# High Performance Computing in Framework 6

## Information Society Technologies DG
### Grids for Complex Problem Solving

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# Outline

- **HPC and Grids in IST FP5 (1992-2002)**
- **Framework Programme 6 (FP6)**
- **IST Programme in FP6**
- **Grid Computing in FP6 (2002-2006)**
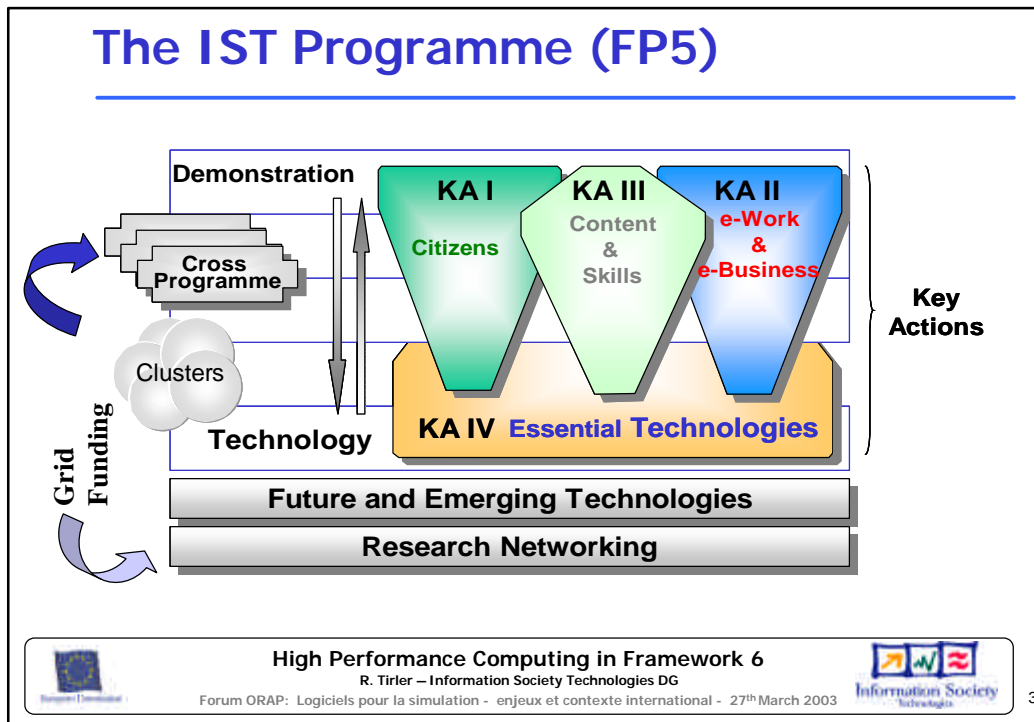- **IST - WP2003-2004**
- **Conclusion**

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## The IST Programme (FP5)

**Demonstration**

**KA I** **KA III** **KA II**

**Citizens** Content & Skills **e-Work & e-Business**

**Cross Programme**

**Key Actions**

Clusters

**Grid Funding**

**Technology**

**KA IV Essential Technologies**

**Future and Emerging Technologies**

**Research Networking**

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## HPC in FP5

- **Key Action IV.4**
  - Real-time and large-scale simulation and visualisation technologies
    - ➢Real-time simulation and visualisation technologies
    - ➢Large-scale shared virtual and augmented environments
  - This work addresses "the development and integration of advanced simulation and visualisation technologies and environments in all applications".

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# HPC Projects in FP5 (1)

- **SIMBIO**
  - **A Generic Environment for Bio-numerical Simulation**
- **ESTEDI**
  - **European Spatio-TEmporal Data Infrastructure for high-performance computing**
- **BLANKSIM**
  - **Blanking simulation using HPCN technology: Action Line: Real-time and large-scale simulation and visualisation technologies - Real-time simulation and visualisation technologies.**
- **COPHIT**
  - **Computer-Optimised Pulmonary delivery in Humans of Inhaled Therapies**
- **JPD**
  - **Development of a specialised software environment for the design of standard total hip replacement**

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# HPC Projects in FP5 (2)

- **VSUR**
  - **Virtual Reality Surgery Training System. Action Line: Real-time and large-scale simulation and visualisation technologies**
- **VISICADE**
  - **VIrtual SImulation environment for a seamless integration of CAD/CAE into VR**
- **RIMM**
  - **Real-time Interactive Multiple Media (RIMM) Content Generation Using High Performance Computing and Multi-Parametric Interfaces**
- **BIOWOLF**
  - **Speeding-up Biocomputing applications using a commodity-based parallel computer**
- **MADISON**
  - **Multi-tier Architecture for Distributed Interactive SimulatiON**
- **OZONE**
  - **New technologies and services for emerging nomadic societies; Action Line: Computing, Communications and Networks - Distributed systems and services provision**

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# FP5 IST - Grid and P2P Projects

| | Project name | Start date | Duration | Funding (€) |
|---|---|---|---|---|
| 1 | EUROGRID | 01.11.2000 | 36 | 2,065,769 |
| 2 | DATAGRID | 01.01.2001 | 36 | 9,872,506 |
| 3 | DAMIEN | 01.01.2001 | 30 | 1,229,348 |
| 4 | GRIA | 01.12.2001 | 30 | 2,016,213 |
| 5 | DATATAG | 01.01.2002 | 24 | 3,980,826 |
| 6 | GRIDLAB | 01.01.2002 | 36 | 5,085,998 |
| 7 | GRIP | 01.01.2002 | 24 | 1,338,996 |
| 8 | EGSO | 01.03.2002 | 36 | 2,400,000 |
| 9 | CROSSGRID | 01.03.2002 | 36 | 4,860,001 |
| 10 | MOSES | 01.03.2002 | 30 | 1,505,604 |
| 11 | MMAPS | 01.03.2002 | 30 | 2,392,000 |
| 12 | GRIDSTART | 01.04.2002 | 36 | 1,449,066 |
| 13 | GRASP | 01.04.2002 | 30 | 1,955,455 |
| 14 | WEBSI | 01.05.2002 | 24 | 1,799,998 |
| 15 | ASP-BP | 01.05.2002 | 24 | 3,485,992 |
| 16 | P2PEOPLE | 01.07.2002 | 19 | 763,582 |
| 17 | FLOWGRID | 01.09.2002 | 24 | 1,099,120 |
| 18 | OPENMOLGRID | 01.09.2002 | 27 | 1,988,579 |
| 19 | GRACE | 01.09.2002 | 30 | 1,889,995 |
| 20 | COG | 01.09.2002 | 18 | 1,061,703 |
| 21 | BIOGRID | 01.09.2002 | 24 | 834,445 |
| 22 | GEMSS | 01.09.2002 | 30 | 2,626,611 |
| 23 | MAMMOGRID | 01.09.2002 | 36 | 1,899,938 |
| 24 | SELENE | 01.11.2002 | 12 | 283,000 |
| | Total | | | 57,884,745 |

## Grid Project Portfolio

- **Infrastructure**
  - DataTag
- **Computing**
  - EuroGrid, DataGrid, Damien
- **Tools and Middleware**
  - GridLab, GRIP
- **Applications**
  - EGSO, CrossGrid, FlowGrid, BioGrid, OpenMolGrid, Moses, COG, GEMSS, Grace, Mammogrid, Selene
- **P2P / ASP / Webservices**
  - P2People, ASP-BP, WEBSI, MMAPS, Grasp, GRIA
- **Clustering**
  - GridStart

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# FP5 Grid Projects — Short Summary (1)

- **Eurogrid**
  - will demonstrate the use of GRIDs in selected scientific and industrial communities, address the specific requirements of these communities, and highlight the benefits of using Grids;
  - will develop important GRID software components and integrate them into EUROGRID (fast file transfer, resource broker, interface for coupled applications and interactive access)
  - Unicore Middleware
- **Damien**
  - Will develop essential software so that the Grids can be used for industrial simulation and visualisation; will build on existing tools and libraries and develop a set of utilities which will enable developers to port their applications more easily to the Grids.

- **Datagrid**
  - will devise and develop scalable software solutions and testbeds to handle many PetaBytes of distributed data, tens of thousand of computing resources including processors, disks, other devices and thousands of simultaneous users from collaborating research institutes.
  - Will enable next generation scientific exploration which requires intensive computation and the analysis of shared, large-scale databases.
- **DataTag**
  - Will implement a network infrastructure for a truly high-speed interconnection between individual Grid domains both in Europe and the US. The project will incorporate the design & implementation of advanced network services for guaranteed data delivery, transport protocol optimisation, efficiency and reliability of network resource utilisation.

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# FP5 Grid Projects — Short Summary (2)

- **GRIA**
    - will devise business models and processes that make it feasible and cost-effective to offer and use computational services securely in an open Grid marketplace.
- **GRIDLAB**
    - will develop software able fully to exploit dynamic resources.
- **GRIP**
    - will realise the interoperability of Globus and UNICORE.
- **EGSO**
    - will lay the foundations of a virtual solar observatory.

- **CROSSGRID**
    - will develop techniques for large-scale grid-enabled real-time simulations and visualisations.
- **MOSES**
    - MOdular and Scalable Environment for the Semantic web.
- **GRIDSTART**
    - Grid Dissemination, Standards, Applications, Roadmap and Training.
- **GRASP**
    - will aim at studying, designing, developing and validating a new advanced system infrastructure for Application Service Provision (ASP) based on GRID technologies.

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# FP5 Grid Projects — Short Summary (3)

- **WEBSI**
    - will develop and demonstrate three suites of tools for developing data-centric Web applications in the ASP framework.
- **ASP-BP**
    - will constitute a framework in which 6 experiments regarding ASP technology-based applications applied in different industrial field will be realised.
- **FLOWGRID**
    - will establish a CFD Virtual Organisation, by setting up a GRID infrastructure and by deploying and sharing, software, computing resources and knowledge.
- **GRACE**
    - GRid search and Categorisation Engine.

- **OPENMOLGRID**
    - will address large scale molecular design problems
- **COG**
    - Corporate Ontology Grid.
- **BIOGRID**
    - will conduct a trial for the introduction of a grid approach in the biotechnology industry.
- **GEMMS**
    - will demonstrate how Grid technologies can be used to transform healthcare and enable Europe to lead that transformation. Grid-Enabled Medical Simulation Service.
- **SELENE**
    - will address Grid technologies for e-Learning.

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## Framework Programme FP6 (2002-2006)

- **European Research Area (ERA) Concept**
  - **Common European Research policy**
- **Stronger link with National, Regional and other European Initiatives**
- **Three Specific Programmes**
  - **Integrating and Strengthening ERA**
    - ➢ **Priority 2: Information Society Technologies (IST Programme)**
  - **Structuring ERA**
    - ➢ **Research Infrastructures**
  - **Strengthening the Foundations of ERA**
- **Strategic Objectives**
- **New Instruments (Contract types)**

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## FP6 is not business as usual!

- **From "Project"-thinking to "Initiative"-thinking**
  - New instruments: "Integrated Projects" & "Networks of Excellence"
  - More strategic thinking
- **Develop Europe-wide approaches**
  - Making sure that Community funding helps aggregate EU, Member State & private funded effort(s)
  - It is not just supporting a particular RTD work…

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# IST in FP6

- **Vision 'Ambient Intelligence' concept**
  - **Provides a vision of the Information Society where the emphasis is on** greater user-friendliness, **more efficient services support, user-empowerment, and support for human interactions**
  - **Technology needs to be seamless with the ways we work, learn, interact with each other; we want technology to disappear from our consciousness**
  - **Grid: Information Utility available for research, industry, business**
- **Challenges and Objectives**
  - **Build the information and knowledge society for ALL - "people first"**
  - **Support to infrastructure / service development**
  - **Visionary, forward looking (longer term/high risk research)**
  - **Scope of activities: Core technologies & "pull-through" applications**

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# FP6 Budget Breakdown

| | | |
|---|---|---|
| **Integrating & strengthening ERA** | | |
| Genomics | 2255 M€ | |
| IST | 3625 M€ | Of which 50 M€ for GÉANT/Grid Testbeds |
| Nanotechnologies | 1300 M€ | |
| Aeronautics and space | 1075 M€ | Of which 125 M€ for Grid Research |
| Food quality and safety | 685 M€ | |
| Sustainable development | 2120 M€ | |
| Citizens and governance | 225 M€ | |
| Anticipation of S&T needs | | |
|   SMEs | 430 M€ | |
|   Specific INCO | 315 M€ | |
|   Anticipating needs | 555 M€ | |
| **Strengthening ERA foundations** | **320 M€** | |
| **Structuring ERA** | | |
|   Research and Innovation | 290 M€ | |
|   Human resources | 1590 M€ | Of which 200 M€ for GÉANT/Grid Deployment |
|   Research Infrastructures | 655 M€ | |
|   Science/Society | 80 M€ | |
| **Joint Research Centre** | **760 M€** | |
| **Total** | **16,270 M€** | |

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# Grids for complex problem solving

- ## Mission
  - Contribute to the development of future generation Grid-type systems, applications, tool and services
  - Contribute to the solution of complex problems in science, industry, business and society by using Grids
- ## Strategic objectives for 2003/2004
  - To design and develop next generation Grid and Peer-to-Peer architectures
  - To develop enabling application technologies for the solution of complex problems using Grid-based approach
  - To foster co-ordination and integration of programme-wide, national and international developments in Grid

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# Grid Research and Deployment (FP6)
## within DG IST

**Application-oriented Strategic Objectives**
e.g. eBusiness, eGov, eWork, eHealth, risks management

**R&D**

### Grids for Complex Problem Solving
- Architecture, design and development of the next generation Grid
- Enabling application technologies

**DG IST - F2**

**Research & Development**

**125 M€ (IST)**

### Research Infrastructure
- Deployment of specific high performance Grids
- GÉANT Upgrade
- Research networking testbeds

**DG IST - F3**

**Deployment**

**200 M€ RI**

**Technology-oriented strategic objectives**
e.g. semantic web, software and services

**R&D**

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# Grids for Complex Problem Solving
## Research Focus

### Architecture, design and development of the next generation Grids

- **beyond extensions of existing technologies based on a meaning-oriented information model leading to**
  - **open standards**
  - **including security built-in at all levels, programming environments, customisable middleware, resource management**
  - **economic and business models for new services**
- **interoperability with existing GRID and Web services**

### Enabling Application technologies

- **for solution of complex problems requiring a grid-based approach**
- **tools & environments for**
  - **Modelling, simulation, visualisation, data mining,**
  - **process control, remote operation,**
  - **Collaborative work in dynamic virtual organisations**
- **exploiting synergies across different application sectors**

**A multi-disciplinary approach across the relevant levels of the value chain is required**
**Co-operation with research activities in the Member States is necessary for building critical mass**

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# Generic Enabling Application Technologies

| | Sector 1 applic. | Sector 2 applic. | | Sector N applic. | **complex problem solving** |
| | PSE/ Portal | PSE/ Portal | | PSE/ Portal | |
| **Scope of future F2 projects** | Sector-specific comps. | Sector-specific comps. | … | Sector-specific comps. | **enabling technologies** |
| | | **enabling technologies high level Grid services - generic components -** | | | |
| | **Low level Grid services** | | | | **Infra-structure** |
| | **Grid-type environment** | | | | |

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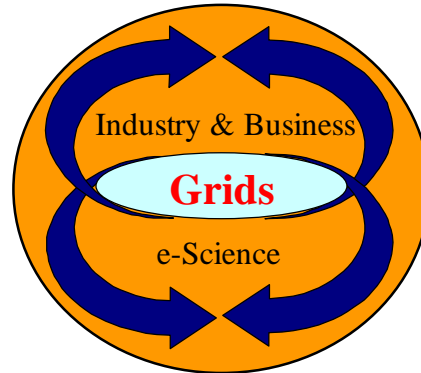R. Tirler – Information Society Technologies DG
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# Moving Grid from e-Science to Industry

## Promote Grid research to

- **Solve complex problems with high economic and societal impact**
- **Exploit the potential of Grids beyond e-Science**
- **Ease access and use of Grids**

Industry & Business

**Grids**

e-Science

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# Links with e-Business

- **Business needs for Grid-based e-Enterprise Applications and Problem Solving Environments:**
  - engineering, development, testing, production, product data management, ... for full product life cycle optimisation
  - faster business analytics for finance markets, marketing analysis and intelligence, customer relationship management, etc
  - modelling, design, simulation in bio-technologies and life sciences
- **New opportunities for Grids enabled collaborative working and virtual organisations:**
  - integrated in enterprise complex IT infrastructures and / or implemented as virtual enterprise across the supply / valued added chain
  - transaction oriented applications, e-business, on-demand and utility service offering

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## IST-FP6 commitment to Grid research

- First actions launched in IST-FP5
- Grid research is a strategic objective
- New Unit dedicated to Grid research

**125M€**

**FP6**

**58M€**

**From FP5 to FP6 funding on Grid research more than doubles**

**FP5**

2000-2002     2002-2006

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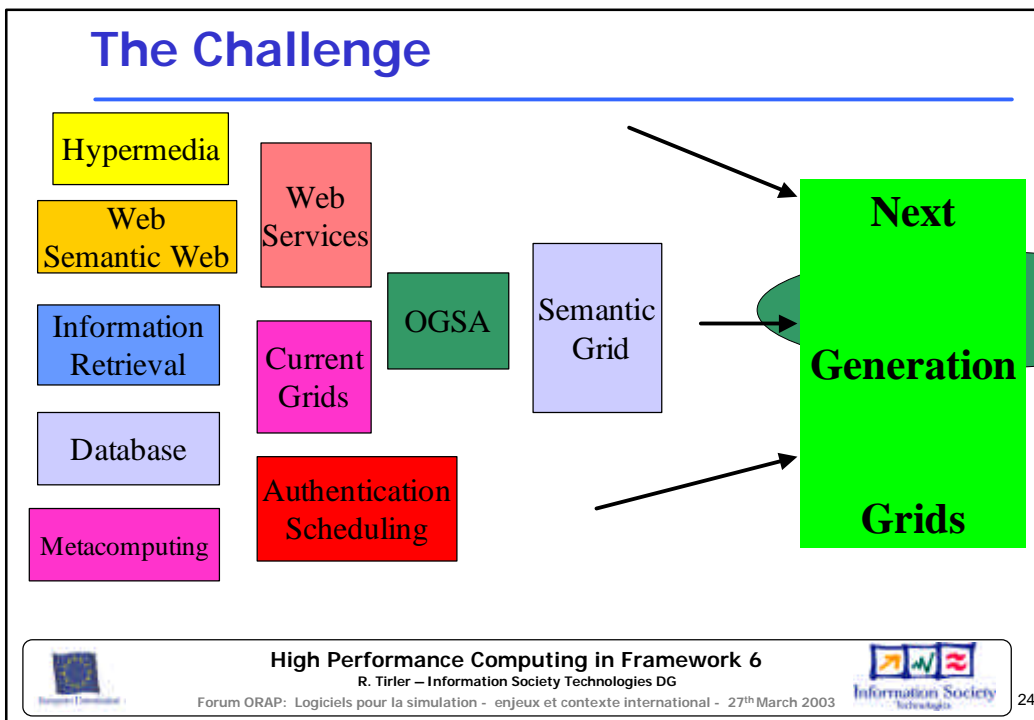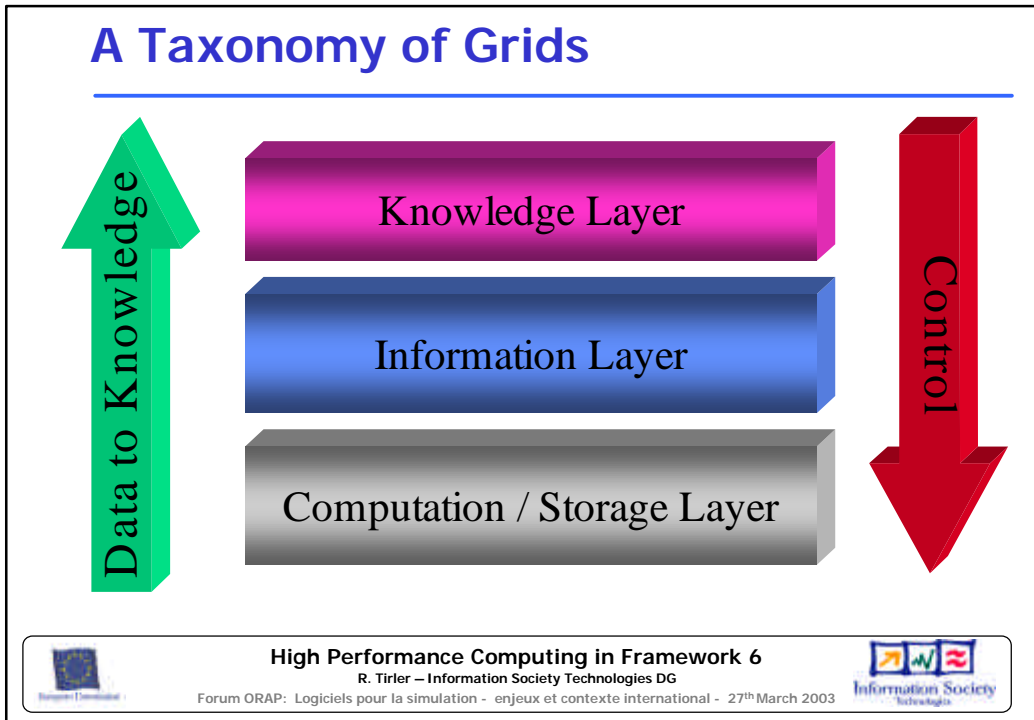
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## Main Grid WS Recommendations

- **Make inventory of present Grid research**
  - Technology re-use should be assured
  - Learn from 1st generation projects / Inventory by 'GridStart' Project
- **Set up a small group of 'visionary' experts to**
  - Identify research priorities for the next 5-7 years and propose pragmatic steps to be taken;
  - Propose a roadmap for the implementation of these steps (in view of upcoming calls for proposals);
  - Align technology priorities and means of implementation with policy objectives, e.g. ERA, European Centres of Excellence, etc.
  - Network/liaise and discuss findings with the Grid research community;
  - Propose actions to increase efficiency in international collaboration.
- **Workshop results: http://www.cordis.lu/ist/grids/**

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**A Taxonomy of Grids**

Data to Knowledge

Knowledge Layer

Information Layer

Computation / Storage Layer

Control

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**The Challenge**

Hypermedia

Web
Semantic Web

Information
Retrieval

Database

Metacomputing

Web
Services

Current
Grids

Authentication
Scheduling

OGSA

Semantic
Grid

**Next**

**Generation**

**Grids**

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# Grid in Call 2 of IST WP2003-2004

- **Call 2 of IST/FP 6 (planned)**
  - **expected opening:** **17th June 2003**
  - **expected closure:** **15th October 2003**
- **Grids for Complex Problem Solving**
  - **Indicative Budget: 45 M€**
  - **Instruments: IP, NoE, STREPs, CA, SSA**
- **Indicative budget on Grids for Complex Problem Solving in FP6: 125 M€**
  - **Links with other 'Strategic Objectives'**

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# Research Infrastructure Unit

**FP6 goals**

| | |
|---|---|
| GÉANT | 100+ Gigabit/s, Terabit/s, - progressive inclusion in schools |
| International | Global connectivity |
| Grids | Large scale Grid platforms (virtual communities) |
| Test-beds | Next Generation Internet solutions for the Research Community |

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## Research Networking Test-beds - Objectives

- **This work is complementary to and in support of the activities carried out in the area of Research Infrastructures on high-capacity and high-speed communications network for all researchers in Europe (GÉANT) and specific high performance Grids.**

- **Objectives: To integrate and validate, in the context of user-driven large scale test-beds, the state-of-the-art technology that is essential for preparing the future upgrades in the infrastructure deployed across Europe. This should help support all research fields and identify the opportunities that such technology offers together with its limitations. The work is essential for fostering the early deployment in Europe of Next Generation Information and Communications Networks based upon all-optical technologies and new Internet protocols and for incorporating the most up-to-date middleware**

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## Call  Call b.1:  RI -  (2002-2003)

- **Communication Network Development - Grids**
  - *Specific Programme :* **Structuring the European Research Area**
  - **Activity :  Support for Research Infrastructures**
  - **Call title : Communication Network Development - Grids**
  - **Date of publication  : 17 December 2002**
  - **Closure date(s)  : 6 May 2003 at 17h00 (Brussels local time)**
- **Instruments: I3, CA, SSA**
- **Budget: 50 M€**

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# Conclusions

- **Grid is an emerging key priority in IST-FP6 supporting the evolution of ERA**
- **Call 2 addresses well-targeted and challenging objectives**
- **Specific CA or SSA actions should be promoted to create a more coherent landscape for Grid research in Europe**
- **Broadening of Grid constituency building is well under way**

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# IST & Grid Research - Sources of Information

**IST on CORDIS:** http://www.eoi.cordis.lu/ist

**FP6 web main page:** http://europa.eu.int/comm/research/fp6/index_en.html

**New Instruments:** http://europa.eu.int/comm/research/fp6/networks-ip.html

**Model Contracts:** http://europa.eu.int/comm/research/fp6/working-groups/model-contract/index_en.html

**Frequently asked Questions:** http://europa.eu.int/comm/research/faq.html

**The European Research Area:** http://europa.eu.int/comm/research/era/index_en.html

**CORDIS RTD beyond 2002:** http://www.cordis.lu/rtd2002/

**FP6 on CORDIS:** http://www.cordis.lu/fp6

**Expressions of interest:** http://www.cordis.lu/search_form.cfm

**IST roadmap & workshops:** http://www.cordis.lu/fp6/calls.cfm

**Grids in IST-FP6:** http://www.cordis.lu/ist/grids/

**IST in FP6:**

> http://www.cordis.lu/ist/fp6/fp6.htm
>
> http://www.cordis.lu/ist/fp6/pcms.htm
>
> http://www.cordis.lu/ist/fp6/workshops.htm

**Registration for FP6 database of experts:** http://www.cordis.lu/experts/fp6_candidature.htm

**Re-registration of FP5 experts for FP6:** http://candidature.cordis.lu/expert-evaluators/

> **IST helpdesk**
> **Fax : +32 2 296 83 88**
> **E-Mail : ist@cec.eu.int**

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