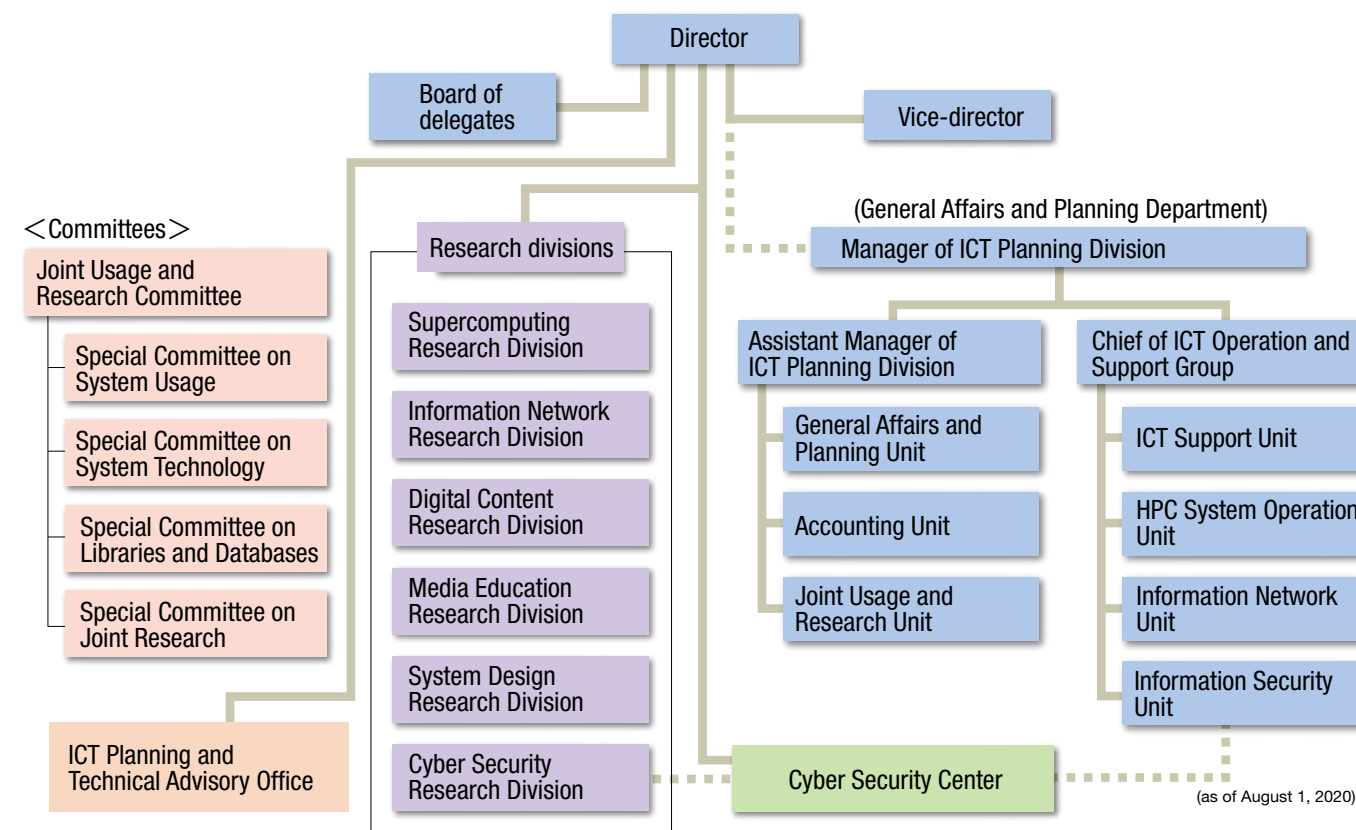


## Administrative organization of the Information Initiative Center



Information Initiative Center		
Research Divisions	Professor	7
	Associate Professor	5
	Assistant Professor	2
	Specially Appointed Assistant Professor	1
	Research Support Assistant	2
Administrative Division (ICT Planning Division of the General Affairs and Planning Department)	Administrative Staff	13
	Technical Staff	11
	Professional Associate	1
	Fixed-term Employee	1
	Administrative Assistant (full time)	2
	Administrative Assistant (part time)	4
	Technical Assistant (full time)	1
Total		50

(As of July 1, 2020)



## Hokkaido University Information Initiative Center

Kita 11, Nishi 5, Kita-ku, Sapporo, 060-0811, Japan  
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<https://www.iic.hokudai.ac.jp/en>

# HOKKAIDO UNIVERSITY INFORMATION INITIATIVE CENTER

2020-2021

Hokkaido University Information Initiative Center



## A message from the director



**Masaharu Munetomo**  
Director, Hokkaido University  
Information Initiative Center

Established in April 2003 through the integration of the Supercomputing Center and the Center for Information and Multimedia Studies, the Hokkaido University Information Initiative Center (IIC) promotes R&D aimed at advancing the university's information infrastructure. In December 2018, the Center launched a new interdisciplinary large-scale computer system comprised of a supercomputer system and an inter-cloud system. The new supercomputer system boasts approximately four petaFLOPS of computational power—more than 20 times higher than that of the previous system—and is already used by many researchers as a user-friendly system that is both convenient and program-compatible. The system is currently operating at almost full capacity, and is being utilized for leading-edge joint research projects, for which ideas are gathered from the public nationwide under the Joint Usage/Research Center for Interdisciplinary Large-scale Information Infrastructures (JHPCN) and the High Performance Computing Infrastructure (HPCI). The Center has also been providing Hokkaido University High Performance Inter-cloud services that offer nationwide inter-cloud system infrastructure for coverage from Hokkaido to Kyushu as well as making large-scale, wide-area-distributed cloud system infrastructure available as a package users can apply for with just one click.

The Center's mission covers all information-related fields, including R&D on networks and security, and educational research utilizing content and media. In the six divisions that constitute the Center—the Supercomputing Research Division, the Information Network Research Division, the Digital Content Research Division, the Media Education Research Division, the System Design Research Division, and the Cyber Security Research Division—R&D making the most of the characteristics of individual divisions is being promoted. In addition, the Cyber Security Center established within the Center is promoting activities aimed at realizing safer and more secure information infrastructure.

The social structure is currently going through sweeping changes due to the global spread of COVID-19. Infection prevention measures, such as the promotion of telecommuting and full implementation of remote meetings and distance learning, must be introduced by taking full advantage of ICT-related technologies. The Information Initiative Center established the ICT Planning and Technical Advisory Office in August 2020 to establish and operate campus network and cloud system services in close cooperation with the university's Office for ICT Environment, lead the university's cyber security measures and support the operation of educational computer systems for distance learning in cooperation with the Open Education Center. Although the pandemic has little influence on supercomputer and inter-cloud system services provided by the Center's interdisciplinary computer systems that are used from remote locations via networks, the establishment and support of high-performance and secure networks for remote operation of experiment equipment and research data management will be a major challenge in the future for fields in which research activities are being delayed for infection prevention. The Center will make steady efforts to promote R&D as an institute truly necessary for the university and society as a whole mainly in academic fields as well as to keep pace with major social changes in the future. We look forward to your continued support of these efforts.

Information Initiative Center  
North Building



Information Initiative Center  
South Building



## HISTORY

### 1960s

#### Large-scale computing infrastructure

Aug. 1962 Hokkaido University Computation Center established (for joint use by Hokkaido University, other national universities and technical colleges in Hokkaido) (HIPAC 103, Hitachi; NEAC2203, NEC; storage capacity: 10 K words)



NEAC2203-G

### 1970s

Apr. 1970 Hokkaido University Large-scale Computer Center established (for domestic joint use) (FACOM230-60, Fujitsu (160 K words))

Nov. 1977 Terminal connection service involving the use of switched lines launched

Oct. 1979 Hitachi system introduced (HITAC M-180 (6 MB))

#### Educational information infrastructure

Apr. 1979 Center for Information Processing Education established (for on-campus joint use) (HITAC M-170, Hitachi)

### 1980s

Oct. 1981 Large-scale Computer Center's N1 network service launched

Aug. 1986 Supercomputer introduced (S-810/10, Hitachi (128 MB))



Initial practical training

### 1990s



Painted S3800/380 supercomputer

Oct. 1993 Internet service (e-mail, web) launched

Mar. 1996 Large-scale general-purpose computers replaced with WS- and PC-based server-client system

Apr. 1999 Center for Information Processing Education reorganized into Center for Information and Multimedia Studies

#### Network infrastructure

Mar. 1992 Hokkaido University Information Network System (HINES) established (FDDI)

Jan. 1995 Super information highway (ATM) operation launched

Mar. 1999 Operation of ultra-high speed campus network extension system launched

### 2000s

#### Foundation of the Information Initiative Center

Apr. 2003 Information Initiative Center established

Nov. 2003 Center opening ceremony held

2003 Information Processing Research Conference held

Educational information system updated

Mar. 2005 Supercomputers updated

Jan. 2006 General-purpose computer system updated

Mar. 2007 Campus network system updated

Mar. 2009 Center inaugurated as network-type constituent of JHPCN (for the period from Apr. 2010 to Mar. 2016)

Jul. 2009 Academic exchange agreement concluded with the Graduate School of Education at Korea University College of Education (Republic of Korea)



Approx. 90 attendees from the Ministry of Education, Culture, Sports, Science and Technology, the Hokkaido Government, the Sapporo Municipal Government, Hokkaido University and other national, public and private universities



2003 Information Processing Research Conference

### 2010s

Mar. 2010 Educational information system updated

Jul. 2010 Research agreement on large-scale demonstration experiment for a next-generation green supercomputer concluded with the National Institute of Informatics and Tokyo Institute of Technology Center selected as a constituent of a consortium in preparatory stages toward innovative high-performance computing infrastructure (HPCI) development (computational resource provision)

Oct. 2010 Academic exchange agreement concluded with Hangsung University College of Arts (Republic of Korea)

Jul. 2011 Large-scale computer system updated (interdisciplinary computer systems (e.g., supercomputer, cloud) introduced)

Nov. 2011 HPCI service launched

Sep. 2012 HPCI service launched

Nov. 2013 Information Initiative Center 10th anniversary ceremony held

Apr. 2014 Petabyte-class integrated data science cloud storage service launched

Mar. 2015 Campus network system updated

Education information system updated

Oct. 2015 Research departments reorganized (from 4 to 6); Cyber Security Center established

Jan. 2016 Certification as a network-type Joint Usage/Research Center for Interdisciplinary Large-scale

Information Infrastructures renewed (for the period from Apr. 2016 to Mar. 2022)

Dec. 2018 Large-scale computer system updated (interdisciplinary computer system [Hokkaido University High Performance Inter-cloud] introduced)

Dec. 2019 AI-compatible advanced computer system introduced

Aug. 2020 ICT Planning and Technical Advisory Office established



Launch ceremony for an interdisciplinary large-scale computer system



Launch ceremony for an interdisciplinary large-scale computer system



# Interdisciplinary large-scale computer system

\*The content is based on the information at the time of the production of the pamphlet and is subject to change.

## Hokkaido University High-Performance Intercloud

The Information Initiative center replaced the interdisciplinary large-scale computer system consisting of the supercomputer and cloud systems, and launched the services of the new system at the beginning of December 2018. The overall peak performance of the new system is 4PFLOPS, which is a significant increase from that of the previous system. The Information Initiative center will realize the Hokkaido University High-performance Intercloud system, which is an advanced computer system including a nation-wide-scale distributed cloud system.

The Information Initiative center expects that the new system will be used for R&D related to computational science and computer science in Hokkaido University. The Information Initiative center will provide the computational resources of the system to open-type joint researches such as innovative high-performance computing infrastructure (HPCI) and the Joint Usage/Research Center for Interdisciplinary Large-scale Information Infrastructures (JHPCN) projects, which will support researchers in both academia and industry all over Japan. The Information Initiative center will also promote education and human resource development related to computational science and computer science by use of the system, which will contribute to various fields. With the installation of the new system, the Information Initiative center further contributes to society.

### Overview of the Interdisciplinary large-scale computing system

## Supercomputer system

### Grand Chariot [subsystem A], 1,004 nodes

FUJITSU Server PRIMERGY

CX 400/CX2550 M4

[Node architecture]

CPU: Intel Xeon (Gold 6148/20 core) x 2

Memory: 384 GB



### Polaire[subsystem B], 288 nodes

FUJITSU Server PRIMERGY

CX 600/CX1640 M1

[Node architecture]

CPU: Intel Xeon Phi (7250/68 core) x 1

Memory: 96 GB



### Storage system

DDN ES14KX  
16 PB



Peak performance  
**3.96PFLOPS**

## Intercloud system

(Hokkaido University Information Initiative Center)

### Virtual server 500+ VM (baremetal, 16 nodes)

FUJITSU Server PRIMERGY CX400/CX2550 M4

CPU: Intel Xeon (Gold 6138/20 core) x 2

Memory: 256 GB



### Baremetal servers 44 nodes

FUJITSU Server PRIMERGY CX400/CX2550 M4

CPU: Intel Xeon (Gold 6138/20-core) x 2

Memory: 256 GB



### GPU servers 4 nodes

FUJITSU Server PRIMERGY RX2540 M4

CPU: Intel Xeon (Gold 6138/20-core) x 2

Memory: 256 GB

GPU: NVIDIA Tesla V100 (PCIe) x 2

Storage: 3.84TB SSD x 2 (RAID1)



### Cloud middleware

Mirantis Cloud Platform

• OpenStack Nova + KVM (virtual servers)

• OpenStack Ironic (baremetal, GPU servers)

### Cloud Storage System

DDN GS7K

1 PB

Nextcloud



## Cloud archive system

Kitami Institute of Technology

Backup control servers

PRIMERGY RX2530M4

x 4



Tape archive

ETERNUS

LT270 (LTO)

5PB



## Intercloud system (remote sites)

U. Tokyo

Osaka U.

Kyushu U.

Baremetal  
3 nodes

Baremetal  
3 nodes

Baremetal  
1 node

Large-format  
printer

Application  
servers

## Supercomputer system

The supercomputer system consists of Grand Chariot (Subsystem A), Polaire (Subsystem B) and the storage system. Both subsystems have Intel CPU and Linux OS, which is close to computational environments where users usually run their programs in laboratories and so on. The computational resources of both subsystems will be provided as “shared nodes” and “fixed-rate exclusive nodes” to enable usage suited to user needs.

### Hardware

#### ■ Grand Chariot (Subsystem A, FUJITSU Server PRIMERGY CX 400/CX2550 M4)

The system consists of 1,004 nodes, and each node has two Intel multicore CPUs (Xeon Gold 6148, 20-core, Skylake) and 384 GB memory. Computation nodes are linked with each other via the Intel Omni-path network.

#### ■ Polaire (Subsystem B, FUJITSU Server PRIMERGY CX600/CX1640 M1)

The system consists of 288 nodes, and each node has one Intel many-core CPU (Xeon Phi 7250, 68 core, KNL) and 96 GB memory. Computation nodes are linked with each other via the Intel Omni-path network.

#### ■ Storage system (DDN ES14KX)

The storage system has a physical capacity of 16 PB in total and employs a Lustre-based parallel file system (EXAScaler).

### Software

The Intel Compiler (Fortran, C, C++), numerical libraries (MKL) and MPI library are provided on Grand Chariot and Polaire. Java and Python are also available. As application software programs, Gaussian and V-FaSTAR are available (only on Grand Chariot). In addition, there are free software programs, such as OpenFOAM for computational science and Chainer for machine learning.

### Services

The following services are provided on Grand Chariot and Polaire. In both service types, computational resources that a user applied can be shared among other users who belong to the applicant's research group.

#### ■ Use of shared nodes

In this service type, multiple users share same nodes and can use them by consuming tokens based on the elapsed time and the number of nodes used. Users can run large-scale jobs that need many nodes.

#### ■ Use of fixed-rate exclusive nodes

In this service type, a user can always use nodes without waiting. Depending on the number of nodes that the user applied for, the user can also use a certain amount of the storage area.

## Intercloud system

The intercloud system provides an advanced cloud environment, including a nationwide distributed cloud system extending from Hokkaido to Kyushu. There is also a magnetic tape archive device in Kitami Institute of Technology for the long-term storage of research data and provision of an environment that serves as the basis of open sciences. This cloud system places emphasis on performances, including the operation of a GPU server and other bare metal servers. Together with virtual servers that provide flexibility, the system meets the demands of various researchers within and outside of the university.

### Hardware

#### ■ FUJITSU Server PRIMERGY CX400/CX2550 M4, RX2540 M4

Each server has two Intel Xeon Gold 6138 processors, 256 GB memory and 25GbE x2 network interfaces. The GPU server has two

additional units of NVIDIA Tesla V100 (PCIe). There are 64 servers at the Hokkaido University Information Initiative Center, three at the University of Tokyo, three at Osaka University and one at Kyushu University, providing overall computing performance of 166 TFLOPS or more. These bases are linked with each other via a virtual private network using the ultrahigh-speed, low-latency academic information network SINET5.

#### ■ FUJITSU Storage ETERNUS DX500 S4

As an area for the start storage and additional storage of the cloud system, a physical HDD capacity of 500 TB in total is provided. An SSD with a total capacity of 30 TB is also used as a hybrid storage.

#### ■ DDN GS7K

This high-capacity storage system with a physical capacity of 1PB serves as the basis of open sciences. It provides a highly functional and convenient web-based GUI of Nextcloud and client software that can be used on PCs and smartphones to realize a WebDAV storage.

#### ■ FUJITSU Storage ETERNUS LT270 S2 (LTO)

This provides a physical archive capacity of 5 PB as a magnetic tape archive device. It functions as a disaster-resistant remote backup system, and is intended to address research misconduct and other problems and store research data for 10 or more years.

## Basic software for cloud systems

### ■ Mirantis Cloud Platform

The current system uses OpenStack as basic software for cloud systems. In addition to the virtual server realized as a virtual machine of KVM, the bare metal servers of physical/GPU servers are managed using OpenStack Ironic, to enable unified management and operation on the same OpenStack display. The system can be used for both interactive operations between users via a web portal and automatic server operations via REST API.

## Services

As the successor of the project servers of the former Interdisciplinary Large-scale Computing System, this intercloud system will provide the following services and functions for full-edged utilization for research purposes.

### ■ Virtual servers

Virtual machines using OpenStack Nova and KVM will be provided as virtual servers. One unit consists of a CPU core, 6 GB memory and 50 GB disc and a user can flexibly constitute a resource pool by using at least two units. After creating a resource pool, virtual servers of various sizes can be created and used within the limit of the available resource.

### ■ Physical/GPU servers

Bare metal servers managed using OpenStack Ironic will be provided as physical servers. It is also possible to provide up to four servers, each equipped with two units of NVIDIA Tesla V100, as GPU servers.

### ■ Intercloud packages

A wide-area distributed virtual private cloud environment with one physical server at each base will be provided as an intercloud package. There are two kinds of packages with 3 or 4 bases, depending on the combination of bases constituting the package.

## Other

### ■ Application servers

Various applications (e.g., Mathematica, MATLAB, COMSOL, AVS) are available.

\*Some of the programs are only available for researchers and students who belong to Hokkaido University.

### ■ Large-format printer

The printer can print A0-size and other large-format color prints on normal paper, glossy paper and cloth.



# Joint research

## Joint Usage/Research Center

The Center serves as a joint-usage facility for the eight universities constituting the network-type Joint Usage/Research Center for Interdisciplinary Large-scale Information Infrastructures (JHPCN; a network organization established in line with the School Education Law's Enforcement Regulations).

### ■ Facilities of the network-type Joint Usage/Research Center

- Information Initiative Center, Hokkaido University
- Cyber Science Center, Tohoku University
- Information Technology Center, University of Tokyo (core base)
- Global Scientific Information and Computing Center, Tokyo Institute of Technology
- 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



### ■ Effective designation period

April 1, 2016 – March 31, 2022

### ■ Center mission

The network-type center's mission is to contribute to the further advancement and ongoing development of Japanese academic and research facilities through interdisciplinary joint usage/research relating to grand challenges (i.e., particularly difficult issues) using super-large-scale computers, super-high-capacity storage/network resources and other types of information infrastructure. Its work covers information processing fields in general, including the global environment, energy, substances/materials, genome information, web data, academic information, time-series data from sensor networks, image data and program analysis.

### ■ Center operation

JHPCN is operated by the Steering Committee and Joint Research Project Screening Committee under The University of Tokyo Information Technology Center, which is its core base.

### ■ Promotion of open-type joint research

The Joint Usage/Research Center invites research projects in the areas of super-large-scale numerical calculation system applications, super-large-scale data processing system applications, super-large capacity network technologies, as well as the area of super-large-scale information system-related research that integrates the above-mentioned areas. In FY 2020, 52 projects (seven related to the base) are being conducted. A system to recognize joint research projects invited by individual centers constituting the network-type base as JHPCN seminal joint research was launched in FY 2016 in anticipation of the development of such projects into future JHPCN tasks. For FY 2020, 43 cases (of which five are related to the Information Initiative Center's base) have been adopted as of May 2020.

### ■ Computational resources available for open-type joint research at the bases

#### Supercomputer systems

Grand Chariot (subsystem A)  
Polaire (subsystem B)  
\* Use of shared nodes is available.

#### Inter-cloud system

Physical servers  
Inter-cloud packages  
Virtual servers

\* L2VPN is available.

## Promotion of seminal joint research

To fulfill the purpose of the network-type Joint Usage/Research Center for Interdisciplinary Large-scale Information Infrastructures (JHPCN), the Information Initiative Center has conducted its own open-type joint research since FY 2009 in addition to the joint research it conducts as a JHPCN base.

The Information Initiative Center is playing a central role in the implementation of grand challenge-type research using information infrastructure and interdisciplinary joint research projects to promote such research by dividing projects into the following research types as seminal joint research. Ten joint research projects are being conducted with teachers and researchers of domestic research institutions, of which five have been adopted as JHPCN's seminal joint research projects (as of May 2020).

- **Research type A: Type to utilize computational resources**
- **Research type B: Type to support the organization of research meetings**

## Joint research on the AI-compatible advanced computer system

The Center introduced the AI-Compatible advanced computer system and launched its operation for Hokkaido University researchers in December 2019. The system accelerates various research on AI and AI-application including cyber physical systems.

The Center conducts the open-type joint research that uses this system, and five and six projects being adopted in 2019 and 2020, respectively (as of August 2020).

### ■ Overview of the AI-compatible advanced computer system

The system consists of eight computational nodes (FUJITSU PRIMERGY CX400 M4, CX2570 M5) and each node has two Intel CPUs (Xeon Gold 6230, 20 core), four NVIDIA GPUs (Tesla V100 SXM2, 32GB), 384 GB memory and an NVMe-connected 1.6TB SSD. Computational nodes are linked with each other via the Intel Omni-Path network. It also has a storage system comprised of 21 SSDs and has a total physical capacity of 76.8 TB as shared storage (DDN ES200NV). Available software includes software programs for machine learning (e.g., Tensor Flow, PyTorch, Chainer, Caffe) and a parallelizing compiler (PGI Professional Edition).

#### Computational nodes (eight nodes)

FUJITSU PRIMERGY  
CX400M4/CX2570 M5

#### [Node architecture]

CPU: Intel Xeon  
(Gold 6230/20 core) × 2  
GPU: NVIDIA Tesla V100  
(SXM2/32 GB) × 4  
Memory: 384 GB  
Storage: 1.6TB SSD  
(NVMe connection) × 1

#### Shared storage

DDN ES200NV (76.8 TB)

#### Main software programs

Tensor Flow, PyTorch, Chainer,  
Caffe, PGI Professional Edition



Overview of the AI-compatible advanced computer system

# Cyber Security Center

In response to the establishment of the Basic Act on Cybersecurity and social developments, the Cyber Security Center (CSC) was established in the Information Initiative Center in October 2015. The Cyber Security Research Division, established at the same time, plays the central role. CSC works in close cooperation with the ICT Security Office (an on-campus computer security incident response team; CSIRT) for activities on cyber security in the university which used to be conducted collaboratively with the involvement of multiple organizations (e.g., the Information Security Committee, ICT Promotion Office and Information Initiative Center), and provides a wide range of services, including training and education related to cyber security.



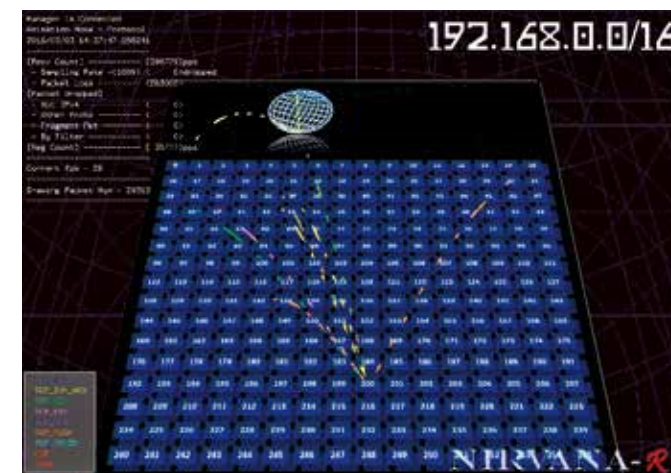
Hokkaido University

<https://www.csc.hokudai.ac.jp/>

## Technical measures for the maintenance of security

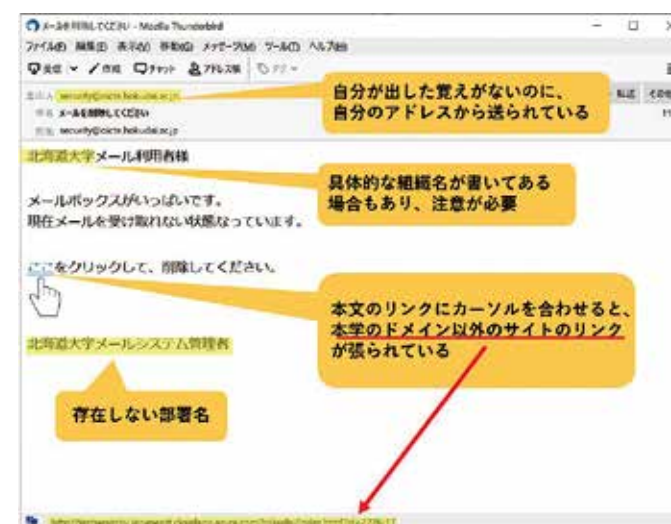
The NIRVANA-R network traffic visualization system, originally developed by the National Institute of Information and Communications Technology (NICT), was introduced at the end of FY 2015. It displays real-time inbound and outbound network traffic at Information Initiative Center entrances during opening hours.

\*Display may be suspended due to maintenance or other reasons.



## Cyber drills

To prevent security incidents, the Center plans, designs and implements cyber drills, including simulated virus mail and virtual incident responses, in cooperation with the ICT Promotion Office.



Reference: 6th targeted email attack drill in FY 2019

## Cooperation for inbound access control

With the inbound traffic filtering policy since January 2016, the Center conducts technical screening for exceptional approval of accesses from outside in collaboration with the ICT Promotion Office and the ICT Security Office.

(Contact for exception requests: [exception-apply@security.hokudai.ac.jp](mailto:exception-apply@security.hokudai.ac.jp))

## On-campus CSIRT activities

In case of a security incident on campus, the Center plays a central role in information collection, identification of the cause, analysis of the incident and development of recurrence prevention measures, in collaboration with the ICT Security Office of the ICT Promotion Office, which is an on-campus computer security incident response team (CSIRT).

## Enlightenment activity

The Center's enlightenment activities include presentations on cyber security and personal information protection for various training courses of national universities held in Hokkaido University, as well as faculty development (FD).

## Collaboration with related organizations

The Center participates in various events and activities in collaboration with related government ministries/agencies and cyber security-related organizations in Hokkaido.



Professor Hiroyuki Minami, Director of the Cyber Security Center in Information Initiative Center, gave an address.



Security mini camp



# Diverse research and development

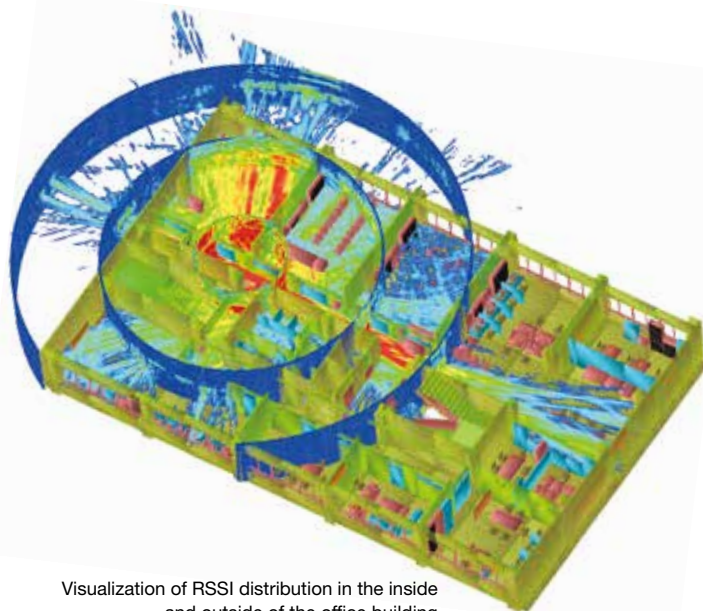
## Supercomputing Research Division

### Development of Jet FDTD and support for the supercomputer users

The large-scale electromagnetic field solver Jet FDTD is continuously developed on our supercomputer system. Featuring high capacity and high-speed processing, this application program supports the design of devices in the microwave frequency bands of more than several hundred MHz and the accurate prediction of indoor radio wave propagation. Using Jet FDTD in conjunction with our supercomputer system enables highly precise and high-speed numerical simulations.

The figure on the right-hand side visualizes the distribution of received signal strength indication (RSSI) in the both of indoor and outdoor environments for a wireless LAN access point at the frequency of 2,442 MHz. The third floor in an office building is used as the target for numerical simulations. Assuming a spatial resolution of 5 mm, the problem space including the target consists of more than 23 billion grids. Such a large-scale numerical simulation is easily conducted using the supercomputer system in Hokkaido University. By using the forty theoretical operation nodes, numerical results can be obtained within 20 hours.

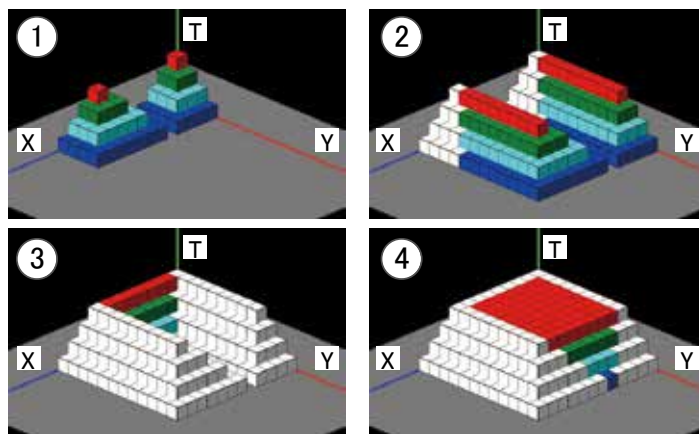
The Jet FDTD is provided to the Hokkaido University's supercomputer users in order to support and accelerate their research activities. Also, the organization of workshops, development of numerical models and visualization of results are conducted.



Visualization of RSSI distribution in the inside and outside of the office building.

### High-performance computing researches for supporting simulation

We conduct researches on high-performance computing for supporting various kinds of simulation on modern computer systems. Since recent supercomputers become larger and more complicated, in addition to mathematical approaches, HPC technologies such as parallelization techniques are vital for fully exploiting the potential of supercomputers. Focusing on important problems and their solution methods in the field of computational science, we have investigated related HPC technologies and developed software frameworks and libraries that support simulation. For example, we have investigated the time-space tiling techniques for iterative stencil computations and iterative methods for solving large-scale linear systems appearing in FEM-based simulation.



Overview of time-space tiling for iterative stencil computation

## Digital Contents Research Division

### Shifting the boundary between academism and creativity

Increasing amounts of academic information can today be made public thanks to the progress of digital technology, but such content is often not consumed efficiently due to inappropriate presentation and methods of utilization. Accordingly, research is conducted to develop methods for the automatic conversion of such information into teaching materials, the promotion of autonomous study using such materials, the introduction of creative approaches to academism, and the integration of creator education with university education.

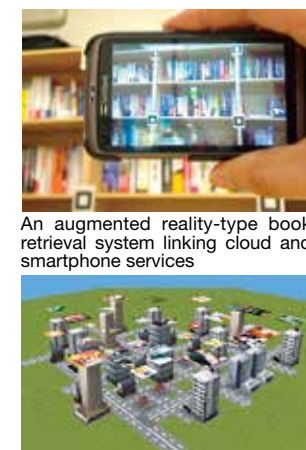
Research on basic science data as evaluation content using computer simulations is also conducted.



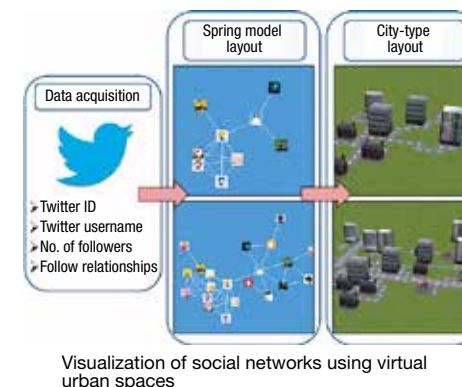
## Information Network Research Division

### Information network visualization

Research is being conducted on visualization systems that support communication via messages tied to objects based on connections between networks and augmented reality (AR). An example of this is the AR book retrieval system, which allows books to be located by simply pointing a smartphone camera linked to a cloud-hosted database at shelves in libraries and other places. The system also allows messages to be attached to books, supporting expectations for new forms of social networking based on encounters with such publications. The division's R&D efforts include work on a system for the visualization of behavior on social network sites in virtual-reality urban spaces via the mapping of complex follow relationships on Twitter and other major social networks.



TwitterCity



### Big data analysis

In today's increasingly computerized society, which is associated with the popularization of the Internet, enormous amounts of information are constantly generated. These are collectively known as big data, and accurate extraction of useful content from them is a major challenge. Against this background, there is a need for approaches that transcend conventional methods in statistics and informatics.

In this context, symbolic data analysis is now viewed as a paradigm by which data are treated

as diverse complexes (e.g., aggregates and distributions) rather than simple numerical values. Areas of research include the extension/application of existing data analysis technologies and the development of analysis methods applicable to big data, such as approaches applicable to data consisting of aggregated multiple distributions (as shown in the figure). This technology is also applied to real data in the fields of information networking, commercial management and medical science.



## Media Education Research Division

### Development of information education/information ethics education

R&D is conducted on learning methods, course content and other aspects of information education compulsory for all students at Hokkaido University. In information ethics education, effective teaching methods for domestic and international students are explored using videos and comics. A method involving the use of single-frame comics is also being examined to identify associated issues and raise related awareness among students.



### Support for education in hospital schools and R&D using information media and networks



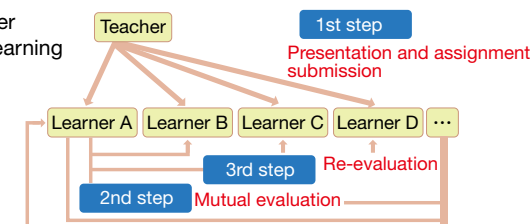
At hospital schools, in-patient minors suffering from conditions of varying severity are provided with tailored treatment. Such children tend to be isolated both spatially and mentally. To establish an open and advanced educational environment, consistent research is conducted with a focus on informatization and educational support for hospital schools. Such efforts include research on tools that help hospitalized children interact with the outside world.

### Research and practice in open education

Activities encompass research and practice in open education, including the use of OpenCourseWare. Flip teaching will be introduced and implemented in information education for all students.

### Evaluation and support for learning using ICT

Multistage peer assessment learning



Research is conducted on the formation of teaching content using ICT and learning assessment in large-group education with a special focus on collaborative education using multistage peer assessment among large numbers of students.



## Diverse forms of research and development

### System Design Research Division

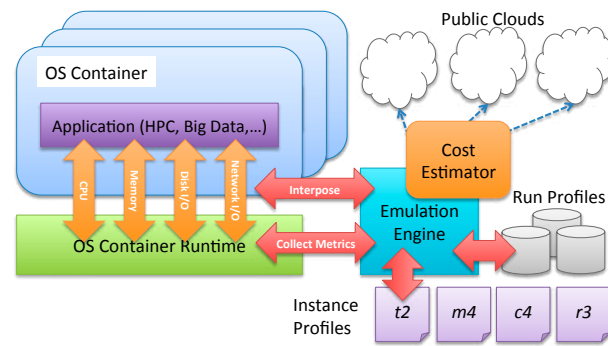
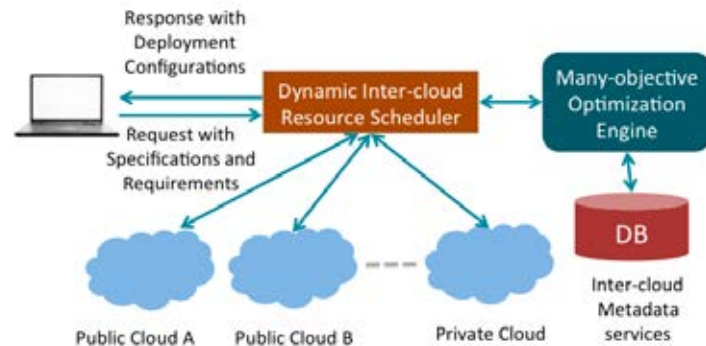
#### Establishment of an academic inter-cloud system

In this division, research is promoted toward the establishment of a high-performance inter-cloud system in today's era of big data. The aim is to create and utilize a nationwide academic inter-cloud system by connecting public cloud systems and private cloud systems run by universities and research institutes nationwide.

Under this project, which is promoted in conjunction with researchers nationwide, Hokkaido University advances the development and implementation of optimization algorithms, with a focus on research on resource allocation optimization on inter-cloud systems. Optimum resource allocation on inter-cloud systems will be realized by solving multipurpose optimization problems in consideration of performance,

cost, reliability and other evaluation axes, while satisfying diverse constraints related to cloud infrastructure and applications. The project also involves researchers in application fields, including genome sequence analysis and fluid acoustic analysis, in addition to those specializing in cloud infrastructure and middleware.

Research on inter-cloud systems, ranging from the collection, accumulation, analysis, learning and inferential reasoning of research data to their real-time processing, is promoted utilizing the newly introduced interdisciplinary large-scale computer system. The division also promotes research on coordination with research data management infrastructure and automatic application building services and R&D on core OS and system software programs to support the above inter-cloud systems.

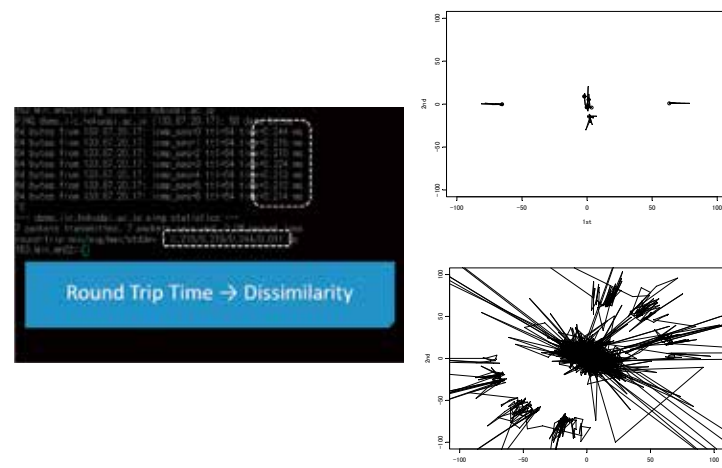


### Cyber Security Research Division

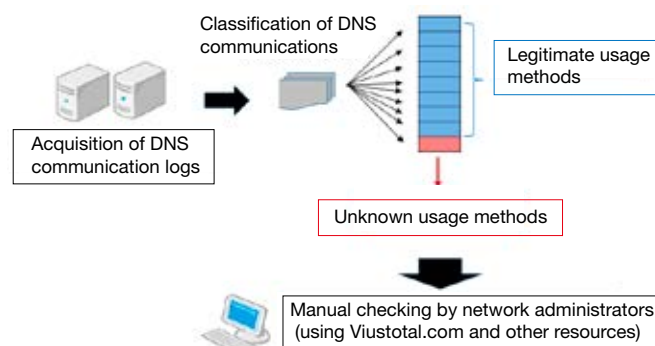
The division handles a wide range of research fields related to cyber security. Specifically, research is conducted to contribute to the protection against and prevention of cyber-attacks. Research subjects include advanced data science techniques to find regularity and useful knowledge from an enormous amount of unauthorized access data, as well as the establishment and efficient implementation of techniques to identify suspicious devices and software programs operating in them from the traffic logs of DNS data, which is a basic technology for Internet operations.

The professors use research results in both technological and practical aspects and contribute to educational activities on cyber security as members of the Cyber Security Center (CSC). They have also been cooperating and working together with other universities concerning cyber security education since FY 2016, as professors in charge of specialized subjects provided as a collaborating university in the security field of the Ministry of Education, Culture, Sports, Science and Technology's Education Network for Practical Information Technologies (enPiT).

#### Symbolic data analysis for ICMP Echo Reply data



#### Botnet communication monitoring system based on DNS traffic log analysis



## Main activities of the Information Initiative Center

In its role as a nationwide joint usage facility, the Center promotes the advancement of education/research and the implementation and support of education based on information media through R&D to facilitate informatization and information infrastructure development/operation.

### Innovative high-performance computing infrastructure (HPCI)

HPCI operation was commenced in September 2012 with the establishment of an innovative computation base for joint use to meet diverse user needs. This was enabled via the high-speed network (SINET5) connection of RIKEN's next-generation supercomputer with other supercomputers at universities and research institutes nationwide.

The Research Organization for Information Science & Technology (RIST) handles project selection, management of common data receipt and other utilization promotion services.

The Center plays a role in system configuration and provides related computation resources. In FY 2020, 19 research projects have been adopted as of May 2020.

### Organizations providing their computational resources as the HPCI system

- RIKEN Center for Computational Science
- Information Initiative Center, Hokkaido University
- Cyber Science Center, Tohoku University
- Center for Computational Science, Tsukuba University
- Information Technology Center, University of Tokyo
- Global Scientific Information and Computing Center, Tokyo Institute of Technology
- 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 Earth Information Science and Technology, Japan Agency for Marine-Earth Science and Technology

### Interdisciplinary large-scale computer system training sessions/consultation meetings

Training sessions and consultation meetings on the interdisciplinary large-scale computer system are held occasionally to support users.

### Past training sessions/consultation meetings

- Training sessions for the supercomputer system and consultation meetings on user's program
- Training sessions for the cloud system
- Training sessions and consultation meetings for application software
  - \* COMSOL Multiphysics
  - \* Mathematica
  - \* Gaussian



Supercomputer training session

### Cloud Week@Hokkaido University (cloud symposium)

In conjunction with the November 2011 establishment of the Hokkaido University Academic Cloud (one of Japan's largest resources of its kind), annual symposiums for discussion on cloud research and related development among related researchers from Japan and elsewhere have been held since FY 2012.



Held in FY 2019 Cloud Week 2019@Hokkaido University

### Conferences/seminars

Conferences and seminars related to the Center are held occasionally.



Conference on Teaching of "Programming-like Thinking" to Elementary School Students

### Exhibition in the Supercomputing Conference (SC)

The Center holds a booth exhibition to present its activities in the Supercomputing Conference (SC), which is an annual international conference on supercomputing in the United States.



Booth exhibition