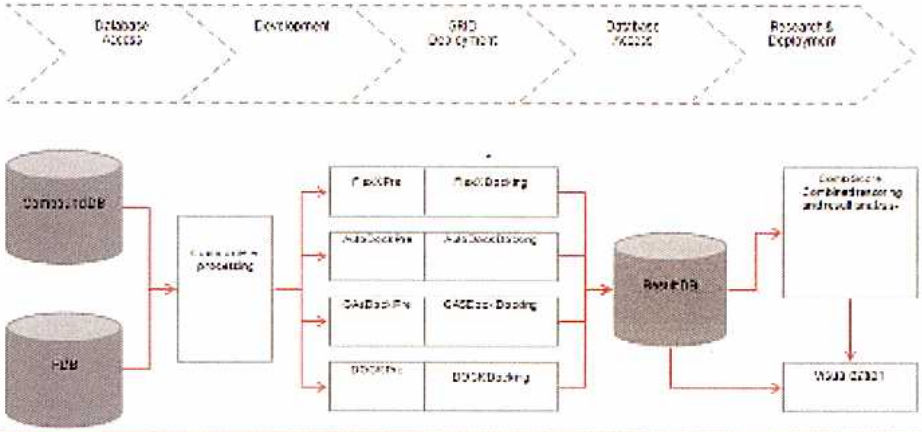
Exciting technological developments which link the EU and China in terms of aerospace, meteorology and pharmacology are currently being explored by the EC funded BRIDGE project. A year after its foundation, Project manager **Gilbert Kalb** looks at its progress

Bridge: supporting east-west GRID cooperation

The advent of Grid computing technology, the aim of which is to speed up virtual problem-solving by bringing together individuals and organisations to share information and computing resources, is an extremely exciting development. When the growth of China as a major world economic power is further taken into account it becomes clear that Grid computing technology has the potential to lead to much improved levels of international cooperation between East and West.

The aptly-named EU IST BRIDGE project (www.bridge-grid.eu) has attracted major industrial and academic partners from across Europe and China. The overall aim is to demonstrate the benefits of Grid technology, particularly in terms of its potential for facilitating improved international cooperation. BRIDGE was proposed for the last call in the EC's 6th Framework Programme.



Grid technology for international cooperation

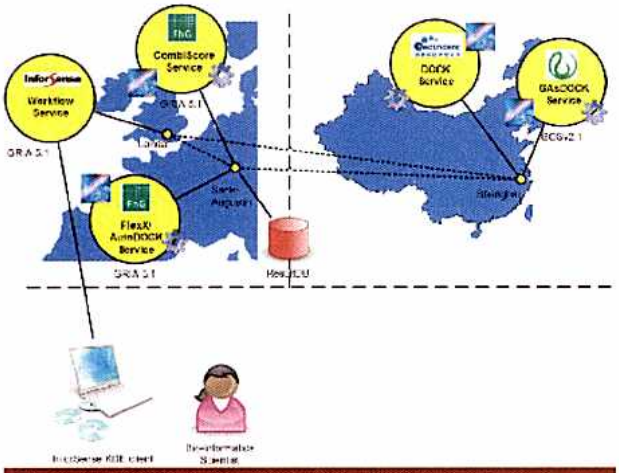
This call was primarily aimed at improving international cooperation, in particular with the economic powerhouse that is China. BRIDGE has 13 partners (seven from Europe and six from China). Counted among them are a number of industrial organisations, including EADS in Europe and AVIC II in China. There has also been involvement from several major organisations in GRID research institutions such as Fraunhofer SCAI in Germany, IT Innovation in UK, and Beihang University in China. The key aims of the BRIDGE project are:

- To demonstrate the benefits of GRID technology for international cooperation.
- To develop, enhance and interconnect European and Chinese GRID middleware technology.
- To set up an integrated GRID test bed using European and Chinese middleware components for application demonstration.
- To set up joint application showcases using distributed workflow and data access technology.
- To disseminate the results of the project to industrial and academic communities.
- To provide a software platform supporting distributed product and process developments, which respects and protects intellectual property rights.

The Grid enabled optimisation platform developed by BRIDGE will be a good prototype for establishing a resource sharing and collaboration environment

The major infrastructure Research and Technological Development (RTD) activities currently being conducted by BRIDGE focus on the issue of interoperability between European and Chinese Grid middleware technologies and Grid-enabling showcase applications in the key areas where we believe these developments will be particularly applicable: the aerospace, meteorological and pharmaceutical sectors.

The interoperability developments are based on two major Grid infrastructures,



The architecture of aerospace application system

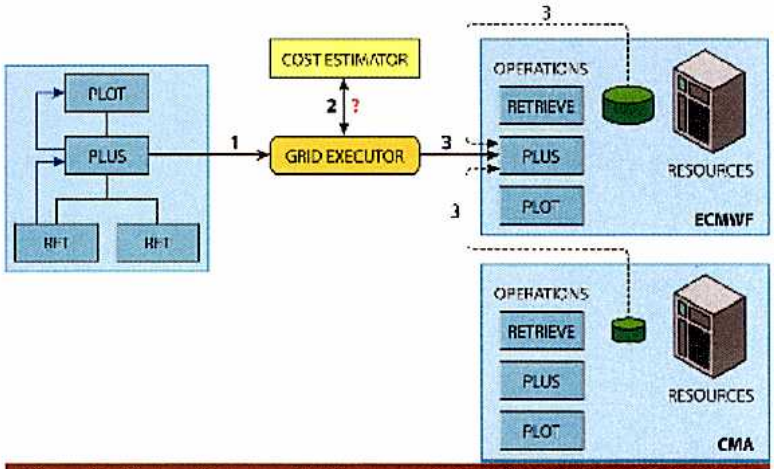


Figure 3: Meteorology application usage scenario

GRIA in the EU and CNGRID GOS (GOS for short) in China. The goal is to establish an intercontinental Grid containing GRIA and GOS services that interoperate, thus providing access to high-end applications in each application sector. The major challenges currently being addressed in Grid interoperability include job submission, data transfer and management, resource management and security.

Scientists and engineers want to develop design processes using workflow tools of their choice that access the Grid and underlying services with no knowledge of the underlying Grid implementation.

Aerospace Application

BRIDGE's aerospace application scenario is to develop optimisation services for virtual product development in the aerospace industry. In order to meet the challenges posed by geographically and logically distributed virtual product development processes, optimisation services have to be both Grid-enabled and integrated into Grid-enabled problem solving environments.

By using the Grid technologies, distributed resources will be virtualised to provide a single, consistent view to the end-user, something that will result in the end-user being able to use these resources without having to worry about infrastructure.

The optimisation process is defined as a workflow of services. Acoustic and aeroelastic optimisation services are provided by EADS and AVIC II, respectively, and they are deployed on the individual compute-infrastructure of EADS and AVIC-II.

Additionally, Optimus - a GRIA-enabled workflow system that has been provided by LMS - allows for the invocation of services encapsulated as GRIA services.

The interoperability between GRIA and GOS allows the invocation to be guided to the specific GRIA or GOS service, a service which is located in a different organisation. A meta-modeling service provided by FhG-SCAI is encapsulated within the workflow to help further improve the efficiency of optimisation.

This Grid-enabled optimisation scenario has been generated on the basis of distributed collaborative product development.

Meteorology Application

The aim of the BRIDGE meteorology activity is to create elaborated meteorological products from model outputs which are distributed at several sites, using applications which are also distributed, while minimising the movement of data.

The scenario of the meteorological application in BRIDGE is defined as: distributed processing on distributed data across both GRIA and GOS middleware. An initial prototype has been established to validate the architectural choices against some of the most pertinent use cases. The prototype will expose basic services that should be deployed in GRIA and GOS. These are:

- Services to access retrieved raw data from the archive
- Services that will perform simple operations on the data

The prototype will demonstrate that an operation deployed as a GRIA service invokes data that is made available by a GOS service and vice-versa. The prototype will also establish various metrics for optimising computer resource usage.

The particular challenges that the meteorological application face include: transparent access to those data archives which are maintained by different organisations, the reliable transfer of large volumes of data across different Grid infrastructures, and of course how to pass through a number of firewalls, firewalls which can be set by a wide range of organisations with a corresponding range of security policies.

Scripts written in the Metview macro language, a powerful language for the manipulation of meteorological data, can now make use of deployed applications, transparently providing users with access to distributed operations and data retrieval facilities.

The decision of which application to run is taken by using a "least cost" strategy, mainly based on minimising data transfers. Sample scripts that retrieve data, perform some operations and produce a plot of the results are currently being successfully run across the Grid.

Pharmacological application

The pharmacological application focuses on the design and development of DockFlow, an interoperable Grid-based virtual screening platform for

pharmaceutical R&D.

This application would enable scientific users to use those multiple protein docking tools deployed over GRIA and GOS-enabled platforms seamlessly in their virtual screening experiments, and also to combine and compare the results generated by those tools.

It will also support improved access to, and integration of. distributed protein docking tools using distributed HPC resources.

The key challenge of DockFlow is to enable interoperability at both the infrastructure level and the algorithmic level. Infrastructure level interoperability within the platform means that the invocation and integration of different protein docking tools can be achieved regardless of the Grid middleware technologies being used.

Algorithmic level interoperability means that the platform is able to deal with different protein-ligand-system representations within the same applications.

BRIDGE's approach to address the key interoperability challenges within DockFlow is to support a high-level, middleware-independent, workflow programming mechanism for describing virtual screening analysis. The execution of these workflows can then be delegated to a workflow server that co-ordinates the execution on the underlying heterogeneous and distributed middleware infrastructures.

Conclusion

In summary, the activities of BRIDGE have aroused great interest among industry and application organisations in both Europe and China.

"The Grid enabled optimisation platform developed by BRIDGE will be a good prototype for establishing a resource sharing and collaboration environment for China's aviation industry", said Degang Cui, the Deputy Director of the Science and Technology Committee of AVIC II Group in China. Mr Cui recently emphasised the importance of the BRIDGE projects R&D work, as well as the significant impact it has already had, at a seminar organised by the Ministry of Science and Technology of China.

"The interoperability work conducted by BRIDGE will be a good reference for more general Grid interoperability", commented Depei Qian of Beihang University, whose team is also participating in the effort of providing interoperability between CNGRID GOS and gLite, another major European Grid middleware, "Experience obtained from BRIDGE will certainly benefit our work in pursuing interoperability with other Grid infrastructures as well as in developing new version of GOS." ★

At a glance

Bilateral Research and Industrial Development Enhancing and Integrating Grid Enabled Technologies

Partners

Aviation Industries of China II; Beihang University; Computer Network Information Center, Chinese Academy of Sciences; Deutscher Wetterdienst; European Aeronautic Defence And Space Company; Fraunhofer-Gesellschaft; Inforsense Ltd; Universitiy of Southampton, IT Innovation Centre; LMS International; NeoTrident Technology Ltd; Chinese National Meteorological Information Centre; Shanghai Institute of Material Medicine.

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e1.7m

Costs

€2.5m

Duration

01.01.07 until 31.12.08

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Gilbert Kalb is a senior scientist with an extensive background in computer science and parallel computing. He has worked for more than five years at the International Business Development Department of Fraunhofer-Gesellschaft, he currently works as the coordinator of the Bridge project.