

# The European HPC Ecosystem for Extreme Computing

SOS11, Key West

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# Topics

- 1. Definitions, motivation and starting position**
- 2. Towards European petaflop computing: HPC in Europe Taskforce (HET)**
- 3. Practical implementation: Partnership for Advanced Computing in Europe (PACE)**
- 4. New HPC Ecosystem in Europe**
- 5. Some future scenarios and advice**

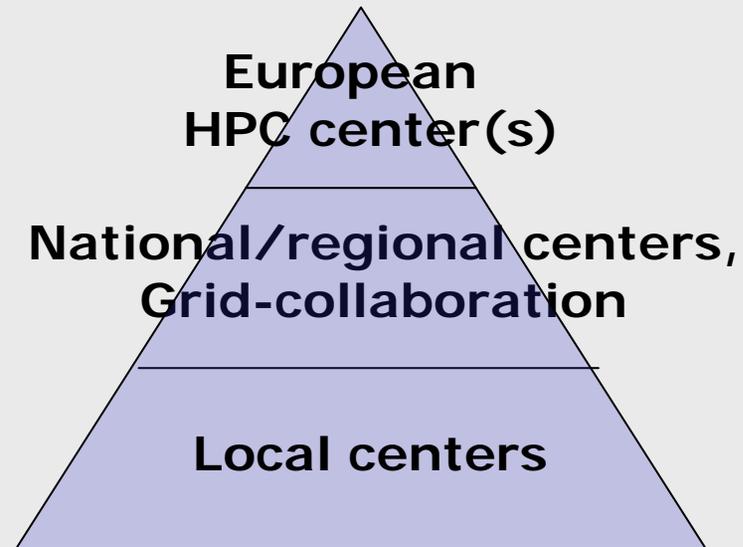
# Terminology and pointers

- **HPC**
  - High Performance Computing
- **HET**, <http://www.hpcineuropetaskforce.eu/>
  - High Performance Computing in Europe Taskforce, established in June 2006 with a mandate to draft a strategy for European HPC ecosystem
- **Petaflop/s**
  - Performance figure  $10^{15}$  floating point operations (calculations) in second
- **e-IRG**, <http://www.eirg.eu>
  - e-Infrastructure Reflection Group. e-IRG is supporting the creation of a framework (political, technological and administrative) for the easy and cost-effective shared use of distributed electronic resources across Europe - particularly for grid computing, storage and networking.
- **ESFRI**, <http://cordis.europa.eu/esfri/>
  - European Strategy Forum on Research Infrastructures. The role of ESFRI is to support a coherent approach to policy-making on research infrastructures in Europe, and to act as an incubator for international negotiations about concrete initiatives. In particular, ESFRI is preparing a European Roadmap for new research infrastructures of pan-European interest.

# Terminology and pointers (cont.)

- **PACE**
  - Partnership for Advanced Computing in Europe
  - EU FP7 project for preparatory phase in building the European petaflop computing centers, based on HET work
- **DEISA**, <https://www.deisa.org/>
  - Distributed European Infrastructure for Supercomputing Applications. DEISA is a consortium of leading national supercomputing centers that currently deploys and operates a persistent, production quality, distributed supercomputing environment with continental scope.
- **EGEE-II**, <http://www.eu-egee.org/>
  - Enabling Grid for E-science. The project provides researchers in academia and industry with access to a production level Grid infrastructure, independent of their geographic location.
- **EGI**, <http://www.eu-egi.org/>
  - An effort to establish a sustainable grid infrastructure in Europe
- **GÉANT2**, <http://www.geant2.net/>
  - Seventh generation of pan-European research and education network

# Performance Pyramid



# 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**
- **Petaflop/s hardware needs petaflop/s applications, which are not easy to program, or not even possible in many cases**
  - Do we even know how to scale over 100000 processors ...



# HPC in Europe Taskforce (HET)





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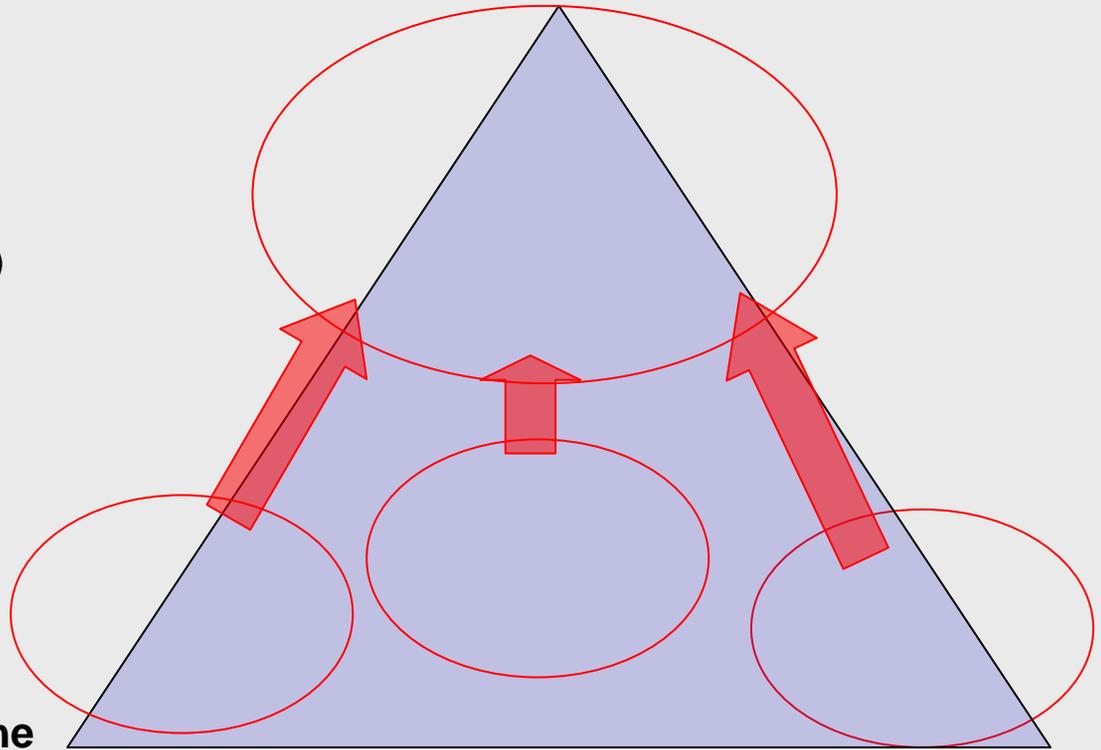
- **Temporary taskforce shaping the European strategy for petaflop computing**
- **Founded in June 2006**
- **Strategy work delivered in January 2007**
- **Members from 11 European countries**
- **Chaired by CSC, Finland**
  
- **Complete documentation available:**  
<http://www.hpcineuropetaskforce.eu/>





# HET Scope: HPC Ecosystem

- **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**





# HET outcome

- **Entry in ESFRI list for petaflop computing**
- **Papers:**
  - Scientific case for European HPC (most work done by previous HPCEUR project)
  - Proposal for funding models
  - Proposal for peer review process
  - Views for HPC Ecosystem
  - Summary paper with recommendations
- **Good team spirit with a common approach**
- **Basis for practical implementation**
  - Consortium for ESFRI Preparatory phase
  - Memorandum of Understanding for European Tier 0 HPC service

# Partnership for Advanced Computing in Europe (PACE)



# ***PACE*** Partnership for Advanced Computing in Europe



Signing of the MoU in Berlin 17.4.2007



# PACE

- **Target to build the basis for European petaflop/s centers, responding to the ESFRI Roadmap item 'European HPC Service'**
- **FP7 Project proposal for preparatory phase, call deadline 2.5.2007**
- **Memorandum of Understanding: 14 countries signed and more to come**
- **PACE consortium partners (14 countries)**
  - Austria, Finland, France, Germany, Greece, Italy, Norway, Poland, Portugal, Spain, Sweden, Switzerland, The Netherlands, United Kingdom



# What is going to happen with PACE?

- **Project proposal deadline was met and proposal is in**
- **If successful, project start assumed November-December 2007**
- **Two years, 10+10 MEUR volume**
- **Prototypes for petaflop computing during 2008-2009**
- **Construction of centers start 2009 aiming at first center operational in 2009-2010**
- **Open issues to be solved during the preparatory phase:**
  - Which companies to prototype and where to place them?
  - Who will host the petaflop centers?
  - Who will pay for construction?
  - Who can use the resources and under which conditions?
  - How to link with other projects, for example DEISA?



New HPC Ecosystem is about to start...



# European HPC after FP6

- **Multiple Grid projects with varying results – learning for collaboration**
- **Early experiences about interoperability between national HPC centers**
- **Communities start to form, in various levels**
- **Research community more active in computational science domain**
- **European Union targets in creating sustainable infrastructures**
- **Petaflop computing raised to European agenda, scientific case for high-end computing available**

# 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 synergy

# Targets for European HPC collaboration 2007 onwards

- **Continuation of existing grid projects (DEISA, EGEE ...) and development in GEANT2 network infrastructure**
- **Building European petaflop computing services integrated in the full HPC ecosystem according to the performance pyramid model (PACE)**
- **Maximal synergy between PACE and DEISA (integration after some time?)**
- **Interoperability between PACE and EGI/EGEE**
- **Building up research infrastructure services for ESFRI roadmap**
- **Target to establish an active European community for HPC: infrastructure, resource sharing, communication and collaboration over country borders**

# Advice for HPC vendors: Europe wants to develop HPC Ecosystem in Europe

- What can you do in Europe?
  - **Manufacturing**
  - **Research**
  - **Software development**
  - **Integration work**
  - **Training**
  - **Other**
- Pre-commercial procurement used increasingly
- Prototyping is part of the petaflop/s project, although the prototypes for tomorrow's petaflop systems are usually today's production systems
  - **Innovation is more in scalable software than hardware**