EU Funding for the GRID and Directions

Information Society DG

Grids for Complex Problem Solving

Roman Tirler

Outline

- Introduction
- Grid Computing in IST FP5 (1998-2002)
- Framework Programme 6 (FP6)
- IST Programme in FP6
- Grid Computing in FP6 (2002-2006)
- Grid Research - Next Generation Grid(s)
- Conclusion

The European Union

Principle of 'Subsidiarity'

Governs the exercise of competencies: whether a shared objective could better be achieved at European level or at Member State level

First pillar: the European Communities	Second pillar: common foreign and security policy	Third pillar: cooperation in justice and home affairs
EC •Customs union and single market •Agricultural policy •Structural policy •Trade policy **New or amended provisions on:** •EU citizenship •Education and culture •Trans-European networks •Consumer protection •Health •Research and environment •Social policy •Asylum policy •External borders •Immigration policy **Euratom** **ECSC**	**Foreign policy** •Cooperation, common positions and measures •Peacekeeping •Human rights •Democracy •Aid to non-member countries **Security policy** •Drawing on the WEU: questions concerning the security of the EU •Disarmament •Financial aspects of defence •Long-term: Europe's security framework	•Cooperation between judicial authorities in civil and criminal law •Police cooperation •Combating racism and xenophobia •Fighting drugs and the arms trade •Fighting organised crime •Fighting terrorism •Criminal acts against children, trafficking in human beings

The EU Policy Framework

- **Framework Programmes:** **The Commission submits a proposal to the European Parliament and the Council**
  - Establish the scientific and technological objectives
  - Fix the maximum overall amount and rules for financial participation
  - Shall be implemented through specific programmes / priorities with annual workprogrammes
  - Shall be adapted or supplemented as the situation changes
- **Linking Research with Policy**

The European Policy context

- **The Lisbon Strategy March 2000**
  - to become the strongest knowledge-based economy in the world by 2010
- **…based on 3 elements:**
  - A single market
  - A single currency
  - A single European approach for research
    European Research Area (ERA)
- **Barcelona Council March 2002**
  - R&D Investments approaching 3% by 2010

Linking Research with Policy

EC Grid History in IST FP5

- **ETAN Report - DG RTD (September 1999)**
  - Transforming European Science through Information and Communication Technologies: Challenges and Opportunities of the Digital Age
- **Research Networking: RN1 → GEANT**
  - Fill the Pipes – Metacomputing, DataGrids
- **Grid Workshops**
  - 22-23 June 2000 – DG IST (Update WP2001)
  - *e*Science Workshop - DG RTD June 2000
- **Research Networking: RN2 → Eurogrid, DataGrid**
- **WP 2001/2: CPA9 → Several Projects**

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 Space

- **Infrastructure**

  DataTag

- **Computing**

  EuroGrid, DataGrid, Damien,

- **Tools and Middleware**

  GridLab, GRIP, GRIA

- **Applications**

  EGSO, CrossGrid, FlowGrid, BioGrid, OpenMolGrid, Moses, COG, GEMSS, Grace, Mammogrid, Selene

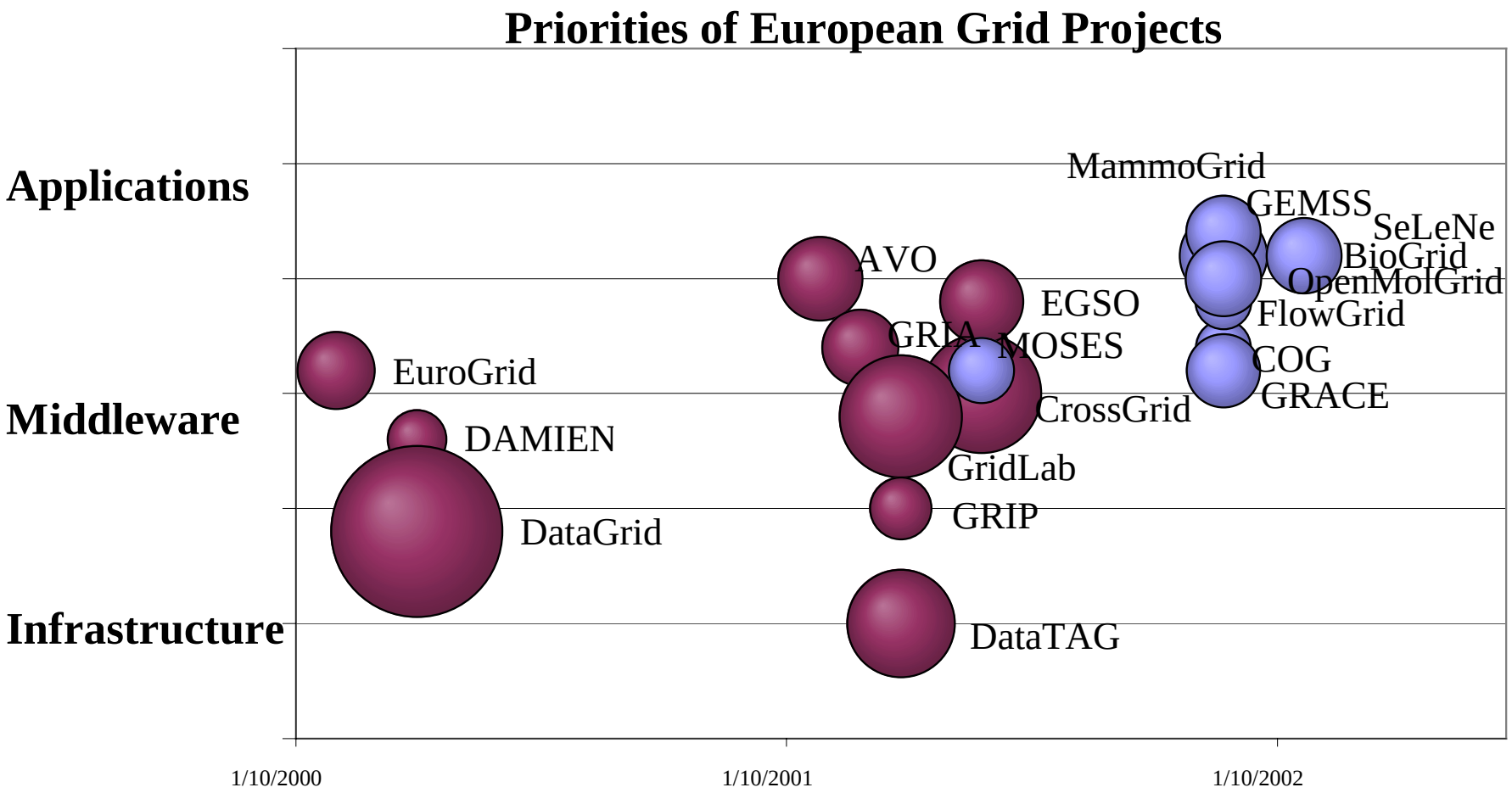
- **Clustering**

  Gridstart

P2P / ASP / Webservices

P2People, ASP-BP, WEBSI, MMAPS, Grasp

FP5 Grid Projects (source GridStart project)



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.

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.

FP5 Grid Projects – Short Summary (3)

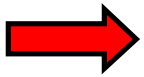
- **WEBSI**
  - will develop and demonstrate three suites of tools for developing data-centric Web applications in the ASP framework.
- **ASP-BP**
  - will constitute a framework in which 6 experiments regarding ASP technology-based applications applied in different industrial field will be realised.
- **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.

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)

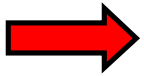
FP6 Budget Breakdown

Integrating & strengthening ERA	
Genomics	2255 M€
IST	3625 M€
Nanotechnologies	1300 M€
Aeronautics and space	1075 M€
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€
Research Infrastructures	655 M€
Science/Society	80 M€
Joint Research Centre	**760 M€**
Total	**16,270 M€**



Of which 100 M€ for GEANT/Grid Deployment

Of which 125 M€ for Grid Research



Of which 200 M€ for GEANT/Grid Deployment

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…
- **Different way of describing content and calls**
  - a lighter workprogramme, different sequencing of calls, ...

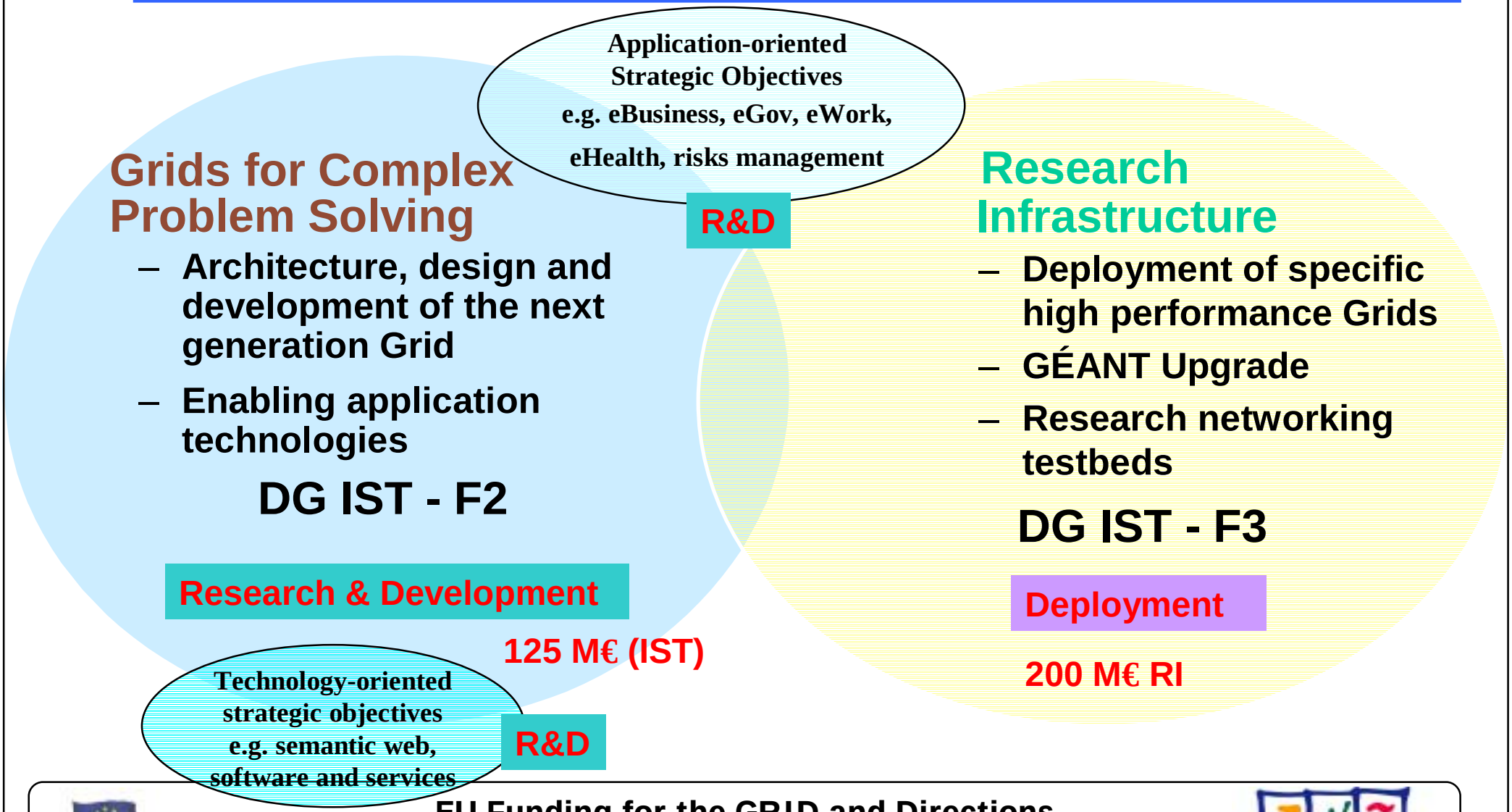
IST Vision in FP6

- **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

IST WP2003-2004

- **Limited Set of Strategic Objectives**
  - Grid-Based Systems for Complex Problem solving (3.2.8)
  - Research Networking Testbeds (3.5)
- **Implementation Plan – Calls**
  - Call 1 - publication 17.12.2002, closed 24.4.2003 indicative budget of around 1095 M€.
  - Call 2 – publication 17.6.2003, closing 15.10.2003 indicative budget of around 525 M€

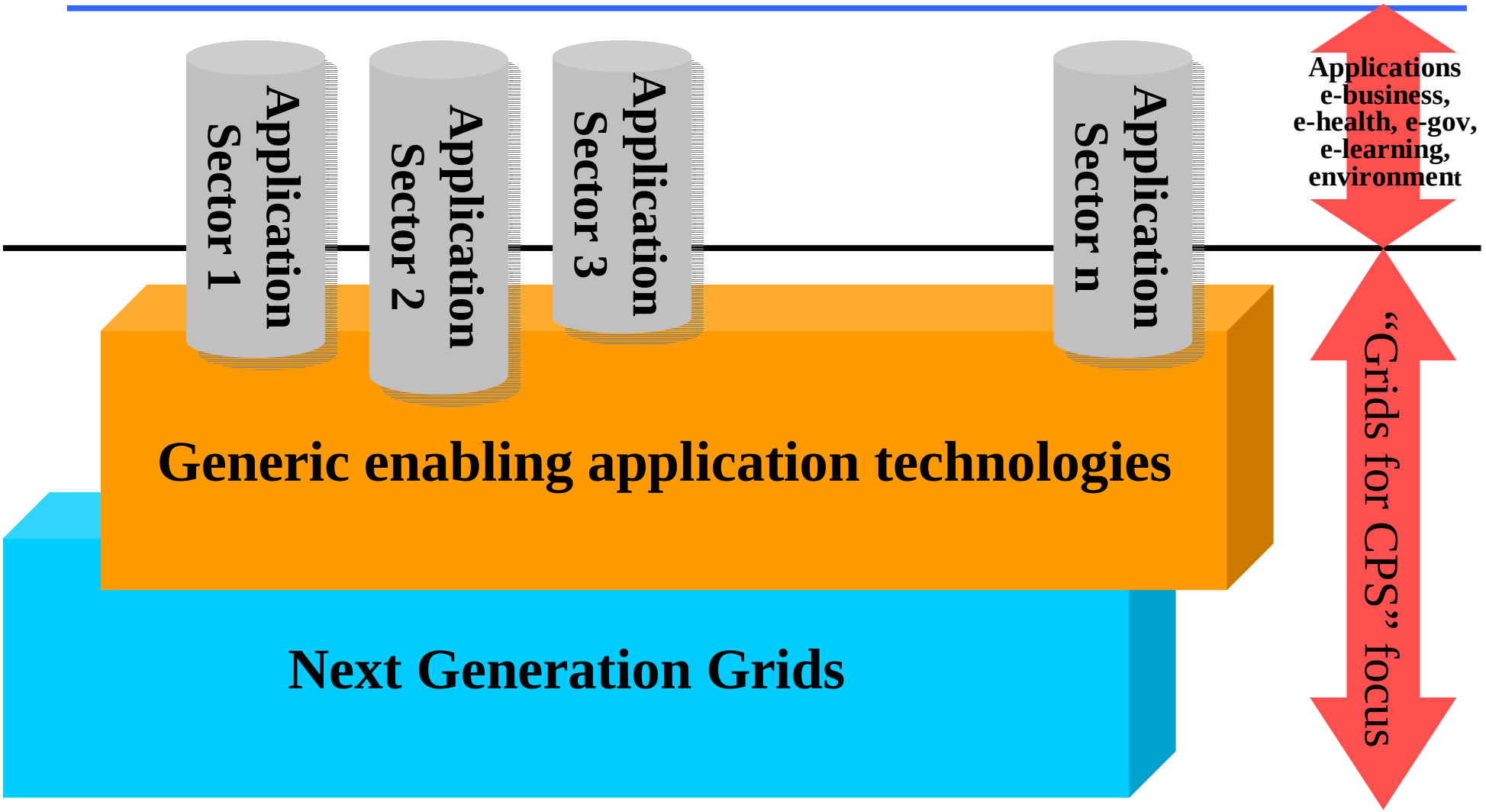
Grid Research and Deployment (FP6)
within DG IST



Grids for Complex Problem Solving
Vision and Objectives

- **Expand potential of Grid/P2P approaches**
  - **To solve complex problems that cannot be solved with current technologies in application fields such as:**
    - **industrial design, engineering & manufacturing,**
    - **health, genomics, & drug design, environment,**
    - **critical infrastructures, energy, new media,**
    - **business & finance**
- **Overcome present architectural and design limitations hampering the use and wider deployment of computing and knowledge Grid/P2P based approaches**
  - **Move from machine-centric computing & data Grids for research to "knowledge" Grids based on a meaning oriented information model**
  - **Enrich Grid capabilities by including new functionalities required for complex problem solving**

Grid-based systems for Complex Problem Solving
- Research Focus -



Enabling Application Technologies
Research Focus

- For the 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 domains - share common layers
- Multi-disciplinary approach across relevant levels of the value chain required

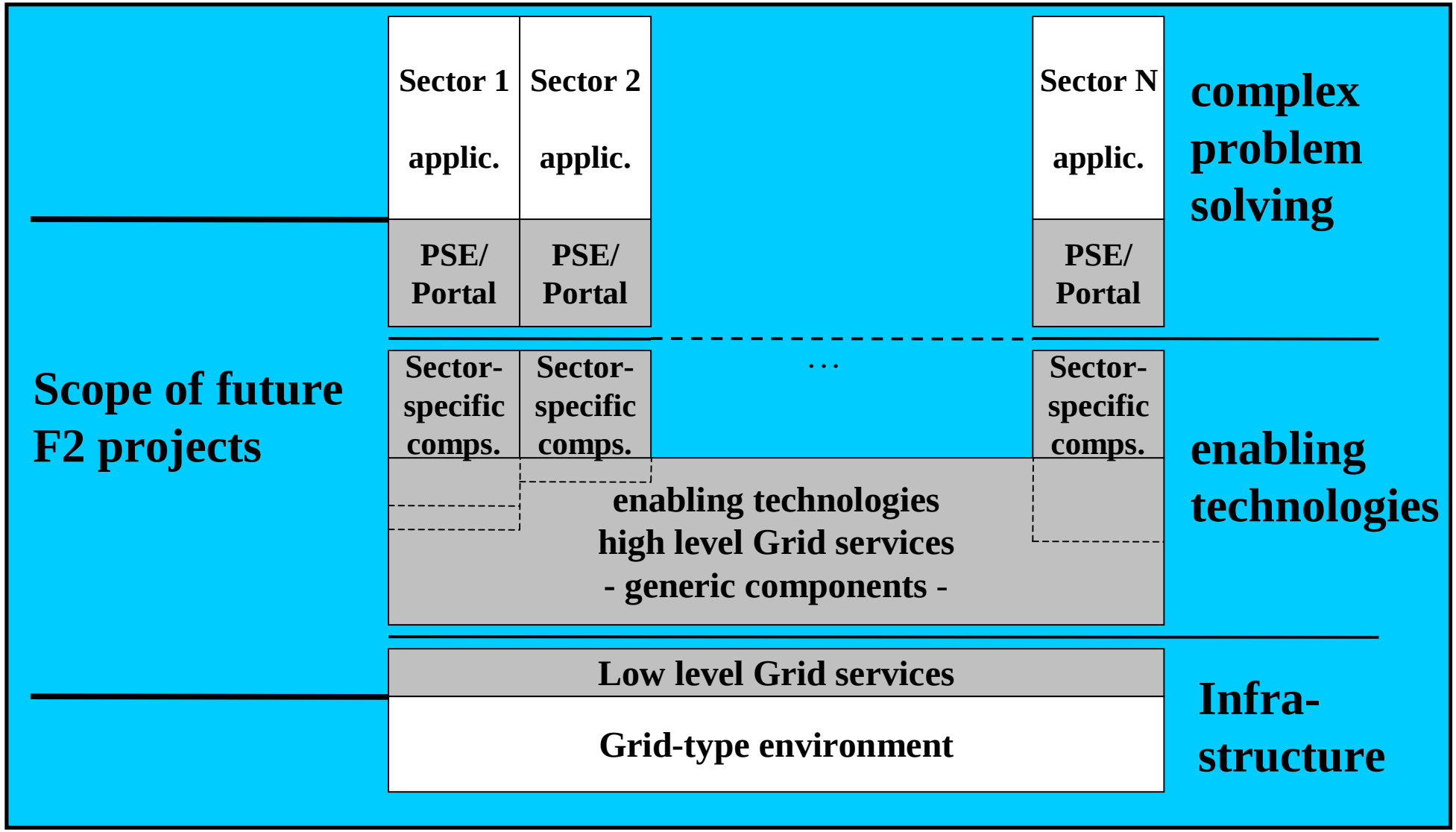
Additional Background Information

- **FP5 *"IST Grid Projects Inventory and Roadmap"*, GRIDSTART Project, first public draft 16 June 2003, update July**
- **Workshop "Grids for Integrated Problem Solving Environments", April 2003**
- **Workshop "Grid-based Virtual Organisations and collaborative e-Enterprise Applications", May 2003**

available together with other additional information on

www.cordis.lu/ist/grids

Generic Enabling Application Technologies



NGG: Research Focus - WP2003-2004

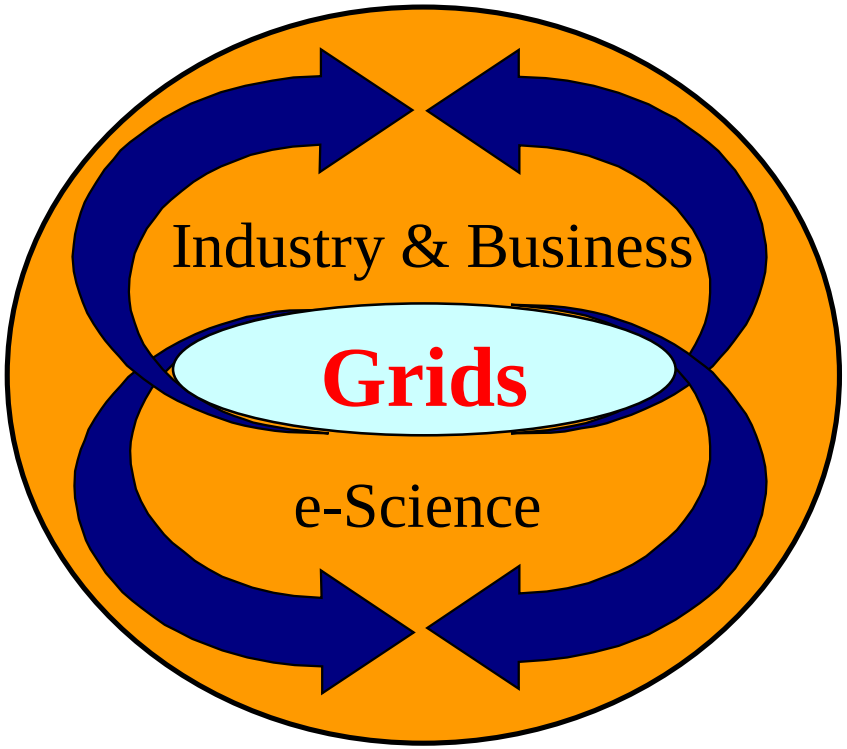
- **Architecture, design and development of the NGG**
  - **Beyond extensions of existing technologies based on a meaning-oriented information model leading to**
    - **Open standards**
    - **Security built-in at all levels, programming environments, customisable middleware, resource management**
    - **Complete virtualisation of Grid resources**
    - **Economic and business models for new services**
    - **etc.**
- **Interoperability with existing Grid & Web services**
- **Focus on Challenges in Computer Science which must be solved in order to develop scalable, robust and manageable Gridsystems**

A inter/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

Moving Grid from e-Science to Industry

Promote Grid research to

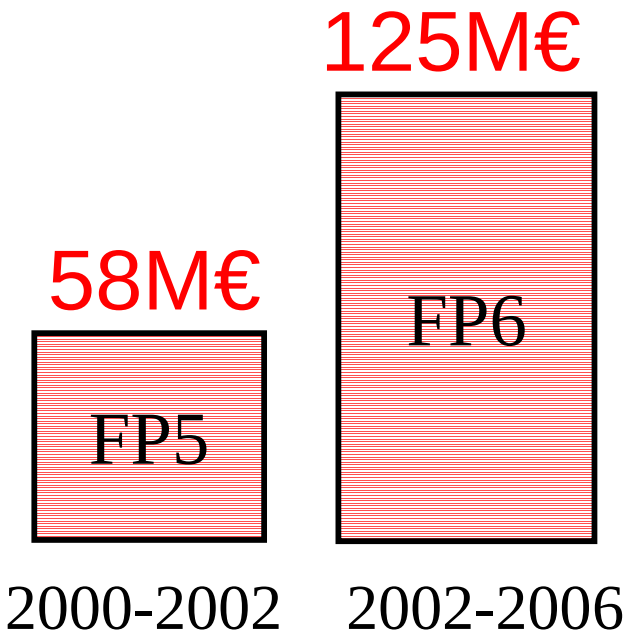
- Solve complex problems with high economic and societal impact
- Exploit the potential of Grids beyond e-Science
- Ease access and use of Grids



IST-FP6 commitment to Grid Research

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

From FP5 to FP6 funding on Grid research more than doubles



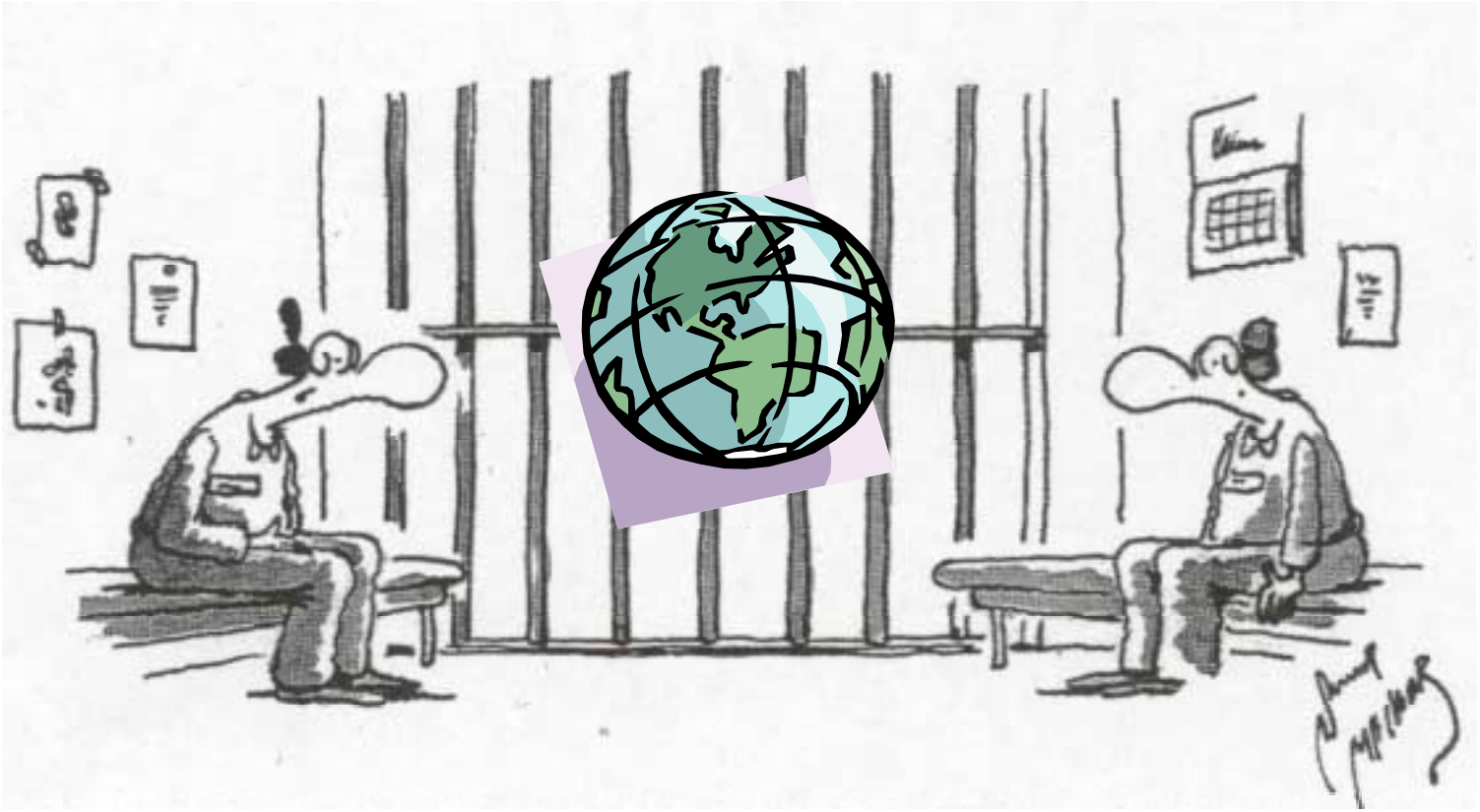
Grid in Call 2 of IST WP2003-2004

- **Call 2 of FP 6**
  - **Call published: 17th June 2003**
  - **expected closure: 15th October 2003**
- **Grids for Complex Problem Solving**
  - **Indicative Budget: 45 M€**
  - **Instruments: IP, NoE, STREPs, CA, SSA**

Next Generation Grid(s) - NGG
Motivation

- **Grid technologies promise to change the way we tackle complex Problems**
- **Different Grid technologies co-exist**
  - Stimulate creativity in the research community
  - Early adopters in business community
- **Grid is at a 'Threshold'**
- **NGG should possess the following properties:**
  - Transparent and reliable, pervasive and ubiquitous
  - Easy to use and program, easy to configure and manage
  - Person-centric, secure and trusted across multiple admin domains
  - Scalable, persistent, self-organising
  - Based on standards for software and protocols
- **Basic Research needed**

Thinking outside the Box



“I was thinking way outside the box.”

NGG - European Grid Research 2005-2010

- **Visions**
  - End User Perspective
  - Architecture Perspective
  - Software Perspective
- **Research Priorities**
  - Properties
  - Facilities
  - Models
- **Report available**

  http://www.cordis.lu/ist/grids/index.htm

  Look at 'GRIDS Highlights'

  (see disclaimer)

End User Perspective

- **A Simple and Pervasive Grid**
  - Hide complexity
  - No longer a need to define it
- **Persistent life-support for data and processes**
  - Define business data and processes in high-level terms alone and have them persist independently of changes in hardware and the underlying service environment
- **A Grid where people are nodes**
  - Integration of the person into the system in a seamless and comfortable way
- **An affordable knowledge discovery service**

Architecture Perspective

- NGG will **virtualise** the notion of distribution in computation, storage and communication over unlimited resources
- Grids will pervade into everyday life, sometimes in the form of ambient intelligence
- Grid may consist of millions of interconnected nodes
- NGG will have self-organising capabilities
- NGG will have the capability to negotiate with agents to provide services
- The next generation Grid will have some mandatory architectural properties:
  - Simplicity to allow for easy life cycle management and smooth evolution;
  - Subsidiarity of control and management, and scalability of services;
  - Resilience, through redundant, self-organising components to minimize points of failure;
  - Transparency to allow many virtual organisations to run over it;
  - Straightforward administration and trouble-free configuration management.

Software Perspective

- **Interoperability as a basic means for problem solving**
  - Grids can be seen as multiple overlapping n-dimensional constructs, which have to interoperate to provide solutions to dynamically changing requirements; interoperation through metadata describing the sources and resources (and users) represented by agents and mediated through brokers
- **Programming Grids through abstraction**
  - Grid infrastructure still fully exposed to programmers: mechanisms needed keep all the intricacies of resource allocation and scheduling, data movement, synchronisation, error handling, load balancing, etc. transparent to the user and developer
  - Adapt existing programming models to the Grid context
- **A global information model for common things**
  - Come up with a small number of high level ontologies with wide applicability, say: one for the sciences, and one for business

NGG - Research Priorities

- **To realize those visions, a number of research priorities have been identified. They fall into three categories:**
  - the **properties** of a Next Generation Grid
  - the **facilities** provided by an NGG
  - the **models** that are needed for orchestrating Grid services
- **Facilities exhibit and depend upon properties to implement models**

Research Priorities - Properties

- Reliability
- Security and trust across multiple admin domains
- Persistence
- Scalability
- Open to wide user communities
- Pervasive and ubiquitous
- Transparent and easy to program
- Person-centric
- Based on Standards for software and protocols

Research Priorities - Facilities

- **Information representation of elements of the Grid**
  - Definition of a semantically rich meta-data model that supports the integration of data from heterogeneous sources and their conversion into the user's target format without loss of data quality, accuracy, etc.
- **Co-ordination and orchestration of Grid elements**
  - Define dynamic and reactive co-ordination and orchestration mechanisms or paradigms using languages, models or frameworks
- **Systems Management**
  - How to establish automatic control in such large-scale distributed systems: mechanisms for automatically configuring and organising (groups of) nodes for providing services, for automatically detecting and recovering from failures
- **Virtual organizations**
  - Techniques for creating such organisations, defining membership, allocating resources, and managing the termination of such resources;
  - Legal and business practice aspects and their mapping into an electronic form;
  - Trust models associated with each component of a virtual organisation.

Research Priorities - Models

- **Business Models**
  - Techniques, models and languages to develop, deploy, and evaluate alternative business models for exploiting the Next Generation Grid; Issues such as accountability, Quality of Service (QoS), micro payments, performance guarantees, pricing, and dynamic negotiation of Service Level Agreements (SLA) need to be addressed
- **Grid Economics**
  - Research should include free (and controlled) market based models, mechanisms for accounting and pricing, and service exchange brokers, as well as the legal and socio-political implications of a global market in Grid services
- **User Interface**
  - Architectures & standards for metadata & agents representing the user
  - Architectures and models for cooperative working
  - Agents and brokers and the metadata to control and parameterise them

Implementation Modalities

- **Horizontal projects**
  - Co-ordinated and targeted at a defined framework/architecture; probably IPs
  - All are members of the European Virtual Laboratory
- **Smaller projects:**
  - Possibly vertical or targeted in some other way?
  - Instruments to be defined
- **Build a European Virtual Laboratory on middleware research**
  - Co-operation (as leaders) with other Initiatives
  - Include interaction with national efforts
  - Near market software Incubator - (Startups?)
- **Co-ordination Actions to be continued**
  - Continue with a structure like this group
  - Prepare ongoing roadmaps etc.
- **Increase efficiency in international collaboration**
  - Easy participation to international events (GGF, W3C, IETF, ...).
  - International exchange program including industry.

NGG - Europe's Potential

- **NGG Systems: can profit from work in recent years into massively scaleable Distributed Systems for Computation, Storage, Content Distribution and Collaboration**

- **Europe has expertise and competence in the field**
  - **Build critical mass, join forces, IPs and NoEs as enablers**

Conclusions

- This a Collection of visions that cannot be realised in full based on existing or near term Grid technologies
- Areas of research have been identified that need to be addressed in order to realise these visions
- Addressing these research priorities in the 2005 to 2010 timeframe will enable Europe to take the global lead in Grid technology and its application in the Information Society of the future

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

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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/