Planned Developments of High End Systems Around the World

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Planned Development of HPC

- Quick look at current state of HPC through the “eyes” of the Top500
- The Japanese Efforts
- The European Initiatives
- The state of China’s HPC
- India’s machine
H. Meuer, H. Simon, E. Strohmaier, & JD

- Listing of the 500 most powerful Computers in the World
- Yardstick: Rmax from LINPACK MPP
  \[ Ax=b, \text{ dense problem} \]

- Updated twice a year
  SC"xy in the States in November
  Meeting in Germany in June

- All data available from www.top500.org
Top500 Systems November 2007

![Graph showing performance and ranking of systems]

50 systems > 19 Tiflop/s
7 systems > 100 Tiflop/s
21 systems > 50 Tiflop/s
149 systems > 10 Tiflop/s

Rmax (Tflop/s)

5.9 Tiflop/s (~1.3K cores w/GigE)

30th Edition: The TOP10

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Computer</th>
<th>Rmax (TF/s)</th>
<th>Installation Site</th>
<th>Country</th>
<th>Year</th>
<th>#Cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 IBM</td>
<td>Blue Gene/L eServer Blue Gene Dual Core .7 GHz</td>
<td>478</td>
<td>DOE Lawrence Livermore Nat Lab</td>
<td>USA</td>
<td>2007</td>
<td>212,992</td>
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<tr>
<td>2 IBM</td>
<td>Blue Gene/P Quad Core .85 GHz</td>
<td>167</td>
<td>Forschungszentrum Jülich</td>
<td>Germany</td>
<td>2007</td>
<td>65,536</td>
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<tr>
<td>3 SGI</td>
<td>Altix ICE 8200 Xeon Quad Core 3 GHz</td>
<td>127</td>
<td>SGI/New Mexico Computing Applications Center</td>
<td>USA</td>
<td>2007</td>
<td>14,336</td>
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<tr>
<td>4 HP</td>
<td>Cluster Platform Xeon Dual Core 3 GHz</td>
<td>118</td>
<td>Computational Research Laboratories, TATA SONS</td>
<td>India</td>
<td>2007</td>
<td>14,240</td>
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<tr>
<td>5 HP</td>
<td>Cluster Platform Dual Core 2.66 GHz</td>
<td>102.8</td>
<td>Government Agency</td>
<td>Sweden</td>
<td>2007</td>
<td>13,728</td>
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<tr>
<td>6 Cray</td>
<td>Opteron Dual Core 2.4 GHz</td>
<td>102.2</td>
<td>DOE Sandia Nat Lab</td>
<td>USA</td>
<td>2007</td>
<td>26,569</td>
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<tr>
<td>7 Cray</td>
<td>Opteron Dual Core 2.6 GHz</td>
<td>101.7</td>
<td>DOE Oak Ridge National Lab</td>
<td>USA</td>
<td>2006</td>
<td>23,016</td>
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<tr>
<td>8 IBM</td>
<td>eServer Blue Gene/L Dual Core .7 GHz</td>
<td>91.2</td>
<td>IBM Thomas J. Watson Research Center</td>
<td>USA</td>
<td>2005</td>
<td>40,960</td>
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<tr>
<td>9 Cray</td>
<td>Opteron Dual Core 2.6 GHz</td>
<td>85.4</td>
<td>DOE Lawrence Berkeley Nat Lab</td>
<td>USA</td>
<td>2006</td>
<td>19,320</td>
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<tr>
<td>10 IBM</td>
<td>eServer Blue Gene/L Dual Core .7 GHz</td>
<td>82.1</td>
<td>Stony Brook/BNL, NY Center for Computational Sciences</td>
<td>USA</td>
<td>2006</td>
<td>36,864</td>
</tr>
</tbody>
</table>
Performance of the Top50

- United States: 67%
- Germany: 9%
- Taiwan: 1%
- Italy: 1%
- Netherlands: 1%
- United Kingdom: 3%
- France: 3%
- Russia: 1%
- Japan: 2%
- Spain: 2%
- Sweden: 2%
- India: 3%
- Systems: 32

DOE NNSA

- **LLNL**
  - IBM BG/L
    - Power PC
    - Cores: 212,992
    - Peak: 596 TF
    - Memory: 73.7 TB
  - IBM Purple
    - Power 5
    - Cores: 12,208
    - Peak: 92.8 TF
    - Memory: 48.8 TB

- **SNL**
  - Red Storm Cray
    - AMD Dual Core
    - Cores: 27,200
    - Peak: 127.5 TF
    - Memory: 40 TB
  - Thunderbird Dell
    - Intel Xeon
    - Cores: 9,024
    - Peak: 53 TF
    - Memory: 6 TB

- **LANL**
  - RoadRunner IBM
    - AMD Dual Core
    - Cores: 18,252
    - Peak: 81.1 TF
    - Memory: 27.6 TB
  - Q HP
    - Alpha
    - Cores: 8,192
    - Peak: 20.5 TF
    - Memory: 13 TB
LANL Roadrunner
A Petascale System in 2008

“Connected Unit” cluster
192 Opteron nodes
(180 w/ 2 dual-Cell blades
connected w/ 4 PCIe x8 links)

≈ 13,000 Cell HPC chips
≈ 1.33 PetaFlop/s (from Cell)
≈ 7,000 dual-core Opterons

≈ 18 clusters

2nd stage InfiniBand 4x DDR interconnect
(18 sets of 12 links to 8 switches)

Based on the 100 Gflop/s (DP) Cell chip

Approval by DOE 12/07
First CU being built today
Expect a May Pflop/s run
Full system to LANL in December 2008

DOE OS

ORNL
- Jaguar Cray XT
  - AMD Dual Core
  - Cores: 11,706
  - Peak: 119.4 TF
  - Upgrading 250 TF
  - Memory: 46 TB
- Phoenix Cray X1
  - Cray Vector
  - Cores: 1,024
  - Peak: 18.3 TF
  - Memory: 2 TB

LBNL
- Franklin Cray XT
  - AMD Dual Core
  - Cores: 19,320
  - Peak: 100.4 TF
  - Memory: 39 TB
- Bassi IBM
  - PowerPC
  - Cores: 976
  - Peak: 7.4 TF
  - Memory: 3.5 TB
- Seaborg IBM
  - Power3
  - Cores:
  - Peak: 9.9 TF
  - Memory: 7.3 TB

ANL
- BG/P IBM
  - PowerPC
  - Cores: 131,072
  - Peak: 111 TF
  - Memory: 65.5 TB
NSF HPC Systems available on TeraGrid

10/01/2007

High Performance Computing Systems

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>System</th>
<th>CPUs</th>
<th>Peak TF/s</th>
<th>Memory (TB)</th>
<th>Memory Type</th>
<th>Peak TF/s</th>
<th>Memory (TB)</th>
<th>Memory Type</th>
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<tbody>
<tr>
<td>LSU</td>
<td>NCAA</td>
<td>Dell Intel 64</td>
<td>5600</td>
<td>89.47</td>
<td>9.38</td>
<td>100.00</td>
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<tr>
<td></td>
<td></td>
<td>PowerEdge</td>
<td>5840</td>
<td>62.36</td>
<td>11.60</td>
<td>106.90</td>
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<td>Big Red</td>
<td>TACC</td>
<td>Dell PowerEdge</td>
<td>6172</td>
<td>51.26</td>
<td>6.00</td>
<td>206.90</td>
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<tr>
<td>Blue Gene</td>
<td>SDSC</td>
<td>Dell Blue Gene</td>
<td>6144</td>
<td>17.10</td>
<td>1.50</td>
<td>19.50</td>
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<tr>
<td>TeraGrid</td>
<td>NCAA</td>
<td>Dell XT3</td>
<td>2550</td>
<td>16.38</td>
<td>3.75</td>
<td>109.90</td>
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<td>Oakgrid</td>
<td>SDSC</td>
<td>Dell PowerEdge</td>
<td>2136</td>
<td>14.30</td>
<td>5.75</td>
<td>115.00</td>
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<tr>
<td>Theta</td>
<td>NCAA</td>
<td>IBM Power4</td>
<td>1744</td>
<td>10.23</td>
<td>4.47</td>
<td>60.00</td>
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<tr>
<td>CoBalt</td>
<td>NCAA</td>
<td>IBM Power4</td>
<td>1024</td>
<td>6.60</td>
<td>2.00</td>
<td>20.00</td>
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<td>Frontera</td>
<td>NGB</td>
<td>IBM Power4</td>
<td>1024</td>
<td>6.55</td>
<td>3.00</td>
<td>100.00</td>
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<td>Texas Grid</td>
<td>SDSC</td>
<td>IBM Power4</td>
<td>7944</td>
<td>3.30</td>
<td>1.02</td>
<td>48.90</td>
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<td>Yonder</td>
<td>NGB</td>
<td>IBM Power4</td>
<td>5484</td>
<td>2.00</td>
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<td>30.00</td>
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<td>Oakgrid</td>
<td>SDSC</td>
<td>IBM Power4</td>
<td>192</td>
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<td>0.80</td>
<td>115.00</td>
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<tr>
<td>TeraGrid</td>
<td>NCSA</td>
<td>IBM Power4</td>
<td>128</td>
<td>0.61</td>
<td>0.24</td>
<td>4.30</td>
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<td></td>
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<tr>
<td>Pangea</td>
<td>ORNL</td>
<td>IBM Power4</td>
<td>50</td>
<td>0.24</td>
<td>0.07</td>
<td>2.14</td>
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<tr>
<td>Rachel</td>
<td>SDSC</td>
<td>HP Alpha 8500</td>
<td>128</td>
<td>0.31</td>
<td>0.50</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total: 40,780 288,000 56.15 1215.04

Does not show:
LSU: Queen Bee
TACC: Ranger
Tennessee: Cray XT/Baker

NSF - New TG systems

<table>
<thead>
<tr>
<th>System</th>
<th>Peak TF/s</th>
<th>Memory (TB)</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU Queen Bee</td>
<td>50.7</td>
<td>5.3</td>
<td>680n 2s 4c 8-way SMP cluster; 8GB/node; IB</td>
</tr>
<tr>
<td>UT-TACC Ranger</td>
<td>504</td>
<td>123</td>
<td>Sun Constellation - 3936n 4s 4c 2.0GHz AMD Barcelona - 16-way SMP cluster; 32GB/node; IB</td>
</tr>
<tr>
<td>UTK/ORNL Track 2b</td>
<td>164</td>
<td>17.8</td>
<td>Cray XT4 - 4456n 1s 4c AMD Budapest (April 2008)</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td>80</td>
<td>Cray Baker (80,000 cores) expected 2Q 09</td>
</tr>
<tr>
<td>?? Track 2c</td>
<td></td>
<td></td>
<td>Proposals under evaluation today</td>
</tr>
<tr>
<td>UIUC Track 1</td>
<td>Sustained</td>
<td>P flop/s</td>
<td>To be deployed in 2011</td>
</tr>
</tbody>
</table>
Japanese Efforts

- TiTech Tsubame
- T2K effort
- Next Generation Supercomputer Effort

TSUBAME as No.1 in Japan since June 2006

Original: 85 TFlop/s Today: 103 TFlop/s
Peak: 1.1 Pbyte (now 1.6 PB)
4 year procurement cycle, $7 mil/y
Has beaten the Earth Simulator
Has beaten all the other Univ. centers combined

Storage

- Sun Galaxy 4 (Opteron Dual core 8-socket)
- 10480core/655Nodes
- 32-128GB
- 21.4TBytes
- 50.4TFlop/s
- OS Linux (SuSE 9, 10)
- NAREGI Grid MW

Voltaire ISR9288 Infiniband
10Gbps x2 ~1310+50 Ports
~13.5Terabits/s
(3Tbits bisection)
Universities of Tsukuba, Tokyo, Kyoto (T2K)

- The results of the bidding announced on December 25, 2007.
  - The specification requires a commodity cluster with quadcore Opteron (Barcelona).
- Three systems share the same architecture on each site
  - Based on the concept of Open Supercomputer
    - Open architecture, (commodity x86)
    - Open software, (Linux, open source)
- University of Tokyo: 140 Tflop/s (peak) from Hitachi
- University of Tsukuba: 95 Tflop/s (peak) from Cray Inc.
- Kyoto University: 61 Tflp/s (peak) from Fujitsu
- They will be installed in summer 2008.
- Individual procurement: Not a single big procurement for all three systems

NEC SX-9 Peak 839 Tflop/s

- 102.4 Gflop/s per cpu
- 16 cpu per unit
- 512 units max.
- Expected ship in March 2008

- German Weather Service (DWD)
  - 39 TF/s, €39 M, operational in 2010.
- Meteo France
  - sub-100 TF/s system
- Tohoku University, Japan
  - 26 TF/s
Japanese Efforts:
The Next Generation Supercomputer Project

- Roughly every 5-10 years Japanese government puts forward a Basic Plan for S&T

- Today “3rd Science and Technology Basic Plan”

- The 2nd S&T Plan gave rise to the Earth Simulator

Six Goals of Japan’s “3rd Science and Technology Basic Plan” and Next-Generation Supercomputer Project

- **Goal 1**: Discovery & Creation of Knowledge toward the future
- **Goal 2**: Breakthroughs in Advanced Science and Technology
- **Goal 3**: Sustainable Development - Consistent with Economy and Environment -
- **Goal 4**: Innovator Japan - Strength in Economy & Industry -
- **Goal 5**: Good Health over Lifetime
- **Goal 6**: Safe and secure Nation
**Project Organization**

**MEXT: Policy & Funding**
Office for Supercomputer Development Planning
MEXT: Ministry of Education, Culture, Sports, Science and Technology

**Industry Users**
Industrial Committee for Promotion of Supercomputing

**R&D Scheme**
RIKEN: Project HQ
Next-Generation Supercomputer R&D Center (Ryoji Noyori)
Project Leader: Tadashi Watanabe

**Evaluation Scheme**

**Advisory Board**
Universities, Laboratories, Industries

**Total Budget:** about 115 billion Yen (~$1 billion)

**Next Generation Supercomputer Schedule**

<table>
<thead>
<tr>
<th>System</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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</thead>
<tbody>
<tr>
<td>Processing unit</td>
<td>Conceptual design</td>
<td>Detailed design</td>
<td>Prototype and evaluation</td>
<td>Production, installation, and adjustment</td>
<td>Operation</td>
<td>Completion</td>
<td></td>
</tr>
<tr>
<td>Front-end unit (total system software)</td>
<td>Basic design</td>
<td>Detailed design</td>
<td>Production and evaluation</td>
<td>Tuning and improvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared file system</td>
<td>Basic design</td>
<td>Detailed design</td>
<td>Production, installation, and adjustment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Next-Generation Integrated Nanoscience Simulation</td>
<td>Development, production, and evaluation</td>
<td>Verification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Next-Generation Integrated Life Simulation</td>
<td>Development, production, and evaluation</td>
<td>Verification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer building</td>
<td>Design</td>
<td>Construction</td>
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<tr>
<td>Research building</td>
<td>Design</td>
<td>Construction</td>
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<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Decisions on policies and systems</td>
<td>Preparation</td>
<td>Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note) NII: National Institute of Informatics,
IMS: Institute for Molecular Science
The Next-Generation Supercomputer project

Due to be ready in 2012, the peta-scale computing by the new supercomputer will ensure that Japan continues to lead the world in science and technology, academic research, industry, and medicine.

System architecture is a heterogeneous computing system with scalar and vector units connected through a front-end unit which is now being defining.

[System configuration]

The Next-Generation Supercomputer will be hybrid general-purpose supercomputer that provides the optimum computing environment for a wide range of simulations.

• Calculations will be performed in processing units that are suitable for the particular simulation.
• Parallel processing in a hybrid configuration of scalar and vector units will make larger and more complex simulations possible.
MEXT's Vision for Continuous Development of Supercomputers

- Sustained Performance (FLOPS)
- Government Investment

The Next Generation Supercomputer Project

- National Infrastructure Institute, University
- Enterprise Company, Laboratory

Next-next Generation Project

- National Infrastructure Institute, University
- Enterprise Company, Laboratory

Next-next-next Generation Project

- National Infrastructure Institute, University
- Enterprise Company, Laboratory

Upgrades Towards Petaflops

- US >10P (2011~12?)
- Japanese NLP >10P (2012-10?)

- Other

- T11 TF, 1.6 PB, 128GB Nodes (2007)
- TSUBAME Upgrade 1 (2005)
- Earth Simulator 40TF (2002)
- Titech Campus Grid Clusters
- 1.3TF

- TSUBAME 85TF 1.1 PB (2006)
- U: Tokyo, Kyoto U, Tai-hedan 95-140TF (2008)
European Systems

• France: 2 machines in the Top50 (CEA)
  ▪ CEA has 2 systems from Bull
    • Itanium, Quadrics, 9968 cores, 53 Tflops/s peak in 2006
    • Itanium, Infiniband, 7680 cores, 42 Tflop/s peak in 2007
    • Expected to acquire a Pflop/s system in 2010.
  ▪ CNRS - IDRIS (Institut du Développement et des Ressources en Informatique Scientifique)
    • IBM BG/P (10 rack) 139 T flop/s peak
    • IBM Power6 68 T flop/s peak
    • 1/08 installed, full operation 3/08
  ▪ EDF
    • IBM BG/P (8 rack) 111 T flop/s peak
    • 1/08 installed, full operation 6/08
  ▪ CINES (Montpellier)
    • Center funded by the ministry of research
    • RFP for a 50 T flop/s system

European Systems (continued)

• England: 2 machines Top50 (Edinburgh #17 & AWE #35)
  ▪ U of Edinburgh’s HECToR 63.4 T flop/s Cray XT4 system today, going to 250 T flop/s in 2009, £113M
  ▪ ECMWF, 2 IBM POWER6 systems to be installed total 290 T flop/s in 2008
• Netherland: 1 machine in the Top50 (Groningen #37)
  ▪ SARA (Stichting Academisch Reken Centrum) to upgrade from 14 to 60 T flop/s (Power6) in May 2008.
• Spain: 1 machine in the Top50 (Barcelona #13)
  ▪ Barcelona, PowerPC w/Myrinet, 10K processors, 94 T flop/s peak since 2006
• Finland: No machines in the Top50
  ▪ CSC has a “new” 70 T flop/s Cray XT and a 10 T flop/s HP cluster
European Systems (continued)

- **Sweden**: 2 machines in Top50 (#’s 5 & 23)
  - The National Defense Radio Establishment
    - HP Cluster, 146 Tflop/s peak
  - Computer Center, Linköping University
    - HP Cluster, 60 Tflop/s peak

- **Italy**: 1 machine in Top50 (#48)
  - CINECA
    - IBM Cluster, 61 Tflop/s peak

- **Russia**: 1 machine in Top50 (#33)
  - Joint Supercomputer Center
    - HP Cluster, 45 Tflop/s peak

European Systems (continued)

- **Germany**: 4 machines in the top50 (#’s 2, 15, 28 and 40)
  - 2 BG/P and a BG/L (FZJ and MPI) also SGI Altix (LRZ Munich)
  - HLRN (6 North German States) SGI Altix
    - 70 Tflop/s system (split between Berlin and Hannover) in Q2-2008
    - 312 Tflop/s system in 2009
    - 30 M € total

  - German Climate Computing Centre (DKRZ)
    - Planning a new IBM (Power6) with a peak speed of 140 Tflop/s in 2008

  - FZ Jülich
    - General purpose cluster > 200 Tflop/s (Intel w/Quadrics) in 2008
    - A Pflop/s system in 2009

  - HLRS University of Stuttgart
    - Planning for 1-2 Pflop/s in 2011
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
- High end should be renewed every 2–3 years
- Close links to national/regional centers to establish a European HPC ecosystem

European High Performance Computing Service includes:

- Capability Computing
- Grid architectures
- Software
- Data management and curation

There is a need for a combination of centralized, distributed, and networked aspects, based on a pyramid-like organization, including a few very high-end centres at the top

- HPC Provisioning pyramid
  - Tier-0: 3-5 European HPC-facilities
  - Tier-1: National HPC-facilities
  - Tier-2: Regional / University Centres
The Partnership for Advanced Computing in Europe (PRACE) Initiative

- The PRACE MoU has been signed by the representatives of 14 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

What is going to happen with PRACE?

- Project will start 1.1.2008
- Consortium partners (14 countries)
  - Austria, Finland, France, Germany, Greece, Italy, Norway, Poland, Portugal, Spain, Sweden, Switzerland, The Netherlands, United Kingdom
- Two years, 10+10 MEUR volume
- Prototypes for petaflop computing during 2008-2009
- Target to have the 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?
The host country will be determined by which government will invest the majority of cost (and also have access to majority of cycles).

Primary partners (= willing to host) appear to be:
- Germany, UK, France, Spain and the Netherlands.

A dozen national HPC centers at major universities (each a few TF) connected by gigabit level network
- Research at universities is weak but improving
- But ample numbers of CS graduates
HPC Technical Committee to direct national priorities
HPC Standardization Committee to coordinate and create Chinese standards (i.e., for blades, cluster OS, security, etc) with vendor participation
### 2007 China TOP100 (1-10)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Vendor</th>
<th>System</th>
<th>Installation Site</th>
<th>Internet/Computation</th>
<th>Application Area</th>
<th>Processor Type</th>
<th>Linspack (Gflops)</th>
<th>Linpack (Gflops)</th>
<th>Speed (Gflops)</th>
<th>Efficiency</th>
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<td>1</td>
<td>IBM</td>
<td>IBM BladeCenter HS21 Cluster, Intel Xeon Quadruple-Core 2.33 GHz/2.33 GHz</td>
<td>China Petroleum &amp; Chemical Corporation</td>
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<td>2007</td>
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<td>10350.00</td>
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<td>DAIRN/NG</td>
<td>IBM pSeries 940</td>
<td>Shanghai Supercomputing Center</td>
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</table>

The Specialty Association of Mathematical & Scientific Software (SAMSS)  [http://www.samss.org.cn](http://www.samss.org.cn)

### Trend of China HPC Performance (1993-2007)

![Trend of China HPC Performance (1993-2007)](image)

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**Trends and Predictions for China HPC**

- Strong government commitment
- 2008: 100 Tflop/s peak system will be in use
- 2008 - 2009: Total Performance in China will be at 1 Pflop/s
- 2010 - 2011: 1 Pflop/s peak machine will be in use.

**INDIA**

India’s #4 in the Top500 notwithstanding
China leads India in all aspects of HPC
  - Infrastructure & facilities
  - Diffusion into industry
  - Local vendors
  - Research output and quality
  - Government commitment
India

• CRL (Computational Res Labs)
  – Pune facility, funded by Tata & Sons Inc
    • Tata: ~4% of India’s GDP
    • History of long term investment in strategic national facilities.
      – Tata Inst of Science ➔ Indian Inst of Science (IISc) (100yrs)
      – Tata Inst of Fundamental Research (TIFR)
  – US$30M for large blade system from HP
    • #4 on Top500 (Nov 2007) 120TF Linpack (200TF peak)
    • Purchased and installed quickly in 3Q-4Q2007

India

• Universities & Govt labs
  – Weak HPC presence
    • Few large systems (IISc, TIFR have some HPC presence)
    • Researchers are not driven to push their problems to large HPC environments
    • Little credible HPC research
      – Few CS PhDs
      – Emphasis on searching technologies (i.e., for Google, Yahoo!, etc)
  – HiPC is best HPC meeting in the country. Most recent Dec 2007, found few HPC research achievements from Indian universities
Summary

- US dominates in the use of HPC
  - US dominates producing the components (processors, interconnects, and software) for HPC
- Japan will have a 10 Pflop/s system in 2010-2011
- Coordinated European effort will place a Pflop/s system soon
- India system is a one off, no national effort

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