From UNICORE[1] to EUROGRID[2]: A Software Infrastructure for Grid Computing

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1. What is Grid Computing?

Grid Computing defines a new powerful computing paradigm in analogy to the electric *Power Grid*. The metaphor introduced by Ian Foster and Carl Kesselmann [1] in 1998 focused the results of previous and ongoing research in networking, distributed computing, seamless computing, metacomputing, web technologies, and other related topics. Especially the universal connectivity provided through the Internet gives hope that the vision depicted by a *Computational Grid* can become reality in day-to-day production outside a closed research community.
Eventually, a customer of the *Grid* will be able to use his or her private work place (Workstation, PC, UMTS phone, ...) to invoke any application at a remote system, use the system best suited for the particular application, access data securely and consistently at remote systems, exploit multiple systems to complete complex tasks in an economical manner, use multiple systems to solve large problems that exceed the capacity of a single one. Multiple Grids will exist in the Internet and in Intranets.
Although work is ongoing around the globe and researchers have made progress in important fields to enable grid computing a score of problems remain to be solved spanning the range from computer science to building prototypes and using them in practice.

2. UNICORE: Uniform Interface to Computing Resources

In 1996 the heads of German High Performance Computing Centres, researchers, and vendors of HPC systems convened to identify what prevents the effective use of the available distributed resources. Among them are: difficult to use software on incompatible systems from different vendors, historically grown computer centre practices and conventions, conflicting policies about data storage, access, and security. As a result of the meeting the centres started an initiative to overcome these obstacles. A team was installed to propose a solution; this became project UNICORE in 1997. The *Grid* was not invented at that time so UNICORE had to design and implement an architecture for a total solution. The initial goals of UNICORE were:

- Submission of batch jobs to any target system at participating sites in a consistent and secure way
- Creation of multi-system and multi-site jobs where the user selects the systems and UNICORE synchronised the jobs
- Automatic data staging between systems and sites as required by the jobs
- Full control over the jobs through a graphical user interface.

The project used the term seamless computing to characterise the proposed system. The following key design decision were taken early in the project:

- Exploitation of existing technologies and using available software where ever possible. This includes Internet protocols like https, X.509 certificates, Web browsers and Java applets.
- Abstraction of system functions, commands, and user actions to achieve system and installation independence. This led to the definition and development of the Abstract Job Object (AJO) the core technique of UNICORE.
- Retaining full administrative autonomy of participating centres thus minimising the intrusion into computer centre policies and practices.

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[2] Project EUROGRID is funded in part by EU contract IST-1999-20247

The first phase of the project was scheduled for a two year period. This limited the range of conceivable functions that a system like UNICORE might have. In September 1999 the successful completion of the project was demonstrated at an international Symposium in Jülich [2] and is documented in the final project report [3]. In parallel a follow-on project UNICORE Plus was proposed and approved by BMBF for a three year period till December 2002 to continue the development of UNICORE and to add new functions.

3. EUROGRID – Application Test Bed for European GRID Computing

Whereas UNICORE was primarily targeted as a system to link German HPC centres, EUROGRID takes this paradigm to the European level. Partners from industry and research team-up to enhance the UNICORE software by adding functions like interactive access or resource brokers, demonstrate grid computing across national boundaries, and to exploiting the technology in selected application areas:

- Bio-Grid – to enable chemists and biologists to work on different architectures without intimate knowledge of the underlying systems
- Meteo-Grid – to foster a new way for local weather predictions on demand
- CEA-Grid – to demonstrate coupled distributed applications, like vibro-acoustics
- HPC-Grid – to analyse data from experimental facilities.

The EUROGRID project is scheduled to start in November 2000 for a duration of three years. The different development tracks that are pursued by the UNICORE Plus and EUROGRID projects are to be merged into a commercially supported product by Pallas GmbH at the end of the projects.

4. Quo vadis clatri[3] ?

Grid computing – in spite of its obvious popularity and its undisputed promise – is still in its infancy. Some basic technologies already exist, for example web communication. Security can be based on an existing standard like X.509, however, an ubiquitous Public Key Infrastructure has yet to be deployed. This was expected to come quickly from e-commerce, and eventually it will. In other fields, like resource scheduling and quality of service in wide area networks basic research is needed before more than trials can be performed. Two aspects are critical to the success of grid computing:

1. Managing the expectation – Proponents, funding agencies, and potential users should keep in mind how long it took to install the grid's namesake, the electric power grid, from the early inventions by Werner von Siemens (1866) or Thomas A. Edison (1879), not to speak of the first experiments by Alessandro Volta in the 18th century.
2. Globalisation – like the Internet a *computational grid* will span the globe. A parochial approach to develop purely national or continental solutions is bound to fail.

Project partners

UNICORE: http://www.fz-juelich.de/unicoreplus
EUROGRID: http://www.eurogrid.org/

Reference

[1] I. Foster and C. Kesselmann, ed.
The Grid: Blueprint for a New Computing Infrastructure. Morgan Kaufman Publishers, 1998
[2] http://www.fz-juelich.de/mcdc
[3] D. Erwin, ed.
UNICORE – Uniformes Interface für Computer Ressourcen. Gemeinsamer Abschlußbericht des BMBF-Verbundprojekts, ISBN 3-00-006377-3

[3] clatri, lat.: grid