, and
- The possibility to put into production additional resources provided by the project.

We have identified 4 regional centers in France (Ile de France, Annecy, Clermont-Ferrand and Marseille) which have the necessary experience and human resources to put an additional ~100 TB of storage into production. In the framework for the LCG project, the Ile de France site consists of three branches, Orsay, Saclay and LPNHE-Jussieu, served by a unified team and presenting a unique interface to the outside. A similar goal will be pursued in MAGIE thru the collaboration of the various Jussieu teams. The project will not only provide the storage resources, but also the necessary servers to deploy high-performance, distributed file systems (GFS, GPFS, LUSTRE, etc.). These systems will be studied to determine if their behaviour is suitable for a grid environment.

For a large acquisition of disk space, the current cost is expected to be, at the beginning of 2006 when the first third of the procurement will be made, approximately 1.5 Euro/GB. The budget of 1 MEuro will permit a purchase of approximately 600 TB to be distributed between the 4 selected regional sites. For each site, a priority application has been selected in order to ensure a fair share of the pooled resources for all application. This does not imply that the priority application will be the major user of these resources but that their requests will be treated with priority. The Resource board mentioned in section 2 will closely monitor this allocation. The following table summarizes the repartition per site

Site	MAGIE Data Volume (TB)	Priority Application
Ile de France-Jussieu	120	Earth Science
Ile de France-DAPNIA	120	HEP
Ile de France Orsay	120	Astrophysics
Clermont	75	HEP
Annecy	120	Life science
Marseille	75	Life science

All the sites will in addition store the data generated by EGEE monitoring and instrumentation.

4.3.11 P DT. 1 Data Transfer

The EGEE grid uses the national research networks in Europe (NRENs), which are federated by the pan-European multi-gigabit research network (GEANT), to connect the providers of computing, storage, instrumentation and applications resources with user virtual organisations.

An operational grid infrastructure in France is a good opportunity for the development of the future production network services:

- To set up a controlled infrastructure on a great number of sites in a global project allows gathering use traces in a real environment which stress the network.
- The end to end control of the network elements linking the users, the storage elements, the computer elements allow the experiment of new protocols and new strategy in order to provide a network quality of service really adapted to the applications requirements.

The objective of the network activity in this project is to have a pivotal role in:

- The deployment of an operational network between the sites by using the facilities of the new version of Renater (French NREN), particularly the dark fibres network dedicated to projects which will allow the building of links between sites not only based on the IP services of Renater.
- The integration of this network in the EGEE monitoring space, particularly the deployment of end-to-end networking monitoring tools;

- The access to the Classes of Service (CoS) of EGEE on IP services provided by GEANT2/NRENs
- The networking support for the French community, mainly an overall networking coordination in order to get a network expertise in an operational framework associated with a mastery on the “French production grid network”

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6 SECTION EXPECTED RESULTS AND WORKPLAN

6.1 Expected results

The detailed expected results have been listed for each workpackage and are not repeated here. The overall objective of MAGIE is to demonstrate the efficient distributed usage of very large data volumes on a production grid infrastructure. The following steps are necessary to achieve this result:

a) Deploy significant data volumes in the infrastructures and analyse them

b) Instrument and monitor EGEE infrastructure. Analyse the results

c) Develop new solutions to tackle identify bottlenecks

These three steps, which will be pursued in parallel, will correspond to important deliverables and milestones of the MAGIE project. The MAGIE results will be classified in several categories:

i) Requirements documents coming the various applications fields and relative to data access, storage, mining and security issues

ii) Quantitative assessment of the performance of the EGEE infrastructure as it is running today in all aspects connected to large data volumes

iii) Computing research publications, describing the novel methods developed to overcome the identified bottlenecks

iv) Development of novel data analysis methods, best suited for huge distributed volumes

v) Middleware development to produce an integrated demonstrator based on the most promising results obtained above.

vi) Quantitative assessment of the improvement brought by the experimental deployment of the demonstrator onto the production infrastructure

vii) Scientific publications in the various applications fields, enabled by the efficient use of the EGEE and MAGIE resources .

viii) Detailed assessment of the key advantages provided by this new computing infrastructure, that were exploited to obtain these results.

6.2 Impacts

A successful MAGIE will have a very significant scientific impact by the mere production of all the expected results described above. But MAGIE impact will be even larger because it will form the basis of a deep and permanent working relationship between a significant fraction of the computing scientist community and major application consumers. It is a well known fact that such a relationship is difficult to establish in the absence of a common high profile project. MAGIE will allow common work “on the ground” for these two communities and this will have a major impact for all future collaborations. MAGIE will thus form the core of an integrated national Grid infrastructure program, which will form the French basis for an integrated project at the European level, which is the ultimate goal of EGEE-II. Significant impact is also expected beyond MAGIE boundaries, by a strong collaboration with other national complementary grid projects, namely GRID5000 and DEISA. Fruitful synergies will naturally emerge from the dialog between the experimental measurements performed on EGEE and the modelisation and simulation activities performed on GRID5000 and GRID Explorer.

6.3 Workplan

	T0-T0+6	T0+6-T0+12	T0+12-T0+24	T0+24-T0+36
WPCR1 Task 1.1	Initial experiments with R-GMA Interaction with WP CR5	Monitoring software design Database schema Portal design	Monitoring software deployment Database population	Database population Extensions
WP CR1 Task 1.2	Interaction with WP1.1 Exploitation of existing databases: Fault classification	Interaction with WP1.1 Exploitation of existing databases: user access patterns	Phenomenology of new data	Grid models
WP CR2	Interaction with applications Interaction with WP CR5	Centre of expertise start-up Specification of a NoE PASCAL data challenge	Centre of expertise production Participation to SC analysis challenge	Centre of expertise production Participation to SC analysis challenge
WP CR3 Task DS1	Study of EGEE middleware	Integration of Access Control and Encryption in EGEE middleware		
WP CR3 Task DS2		Study of first output of WP CR4	Proposal for access control into workflow managers	Integration of security in a workflow manager
WP CR3 Task DS3	Identify existing technologies capable of solving key data integration and sharing problems in the absence of privacy constraints	Determine privacy requirements inhibiting use of existing technologies	Develop algorithms to prove the concept of privacy-preserving integration for specific known problems, establish basic framework for privacy-preserving data integration and sharing problems	Develop general privacy-preserving techniques
WP CR4	Collection of application needs regarding workflows. Basic workflow engine enabling on the grid infrastructure (functionnality without performances).	Wokflow to resources mapping taking into account the granularity of computations. Enacting a workflow of web services on the grid infrastructure.	Modification of the scheduling strategy to take into account the data. Study of the data format problems and heterogeneous computing units.	Integration of data sets and computations granularity into the worlkflow manager. Enactment of the fully gridified workflow manager with capability of reusing legacy code and optimizing computation time.
WP CR5 Task CR5.1	Interaction with applications and grid technologies	Schema Matching	Advanced Querying	Object matching and consolidation
WP CR5 Task CR5.2	Interaction with applications and grid technologies	Query service	Mobile execution model Study of first output of monitoring software	Integration of a cost model into mobile agents and using monitoring software
WP A1	Specify requirements and needs	Store ES data on up to two sites	Run applications with complex workflows and distributed data	Full deployement with scienc producing applications
WP A2	Share expertise and medical data schema	Medical image databases	Application enabled on the infrastructure on top of the security and workflow services	Production of scientific results and report on security and workflows.
WPA3		20% of disk space available and 1Gbit/s connection available between Tier-2 and Tier-1 facilities. Feedback from SC3 service challenge and first use of new file transfer and file system tools.	100% disk space available. Test of final tool in SC4 service challenge and processing of first data taken during commissioning period using the final tools.	First year of data taking, processing and analysis. Feedback from final grid performance in real condition will be available with data from one year of observation.

WP A4	Specify requirements and needs	Store some astrophysics data on up to two sites	Run applications with complex workflows and ditributed data	Full deployment with science producing applications
WP RD	Prepare procurement	Deploy 1/3 of the full capacity	Deploy full capacity	Maintain full system
WP DT	Prepare monitoring tools and SLA	Perform network studies	Perform network studies	Perform network studies

The workplan indicated above will be refined at Month 6 of the MAGIE project when the various teams composing the MAGIE consortium will have learned to work with each other and will develop a better comprehension of the workpackages interfaces.

7 FINANCIAL ASPECTS

The total request to ANR for the MAGIE project is 2 M€. The table below summarizes the attribution for the funded teams, as reported on the ANR server. It is very important to note that this sum, although considerable, represents only a small fraction of the investment already prodived by all the MAGIE partners sponsors, which support the various projects which form MAGIE context to the maximum of their capabilities. ANR supplementary financing will lead, in our mind, to a very good return on investment, since the MAGIE program of work and its related exemplary pluridisciplinary collaboration will not be undertaken without this funding and the expected results could not be of any value without all the other investments realized by MAGIE partners sponsors. The total amount invested by the various sponsors in hardware or manpower directly connected to MAGIE program of work amounts to 17 M€ on a 3 year-period. This does not include the considerable investment in EGEE/LCG hardware located in other sites in France or in Europe which will represents around 100 M€, from which MAGIE will directly benefit.

Partner	Material (k€)	Manpower (k€)	Total (k€)
LAL	190.5	150	340,5
LAPP	190.5		190,5
LPC	119		119
CPPM	119		119
IPSL	190.5		190,5
I3S		143,5	143,5
LRI		149,6	149,6
LSS		49,8	49,8
DAPNIA	190.5		190,5
IRISA		130,4	130,4
UREC		84,5	84,5
LIRIS		204,4	204,4
IRIT		94	94
Total	1000	1000	2000

Financing request (in k€) to ANR for each funded laboratory

Funding source	Hardware	Manpower	Operations
CNRS		8491	
CEA			
INRIA			
CNRS/COMI	250		450(1)
EGEE		4800 (2)	
EPA	400		
IN2P3			100
CG 91 (3)	150		
CEA/DSM	200		100
Auvergne	1000		
LAL	100		20
Ile de France (4)	1000		
Total	3100	13291	670

MAGIE members funding support . The total amounts to 17 M€

(1) Based on 2004 allocation

(2) Based on EGEE-1 (2004-2006), assuming EGEE-II (2006-2008) will be the same

(3) Request ASTRE submitted in June 2005 to Essonne department

(4) Request SESAME to be submitted in June 2006

APPENDIX A TEAMS LEADERS CV AND PUBLICATIONS

Project Coordinator :Guy Wormser (LAL Orsay)

G. Wormser is first class research director in CNRS and a high energy physicist. Member of Laboratoire de l'Accélérateur Linéaire d'Orsay since 1977 after studies in Ecole Normale Supérieure, rue d'Ulm. He graduated in 1984 in Paris-Sud University ("Study of high pt photon photoproduction in NA14 experiment at CERN"). He worked on several HEP experiments located at CERN (NA14, NA14/2, DELPHI), DESY-Germany (CELLO) and SLAC-USA (PEP-V, MarkII, BABAR). From 1999 to 2003, he was appointed deputy Director of IN2P3, the French national funding agency for High energy and nuclear physics. During that period, he launched the French effort in the pioneering DATAGRID initiative, which laid the ground to the EGEE project. He was the leader of the CNRS DATAGRID team and the French representative at the DATAGRID management board. He was selected as chairman of this board in 2003. Many efforts were spent during this period to promote the emerging Grid concept in France, in the research, industry and general public areas. He played an important role in the launching of the EGEE project, in which he chairs EGEE Generic Application Advisory Panel and EGEE Industry Forum. He leads the LAL EGEE group (http://grid.lal.in2p3.fr), the CNRS EGEE groups (~85 persons from 9 laboratories and 4 scientific departments) and the French federation in EGEE. In 2001, Guy Wormser was elected chair of the HEPCCC committee, a coordination committee for HEP computing in Europe. In this position, he played an important role to launch the LHC Grid Computing project (and was a member of several task forces and its Overview Board. He suggested the creation of the HEP International Grid Collaboration Board, to foster collaboration between the various grid projects worldwide. In 2004, Guy Wormser created the IHEPCCC, International HEP Computing Coordination Committee which he currently chairs. Guy Wormser was a member of the ACI GRID scientific council. He received in 1991 the Thibaud prize from Lyon Science Academy and the "Médaille du Mérite" in 2002.

Publications

350 publications en physique des particules dans les expériences CELLO (1979), NA14 1979-1984), NA14/2(1984-1986), PEP-V et MarkII (1986-1988), DELPHI (1989-1993) et BABAR (1994-2005)

Recent ones include :

1) MEASUREMENT OF THE B ---> X(S) L+ L- BRANCHING FRACTION WITH A SUM OVER EXCLUSIVE MODES.
By BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10395, BABAR-PUB-04-10, Apr 2004. 7pp.
Submitted to Phys.Rev.Lett. e-Print Archive: hep-ex/0404006

2) MEASUREMENT OF THE RATIO OF DECAY AMPLITUDES FOR ANTI-B0 ---> J / PSI K*0 AND B0 ---> J / PSI K*0.
By BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10394, BABAR-PUB-03-016, Apr 2004. 7pp.
Submitted to Phys.Rev.Lett, e-Print Archive: hep-ex/0404005

3) MEASUREMENT OF THE DIRECT CP ASYMMETRY IN B ---> S GAMMA DECAYS.
By BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10386, BABAR-PUB-04-012, Mar 2004. 7pp.
Submitted to Phys.Rev.Lett., e-Print Archive: hep-ex/0403035

4) MEASUREMENTS OF MOMENTS OF THE HADRONIC MASS DISTRIBUTION IN SEMILEPTONIC B DECAYS.
By BABAR Collaboration (B. Aubert et al.). SLAC-PUB-10380, BABAR-CONF-03-034, Mar 2004. 10pp.
Submitted to Phys.Rev.D, e-Print Archive: hep-ex/0403031

Grid related talks:

2004 Université d'Hourtin EGEE status report

Health grid Conference, Lyon, Oct 2003: EGEE , Enabling Grid for European Science

BEGRID workshop, Brussels, 2004 The EGEE initiative

2003 e-learning Conference, Paris: Recent Results from DATAGRID

Eric AUBOURG (APC)

Doc Phys (1992), Agr Math (1989).
Chercheur au laboratoire Astroparticule et Cosmologie (APC), UMR 7164, et au CEA/DAPNIA.
Principaux projets de recherche :
1989-2003 : EROS (Microlentilles vers le LMC et le SMC)
1992-1994 : CDMS (Cryogenic Dark Matter Search, Univ. Berkeley).
1998-2002 : Archeops (Observations du CMB depuis un ballon stratospherique)
2002- : SNLS (Recherche de supernovae avec le CFHTLS)

Bibliographie
Sélection d'articles et de communications (parmi plus de 50 articles avec referee) :
Afonso et al. (EROS Coll), Limits on Galactic dark matter with 5 years of EROS SMC data, A&A 400,951 (2003)
Benoit et al. (Archeops Coll), The cosmic microwave background anisotropy power spectrum measured by Archeops,
A&A 399, L19 (2003)
Aubourg E, EROS Microlensing Results, Sources and Detection of Dark Matter and Dark Energy in the Universe, 2001
Aubourg E et al, A search for Galactic Dark Matter with EROS 2, New Astronomy 4, 265 (1999)
Aubourg E et al, Microlensing optical depth of the Large Magellanic Cloud, A&A 347, 850 (1999)
Aubourg E et al, Evidence for Gravitational Microlensing by Dark Objects in the Galactic Halo, Nature 365, 623, 1993

Christian BARILLOT (IRISA)

Christian Barillot got his Ph.D. thesis from the University of Rennes I on "Information Processing" in 1984 and his "Habilitation" thesis <ftp://ftp.irisa.fr/techreports/habilitations/barillot.pdf> on Computer Sciences in 1999. In 1986, he was appointed from the CNRS <http://www.cnrs.org> (National Center of Scientific Research) as a tenure Researcher. In 1987, 1988 and again partially in 1991, he was research fellow at Mayo Clinic <http://www.mayo.edu>, Rochester, MN in the Biomedical Imaging Resources <http://www.mayo.edu/bir/BIR_home.html>, dept. of physiology and biophysics chairs by Prof. R.A. Robb. Between 1988 and 1996 he worked for the INSERM U335 unit at the University of Rennes I. In 1996, he joined IRISA, collaborating first with the VISTA <http://www.irisa.fr/vista/Vista.english.html> Team. Since 2004, he is the scientific leader of the VisAGeS <http://www.irisa.fr/visages> Team. In 2003, he was a visiting professor at the Robarts Research Institute, University of Western Ontario <http://www.imaging.robarts.ca>, London, Canada collaborating with Professors T. Peters and A. Fenster. His research topics aimed at the processing of multidimensional images applied to medicine. He worked first on the aspects of 3D display and the related 3D reconstruction problems (surface rendering and volume rendering methods). Afterwards his works turned to address the problems of 3D images analysis and data fusion. His research has been mainly applied to the field of 3D multimodal medical imaging (CT scanner, MRI, Ultrasound, Angiography), to radiation treatment planning and to brain imaging (human brain mapping, pre surgical mapping, brain atlases). On these aspects, he has been collaborator and principal investigator of over ten national and international grants with institutions like NIH, HFSPO, French Ministry of Research, Brittany Region Council or INRIA. He is (co)author of over 100 refereed scientific articles (abstracts excluded) on medical image processing, was co-chairman of the 14th edition of the IPMI (Information Processing in Medical Imaging) international conference in 1995. In 2004, he was the General Chair of MICCAI-2004 <http://miccai.irisa.fr>, the 7th edition of the international conference MICCAI (Medical Image Computing and Computer Assisted Intervention) <http://www.miccai.org>, and is member of the board of the Miccai Society <http://www.miccai.org>. He is also a regular reviewer for grants from national and international institutions. He regularly serves on the scientific committees of international conferences (e.g. IPMI, MICCAI, ECCV, CVPR, IJCAI, IEEE, etc.) or on review of international journals (IEEE EMB, Medical Image Analysis, Computerized Medical Imaging and Graphics, Journal of Computed Assisted Radiology, as Peer Reviewer, Image and Vision Computing, Neurimage ...). He is associate editor of IEEE Transactions on Medical Imaging <http://www.ieee-tmi.org/>.

Hugues BENOIT-CATTIN (CREATIS)

Hugues BENOIT-CATTIN received in 1992 the Engineer Degree (Electrical Engineering) and in 1995 the Ph. D Degree (Wavelet image coding of medical images), both from INSA Lyon, France. He is Assistant Professor at INSA Lyon, at the Telecommunications Department where he is mainly teaching information theory, signal and image processing.

He worked since 1992 at CREATIS Laboratory (UMR CNRS 5515, Inserm U 630). Member of the Volumic Imaging Team, his research activities concern MRI image simulation, MRI artefact correction, medical image segmentation and segmentation assessment. He was in charge of the MRI simulation application SIMRI3D in the European projects DATAGRID and EGEE.

FIVE SELECTED PUBLICATIONS

1. H. Benoit-Cattin, G. Collewet, B. Belaroussi, H. Saint-Jalmes, C. Odet, “The SIMRI project: A versatile and interactive MRI simulator”, Journal of Magnetic Resonance, vol. 173, pp. 97-115, 2005.

2. J. MONTAGNAT, F. BELLET, H. BENOIT-CATTIN, V. BRETON, L. BRUNIE, H. DUQUE, Y. LEGRE, I. E. MAGNIN, L. MAIGNE, S. MIGUET, J. M. PIERSON, L. SEITZ, T. TWEED, “Medical images simulation, storage, and processing on the European DataGrid testbed”, Journal of Grid Computing, vol. 2, n° 4, pp. 387-400, 2004.

3. S. BALAC, H. BENOIT-CATTIN, T. LAMOTTE, C. ODET, “Analytic solution to boundary integral computation of susceptibility induced magnetic field inhomogeneities”, Mathematical and Computer Modelling, vol. 39, pp.437-455, 2004.

4. T. Zouagui, H. Benoit-Cattin, C. Odet, “Image segmentation functional model”, Pattern Recognition, vol. 37, n° 9, pp. 1785-1795, 2004.

5. H. BENOIT-CATTIN, F. BELLET, J. MONTAGNAT, C. ODET, “Magnetic Resonance Imaging (MRI) simulation on a grid computing architecture”, In Proc. of IEEE CGIGRID'03- BIOGRID'03, Tokyo, 2003.

Christophe BLANCHET (IBCP)

Christophe Blanchet obtained his doctorate in Bioinformatics/Biochemistry in 1999, and took a position at the Institute of Biology and Chemistry of Proteins (CNRS UMR5086) working on Bioinformatics. He became interested in grid technologies applied to Bioinformatics through his participation to the European DataGrid (EDG) project since 2001, and after to the Enabling Grids for E-scienceE (EGEE) project, within he is the deputy of the Biomedical Applications Activity. Since 2005, he also take an active role in the European Network of Excellence "European Model for Bioinformatics Research and Community Education" (EMBRACE) within he is the scientific responsible of the CNRS partner.

SELECTED PUBLICATIONS

MPSA : Integrated System for Multiple Protein Sequence Analysis with client/server capabilities. Blanchet C., Combet C., Geourjon C. et Deléage G. Bioinformatics, 2000, 16, 286-287.

NPS@: Network Protein Sequence Analysis. Combet C., Blanchet C., Geourjon C. et Deléage G. Tibs, 2000, 25, 147-150.

Grid Technology for Biomedical Applications. Breton, V., Blanchet, C., Legr?, Y., Maigne, L. and Montagnat, J. M. Dayd. et al. (Eds.): VECPAR 2004, LNCS 3402, pp. 204Ð218, 2005.

Grid as a Bioinformatic Tool. Jacq, N., Blanchet, C., Combet, C., Cornillot, E., Duret, L., Kurata, K., Nakamura, H., Silvestre, T. and Breton, V. Parallel Comp., 2004, (Special issue: High-performance parallel bio-comp.), 30 (9-10) 1093-1107.

Vincent BRETON (LPC Clermont)

Ingénieur de l’Ecole Centrale de Paris, Vincent Breton a obtenu une thèse en physique nucléaire de l’université Paris XI – Orsay en 1990. Depuis 1990, il est chargé de recherches au CNRS. Il a fondé en 2001 l’équipe Plate-Forme de Calculs pour les Sciences du Vivant (http://clrpcsv.in2p3.fr) sur l’application des outils et méthodes informatiques de la physique corpusculaire aux sciences du vivant.

L'équipe étudie particulièrement les applications biomédicales des grilles informatiques. Co-fondateur de l'initiative Healthgrid, chairman des conférences Healthgrid en 2003 et 2004, il anime des groupes de travail dans plusieurs projets européens (DataGrid, EGEE, Embrace).

SELECTED PUBLICATIONS

Medical images simulation, storage, and processing on the European DataGrid testbed, J. Montagnat, F. Bellet, H. Benoit-Cattin, V. Breton, L. Brunie, H. Duque, Y. Legré, I.E. Magnin, L. Maigne, S. Miguet, J.-M. Pierson, L. Seitz, T. Tweed, to be published in Journal of Grid Computing, 2005

Grid as a bioinformatic tool, N. Jacq, C. Blanchet, C. Combet, E. Cornillot, L. Duret, K. Kurata, H. Nakamura, T. Silvestre and V. Breton, Parallel Computing 445, Vol 30/9-10 (2004) 1093-1107

Empowering humanitarian medical development using grid technology, J. Gonzales, S. Pomel, V. Breton, B. Clot, JL Gutknecht, B. Irthum, Y. Legré., submitted to proceedings of Healthgrid 2004 to be published in Methods of Information in Medecine

Parallelization of Monte Carlo Simulations and Submission to a Grid Environment, L.Maigne, D. Hill, P. Calvat, V. Breton, D. Lazaro, R. Reuillon, Y. Legré, D. Donnarieix, Parallel Processing Letters, Vol. 14, No. 2 (June 2004), p 177-196.

DataGrid, prototype of a biomedical grid, V. Breton, R. Medina & J. Montagnat, proceedings of the Conference on synergy between research in medical informatics, bio-informatics and neuro-informatics, Bruxelles, Décembre 2001, MIMST, 42(2), 2003

JEAN-PAUL GAUTIER (UREC)

Jean-Paul Gautier is Ingénieur de Recherche au CNRS. He specialized in networking since 1992 when he joined UREC. His areas of expertise are

- Networks protocols and tools mainly from Layer 1 to Layer 4 of the OSI Model.
- MAN and Campus networks architecture
- Project management and networks design.
- Operation and technical coordination (NOC) of large networks.

His main actions were technical manager of the network project for the CNRS headquarters, (1993) Technical manager of the project "The new network architecture for the CNRS regional headquarters and the Renater connectivity(1995), project manager in "An ATM network for the University and CNRS at Sophia-Antipolis and Nice"(1997), Technical coordination of the research network project MIRIHADE inside a partnership CNET/CNRS to build an high speed infrastructure over ATM services supplied by a provider. Technical coordination in EFRA (Experimentation of ATM Networks in Ile-de-France), The "Paris Academic Network" project (RAP), a high speed Metropolitan Area Network for research and educational in Paris (43 establishments, 100 sites, 350000 users), Technical coordination for the studies and request for proposal. He got in 2002 the "Telecom & Networks Manager" price awarded by Réseaux&Télécoms (newspaper) and INT (National Institute of Telecommunications). Since February 2004: Activity manager of the "Network resource provision" activity in the Enabling Gridsfor E-scienceE (EGEE) project.

Teaching

- Course on networking for CNRS, University Pierre & Marie Curie and INSERM (1992-1999).
- ATM Tutorial 1995-1998 in many places in France.

CONFERENCES

- Summer School HD'96 on high speed networks: organizer and speaker.
- JRES'99, speaker on optical networks.

- JRES’2001, member of the program committee and speaker on “RAP, an optical network”.
- JRES’2003, member of the organization committee.
- Meeting Juniper at TERENA 2003 (Zagreb), speaker on “Paris Academic Network”.

Abdelkader HAMEURLAIN (IRIT)

Abdelkader Hameurlain is professor in Computer Science at Paul Sabatier University. He is a member of the Institute of Research in Computer Science of Toulouse (IRIT). His current research interests are in query optimization in parallel and large scale distributed environment, mobile databases, and database performance. He is scientific leader of a part of GGM project -Optimized services for biomedical queries (ACI Masse de Données 2004)-. Prof. Hameurlain has been the general chair of the International Conference on Database and Expert Systems Applications (DEXA'02). He was guest editor of two special issues of a journals on “Mobile Code and Agents” and “Mobile Databases”.

PUBLICATIONS

A. Hameurlain. Mobile Databases. In: International Journal of Computer Systems Science & Engineering, CRL Publishing Ltd, 9 De Montfort Mews Leicester LE1 7FW UK, Vol. 20, N. 2, March 2005.

J.-P. Arcangeli, G. Bernard, A. Hameurlain, et J. F. Monin, Revue TSI Technique et Science Informatiques, Numéro Thématique “Agents et code mobiles”; Vol. 21, No. 6, 2002.

Franck Morvan, Abdelkader Hameurlain. Mobilité dans les systèmes d'information et de bases de données. Dans : Revue Ingénierie des Systèmes d'information, Hermes Science Publication, novembre 2005.

Belgin Ozakar, Franck Morvan, Abdelkader Hameurlain. Query Optimization: Mobile Agents versus Accuracy of the Cost Estimation. In: International Journal of Computer Systems Science & Engineering, CRL Publishing Ltd9 De Montfort Mews Leicester LE1 7FW UK, V. Vol. 20 N. 3, p. 161 - 168, mai 2005.

Belgin Ozakar, Franck Morvan, Abdelkader Hameurlain. Mobile Join Operators for Restricted Sources. In: Mobile Information Systems: An International Journal, IOS PressNieuwe Hemweg 6B, 1013 BG Amsterdam, The Netherlands, V. 1 N. appear in the 3rd issue of 05, p. 1-18, 2005.

Charles LOOMIS (LAL Orsay)

Charles Loomis obtained his doctorate in High-Energy Physics in 1992 and worked as a post-doctoral researcher at Fermilab in the United States and at CERN in Switzerland. He became interested in grid technologies and took a position at the Laboratoire de l'Accelerateur Lineaire working on the European DataGrid project. In this project he was responsible for the Integration Team which evaluated the project's software, assembled it into a release, and deployed it onto the testbed. The testbed comprised approximately 20 sites and was the largest production grid in the world at the time. The project successfully concluded after three years. Afterwards, he became involved in the LHC Computing Grid (LCG) and Enabling Grids for E-scienceE (EGEE) projects. Within LCG, he is responsible for the Quattor Working Group which maintains a Quattor-based release of the LCG production software. Quattor is a toolkit for the installation, configuration, and management of clusters. He has made extensive contributions to the Quattor code base. Similarly he has taken an active role in the EGEE project serving as chair of the Project Technical Forum (PTF) which reviewed the EGEE architecture. Recently he has also become the deputy of the EGEE Applications Activity and plays an active role ensuring that the needs of the scientists are met.

Jean-Pierre MEYER (CEA)

- Particle physics PhD (1989)

- Habilitation of PhD training (1999)

He started his research work in 1989 at CEA (Commissariat à l'Energie Atomique) in the Department of astrophysics, nuclear physics and particle physics (DAPNIA) studying the prompt photon production in the UA2 experiment located on the proton anti-proton collider at CERN. From 1990 to 1995 hi worked on the RD3 research and development program aimed to build an electromagnetic calorimeter for the LHC (Large Hadron Collider). In 1991, hi started working in parallel on the NOMAD experiment which was build to search for muon neutrino to tau neutrino oscillations. This experiment took data from 1994 to 1998. After having completed the co-supervision of a PhD having as subject the search for tau neutrino appearance in a muon neutrino beam, hi left NOMAD in 1999. From 1999 to 2003 he worked on the LENS research and development program aimed to build a solar neutrino experiment able to detect in real time solar neutrino down to the pp neutrino energy range. Since his studies showed that, this goal is not achievable with LENS, hi started in 2003 to work on the Double CHOOZ project. This experiment has the ambition to measure theta13 (the third neutrino mixing angle of the CKM matrix) down to a few percent in sinus square two theta13. In parallel hi joined in 1999 the ATLAS experiment, working specially on the liquid argon electromagnetic calorimeter, construction and testing as well. Hi is actually supervising a PhD student working on the study of the electron reconstruction in ATLAS and the search for the HIGGS boson in the decay channel HIGG to four electrons. Since spring 2005 hi is also in charge of the Grid computing project in the Paris region.

Publications : Among his 70 publications the last five are listed below:

LETTER OF INTENT FOR DOUBLE-CHOOZ: A SEARCH FOR THE MIXING ANGLE THETA(13). F. Ardellier et al.. DAPNIA-04-84, May 2004. 102pp., e-Print Archive: hep-ex/0405032

WHITE PAPER REPORT ON USING NUCLEAR REACTORS TO SEARCH FOR A VALUE OF THETA(13).
K. Anderson et al.. FERMILAB-PUB-04-180, Jan 2004. 167pp. e-Print Archive: hep-ex/0402041

YTTERBIUM BASED SCINTILLATORS, A NEW CLASS OF INORGANIC SCINTILLATORS FOR SOLAR NEUTRINO SPECTROSCOPY.Nucl.Instrum.Meth.A486:228-233,2002

Object oriented reconstruction and particle identification in the ATLAS calorimeter / Caron, Bet al. ISN-01156.- Grenoble : Grenoble 1. Inst. Sci. Nucl., 2001

UPDATED RESULTS FROM THE NU/TAU APPEARANCE SEARCH IN NOMAD.
By NOMAD Collaboration (P. Astier et al.). CERN-EP-2000-049, Mar 2000. 26pp.
Published in Phys.Lett.B483:387-404,2000

Johan MONTAGNAT (I3S)

Researcher in computer science. He got is PhD thesis in the field of medical image processing in 1999 (Supervisor: H. Delingette in N. Ayache team). After a postdoc at the Montreal Neurological Institute, he obtained a permanent position as a researcher of the French National Center for Scientific Research (CNRS). His research interests are medical image processing and grid computing for health related issues. He is involved in the EGEE European project as the leader of the biomedical applications activity. EGEE aims at deploying a world-wide academic grid infrastructure. He is also leading the French ACI-GRID project MEDIGRID, and he participates to the ACI-MD project AGIR, dealing with the problems of medical data management and enabling medical applications on grids. As a research activity, he has recently published works in the fields of requirements collection of medical image processing applications for grids, efficient execution of medical applications on a grid infrastructure, and enabling workflows on grids.

Selected publications

Medical images simulation, storage, and processing on the European DataGrid testbed, J. Montagnat, F. Bellet, H. Benoit-Cattin, V. Breton, L. Brunie, H. Duque, Y. Legré, I.E. Magnin, L. Maigne, S. Miguet, J.-M. Pierson, . Seitz, and T. Tweed, Journal of Grid Computing, vol 2., num. 4, pp 387-400, Kluwer, dec. 2004

Partitioning medical image databases for content-based queries on a grid., J. Montagnat, Vincent Breton, Isabelle E. Magnin, Methods of Information in Medicine, vol. 44, num. 2, 2005, Schattauer

Using grid technologies to face medical image analysis challenges, J. Montagnat, V. Breton, I. E. Magnin, Biogrid'03, proceedings of the IEEE CCGrid03, pp 588-593, May 2003, Tokyo, Japan.

NADINE NEYROUD (LAPP)

Nadine Neyroud is a Research Engineer in CNRS. Since 2002, she heads the computing group of Laboratoire d'Annecy de Physique des Particules) and manages 20 technicians and engineers. She takes care of the system and development for experiments EGEE Grid service provider (Resource Broker).

2000-2001 Managed Storage International (European headquarter, Toulouse)

International company, created in May 2000 as a spin off from StorageTek. Leading European Storage Service Provider (SSP) in the Internet world, present in 3 countries.

European Technical Product Manager : Offering definition, European customization and implementation of tools and processes to deliver Internet PC backup service platforms and services. Strong interaction with US development team.

1999-2000 StorageTek (Solutions Business Group, European headquarter, Toulouse)

International US company, one of the leaders in Tape and SAN storage and associated services. Mid-98, new solution oriented entity creation.

European Program Manager : Implementation of tools and process to sell and deliver integrated hardware and software solutions ("Appliances") in the backup and archive arena

1987-1998 Digital Equipment Corporation (CustomSystems, Europe)

European Unit Segment Manager (CustomSystems, Europe, Annecy)

Creation and development of new European business segment based on Unix, VMS "off the shelf" Cluster packages and integration projects.

Network Consultant (Local office in Lyon, then Expertise Center, Paris)

Consulting and Project management in the National Network Expertise Center

1983-1986 CNRS (Centre National de Recherche Scientifique , IN2P3, Annecy)

System Manager (Laboratoire d'Annecy de Physique des Particules)

In charge of local VAX Cluster and X.25 networks in close cooperation with CERN in Geneva

Education: Masters degree in engineering: 1982, ENSIMAG Grenoble, Graduated as Computer Science Engineer

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Monique PETITDIDIER (CETP/IPSL)

Monique Petitdidier is a doctor in Physics Science from the University of Paris, senior scientist, presently Research director in CNRS at Centre d'études des Environnements Terrestre et Planétaire, laboratory belonging to the Institut Pierre Simon Laplace (CETP/IPSL). Her topic of research has been atmospheric processes related to the dynamics, at first in the upper atmosphere and then in meteorology. She was associate researcher of Cornell University (USA) in the National Atmospheric and Ionospheric Center (NAIC). She had in charge the development of optical complex photometers for her thesis and in 1985 of a bi-frequency wind-profiler radar, prototype for the research and operational networks. She has participated to many international field campaigns, reduced and interpreted the results in terms of dynamical processes. She has published as author and co-author more than 90 papers.

She participated to COST action about the deployment of wind profilers over Europe to improve weather forecasting.

At Institut Pierre Simon Laplace, she created an activity about data, initiated a centralized metadata catalogue in collaboration with XMLMedia [Start-up created by G. Gardarin (Prism)], organized seminars on databases, data mining, etc, participated to European proposals on climate network and project like DataGrid. In EGEE, she has coordinated the Earth Science activity.

Publications

S. Casadio, F. del Frate, S. Godin-Beekmann, M. Petitdidier, Grid technology for the analysis of atmospheric ozone from satellite data. proceedings of Data Systems in Aerospace (Dasia), Prague, Tchéquie, 2-6 June 2003.

Del Frate F., Iapaolo M., Casadio S., Godin-Beekmann S. and Petitdidier M., “Neural networks for the dimensionality reduction of GOME measurement vector in the estimation of ozone profiles”, J. Quantitative Spectroscopy and Radiative Transfer, 2005.

L. Fusco, J. Linford, W. Som deCerff, C. Boonne, C. Leroy, M. Petitdidier: Earth Observation Applications Approach to Data and Metadata Deployment on the European DataGrid Testbed; Proceedings of Global Grid Forum, the future of Grid data environments workshop, Berlin, March 9, 2004.

Jean-Marc PIERSON (LIRIS)

J.M. Pierson received his PhD in 1996 from the Ecole Normale Supérieur in Lyon, France. His thesis was done in the field of Parallelism and Computer Graphics. After four years in Calais working in Distributed Systems and Visualization, he is now involved in Data Management in Large Scale Distributed Systems at the LIRIS laboratory in Lyon. His interests are related to Pervasive Information Systems and Data Grids. He is an Associate Professor since 1997 (since 2001 at INSA de Lyon) and the advisor of 5 PhD students, working on Access Control in Grid Computing, Mediation and Negociation in Data Grids, Caching in Grids, Data Replication and finally Multimedia Content Adaptation in Pervasive Systems."

Grid related publications:

J. Montagnat, JM. Pierson, L. Seitz, H. Duque, L. Brunie et al. Medical images simulation, storage and processing on the European DataGrid testbed. Journal of Grid Computing, to be published by Kluwer Academic Publishers.

L. Seitz, JM Pierson and L. Brunie. Encrypted Storage of Medical Data on a Grid. Journal Methods of Information in Medicine (special issue), extended version of article presented at Healthgrid'2004 ; N°2 (2005).

JM. Pierson, L. Brunie, M. Miquel, A. Tchounikine, C. Dhaenens, N. Melab, EG Talbi, A. Hameurlain, F. Morvan. Grid for Geno-Medicine : A Glimpse on the project. BioGrid'05 (held in Conjunction with ACM/IEEE CCGRID'05), 9-12 May, Cardiff, UK. IEEE CS Press

L. Seitz, J. Montagnat, JM. Pierson, D. Oriol and D. Lingrand. Authentication and authorisation prototype on the mgrid for medical data management. Third International Conference on Healthgrids (Healthgrid'2005), April 7-9, 2005, Oxford, U.K, IOS Press, ISBN I-58603-510-X, pp 222-233

JM. Pierson, L. Seitz, J. Montagnat and H. Duque. Metadata Management for Efficient, Secure and Extensible Access to Data in a Medical Grid Globe'04, held in conjunction with 15th International Workshop on Database and EXpert systems Applications DEXA'04, Saragossa, Spain, IEEE Press, pp562-566.

L. Seitz, JM Pierson and L. Brunie. Semantic Access Control for Medical Applications in Grid Environments. ACM Europar'03, Klagenfurt, Austria, august 2003, LNCS Springer Verlag, LNCS2790, pp374-383.

Michèle SEBAG (LRI)

Martine Michèle Sebag is research director in CNRS. She joined LRI in 2002 after 10 years in Laboratoire de Mécanique du Solide in Ecole Polytechnique. After Ecole Normale Superieure (Sèvres), she worked for 6 years in industrial companies (Thomson CSF) as CAD engineer, project leader and computer expert. She got her PhD degree in1990 in Université Paris-IX Dauphine, Une approche symbolique-numérique pour la discrimination à partir d'exemples et des règles. Her habilitation thesis took place in 1997 in Université Paris-XI Orsay, Apprentissage stochastique, Apprentissage pour l'Optimisation stochastique. Michèle Sebag is a recognized expert in inference and learning. She benefits from a very high international visibility, chairing many colloquia, editorial boards, taking take of important international publications such as Machine Learning Journal, Knowledge of information systems. She directs many students and is very often asked to participate in thesis jury. She produced commercialized middleware, writes many books and teaches in Paris-Sud University.

Middleware : SEA, (1989), Systèmes Experts par Apprentissage, en collaboration avec M. Schoenauer et M. Terrien
Publications :
H. Blockeel and M. Sebag. Scalability and efficiency in multi-relational data mining. ACM SIGKDD, Special Issue on Multi-Relational Data Mining, 5(1):17-30, 2003.
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pages 637-640, 2003.

Andrei TSAREGORODTSEV (CPPM, Marseille)

A. Tsaregorodtsev is a research engineer in the Centre de Physique des Particules de Marseille since 1998. He received the Engineer-Physicist degree from the Leningrad Polytechnical Institute in 1984 and obtained his doctorate in Nuclear Physics in 1993 at the Leningrad Nuclear Physics Institute. in 1991-1993 he worked in the L3 experiment and then joined the LHCb experiment at CERN. In 1994-1998 he was a computing coordinator of the LHCb Collaboration, the main author of the LHCb simulation software framework as well as responsible for the distributed data production and management of the LHCb computing resources. Currently, A. Tsaregorodtsev is leading the LHCb distributed computing project DIRAC which is integrating all the LHCb computing resources including those available through the LHC Computing Grid (LCG) for the needs of the simulation data production and analysis. He is responsible for the LHCb production system which is used in the Data and Service Challenges. He is a member of several grid related task forces (LCG ARDA RTAG, Grid Applications Group, Baseline Services Group, EGEE NA4 group). He is also the LHCb-France computing coordinator, a member of the LHCb National Computing Board and a member of the LCG-France project direction team. He is a supervisor of one PhD student working on the grid workload management research and of two Marie-Curie program fellows working on distributed analysis workflow optimization and efficient data replication algorithms respectively.

Some recent publications:

N.Brook et al, LHCb Distributed Computing and the Grid, Nucl.Instrum.Meth.A502:334-338, 2003.
I.Augustin et al, HEP APPLICATIONS EVALUATION OF THE EDG TESTBED AND MIDDLEWARE, Proceedings of the 2003 Conference for Computing in High-Energy and Nuclear Physics (CHEP 03), La Jolla, California, 24-28 Mar 2003.

A.Tsaregorodtsev et al, DIRAC - The Distributed MC Production and Analysis for LHCb, Proceedings of the 2004 Conference for Computing in High-Energy and Nuclear Physics (CHEP 04), Interlaken, Switzerland, 27 September - 1 October, 2003.

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V.Garonne, A.Tsaregorodtsev, I.Stokes-Rees, DIRAC: A Scalable Lightweight Architecture for High Throughput Computing, Proceedings of 5th IEEE/ACM International Workshop on Grid Computing (Grid2004), 8 November, 2004, Pittsburgh, USA.

Jean-Pierre VILOTTE (IPGP)

Jean-Pierre Vilotte graduated in 1989 with geophysics degree from University of Montpellier. He is a first class “Physicien des Observatoires”. His work deals with the modelisation of dynamics of earthquakes, modelisation of the propagation of waves in complex media and in numeric modelisation and parallel computing. He has directed 11 thesis and teaches in University Paris 6. He is the present director of the Laboratory of Seismology (IPGP/CNRS-UMR7580), responsible of the department of physical and digital modelisation of IPGP and responsible of the group Modelation and geophysical tomography of the Sismology laboratory. He is author or coauthor of 50 international publications.

Eric WALTER (L2S)

Eric Walter was born in 1950. He studied applied physics at the University Pierre et Marie Curie up to a Master in Electrical Engineering in 1973. He then prepared a PhD thesis in control theory at the Laboratoire de Génie Electrique de Paris (completed in 1975). In 1976, he became a researcher at CNRS, and prepared his “these d’état” in Control theory at the Laboratoire des Signaux et Systèmes (completed in 1980). He became directeur de recherche at CNRS in 1989, and director of the Laboratoire des Signaux et Systèmes in 2001. The Laboratoire des Signaux et Systèmes is a common research unit of CNRS, the Electrical Engineering school Supélec and the university Paris-Sud, with a staff of about 110 (doctoral students included).

His research centres on developing a methodology for extracting pertinent information contained in signals collected on systems (parameter identification, state estimation), with applications in control, chemical engineering, chemistry, medicine, pharmacokinetics and robotics.

He is the author or coauthor of three books, and more than 200 papers in refereed international journals, in the proceedings of international conferences or as chapters of collective works.

Books :

[L-1] E. Walter, Identifiability of State-Space Models, Springer, volume 46 des Lecture Notes in Biomathematics, Berlin, 1982, 202 pages.

[L-6] E. Walter, L. Pronzato, Identification of Parametric Models from Experimental Data, Springer, Communications and Control Engineering Series, Londres, 1997, 413 pages.

[L-8] L. Jaulin, M. Kieffer, O. Didrit, E. Walter, Applied Interval Analysis, 2001, Springer-Verlag, Londres, 2001 (379 pages). La traduction en russe vient de paraître.

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[RI-77] C. Durieu, E. Walter, B. Polyak, Multi-input multi-output ellipsoidal state bounding, J. of Optimization Theory and Applications, 2001, 111(2), 273-303.

[RI-80] M. Kieffer, L. Jaulin, E. Walter, Guaranteed recursive nonlinear state bounding using interval analysis, International J. of Adaptive Control and Signal Processing, 2002, 6(3) 193-218.

[RI-90] M. Kieffer, E. Walter, Guaranteed nonlinear state estimator for cooperative systems, Numerical Algorithms, 2004, 37, 187-198.

[RI-91] E. Vazquez, E. Walter, Instrinsic Kriging and prior information, Applied Stochastic Models in Business and Industry, 2005, 21(2): 215-226.

APPENDIX B ASSOCIATED LABORATORIES

The following laboratories/ institutions/projects have expressed their support to MAGIE:

Institution	Contact	Primary interest
EGEE	F. Gagliardi (CERN)	Grid monitoring, advanced tools
Institut d'Astrophysique de Paris (IAP)	F. Bouchet (INSU/CNRS)	Astrophysics
CC_IN2P3	D. Boutigny (IN2P3/CNRS)	High energy physics, EGEE instrumentation and monitoring
LPHNE	F. Derue (IN2P3/CNRS)	High Energy Physics
LIP6	P. Sens (U. Paris 6)	
LIP	P. Primet (INRIA)	Data transport
RENATER	D. Vandrome (RENATER)	Data Transport
FR-GRID	P. D'Anfray (CEA)	Grid usage for industry
ORACLE	J. Valat	Database
C-S	J.F. Musso	Monitoring
CGG	D. Thomas	Earth science