# High Performance Computing Infrastructure in JAPAN

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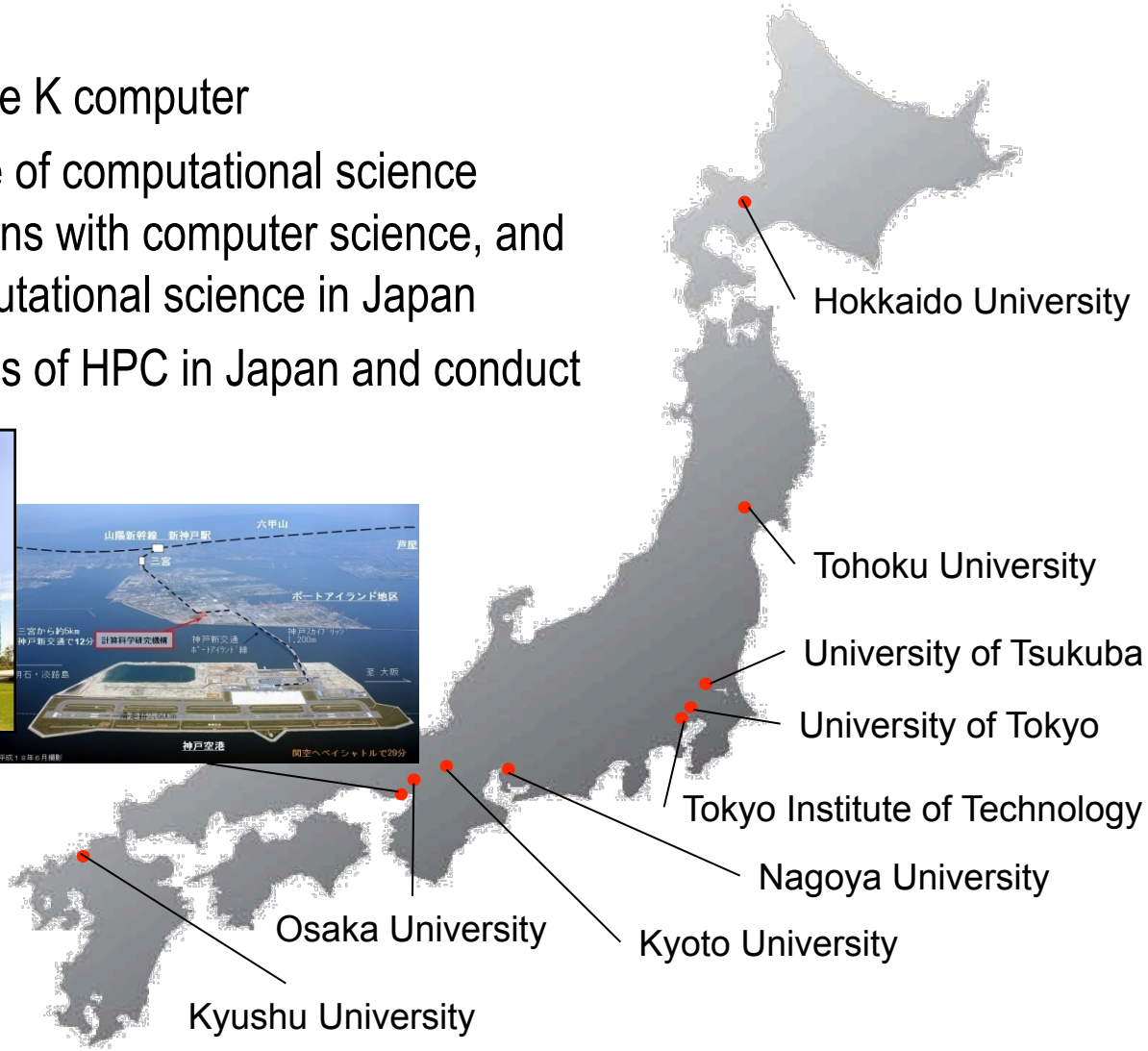
# AICS RIKEN and Supercomputer Centers in Universities

AICS was established at Kobe in July 2010

- Objectives:
  - Taking responsibility to run the K computer
  - Carrying out the leading edge of computational science technologies with collaborations with computer science, and contributing for COE of computational science in Japan
  - Proposing the future directions of HPC in Japan and conduct it.




280 miles from Tokyo



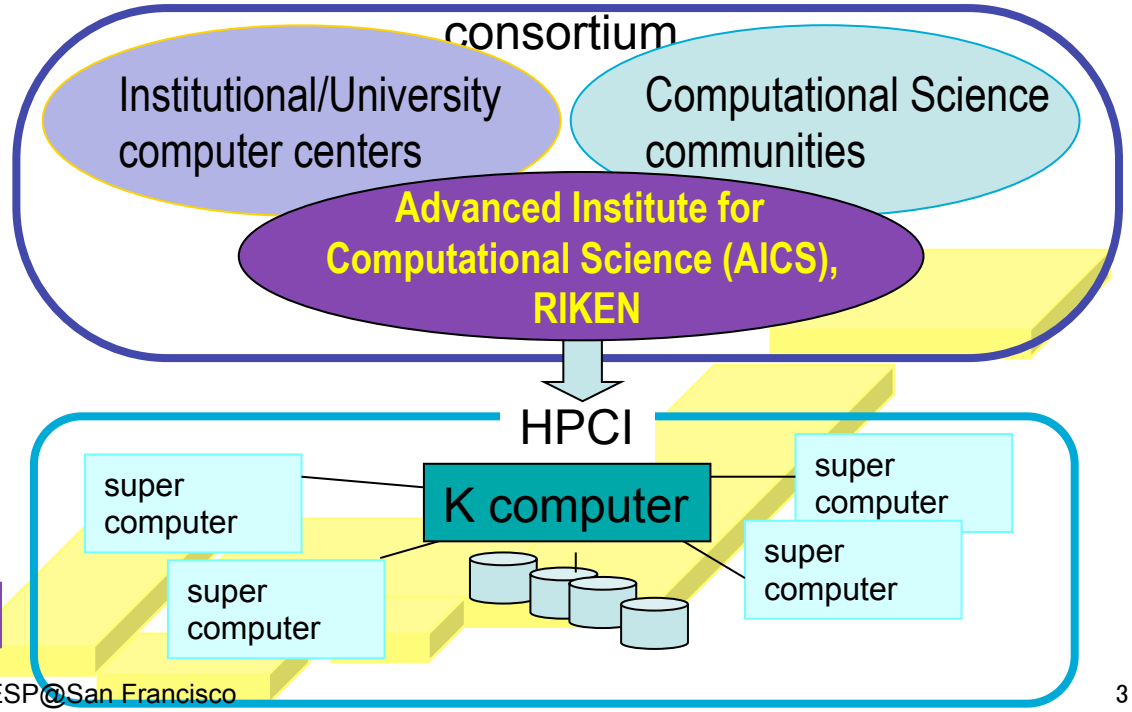
# What is High Performance Computing Infrastructure (HPCI)

- Background:
  - The goal of the Japan Next Generation Supercomputer, K computer, was reconsidered by the new government in terms of accountability for "taxpayers"
  - As a result, creation of the Innovative “High-Performance Computing Infrastructure (HPCI)” has been considered

- HPCI: High-Performance Computing Infrastructure
  - Integrated operation of K computer with other supercomputer centers
  - Seamless access from supercomputers and user's machines to K computer.
  - Large-scale storage systems shared by K computer and others.

- HPCI Consortium
  - To play a role as the main body to design and operate HPCI.
  - To organize computational science communities from several application fields and institutional/university supercomputer centers.
    - Including Kobe Center

The preparatory consortium has been organized



# HPCI Preparatory Consortium Members

## User Communities (13)

- RIKEN
- Computational Materials Science Initiative
- Japan Agency for Marine-Earth Science and Technology
- Institute of Industrial Science at University of Tokyo
- Joint Institute for Computational Fundamental Science
- Industrial Committee for Super Computing Promotion
- Foundation for Computational Science
- BioGrid Center Kansai
- Japan Aerospace Exploration Agency
- Center for Computational Science & e-Systems, Japan Atomic Energy Agency
- National Institute for Fusion Science
- Solar-Terrestrial Environment Laboratory, Nagoya University
- Kobe University

## Resource Providers (25)

- Information Initiative Center, Hokkaido University
- Cyberscience Center, Tohoku University
- Information Technology Center, University of Tokyo
- Information Technology Center, Nagoya University
- Academic Center for Computing and Media Studies, Kyoto University.
- Cybermedia Center, Osaka University
- Research Institute for Information Technology, Kyushu University
- Center for Computational Sciences, University of Tsukuba
- Global Scientific Information and Computing Center, Tokyo Institute of Technology
- Institute for Materials Research, Tohoku University
- Institute for Solid State Physics, University of Tokyo
- Yukawa Institute for Theoretical Physics, Kyoto University
- Research Center for Nuclear Physics, Osaka University
- Computing Research Center, KEK(High Energy Accelerator Research Organization)
- National Astronomical Observatory of Japan
- Research Center for Computational Science, Institute for Molecular Sciencce
- The Institute of Statistical Mathematics
- JAXA's Engineering Digital Innovation Center
- The Earth Simulator Center
- Information Technology Research Institute, AIST
- Center for Computational Science & e-Systems, Japan Atomic Energy Agency
- Advanced Center for Computing and Communication, RIKEN
- Advanced Institute for Computational Science
- National Institute of Informatics
- Research Organization for Information Science & Technology

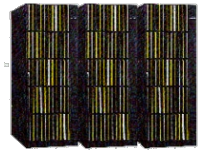
# Four Key Resources in HPCI

- Computational Resources
- Storage Resources
- Internet Resources
- Human Resources

# AICS and Supercomputer Centers in Japanese Universities

**AICS, RIKEN：**
**K computer** (10 Pfflops, 4PB)
Available in 2012

**Hokkaido Univ.：**
SR11000/K1(5.4Tflops, 5TB)
PC Cluster (0.5Tflops, 0.64TB)



**Kyoto Univ.**
T2K Open Supercomputer
(61.2 Tflops, 13 TB)

**Tohoku Univ.：**
NEC SX-9(29.4Tflops, 18TB)
NEC Express5800 (1.74Tflops, 3TB)

**Osaka Univ.：**
SX-9 (16Tflops, 10TB)
SX-8R (5.3Tflops, 3.3TB)
PCCluster (23.3Tflops, 2.9TB)

**Univ. of Tsukuba：**
T2K Open Supercomputer
95.4Tflops, 20TB

**Kyushu Univ.：**
PC Cluster (55Tflops, 18.8TB)
SR16000 L2 (25.3Tflops, 5.5TB)
PC Cluster (18.4Tflops, 3TB)

**Univ. of Tokyo：**
T2K Open Supercomputer
(140 Tflops, 31.25TB)

A 1 Pflops machine without accelerator will be installed by the end of 2011

**Nagoya Univ.：**
FX1(30.72Tflops, 24TB)
HX600(25.6Tflops, 10TB)
M9000(3.84Tflops, 3TB)

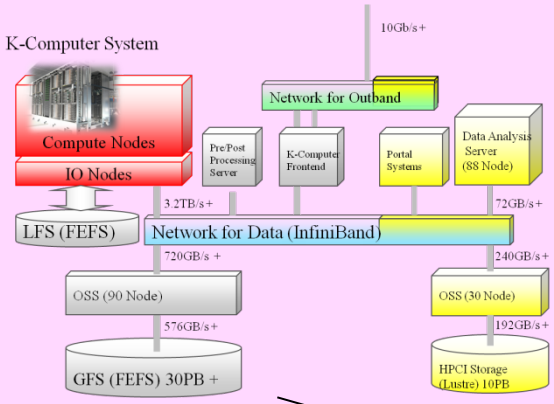
**Tokyo Institute of Technology：**
Tsubame 2
(2.4 Pflops, 100TB)

# Initial Storage System in HPCI

## HPCI WEST HUB

AICS, RIKEN

- 10 PB storage (30 OSS)
- Cluster for data analysis (88 node)



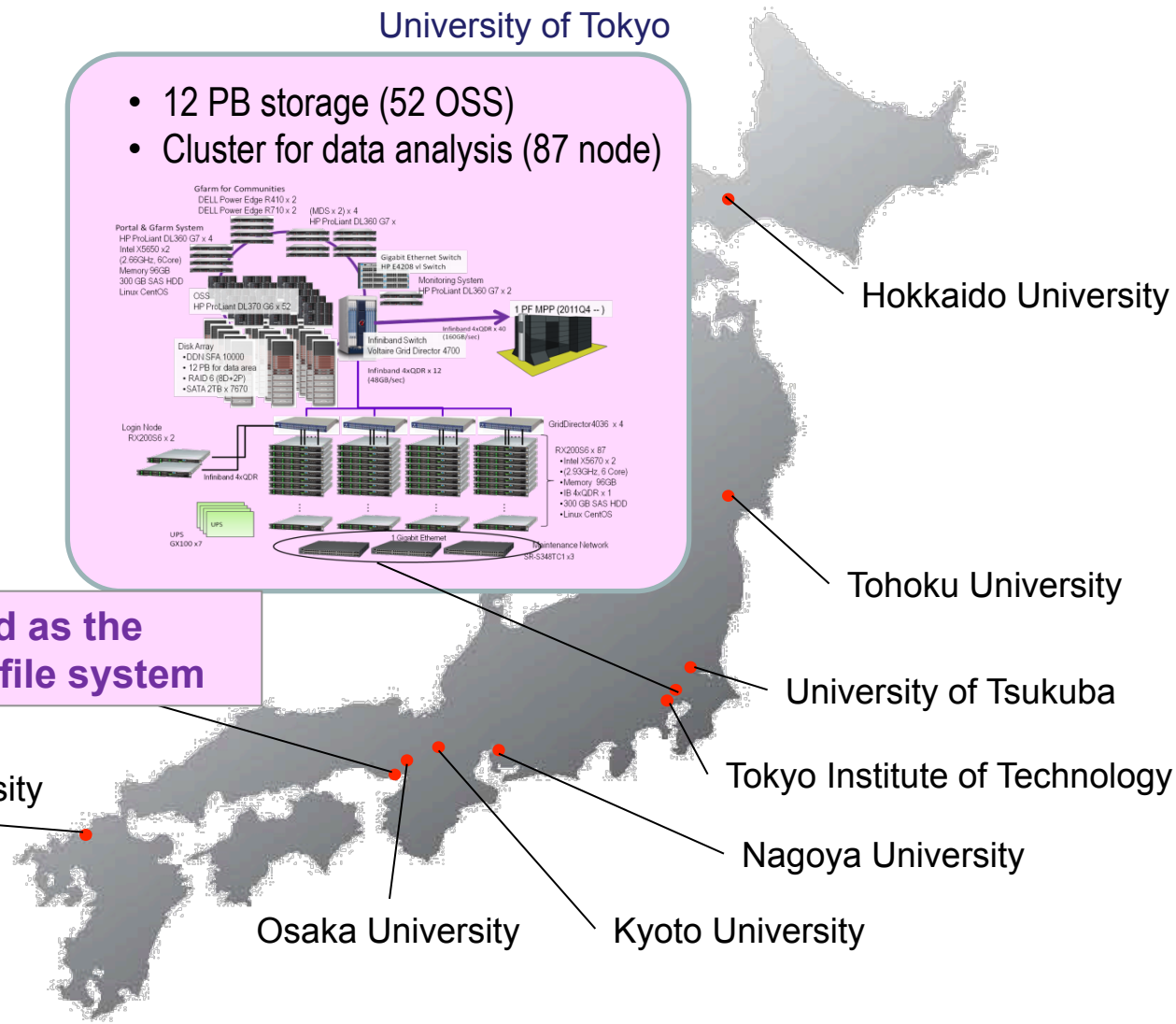

## HPCI EAST HUB

University of Tokyo

- 12 PB storage (52 OSS)
- Cluster for data analysis (87 node)

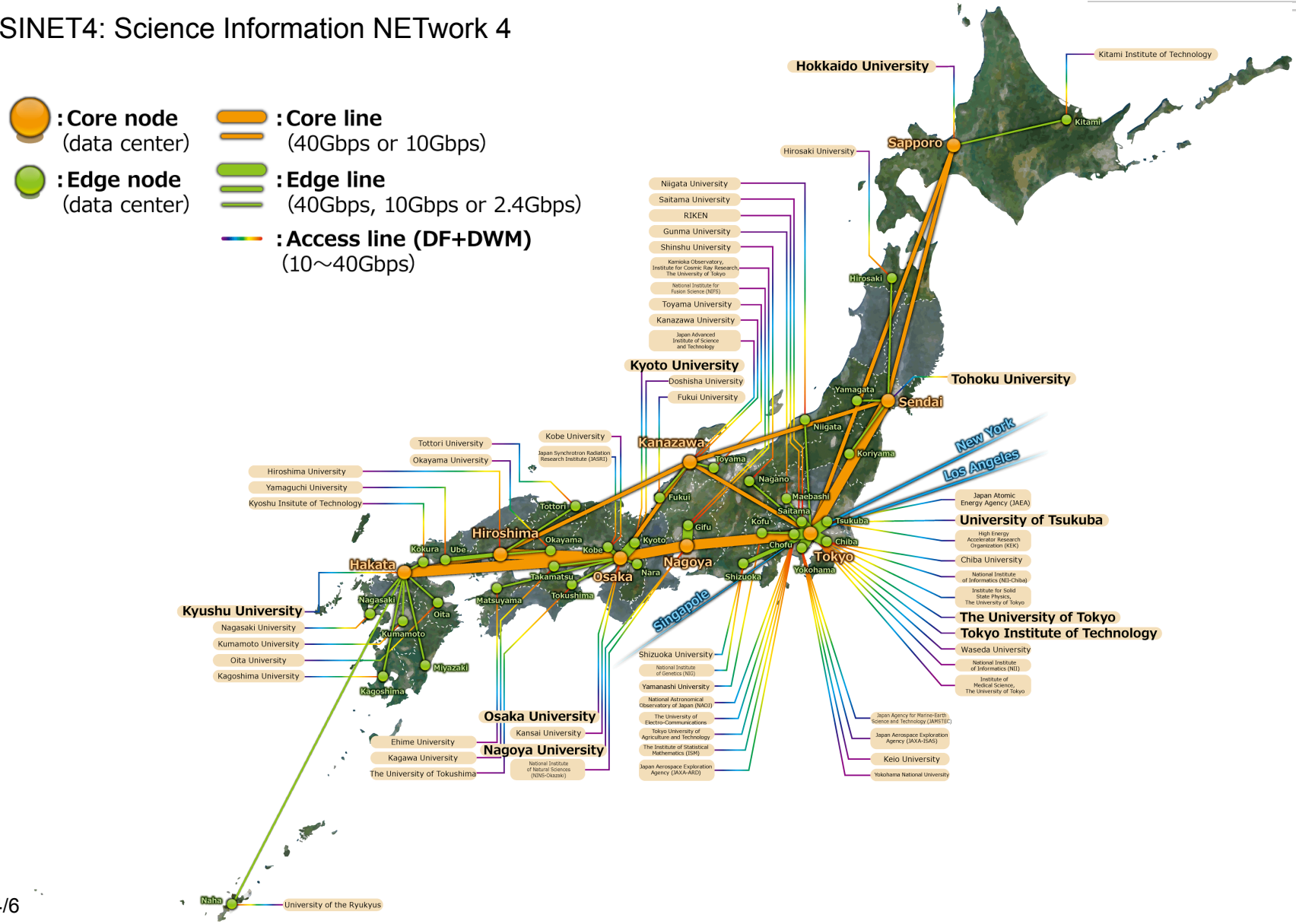



**Gfarm2 is used as the global shared file system**



# Network Infrastructure: SINET4

SINET4: Science Information NETwork 4

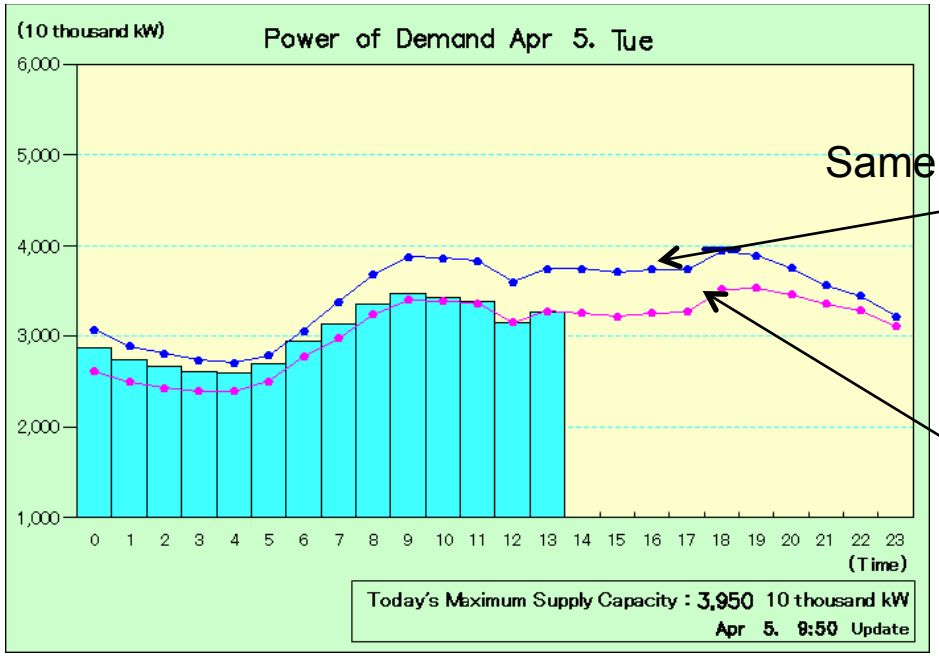


# Development of Human Resource

- Three kinds of researchers and engineers
  - Application Users
  - Application Developers
  - Researchers and developers for making advanced computing environments
    - New programming models & languages, runtime systems, architectures, and hardware
- Development of human resource is the important role of the HPCI consortium

# Power Consumption in Great Tokyo Area

- After the big earthquake/tsunami happens, planned power outage has been scheduled everyday due to the limited power supply (35 GW at disaster).
- Tokyo Electric Power Company expect 55GW in **peek demand** of this summer (more than 60 GW if excessive heat), but only 46.5 GW can be supplied at the summer time.
  - This means about **30 % power cut** in peek is required
- This situation will continue for several years




Same day in last year

Yesterday

39.5 GW

# What are impacts and considerations

- A new machine, the Univ. of Tokyo will install in the end of this year, requires much power consumption, around 1 MW for 1 Pflops
- The total power consumption will increase 1.5 times larger than the last year at the Univ. of Tokyo
- 30 % power cut is based on the last year's record !
  - Though 1 PFlops machine is introduced, only a half or less of machine power can be used

- Peek-power-aware Job scheduling with smart Grid is required for supercomputers in the great Tokyo area !

# Power Consumption at U. of Tokyo

50 MW to 30 MW

The University is now thinking 30 % peak power consumption cut