

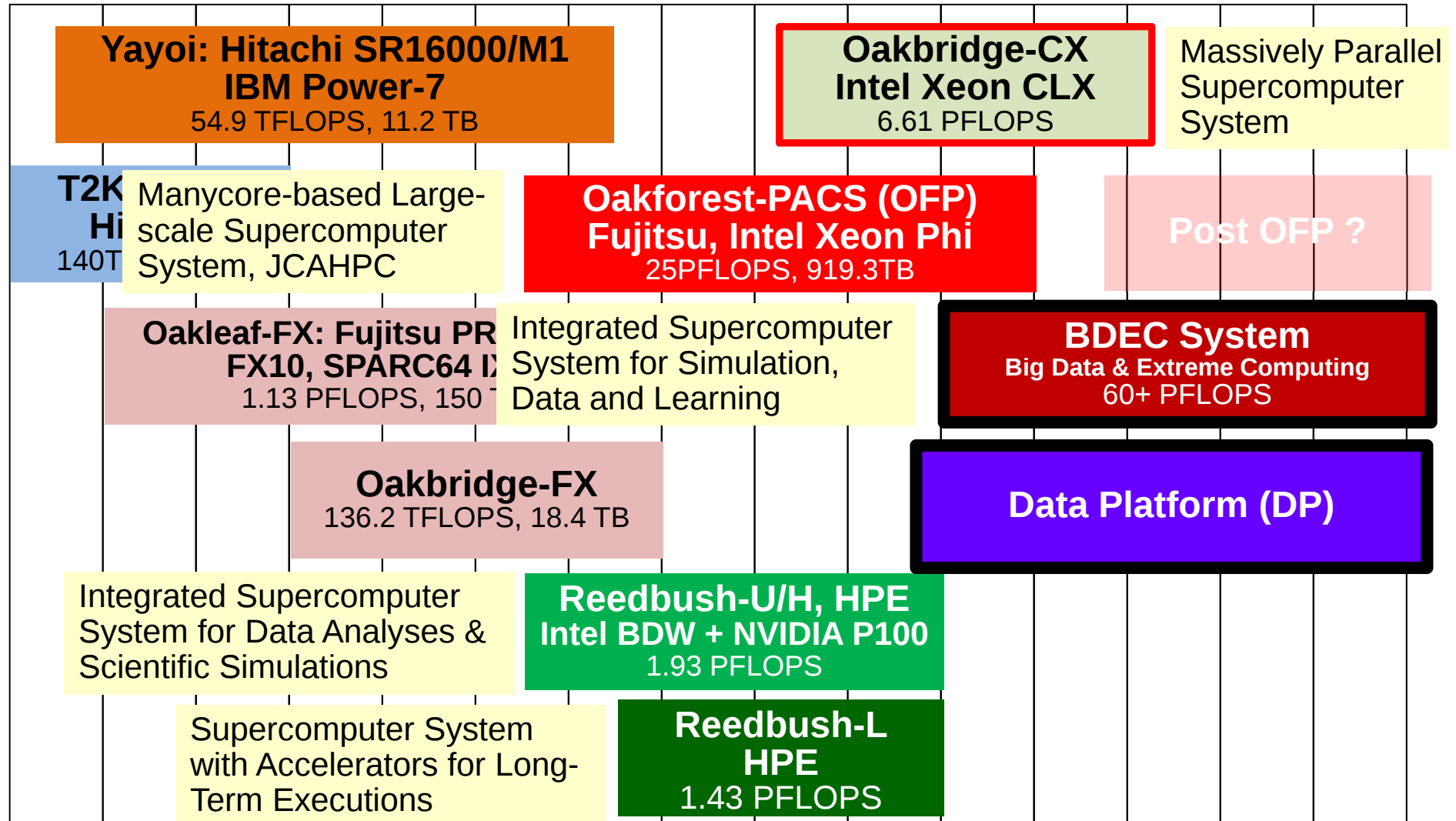
Overview of Oakbridge-CX

How to Login

Information Technology Center
The University of Tokyo

<http://www.cc.u-tokyo.ac.jp/>

FY11 12 13 14 15 16 17 18 19 20 21 22 23 24 25



Now operating 3 Systems !!

2,000+ users (1,000 from outside of U.Tokyo)

- **Reedbush (HPE, Intel BDW + NVIDIA P100 (Pascal))**
 - Integrated Supercomputer System for Data Analyses & Scientific Simulations
 - Jul.2016-Jun.2020
 - [Our first GPU System](#), DDN IME (Burst Buffer)
 - Reedbush-U: CPU only, 420 nodes, 508 TF (Jul.2016)
 - Reedbush-H: 120 nodes, 2 GPUs/node: 1.42 PF (Mar.2017)
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- **Oakforest-PACS (OFP) (Fujitsu, Intel Xeon Phi (KNL))**
 - JCAHPC (U.Tsukuba & U.Tokyo)
 - 25 PF, #16 in 53rd TOP 500 (June 2019) (#2 in Japan)
 - Omni-Path Architecture, DDN IME (Burst Buffer)
- **Oakbridge-CX (OBCX) (Fujitsu, Intel Xeon Platinum 8280, CLX)**
 - Massively Parallel Supercomputer System
 - 6.61 PF, #45 in 53rd TOP 500, July 2019-June 2023
 - SSD's are installed to 128 nodes (out of 1,368)



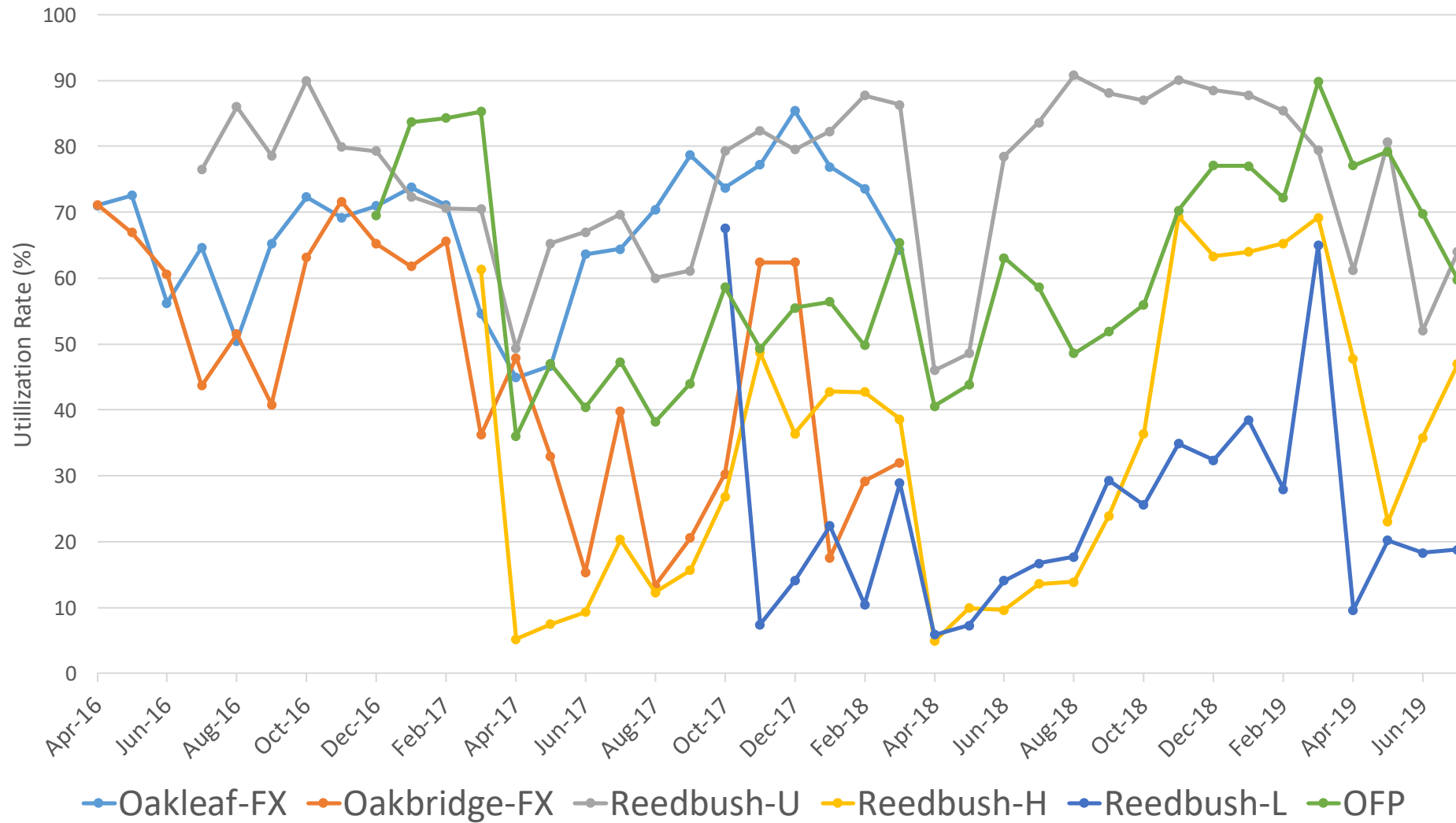
Recently Retired Systems

Fujitsu PRIMEHPC FX10 Commercial Version of K

- Oakleaf-FX (Fujitsu PRIMEHPC FX10)
 - 1.135 PF, Apr.2012-Mar.2018
- Oakbridge-FX (Fujitsu PRIMEHPC FX10)
 - 136.2 TF, Apr.2014-Mar.2018
 - for long-time use (up to 168 hr's)



Utilization Rate (Apr. 2016 - Jul. 2019)



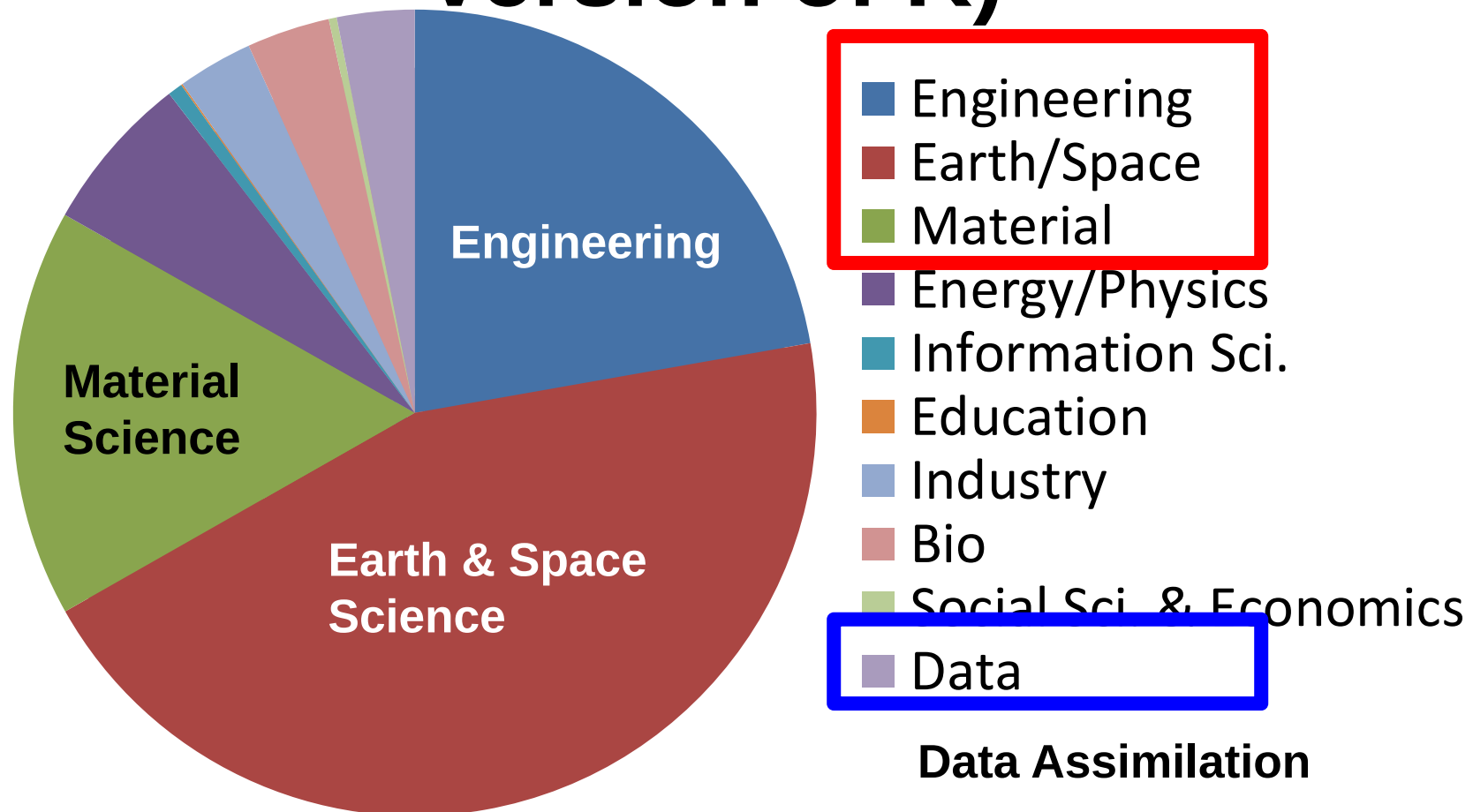
[R.Nakahari (ITC/U.Tokyo)]

JPY (=Watt)/GFLOPS Rate

Smaller is better (efficient)

System	JPY/GFLOPS
Oakleaf/Oakbridge-FX (Fujitsu) (Fujitsu PRIMEHPC FX10)	125
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Reedbush-L (HPE) (Intel BDW+NVIDIA P100x4/node)	13.4
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Research Area based on CPU Hours⁷ FX10 in FY.2017 (Commercial Version of K)

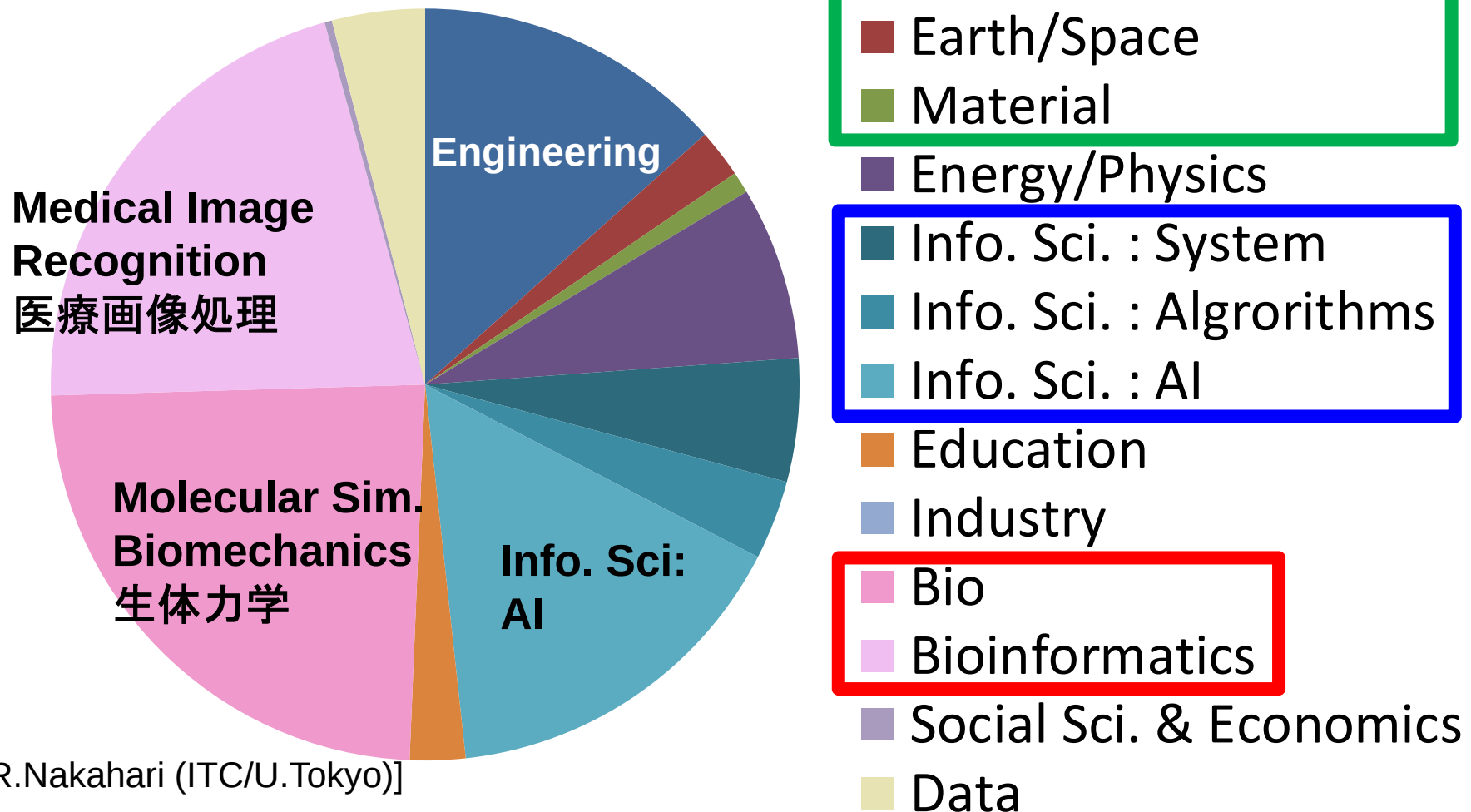


Oakleaf-FX + Oakbridge-FX

Research Area based on CPU Hours⁸

Reedbush-H in FY.2018

2-GPU's/Node



[R.Nakahari (ITC/U.Tokyo)]

Oakforest-PACS (OFP): KNL & OPA

- 8,208 Intel Xeon/Phi (KNL), 25 PF Peak Performance
 - Fujitsu
 - Full operation started in December 2016



- **TOP 500 #16 (#2 in Japan/柏市),
HPCG #9 (#3) (June 2019)**

- **JCAHPC: Joint Center for Advanced High Performance Computing**

- University of Tsukuba
- University of Tokyo



筑波大学
University of Tsukuba



東京大学
THE UNIVERSITY OF TOKYO

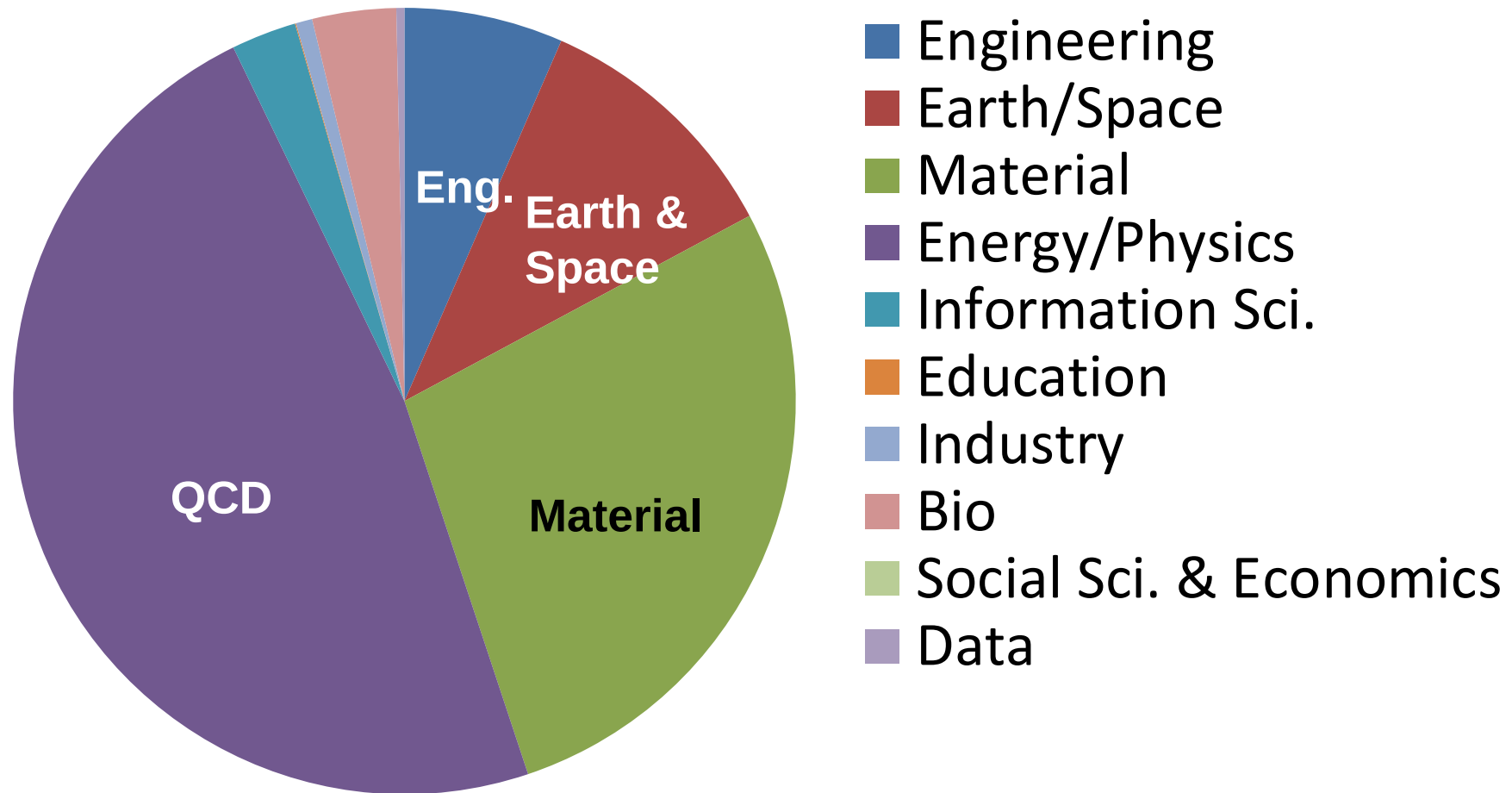
- Kashiwa-no-Ha (Leaf of Oak) Campus/U.Tokyo,
which is between Tokyo and Tsukuba

- <http://jcahpc.jp>



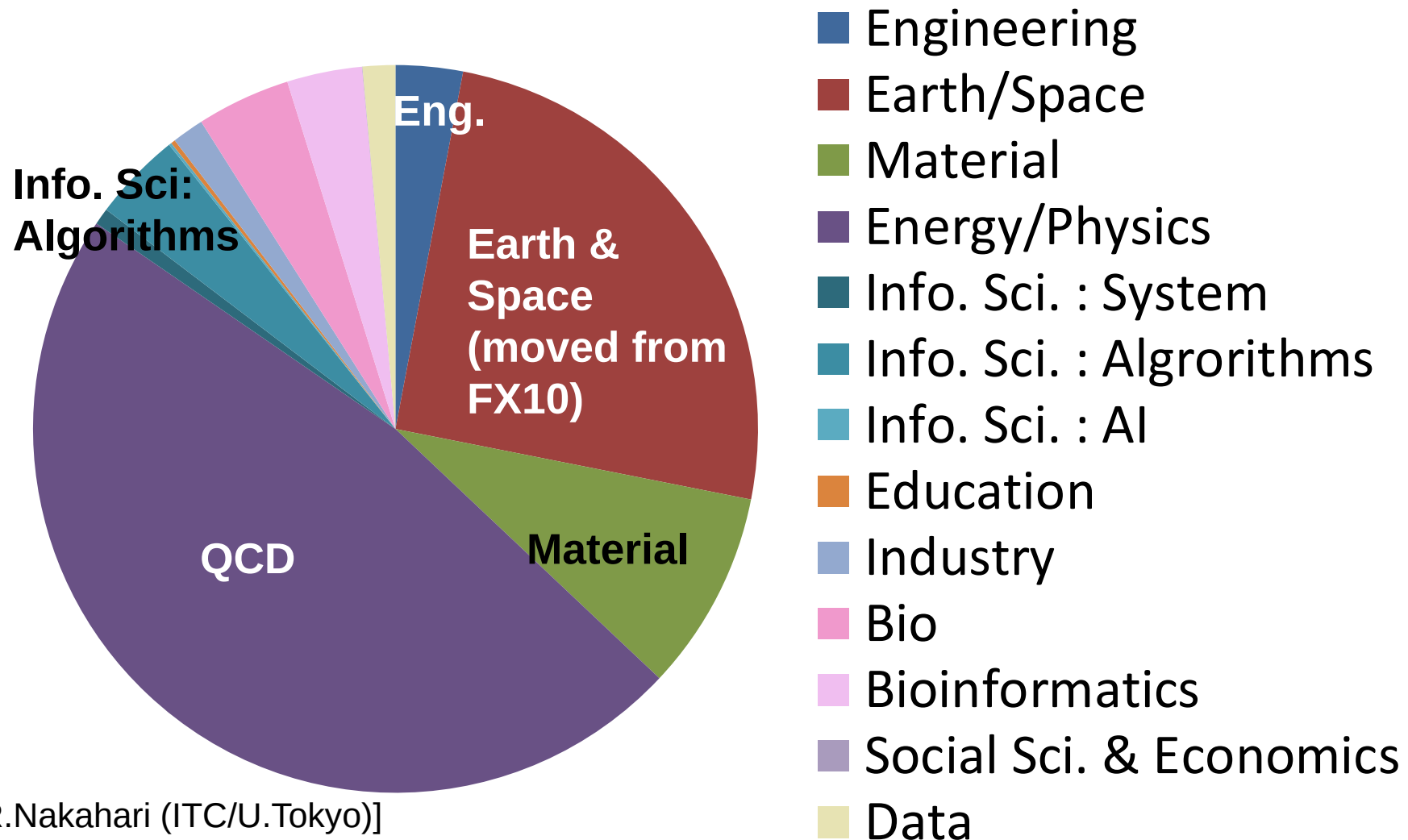
- **In spite of KNL & OPA, still an excellent system for R&D on SW/Algorithms for large-scale computing**

Research Area based on CPU Hours Oakforest-PACS in FY.2017



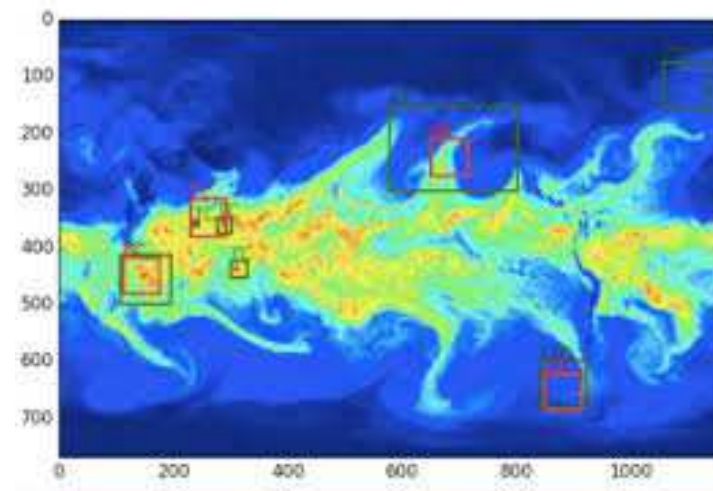
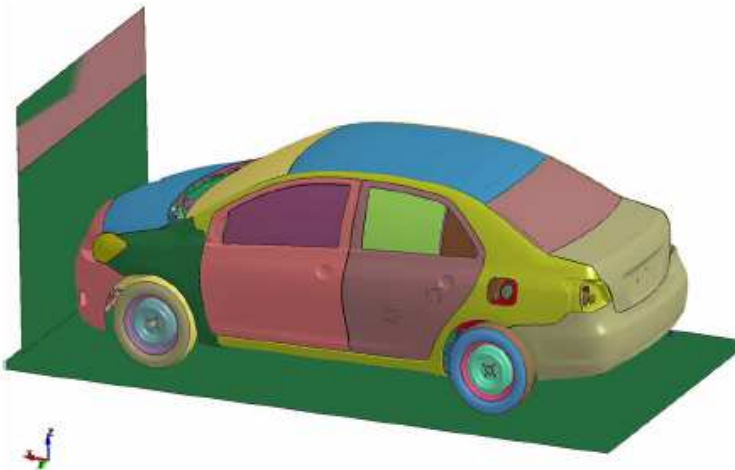
[R.Nakahari (ITC/U.Tokyo)]

Research Area based on CPU Hours Oakforest-PACS in FY.2018



Other Challenges on OFP

- Collaboration with JAMA
 - Japan Automobile Manufactures Association (日本自動車工業会)
 - Optimization of LS-DYNA on KNL under support by Intel (USA/France) and S/W Vendors
- Massively Parallel Deep Learning
 - TensorFlow, Caffe, and Chainer are available.



[LBNL SC17]

Another Important Role of OFP

Alternative National Flagship System

- K computer has been shut down in August 2019.
- OFP is the biggest system in HPCI for shared usage
- Very Important Computational Resource in Japan until the Fugaku (Post K) starts its operation in 2020-2021



- Manycore
- Wide SIMD
- (Small) HBM



Fiscal Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Hokkaido	HTAC-HR 10000 N (1.72TF, 22TB) Cloud System S-2000 (1.4TF, 14TB) 2nd Science Cloud Storage H4000 H40000 (10TF, 1.9PB)			3.96 PF (UCC + CFL/M) 0.9 MW 0.16 PF (Cloud) 0.1MW					35 PF (UCC + CFL-M) 2MW			
Tohoku			SX-ACE(707TF, 160TB, 655TBa) LX406e(31TF, Storage(4PB), 3D Vls, 2MW				~30PF, ~30PB/s Mem BW (CFL-D/CFL-M) ~3MW					100-200 PF, 100-200 PB/s (CFL-D/CFL-M) ~4MW
Tsukuba			PPX1 (82TF) PPX2 (82TF) COMA (PACS-X) (1001TF)				Cygnus 3+PF (TPF) 0.4MW					PACS-Xi 100PF (TPF)
Tokyo				Oakforest-PACS (OFF) 25 PF (UCC + TPF) 3.2 MW					Post OFP 100+ PF 4.5-6.0MW (UCC + TPF)			
Tokyo Tech.				Readout/CLK 1.8 PF (PACS) 0.71MW Readout/CLK 1.8 PF (PACS) 0.71MW Readout/CLK 1.8 PF (PACS) 0.71MW					BDEC 60+ PF (FAC) 3.5-4.5MW			
Nagoya				TSUBAME 3.0 (12.15 PF, 1.66 PB/s)			TSUBAME 4.0 (~100 PF, ~10PB/s, ~2.0MW)					
Kyoto				Fujitsu FX100 (2.9PF, 81TB) Fujitsu CX400 (7.74TF, 71TB) 2MW in total			20+ PF (FAC/UCC + CFL-M) up to 3MW					100+ PF (FAC/UCC+CFL-M) up to 3MW
Osaka				Cray XC40(5.5PF) + CS400(1.0PF) 1.33 MW			20-40+ PF (FAC/TPF + UCC) 1.5 MW					80-150+ PF (FAC/TPF + UCC) 2 MW
Kyushu				NEC SX-ACE NEC Express5800 (423TF) (22.4TF)			3.2PB/s, 15-25Ptop/s, 1.0-1.5MW (CFL-M)					25.6 PB/s, 50-100Ptop/s (TPF) 1.5-2.0MW
JAMSTEC				OCTPUS 1.463PF (UCC)								
ISM				Fujitsu PRIMERY CX subsystem A + B, 10.4 PF (UCC/TPF) 2.7MW								100+ PF (FAC/TPF + UCC/TPF) ~3MW
				SX-ACE(1.3PF, 320TB) 3MW			100PF, 3MW					
				UV2000 (98TF, 128TB) 0.3MW			2PF, 0.3MW					

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Oakbridge-II (Oakbridge-CX)

- Cluster without Accelerators
 - Intel Xeon/Skylake or Cascade Lake
 - AMD EPYC, IBM P9, ARM
- Initial Plan
 - (5+ PFLOPS), 350+ TB/sec, 250+ TiB
 - Fast Cache: SSD (e.g. Intel Optane): 500+GB/node, 0.5% of memory BW
 - Staging, Check-Pointing, Data Intensive App., External Memory
 - 100+ Gb, Full Bi-Section
 - Storage: 10+ PB, 150+ GB/sec
 - Approx. 1MVA

Oakbridge-CX (OBCX)

計算ノード

Chassis: PRIEMRGY CX400 M1 x342 <4node / Chassis>
Node: PRIMERGY CX2550 M5 x1,240, CX2560 M5 x128



x1,368 node



全体性能

理論演算性能: 6.61PF
主記憶容量: 256.5TiB
メモリバンド幅: 385.1TB/s
ラック数: 21ラック
SSD搭載: 128ノード

ノード単体

理論演算性能: 4.8384 TF
主記憶容量: 192GiB
メモリバンド幅: 281.6GB/s

計算ノード間ネットワーク (Omni-Path Architecture) 通信性能 100Gbps

ログインノード



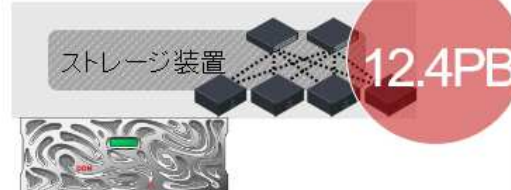
FUJITSU Server
PRIMERGY CX2560 M5 x 10

管理サーバ群



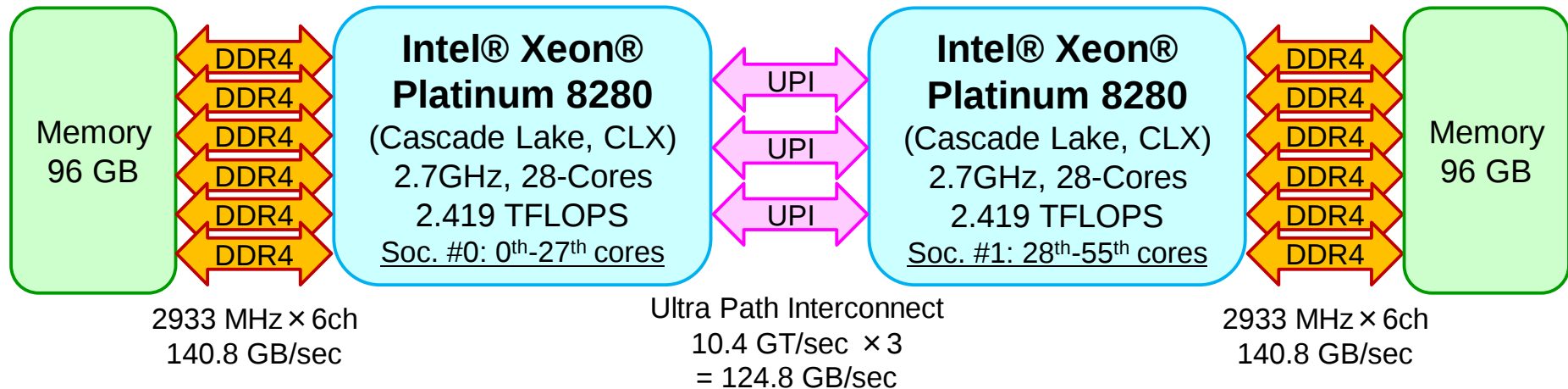
FUJITSU Server
PRIMERGY RX2530 M4 x 15
(ジョブ、運用、認証、Web、
セキュリティログ保存)

並列ファイルシステム



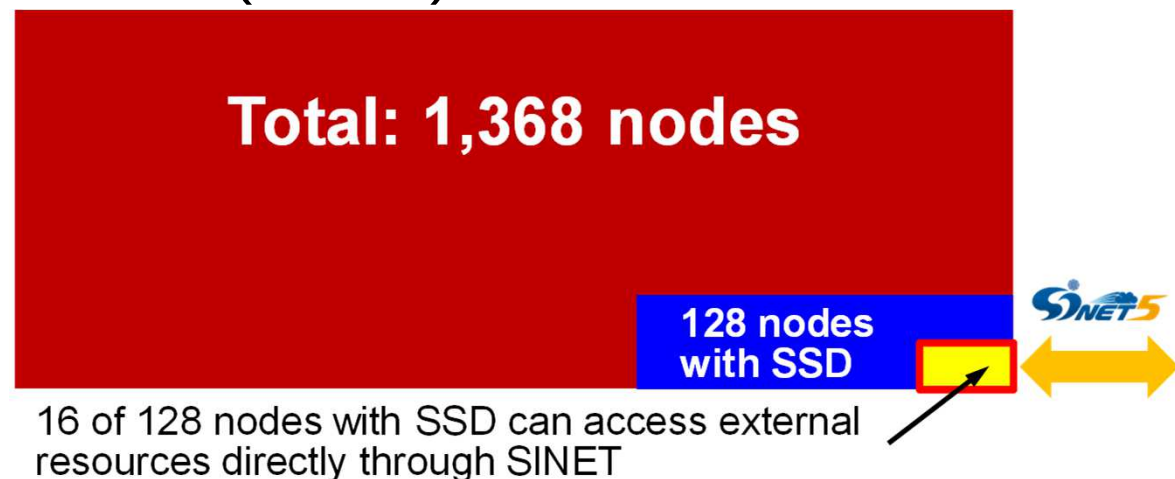
ストレージ装置: DDN ES18KE x2セット
ファイルシステム: DDN ExaScaler
(Lustreベースファイルシステム)

Intel Xeon Platinum 8280 (Cascade Lake, CLX)



Oakbridge-CX (OBCX)

- Intel Xeon Platinum 8280 (Cascade Lake, CLX), Fujitsu
 - 1,368 nodes, 6.61 PF peak, 385.1 TB/sec, 4.2+ PF for HPL **#45 in 53rd Top500**
 - Fast Cache: SSD's for 128 nodes: Intel SSD, BeeGFS
 - 1.6 TB/node, 3.20/1.32 GB/s/node for R/W
 - Staging, Check-Pointing, Data Intensive Application
 - **16 of these nodes can directly access external resources (server, storage, sensor network etc.) through SINET**
 - Network: Intel Omni-Path, 100 Gbps, Full Bi-Section
 - Storage: DDN EXAScaler (Lustre) 12.4 PB, 193.9 GB/sec
 - Power Consumption: 950.5 kVA
- Operation Start: July 1st, 2019

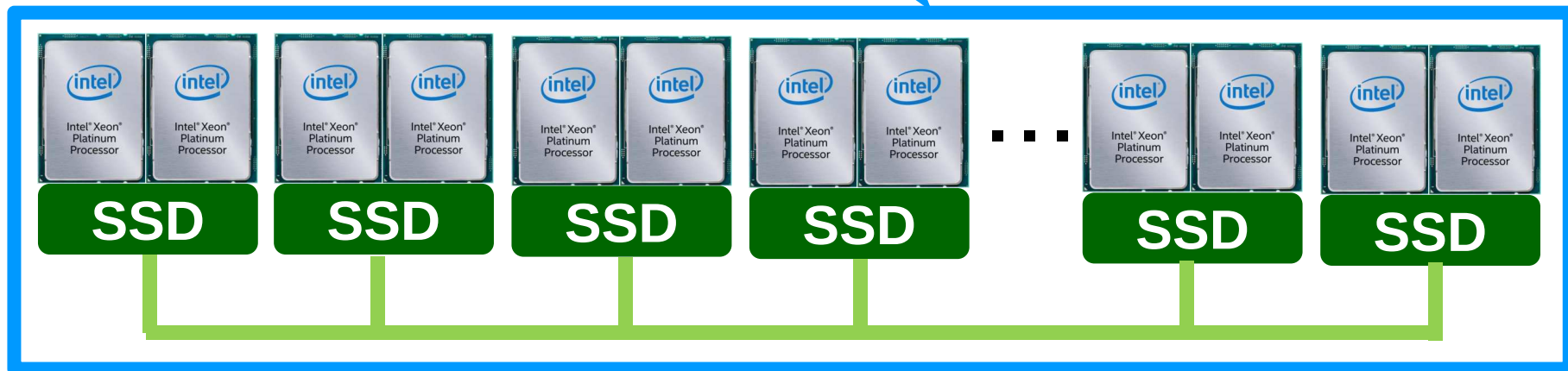


128xSSD's: Single Fast File System

Total: 1,368 nodes

128 nodes
with SSD

16 of 128 nodes with SSD can access external
resources directly through SINET



Single Fast File System with 200+ TB

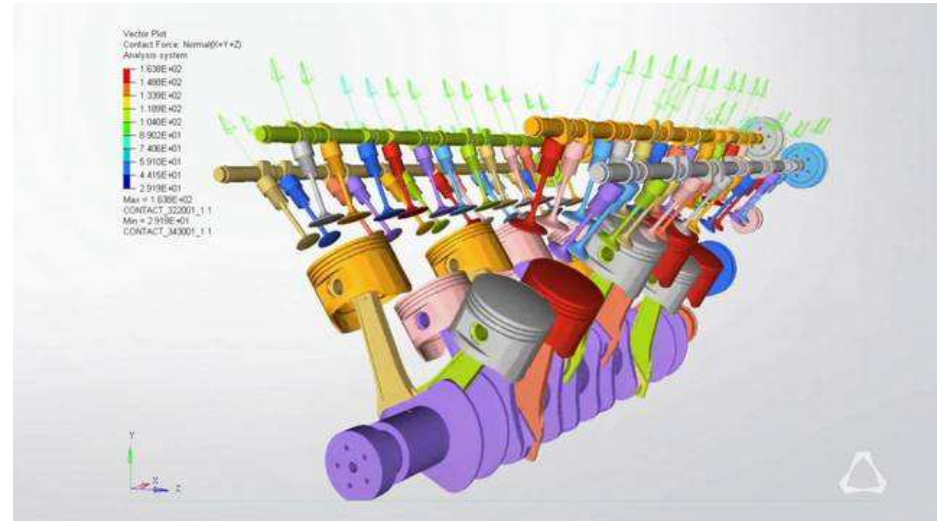
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Oakbridge-CX (Fujitsu) (Intel Cascade Lake (CLX))	20.7

Altair Hyperworks

- Service started in January 2019
 - On Reedbush System
 - OBCX after July 2019
- Basically, Only for University Users
- Public Research Institute, and Industry Users can use upon Requests (License needed)



How to Login (1 / 3)

23

- Public Key Certificate

- Public Key Certificate

- Password provided by ITC
with 8 characters is not used
for “login”

How to Login (2/3)

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- Password with 8 characters by ITC
 - ▣ for registration of keys
 - ▣ browsing manuals
 - Only users can access manuals
 - SSH Port Forwarding is possible by keys

How to Login (3/3)

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- Procedures
 - ▣ Creating Keys
 - ▣ Registration of Public Key
 - ▣ Login

Creating Keys on Unix (1 / 2)

26

- OpenSSH for UNIX/Mac/Cygwin
- Command for creating keys
\$ ssh-keygen -t rsa
- RETURN
- Passphrase
- Passphrase again

Creating Keys on Unix (2/2)

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```
>$ ssh-keygen -t rsa
```

Generating public/private rsa key pair.

Enter file in which to save the key (/home/guestx/.ssh/id_rsa):

Enter passphrase (empty for no passphrase): (your favorite passphrase)

Enter same passphrase again:

Your identification has been saved in /home/guestx/.ssh/id_rsa.

Your public key has been saved in /home/guestx/.ssh/id_rsa.pub.

The key fingerprint is:

```
>$ cd ~/.ssh
```

```
>$ ls -l
```

total 12

-rw-----	1	guestx	guestx	1743	Aug 23 15:14	id_rsa
-rw-r--r--	1	guestx	guestx	413	Aug 23 15:14	id_rsa.pub

```
>$ cat id_rsa.pub
```

(cut & paste)

Registration of Public Key

- ▶ https://obcx-www.cc.u-tokyo.ac.jp/cgi-bin/hpcportal_gm.en/index.cgi
- ▶ User ID
- ▶ Password (8 characters)
- ▶ “SSH Configuration”
- ▶ Cut & Paste the Public Key

Oakbridge-CX User Portal

https://obcx-www.cc.u-tokyo.ac.jp/cgi-bin/hpcportal_gm.en/index.cgi

Oakbridge-CX User Portal Group Manage Logout

Information

- SSH Public Key
- E-mail
- Password
- Token usage
- Disk usage
- Prepost reservation
- Document
- OSS

Login Message

Oakbridge-CX Information Date: Oct. 25, 2019

Welcome to Oakbridge-CX system

* Operation Schedule
10/25(Fri) 20:00 - 11/29(Fri) 09:00 Normal Operation
11/29(Fri) 09:00 - 11/29(Fri) 22:00 System Maintenance
11/29(Fri) 22:00 - Normal Operation

For more information about this service, see
<https://www.cc.u-tokyo.ac.jp/supercomputer/schedule.php>

* How to use
Users Guide can be found at the User Portal (<https://obcx-www.cc.u-tokyo.ac.jp/>).

If you have any questions, please refer to the following URL and contact us:
<https://www.cc.u-tokyo.ac.jp/supports/contact/>

* Updated OBCX Users Guide
10/01(Tue): v1.0

What's NEW

2019.10.01 [Oakbridge-CX system announcement](#)

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Oakbridge-CX User Portal

Group Manage

Logout

Information

SSH Public Key

E-mail

Password

Token usage

Disk usage

Prepost reservation

Document

OSS

SSH Public Key

Registered Public-keys	Kengon@Kengon-VAIO	ssh-rsa AAAAB3NzaC.....pWGVie6w==	表示	削除
------------------------	--------------------	-----------------------------------	----	----

Registration Method

☒ Direct Input

☐ File Upload

Please paste your SSH Public Key

Register

Notice for registering public-key.

- * Line feed codes should not be included.
- * Header (ssh-rsa or ssh-dss or ecdsa-sha2-nistp256 or ecdsa-sha2-nistp384 or ecdsa-sha2-nistp521 or ssh-ed25519) should be included at the beginning of the line.
- * RSA Public-key should be encrypted with over 2048 bit.

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Login

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□ Login

```
$ ssh obcx.cc.u-tokyo.ac.jp -l t370XX (or)
```

```
$ ssh t370XX@obcx.cc.u-tokyo.ac.jp
```

□ Directory

```
$ /home/gt37/t370XX          login -> small
```

- ▣ Type “cd” for going back to /home/gt37/t370XX

```
$ cd /work/gt37/t370XX      please use this directory
```

□ Copying Files

```
$ scp <file> t370**@obcx.cc.u-tokyo.ac.jp:~/.
```

```
$ scp -r <dir> t370**@obcx.cc.u-tokyo.ac.jp:~/.
```

□ Public/Private Keys are used

- ▣ “Passphrase”, not “Password”

Please check schedule of maintenance

- Last Friday of each month
 - other non-regular shutdown
- <http://www.cc.u-tokyo.ac.jp/>
- <https://www.cc.u-tokyo.ac.jp/en/supercomputer/obcx/service/>
- <https://www.cc.u-tokyo.ac.jp/supercomputer/obcx/service/>

**If you have any questions,
please contact KN (Kengo
Nakajima)**

nakajima(at)cc.u-tokyo.ac.jp

Do not contact ITC support directly.