European e-Infrastructure: current status, opportunities, challenges

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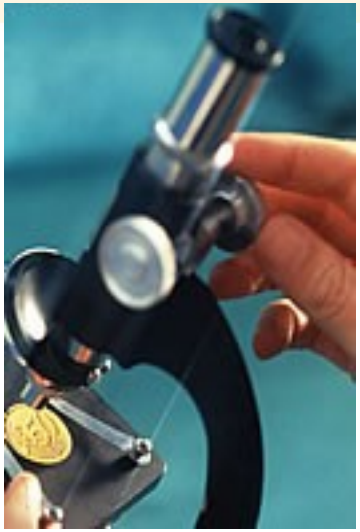
Political, economic context

Research & Innovation defines the future of the nations - role of ICT

- Lisbon strategy: Research and Innovation are the most important factors in determining Europe's success through next decades
- Innovation is the societal and economic manifestation of hope *("Innovate America", Dec 2004)*
- ICT: EU's most innovative and research intensive sector (standing for 25% of total EU research effort, 5.6% of GDP, and 45% of EU productivity gains in 2000-2004) *(EU i2010 Annual Report 2006)*
- However in ICT research Europe invests half as much as its main competitors; EU growth (2% in 2006) still well below annual GDP growth in the US (2.7% on average in 2000-2005)



Facts about investment in EU Research Infrastructures (RI)

- Each 1€ of public R&D leads to 93 cent of business R&D investment (FP7 Impact Analysis)
- Effect typically much bigger when investment concerns multiple purpose and cross-border RI (notably ICT)
  - Higher economic multiplier effect from trans-national collaboration
  - Lower investment risk through involvement of key research players and of broad range of expertise
  - Used and exploited by large community of users

Role of e-Infrastructures

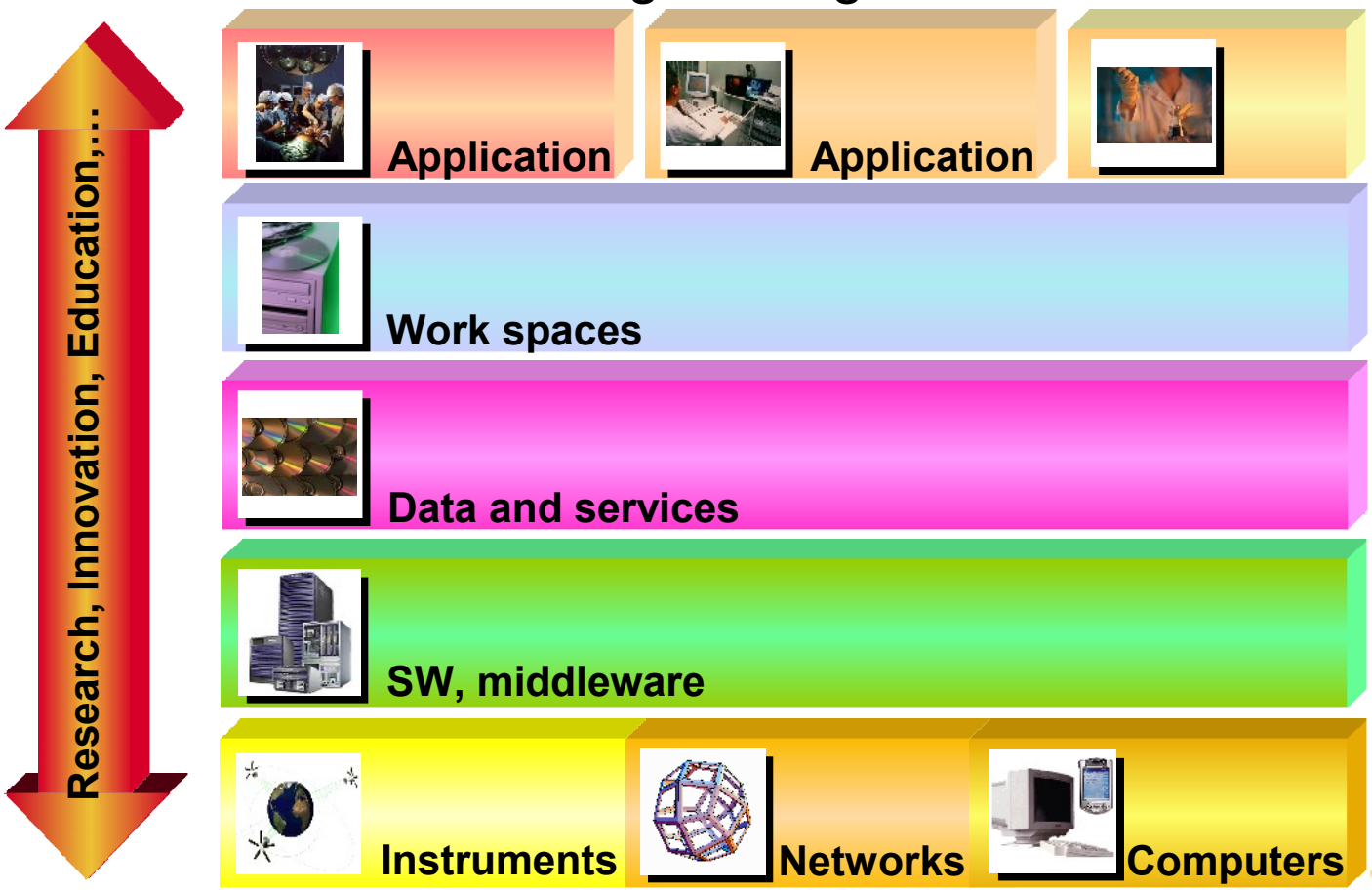
Drivers

- Science and engineering processes highly complex
  - Data- and compute-intensive (sophisticated simulations, distributed observing network complexes etc)
  - Need to collect and combine knowledge, expertise and resources that are distributed across various geographical locations and administrative domains
  - Sharing of resources
  - Education and training

Such needs can only be addressed by a comprehensive and resource-integrating RI that capitalises on advances of ICT-technology

e-Infrastructures

Domain-independent ICT-based RIs designed to support research; they integrate in a seamless way networks, computers, SW, data resources, experimental and training facilities to enable collaborative science and engineering

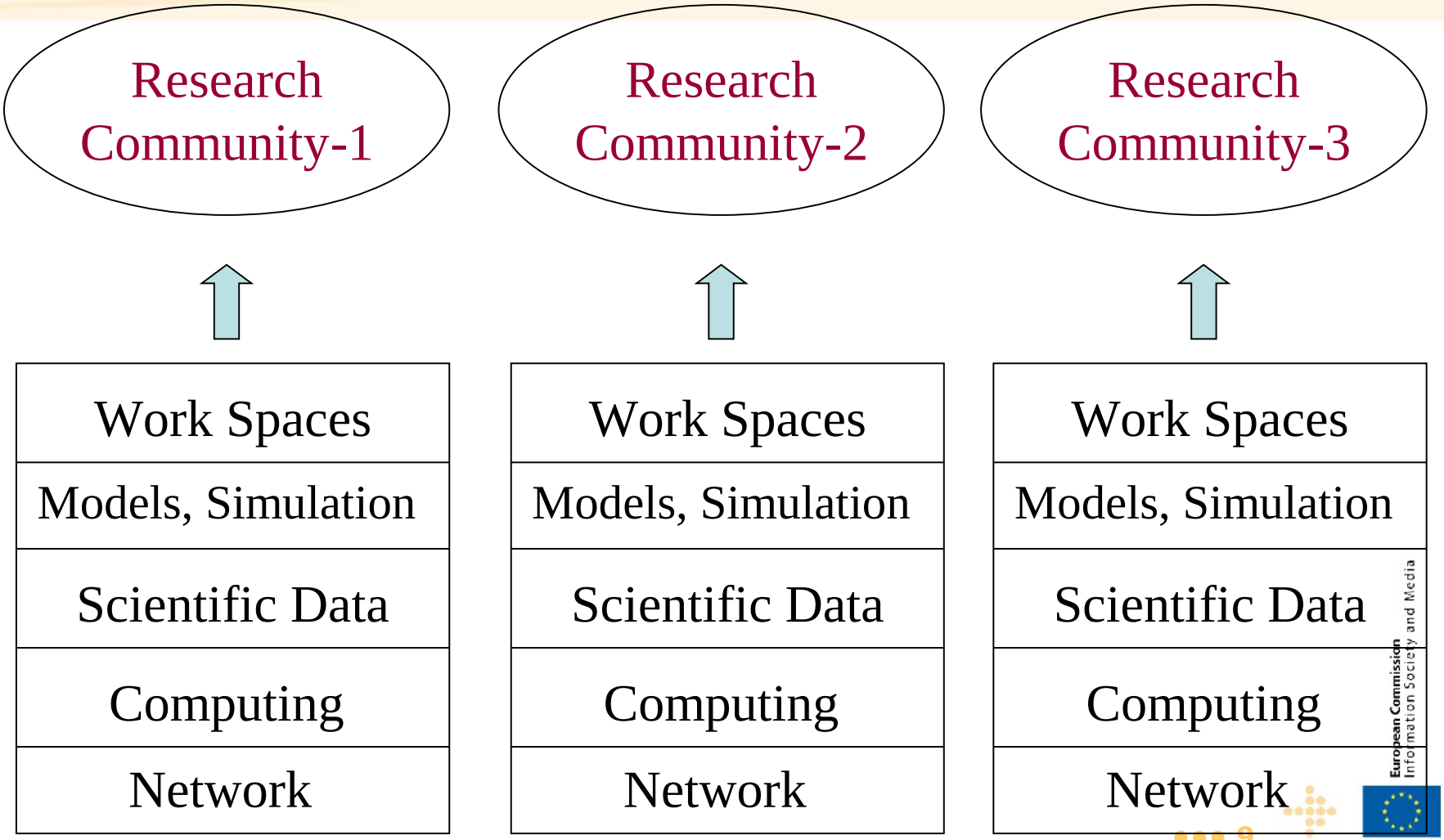


e-Infrastructures

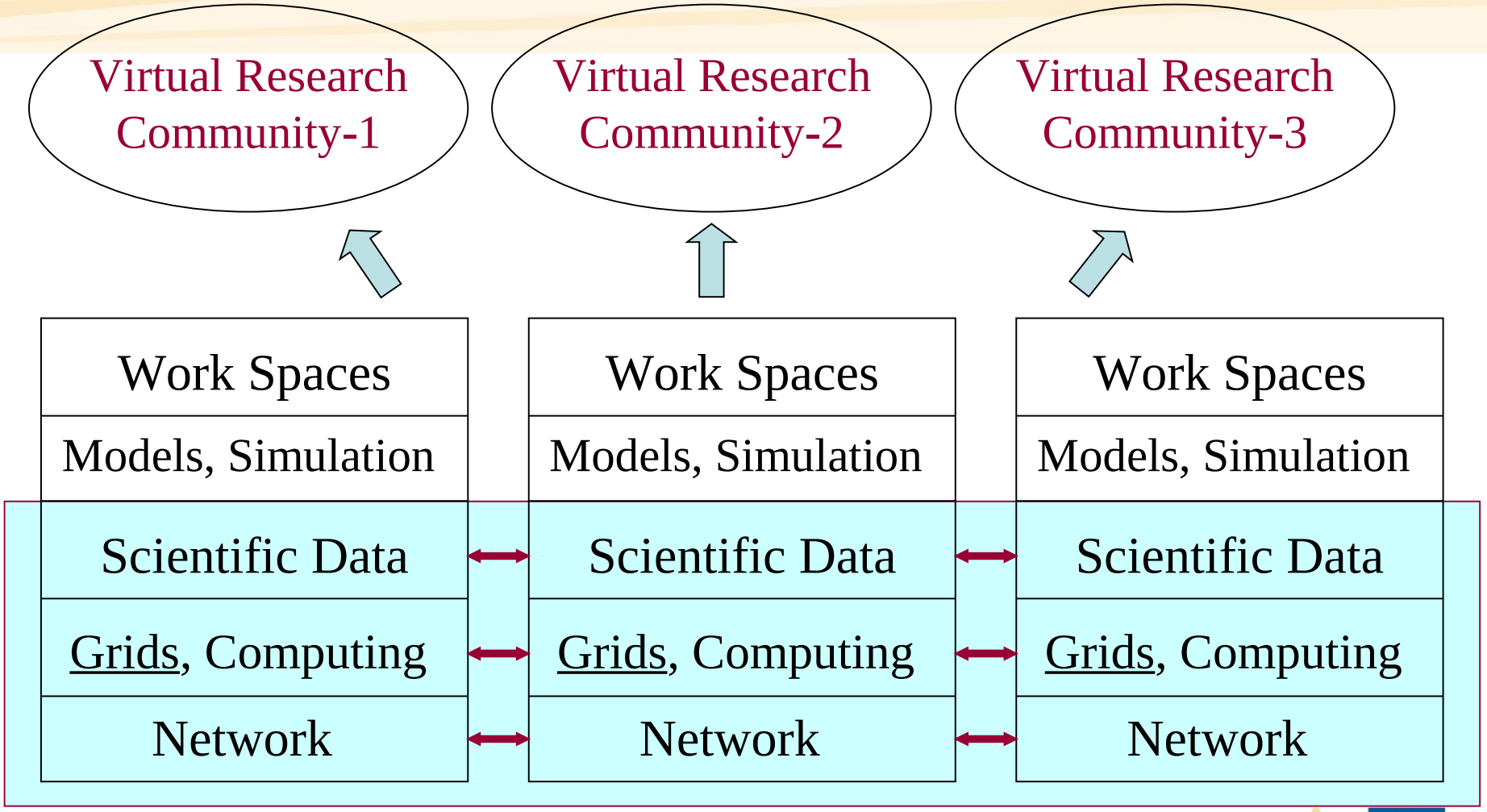
Domain-independent ICT-based RIs designed to support research; they integrate in a seamless way networks, computers, SW, data resources, experimental and training facilities to enable collaborative science and engineering

- **enabling researchers to face new challenges**
- **creating new methods in doing science & engineering**
- **building economies of scale, creating larger economic effects**

e-Infrastructures transforming science: Science as we know it today (application "silos")



e-Infrastructures transforming science: Science of tomorrow based on *Global Virtual Research Communities*



Global Virtual Research Communities are complementary to physical research centres; they are not replacing them

Leading creation of new generation of ICT-infrastructures

End-user view: "unlimited" access to ICT-resources distributed world-wide, global collaborations simplification

Developer view: abstraction, effective service creation

Infrastructure-provider view: Integration, pervasive virtual organisations, streamlining and longer-term protection of investment

Flexible control and sharing of distributed resources

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e-Infrastructures as icebreakers for industry

e-Infrastructures

- Technology validation in real world settings (communities of practice, test-beds, production-quality facilities, sustainable environments)
- Policy challenges
- Education/Training
- Pre-commercial procurement

Standards: catalytic role

Industry

- Academia-Industry partnerships, innovation
- Skilled workforce
- Earlier adoption
- Shorter cycles for new products
- Industrial requirements and quality

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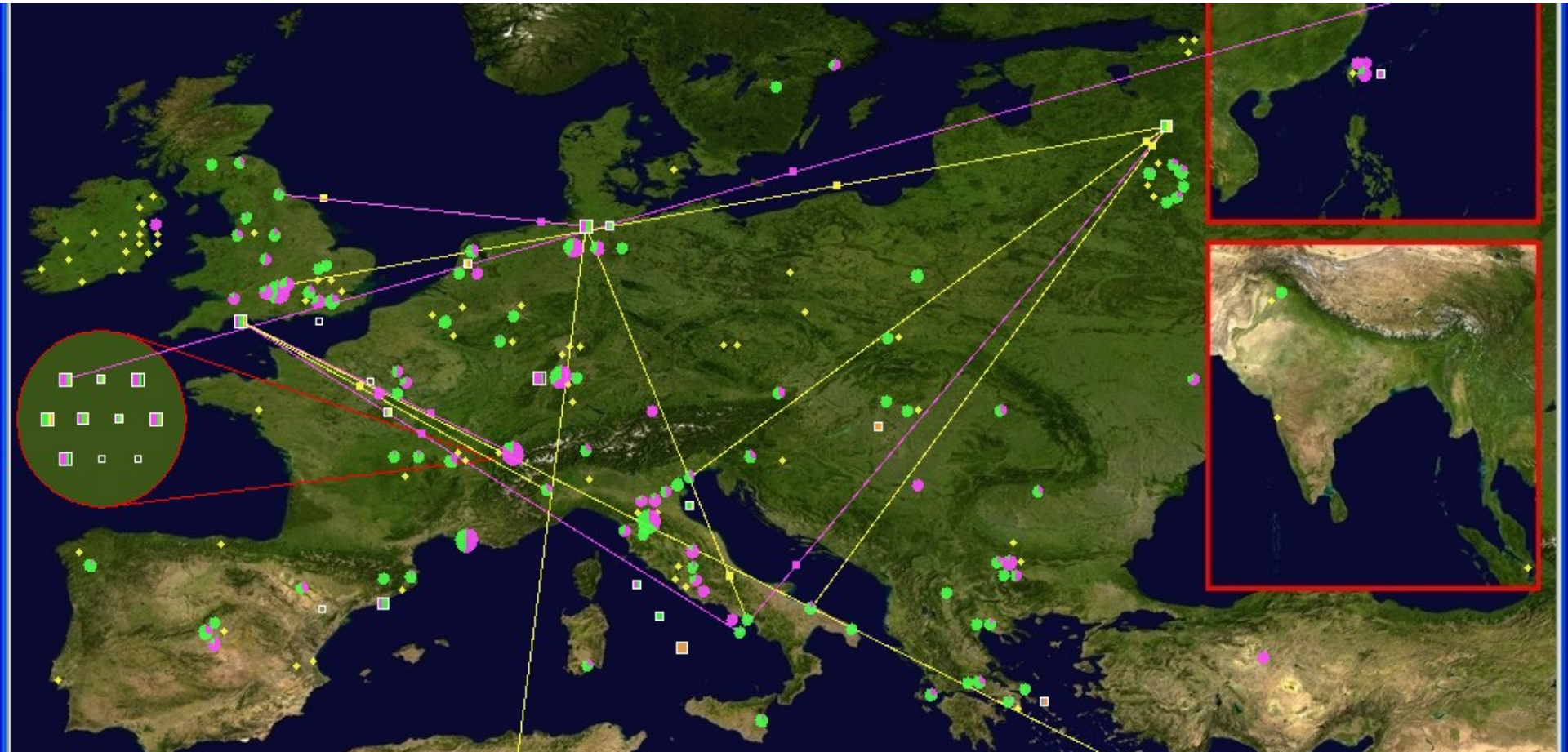
e-Infrastructures today

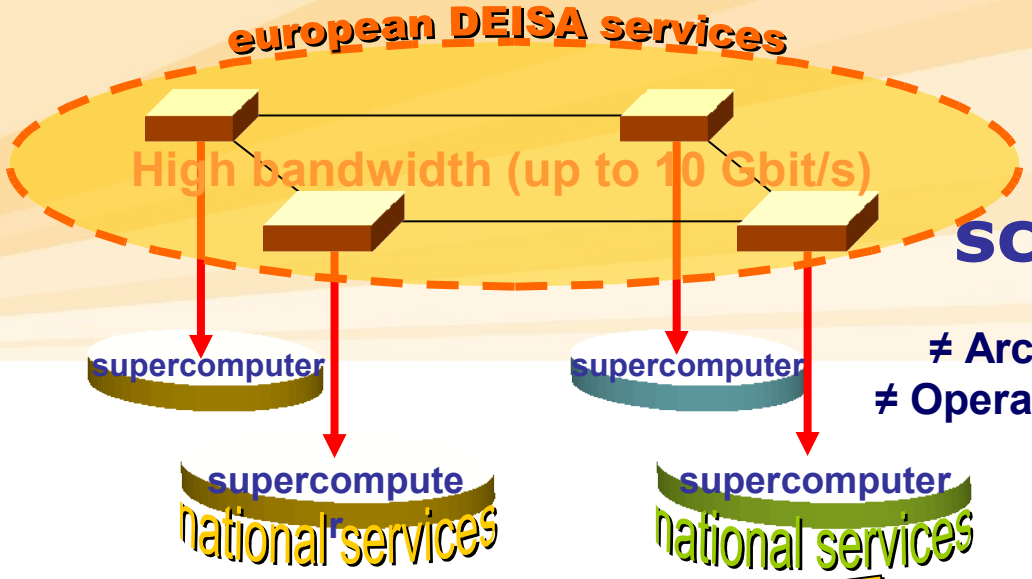
EGEE: global collaborations in science

- ~ 500 sites in 40 countries
- > 60 Virtual Organisations
- ~ 30 000 CPUs
- > 5 PB storage
- > 20 000 concurrent jobs/day

- Scientific communities
  - High Energy Physics
  - Astrophysics
  - Computational Chemistry
  - Fusion
  - Life Sciences
  - Biomedics
  - Earth Sciences
  - Finance
  - Geophysics
  - Multimedia…



DEISA: High End Computing for next science breakthroughs



≠ Architectures
≠ Operating systems

21.900 processors and 145 TF in 2006, more than 190 TF in 2007

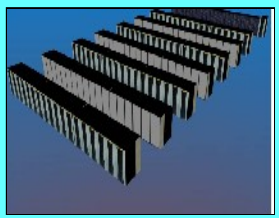
AIX IBM domain


RZG (DE)


IDRIS (FR)

LINUX SGI


SARA (NL)


LRZ (DE)


ECMWF (UK)

High Performance Common Global File System

LINUX Power-PC

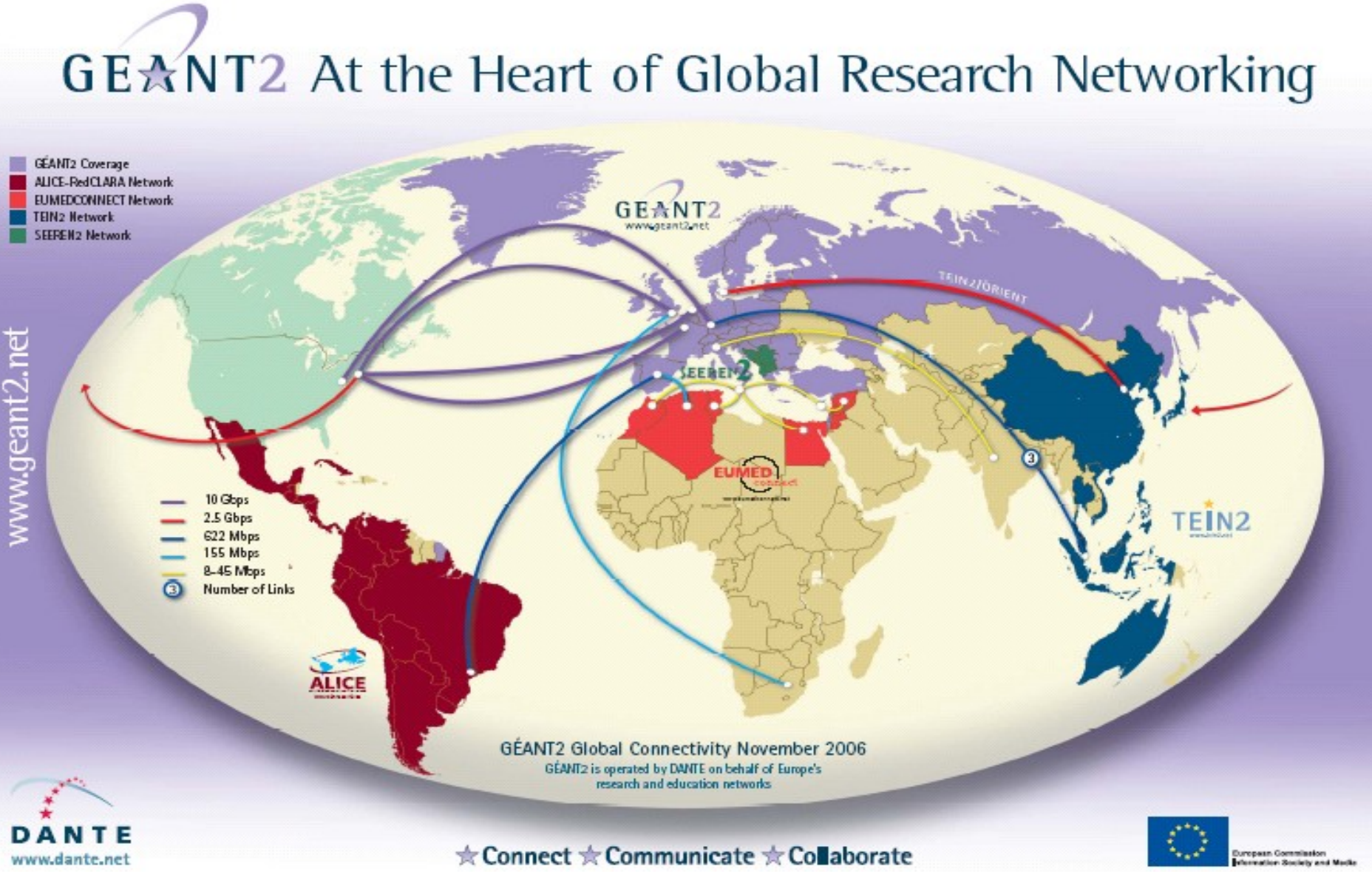

CSC (FI)


CINECA (IT)


FZJ (DE)


BSC (ES)

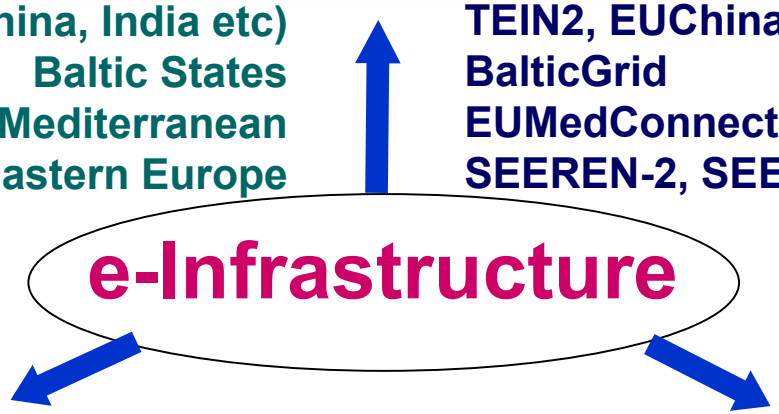
GÉANT: linking the world



Portfolio of projects

Geographical expansion of collaboration

Eastern Europe, NIS, Caucasus	OCCASION, PORTA OPTICA STUDY
Latin America	ALICE, EELA, AUGERACCESS
Asia (China, India etc)	TEIN2, EUChinaGrid, EC-GIN, Orient, EUIndiaGrid
Baltic States	BalticGrid
Mediterranean	EUMedConnect, EUMedGrid, ITHANET
South-Eastern Europe	SEEREN-2, SEEGRID-2



New Applications

Molecular, Clinical	ITHANET
Bioinformatics, Biology	BioInfoGrid
Civil Protection	CYCLOPS
Astronomy	EuroVO-DCA, EXPRES
Earth science	DEGREE
Chemical	Chemomentum
Industrial Applications	SIMDAT
Grids/GÉANT & DLs	DILIGENT,DRIVER
Applications on IPv6	6DISS, IPv6TF

Support, Enhancements

Synergy, Outreach, Training	BELIEF,Go4IT,Iceage
Security, Policy support	ISSeG, E-IRGSP
SW-interoperability, testing	OMII-Europe, ETICS
Grid services *(interactive, workflow-centric, quasi-supercomputing,…)*	int.eu.grid, KnowARC Chemomentum QosCosGrid
Control remote instruments	GridCC, RINGrid
Traffic Monitoring, e2e QoS	Lobster, Phosphorus
Optical networks	MUPPED
Connected Test-beds/NREN	EUROLabs, WEIRD

e-Infrastructures in the press

e-Infrastructures in the press

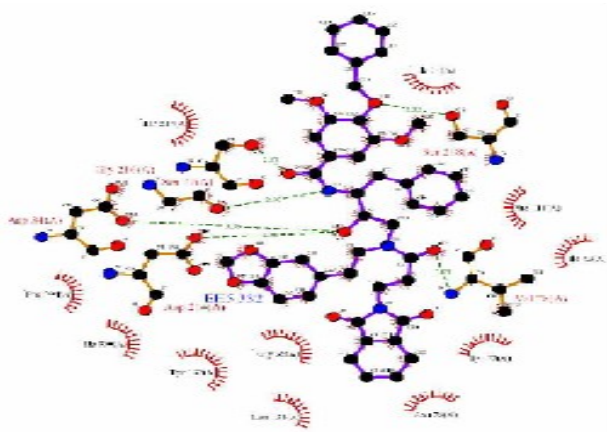
Global weather forecast system uses power of GÉANT to share data and resources (Nov 2005)

The planned Global Interactive Forecasting System (GIFS), to become operational by 2008, aims to improve weather prediction speed and accuracy, reducing the effects of extreme weather on the developed and developing world. GIFS relies on GÉANT2 to transmit as much as 500 Gb of data daily between distributed researchers – the equivalent of over 700 CDs worth of information.

e-Infrastructures in the press

EGEE battles Malaria with Grid Wisdom (Feb 2007)

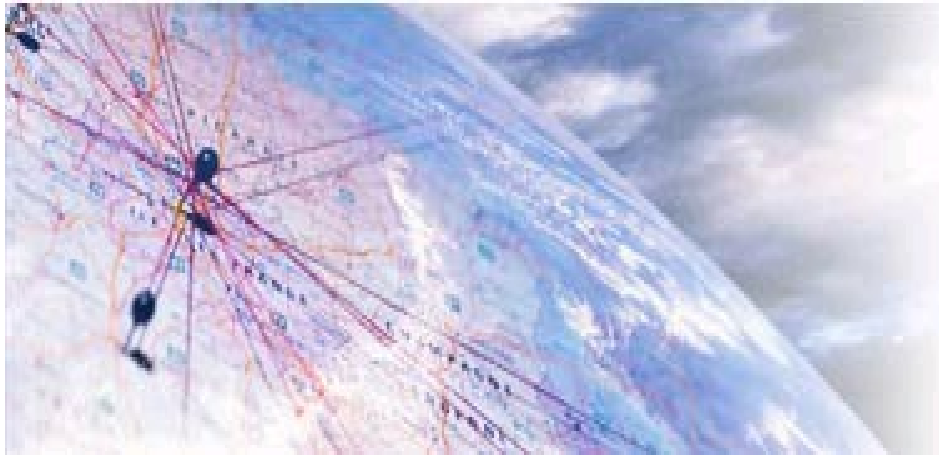
Using the EGEE grid infrastructure, scientists of the WISDOM project analysed an average of 80,000 possible drug compounds against malaria every hour. In total, the challenge processed over 140 million compounds. Up to 5000 computers were used simultaneously across more than 15 countries, generating a total of 2000 GB (2,000,000,000,000 bytes) of useful data.



e-Infrastructures in the press

The US TeraGrid and the EU DEISA Supercomputing infrastructures linked by a common wide-area global file system (Dec 2005)

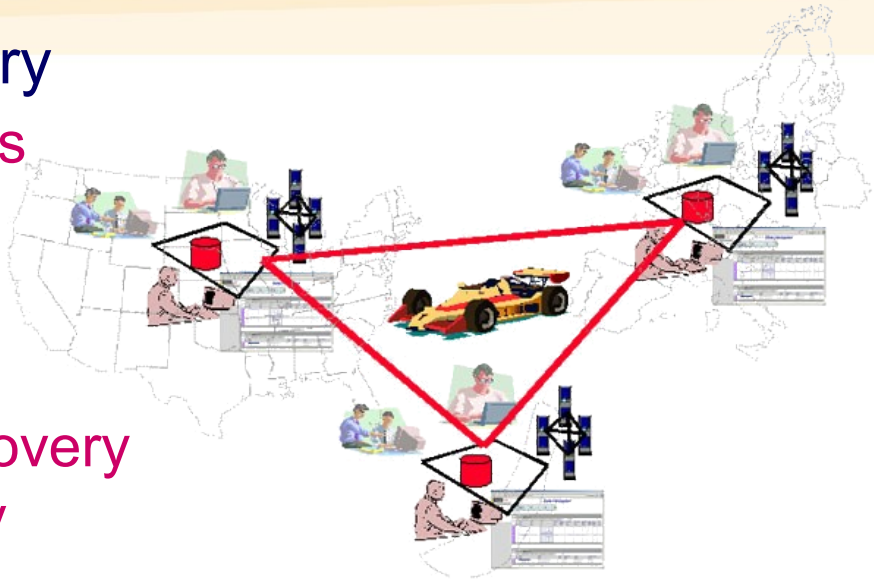
Through this link any scientist, accessing TeraGrid from the US, or accessing DEISA from Europe can directly and transparently create or access data stored in the now common file system of TeraGrid and DEISA with one common file address space



Grid project SIMDAT

Grid Solutions for Complex Problems in Industry

2. Grid-enabled data integration across administrative domains
3. Grid-powered collaboration across manufacturers and suppliers
4. Novel analysis and knowledge discovery services exploiting Grid connectivity



Grid Technologists

FhG, NEC, intel, iT innovation, IBM, ORACLE, Universität Karlsruhe (TH)

Capability Providers

ESI GROUP, InforSense, MSC SOFTWARE, lms, LION, ontoprise

Automotive
Pharmaceutical
Aerospace
Meteorology

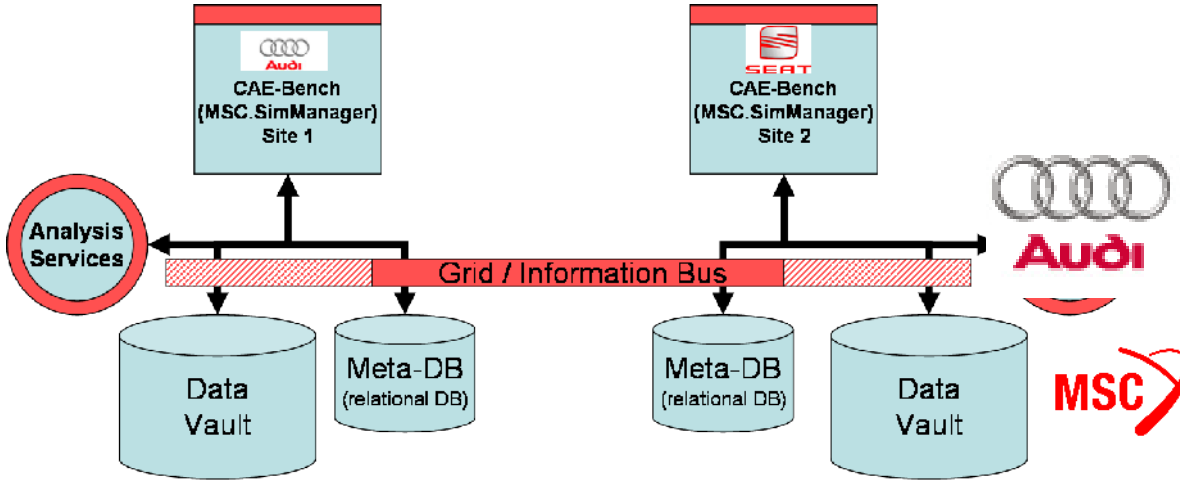
End Users

gsk, Audi, EADS, Met Office, RENAULT, EUMETSAT, METEO FRANCE, DWD, BAE SYSTEMS

e-Infrastructures in the press: SIMDAT successes

Successful installation of Grids including integrated access to distributed data repositories in seven industrially led prototypes

- Grid technology development on collaboration to be deployed in the next phase prototypes
- One prototype already fed into a new product:
  Grid-based integration environment for the automotive industry decided to be deployed at AUDI and SEAT in 2007

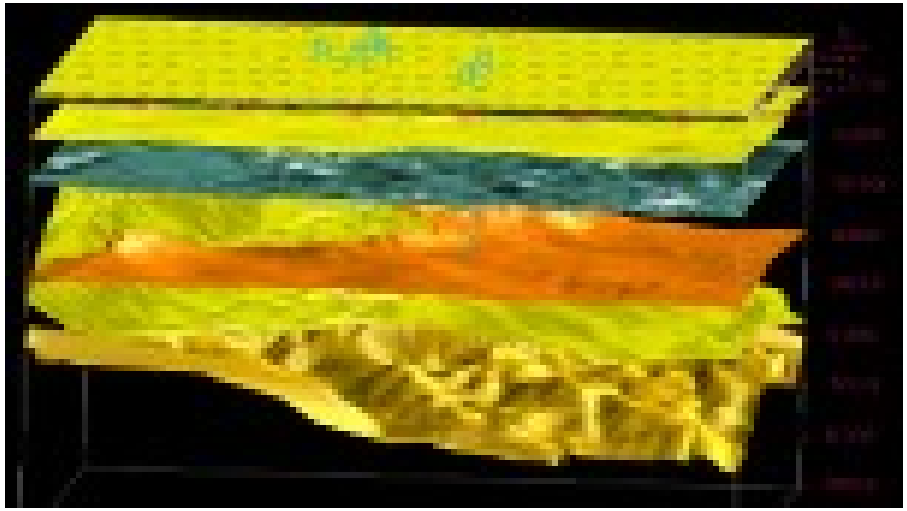


Transferred within Volkswagen Group to SEAT Spain

e-Infrastructures in the press

Industrial application running on EGEE (Mar 2005)

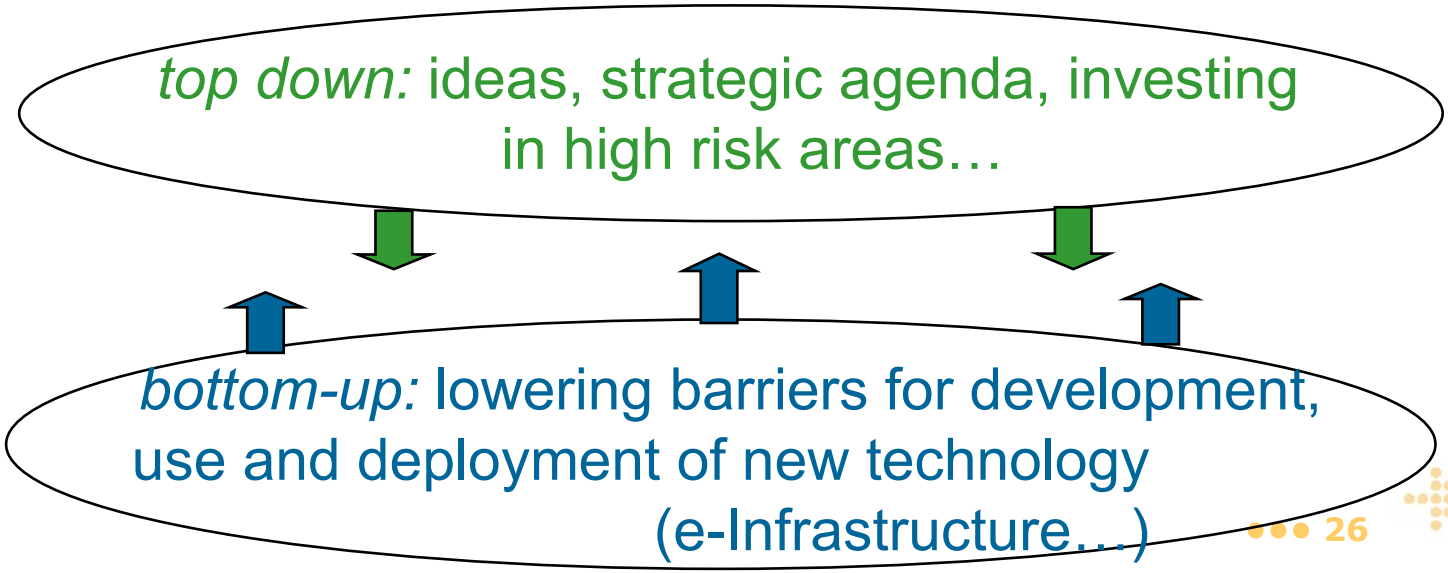
Geocluster (industry seismic processing solution developed and marketed by the Companie Générale de Géophysique in France, a supplier of products and services to the worldwide Oil and Gas, Mining and Environmental industries) is running as an application on EGEE



e-Infrastructures in FP7

FP7: a comprehensive approach

- Cooperation Programme:
  - **Investing in high risk research areas**
  - **Strategic orientation and agendas (European Technology Platforms…)**
- Ideas: **"Frontier research" activity**
- People: **Developing & strengthening human potential of European research**
- Capacities Programme:
  - **Enhancing research and innovation capacity throughout Europe (RIs, innovation capacity of SMEs, convergence, bridging science & society, research policies, international cooperation)**

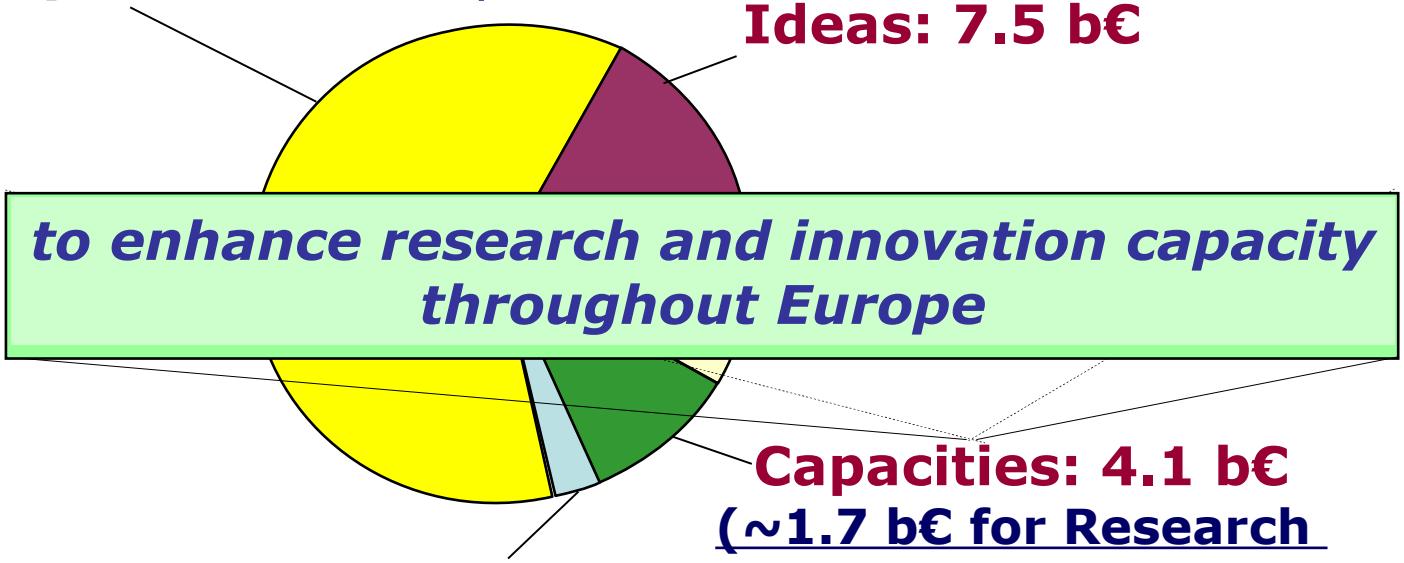


FP7 Capacities Programme 2007-2013

Total: 50582 m€

Cooperation: 32.4 b€
(8.8 b€ for ICT)

Ideas: 7.5 b€



Capacities: 4.1 b€
(~1.7 b€ for Research Infrastructures [RI] including ~0.57 b€ for e-Infrastructures)

JRC: 1.8 b€

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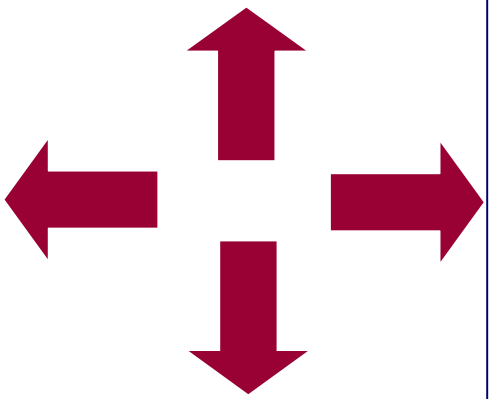
e-Infrastructure: main orientations in FP7

Support the further evolution and deployment of grid and networking infrastructures

Foster the creation of a new generation of HPC facilities in Europe (petaflop scale)



Promote a coordinated and federated approach in the deployment of data infrastructures to enable researchers to effectively aggregate and combine information to generate and share knowledge

Support emergence of new organisational models for service provisioning in domain of grid & data infrastructures (application & resource provider neutral)

Foster adoption of e-Infrastructures by user communities

Support resource sharing policy initiatives (e-IRG…)

Promote international cooperation

Conclusions

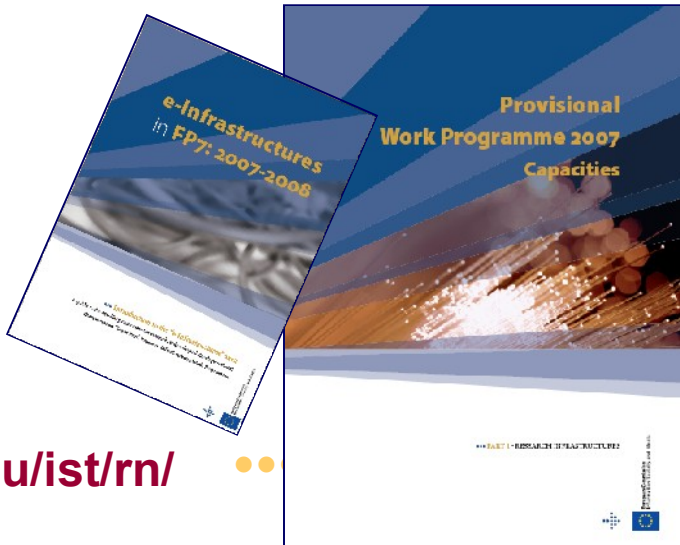
- Need to optimise entire society for innovation, not only organisations
- Increase investment in ICT
  (Viviane Reding, EU Commissioner: "Only through stronger investment in ICT research & effective cross-border competition we will ensure that the great potential of ICT is used to lift our competitive performance across the economy")
- e-Infrastructure:
  - built to address needs of modern science and engineering
  - integrates broad range of technologies, services, actors
  - supports and complements strategic ICT-research agendas
  - unique platform boosting research intensity and enhancing innovation capacity
- Ensuring sustainability, interoperability and openness, alignment of policies, training, and efficient governance and evolution of the e-Infrastructure model across the whole Europe are important FP7-priorities calling all stakeholders to action

Some recommendations proposed to be adopted by the e-IRG

- Build an efficient and sustainable governance model for the whole e-Infrastructure and not only for its parts (e.g. networking, data, computing issues need to be dealt with in more integrated ways)
- Legal, financial and societal aspects in the context of the e-Infrastructure will need to be addressed more intensively in the future
- Build stronger liaison between the European Technology Platforms and the e-Infrastructure teams
- The e-Infrastructure to address the common ICT-based needs of the new RIs that are identified in the relevant roadmap of the European Strategy Forum for Research Infrastructures (ESFRI)

e-infrastructure

- **Connecting the finest minds**
- **Sharing the best scientific resources**
- **Building virtual global research communities**



Information on calls: www.cordis.europa.eu

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