



筑波大学
University of Tsukuba



東京大学
THE UNIVERSITY OF TOKYO

University of Tsukuba and University of Tokyo

Joint Center for Advanced HPC



Mitsuhisa Sato

Manager, JCAHPC

Background (as of 2011-2012)

- Computational science, by Large-scale simulations using high-performance supercomputers (HPC), is a critical and cutting-edge methodology in all of science and engineering disciplines in 21th Century.
- The K computer is now in service for the public users since September 2012. To keep the amount of computing resource at the current level in our country, centers in universities should make an effort to develop and acquire a high-level computing resource.
- We did T2K effort, which design, acquire & operate the next supercomputer as a part of inter-university computing resources, making “Open supercomputer” alliance with Univ. of Tokyo and Kyoto Univ (T2K).
- JCAHPC is an extended effort from T2K.

Computing resources in HPCI

As of Jun 2012

AICS, RIKEN :
K computer (11.28 PF, 1.27PiB)



Hokkaido Univ. :
SR16000/M1(172TF, 22TB)
BS2000 (44TF, 14TB)



Kyoto Univ.
XE6 (300.8 TF, 59 TB)
GreenBlade8000(242.5TF, 38TB)
2548X(10.6TF, 24TB)



Osaka Univ. :
SX-9 (16TF, 10TB)
SX-8R (5.3TF, 3.3TB)
PCCluster (6.1TF, 2.0TB)



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



Univ. of Tsukuba :
T2K (95.4Tflops, 20TB)
HA-PACS (802Tflops, 34.3TB)
FIRST (36.1TFlops, 1.6TB)



Kyushu Univ. :
FX10 (181.6TF, 24TB)
CX400 (510.1TF, 184.5TB)
SR16000 L2 (25.3Tflops, 5.5TB)



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



Univ. of Tokyo :
FX10 (1.13PF, 150TB)
SR16000/M1(54.9TF, 10.94TB)
T2K (140 TF, 31.25TB)

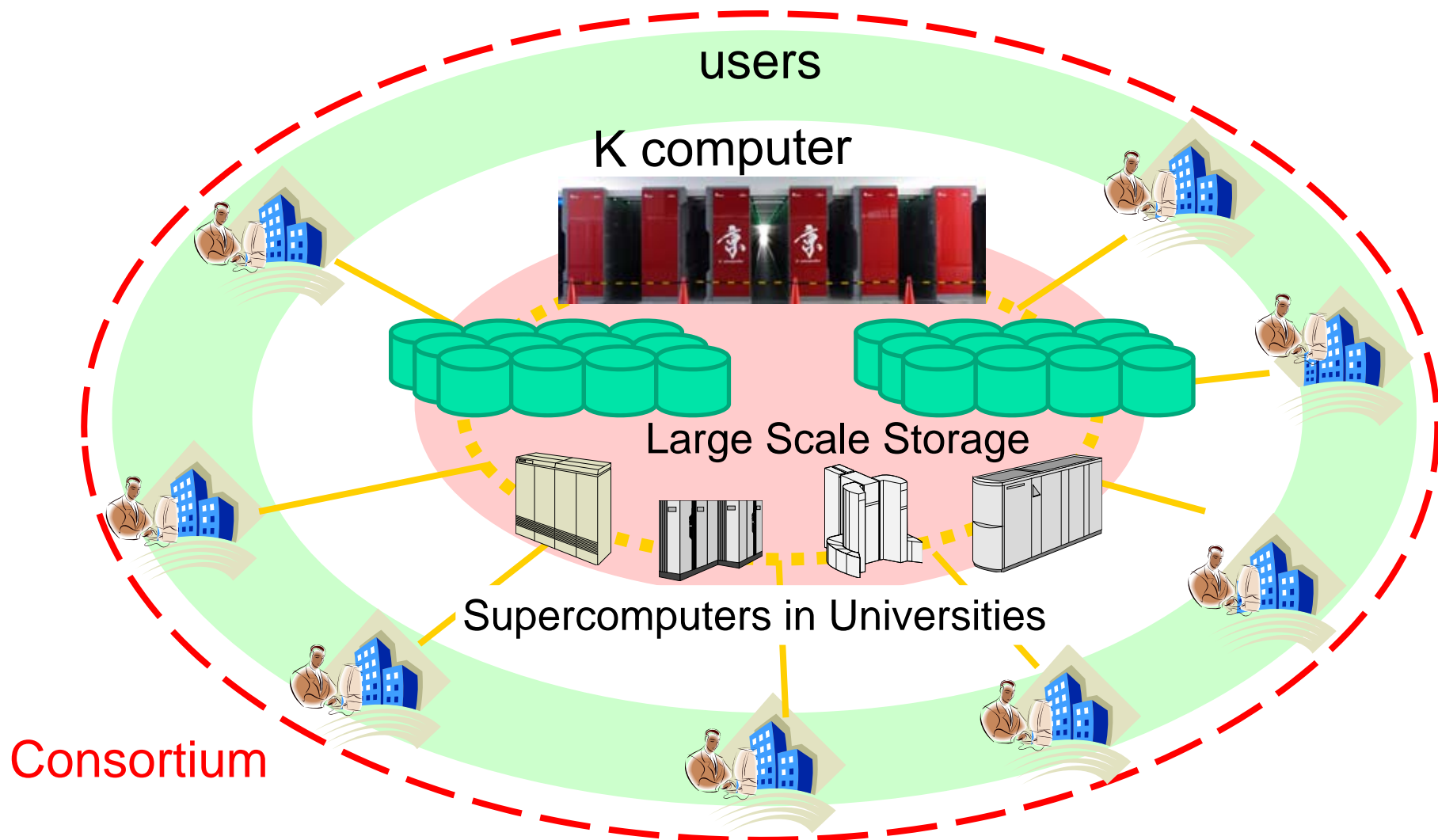


Tokyo Institute of Technology :
TSUBAME2.0 (2.4 PF, 100TB)



11.28 PF + 0.757496 PF + 2.21248 PF

The Conceptual View of HPCI

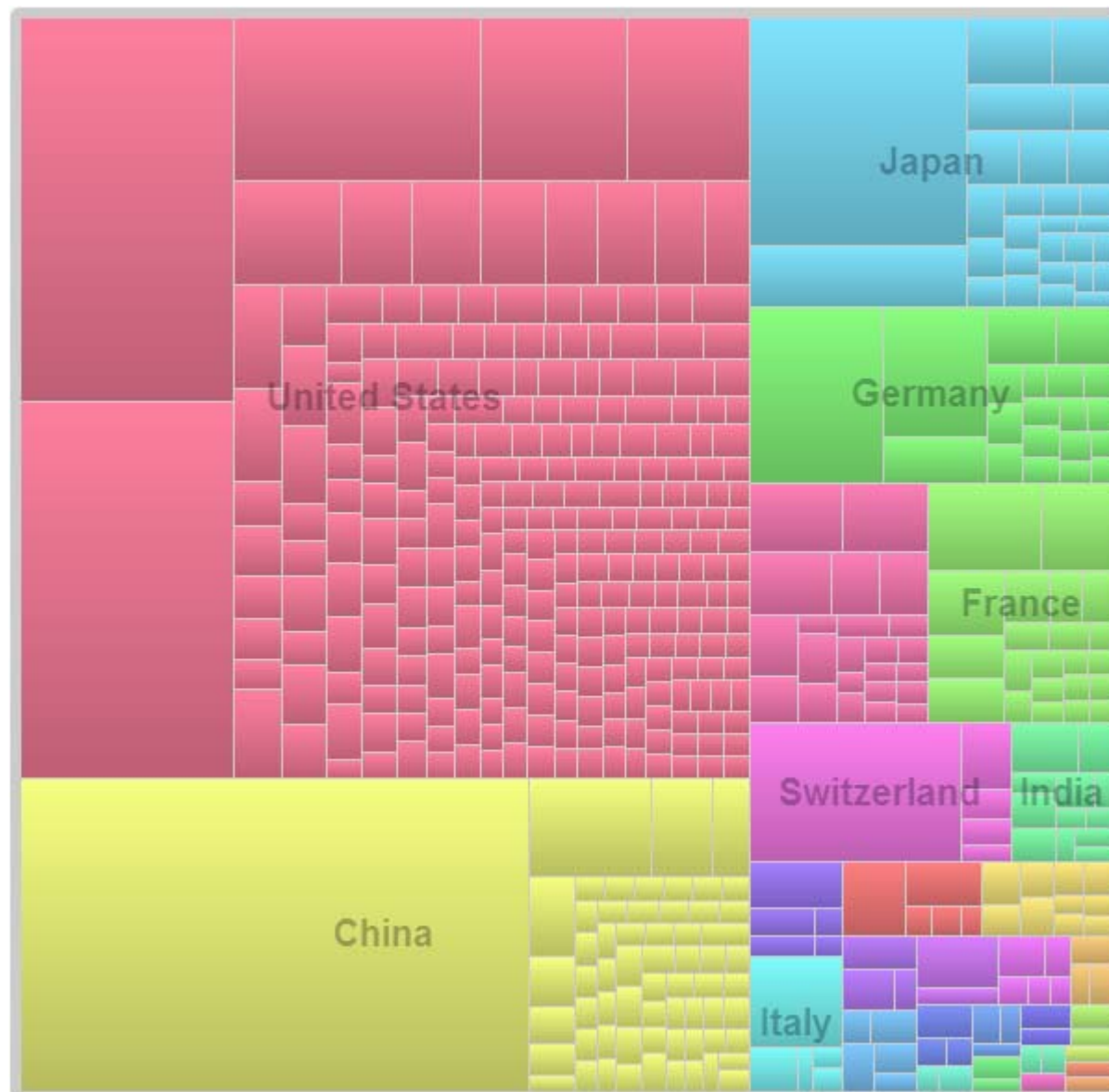


HPCI is a comprehensive advanced computing infrastructure in which the supercomputers and large scale storages are connected together through the high speed network.

June 2013

| Rank | Name | | Installation | Vender | System, Processor Interconnect | Cores | Rmax Rpeak (TFlop/s) | Power (kW) |
|------|-------|--------------------------------|--|------------------|---|--------|----------------------------------|---------------|
| | Japan | World | | | | | | |
| 1 | 4 | K computer 京 | RIKEN dvanced Institute for Computational Science | Fujitsu | SPARC64 VIIIfx .0GHz, Tofu interconnect | 705024 | 10510.0 11280.4 | 12660 |
| 2 | 20 | Helios (愛称:六ちゃん) | International Fusion Energy esearch Centre(IFERC),EU(F4E) – apan Broader Approachcollaboration | Bull SA | Bullx B510, Xeon E5-2680 8C .700GHz, Infiniband QDR | 70560 | 1237.0 1524.1 | 2200 |
| 3 | 21 | TSUBAME 2.0 | GSIC Center, Tokyo Institute of Technology | NEC/HP | HP ProLiant SL390s G7 Xeon 6C X5670, Nvidia GPU, inux/Windows | 73278 | 1192.0 2287.6 | 1399 |
| 4 | 26 | Oakleaf-FX オークリーフ FX | Information Technology Center, The University of Tokyo | Fujitsu | PRIMEHPC FX10, SPARC64 IXfx 6C 1.848GHz, Tofu interconnect | 76800 | 1043.0 1135.4 | 1177 |
| 5 | 43 | – | Research Institute for Information Technology, Kyushu University | Fujitsu | Fujitsu PRIMERGY CX400, eon E5-2680 8C 2.700GHz | 23616 | 621.0 812.0 | – |
| 6 | 47 | – | Central Research Institute of Electric Power Industry (CRIEPI) | SGI | SGI Altix X, Xeon E5-2670 C 2.600GHz, Infiniband FDR | 32256 | 582.1 670.9 | 720 |
| 7 | 50 | HIMAWARI ひまわり | High Energy Accelerator Research Organization (KEK) | IBM | BlueGene/Q, Power BQC 6C 1.600GHz, Custom Interconnect | 49152 | 536.7 629.1 | 247 |
| 8 | 51 | SAKURA さくら | High Energy Accelerator Research Organization (KEK) | IBM | BlueGene/Q, Power BQC 16C 1.60GHz, | 49152 | 536.7 629.1 | 247 |
| 9 | 62 | HA-PACS | Center for Computational Sciences, University of Tsukuba | Cray Inc. | Xtream-X GreenBlade 8204, eon E5-2670 8C 2.600GHz, nfiniband QDR, NVIDIA 2090 | 20800 | 421.6 778.1 | 407 |

Nov. 2013



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- The K computer is now in service for the public users since September 2012. To keep the amount of computing resource at the current level in our country, centers in universities should make an effort to develop and acquire a high-level computing resource.
- We did T2K effort, which design, acquire & operate the next supercomputer as a part of inter-university computing resources, making “Open supercomputer” alliance with Univ. of Tokyo and Kyoto Univ (T2K).
- JCAHPC is an extended effort from T2K.

T2K Open Supercomputer Alliance

- Primary aiming at design of common specification of new supercomputers.
- Now extending to collaborative work on research, education, grid operation, ..., for inter-disciplinary computational (& computer) science.
- *Open* hardware architecture with commodity devices & technologies.
- *Open* software stack with open-source middleware & tools.
- *Open* to user's needs not only in FP & HPC field but also IT field.

Kyoto Univ.

416 nodes (61.2TF) / 13TB

Linpack Result:

Rpeak = 61.2TF (416 nodes)

Rmax = 50.5TF (82.51 %)



Univ. Tokyo

952 nodes (140.1TF) / 31TB

Linpack Result:

Rpeak = 113.1TF (512+256 nodes)

Rmax = 83.0TF (73.38 %)



Univ. Tsukuba

648 nodes (95.4TF) / 20TB

Linpack Result:

Rpeak = 92.0TF (625 nodes)

Rmax = 76.5TF (83.15 %)

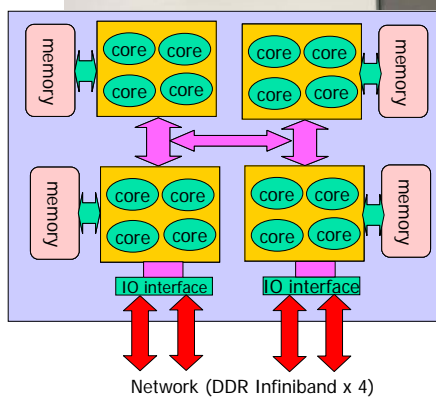


T2K Tsukuba System

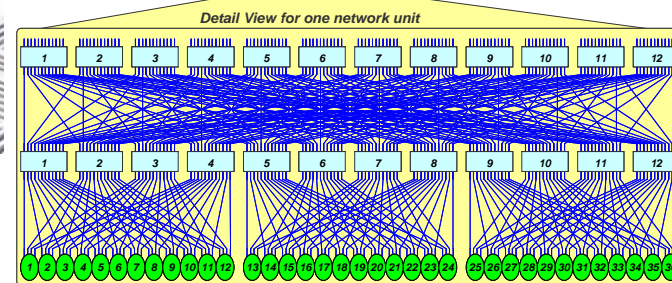
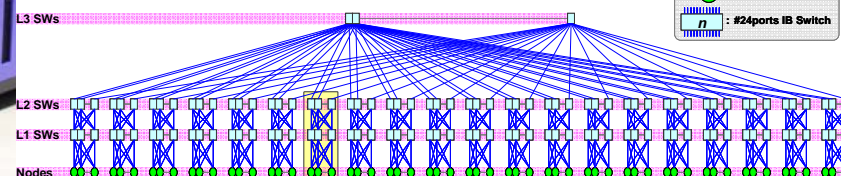
(T2K: Tsukuba, Tokyo and Kyoto Open Supercomputer Alliance)



648 nodes
 Peak performance : 95.4TF
 (95.4 trillion 10^{12} operations/sec)
 Memory 20TB
 Disk 800TB
 Linpack Result:
 Rpeak = 92.0TF (625 nodes)
 Rmax = 76.5TF (83.15 %)
 20th position in 2008 Jun Top500



Full bi-sectional FAT-tree Network



| Item | # |
|----------------|-----|
| Node | 696 |
| Level 3 switch | 144 |
| Level 2 switch | 240 |
| Level 1 switch | 232 |
| Total switch | 616 |

※ノード総数696台には
 オンラインのスペア
 ノード4台を含みます。

Motivation

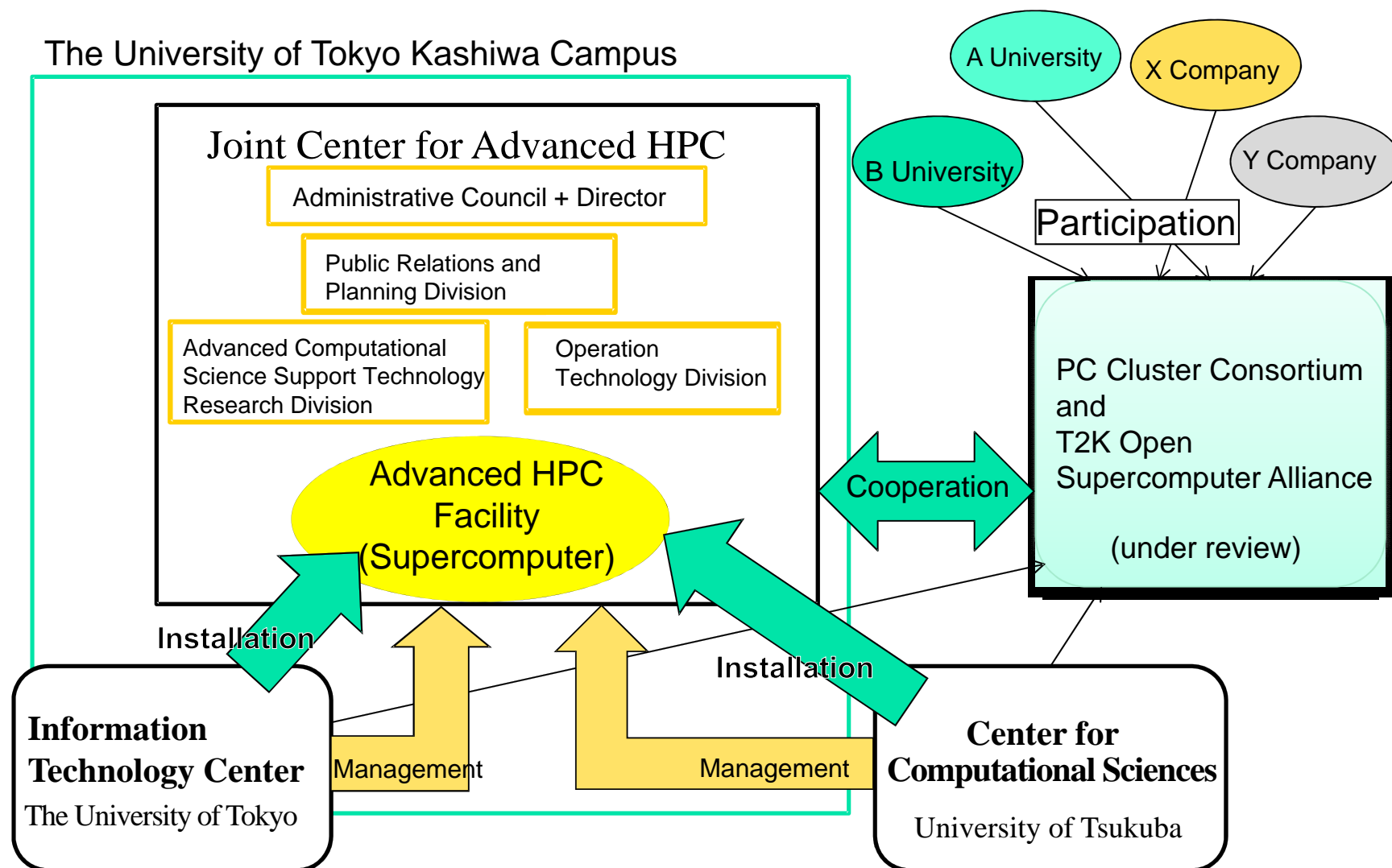
- We started a discussion on next step of T2K effort from 2011
 - What's are advantages and disadvantages of installation in one place.
 - Changes of conditions and environments for high-end supercomputers.
 - Budget so far ... , Space and Power supply now
 - How to organize a joint-center
 - Consortium ?, ...
- In 2012, both University of Tsukuba and University of Tokyo reached an agreement
 - Exchanges the MOU about collaborations on JCAHPC between presidents of both universities



Joint Center for Advanced HPC (JCAHPC)

- The objective of the JCAHPC mission is to design and develop of a large-scale HPC system worthy of becoming the hub of Japan's computational sciences, and to design an advanced system that exploits **many-core technology**, which is expected to be the key to the coming HPC systems.
- JCAHPC was organized to handle the installation of a supercomputer system, designed (for the most part) by the faculties of both organizations, at the Information Technology Center (ITC) at the Kashiwa Campus of the University of Tokyo.
- This system is scheduled to be installed for operation and management in **2015**. We expect the system to be installed will have more than **20PF** in theoretical peak performance.

Organization and structure of JCAHPC



Manager (Director): Mitsuhsa Sato (U. Tsukuba)
Deputy Manager: Yutaka Ishikawa (U. Tokyo)

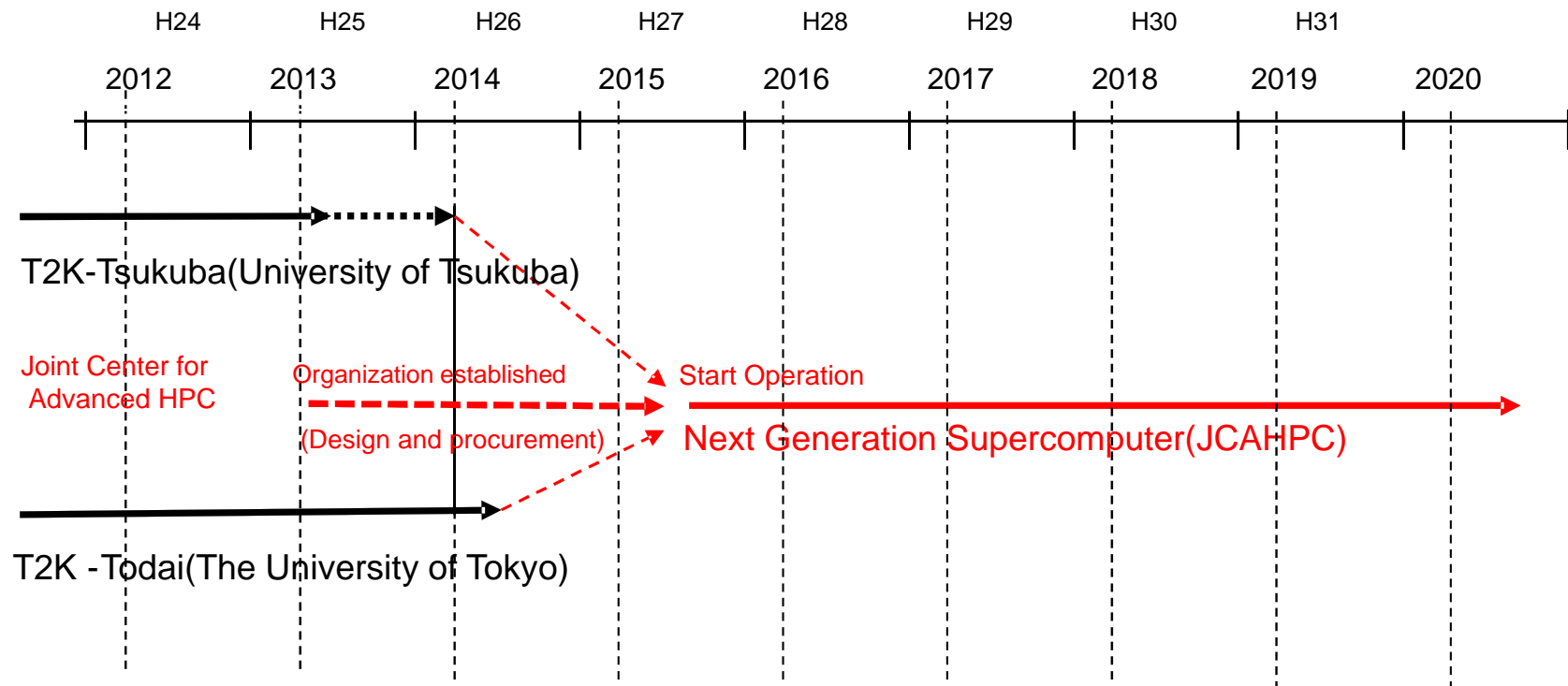
Mission ① Development of next-generation large-scale HPC systems

- Design of the next-generation supercomputing system by using timely advanced technologies.
 - A key to design high-performance system is how to integrate advanced technologies and high-end components.
 - We will focus on many-core technologies as a main component.
- Design and development of system software and libraries, applications for the system.
 - Operating system kernel for manycore, McKernel
 - Programming language for manycore such as XcalableMP
 - others, ...
- Organize collaborations with other university centers and research institution

Mission ② joint procurement, and installation, management of the system

- Based on this design and development, the institutions will jointly procure, operate, and administer the supercomputer.
- A plan is to share the system by the amount of computing resources (#time x #node)
 - Both centers (U Tsukuba and U Tokyo) will perform their own program by shared resources.
 - Organizing joint projects for advanced computational sciences.
 - Saving cost of management and maintenance.
 - Sharing "know-how" about programming of manycore and management, ...
- This project (joint procurement, and installation, management of supercomputers) is the first project to install the system together in one place from two centers in Japan.

Schedule and Status



- Currently, under RFI (Request for Information)
- COMA: a pilot manycore system for JCAHPC post-peta system in 2014.
- We are working on system design, benchmark programs
 - We expect a system with > 20PF theoretical peak performance.
- RFP 3Q/2014, Bedding at end of 1Q/2015
- Installation and operation, 3Q/2015