JAPAN UPDATE:

SDHPC
Strategic Direction/Development of HPC

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Disclaimer: Most information comes from public documents written in Japanese. English translations are not official.
Players and Major Project in Japan at the last IESP

Council for Science and Technology Policy (CSTP)

MEXT: Ministry of Education, Culture, Sports, Science, and Technology

Council for HPCI Plan and Promotion

This is a council to Deputy Director-General, Research Promotion Bureau at MEXT

JST (Japan Science and Technology Agency)

Encouraging young Japanese researchers’ involvement to consider strategic development of HPC

The consortium will play an important role of the future HPC R&D

Workshop of SDHPC (Strategic Development of HPC)

Organized by
Univ. of Tsukuba
Univ. of Tokyo
Tokyo Institute of Tech.
Kyoto Univ.
RIKEN supercomputer center and AICS
AIST
JST

HPCI Consortium established in 2012
Users and supercomputer centers (resource providers)

Basic Research Programs CREST:
Development of System Software Technologies for post-Peta Scale High Performance Computing
2010 -- 2018

We already introduced this program at the last IESP
What Japan has been doing since the last IESP

MEXT: Ministry of Education, Culture, Sports, Science, and Technology

• MEXT organized a working group, discussing future development of HPC technologies, under the “Council for HPCI Plan and Promotion”

In other words, demonstrating scientific and technological values in exa-scale computing is very important for tax payers

The WG advised

• The first step should be discussion on how HPC technologies are applied to science and technology fields

• The system should be co-designed and developed with applications, computer architectures, and system software

• Several application-oriented computer architectures should be considered

• Prior to developing an exa-scale machine, tens to hundreds peta-scale machines should be deployed

• Strategic development, which pieces are developed in Japan and which pieces are internationally collaborated, should be determined

• The development of novel computational models and algorithms is also important

• The new application fields should be investigated
Players and Projects in Japan NOW

**HPCI Consortium**
- established in 2012
- Users and supercomputer centers (resource providers)

**The consortium will play an important role of the future HPC R&D**

**MEXT**
- Council for Science and Technology Policy (CSTP)

**Council on HPCI Plan and Promotion**
- WG for applications
- WG for systems

**Preparing white paper for strategic direction/development of HPC in JAPAN**

**Feasibility Study of Advanced High Performance Computing**
- 2012 -- 2013

**JST (Japan Science and Technology Agency)**
- Basic Research Programs CREST:
  - Development of System Software Technologies for post-Peta Scale High Performance Computing 2010 -- 2018

**Workshop of SDHPC**
- Strategic Development of HPC
- Organized by
  - Univ. of Tsukuba
  - Univ. of Tokyo
  - Tokyo Institute of Tech.
  - Kyoto Univ.
  - RIKEN supercomputer center and AICS
  - AIST
  - JST
  - Tohoku Univ.

**Council for Science and Technology Policy (CSTP)**
- Council on HPCI Plan and Promotion
• White paper for Strategic Direction/Development of HPC in JAPAN is now being written by young Japanese researchers with advisers (seniors)
• The white paper will be approved by the Council for HPCI Plan and Promotion by the end of FY 2011.
• Contents (draft)
  – Expected scientific and technological values in exa-scale computing
  – Challenges towards exa-scale computing
  – Current research efforts in Japan and other countries
  – Approaches
  – Competitive vs Collaboration
  – Plan of R&D and organization
• The white paper will be used for call for proposals in “Feasibility Study of Advanced High Performance Computing”
Feasibility Study of Advanced High Performance Computing

• MEXT (Ministry of Education, Culture, Sports, Science, and Technology) has just proposed two-year project for feasibility study of advanced HPC which will start in FY2012 (April of 2012)

• Objectives
  – The high performance computing technology is an important national infrastructure
  – Keeping development of top-level HPC technologies is one of Japanese international competitiveness and contributes national security and safety
  – This two-year project is to study feasibilities of such development that Japanese community should focus on

• Budget requested
  – 11.45M USD (859M JPY) / Year
Feasibility Study of Advanced High Performance Computing

• Plan
  – Several computer architectures will be selected based on their potential advantages in solving respective key socio-scientific problems in Japan.
  – For each system
    • Hardware trends are investigated
    • The system architecture and system software are designed (with applications and, its prototype system is developed)
  – As a result of this study, further R&D for Japanese HPC funded by the government is decided.

• Organizations
  – Several R&D teams (maybe three) will be selected.
## Plans

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Three teams will run

Whether or not the national R&D project starts depends on results of those feasibility studies

- 2011Q4: HA-PACS, 0.8PF, Univ. Tsukuba
- 2012: BG/Q, 1.2PF, KEK
- 2012Q1: <1PF, Univ. Tokyo
- 2012Q2: 0.7PF?, Kyoto-U
- 2015: 100PF?, ??
CREST: Development of System Software Technologies for post-Peta Scale High Performance Computing (1/3)

- **Objectives**
  - Co-design of system software with applications and post-peta scale computer architectures
  - Development of deliverable software pieces

- **Research Supervisor**
  - Akinori Yonezawa, Deputy Director of RIKEN AICS

- **Run by JST (Japan Science and Technology Agency)**

- **Budget and Formation (2010 to 2018)**
  - About 60M $ (47M$ in normal rate) in total
  - Round 1: From 2010 for 5.5 year (23M $ (1750M JPY))
  - Round 2: From 2011 for 5.5 year (17M $ (1410M JPY))
  - Round 3: From 2012 for 5.5 year (20M $?)

http://www.postpeta.jst.go.jp/en/
Round 1: From 2010 for 5.5 year

- Highly Productive, High Performance Application Frameworks for Post Petascale Computing
  - Naoya Maruyama, Tokyo Institute of Technology
- System Software for Post Petascale Data Intensive Science
  - Osamu Tatebe, University of Tsukuba
- ppOpen-HPC: Open Source Infrastructure for Development and Execution of Large-Scale Scientific Applications on Post-Peta-Scale Supercomputers with Automatic Tuning (AT)
  - Kengo Nakajima, University of Tokyo
- Parallel System Software for Multi-core and Many-core
  - Atsushi Hori, RIKEN AICS
- Development of an Eigen-Supercomputing Engine using a Post-Petascale Hierarchical Model
  - Tetsuya Sakurai, University of Tsukuba
Round 2: From 2011 for 5.5 year

• Development of a Numerical Library based on Hierarchical Domain Decomposition for Post Petascale Simulation
  – Ryuji Shioya, Toyo University

• Advanced Computing and Optimization Infrastructure for Extremely Large-Scale Graphs on Post Peta-Scale Supercomputers
  – Katsuki Fujisawa, Chuo University

• An evolutionary approach to construction of a software development environment for massively-parallel heterogeneous systems
  – Hiroyuki Takizawa, Tohoku University

• Development of Scalable Communication Library with Technologies for Memory Saving and Runtime Optimization
  – Takeshi Nanri, Kyushu University

• Software development for post petascale super computing --- Modularity for Super Computing
  – Shigeru Chiba, Tokyo Institute of Technology
Associated Post Petascale Projects

• Tokyo Institute of Technology
  – JSPS Grant-in-Aid for Scientific Research(S) “Billion-Way Parallel System Fault Tolerance”
    2011-15, Total 1.6 mil Euro
    • PI: Satoshi Matsuoka, Collaborators Franck Cappello (INRIA), Hideyuki Jitsumoto (U-Tokyo)
  – MEXT – Tokyo Tech “Ultra Green Supercomputing”
    2011-15 Total 2.6 mil Euro
    • PI: Satoshi Matsuoka

• Univ. of Tsukuba
  – HP PACS(Highly Accelerated Parallel Advanced system for Computational Sciences) project (2011 to 2013, total 4.0 mil Euro)
    • Objective: to investigate acceleration technologies for post-petascale computing and its software, algorithms and computational science applications, and demonstrate by building a prototype system
      - Design and deploy a GPGPU-based Cluster system
      - Research on programming model and languages, environment for parallel system with accelerators.
      - Design of Algorithms and applications for parallel system with accelerators.
      - Research on architectures for parallel system with accelerators.
Research activities in AICS RIKEN

• XcalableMP(XMP): A PGAS parallel programming model and language
  – Partners: AICS Programming environment research team and Univ of Tsukuba
  – The specification is proposed by a special interest group, XMP SPEC WG, organized in Japan PC Cluster consortium.
    • XMP extends C99 and Fortran 95 with directives, Co-array syntax, and user APIs.
    • XMP supports typical parallelization under global-view programming model. Many ideas on “global-view” programming are inherited from High Performance Fortran.
    • Co-array (both for Fortran and C) as local-view programming model
    • Other features: XMP-IO, MPI library interface, Accelerators/GPU extension (XMP-dev)
  – [http://www.xcalablemp.org](http://www.xcalablemp.org)

• System Software for many-core architectures
  – Partners; AICS System software research team, Univ. of Tokyo, Tokyo Univ. of Agriculture and Technology, Kinki Univ, and Development WG in Japan PC Cluster consortium
  – Software packages will be distributed by Japan PC Cluster consortium
    • Micro kernel, smart message passing middleware, and I/O middleware