HPC is a “Key Technology”

- Supercomputers are the tool for solving most challenging problems through simulations
- Access to capability computers of leadership class is essential for international competitiveness in science and engineering
- Providing competitive HPC services is a continuous endeavor
- This has been acknowledged by leading industry nations such as USA and Japan since the 1990’s
- And in Europe?
Europe’s current position in HPC

Aggregated LINPACK Performance
in PetaFlops in November Top 500 Lists

75% of European HPC-power is within PRACE
PRACE: The European Access to HPC-Technology
6 years technology advantage with a #1 system

after 12 years the power is on the desk
Computational science infrastructure in Europe

The European Roadmap for Research Infrastructures is the first comprehensive definition at the European level.

Research Infrastructures are one of the crucial pillars of the European Research Area.

A European HPC service – impact foreseen:
- strategic competitiveness
- attractiveness for researchers
- supporting industrial development
The ESFRI Vision for a European HPC service

- European HPC-facilities at the top of an HPC provisioning pyramid
  - Tier-0: 3-5 European Centres
  - Tier-1: National Centres
  - Tier-2: Regional/University Centres

- Creation of a European HPC ecosystem involving all stakeholders
  - HPC service providers on all tiers
  - Grid Infrastructures
  - Scientific and industrial user communities
  - The European HPC hard- and software industry
ESFRI – Estimated costs

- Unlike other European Research Infrastructures:
  - Tier-0 resources have to be renewed every 2-3 years
  - Construction cost 200 – 400 Mio. € every 2-3 years
  - Annual running cost 100 – 200 Mio. €

- A truly European challenge – also in terms of funding

- PRACE – The Partnership for Advanced Computing in Europe
  - An Initiative created to implement the ESFRI vision of a European HPC service
First Steps and Achievements

- Production of the HPC part of the ESFRI Roadmap; Creation of a vision, involving 15 European countries
- Bringing scientists together
- Creation of the Scientific Case
- Signature of the MoU
- Submission of an FP7 project proposal
- Approval of the project
- Project start
- 2004
- 2005
- 2006
- 2007
- 2008
- HPCEUR
- HET
- PRACE Initiative
First Steps and Achievements

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

Bringing scientists together
Creation of the Scientific Case

- 2004
- 2005
- 2006
- 2007
- 2008
HET: The Scientific Case

- **Weather, Climatology, Earth Science**
  - degree of warming, scenarios for our future climate.
  - understand and predict ocean properties and variations
  - weather and flood events

- **Astrophysics, Elementary particle physics, Plasma physics**
  - systems, structures which span a large range of different length and time scales
  - quantum field theories like QCD, ITER

- **Material Science, Chemistry, Nanoscience**
  - understanding complex materials, complex chemistry, nanoscience
  - the determination of electronic and transport properties

- **Life Science**
  - system biology, chromatin dynamics, large scale protein dynamics, protein association and aggregation, supramolecular systems, medicine

- **Engineering**
  - complex helicopter simulation, biomedical flows, gas turbines and internal combustion engines, forest fires, green aircraft,
  - virtual power plant
### Status and Requirements, e.g.: German Case

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<tr>
<td>Plasma Physics</td>
<td>10</td>
<td>50</td>
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A. Bode, W. Hillebrandt, and Th. Lippert: German Scientific Case for the BMBF, 8/2005
Supercomputing Drives Science through Simulation

- Environment: Weather/ Climatology, Pollution / Ozone Hole
- Ageing Society: Medicine, Biology
- Materials/ Inf. Tech: Spintronics, Nano-science
- Energy: Plasma Physics, Fuel Cells
First Steps and Achievements

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

- Bringing scientists together
- Creation of the Scientific Case

- Signature of the MoU
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- Submission of an FP7 project proposal

Timeline:
- 2004
- 2005
- 2006
- 2007
- 2008

PRACE Initiative
PRACE – Project Facts

- Objectives of the PRACE Project:
  - Prepare the contracts to establish the PRACE permanent Research Infrastructure as a single Legal Entity in 2010 including governance, funding, procurement, and usage strategies.
  - Perform the technical work to prepare operation of the Tier-0 systems in 2009/2010 including deployment and benchmarking of prototypes for Petaflops systems and porting, optimising, peta-scaling of applications

- Project facts:
  - Partners: 16 Legal Entities from 14 countries
  - Project duration: January 2008 – December 2009
  - Project budget: 20 M € , EC funding: 10 M €

PRACE is funded in part by the EC under the FP7 Capacities programme grant agreement INFSO-RI-211528
PRACE – Project Consortium

New Partners - since May 2008 - of the PRACE Initiative:
The next tasks (I/II):

… growing into a persistent Research Infrastructure

- Define the legal form and governance
- Secure initial and continuous funding
- Prepare procurement and installation of the first Petaflops systems
- Establish the peer review process for academic usage
- Promote Europe wide collaboration between scientific communities using leading edge scientific simulation
- Encourage new projects to increase software and simulation competence
- Provide training and education and disseminate results
Project governance – a model for the RI
ERI – A new European Legal Framework

• ESFRI roadmap 2006: 35 Research Infrastructures to be established with high priority – 35 new legal entities
  – International Treaties, European Joint undertakings – hard to negotiate in the given timeframe
  – need for a new dedicated legal framework

• ERI – European Research Infrastructure
  – Nature: Scientific non-commercial character, EU flavour
  – Members: states or legal entities designated by them, non-European countries not excluded
  – Status: under construction by EC with involvement of all stakeholders
  – Timetable: Foreseen adoption by the Council by December 2008

• ERI – a promising option for the PRACE legal entity
HPC Ecosystem Links

User Communities
e.g. ESFRI Infrastructures

Letters of Support from:
- DEISA
- HPC-Europa

Letters of Support from:
- National Research Ministries of PRACE Partner countries
- European Science Foundation
- EGI
- OMII-Europe

Letters of Support from:
- PRACE
- Tier-1: National
- Tier-2: Regional

Letters of Support from:
- EdFA (Fusion)
- EMBL-EBI (Molecular Biology)
- ENES (Earth Sciences)
- ESA (Space Agency)
- MOLSIMU (Molecular Simulations)
- Psi-k (Electronic Structure)
- ETMC (Lattice QCD)

Grid Infrastructures

Overlapping user communities, interoperability

HPC Hardware and Software Industries

HPC service provisioning

Funding, governance

Requirements, scientific steering/peer review

Fostering European developments
HPC Services for the European Industry

- Usage of HPC technology in industry is 6-8 years behind technology frontier – as available to top research
- The USA undertakes to boost competitiveness of local industry by shortening this period
  - free-of-charge access to HPC resources through INCITE program
- PRACE is striving towards a similar model
  - Understand industrial needs
  - Raise awareness for competitive advantages of tier-0 HPC usage
  - Design a usage model suited for European industry and SMEs
- **1st PRACE Industrial Seminar: Amsterdam, Sept. 3-4, 2008**
HPC in the automotive industry
The virtual airplane

C³A²S²E
Center for Computer Applications in AeroSpace Science and Engineering

France: MOSART

Frontal
MareNostrum
Teratec

UK

CFMS
Centre for Fluid Mechanics Simulation
HPC and the finance sector

risk simulation

Insurance: simulating a flooding, a taifun, an eruption

financial modelling
The next tasks (II/II):

... growing into a persistent Research Infrastructure

- Identify architectures and vendors capable of delivering Petaflops systems by 2009/2010
- Install prototypes at partner sites to verify viability
- Define consistent operation models and evaluate management software
- Capture application requirements and create a benchmark suite
- Port, optimize and scale selected applications
- Define an open, permanent procurement process
- Define and implement a strategy for continuous HPC technology evaluation and system evolution within the RI
- Foster the development of components for future multi-petascale systems in cooperation with European and international HPC industry

- **Start a process of continuous development and cyclic procurement of technology, software and systems for the permanent PRACE Research Infrastructure**
Fostering European HPC Industry

- Most HPC vendors today are US- or Japan-based
- An independent access to HPC-technology is a strategic issue for Europe
- PRACE will foster European developments by
  - Translating user requirements to architectural specifications for future multi-petascale HPC systems
  - Supporting the creation of consortia of industrial and academic stakeholders to develop future components and systems
    - Europe-based and international companies with R&D activities in Europe
    - European HPC centres
  - Example: PROSPECT INTEL, IBM, QUADRICS, ParTec, BSC, DWD, FZJ, LRZ, …
  - Example: TALOS BULL, CEA, HLRS, INTEL, QUADRICS
PRACE Roadmap

Procurement of the first tier-0 systems
Legal form, funding, peer review defined
Prototype procurement
Creation of the legal entity providing the European Tier-0 HPC service

PRACE Project

PRACE Initiative

PRACE Research Infrastructure

Beginning of close cooperation

2007 2008 2009 2010 2011

DEISA, eDEISA, DEISA2 Projects
French – German HPC Cooperation

• Strategic Partnership of FZJ and CEA formed
  – MoU signed under patronage of Research Ministers at 3rd French – German Forum on Research in Paris, February 2008

• Supercomputing is a main subject of cooperation
  – Joint research on I/O, petascaling applications, energy efficiency
  – Joint proposal for a prototype of a Petaflops system for 2009/2010 within the PRACE project
  – The centres are willing to host two of the European tier-0 level HPC centres
Opportunities ahead

- **PRACE builds upon**
  - the HPC expertise of 14 European countries in HPC service provisioning and on projects like DEISA
  - the expressed support of our national governments, the European Commission and many scientific communities
  - an excellent team-spirit grown during the past years of HPCEUR, HET, PRACE and other joint endeavors

- **The time is right to**
  - boost competitiveness of European research and economy through HPC
  - create services to fulfill the HPC requirements of the upcoming ESFRI infrastructures
  - create and shape the European HPC ecosystem
About PRACE

- The aim of PRACE is to provide scientists in Europe with unlimited and independent access to fast supercomputers and competent support. PRACE prepares the creation of a persistent pan-European HPC service, consisting several tier-0 centres providing European researchers with access to capability computers and forming the top level of the European HPC ecosystem. PRACE is a project funded in part by the EU’s 7th Framework Programme. The following countries collaborate in the PRACE project: Germany, UK, France, Spain, Finland, Greece, Italy, Ireland, The Netherlands, Norway, Austria, Poland, Portugal, Sweden, Switzerland and Turkey. The PRACE project is coordinated by the Gauss Centre for Supercomputing (Germany), which bundles the activities of the three HPC centres in Jülich, Stuttgart, and Garching.

- [http://www.prace-project.eu/](http://www.prace-project.eu/)

- The PRACE project receives funding from the EU's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° RI-211528.