MEXT
MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE AND TECHNOLOGY-JAPAN

HPC User Forum

at

High Performance Computing Center Stuttgart

HPC in Japan

Oct. 7, 2010

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Office
of
Supercomputer Development Promotion

MEXT

Contents

- science and technology policy in Japan
- features of the next generation supercomputer
- specially designed application software in nano and life sciences
- strategic program to promote HPC activity in Japan
- new attempt named HPCI to link all computer facilities in Japan
- conclusions

Outline of the 3rd S&T Basic Plan (2006-2010) by CSTP

The chairman of CSTP is the prime minster

1. Fundamental Concept

- Recent situation revolving around S&T
- Basic stance **toward the 3rd plan**
- Fundamental ideas and policy goals
- Total governmental R&D investment:
  ¥25 trillion (210 billion euro)

2. Strategic Priority Setting in S&T

- Promotion of basic researches
- Prioritization of R&D for policy-oriented subjects
  Primary prioritized areas; ***Life science, IT, Environmental sciences, Nano-tech. & materials***
  Secondary prioritized areas; *Energy, MONODZUKURI tech., Infrastructure, Frontier (outer space & oceans)*
- Promotion strategy for the prioritized areas

3. S&T system reforms

- Fostering S&T personnel and providing opportunities
- Progress in science and leading to **innovation**
- **Upgrading infrastructures for S&T promotion**
- Strategic commitment on international S&T activities

4. Public Confidence and Engagement

- Responsible actions regarding ethical, legal and social issues
- Reinforcement of accountability and public relations of S&T activities
- Promotion of public understanding of S&T
- Facilitation of public engagement with S&T-related issues

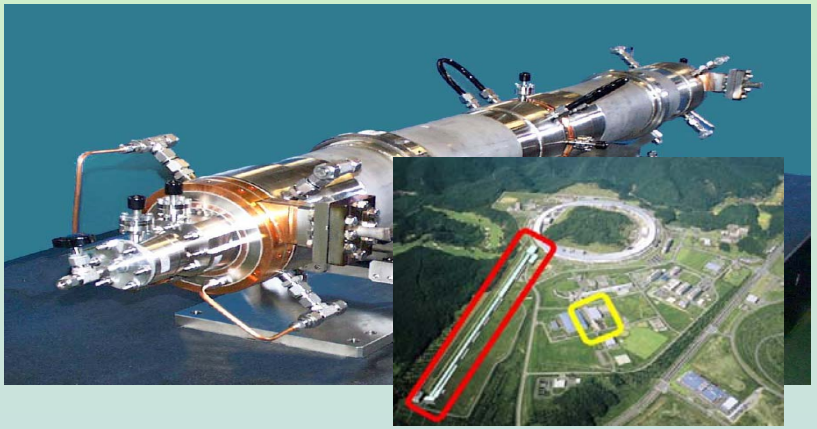
5. Missions of the **CSTP**

- More efficient and effective management of governmental R&D
- Break of institutional or operational bottle necks
- Follow-up of the Plan and promotion of progress in S&T

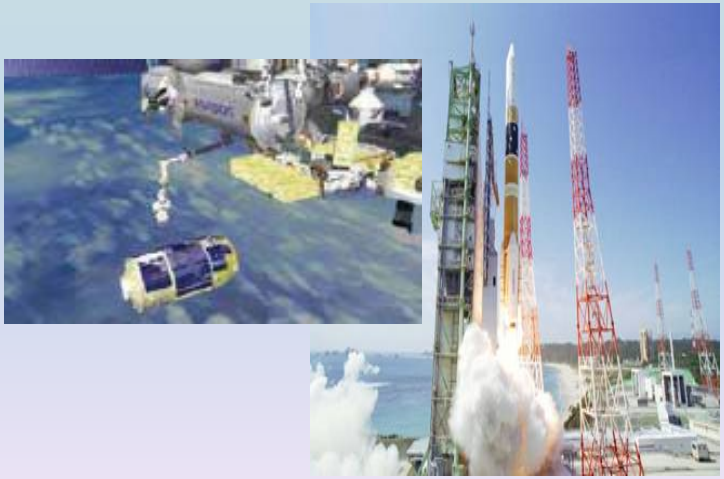
Key Technologies of National Importance

Chosen in the 3rd Basic Plan

Next Generation Supercomputer

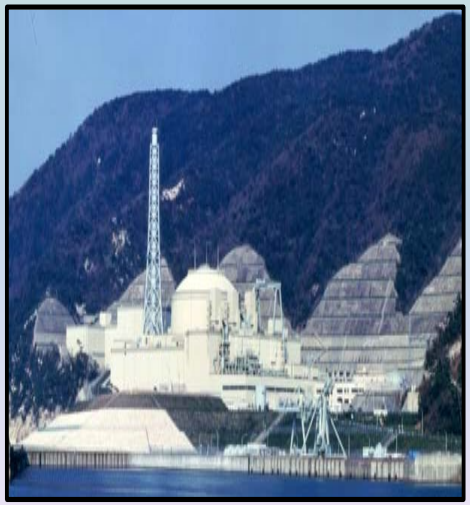


X-ray free electron laser



Space transport system

Ocean & earth exploration system



Fast breeder reactor

Next Generation Supercomputer named "KEI"

- The nickname of Next-generation Supercomputer is "京 (KEI)" which means 10 peta in Japanese

- Another meaning of "京 (KYO)" is "Land of Emperor Palace"

京

K computer

Goals of the Next Generation Supercomputer Project

◇ The 3rd Science and Technology Basic Plan (FY2006-FY2010)

- To develop an advanced high performance supercomputer system (10petaflops)→ Next-Generation Supercomputer
- To develop technologies to efficiently use it including application software
- To establish Center of Excellence for computational science established as **Advanced Institute for Computational Science**

◇ The 4th Science and Technology Basic Plan (FY2011-FY2015)

- Now under discussion toward exa flops

System Configuration
～ Scalar processors based system ～

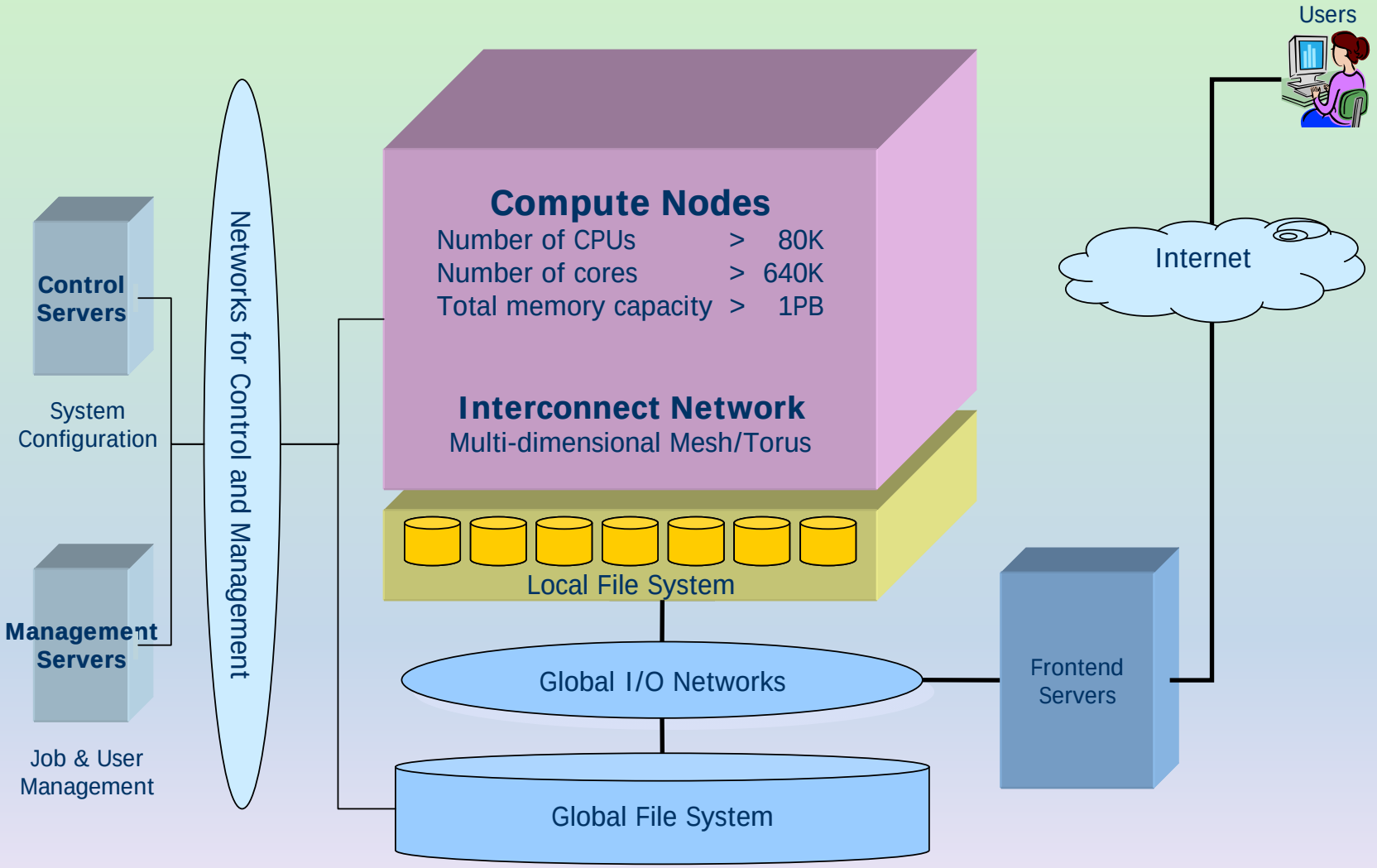
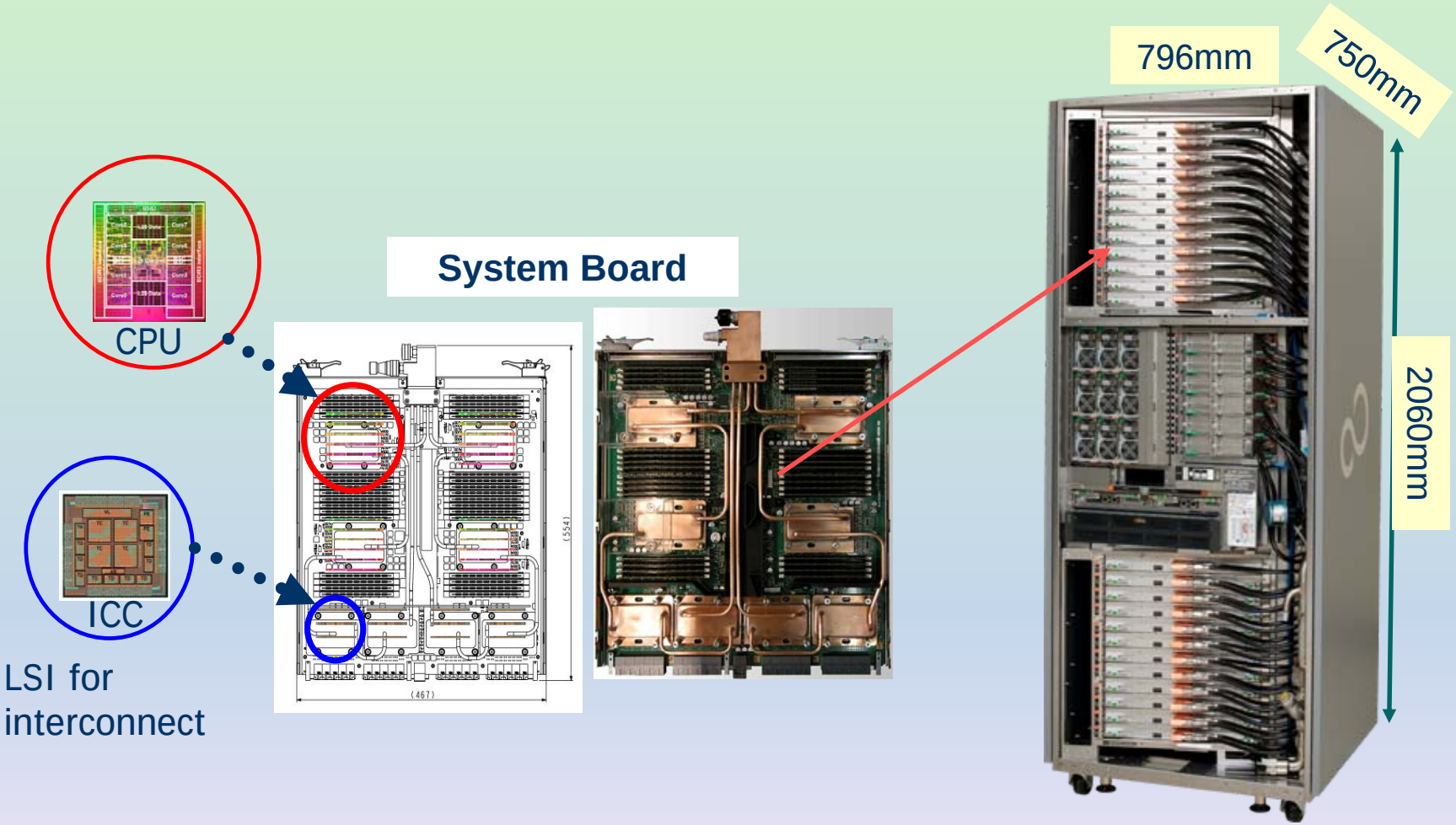


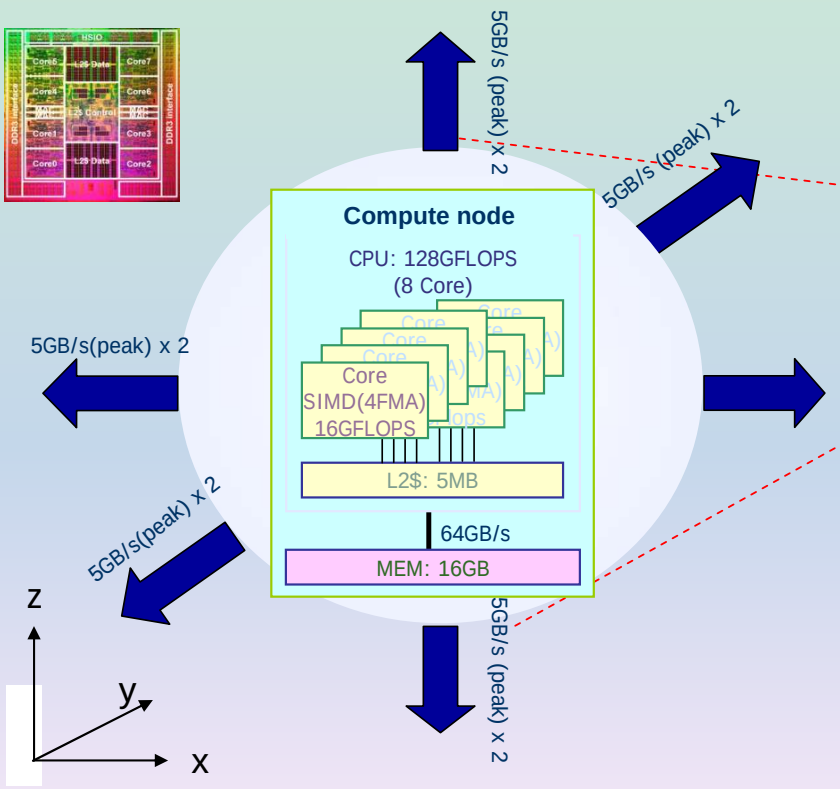
Photo of Proto-Type System

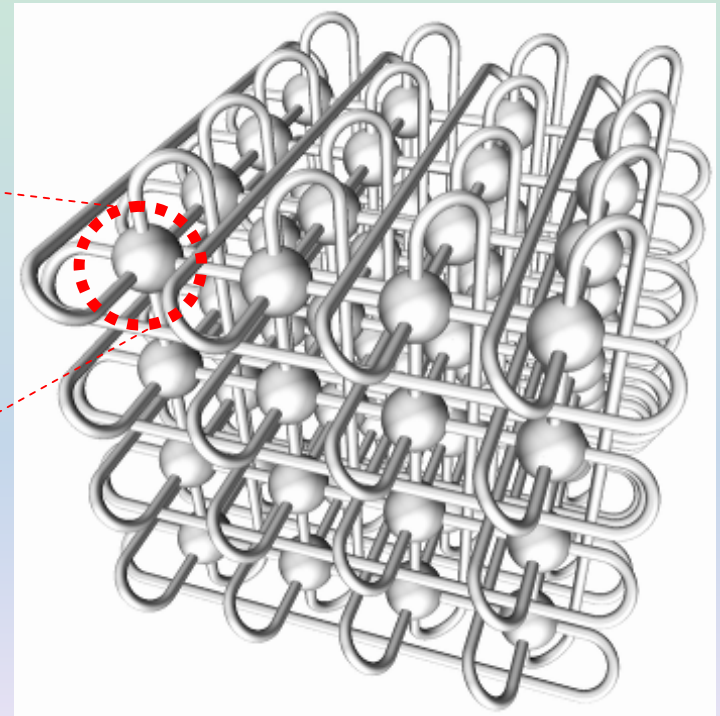


Compute Nodes of KEI

- Compute nodes (CPUs): > 80,000
  - Number of cores: > 640,000
- Peak performance: > 10PFLOPS
- Memory: > 1PB (16GB/node)

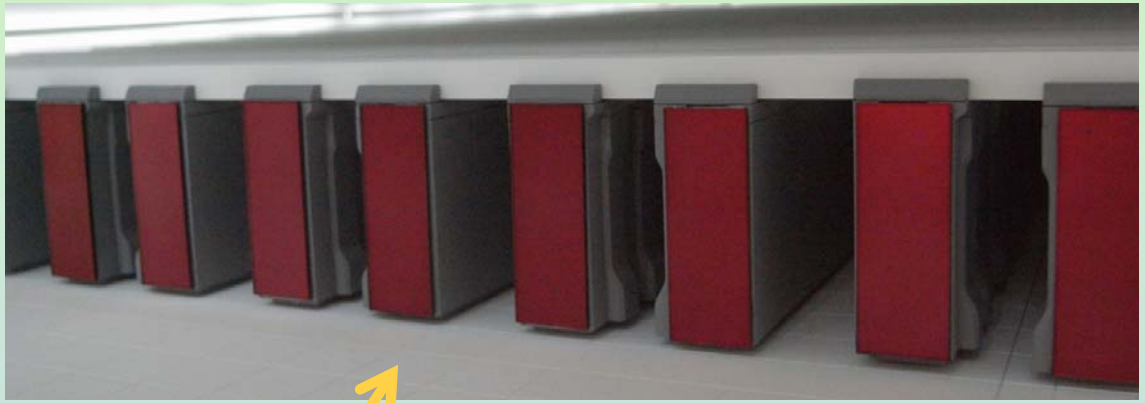
- Logical 3-dimensional torus network
- Peak bandwidth: 5GB/s x 2 for each direction of logical 3-dimensional torus network
- bi-section bandwidth: > 30TB/s

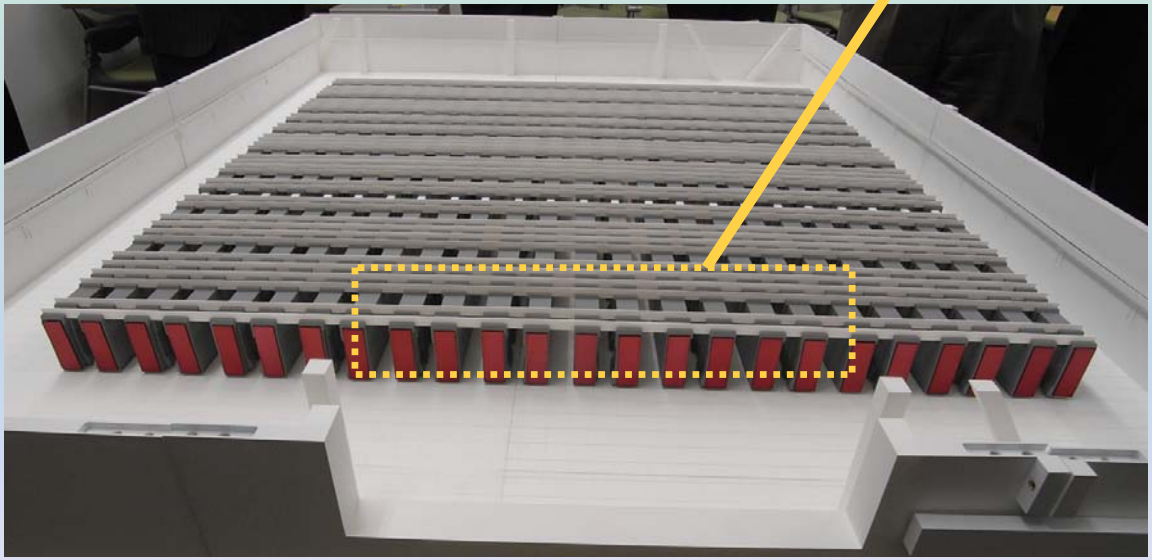




Courtesy of FUJITSU Ltd.

Image of the K computer

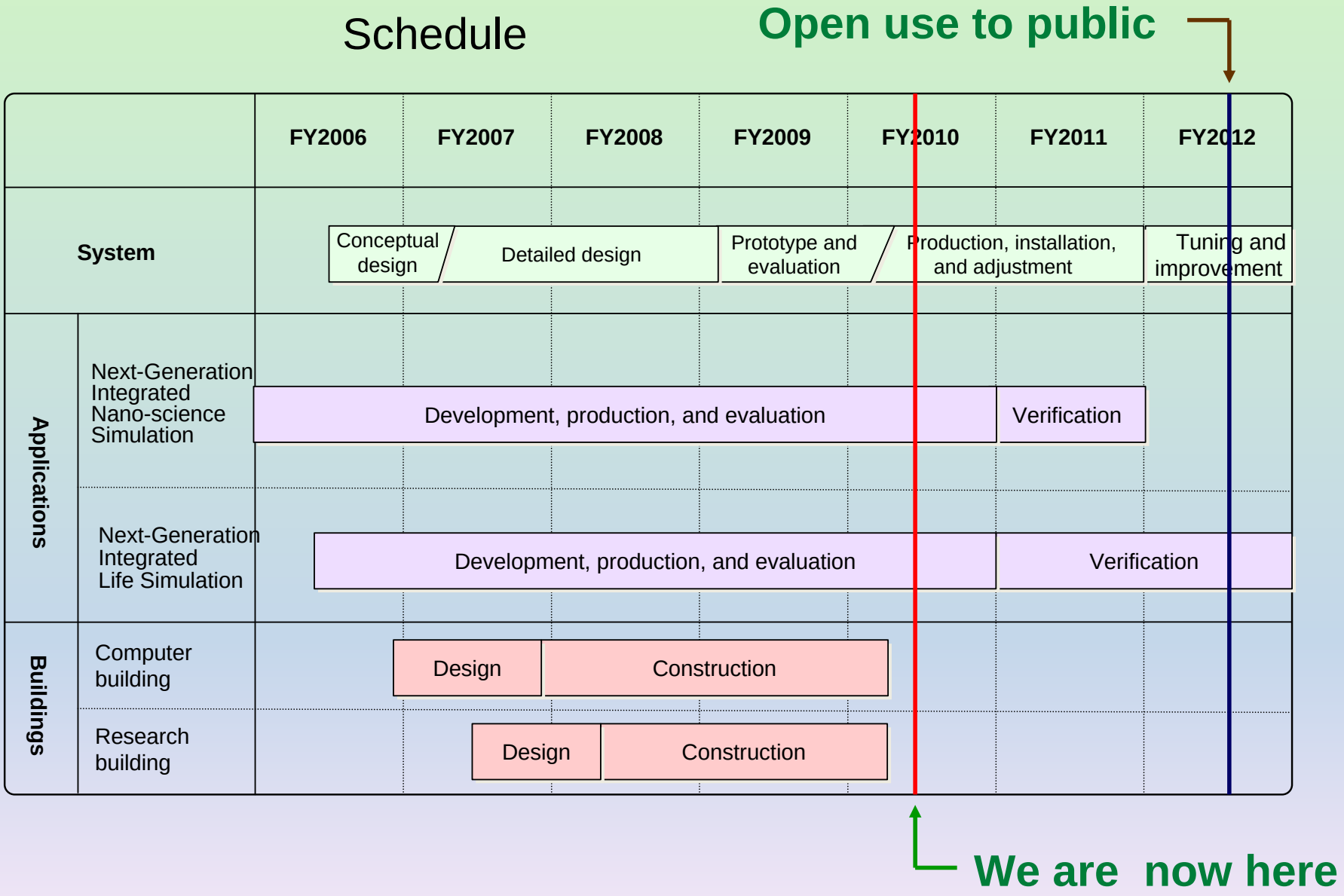




There will more than 800 cabinets

The Next-Generation Supercomputer Project

Schedule



Location of the Supercomputer Site, Kobe-City

450km (280miles) west from Tokyo

Port Island is an artificial island

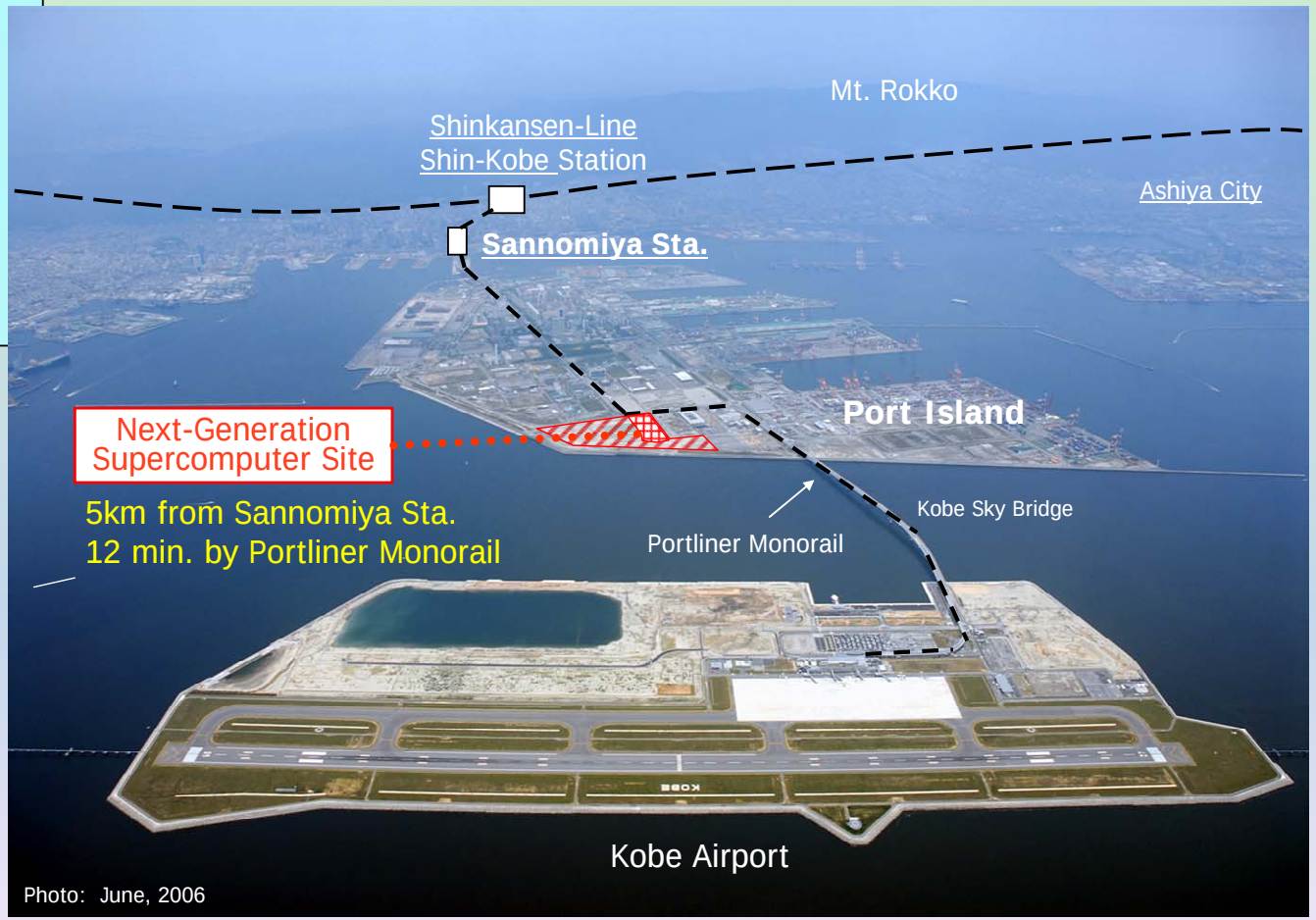


Image of Research and Computer Buildings

(Advanced Institute for Computational Science)

The first cargo of the computer racks have been delivered on Sept. 29.

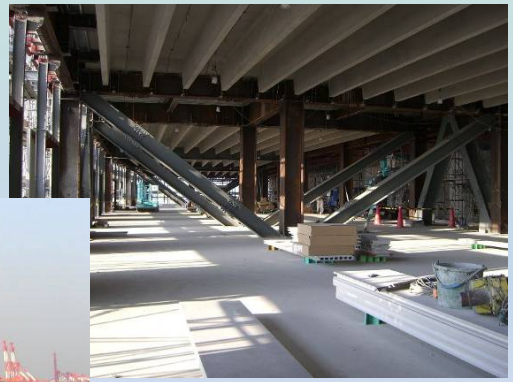
Delivery will continue.

Nearly 200 researchers will work there.

Pictures of Inside of the building

Computer room（3F）

Making a double floor



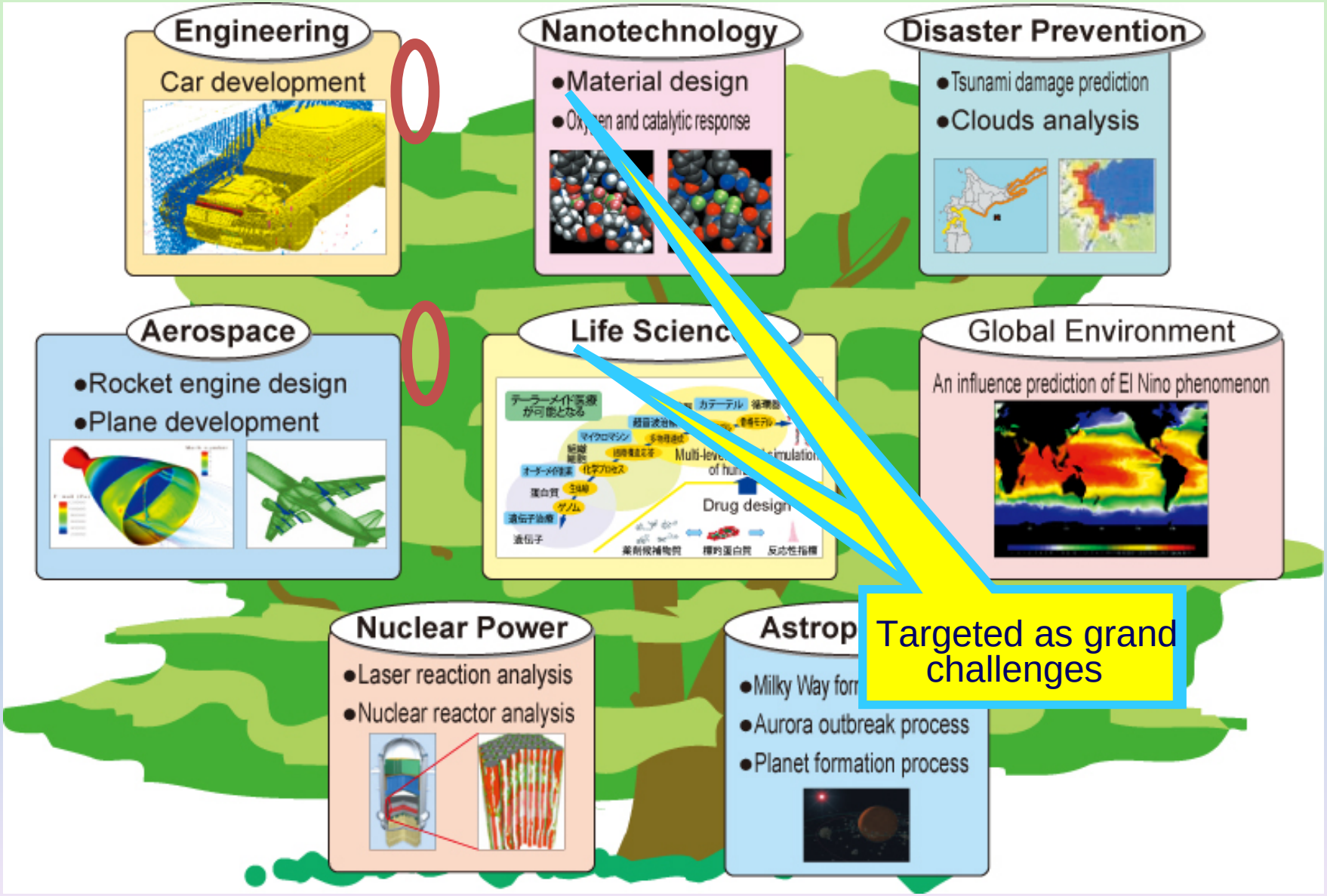
Research building

Chillers

Solar panels on the top

2010/10/7

Major Applications of Next Generation Supercomputer



National Project to Develop Grand Challenges Application Codes

The objective of this project is to develop codes which demonstrate the full capability of the Next Generation Supercomputer

Life Science

Conducting Institute: RIKEN

Budget for 2008 Fiscal Year: 14.4 Million US Dollars

Contributing Institutes and Universities: 14

Nano Science

Conducting Institute: Institute for Molecular Science (IMS)

Budget for 2008 Fiscal Year: 5.6 Million US Dollars

Contributing Institutes and Universities: 6

Basic Concept for Simulations in Life Sciences

Meso

Organ

Micro-machine

http://info.med.vale.edu/

Organism

Vascular System

Blood Circulation

Macro

http://ridge.icu.ac.jp

Tissue Structure

Multi-physics

HIFU

Cell

Tissue

Catheter

RIKEN

Chemical Process

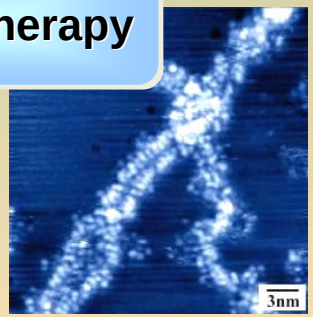
Bio-MD

DDS

Protein

Genome

Gene Therapy



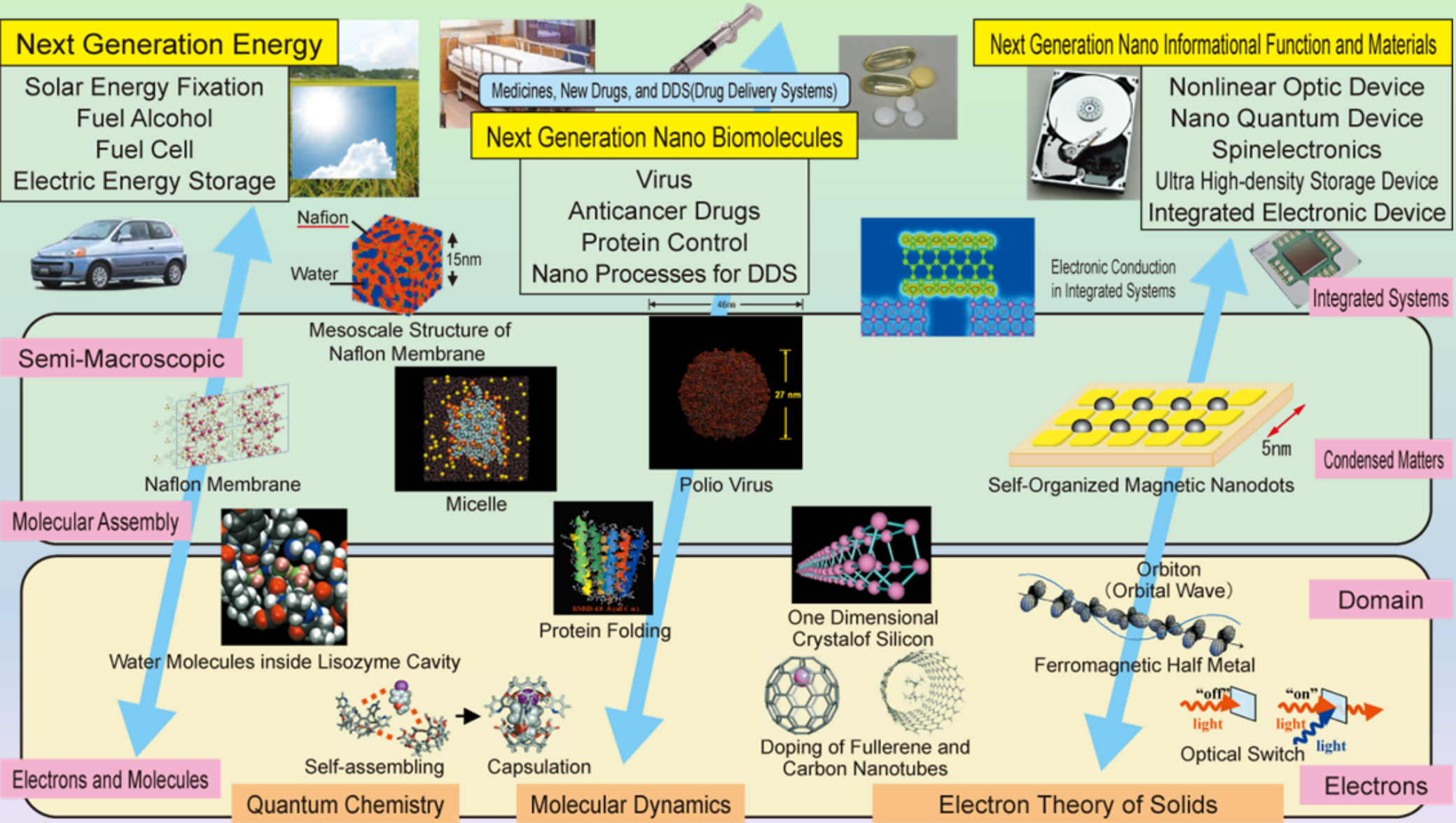
RIKEN

Genes

Micro

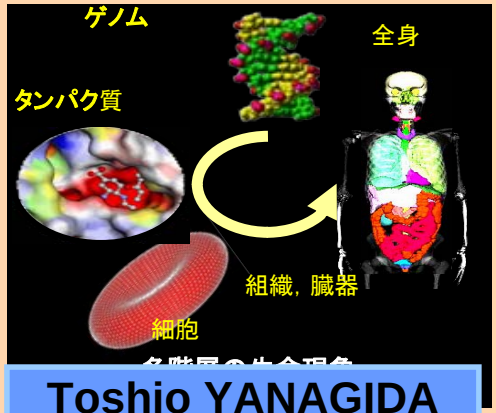
Under total combination of simulation physics …

Basic Concept for Simulations in Nano-Science



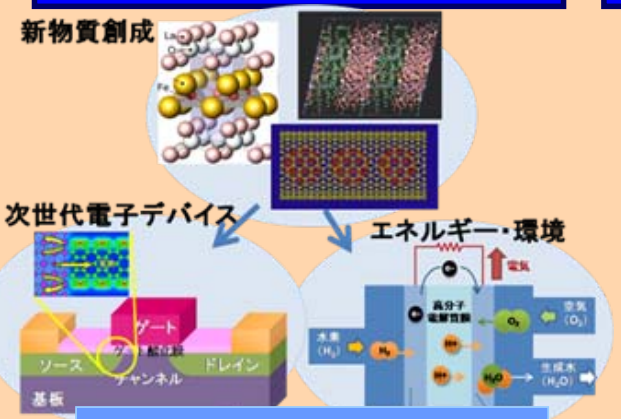
Five Strategic Simulation Fields from National Point of View

Life science/Drug manufacture



Toshio YANAGIDA
RIKEN

New material/energy creation

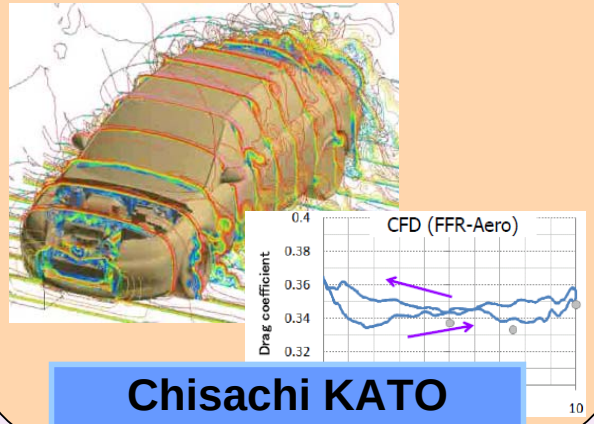


Shinji TUNEYUKI
University of Tokyo

Global change prediction for disaster prevention/mitigation

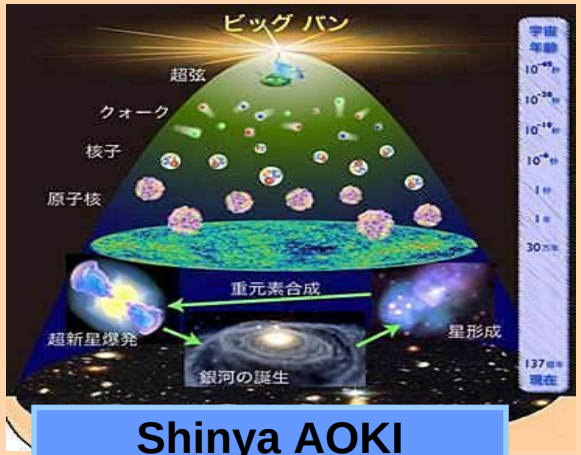
Shiro IMAWAKI
JAMSTEC

Monodukuri (Manufacturing technology)



Chisachi KATO
University of Tokyo

The origin of matters and the universe



Shinya AOKI
University of Tsukuba

Creation of High-Performance Conputing Infra-structure (HPCI)

After re-evaluation of the Next-Generation Supercomputer Project by the new government, the project has been restarted as "Creation of the Innovative High-Performance Conputing Infra-structure (HPCI)".

<Goals of HPCI>

- To establish a hierarchical organization of the Next-Generation Supercomputer linked with other supercomputers at universities
- To set up a large-scale storage system for the Next-Generation Supercomputer and other supercomputers
- To establish a consortium, which will lead the creation of HPCI

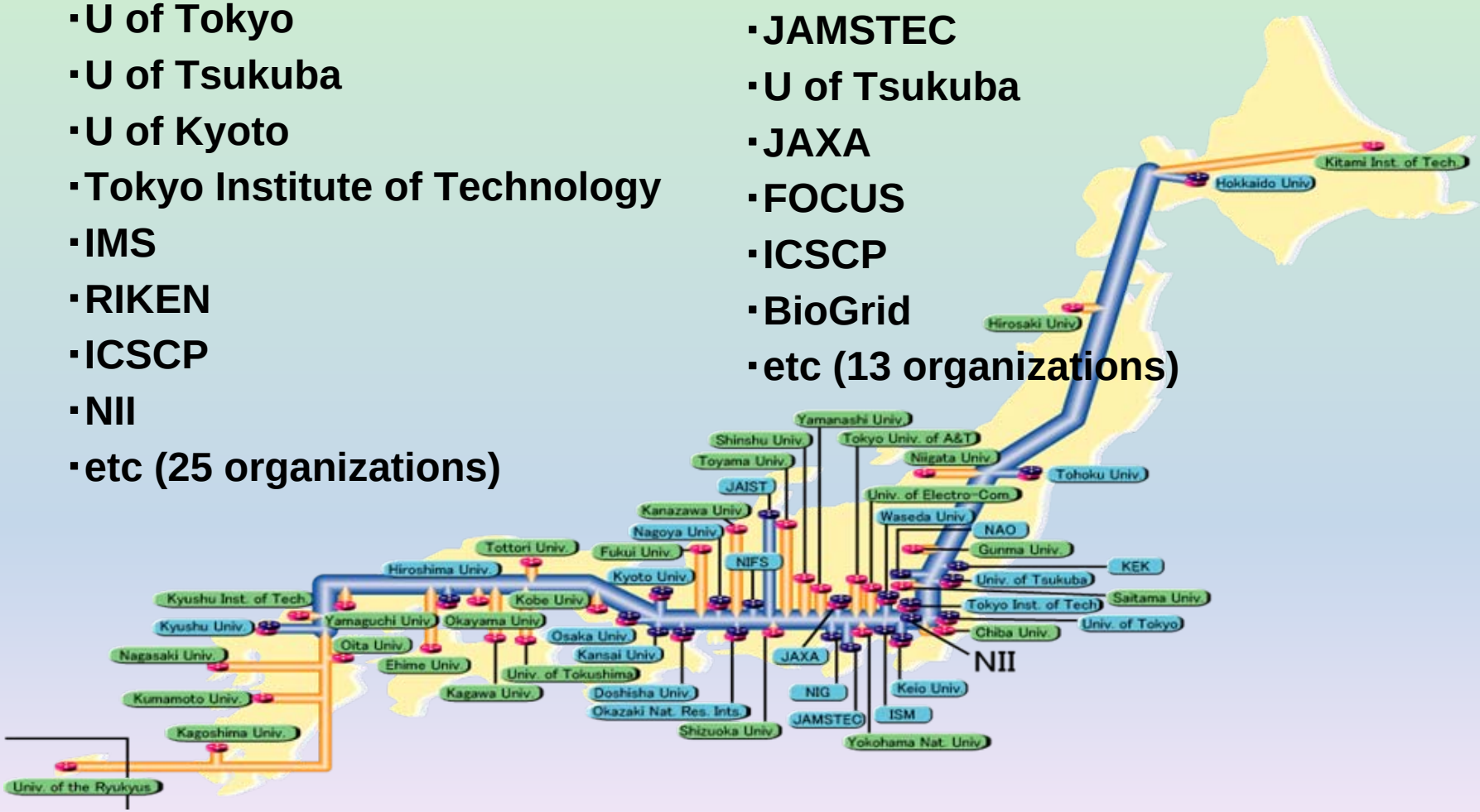
Organizations Participated in HPCI

From Resource Community

- U of Hokkaido
- U of Tohoku
- U of Tokyo
- U of Tsukuba
- U of Kyoto
- Tokyo Institute of Technology
- IMS
- RIKEN
- ICSCP
- NII
- etc (25 organizations)

From User Community

- RIKEN
- Institute for Solid State Physics
- JAMSTEC
- U of Tsukuba
- JAXA
- FOCUS
- ICSCP
- BioGrid
- etc (13 organizations)



The 10 core organizations are now working on figuring out the action plans for HPCI

Activities for Industrial Usage of HPC in Japan

1. Industrial use of university computer under support by MEXT
   - **nearly 40 industries join program organized by MEXT**
   - **Nest Generation Supercomputer will provide CPU hours for industries**

2. Private organizations newly created to promote simulations
   - **organizing seminars and practice of application software**

   ◇FOCUS (**Foundation for Computational Science**)
      - **more than 40 companies joined**
      - **targeting at industries in KANSAI region**

   ◇ ICSCP (Industrial Committee for Super Computing Promotion
      - **more than 170 companies joined**
      - **mainly targeting at industries related manufactures**

   ◇BioGrid (NPO Bio Grid Center KANSAI)
      - **nearly 30 companies joined**
      - **targeting at medical industries for drug designs**

3. SaaS business begun **by software houses as a service provider**
   - **university computers joined as resource providers**

Concluding Remarks

1. Time for simulations to move from fundamental research levels to actual applications both in academic and industrial sectors
   - Giga FLOPS ～: car crush, structure analysis
   - Tera FLOPS ～: global warming prediction, jet-plane designing
   - Peta FLOPS ～: functional materials, tailor made medicine
   - Exa FLOPS ～: ？？？
2. Time to create new mechanisms to let experimentalists use simulations as daily research tools
   - simulation results are nothing but information
   - HPCI will be a first step as the new mechanism
   - HPC cloud or HPC as a Service (HPCaaS) might be an answer
3. Time for computational scientists to truly collaborate with computer scientists for effective use of many node computers
   - entering into un-experienced world of many cores and many nodes
   - necessity of tuning beyond knowledge of computational scientists