# Bilateral Research and Industrial Development Enhancing and Integrating Grid Enabled Technologies

www.bridge-grid.eu

BRIDGE is an EU FP6 STREPS project addressing bilateral research and industrial development between EU and China for enhancing and integrating Grid enabled technologies.
Major organizations in Grid research such as Fraunhofer SCAI in Germany, IT Innovation in UK, and Beihang University in China are playing active roles in the project.

BRIDGE develops an interoperability interface between heterogeneous infrastructures based in Europe (GRIA) and in China (GOS). It allows in particular the execution of distributed workflows as well as access to distributed data repositories. Remote access to specific analysis services will allow the actual and controlled usage of these analysis services for product and process development without disclosing all details. It addresses technical issues, which result from the far distance of the collaboration partners as well as from the conflicting goal of intense collaboration and protection of intellectual property rights.

## Target users

Developers of Problem Solving Environments, Technology Providers, Software and Application Developers

## Chinese Partners

## European Partners

## BRIDGE Objectives

The BRIDGE projects aims at demonstrating the benefits of Grid technology for international cooperation, in particular between Europe and the target country China.

- Demonstrate the benefi ts of Grid technology for international cooperation
- Provide a platform supporting distributed product and process developments, respecting and protecting intellectual property rights
- Develop, enhance and interconnect European (GRIA) and Chinese (GOS) Grid middleware technology
- Set up an integrated Grid test bed using European and Chinese middleware components for application demonstration
- Create joint application show cases using distributed workfl ow and data access technology
- Provide a software platform supporting distributed product and process developments, which respects and protects intellectual property rights

The activities of BRIDGE have aroused interests of industry and application organisations in both Europe and China.

The Grid enabled optimisation platform developed by BRIDGE will be an excellent prototype for establishing a resource sharing and collaboration environment for the aviation industry.

The interoperability work will be a good reference for more general Grid interoperability in Europe and China.

## BRIDGE Perspectives

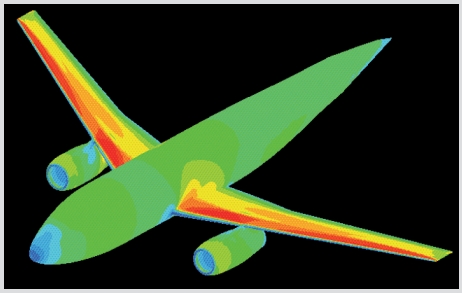
BRIDGE can offer a set of perspectives. For the aerospace industry, it will provide extensions on the existing commercial-of-the-shelf software package to allow the definition and execution of analysis programs (like aero-elasticity, acoustic simulation) through Grid enabled analysis services. For the pharmaceutical industry, extensions to workflow systems will enable the interoperability between different distributed protein docking tools both at algorithmic and infrastructure levels.

In general, BRIDGE helps to access the Chinese and vice versa the European market for many existing products and services based on Grid technology, in particular for results from European and Chinese research programmes.
It could lead to a platform for global efforts to attack the energy problem and to improve environmental protection.

## BRIDGE Achievements

BRIDGE has established an inter-continental Grid containing GRIA and GOS services that interoperate providing access to high-end applications in each application sector. Major challenges being addressed in Grid interoperability include job submission, data transfer and management, resource management and security. By using BRIDGE results, scientists and engineers can develop design processes using workflow tools of their choice that access the Grid and underlying services with no knowledge of the underlying Grid implementation.

BRIDGE application Scenarios

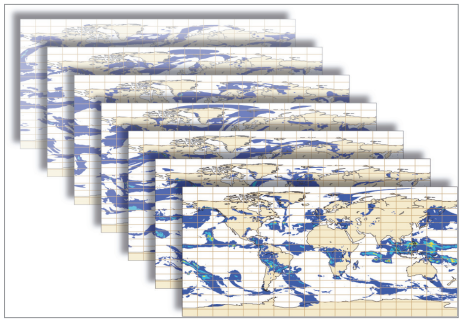


## Scenario 1: Simulation and Design in Aerospace Industries

The BRIDGE aerospace application scenario is to develop optimisation services for the virtual product development in aerospace industry. To meet the challenges of geographically and logically distributed virtual product development processes, optimisation services have to be Grid-enabled and integrated into Grid-enabled problem solving environments. By using the Grid technologies, distributed resources are to be virtualised to provide a single, consistent view to the end-user and allow the end-user to use these resources without having to worry about infrastructure.

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

A GRIA-enabled workflow system, Optimus, provided by LMS allows invocation to services encapsulated as GRIA services. The interoperability between GRIA and GOS allows the invocation to be guided to the specific GRIA or GOS services located in different organizations. A meta-modelling service provided by FhG-SCAI is encapsulated into the workflow to further improve the efficiency of optimisation. This Grid-enabled optimisation scenario is the basis of distributed collaborative product development.

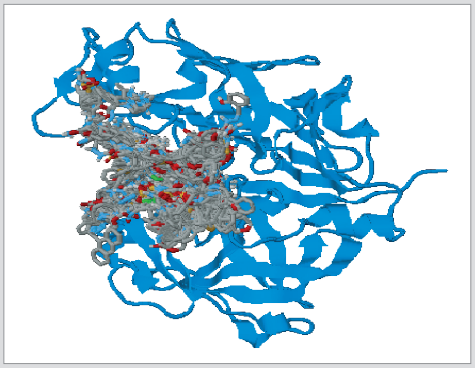


## Scenario 2: Environmental Disaster Prediction

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 transfer of data. The scenario of the meteorological application in BRIDGE is defined as: distributed processing on distributed data across GRIA and GOS middleware. A prototype has been established to validate the architectural choices against some pertinent use cases. It exposes basic services deployed in GRIA and GOS:

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

The prototype demonstrates that an operation deployed as a GRIA service invokes data that is made available by a GOS service and vice-versa. The prototype establishes various metrics for optimising computer resources usage. Challenges faced by the meteorological application include transparent access to data archives maintained by different organisations, reliable transfer of large volumes of data across different Grid infrastructures, and passing through firewalls set by different organisations with different security policies.



## Scenario 3: Drug Discovery

The pharmacological application focuses on the design and development of DockFlow, an interoperable Grid-based virtual screening platform for pharmaceutical R&D. It enables scientific users to use multiple protein docking tools deployed over GRIA and GOS-enabled platforms seamlessly in their virtual screening experiments and to combine and compare the results generated by those tools. It also supports access and integration of distributed protein docking tools using distributed HPC resources.

The key challenge of DockFlow is to enable interoperability at both infrastructure level and 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 application.

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.