Personal Supercomputers: Past, Present and Future

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Oct 28, 2012
Outline

- Disclaimer Notice
- Motivations behind pHPC
- What constitutes a pHPC?
- pHPC development in China
- Where are we?
- Future challenges
- Some references
pHPC Timeline

- **2009**: PHPC200 
  - Sugon

- **2006**: KD50 
  - USTC

- **2007**: CX-1 
  - Cray/MS

- **2008**: PHPC100 
  - Sugon

- **2009**: Octane III 
  - SGI

- **2010**: KD60 
  - USTC

- **2011**: NEXXUS C 
  - Ciara Tech

- **2012**: Node-1 
  - Desktoppc.com

- **2005**: Typhoon600 
  - Tyan

- **2007**: OfficeBlade 
  - Supermicro

- **2008**: PowerScale1000 
  - PowerLeader

- **2008**: ESC1000 
  - ASUS

- **2009**: Yitian 
  - Inspur

- **2010**: PowerScale1000 
  - PowerLeader

- **2011**: CXT5000 
  - Colfax

- **2012**: T-Mini P 
  - T-Platform

- **2005**: Octane III 
  - SGI

- **2006**: Tyan

- **2007**: ASUS

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- **2009**: PowerLeader

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- **2012**: T-Platform

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**GPGPU**

- Loongson 2F/3

- Xeon Phi
A Survey of the Practice of Computational Science[1]
The Facts

The Deadline Rush Phenomenon

- Parkinson’s Law reads, *Work expands to fill the time available for its completion.*
- No one likes queuing.

Data Locality

- Data is the King
- Data movement challenges
- Infrastructure demands.
The Economy for buyers

“The new SGI system joins a $2 billion worldwide market of high-performance computing (HPC) systems that cost less than $100,000. That market is expected to grow to $2.7 billion by 2013, or nearly 6% annually, which is a good rate considering that server sales generally cratered this year.”

Steve Conway, IDC, 2009

<table>
<thead>
<tr>
<th>Segment</th>
<th>CAGR  (2012~2016)</th>
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<tbody>
<tr>
<td>Workgroup</td>
<td>11.9%</td>
</tr>
<tr>
<td>Departmental</td>
<td>5.9%</td>
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<tr>
<td>Divisional</td>
<td>9.5%</td>
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<tr>
<td>Supercomputer</td>
<td>5.3%</td>
</tr>
<tr>
<td>Total HPC Market</td>
<td>6.9%</td>
</tr>
</tbody>
</table>
The Economy for builders

- Constraints in building high-end HPCs
  - One of a kind, literally.
  - Too many uncertainties. Many are uncontrollable by architects and engineers.

- pHPC: Incubator for the next big thing
  - Fixed budget HPC construction and comparison (Prof. Qian Depei)
What constitutes a pHPC?

- High performance
  - At least 10 times of high-end PC
- High reliability
- Low cost
- Low power consumption
  - 2~3KW
- Low Noise
  - < 70dB
- Desktop/Deskside footprint
- User friendly (Programming/Management/Use)
pHPC development in China

The roadmap set in 2007\(^2\)

- To deliver 1 TFLOPS in three stages to desktop

Characteristics

- Emphasis on new architecture/hardware
- Emphasis on home-grown technologies
The Software

The "dusty deck" syndrome
- Inertia is a two-edged sword
- Software is #1 headache: It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness…
- Thinking outside of the box

The most common practices
- Preinstalled OS and system manager: identical to a cluster
- Taking advantage of cloud computing infrastructure
- Single system image: revitalized
Where are we?

- Benchmarking of pHPC
  - LINPACK/GRAPH500/Green500?
  - PHPC Top100 ([www.phpc100.org](http://www.phpc100.org) in construction)

- Ease of Usage Benchmarking
  - The most desired progress in this field
  - 10 novice grads/groups, 10 selected applications
  - A good HPC outreach and user training program!
    - Call for participation!
Future challenges

- Economic issues will play a key role
  - Always bear commercialization in mind.
  - Competition: The ultimate way to realize “low cost”

- Technology trends
  - HW: Understood well enough?
    - GPGPU, MIC/Xeon Phi
    - ARM: It depends on SW
  - SW
    - Making a difference
    - Open to live: OSS will continue to dominate, but…
    - All-in-one/Specialized system will seize market shares
Q&A
Some references

2. 陈国良，蔡晔，罗秋明. 国产个人高性能计算机系统研制，深圳大学学报理工版，vol.18, no.6, 2011.