Heike Neuroth, Martina Kerzel,
and Wolfgang Gentzsch (Ed.)

German Grid Initiative

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Foreword

The Internet has long become an indispensable part of our everyday professional and social lives. In Germany, over 90 percent of all young people and adults under the age of 55 use the Internet, over half of them on a daily basis. Today, the Internet is still largely restricted to the exchange of information via services such as the World Wide Web and e-mail. In future, however, the grid will enable world-wide and transparent access to data storage units, supercomputers, programs, and measuring instruments. The technical equipment available at any given location will become a secondary issue – grid technology will make it possible to work in a networked service environment via the Internet.

The D-Grid Initiative, which was launched and funded by the Federal Ministry of Education and Research (BMBF), is on the right track to turning the grid from a science-oriented instrument into a universal tool. This year, a second group of D-Grid collaborative projects was launched, with the aim of integrating businesses more strongly in the development of grid services based on a sustainable grid infrastructure. The BMBF is currently providing over €60 million of funding to more than 150 D-Grid projects. As part of the High-Tech Strategy for Germany, the BMBF is placing the development of the D-Grid on an even broader basis through the involvement of additional user groups. The aim is to enable science and industry to use the opportunities offered by the grid in their day-to-day work.

For this reason, in addition to efforts to improve and adapt the technology itself, future D-Grid projects will also focus on developing business and application models for grid services. After all, the users and providers themselves will have to find ways of regulating payment for the services used – be it access to programs and databases or the computing power of supercomputers.

The success of the D-Grid Initiative will be measured by whether we in Germany are able to develop internationally leading, sustainable grid structures that contribute to the economic development of our country and endure beyond the end of BMBF project funding. I wish all those who are working on the D-Grid Initiative every success in this endeavour!

Dr Annette Schavan, MdB
Federal Minister of Education and Research

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Grid Computing and the German D-Grid Initiative

After the World Wide Web, recently, another Internet revolution is emerging: Grid Computing. While the Web offers easy access to mostly static information, the grid adds another fundamental layer to the Internet, by enabling direct access to computers, storage, scientific instruments and experiments, sensors, applications, data, and middleware services. Based on widely accepted grid and web services standards, resources communicate with each other and deliver results as services back to the user.

Grid infrastructures provide a wide spectrum of benefits, for example: transparent access to and better utilization of resources; almost infinite computing and storage capacity; flexibility, adaptability and automation through dynamic and concerted interoperation of networked resources; cost reduction through a utility model; higher quality of results; and shorter time-to-market. This grid revolution is well underway in scientific and engineering organizations with high demand of computing and data processing.

Besides the obvious benefits for the researchers, the grid technology has great benefits also for the industry. In an era of increasing dynamics, shrinking distances, and global competition, those organizations are in an advantageous position which have access either to natural or to highly specialized resources, on demand, in an efficient and effective way. It enables engineers to access any IT resource (computers, software, applications, data, etc) in an easy and efficient way, to simulate any process and any product - even the whole product life cycle - in virtual reality before it is built, resulting in higher quality, increased functionality, and cost and risk reduction. Grid technology helps to adjust an enterprise's IT structures to real business requirements.

German scientists and scientific organizations in 2003 jointly published a strategic paper which examined the status and consequences of grid technology on scientific research in Germany and recommended a long-term strategic grid research and development initiative. This resulted in the German D-Grid Initiative founded by the German

Federal Ministry of Education and Research (BMBF) in March 2004, together with a call for proposals in the areas of Grid Computing, e-Learning, and Knowledge Management.

The first D-Grid projects started on September 1, 2005. BMBF's plan is to fund several 100 German research and industry organizations with 100 Million Euro over the next 5 years. The goal is to design, build and operate a network of distributed integrated and virtualized high-performance resources and related services to enable the processing of large amounts of scientific data and information. So far, BMBF is funding the assembling, set-up and operation of the grid infrastructure in several overlapping stages:

D-Grid 1, 2005-2008: IT services for scientists, designed and developed by the 'early adopters' of the computer science and scientific computing communities. This global services infrastructure is being tested and used by so-called Community Grids in the areas of high-energy physics, astrophysics, alternative energy, medicine and life sciences, earth sciences (e.g. climate), engineering sciences, and scientific libraries.

D-Grid 2, 2007-2010: IT services for scientists, industry, and business, including applications in the construction industry, finance, aerospace and automotive, enterprise information and resource planning systems, geographical data, and general IT services.

Next steps will extend the grid infrastructure with a Service Level Agreement (SLA) and a knowledge management layer, adding several virtual competence centres, encouraging global service-oriented architectures in the industry, and using this grid infrastructure for the benefit of our whole society.

A short-term goal of D-Grid has been achieved already: a core grid infrastructure for the German scientific community has been built. Currently, first test and benchmark computations are being performed by the Community Grid projects, to provide technology feedback to the D-Grid Infrastructure (DGI) project. Then, climate researchers of the C3-Grid, for example, will be able to predict climate changes faster and more accurately than before, to inform governments about potential environmental measures. Similarly, astrophysicists will be able to access and use radio telescopes and supercomputers remotely

via the grid, which they wouldn't be able to access easily otherwise, resulting in a novel quality of research and the resulting data.

In the near future, on such an enhanced Internet, all kinds of service providers will offer their services for computing, data, applications, and more. On an enhanced World Wide Web, via secure Web Portals, we will access grid components like Lego building blocks, which enable us to dynamically build grids 'on the fly', according to our specific needs. We will rent or lease the resources required and just pay for what we use. From a bird's eye view, the business model for grid services will be similar to those for electrical power, water, or telephony: our payments will be based on widely agreed billing units which include cost for computers, storage, software, applications, work, electrical power, square footage for the equipment, and personnel for maintenance.

All this will take a few more years to happen. Firstly, we have to 'grid-enable' our data, our applications, our knowledge repositories. We need security technologies which guarantee that one's identity can't be stolen and that confidential data can be stored in highly secure digital containers if needed. This requires close collaboration among computer scientists, researchers, engineers, and businesses.

As with any new infrastructure, development and deployment of the next Internet generation will require vision and endurance. We have to work continuously on strategic, long-term projects on a national and international scale, which demand collaboration of research and industry on complex inter-disciplinary projects, and which will improve the tools of our scientists, business people, and educators and strengthen our competitive position in a global world.

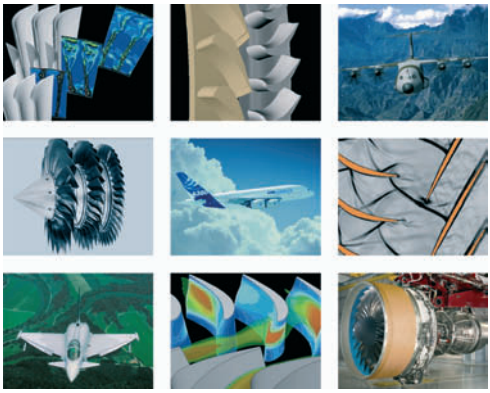
Wolfgang Gentzsch, D-Grid Coordinator
In Collaboration with European Media Laboratory GmbH

AeroGrid

Grid-Based Cooperation between Industry, Research Centres, and Universities in Aerospace Engineering

D-Grid II, Aerospace Engineering

The AeroGrid project aims at providing an efficient grid-based working environment for the national aerospace research community. The AeroGrid environment will be a permanent and effective grid infrastructure for the cooperation between industry, research centres, and universities in aerospace engineering and research. Compared to other industrial sectors, most aerospace research is carried out in public and governmental institutes. In the field of computational fluid dynamics (CFD), industry often uses innovative codes which are jointly developed by research centres, such as DLR, and universities.



The AeroGrid environment allows virtual organizations to cooperate in research and development projects, to always use up-to-date program versions, data, and compute resources across all locations, and to document and trace the detailed history of a computational process that leads to a certain result ("Provenance").

The design of the AeroGrid environment addresses two important requirements:

- Suitability for daily use, especially for the productive operation by the service provider after the end of the project.

- Applicability to similarly organized communities in science and industry.

The integration of a Provenance service which records detailed information of all conducted execution steps, increases the dependability of the results and improves the user's confidence in their quality. The Provenance service used in AeroGrid will be provided to all D-Grid projects as a standard service for Provenance recording and querying.
Within the project, the grid environment will be evaluated with the following usage scenarios from the turbine simulation domain:

- Usage of compute resources via the AeroGrid.
- Collaboration during the design of new engine components.
- Cooperative further development of the DLR CFD code *TRACE*.

The AeroGrid environment will consist of two different user interfaces, a Web portal based on the GridSphere server, and the data management client application DataFinder. Both user interfaces will be customized to support the various usage scenarios.

Partner Organisations:
German Aerospace Center; MTU Aero Engines; T-Systems Solutions for Research; Bundeswehr University Munich

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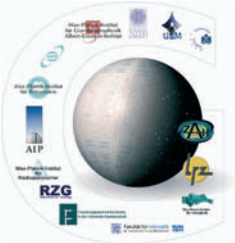
Project Duration: April 2007 - March 2010

http://www.aero-grid.de

AstroGrid-D

The German Astronomy Community Grid

D-Grid I, Astronomy



The AstroGrid-D is a research project for scientific work supporting e-Science and grid middleware within the German D-Grid Initiative.
Leading German astronomy institutes, grid-specific research groups from computer sciences, and supercomputing centers have joined in an interdisciplinary partnership to pursue several strategic goals:

1. To join together astronomical science institutions into a unified nationwide research infrastructure of collaborative distributed environments using innovative grid technologies.
2. To create a grid-based infrastructure for astronomical and astrophysical research, based on integration of their computational facilities and data servers, thus improving the efficiency and usability of their hardware resources.
3. To integrate distributed astronomical data archives and, in an extended time frame, of instruments and experiments into a common research infrastructure.
4. To support other research institutes as well as individual researchers in sharing their resources, data and application software within the AstroGrid-D infrastructure, especially to enable small university workgroups to join the collaboration.
5. To strengthen the ties of the German astronomy community to the huge developments within the international activities of the astronomy community.

The development of a framework and of appropriate standards for collaborative management of astronomy-specific grid resources within the required infrastructure is the core task of the AstroGrid-D. Geographically distributed supercomputing resources and huge astronomical data archives, remote-controlled radio telescopes and robotic telescopes and gravitational wave detectors are to be integrated into this coherent framework. Standardized user interfaces allowing unified and location-independent access to existing computing resources will simplify astrophysical numerical simulations. Transparent access to local data archives and those available within the grid is expected to simplify community-developed data analysis tools and complex data processing. Using the standards of International Virtual Observatory Alliance (IVOA) ensures the interoperability of all kinds of astronomical datasets and software applications. The existence of such a fully operational, transparent and user friendly e-Science infrastructure is a prerequisite for many future data-intensive astronomy projects, in particular the Low Frequency Array (LOFAR) or the Large Synoptic Survey Telescope (LSST).

Based on a wide range of Use Case studies AstroGrid-D extends the available grid middleware with specialized tools and services for the community. Our information service StellarIS, which seamlessly integrates with grid middleware, accommodates for the wide variety of metadata from astronomical archives to simulation data, from resource information to runtime information for grid jobs. StellarIS is based on RDF (Resource Description Framework) and comes with powerful query tools. AstroGrid-D develops efficient grid-based methods for processing data streams from instruments or data sources as well as extended data management and data replication services. Efficient access and processing of large distributed data catalogs, often stored in databases, is essential for astrophysical problems now and even more in the future. With Gridsphere, developed in the Astro Community, a web portal featuring customized user interfaces for grid jobs is available.

Partner Organisations:
Astrophysical Institute Potsdam (AIP); Max-Planck-Institute for Gravitational Physics (AEI); Max-Planck-Institute for Astrophysics (MPA); Max-Planck-Institute for Extraterrestrial Physics (MPE); Technische Universität München (TUM); Center for Astronomy Heidelberg (ZAH); Zuse Institute Berlin (ZIB)
Associated Organisations: Max-Planck-Institute for Astronomy Heidelberg (MPIA); Max-Planck-Institute for Radioastronomy (MPIfR); Universität Potsdam (UP); Universtitässternwarte München (USM); Forschungszentrum Karlsruhe (FZK); Leibniz Computing Center Garching (LRZ); Rechenzentrum Garching (RZG)

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Project Duration: September 2005 - August 2008

http://www.gac-grid.org

BauVOGrid

Grid-Based Platform for the Virtual Organisation in Construction

D-Grid II, Construction Industry

A basic prerequisite for the success of every Virtual Organisation (VO) is the efficient cooperation of the participating companies. This is especially important for the construction industry which is characterised by one-of-a-kind products and one-of-a-kind projects, typically leading to complex project structures including intricate contractual relations, frequently changing tasks and high dependability on external factors (environment, transportation, socio-political aspects etc.) Such complex structures cannot be efficiently managed by conventional technologies. They require a grid Platform and grid-based services, combined with semantic methods and goal- and function-oriented process management.

BauVOGrid develops an extensible *Construction-Community-Solution* that shall provide the basis for next generation VO grid services. The goal is to improve decisively the structure, functioning and operability of virtual organisations in the construction sector via a flexible and reusable infrastructure. This is being achieved by a D-Grid-based approach that enables:

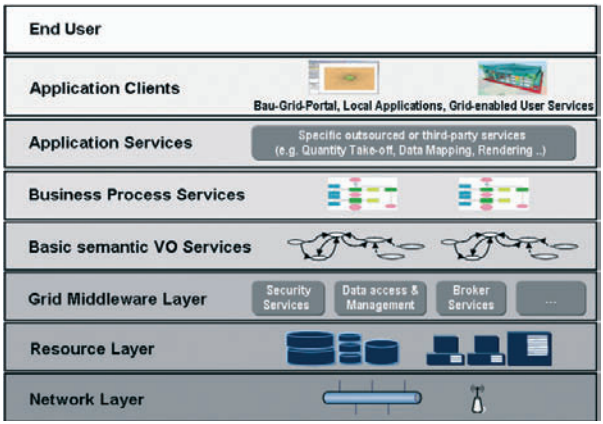
- controlled representation of responsibility/authorisation structures,
- fast configuration and management of both global VO processes and local company-specific processes in accordance with the set up responsibility VO structure,
- fast, flexible and secure access to information from different sources (documents, drawings, photographic material etc.) both from headquarters and from the construction site,
- ad-hoc changes in the process flow, using semi-automatic process simulation,

- mobile capturing of processes and process/product data on the site, thereby providing a basis for faster and more efficient decision making with participation of all site workers.

The project takes into account existing reference data structures in the construction industry as well as grid and general IT standards and reference implementations such as UNICORE, the Globus Toolkit, OGSA-DAI, WSRF, OWL/OWL-S, WSDL, SOAP, BPEL etc.

A normative basis for Meta Document Data does not exist in the construction domain but is recognised as an important aspect of distributed VO infrastructures. Therefore, BauVOGrid aims at achieving a respective contribution to standardisation.

The operational technological goal is the development of a coherent, integrated, process-centred infrastructure that combines four modern information technologies: (1) grid, (2) semantic web, (3) process modelling and management, and (4) mobile information management. The focus is on the grid-based virtualisation of resources and the ontology-based process and information management, built upon the ARIS Methodology of Business Engineering.



High-level System Architecture

BauVOGrid will demonstrate in a practice-relevant pilot that these technologies can be merged together via respectively developed VO-Management and Process Semantics models and services to provide a

higher quality integrated solution than currently available. This solution is expected to deliver new business perspectives both to construction practice and to software providers. It will also enable VO-adequate use of domain-specific, computationally intensive simulation, analysis and presentation tools developed by the project partners or by third parties, taking into account organisational, legal and technical constraints of the VO. This will be implemented and verified on selected examples such as mobile Workflow Simulation and Errors and Omissions Management.

Partner Organisations:
Academic and Research Organisations: Dresden University of Technology (TUD); Fraunhofer Institute Computer Architecture and Software Technology; Institute for Information Systems at the German Research Centre for Artificial Intelligence (DFKI)
Commercial Companies: Bilfinger Berger AG; BAM Deutschland AG; IDS Scheer AG; RIB Information Technologies AG; Seib ITC GmbH; TransMIT Gesellschaft für Technologietransfer mbH

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Project Duration: June 2007 - May 2010

http://www.bauvogrid.de

BIS-Grid

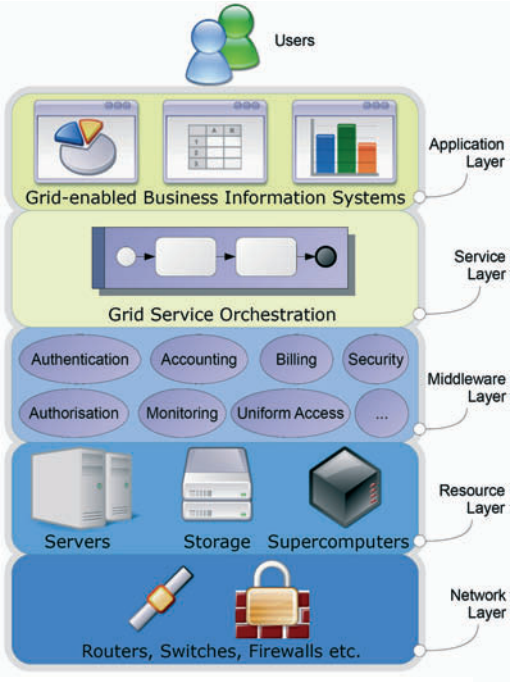
Grid-Based Integration and Orchestration of Business Information Systems

D-Grid II, Business Information Systems

Business Information Systems (BIS) facilitate resource management within an organisation (ERP systems), efficient customer relationship management (CRM systems), and production and service support (PDM systems), to name a few. In order to create such information systems, often both existing and new subsystems have to be adapted and integrated. Thereby, workflow systems are employed to support the effective and efficient integration of organisational workflows by means of subsystem services orchestration. In doing so, Enterprise Application Integration (EAI) has gained a tremendous relevance to the realisation of business processes that typically affect multiple information systems within one or multiple organisations. This integration of information systems is accomplished via orchestration in service-oriented architectures (SOA) which especially aim at effectively mapping the application domain to the technology. Since grid services are introduced with corresponding standards that are based on web service technologies (such as WSRF), grid technologies can also be used to build SOA. Thereby, grid technologies and EAI have much in common since both technologies focus on integration problems within a heterogeneous environment – grid technologies on resource level and EAI on application level.

In BIS-Grid, we intend to realise a horizontal *Service Grid* in the application domain of business information systems. The overall goal is to enable grid technologies to be used for the integration of decentralised business information systems. This will be achieved by developing and providing organisational and technical extensions based on the current state of the art in grid technologies, EAI, and SOA. On the organisational layer, we will develop new forms of inter-organisational collaboration and new business models. On the technical layer, we will extend WS-BPEL-based orchestration to allow the

orchestration of stateful WSRF-based grid services. Thereby, we plan to integrate existing middleware systems that are already well-established in the commercial sector such as JBoss (www.jboss.com), and grid-specific middleware systems such as UNICORE 6 (www.unicore.eu).



BIS-Grid grid architecture

The achievement of these goals will be evaluated by means of two application scenarios at our industrial partners. We will evaluate the developed generic services exemplarily for the integration of ERP, PDM, and CRM systems, covering the major sectors of business information processing. Thus, the results of BIS-Grid provide a significant contribution for applying grid technologies in the domain of real-world business information systems integration.

To achieve an optimal exploitation of our results, we will also develop dedicated exploitation and marketing plans that especially aim at SMEs. Via grid providing or grid software consulting, SMEs will be

capable of providing additional IT services to the market and thus will be able to improve their market position. As a consequence, grid technologies gain access to a whole new application domain. To summarise, our intent is to extend the application potential of grid technologies to explicitly support SMEs in business information processing.

Partner Organisations:
CADsys Vertriebs- und Entwicklungsgesellschaft mbH; CeWe Color AG & Co OHG; Research Centre Jülich (associated partner); KIESELSTEIN GmbH; OFFIS – Institute for Information Technology; Siemens AG – Siemens IT Solutions and Services; TU Berlin; University of Paderborn

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Project Duration: May 2007 - April 2010

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Biz2Grid

D-Grid II, Grid Technology for Enterprises

With the increasing complexity of IT systems, the total cost for IT infrastructures (e.g. costs for hardware, personnel, and maintenance) have been increasing significantly. The main reason for this increase stems from the heterogeneity of IT components, which augment the complexity of the resulting infrastructures. In total, the average system utilization is rather low and, as a consequence, IT resources are idle most of the time.

In addition, demand for IT resources strongly increases even though resource capacities (hardware, software) are also constantly growing but at a lower rate than demand. This tendency is mainly caused by resource-intensive applications such as crash test simulations. Both trends – increasing overcapacity and increasing demand – combined with the need for flexible maintenance of IT infrastructures fosters virtualization efforts on national and international levels. With regard to the commercial usage, the central achievement of these attempts is the standardization (OGSA) and reference implementation of grid middleware (Globus Toolkit 4.0).

In the industrial context, moving commercial applications to existing grid middleware is only possible if organizational policies are taken into account. This includes a certain standardization of related business processes, budgeting of IT costs, licensing of applications and services as well as the assignment of IT costs to single cost centers. In order to fulfill these requirements, organizational policies have to be integrated into existing grid infrastructures and have to be extended by adequate billing and pricing mechanisms. The accounting, pricing, and billing infrastructure that will be developed within this project is based on a market that acts as a meta-scheduler. This scheduler is responsible for allocating available resources to service requests. The resulting allocation is realized on the basis of bids that prioritize the urgency of service requests and available resources. The market-based meta-scheduler will be generically designed and implemented to act for any kind of grid application. Meet2Market will be realized as a service that is based on standardized communication protocols such as WSRF. As a consequence, the service will be compatible to the exist-

ing D-Grid base infrastructure. Biz2Grid offers a price-based scheduler to the D-Grid community and to other related projects. The virtues of the D-Grid extensions will be demonstrated by means of two commercial scenarios within the automotive industry.

The main objective of Biz2Grid is to provide foundations for an effective application of grid technologies in enterprises. In order to achieve this goal, business and economically driven questions have to be answered and technical challenges have to be solved. The case studies gain specific attention as "best practice" for future business grid solutions. The design and implementation of the billing and pricing component will be realized in strong collaboration with D-Grid. This collaboration guarantees the sustainability of the component for the D-Grid community. Currently, existing grid infrastructures do not implement any price-based resources allocation mechanisms. As a consequence, Biz2Grid provides the foundations for the application of D-Grid infrastructures in business contexts.

From a scientific point-of-view, business models have to be developed that are adequate for an application in the grid. In addition, Biz2Grid addresses technical research questions. Currently, the seamless adaption of applications to grid technologies is hardly realizable. As a consequence, it is a challenge of the project (i) to distribute and parallelize real world applications and (ii) to conceptualize and implement economic business models at the same time.

Partner Organisations:
IBM Deutschland Entwicklung GmbH; Universität Karlsruhe (TH); Philipps-Universität Marburg; FZI Forschungszentrum Informatik Karlsruhe
Associated Partner: BMW München

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Project Duration: July 2007 - June 2010

http://www.biz2grid.de

C3Grid

Collaborative Climate Community Data and Processing Grid

D-Grid I, Collaborative Climate Community

The project “Collaborative Climate Community Data and Processing Grid – C3Grid”, sponsored by the German Ministry for Research and Education (BMBF), aims at building up a grid infrastructure for a seamless and fast access to the traditional data resources in Earth System Sciences. This is essential for effective data processing and analysis.

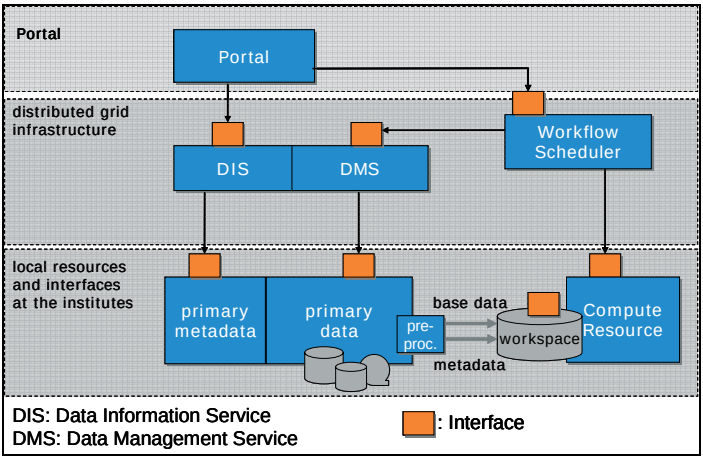
In Climate research and Earth System Sciences different data sources from simulation runs of coupled earth system models and a multitude of observational data are combined. These data sets are often of high volume and are distributed over many archives and sites worldwide. Furthermore they have different states with respect to general accessibility, format, description and data quality. Therefore the daily work of a researcher in this field consists of tedious procedures for data access, data quality control and extraction, before he is able to even start the process of scientific evaluation of theses data sets. It is obvious, that only a common platform with uniform access mechanisms and standardized data descriptions can substantially improve the scientists’ ability to use this data in a successful way to explore and explain the earth system.

The C3Grid Mission Statement essentially reflects this situation by

- enhancing uniform and easy access to distributed and heterogeneous data sources,
- adopting a workflow-oriented approach,
- provisioning standardized data descriptions based on ISO standards, and
- delivering combined storage and processing facilities for scientists.

The C3Grid uses available software and applies international standard architecture whenever possible. This ensures the sustainability of all

the developed services. Standard components from D-Grid DGI like Globus Toolkit 4.x and GridSphere provide the basis middleware complemented by some C3Grid-specific components. Besides especially for scheduling and data management proprietary developments are deployed to meet the community-specific requirements.



C3Grid is developed in close collaboration with international grid projects, e.g. EGEE, Nerc Data Grid and Earth System Grid.

Partner Organisations:

Scientific users and Data Providers: AWI Alfred Wegener Institute for Polar- and Marine Research, Bremerhaven; World Data Centers: WDC Climate, WDC Mare, WDC RSAT; DWD German Meteorological Service; DKRZ German Climate Computing Center; MPI-M Max Planck Institute for Meteorology, Hamburg; IFM-GEOMAR Leibniz Institute of Marine Sciences, Kiel; University of Cologne; FUB Freie Universität Berlin; PIK Potsdam Institute for Climate Impact Research; DLR German Aerospace Center; GKSS Research Center Geesthacht

Partners of Information Sciences: University of Dortmund; ZIB Zuse Institute Berlin

Associated Partners: University of Hannover; University of Bonn; Science Center Karlsruhe; Sun Microsystems Inc.; NEC Corporation; Brockmann Consult

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Project Duration: September 2005 - August 2008

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DGI

The D-Grid Integration Project

D-Grid I, D-Grid Integration Project

The D-Grid integration project belongs to the first groups of projects of the D-Grid Initiative. It provides infrastructure components that are shared among the various commercially or scientifically oriented disciplines participating in D-Grid. Therefore, it supports those disciplines in establishing their own community-specific grid infrastructure. In addition, it will integrate those infrastructure components that are developed by a community project and are of interest to grids of other communities. Finally, it is anchor to so called gap and service grid projects that provide additional services to be used by the grids of the various communities.

Internally, the project is divided into four work packages that interact with each other:

Work Package 1 **D-Grid Base-Software** provides support for various grid middleware and data management software components. Those components have been selected based on the results of pre-project working groups that included participants from many disciplines. They comprise the Globus Toolkit V4, UNICORE, and gLite/LCG as middleware tools already in use at many installations, GridSphere as a general portal framework, the Grid Application Toolkit (GAT) as a set of generic and flexible APIs for accessing grid services, SRM/dCache, OGSA/DAI, SRB and Datafinder as components to access data that are organized in various ways. Further, VO management concepts are developed in this work package and have resulted in a separate project IVOM. The partners in this work package support the Community Grids by providing tutorials to learn about the components and appropriate installations packages. Further, the components are adapted to the needs of the communities and the developers of the communities are supported in customizing those tools to fit their requirements.

Work Package 2 **Deployment and operation of the D-Grid infrastructure** builds up a Core-D-Grid for demonstrating the infrastruc-

ture. This will be used as a prototype to test the operational functionality of the system. This work package also deals with the challenges of monitoring, accounting and billing of grid resources and services. It is the goal to establish an appropriate accounting and billing solution for mutual provision and sustainable usage of grid. Therefore, the development of efficient monitoring tools is a precondition. Those tools provide the instruments to visualize the state and the availability of grid resources and services.

Work Package 3 **Networks and Security** provides extensions to the existing network infrastructure according to the needs of the grid middleware used in D-Grid. This network infrastructure in D-Grid is based on the DFN Wissenschaftsnetz X-WiN. To improve network transfer rates of grid applications, alternative transport protocols are being evaluated and recommendations for their application will be offered. Further tasks are building a comprehensive Authentication and Authorization Infrastructure (AAI) for the three supported grid middlewares in D-Grid, to develop firewall concepts, which are essential for building and operating a secure D-Grid network infrastructure and to set up grid specific CERT services managed by the DFN Computer Emergency Response Team.

Work Package 4 **D-Grid project office** is responsible for the integration of the deliverables from the D-Grid integration project and the deliverables from the different community projects in one common D-Grid platform. It also deals with the challenge of archiving sustainability in D-Grid and grid-based e-Science systems generally. The long-term and sustainable usage of a national or international grid infrastructure for e-Science is a huge and cost-intensive challenge, just like the installation of such an infrastructure. Legal requirements like legal frameworks and their consideration by technical implementations, software licenses, privacy, adequate business models and security are essential for achieving sustainability of emerging grid infrastructures.

The GAP project **IVOM** is associated with the DGI. The project aims at the integration of Shibboleth-based authentication and authorization mechanisms into the established D-Grid AAI, which is built on X.509-based authentication and the management of Virtual Organisations using VOMRS/VOMS. Additionally, development work is being

conducted with the goal of integrating support for VOMS-based authorization in the grid middleware UNICORE.
In cooperation with some community projects, the DGI has established a reference installation to help institutions to integrate their resources into the grid. A significant amount of additional resources have been funded by the Federal Ministry of Education and Research. Based on the feedback obtained by the communities, a second phase of the project has been proposed. This second phase will continue the support for the communities and build a core infrastructure that will eventually be an important part of a sustainable D-Grid world consisting of many different Community Grids.

Partner Organisations:
Scientific: Deutsches Elektronen-Synchrotron (DESY), Hamburg; Deutsches Zentrum für Luft- und Raumfahrt, Köln; Forschungszentrum Jülich; Forschungszentrum Karlsruhe; Fraunhofer Gesellschaft (Institutes: FIRST, IAO, ITWM, SCAI, SIT); Leibniz Rechenzentrum Garching, Max-Planck-Gesellschaft (Institutes: AEI, RZG); Paderborn Center for Parallel Computing; Technische Universität Aachen; Technische Universität Dresden; Technische Universität Kaiserslautern; Universität Dortmund; Universität Hannover; Universität Karlsruhe; DFN-Verein; Zuse Institut Berlin

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Project Duration: September 2005 - August 2007

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D-MON

Horizontal Integration of Resource and Service Monitoring in D-Grid

D-Grid II, Resource and Service Monitoring

D-MON's vision is to realize a grid-wide monitoring architecture across several underlying, heterogeneous systems taking in consideration multiple resource providers and virtual organisations. Almost all different middlewares used within D-Grid provide independent monitoring and information systems, which differ in functionality, information models and schema, implemented standards as well as architectures. As a result these systems are not able to interoperate. The intention of D-MON is to lay the base towards a D-Grid wide monitoring system that can serve all the monitoring information provided by different middlewares as well as external tools.

This is indispensable for the monitoring of the state of grid resources and services as well as of jobs which are running on machines in different middleware environments.

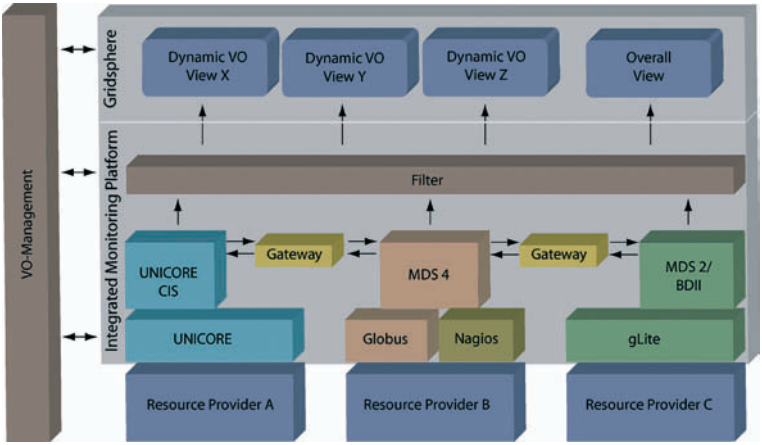
One aspect of D-MON wants to pursue is the horizontal integration of different grid-monitoring services. Problems that have to be handled regarding this aspect will be the different interfaces, non-uniform software architectures and irregular information models and schemas used by different state-of-the-art monitoring and information facilities (Globus MDS4, gLite BDII/MDS2 and UNICORE CIS).

A close connection between a D-Grid-wide monitoring system and the local management systems used by the resource providers will alleviate the daily work of resource providers. Therefore an adapter for integrating external administrative management and monitoring tools into grid monitoring and vice versa will be implemented. This will be done exemplary by connecting Nagios, which is a tool used for cluster monitoring.

As further steps, tests will be conducted between the different environments, gaps will be identified and gateways between the different monitoring and information systems will be developed, in order to

share information about resources, services, and jobs between the different environments.

D-MON will provide communities and virtual organizations with multitenant VO-specific views onto – and solely onto – their grid resources. This is absolutely necessary, because of the large number of communities in the D-Grid using the same D-Grid infrastructure. The vertical integration within D-MON deals with the integration and provisioning of an VO-specific information within the monitoring architecture. The vertical integration also involves the development of Gridsphere portlets for the presentation layer.



The resulting system, as it can be seen in the architecture figure, should allow dynamic, VO-based, and customer-centric views on the provisioned resources and services. This can be reached by joining VO-Management information with the monitoring data provided by the information systems (CIS, MDS 4, and BDII) of the middlewares. In fact, this combination acts as a filter, which makes it possible to easily create dynamic views on data of virtual organisations. Gateways connecting different information systems and architectures enable this mechanism to operate grid-wide and across all middlewares. These components – a filter on the one hand and gateways on the

other hand - will be built by the D-MON project in order to realize the D-MON vision.

Partner Organisations:
Leibniz Supercomputing Centre, Garching; Max Plank Institute for Gravitational Physics, Potsdam; Research Centre Jülich; Research Centre Karlsruhe
Associated Partners: AstroGrid-D: Astrophysical Institute Potsdam; TextGrid: DAASI International GmbH

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Project Duration: July 2007 - June 2009

F&L-Grid

A Service Grid for Research and Education

D-Grid II, Service Grid for Research and Education

The project F&L-Grid has the goal to set up a productive service grid for IT services targeted at research and education. The project is based on a public/private partnership (PPP) and the services will be provisioned on the base of the German Research Network (DFN). During the project phase the services will be manufactured by T-Systems and the Karlsruhe Institute of Technology. The concept however is open to integrate new providers in the productive phase after the funding period and also for an expansion towards other market segments, specifically SMEs. The system integration work will mainly be performed by the University of Marburg. DFN will organize the pilot use and will transfer the results of the project into a regular service.

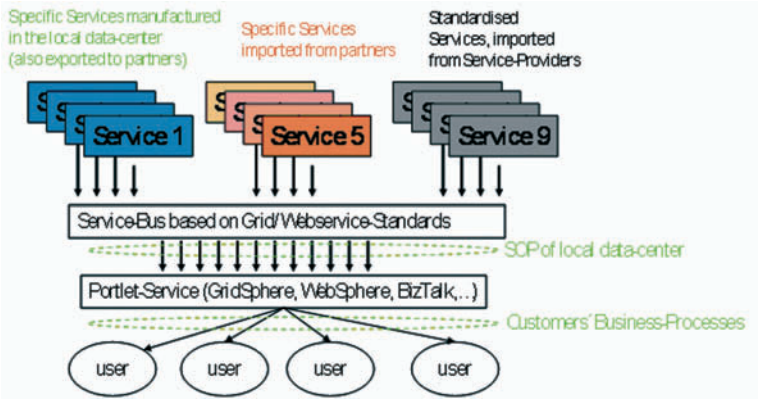
Most of the IT services offered in research and education today are manufactured by the respective local data center. There are only a few exceptions based on bilateral and multilateral collaborations of research institutions or on outtasking specific services to service providers. In these cases the interfaces are based on mutual agreements rather than on generally available standards as they have emerged with grid technology.

The continous innovation in the field of IT services however has led to the situation, that many organisations (especially smaller ones) have big difficulties to fulfill the resulting requirements with their existing capabilities and capacities. Also many IT services need economy of scale. This is especially true of volume services like Backup/Archive which is the pilot service of this project.

The necessary economy of scale can only be achieved by accumulating the service requirements of many customers. This is only possible in partnership with a network service provider with a strong geographic presence like DFN.

Consequently, the goal of the project is the expansion of DFN´s service offering in the direction of IT services that can be manufactured

remotely. The focus is on the optimal integration of all services, independent of their origin, to achieve a seamless service environment.
Depending on the nature of services, the delivery can be performed by commercial service providers or larger IT centers from the scientific community.
From the viewpoint of an end user organisation, the target architecture has the following form:



Based on the standards for web- and gridservices, a service bus as a component of a service oriented architecture (SOA) will be set up. The technical base is mainly provided by the middleware stack of DGI. The services of the respective providers will be attached to this bus. This applies to services of commercial providers as well as to services provided by partner organisations or the one's own IT department. All the services of more general interest become part of the service offering of DFN. Although the scope of the project is restricted to a very small service portfolio, the intention is to create an environment for the integration of IT services of any kind.
From the business model point of view, the IT departments of research organisations are clients of DFN. The end users consequently remain clients of their local IT department. So the concept is more or less the opposite of classical outsourcing. Instead of replacing one's own IT organisation with an external provider, the concept is based on strengthening one's own IT organisation by selectively integrating

external services. There is no need to expose the external service provider to the end user.
Several use cases are part of the project and have the role of pilot service scenarios. On the base of the experience with these use cases, best practice guidelines for future users of the services will be worked out.

Partner Organisations:
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Project Duration: May 2007 - April 2009

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FinGrid

Financial Business Grid – the Next Step in Creating Efficient Banking Processes

D-Grid II, Financial Business

Increasing competition in the German banking sector is leading to a high pressure for restructuring and further automation in IT-related business processes in banks and financial services providers. Additionally, new legal regulations such as Basel II and customer needs that are changing into the direction of highly customized on-demand financial products enhance this pressure. To face these challenges, the Financial Business Grid (FinGrid) project strives to identify suitable services and processes in the financial services sector and to develop grid-based systems that enable financial service providers to reorganize their processes efficiently and to realize applications that have been impossible so far in terms of computational requirements. Recent projects mainly focussed on the technical implementation of grid systems, while research on sustainable business models and commercial applications are still rare. Therefore, FinGrid aims both to contribute to the literature by rigorous empirical analysis of the potentials of grid from an economic perspective and by the design and development of grid-based prototypes.

To guarantee relevance for the target industry, the projected research will be performed jointly with leading financial industry research partners. Grounding on the technical foundations of D-Grid new applications for banking service provisioning together with integrated pricing and accounting structures will be developed, tested, and implemented within the financial services sector. During the course of this project three grid-based prototypes will be developed for proving the feasibility of theoretical and economical concepts: prototype I is a pricing and billing component for grid-based services, prototype II is a grid-based customer portfolio performance measurement and management tool, and prototype III is an asset-backed security factory based on grid architecture.

These prototypes will be developed and implemented under consideration of existing D-Grid middleware and resources. Sustainability of the research results is guaranteed due to the direct transfer of results into the financial services sector and the expected publications in national and international academic peer-reviewed media.

Partner Organisations:
Scientific: University of Frankfurt; University of Marburg; University of Siegen; University of Stuttgart (HLRS)
Commercial: DataSynapse; Deutsche Bank; Dresdner Bank; E-Finance Lab; FinanzIT; IBM Deutschland GmbH; PA Consulting Group

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Project Duration: May 2007 - April 2010

http://www.fingrid.de

GDI-Grid

Efficient Mining and Processing of Spatial Data for Simulation of Noise Dispersion and Disaster Management

D-Grid II, Spatial Data Infrastructure

The aim of the project is the integration of geo-information technologies with grid technologies in order to establish a Spatial Data Infrastructure Grid (German: Geodateninfrastruktur-Grid, GDI-Grid), utilizing the complementarities of the two technologies: While the well-established Geo-Information Systems (GIS) and Spatial Data Infrastructures (SDI) mainly provide access to spatial data resources, grids perform the processing of enormous amounts of data.

From a technical point of view, it is necessary to combine the current base technologies of SDI and grid middleware, to enable seamless processing of spatial data in grids. In order to achieve this goal, data and models must be coupled with grid services and security mechanisms to create and enable entire SDI-Grid workflows.

With the OpenGIS Reference Model (ORM) and the architecture of the OGC Web Services (OWS) a paradigm has been developed to solve interoperability problems in distributed processing of spatial data. The paradigm itself is based on the "slow computing" of web services. A fundamental assumption in GDI-Grid is that this paradigm is also applicable to the grid. The Open Grid Forum (OGF) and in particular the Globus Alliance explicitly endorse the integration of Web services in Globus Toolkit 4, which is regarded as the grid middleware of choice in GDI-Grid. With further investigations the hypothesis is expected to be refined during the project. Common conceptual and methodical requirements for the OWS architecture and the Globus Toolkit 4 as well as their differences will be worked out considerably.

Therefore, the main target of GDI-Grid is to fulfill the demands of distributed spatial data processing – which is currently inadequately covered by SDI – by means of grid architectures and services and by building up grid-enabled workflows. The solutions are based on de-

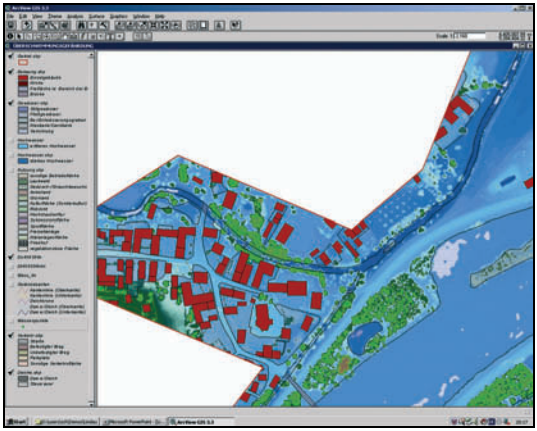
veloped OGC and OGF standards and well established methods in SDI and grid. One key component is the set of GDI-Grid services that provide generic access to grid resources by adopting OGC specific components in the Globus Web services API. Another key component is the grid-enabled access to data resources in spatial data infrastructures. By combining both techniques legacy applications may use SDI and grid infrastructures almost seamlessly.

The implemented components and services are evaluated with three selected scenarios which cover large areas in 3D spatial data applications:

- spatial simulation of flood disasters - flood hazard (see illustrations below),
- noise dispersion simulation for noise pollution predictions,
- real-time route optimization for disaster management.

Terrain discretisation and remote-sensing-based roughness determination for a flood simulation

Examinations of market usability and customer consultations are carried out to ensure the sustainability of the project results and their practical use.



Flooding Boundaries as typical result of GIS-analysis
(© Planungsbüro Prof. Schaller)

Partner Organisations:
Berlin University of Technology; ESRI Geoinformatik GmbH; Hamburg University of Technology; lat/lon GmbH; Mapsolute GmbH; Leibniz Universität Hannover; Stapelfeldt Ingenieurgesellschaft mbH; University of Applied Sciences Mainz; University of Bonn; University of Kaiserslautern; University of Münster
Associated Partners: Bjoernsen Consulting Engineers; Brüel & Kjaer GmbH; IBM Deutschland GmbH; Intergraph GmbH; LGN – Landesvermessung und Geobasisinformation Niedersachsen

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Project Duration: July 2007 - June 2010

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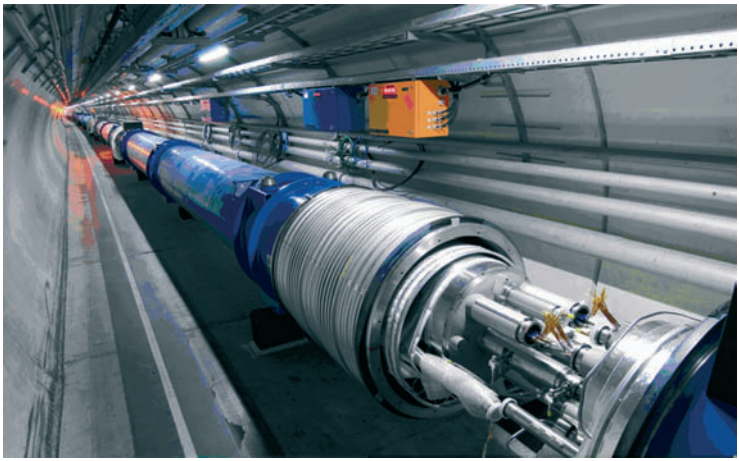
HEPCG

High Energy Physics Community Grid

D-Grid I, High Energy Physics

High energy physics (HEP) explores the innermost structure of matter, space and time as well as the fundamental forces in the universe. The main experimental tools are huge detectors located at a few accelerator centers around the world. Each is used by a world wide distributed community of scientists.



View of the LHC tunnel © CERN

HEP stands at the threshold of a new era of discovery. The Large Hadron Collider (LHC) at CERN (the European Organization for Nuclear Research, located in Geneva, Switzerland), the most ambitious project in HEP is scheduled to start data taking in 2008. Particles travel along a 27-km-long circular tunnel approximately 100m underground. They collide in four large detectors, ALICE, ATLAS, CMS and LHCb. The main tasks are: producing and detecting the still missing key particle foreseen by the so-called standard model, the Higgs boson; to search for “new physics” signa-

tures predicted by extensions of the standard model; to study the physics of the quark-gluon plasma; and to understand the violation of the charge and parity symmetry which might be responsible for the matter/antimatter imbalance at the birth of the universe. Each of these detectors is constructed, operated and used by thousands of physicists distributed over the world.

To analyze the massive volume of data from the LHC experiments (15 million Gigabytes per year), the HEP community develops a world wide distributed computing infrastructure based on the gLite grid middleware stack, the World LHC Grid (WLCG).

The German HEP Community Grid project (HEPCG) extends the functionality that the WLCG provides to users in the areas of distributed data management, job monitoring, and distributed data analysis with a focus on user friendliness.

1. Distributed Data Management

The LHC will produce a sustained stream of data up to 1 Gigabytes/sec, which needs to be distributed and persistently stored at several dozens of sites around the world. Knowing that the WLCG collaboration will have solved most of the issues related to such a challenge, other worldwide operating groups try to profit from middleware used in this area, such as the "International Lattice Data Grid". The purpose of Work Package 1 in HEPCG is to cover a wide range of topics in the data management area and to provide solutions ready to be used. This ranges from a flexible and customizable metadata catalog to manage worldwide distributed data, up to a highly scalable Storage Element, capable of storing data in the Petabyte range. Moreover, a solution is offered on how to use storage location and data retention information in order to optimize grid job distribution among the available grid compute systems worldwide.

2. Job and Resource Usage Monitoring

To monitor the hundreds or thousands of jobs a physicist usually submits for an analysis, intelligent tools are needed to support the user. The existing monitoring tools of the LCG/gLite environment currently provide only limited functionality. Either they focus on the underlying fabric, i.e., hardware infrastructure, or are only simple command line tools flooding the user with textual information. The tools developed in HEPCG provide the user with graphical overviews and detailed

information about the status and resource usage of his/her jobs and give hints on possible upcoming problems. They monitor the execution of job scripts and collect information about job failures and how to fix them. Finally, they even allow an interactive steering and online monitoring of intermediate results.

3. Distributed Data Analysis

Distributed data analysis using grid resources is one of the fundamental applications in HEP to be addressed and realized before the start of LHC data taking. In every experiment up to a thousand physicists will be submitting analysis jobs into the grid. Appropriate user interfaces and helper applications have to be made available to assure that all users can use the grid without too much expertise in grid technology. These tools enlarge the number of grid users from a few production administrators to potentially all participating physicists.

Partner Organisations:

DESY Hamburg and Zeuthen; GSI Darmstadt; University of Dortmund; TU Dresden; LMU München; University of Siegen; University of Wuppertal

Contract Partners: University of Freiburg; Zuse Institute Berlin

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Project Duration: September 2005 - August 2008

In-Grid

Innovative Grid Developments for Engineering Applications

D-Grid I, Engineering Applications

The community project In-Grid provides a grid environment for scientific engineering applications. The flexible use of grid technologies will combine the competences in modeling, simulation and optimization and allow for the common, efficient use of distributed resources. The development of a grid-based "computational engineering community" demonstrates technologically advanced applications of engineering work in research as well as in business innovation management.

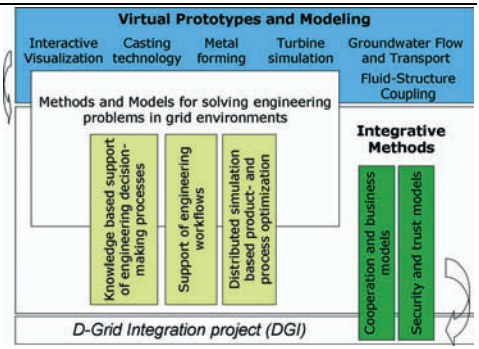
In-Grid is focusing on the question how engineering work can be supported by grid technology. Researchers and developers should be able to work on complex scientific questions, independent of their local environment of computers, programs, data and information. In-Grid provides a grid environment for scientific as well as industrial engineering applications. The flexible use of grid technologies allows for the common, efficient use of distributed resources.

Six typical applications – interactive visualization, casting technologies, metal forming technologies, groundwater flow and transport, turbine simulation and fluid-structure interaction – are considered as showcases in order to cover the three central areas of computationally intensive engineering applications, that are coupled multi-scale problems, coupled multi-discipline problems, and distributed simulation-based optimization.

The virtual prototyping is supported by internet-based collaborative methods, mapping of engineering workflows on a grid environment, and building of portals for selected engineering scenarios.

Co-operation, business, safety and confidence models for scientific engineering applications are to be developed.

The project is concerned with basic research as well as application oriented research.
In-Grid is carried out by eight partners from academies and industry.



Partner Organisations
Academic: University of Stuttgart - High Performance Computing Center Stuttgart (HLRS); University of Stuttgart - Institute of Fluid Mechanics and Hydraulic Machinery (IHS); Philipps University Marburg - Department of Mathematics and Computer Science; University of Siegen - Institute of Business Information Technology; Fraunhofer-Gesellschaft - Institute of Scientific Computing and Algorithms (SCAI); Access e.V. Materials + Processes - RWTH Aachen
Industry: WASY Gesellschaft für wasserwirtschaftliche Planung und Systemforschung mbh, Berlin; T-Systems - Solutions for Research GmbH (SfR)

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Project Duration: September 2005 - August 2008

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IVOM

Interoperability and Integration of VO Management Technologies in D-Grid

D-Grid II, VO Management

Project objectives

Within D-Grid, Community Grids from different fields of science and different industrial sectors have agreed to use a common shared grid infrastructure. As a prerequisite, it is necessary to ensure that the heterogeneous Virtual Organization (VO) management systems and other technologies used in the Community Grids are interoperable among each other. In addition, the foundations for co-operation with comparable international grid communities are to be laid. The major challenge lies in the fact that different grid middleware implementations are being used: the Globus Toolkit 4, different versions of LCG/gLite and UNICORE. These middleware implementations use different authentication and authorization schemes and the VO management technologies used in the communities heavily depend on the respective middleware.

IVOM aims at designing a D-Grid wide VO management infrastructure. For achieving this, currently deployed VO management technologies developed by international VO management projects have been evaluated and compared with the requirements expressed by of the German Grid Communities. The spectrum of products researched by IVOM ranges from PKI-based VOMS to Shibboleth-based myVocs. Another focal point is the enhancement of UNICORE by implementing the yet missing feature of authorization based on VO and Shibboleth attributes. IVOM will also identify remaining gaps on the way to an interoperable and integrated VO management in D-Grid.

Current Results

Relevant international VO management projects were identified and their results evaluated, especially regarding their suitability for D-Grid. gLite's VOMS and the Shibboleth-based myVocs were iden-

tified as presently best candidates available for VO-Management in D-Grid. At the same time, requirements of the D-Grid communities regarding VO-Management were gathered. Based on these findings, several approaches for VO management emerged, which will be further analyzed regarding their pros and cons. Several possibilities regarding transportation of attributes from their attribute authorities to the grid resources, which need them for authorization purposes, have been analyzed. It has been discovered that it is favorable to push attributes to the grid resources. The actual encoding of the attributes depends on the capabilities of the issuing attribute authority and the grid resources. VOMS uses so called attribute certificates whereas Shibboleth-based solutions rely on SAML assertions. A major problem identified in IVOM is the lack of support in current grid middleware implementations for these encodings, but corresponding features are planned for future releases or, in case of UNICORE, are developed by IVOM. Due to the lack of support in current middleware implementations, all currently deployable approaches exhibit deficiencies regarding either scalability or the question of trust.
Based on the objective to establish a consistent foundation for using D-Grid resources and services, the project designed an architecture integrating UNICORE and identified the necessary modifications. The UNICORE extensions will be fully compatible with the current version of UNICORE.

Next steps
Currently the approaches identified are being deployed into a testbed and evaluated regarding their practicability for D-Grid. Finally, deployment and migration plans for the chosen approach will be created.
The architectural draft of the UNICORE integration with VOMS and Shibboleth is currently being implemented and a prototype will be available by the end of 2007.
Furthermore, a national Shibboleth federation (DFN-AAI) mainly for academic use is being built by Germany's National Research and Education Network (DFN). The VO management infrastructure to be developed by IVOM shall make user attributes of DFN-AAI members available for authorization purposes on grid resources.

Partner Organisations:
Scientific: Alfred Wegener Institute for Polar and Marine Research; DFN Verein (associated); Research Centre Jülich (associated); Fraunhofer Institute SCAI; Leibniz Supercomputing Center of the Bavarian Academy of Sciences and Humanities (LRZ) in Garching near Munich; Regionales Rechenzentrum für Niedersachsen (RRZN) und Forschungszentrum L3S; University of Göttingen (associated)
Commercial: DAASI International GmbH; Sun Microsystems GmbH (associated)

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Project Duration: October 2006 - March 2008

http://dgi.d-grid.de/index.php?id=314&L=1

MediGRID

Development of a Grid Infrastructure for Medicine and the Life Sciences

D-Grid I, Biomedical Informatics

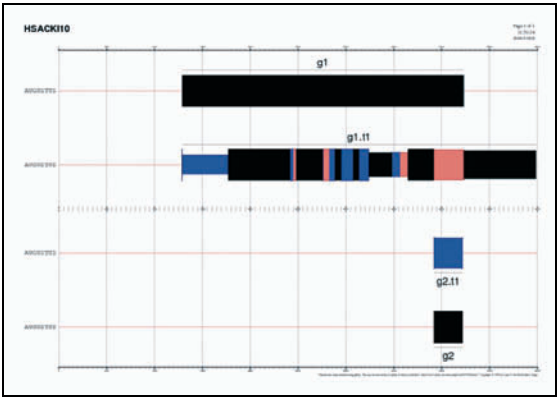
The aim of MediGRID is to develop a grid infrastructure for biomedical research and to demonstrate the possibilities of grid computing by implementing key applications in selected domains for medicine and life sciences. These pilot applications can be found in the MediGRID application portal.

The MediGRID consortium is organized in modules. Model applications are implemented by the modules image processing, bioinformatics and clinical research. The modules resource fusion and middleware lay the groundwork for the grid computing with resource availability, middleware and workflow management to link and speed up the applications.

These major activities are supported by the modules ontology, e-Science and coordination. These modules provide support for handling the complexity of medical data, defining the legal framework and coordinating international activities.

Data privacy is ensured with a variety of methods. Patient data can be hidden, for example, or tools used to create pseudonomysed data sets. Data security is a major concern, so the e-Science module is developing policies for users and developers in cooperation with all of the affected parties to make sure that only authorized users can manipulate patient data. It is also vital that patient data is removed completely from the grid when the computation is completed.

Of course, the services and data in the grid can only be used successfully if semantic interoperability among all parties is ensured. For this reason, biomedical ontologies and semantics matching have been implemented for the MediGRID applications to allow the combination of different data sources.



Graphical results of the AUGUSTUS portlet.

We have selected three classes of applications to demonstrate the advantages of grid computing in medicine and the life sciences:
(I) Biomedical informatics: Our goal is to show the connections between molecular data and biological phenomena or a clinical phenotype using computing. The use of computing is an established part of biomedical data analysis. The enormous growth of knowledge through genome sequencing and systems biology will lead to growing numbers of in-silico experiments. These are ideal conditions for the use of grid computing.
(II) Image processing: Quality and quantity of image data are increasing exponentially. The use of tools and methods from grid computing will enable us to solve scientific problems in medical image processing efficiently. The applications currently being tested are statistical analyses of large image data sets from functional nuclear magnetic resonance (fMNR), extensive hemodynamic simulations of virtual vascular surgery and complex analysis of clinical 3D ultrasound pictures of prostate biopsies.
(III) Clinical research: The grid-based analysis of multi parametric data sampled from sleeping patients (polysomnography) requires the consolidation of data from a variety of sources. This requires high levels of data privacy and security for sensitive patient data.

Further information about the project and the applications can be found on our website in the MediGRID portal.

Partner Organisations:
Charité Berlin; University Hospital Schleswig-Holstein, Kiel; Philipps University Marburg; University of Leipzig; Fraunhofer IAO Stuttgart; Fraunhofer FIRST Berlin; Konrad Zuse Institute Berlin; University of Göttingen; TMF e.V. – Common Platform for Medical Research Networks

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Project Duration: September 2005 - August 2008

http://www.medigrid.de
https://portal.medigrid.de

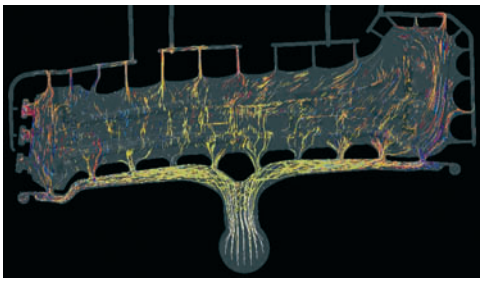
PartnerGrid

Cooperative Grid Solutions for Industrial Applications

D-Grid II, eCollaboration for the Industry

Design and production processes in industry are based more and more on division of labour. The companies concentrate on their core competences and buy parts, equipment and services from third parties, instead of covering the full value chain. With the choice between different potential partners the costs can be reduced and the best fitting partner can be selected.

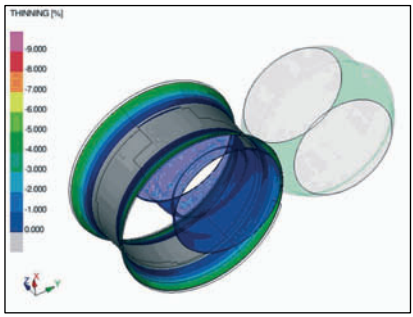
The necessary collaboration processes can be supported efficiently with grid technology and the corresponding soft- and hardware infrastructures, as developed in D-Grid. The project "PartnerGrid" develops a collaboration platform for the co-operation of companies on the basis of D-Grid. The functionality and the benefit of this collaboration platform will be tested and demonstrated with typical scenarios of different branches. A special focus of the project "PartnerGrid" is the application of the grid technology by small and medium enterprises, who don't want to build up and to provide permanently a complex IT-infrastructure on their own.



Simulation of a founding process

The project "PartnerGrid" realises two scenarios. One scenario shows the collaboration of foundries and their customer in designing and optimizing casting processes. Because of the rising quality requirements and the demand of very short development processes the founding industry has a high pressure of competition. The challenges in the founding industry can be solved, if expert knowledge, powerful software tools and professional service work together. Cast-technical simulations are

the basis of the optimisation processes of cast parts design considering the process from the production up to the usage. Out of this it is necessary to involve all available resources (like computing resources, consultation etc.) and to offer them to all at the design process involved parties via grid technology.



Simulation of forming processes

The other scenario shows the collaboration in the metal-processing industry at the planning of forming processes. The usage of virtualisation technologies in the beginning of the product design, as i.e. in crash and plastic deformation simulations, is today an essential tool in the metal-processing industry. Fast and secure transportation and management of CAD-data, calculation results and test data is a standard in every manufacturing company. The collaboration at the corresponding services, like project management, result presentation and expert discussions (collaborative engineering) nevertheless usually takes place at the location of the customer. This offers GNS/GNS-Systems an optimal application scenario with medium-sized entprise customers to realise services like project management, computing services and consultation with grid technologies.

In the project “PartnerGrid” a grid-based software platform (PartnerGrid infrastructure) is developed that will efficiently support the collaborative work in virtual organisations. This platform closes the gap between “generic” services, that are offered by the grid middleware layer and the requirements of companies to a flexible to handle software environment with a wide – application-oriented – functionality.
The platform to develop is based on predevelopments of the participating technology partners (Fraunhofer Institutes SCAI, IAO, ITWM and the DLR) and the usage of the D-Grid infrastructure and the D-Grid services. The scenarios are used as demonstrators for a profit-

able usage of grid technology and will help to propagate the acceptance and the distribution of the technology.
The project PartnerGrid is funded by the Federal Ministry of Education and Research with the grant ID 01G07009A-D.

Partner Organisations:
Deutsches Zentrum für Luft- und Raumfahrt e.V., Köln; Fraunhofer IAO, Stuttgart; Fraunhofer ITWM, Kaiserslautern; Fraunhofer SCAI, Birlinghoven; GNS mbH, Braunschweig; GNS Systems GmbH, Braunschweig; MAGMA Gießereitechnologie GmbH, Aachen

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Project Duration: June 2007 - May 2010

http://www.partnergrid.de

ProGRID

Grid Technology for Collaborative Product Development

D-Grid II, Collaborative Product Development

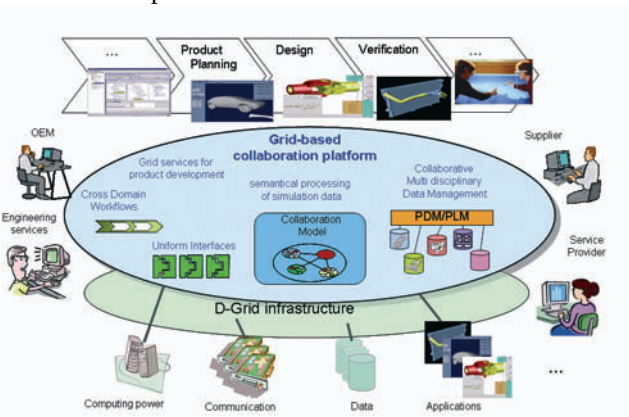
The main objectives of the ProGRID project are to utilize grid technology for collaborative product development and to demonstrate its advantages by means of selected use cases. Grid technology bears great potential for enhancing product development efficiency. For example, in the context of virtual verification, more complex simulation models may be used. This in turn provides for improved predictions, as additional parameters can be considered, so that simulations closer to reality can be carried out. Accordingly, in early stages of the product development the consequences of making changes can be predicted more accurately than it was possible up to now.

Typical users of the technology are “virtual enterprises” consisting of manufacturers, suppliers and engineering service providers who are developing a new product collaboratively. ProGRID is based on existing grid Middleware and security concepts taken from currently running D-Grid infrastructure projects.

On the basis of five future-oriented use cases the project will show the advantages of the new grid infrastructure for virtual product development. Three scenarios will deal with the topics virtual verification and structure optimization. These will cover important aspects like part optimization and reliability validation, fluid dynamic optimization as well as multi disciplinary structure optimization. In addition, an application scenario connecting product data management (PDM) and CAE systems will be specified. This is to ensure smooth data flow between product development and virtual validation. The primary topic of the fifth application will be collaborative product development as well as collaboration environment.

With the aim of facilitating the communication between manufacturer, suppliers, engineering service providers and variant developers, the continuous and consistent availability of product and process data has

to be improved. This is relevant for all stages of development, i.e. product planning, design and simulation. To achieve this, PDM systems and simulation environments need to be tightly networked. In a distributed environment this will ensure that model states are in sync and that only current parts models are being exchanged and evaluated. To be able to access simulation models and data, a simulation platform will be provided, comprising a web service interface that allows access to simulation projects, models and results. Likewise, a collaboration platform will allow the transparent and integrated usage of grid services. Based on a uniform data model, it will be taking care of connecting the simulation data (consisting of simulation models and results) with the corresponding PDM data (product structure and associated CAD models). For this, an existing basic platform will be extended with interfaces to grid middleware to yield a complete grid-based collaboration platform.



Modules for pre- and post-processing, as well as simulation and optimization, will be added as services for numerical analysis at various places. By having access to PDM information, it can be made sure during pre-processing that CAE models are always matching the current state of the CAD models. Similarly, it is possible for the numerical solver to directly apply the mass trim, which means to account for parts and passengers not being modelled by using additional masses. An essential requirement of manufacturers and variant developers is to be able to quickly assess and analyse the current state of development.

In this regard it is necessary to have facilities for transferring huge amounts of data fast and conveniently. Beyond those objectives, the project will focus on improving the utilization of compute services through remote visualization and data compression techniques, as well as fault-tolerant execution of complex workflows in grid environments.

Partner Organisations:
FE-Design GmbH; Fraunhofer Institute for Algorithms and Scientific Computing; Fraunhofer Institute for Production Systems and Design Technology; INTES GmbH; PDTec GmbH; science + computing ag; Wilhelm Karmann GmbH

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Project Duration: June 2007 - November 2009

http://www.progrid.de

SuGI

Concepts for a Sustainable German Grid Infrastructure

D-Grid II, Sustainability Concepts for Academia and Industry

SuGI's major task is to disseminate the knowledge of grid technology and to enhance its use. Therefore, SuGI addresses all the small and medium-sized academic computing centers as well as small and medium-sized enterprises, which still have not adopted grid technology. Today, a backlog exists in the general aim of the grid to connect resource providers and their users.

During this project, research experiences gained in the DGI project will be made available to small and medium-sized computing centers of universities as well as to small and medium-sized enterprises. Therefore, SuGI will offer own training courses; members of SuGI will attend to external courses, create video and audio recordings and provide these online to the D-Grid communities. SuGI will examine the fitness of existing e-learning concepts and will apply the appropriate methods.

As larger institutions may also benefit from these activities, SuGI and the DGI agreed in having SuGI coordinate the further D-Grid training activities. This covers especially the organization of training courses and the multimedia processing of further D-Grid courses for Web based publishing.

Besides the dissemination of the necessary grid know-how SuGI will also work on the applicability of the used grid middleware. At present the installation and maintenance of grid middleware is commonly known to be an awkward task, which slows down the process of dissemination. Therefore, SuGI will work on the simplification of the installation and maintenance tasks. Not only standard middleware installations will be concerned, but also task specific installations will be taken care of. The configuration effort will be minimized to the absolutely necessary topics supporting the standardization of middleware installation and enhancing the general grid productivity.

Furthermore, during the lifetime of an installed grid infrastructure, periodic maintenance has to be carried out. SuGI will develop tools to simplify such tasks and give service providers a chance to concentrate on their main goal, to provide grid services.
In parallel, main aspects for the sustainability of the grid infrastructure will be investigated. If workflows shall be executed across institutional or state boundaries, many organizational and legal questions have to be answered. The German reform of federalism regulating the relationship between local states and central government has a major impact on every public institution that wants to provide grid services. Legal aspects covering software license conditions will be investigated to enable service providers to offer a wide spectrum of grid services in Germany.
Likewise economic aspects such as profitability and standardization have to be taken into account. New insights will lead to case studies showing potential new service providers possibilities on how to offer their services in an easy and economic way.

Partner Organisations:
Scientific: University of Cologne, Center for Applied Informatics (ZAIK); University of Freiburg, Computing Center; Technical University of Kaiserslautern, Regional Computing Center; University of Kassel, Computing Center; University of Siegen, Information Systems Institute
Commercial: IBM Deutschland GmbH; Sun Microsystems GmbH

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Project Duration: July 2007 - September 2009

TextGrid

A Community Grid for the Humanities

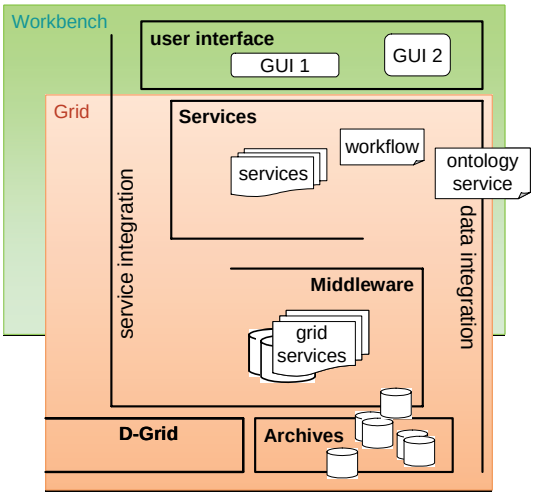
D-Grid I, e-Humanities

TextGrid is one of the first projects in the humanities in Germany and Europe creating a community grid for the collaborative editing, annotation, analysis, and publication of specialist text resources. Providing a computational infrastructure, a collective network, and a comprehensive and extensible toolset for text scholars, it is based on e-Science methods and forms a cornerstone in the emerging e-Humanities. TextGrid builds on existing expertise in the field of e-Science and advances towards the Semantic Grid. Reaching out to the academic community, the project establishes a truly interdisciplinary platform and a virtual workbench for research.

Open interfaces open the door for other projects to plug into the TextGrid. Thus, any specialist in the humanities can adopt TextGrid for their work. In its core functionality, however, TextGrid is focussed on (annotated) text as a data type since there is considerable demand in the community for processing text data. Inspite of modern information technology and a clear thrust towards collaboration, researchers in the humanities can not currently make full use of the potentials of this development. Text scientists, for example, researching into the relations between language and discourse and into the complex processes in the genesis of literature, still mostly work in local systems and project-oriented applications. Current research initiatives also lack integration with already existing text corpora, and they remain unconnected to resources such as dictionaries, lexica, secondary literature and text processing tools. This integration and interconnection, though, bears a wealth of opportunities. With its architecture and integrated tools that satisfy the specific requirements of text sciences, TextGrid is able to provide such forms of integration. Thus, TextGrid could transform the way scholars process, analyse, annotate, edit, and publish text data.

The need for the installation of a grid-enabled architecture in the e-Humanities is obvious for two reasons. On the one hand, past and current initiatives for digitising and accessioning texts have already accrued a considerable data volume, which exceeds hundreds of terabytes with more to be expected in the future. Grids are capable of handling these data volumes. On the other hand, establishing a community grid can effectively make up for the dispersal of the community as well as the scattering of resources and tools. Utilizing grid structures, a platform can be created that connects many experts in various areas and integrates numerous initiatives worldwide.

The overall architecture of TextGrid enhances a Globus-based grid infrastructure with a specific middleware layer and a service layer of specialised functionalities for textual processing including metadata and ontology management. Additional tools can be integrated at any time. While the TextGrid middleware operates as an interface between the low-level grid and the high-level services, the service layer itself is conceived as an open web service environment that will easily elicit participation in active community processes. An Eclipse-based interactive client ties all available services and tools together into a workbench and grants intuitive access for content-providing users. The general public can access published contents using a web interface. The usage of standards including TEI and the XML family, RDF, SOAP, WSDL 2.0, GSI, WSRF, SAML, LDAP, and BPEL fosters openness and interoperability.



Text-Grid-Architecture

Partner Organisations:
Scientific: Technische Universität Darmstadt; Georg August University, Göttingen; Institute for the German Language Mannheim; University of Trier; University of Applied Sciences Worms; University of Würzburg
Commercial: DAASI International GmbH; Saphor GmbH

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Project Duration: February 2006 - January 2009

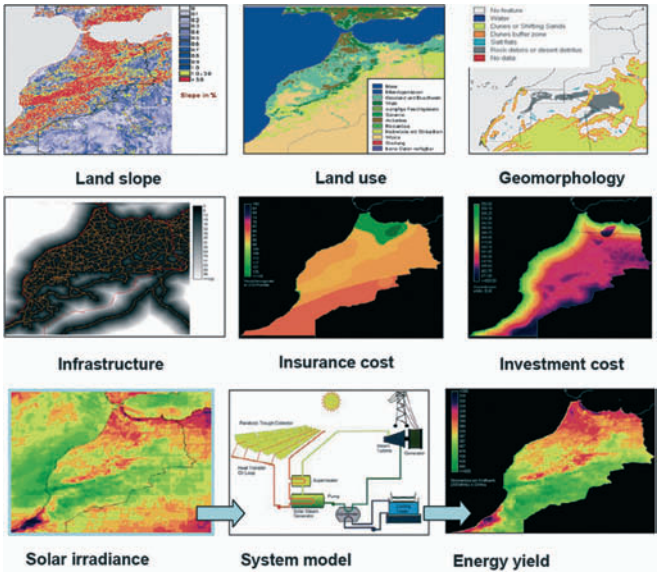
http://www.textgrid.de

WISENT

A Knowledge Network and Community Grid for Energy Meteorology

D-Grid I, Energy Meteorology

Our energy production increasingly depends on renewable energy sources, which impose new challenges for distributed and decentralized systems. One problem is that the availability of renewable energy sources such as wind and solar is not continuous as it is affected by meteorological factors.



The consequential challenge is to develop forecast methods capable of determining the level of power generation in near real-time in order to control power plants for optimal energy production. Apparently, energy meteorology is an interdisciplinary and application-oriented field of research, which investigates the influence of weather and climate on transformation, transport, and utilization of energy. Besides physi-

cal and meteorological methods, an extensive know-how in the field of wind and solar energy conversion, energy supply structures, control techniques, and environmental science is necessary.

The knowledge network WISENT has been created to support the sharing of expertise in the emerging community of energy meteorology. In recent years, the increasing relevance of renewable energy sources (biogas, solar, wind, hydro) in global energy supply, and therefore the rising dependence on meteorological conditions made energy meteorology an essential part of energy research. Meteorological information has become an enormous economical factor in the energy business.

Grid technology is necessary for the energy meteorology community to solve technical challenges such as accessing distributed data, exchanging large heterogeneous data sets, archiving data, and speeding up applications. The grid makes more complex simulation models and the processing of large amounts of data possible and enables the improvement of forecast methods and other applications such as the identification of optimal locations for power plants. For example, the analysis of (archived) solar irradiation data combined with geographical information (lakes, rivers, etc.) and financial information (costs, etc.) can be used to identify optimal places for solar power plants. Such simulations or analyses are based on large heterogeneous data sets, which originate from various satellites, earth stations or other sources. Through the large amount of data the calculation time on a single computer becomes unacceptable. Next generation satellites with higher resolutions will further increase that amount of data. Grid seems to be the only effective solution for handling these amounts of data and for solving the complex computations. Thus, the knowledge network and Community Grid WISENT helps ensuring the power generation of tomorrow based on renewable energy sources.

Partner Organisations:

German Aerospace Center (DLR); OFFIS – Institute for Information Technology; University of Oldenburg; meteocontrol GmbH

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Project Duration: October 2005 - September 2008

http://wisent.d-grid.de

eSciDoc

A Platform for Communication and Publication in Scientific Research Organizations

Scholarly Workbench

eSciDoc is as a joint project of the Max Planck Society and FIZ Karlsruhe, funded by the Federal Ministry of Education and Research (BMBF), with the aim to realize a next-generation platform for communication and publication in research organizations. The result of the entire eSciDoc project is intended to ensure open and persistent access to the research results and materials of the Max Planck Society and to integrate these materials in an emerging e-Science network, to increase the accountability of research and to improve the visibility of the Max Planck Society. At the same time, the project aims to provide effective and comprehensive access to information for Max Planck researchers and their work groups. Additionally, eSciDoc will support scientific collaboration and interdisciplinary research in future e-Science scenarios and optimize the exploitation of information available through an interconnected global scientific knowledge space.

Partner Organisations:
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Project Duration: August 2004 - July 2009

http://www.escidoc-project.de/homepage.html

HyperImage

Image Linking

Our project is concerned with the currently unsolved technical problem of establishing links between image details. Our goal is to develop a web-based workspace that will permit scientists in any image-oriented discipline to create simple and precise links between images and image details, in a fashion similar to that which until now has been the privilege of text.

Partner Organisations:
Humboldt-Universität zu Berlin; Universität Lüneburg

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Project Duration: June 2006 - May 2009

Ontoverse

Cooperative Knowledge Management in the Life Sciences Network

Ontology Building

Ontoverse is a research project funded by the German Federal Ministry of Education and Research. Central objective of the project is the development of a new, web-based application for cooperative and interdisciplinary ontology building in terms of an ontology wiki.
This solution, supplied by the use of information extraction technology and regarding IT security techniques, serves as a central platform for cooperative knowledge management within Life Sciences.

Partner Organisations:
Heinrich-Heine-University Düsseldorf; University Duisburg-Essen; Security Networks AG; Varion GmbH; ARÖW GmbH

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Project Duration: October 2005 - September 2008

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StemNet

Knowledge Management for Stem Cell Biology

Stem Cell Biology

Up until now, crucial information resources for the life sciences (biology, medicine, pharmaceutics), whether bibliographic or factual databases, are isolated from each other. Also, semantic metadata to structure their contents is usually supplied in a manual way. In the StemNet project we aim at developing a framework for semantic interoperability for these resources. This will facilitate the extraction of relevant information from textual sources and the generation of semantic metadata in a fully automatic manner. In this way, (from a computational perspective) unstructured life science documents are linked to structured biological fact databases. Thus, life scientists will be able to seamlessly access information from a homogeneous platform, despite the fact that the original information was unlinked and scattered over the whole variety of heterogeneous life science information resources and, therefore, almost inaccessible for integrated systematic search by academic, clinical, or industrial users.

Partner Organisations:
Friedrich-Schiller-Universität Jena; Medizinische Hochschule Hannover; Clarity AG, Bad Homburg; JSI Medical Systems GmbH

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Project Duration: April 2006 - March 2009

http://www.stemnet.de

WIKINGER

Wiki Next Generation Enhanced Repositories

Semantic Network

WIKINGER provides an internet-based platform that facilitates scientific research and cooperative knowledge creation, with special regard to semantically connect existing with knew knowledge. In order to achieve this, methods and algorithms for Named Entity Recognition and semiautomatic creation of semantic networks are developed. An enhanced wiki system serves as user interface. The semantic network is used to facilitate navigation in the wiki. Changes in the wiki are automatically analyse for their impact on the semantic network, which is updated accordingly.
The pilot application focuses on contemporary history, especially the political and social history of German catholicism.

Partner Organisations:
Fraunhofer Institute Intelligent Analysis and Information Systems (IAIS); Computer Linguistics at the University Duisburg-Essen; Commission for Contemporary History (KfZG), Bonn

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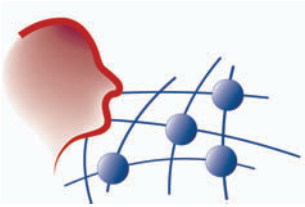
Project Duration: October 2005 - September 2008

http://www.wikinger-escience.de

Im Wissensnetz

Linked Information Processes in Research Networks



e-Science Semantic Desktop

The major goal of the project "Im Wissensnetz" (In the Knowledge Net) is to efficiently support interdisciplinary knowledge creation processes by means of an e-Science Semantic Desktop in the field of the rapid prototyping high-technology. For this purpose proven methodologies and technologies from enterprise knowledge management are transferred into the application field e-Science on an organisational level as well as on an individual level.

Partner Organisations:
Forschungszentrum Informatik an der Universität Karlsruhe; empolis GmbH; Fraunhofer Institut für Graphische Datenverarbeitung; Fraunhofer-Institut für Chemische Technologie; Fraunhofer-Institut für keramische Technologien und Sinterwerkstoffe; Fraunhofer-Institut für Fabrikbetrieb und -automatisierung; Fraunhofer-Patentstelle für die Deutsche Forschung; Fraunhofer - Patente und Lizenzen; Ontoprise GmbH

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Project Duration: November 2005 - October 2008

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This publication gives a detailed overview of the current state of the German Grid Initative with emphasis on the long-term strategic grid research and development activities for academia and industry.

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