Partnership for Advanced Computing in Europe

http://www.prace-project.eu/

CESGA-FINIS TERRAE COMPUTATIONAL SCIENCE CONFERENCE

Santiago de Compostela 12th June 2008

Leif Laaksonen

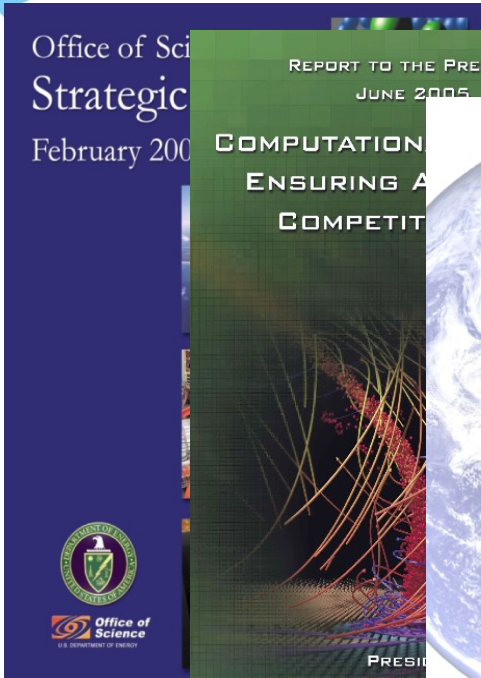CSC – the Finnish IT center for science
Finland

e-infrastructure

Worldwide: HPC brings change in science and engineering

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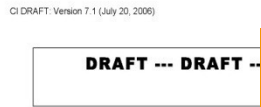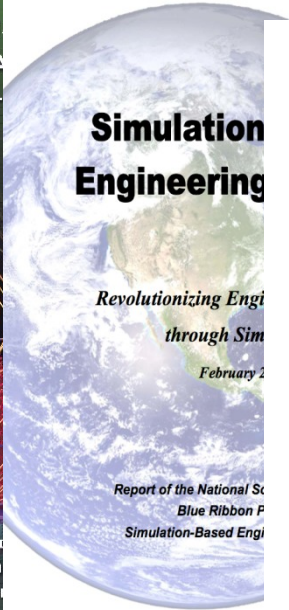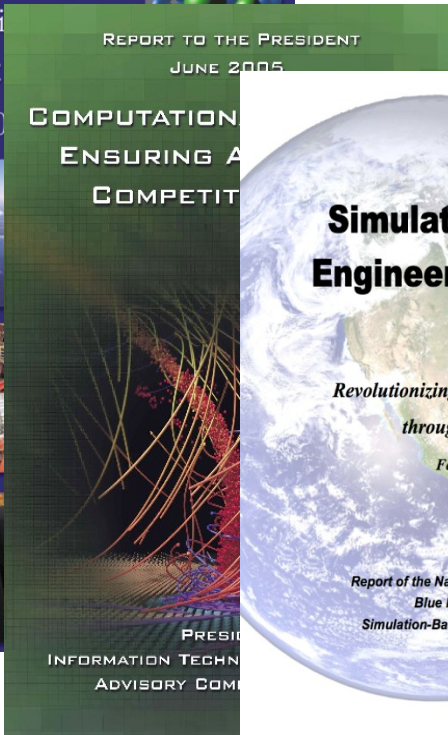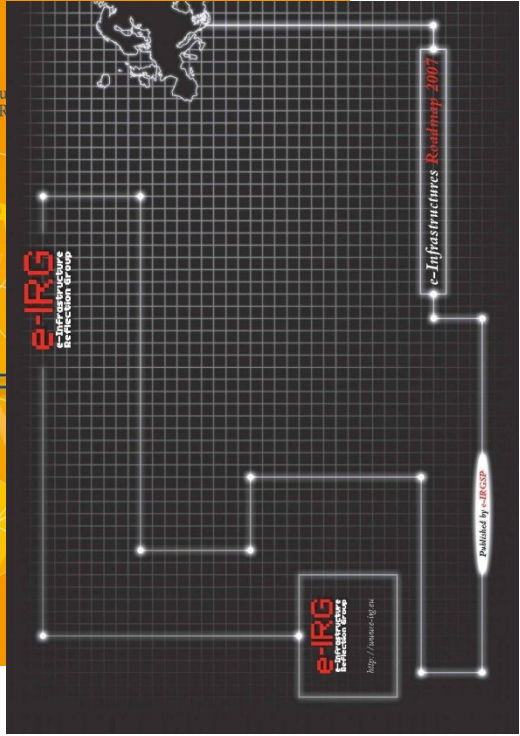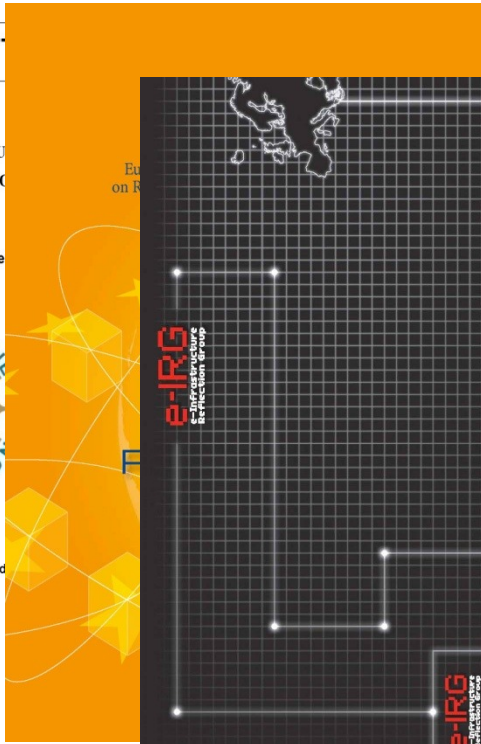
Aggregate TOP500 LINPACK performance in Petaflop/s
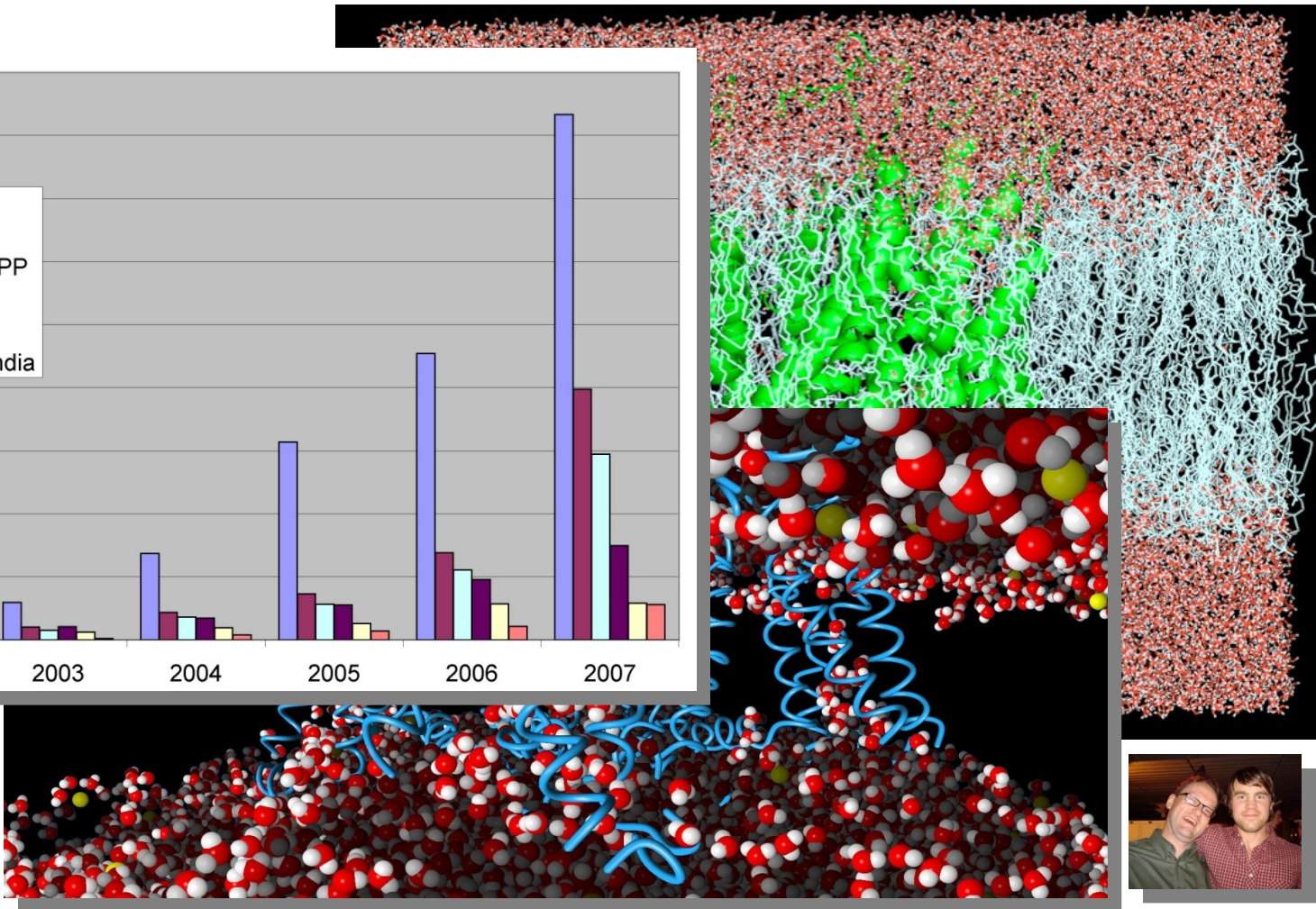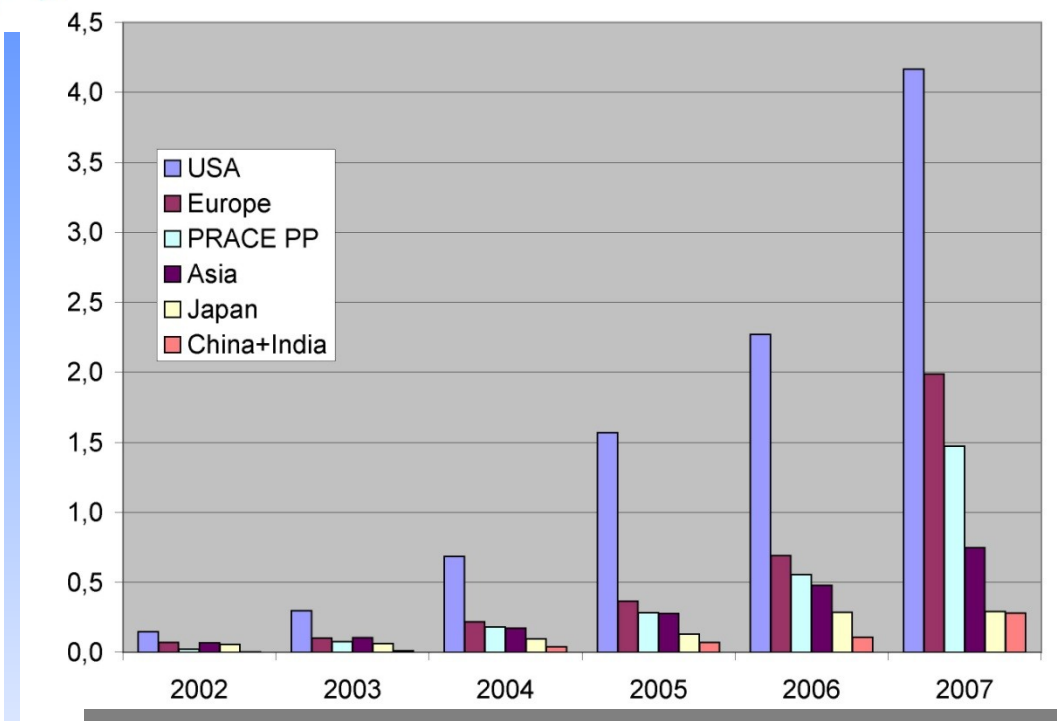
Acknowledgment: assistant prof. Erik Lindahl, Stockholm University and prof. Ilpo Vattulainen, Tampere University of Technology; Ion Channel simulation with 120000 atoms. Visualisation by Jyrki Hokkanen, CSC.

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HPC now in European Research Infrastructures Roadmap

The European HPC infrastructure need was recognized in the **ESFRI** Roadmap (2006)

- Estimated construction cost of 200-400 M€
- Indicative running cost of 100–200 M€ / year

The PRACE Initiative

- **The PRACE MoU signed now by the representatives of 16 European countries**

- **The goals:**
    - " Prepare an European structure funding and operating a permanent Tier 0 HPC Infrastructure
    - " Provide a smooth insertion in the European HPC Ecosystem of national and topical centres, networking incl. GEANT and DEISA, user groups and communities.
    - " Joint endeavours, incl. a FP7 « Preparatory Phase ».
    - " Promote the most effective use of Numerical Simulation at the leading edge
    - " Promote European presence and competitiveness in HPC

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The Vision:

- From cooperative High Performance Computing in Europe to leadership class **European HPC facilities** integrated in a High Performance Computing European Consortium.

The Mission:

- Creation of a persistent pan-European HPC service, consisting of few tier-0 centres providing European researchers with access to capability computers and forming the top level of the European HPC ecosystem.

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14 countries committed to providing European scientists with top level HPC resources.

Now 16 countries!

PRACE is embedded in the European Ecosystem

European
HPC centers

National/regional centers
Grid-collaboration

Local centers
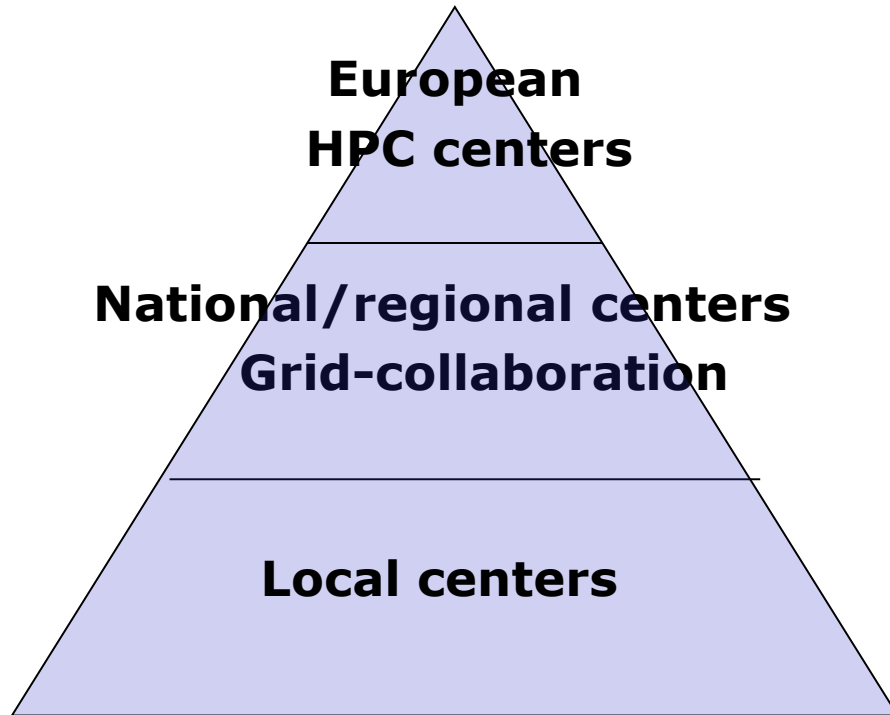
- In addition to providing sufficient resources in each of the Tier-layers, it is important to enable flexible and efficient interoperability

- The European back-bone network (GÉANT) is a critical component

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PRACE Project start

- **FP7 Call for Research Infrastructures**
  - Project started 1/1/08 with a duration of 2yr
  - Coordinator A. Bachem, FZ Jülich

Partnership for Advanced Computing in Europe

Supercomputers are indispensable tools for solving the most challenging and complex scientific and technological problems through simulations. To remain internationally competitive, European scientists and engineers must be provided access to leadership-class supercomputer systems. The Partnership for Advanced Computing in Europe will create a persistent pan-European high performance computing (HPC) service and infrastructure. This infrastructure will be managed as a single European entity. European scientists and technologists will be provided world-class leadership supercomputers with capabilities equal to or better than those available in the USA and Japan. The service will comprise three to five superior HPC centers strengthened by regional and national supercomputing centers working in tight collaboration through grid technologies. In other words, the partnership will become a unique entity of the pan-European HPC ecosystem.

Tasks summary:
- Management
- Organisational concept of RI
- Dissemination, training & outreach
- Distributed system management
- Deployment of prototype systems
- Petascaling & Benchmarking of appls.
- Petaflop/s system for 2010
- Future HPC technologies beyond 2010

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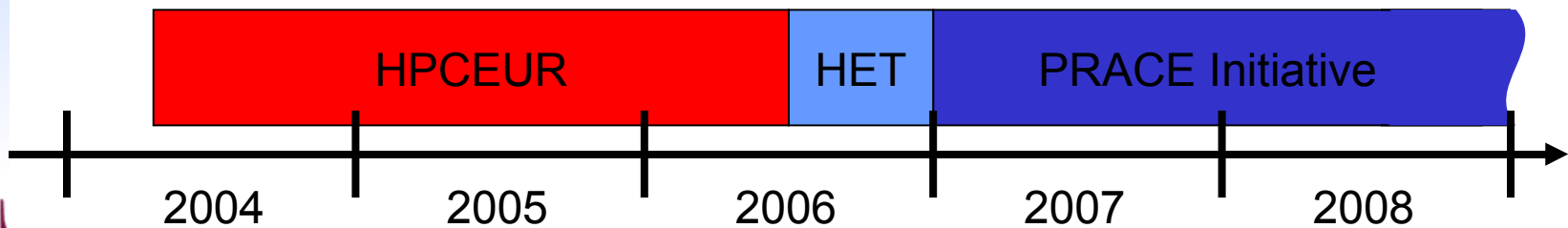Production of the HPC part of the ESFRI Roadmap; Creation of a vision, involving 15 European countries

Signature of the MoU

Submission of the project proposal

Bringing scientists together Creation of the Scientific Case

Approval of the project Kick-off

| HPCEUR | HET | PRACE Initiative |

2004   2005   2006   2007   2008

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Consortium members

1 (Coord.)	Forschungszentrum Juelich GmbH	FZJ	Germany
2	Universität Stuttgart – HLRS	USTUTT-HLRS	Germany
3	LRZ der Bay. Akademie der Wissenschaften	BADW-LRZ	Germany
4	Grand Equipement national pour le Calcul I.	GENCI	France
5	Engineering and Phys. Sciences Research C.	EPSRC	United Kingdom
6	Barcelona Supercomputing Center	BSC	Spain
7	CSC Scientific Computing Ltd.	CSC	Finland
8	ETH Zürich - CSCS	ETHZ	Switzerland
9	Netherlands Computing Facilities Foundation	NCF	Netherlands
10	Joh. Kepler Universitaet Linz	GUP	Austria
11	Swedish National Infrastructure for Comp.	SNIC	Sweden
12	CINECA Consorzio Interuniversitario	CINECA	Italy
13	Poznan Supercomputing and Networking C.	PSNC	Poland
14	UNINETT Sigma AS	SIGMA	Norway
15	Greek Research and Technology Network	GRNET	Greece
16	Universidade de Coimbra	UC-LCA	Portugal

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Project objectives

- Prepare creation of a persistent pan-European High Performance Computing (HPC) service
  - Provide European researchers with world-class computing resources
  - Establish the top-level of the European HPC ecosystem involving national, regional and topical HPC centres
  - Deploy several leadership systems at selected tier-0 centres

- 14 European Countries participate
  - Several are willing to fund and operate a tier-0 centre

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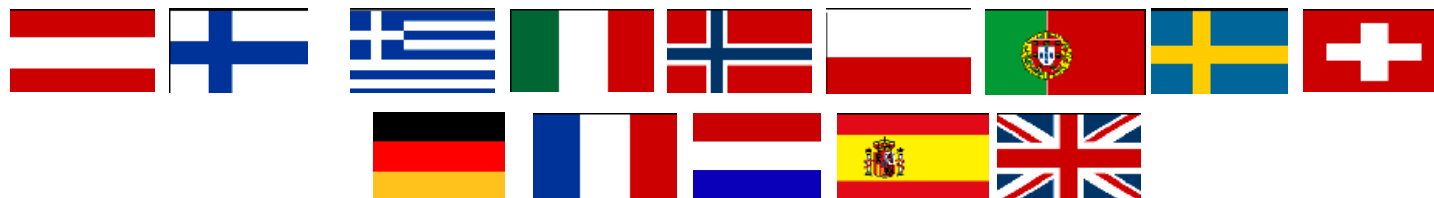
PRACE – Project Consortium

GCS
Gauss Centre for Supercomputing

GENCI

EPSRC

BSC Barcelona Supercomputing Center
Centro Nacional de Supe

NWO

Principal Partners

tier 0

tier 1

CSCS
Swiss National Supercomputing Centre

CINECA
Consorzio Interuniversitario

CSC

General Partners

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Funding base

- Preparatory phase project funding 20 MEUR
  - 10 MEUR EU
  - 10 MEUR consortium (14 countries)
  - Including work (person months) in 8 work packages, costs related to prototyping, dissemination and legal work in building the infrastructure
- Commitment from the Countries. Example: Finnish input
  - 114 person months
  - Aiming at hosting a prototype
- Construction costs
  - Depending on the number of centers
  - 500 MEUR (100-200 MEUR per center) for three centers, costs still estimates which will be more accurate during the preparatory phase project
  - Finnish funding (as also in other countries) still open, no commitments
  - Principal partners (5) aiming at hosting the petaflop computing (initial estimation: +100 MEUR national funding) and general partners with less (still undefined amount of) funding commitment
 - Cost structure will be defined during the preparatory phase

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Work plan outline

- **Preparation of the RI as a single legal entity**
  - Legal form and governance structure, funding, procurement, and usage strategy, Peer Review process
  - HPC Ecosystem links: European and national HPC infrastructures e.g. DEISA, the ESFRI projects, EGEE and EGI, communities, vendors and user industries, …

- **Prepare operation of petascale systems in 2009/2010**
  - Deployment and benchmarking of prototypes
  - Porting, optimising, petascaling of applications
  - Start a process of technology development and assessment for future multi-petascale systems

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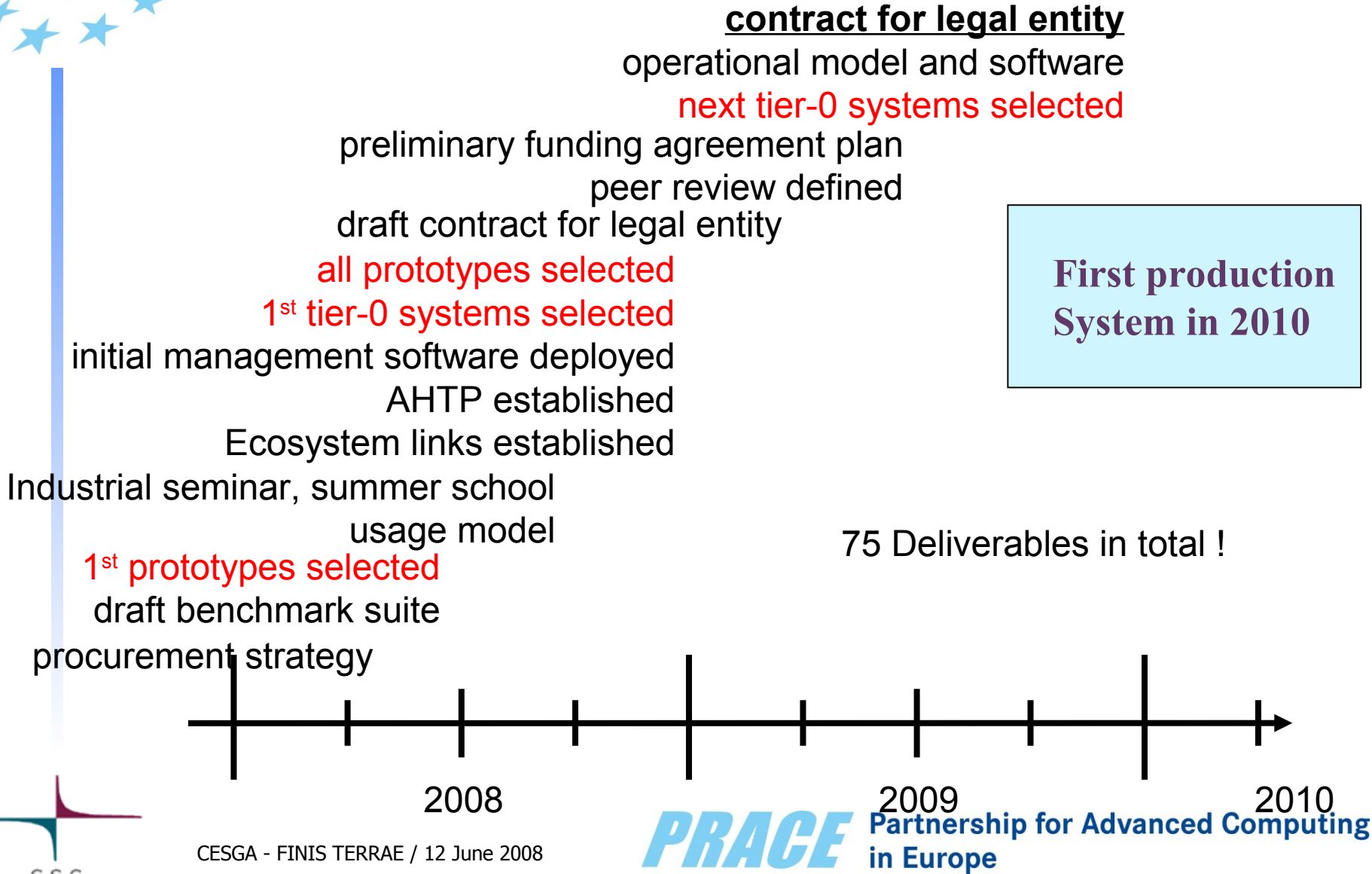
EGEE sites also partners or being partner related sites in PRACE

PRACE interoperability statement

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Standards related work

- PRACE intends to contribute to the international standards process through requirements and best practices
- Standards are required for the interoperation
  - Between tier-0 centre of the PRACE RI
  - With national, regional or institutional HPC services
  - Seamless Grid Access to the RI
- Interoperation requires harmonisation or standardisation e.g. in the areas of
  - User administration and AAA
  - Distributed data management
  - Grid Access
  - Inter-site trust and security
  - Monitoring
  - Resource management

- PRACE will cooperate with other EU projects in these areas
  - Utilising existing technologies e.g. from DEISA
  - Confirmed: DEISA, HPC-Europa, OMII-Europe, EGI, …

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Relevant policy bodies
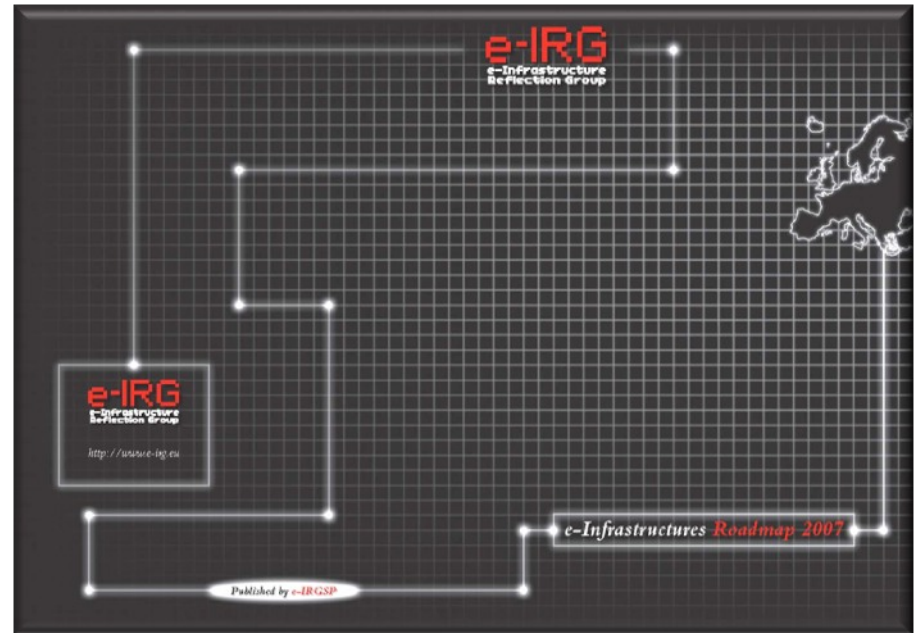
Developing World-class Research Infrastructures for the European Research Area (ERA)
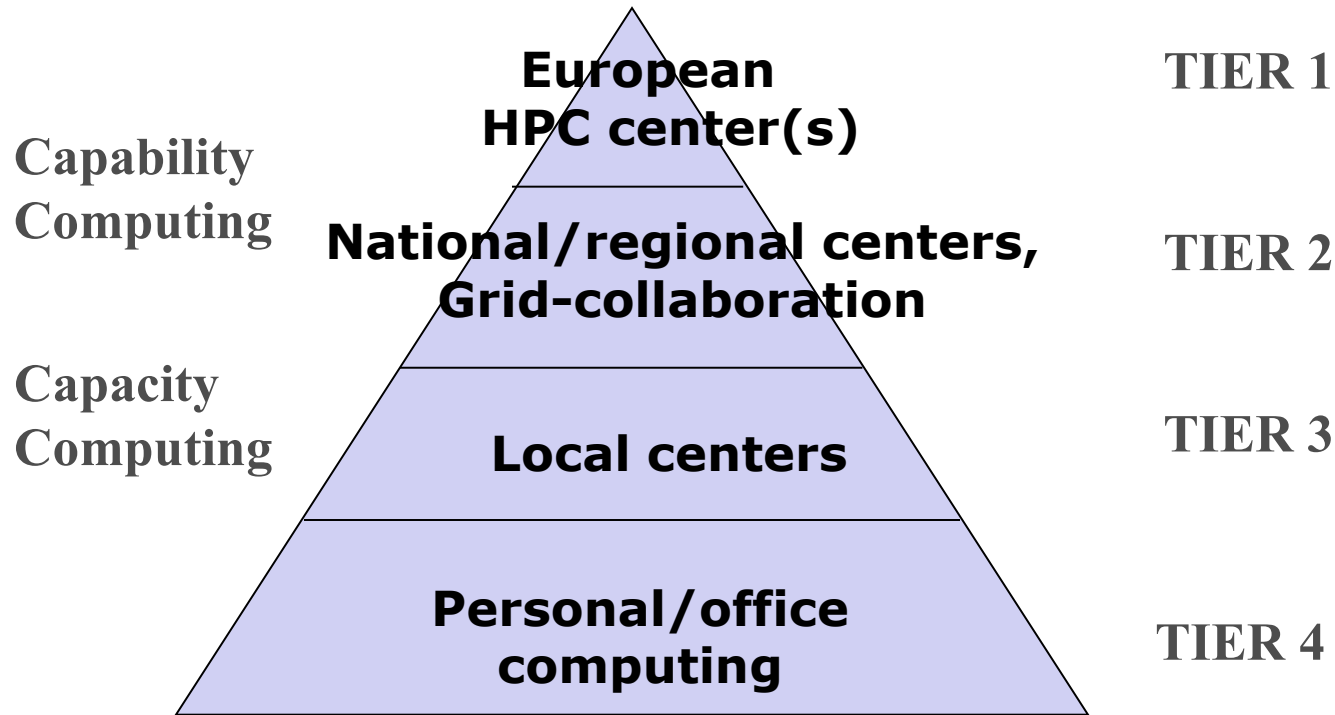
Report of the ERA Expert Group

- Europe should reinforce an e-Infrastructure strategy able to boost the creation of virtual collaborative communities of researchers, ensuring the inclusion and participation of students and researchers from all around Europe.

- A coherent and managed layer of scholarly and academic research resources (including research outputs and data) by bringing together Europe's research repositories.

- An adequate and coordinated high-performance computing provision ecosystem and smooth access to its services.

- Generic virtual presence tools able to facilitate virtual research communities.

- Education and training programmes should be put in place to accelerate the exploitation of the e-Infrastructures by younger researchers and to improve the availability to wider user communities.

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C S C

Performance Pyramid

European
HPC center(s)   TIER 1

**Capability
Computing**

National/regional centers,   TIER 2
Grid-collaboration

**Capacity
Computing**

Local centers   TIER 3

Personal/office   TIER 4
computing

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HPC Ecosystem to support the top

- The upper layers of the pyramid
  - HPC centers / services
  - European projects (HPC/Grid, networking, …)
- Activities which enable efficient usage of upper layers
  - Inclusion of national HPC infrastructures
  - Software development and scalability issues
  - Competence development
- Interoperability between the layers

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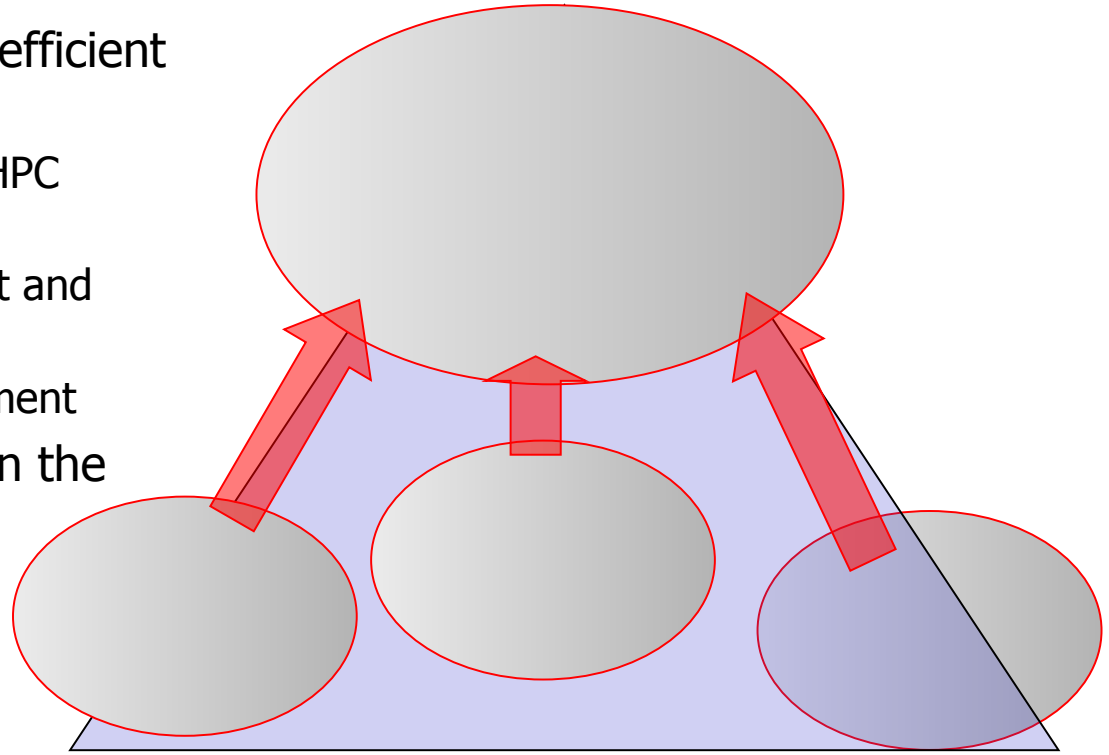
Need to remember about petaflop/s...

- What do you mean with petaflop/s?
    1. Theoretical petaflop/s?
    2. LINPACK petaflop/s?
    3. Sustained petaflop/s for a single extremely parallel application?
    4. Sustained petaflop/s for multiple parallel applications?
- Note that between 1 and 4 there might be several years

- Development is unambiguously in the direction of petaflop/s computers and further.

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Main players in European HPC Ecosystem

- ESFRI Roadmap and 35 new research infrastructures
- PRACE – Petaflop computing centers
- EU-supported infrastructure projects, such as EGEE, DEISA, GEANT2 and OMII-Europe
- European Grid Initiative, EGI
- Policy groups, such as ESFRI and e-IRG
- Regional activities, such as NDGF in North Europe
- National Infrastructures and Initiatives (NGI)
- International centers, such as CERN, EBI and ECMWF
- User communities with HPC requirements, such as material science, high energy physics, fusion and climate

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Some Key Issues

- Sustainability in performance and finance
  - EGEE and DEISA are projects with an end
  - PRACE and EGI are targeted to be sustainable with no definitive end
- ESFRI and e-IRG in the policy fields
  - How do the research side and infrastructure side work together?
  - Two-directional input requested
- Requirement for creation of horizontal services
  - Let's not create disciplinary IT silos
  - Synergy required for cost efficiency and excellence
- ICT infrastructure is essential for research
  - The role of computational science is increasingly growing
- Renewal and competence through training and education
  - Will Europe run out of competent people?
  - Will training and education programs react fast enough?

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Policy overview and trends...

- "Europe has taken a major step forward in the development of a more coordinated approach for policy-making in the field of RIs with the establishment of the European Strategic Forum on Research Infrastructures (ESFRI), the e-Infrastructure Reflection Group (e-IRG),

- the release of the first ever European Roadmap for Research Infrastructures and by establishing the 'preparatory phase' instrument within FP7 which aims to facilitate the construction or upgrade of some of the ESFRI roadmap RIs."

- "Continuous investments in e-infrastructures and ICT provide competitive European advantages and serve as excellent examples of how coordination and cooperation on a European level, paired with major research infrastructure advances, can dramatically change the way research work is being conducted."

Developing World-class Research Infrastructures for the European Research Area (ERA) - Report of the ERA Expert Group, European Commission, 2008.

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New market for European HPC

- 35 ESFRI list new research infrastructure projects, most of them starting a preparatory phase project late 2007
    - 1-4 years
    - 1-7 MEUR * 2 (petaflop computing 10 MEUR * 2)
- Successful new research infrastructures start construction 2009-2011
    - 10-1000 MEUR per infrastructure
- Existing infrastructures are also growing
- Results:
    - Growing RI market, considerably rising funding volume
    - Need for horizontal activities (computing, data, networks, computational methods and scalability, application development,…)
    - Real danger to build disciplinary silos instead of searching IT synergies

DISCIPLINARY INFRASTRUCTURES

HORIZONTAL ICT: PRACE ETC.

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