Update on HPC Efforts in NUDT

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Outline

- Roadmap
- Hardware
- Software
- Application
Overview of TH Roadmap

- National University of Defense Technology
- Tianhe

Timeline:
- 2009
- 2010
- 2014
- 2015
- 2020

Performance:
- 1P
- 10P
- 100P
- 1000P

Locations:
- NUDT
- NSCC-CS
- NSCC-TJ
- Changsha, Tianjin

Map of China with regions and cities marked.
Roadmap

- **12-FiveY project (-2015)**
  - System
    - 100P
    - funding
      - MOST (863)
      - Local government
  - Software (year 2011)
    - NSFC 37 million for basic algorithm and computable model
    - MOST (863) 80 million for Domain applications

- **13-FiveY project (-2020)**
  - ~ 1 E
  - Funding?
Highlights of future TH systems

- Heterogeneous parallel architecture
- Multiple-dimension interconnection network
- Hierarchy I/O storage system
- Autonomic fault tolerant management
- Domain specific programming framework
- Adaptive power aware computing
Multiple-dimension interconnection network
- Support more than 100,000 nodes
- Bandwidth will be improved a lot
- Enhance collective communication
**Hardware**

- Inter-chip optical connection
  - Optical interface between processors
  - Optical switch between CPUs is under research
Software

Large-scale Hybrid Tiered File System

- Scalability to achieve >1TB/s I/O bandwidth by leveraging spatial locality
- Usability by federating multi-level storage into unified name space
- Flexibility by key components re-configuration for application optimization
- Applicability for supercomputers and clusters with hybrid infrastructure
Resilience computing Framework

- Capability to support post-petaflops and Exascale computing
- Collaboration with whole system software stack
- Coherent fault detection
- Coordinate fault tolerant decision
- Cooperation of multiple fault recovery mechanics
- Combination of proactive and reactive strategies
- Customizable fault detection, prediction and recovery approaches
- Support various parallel models
**Software**

Parallel programming Framework

- **Data Dependency**
- **Data Structures**
- **Special Models**
  - Stencils
  - Algorithms
- **Promote Computers**

**Library**

- **Common Models**
  - Stencils
  - Algorithms

- **Communications**
- **Load Balancing**
- **Fault tolerance**

**Parallel Computing Models**

- form
- support

**Extract**

- Application code

**Special Application code**
Software

Parallel programming Framework

Hide the complexity of programming (mil cores/hybrid)
Integrate the efficient parallel fast numerical algorithms
Provide efficient data structures and solver libraries
Support software engineering for code reusing

Data Dependency
Data Structures
Promote Computers

Parallel Computing Models

Communications
Load Balancing
Fault tolerance

support

Common Stencils
Models
Models
Algorithms
Library
Separate
Special
Algorithms
Integrate the efficient parallel fast numerical algorithms

Provide efficient data structures and solver libraries
Support software engineering for code reusing

Hide the complexity of programming (mil cores/hybrid)

Computers

National University of Defense Technology
Software

Parallel programming Framework

Special Application code extract
Models Stencils Algorithms separate

Common Models Stencils Algorithms
Library

Optimization interface
Heterogeneous issues
Communication organization
Load balance
Fault tolerance

System software developers

Promote

Computers
Applications

- Five priority areas
  - Climate & Environment
  - Bio-medicine
  - New energy
  - Equipment engineering
  - Animation
Summary

- Towards Next generation of TH system
  - Heterogeneous architecture
  - New enabling technology
  - High performance scalable interconnection
  - Balance the computing and data accessing
  - Feasible fault tolerant mechanics
  - Usable domain-specific programming framework
  - Selected priority application areas
Thank you