

# Personal Supercomputers:

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Past, Present and Future

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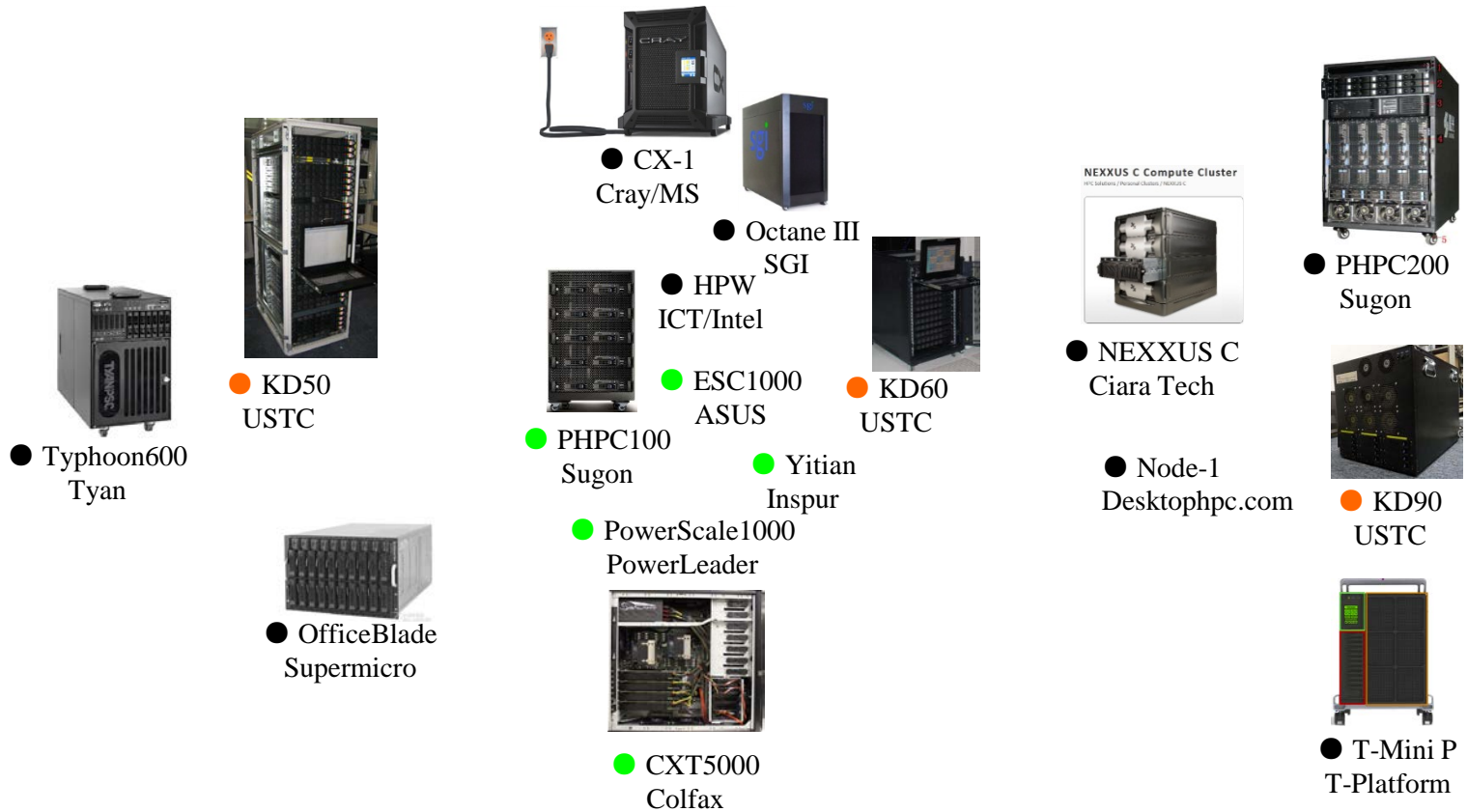


# Outline

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

# pHPC Timeline



Xeon Phi

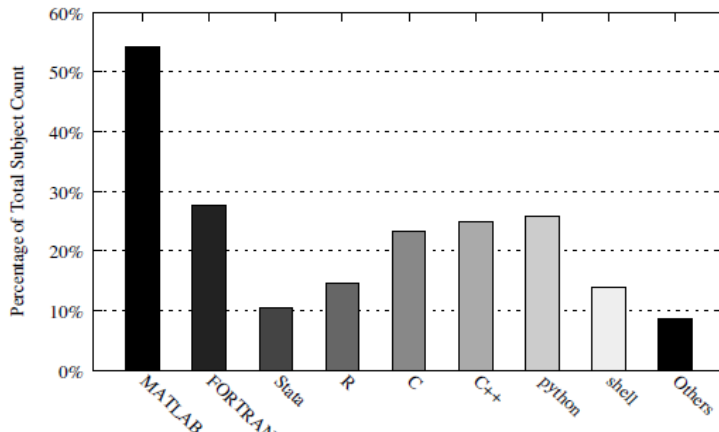
GPGPU

Loongson 2F/3

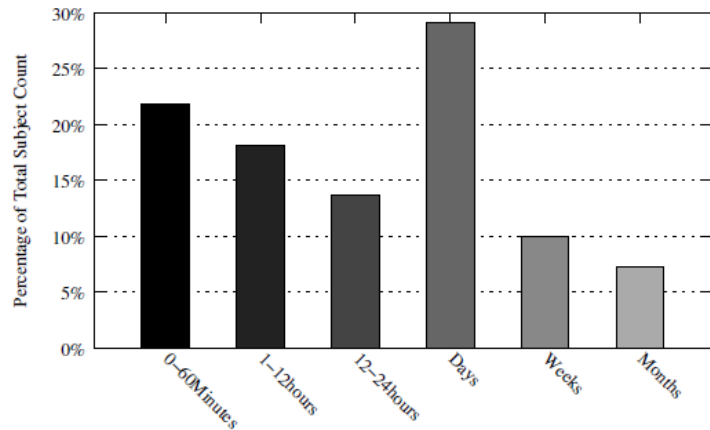
2005      2006      2007      2008      2009      2010      2011      2012

# The Practice

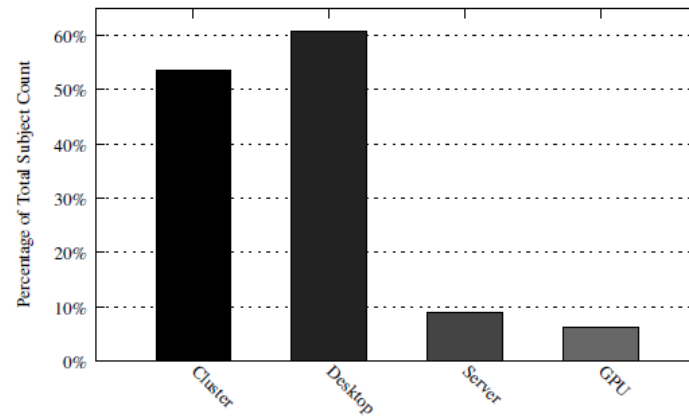
## A Survey of the Practice of Computational Science<sup>[1]</sup>



(b) Programming Language Use Distribution†



(e) Program Execution Time Distribution



(f) Computational Resource Use†

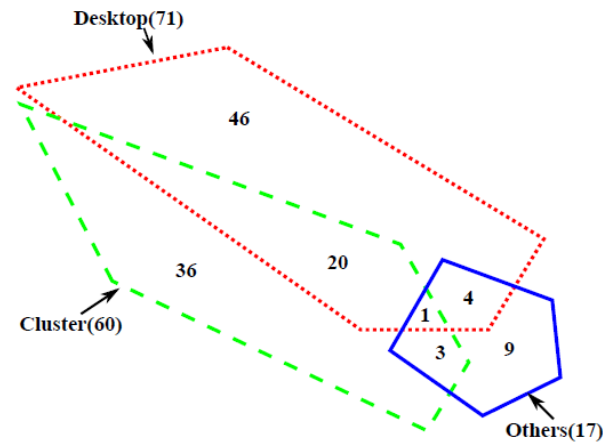


Figure 3: Proportional distribution of Computational Resource Usage. *Others* include Servers and GPUs



# The Facts

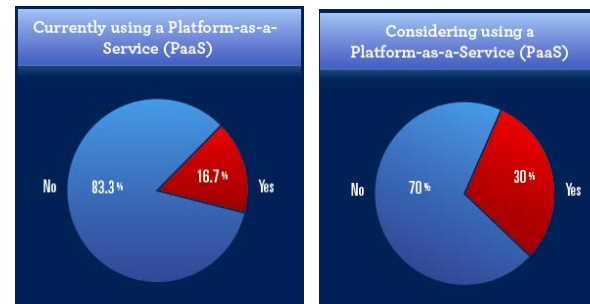
## ■ The Deadline Rush Phenomenon

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



## ■ Data Locality

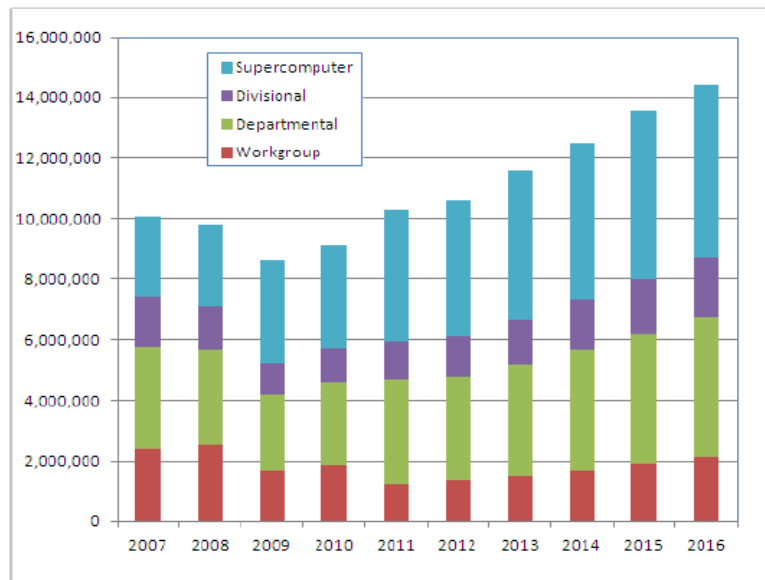
- Data is the King
- Data movement challenges
- Infrastructure demands.



# 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

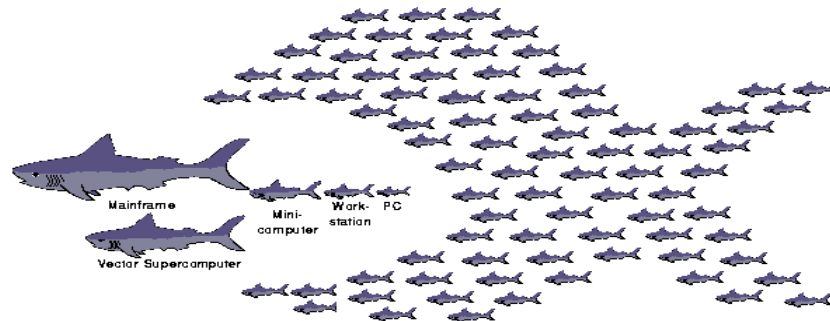


Segment	CAGR (2012~2016)
Workgroup	11.9%
Departmental	5.9%
Divisional	9.5%
Supercomputer	5.3%
Total HPC Market	6.9%



# 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?

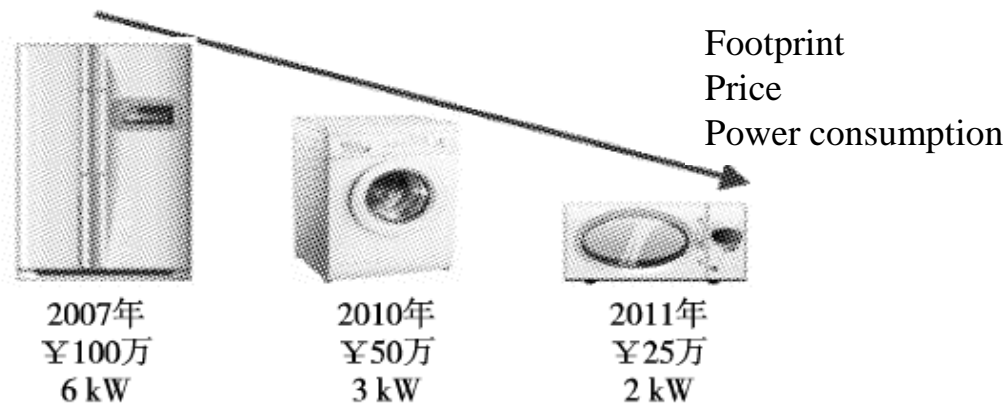
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- High performance
  - At least 10 times of high-end PC
- High reliability
- Low cost
- Low power consumption
  - 2~3KW
- Low Noise
  - < 70dB
- Desktop/Deskside footprint
- User friendly (Programming/Management/Use)



# pHPC development in China

- The roadmap set in 2007<sup>[2]</sup>
  - To deliver 1TFLOPS in three stages to desktop



**The roadmap of domestic pHPC**

- Characteristics
  - Emphasis on new architecture/hardware
  - Emphasis on home-grown technologies

# The Software

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- 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?

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- 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

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- 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



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# Q&A



# Some references

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1. Earl Joseph, Steve Conway, et al. IDC HPC Market Update, June 2012.
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.
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5. [http://mediasrc.zenoss.com/documents/The\\_State\\_of\\_Open\\_Cloud\\_2012\\_infographic\\_Zenoss.pdf](http://mediasrc.zenoss.com/documents/The_State_of_Open_Cloud_2012_infographic_Zenoss.pdf)

