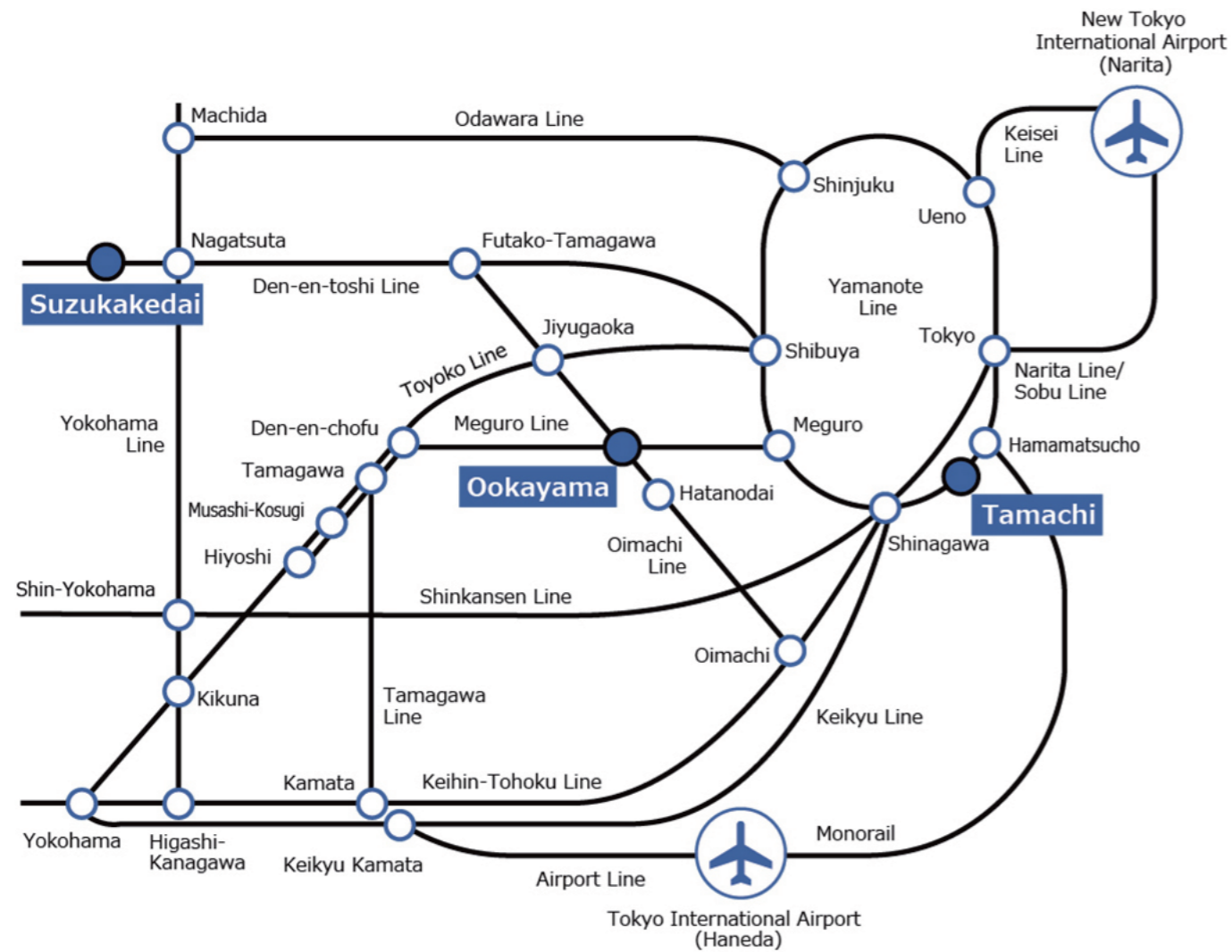


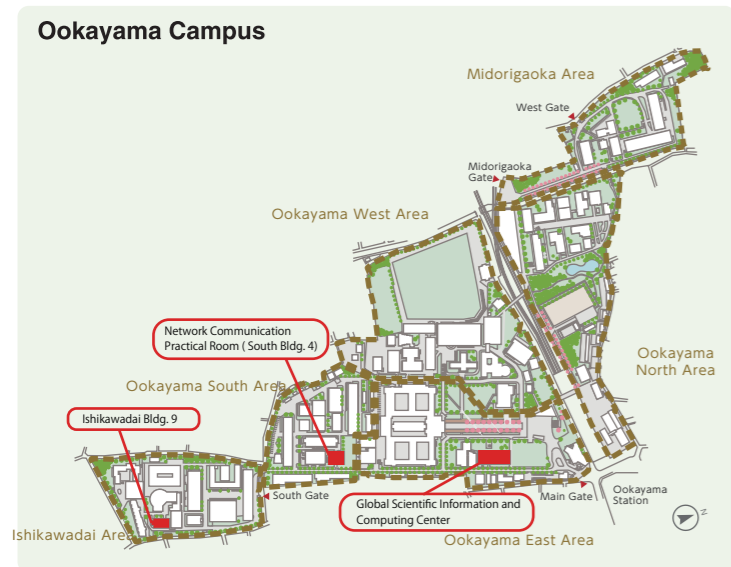
Traffic Access



Ookayama Campus: 1-min, walk from Ookayama Station on the Tokyu Oimachi Line or Meguro Line
Suzukakedai Campus: 5-min, walk from Suzukakedai Station on the Tokyu Denentoshi Line
Tamachi Campus: 2-min, walk from Tamachi Station on the JR Yamanote Line or Keihin Tohoku Line

Map

The GSIC buildings and the Network Communication Practical Room



What's New at GSIC

The Global Scientific Information and Computing Center (GSIC) was established in April 2001 by amalgamating Tokyo Institute of Technology's Computer Center and the International Cooperation Center for Science and Technology.

GSIC's missions are to apply advanced information technology to support research and education activities and to use the technology as a medium for promoting research collaboration at an international level. In line with these missions, GSIC has been showing steady results in developing the university's information infrastructure and supporting its operation, in supporting cutting-edge research in high-performance computation and further research based on its findings, as well as in using IT to promote international collaboration.

In recognition of GSIC's achievements, it was designated a Joint Usage / Research Center alongside the seven other similar centers nationwide. Starting April 2010, the GSIC commenced activities as one of the constituent centers of Japan High Performance Computing and Networking plus Large-Scale Data Analyzing and Information Systems.

In July 2010, GSIC was restructured into an organization with two divisions to help it play an even more effective role in promoting cutting-edge research and international research collaboration as a Joint Usage / Research Center.

After establishing the TokyoTech CERT to manage information security of Tokyo Tech, some members of GSIC have cooperated as the managers since April 2014. In addition, TSUBAME 3.0 has been operating since August 2017, and it ranked No. 1 in the world on the Green500 list of energy-saving supercomputers.

GSIC hopes to continue living up to expectations of both the university and the global community in the coming years through its efforts relating to the university's information infrastructure and advanced research activities.

History of GSIC

1971 Foundation of TITech Computer Center

HITAC 8700 computer system installed

1976 Reorganization of TITech Computer Center

HITAC M-180 computer system installed

- 1977 Introductory computer education started (HITAC M-180)
- 1988 CDC ETA 10 supercomputer installed
- 1994 Campus information networking system (Titanet) started (Titanet network operation center (NOC) established)
- 1995 CRAY C916/12256 supercomputer installed
- 1997 Titanet NOC merged into the computer center
- 1998 Education for computer and communication started (SGI Origin2000)
- 2000 NEC SX-5, SGI Origin2000 supercomputers installed
- 2001 SuperTitanet installed
COMPAQ GS320 research computer system installed

1979 Foundation of the International Cooperation Center for Science and Technology

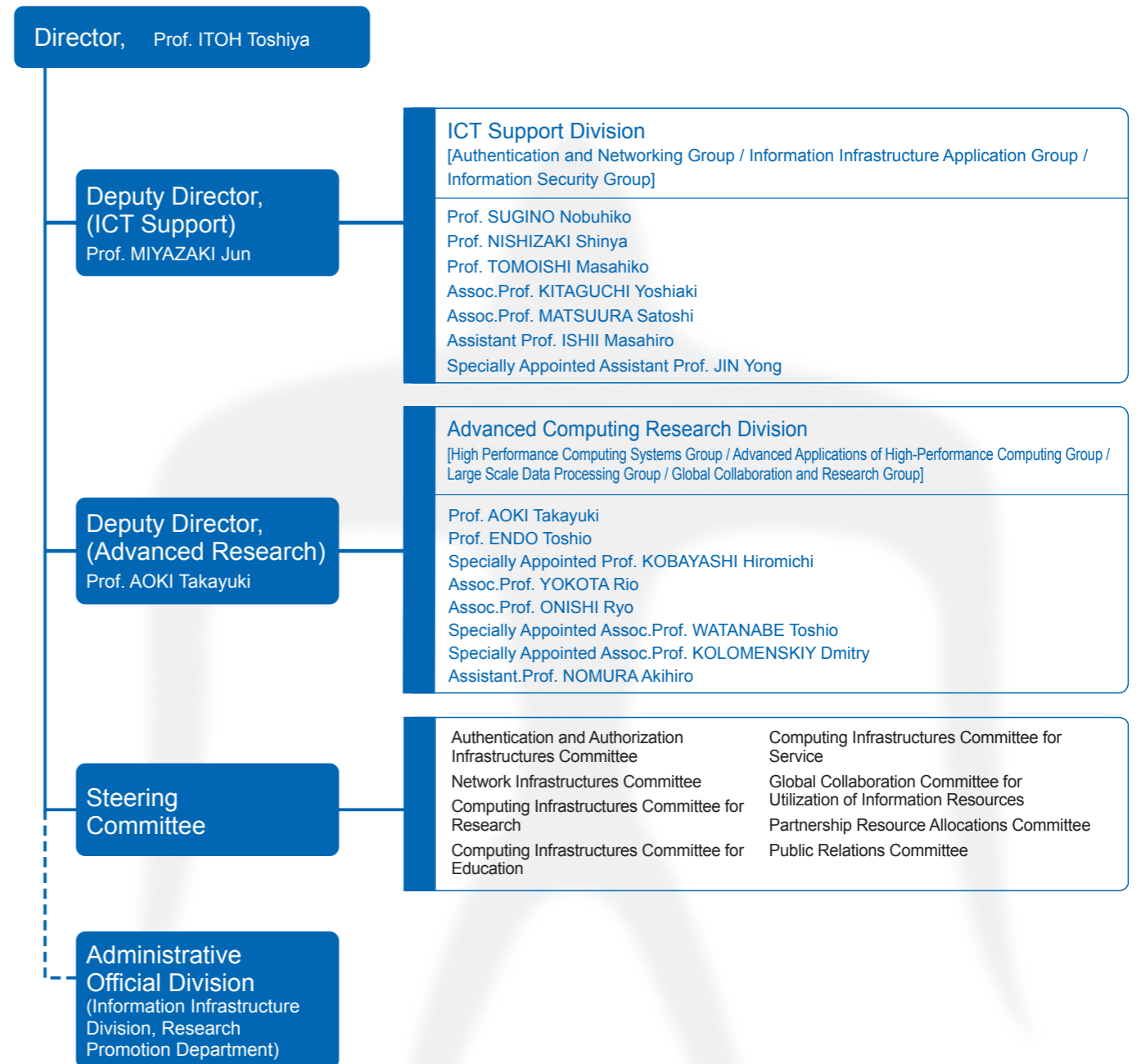
Inauguration of the Academic Exchange Program with Southeast Asian countries under the Core University System, with the University of Indonesia (UI)

- 1980 Inauguration of the Academic Exchange Program with Southeast Asian countries under the Core University System with the Indonesian Institute of Science (LIPI)
- 1984 Inauguration of the Academic Exchange Program with Bandung Institute of Technology
- 1986 Inauguration of the Academic Exchange Program with the University of the Philippines
Inauguration of the Academic Exchange Program with King Mongkut's Institute of Technology
- 1991 Program terminated by JSPS to change to a project-type system

2001 Reorganization of GSIC

- 2002 Titech Campus Grid (800 CPUs) 15 locations on campus
Tokyo Tech Office (Thailand) established
- 2004 Intercampus gigabit links by private optical fiber
Internet connection upgraded to 10Gb
- 2005 Campus-wide Wireless Network started
- 2006 TSUBAME Grid Cluster started
Campus-wide Network Application System (based on PKI) installed
- 2008 SINET3 connection replaced by 10Gb
- 2009 Partnership Resource Allocations started
- 2010 Reorganization to ICT Support Division and Advanced Computing Research Division
Titanet3 installed and Titanet wireless 2 installed
Activities as a Joint Usage / Research Center for Interdisciplinary Large-scale Information Infrastructures started
TSUBAME2.0 started / connected to SINET4
- 2012 SINET4 connection replaced by 20GB
SINET4(Yokohama) direct connection to Suzukakedai Campus
- 2013 TSUBAME 2.5 started
- 2014 T2 CERT(TokyoTech CERT) established
- 2016 SINET5 connection replaced by 100GB
- 2017 TSUBAME 3.0 started
- 2020 Titanet4 installed

GSIC Organization



Number of Staff Members (September 1, 2020)

	Prof.	Assoc. Prof.	Lecturer	Assistant Prof.	Admin. Official	Total
Director	(1)					(1)
Deputy Director	(2)					(2)
ICT Support Division	3	2		1 (1)		6 (1)
Advanced Computing Research Division	2 (1)	2 (2)		1		5 (3)
Administrative Official Division					18 (14) [6]	18 (14) [6]
	5 (3) (1)	4 (2)		2 (1)	18 (14) [6]	29 (3) (4) (14) [6]

() : joint appointment posts at Tokyo Tech, () : Professor (limited term as per contract), () : technical staff, [] : part-time

The TSUBAME Supercomputer

The supercomputer "TSUBAME", which means a "swallow" in Japanese and also is a symbol of our university, is used daily by students, faculties, and researchers both inside and outside the university, and industrial users to provide strong support for research, education and development.

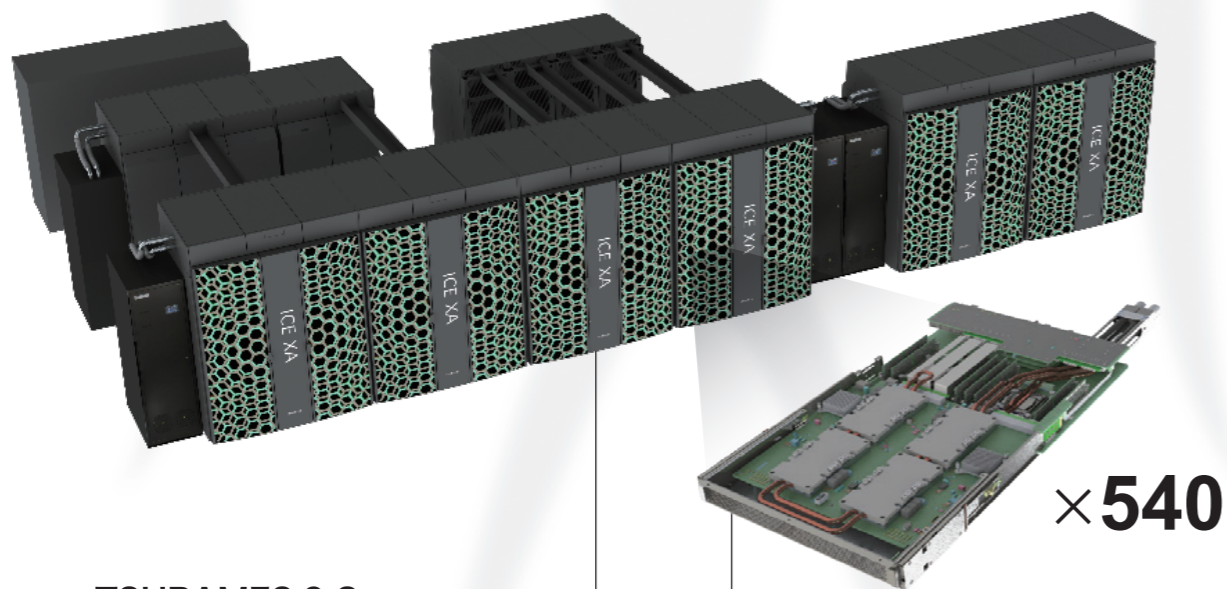
As of 2020, GSIC is operating the TSUBAME3.0 supercomputer since August 2017. This system has computation performance of 12PFlops (in double precision), is the fourth fastest supercomputer in Japan. The main part of this system consists of 540 computing nodes, each of which 28 Intel Xeon CPU cores and four NVIDIA Tesla P100 GPUs. Features of TSUBAME3.0 include hardware and software designs that are suitable not only for scientific simulations, but also big data analysis, machine learning and AI. It is equipped with large scale storage of 16PBytes and 47PFlops computation speed in half precision, which is becoming popular in deep learning. Also, TSUBAME

users can enjoy various deep learning/machine learning frameworks. Additionally, GSIC is preparing environments for interactive data analysis via web browsers.

TSUBAME3.0 is also a highly compact and low-power system, and it was ranked No.1 in the world in June 2017 on the Green500 list, which compares power performance ratios of supercomputers (like fuel efficiency in automobiles). This achievement became possible with knowledge obtained through experiments with TSUBAME-KFC, an energy efficient prototype system in GSIC.

TSUBAME plays important roles in collaboration of Tokyo Tech and industries, the support of research and education, and cultivation of future researchers. Also, TSUBAME is one of the largest systems in "High Performance Computing Infrastructure", which consists of major national supercomputer centers in Japan. By harnessing experiences in TSUBAME operation and design, GSIC is planning to introduce the next-gen infrastructure.

Overview of TSUBAME3.0 Supercomputer



TSUBAME3.0 System

High Performance Compute Node (540 nodes)

- 12.15PFlops (double precision)
- 47.2PFlops (half precision)

Large Scale Shared Storage

- Total Capacity 15.9PByte
- Total Access Speed 150GB/s

Fast Network

- Omni-Path fat tree topology

Compute Node: HPE/SGI ICE-XA

CPU : Intel Xeon E5-2680v4 (14core) × 2

Memory : DDR4-2400 256GB (32GB × 8)

GPU : NVIDIA Tesla P100 × 4

- 16GB HBM2 memory per GPU

SSD : 2TB NVMe

Network : Omni-Path 100Gbps × 4

OS : SUSE Linux Enterprise

Joint Usage/Research Center for Interdisciplinary Large-Scale Information Infrastructures (JHPCN)

JHPCN is a network-type joint usage/research center and is made up of eight supercomputer centers in Japan. Designed as a six-year program of MEXT, JHPCN's first and second stages began in FY2010 and FY2016, respectively.

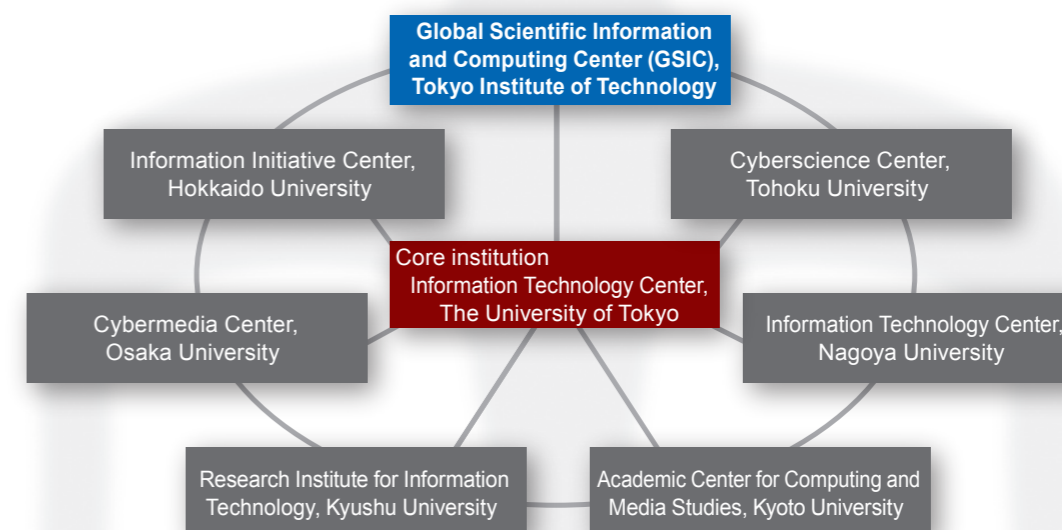
The formal title of this program is "Joint Usage/ Research Center for Interdisciplinary Large-scale Information Infrastructures", but it is also known as "Japan High Performance Computing and Networking plus Large-scale Data Analyzing and Information Systems (JHPCN)".

The objective of JHPCN is to promote the continuous progress of academic research and to lay the groundwork for interdisciplin-

ary collaborative research in Japan. JHPCN strives to tackle highly challenging problems, which were previously thought extremely difficult to solve, by using the combination of the eight centers' supercomputer resources and forming a collaboration among their researchers. In the second stage of JHPCN, we also encourage the international collaboration research, the industrial research, and the challenging exploratory research.

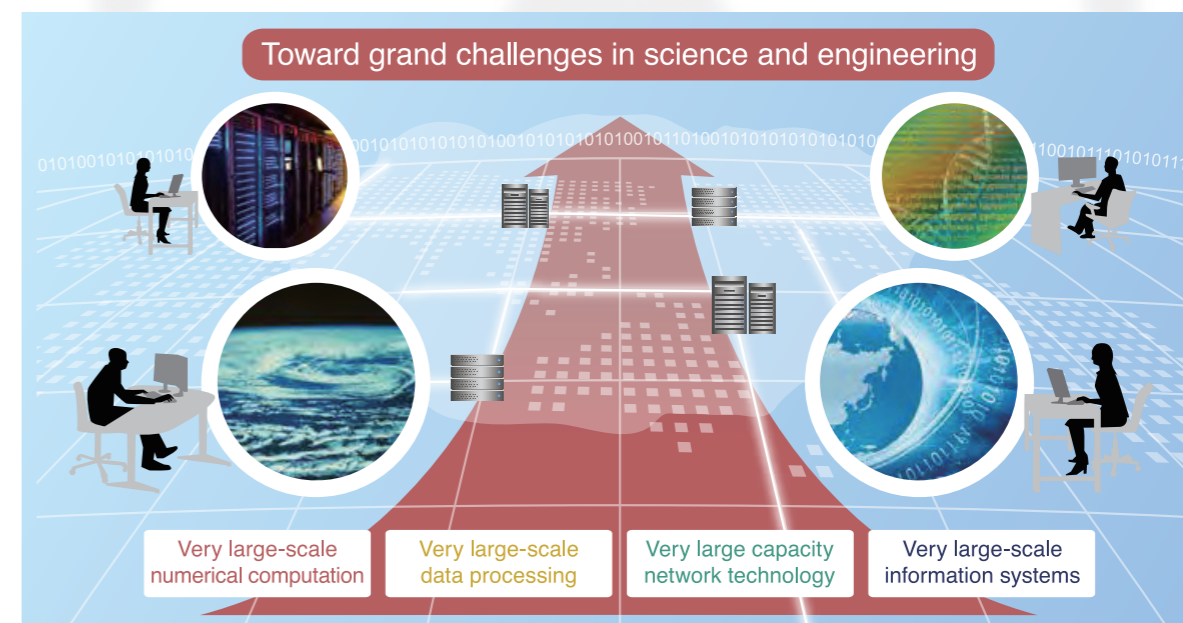
GSIC promotes research collaborations on four research topics: GPU computing and large-scale HPC applications, design and management of new-generation supercomputers, big data and data science, and artificial intelligence (AI), and deep learning.

8 centers comprising JHPCN



Objectives of the JHPCN

Research collaboration with pioneering researchers in the eight centers is expected to resolve the grand challenges of complex research.



High-Performance Computing Infrastructure (HPCI)

HPCI links the *Fugaku* supercomputer and the super-computers located in universities and research institutions nationwide via high speed networks; it is a core system contributing to the realization of a revolutionary high-performance computing environment to meet the needs of a wide variety of users.

The use of HPCI is expected to allow a wide array of HPC users throughout the country to use it more efficiently and that this will accelerate the wider use of HPC from germinating research to large-scale research projects. GSIC provides a computer resource of TSUBAME3.0 for both academic and industrial users.

HPCI system providers

Other system providers making up the HPCI consortium

- Institute for Material Research, Tohoku University
- The Institute for Solid State Physics, The University of Tokyo
- Yukawa Institute for Theoretical Physics, Kyoto University
- Research Center for Nuclear Physics, Osaka University
- High Energy Accelerator Research Organization
- National Astronomical Observatory of Japan
- Institute for Molecular Science
- Japan Aerospace Exploration Agency
- Japan Atomic Energy Agency
- National Institute for Materials Science
- Information Technology Center, Institute of Physical and Chemical Research (RIKEN)
- National Institute of Informatics
- Research Organization for Information Science & Technology

Information Initiative Center, Hokkaido University

Cyberscience Center, Tohoku University

Information Technology Center, Nagoya University

Academic Center for Computing and Media Studies, Kyoto University

Cybermedia Center, Osaka University

Center for Computational Sciences, University of Tsukuba

Information Technology Center, The University of Tokyo

Center for Earth Information Science and Technology, Japan Agency for Marine-Earth Science and Technology

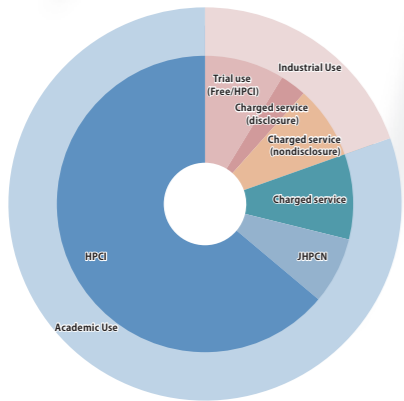
Center for Engineering and Technical Support, The Institute of Statistical Mathematics

Research Institute for Information Technology, Kyushu University

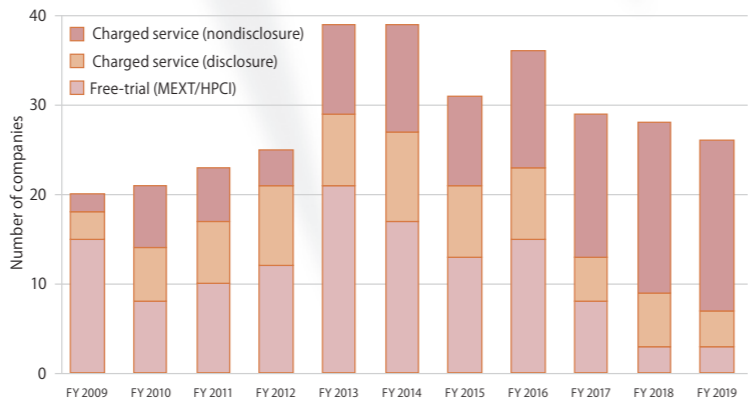
TSUBAME Partnership Resource Allocations / Industrial Use

TSUBAME partnership resource allocations provide computer resources of TSUBAME3.0 for others such as researchers in other universities, government research institutes, and private companies. This resource allocation has two categories: the "disclosure" category for academic and industrial uses, and the "nondisclosure" category, which is only for industrial use. In the nondis-

closure category, it is not necessary to disclose the project title and representative nor the outcome of the project. Intellectual property rights of the project are, in principle, attributable to the project. The support group for the partnership resource allocations is in charge of management and support of users outside Tokyo Institute of Technology.



Breakdown of the TSUBAME resources allocation FY2019



Number of companies using TSUBAME

Campus Network Titanet3

The campus network of Tokyo Tech has reached to Titanet3 after the second upgrade in 2010. Titanet3 is a simple two-tier architecture that consists of 10Gbps core switches with high port density and an edge switch located in each building, which are directly connected by single-mode optical fibers. The upgrade not only provides a high-speed, wide-bandwidth network but it also solves the issues in the conventional 3-tier architecture, such as the breakdown or power failure of the aggregation switches that can widely affect the network, which improves the stability and operability.

analysis and virtual chassis technology have been introduced for high functionality and reliability.

For the connections to the Internet and outside research institutes, Titanet3 is directly connected to academic research network and projects such as SINET, APAN, WIDE and JGN, etc., and it is also designed to select the optimal route for communications. In 2016, with the upgrade of SINET, the network environment of the most frontier research projects has also been upgraded. Specifically, the connection with SINET was increased to 100 Gbps, and the total bandwidth for off-campus connections 110 Gbps.

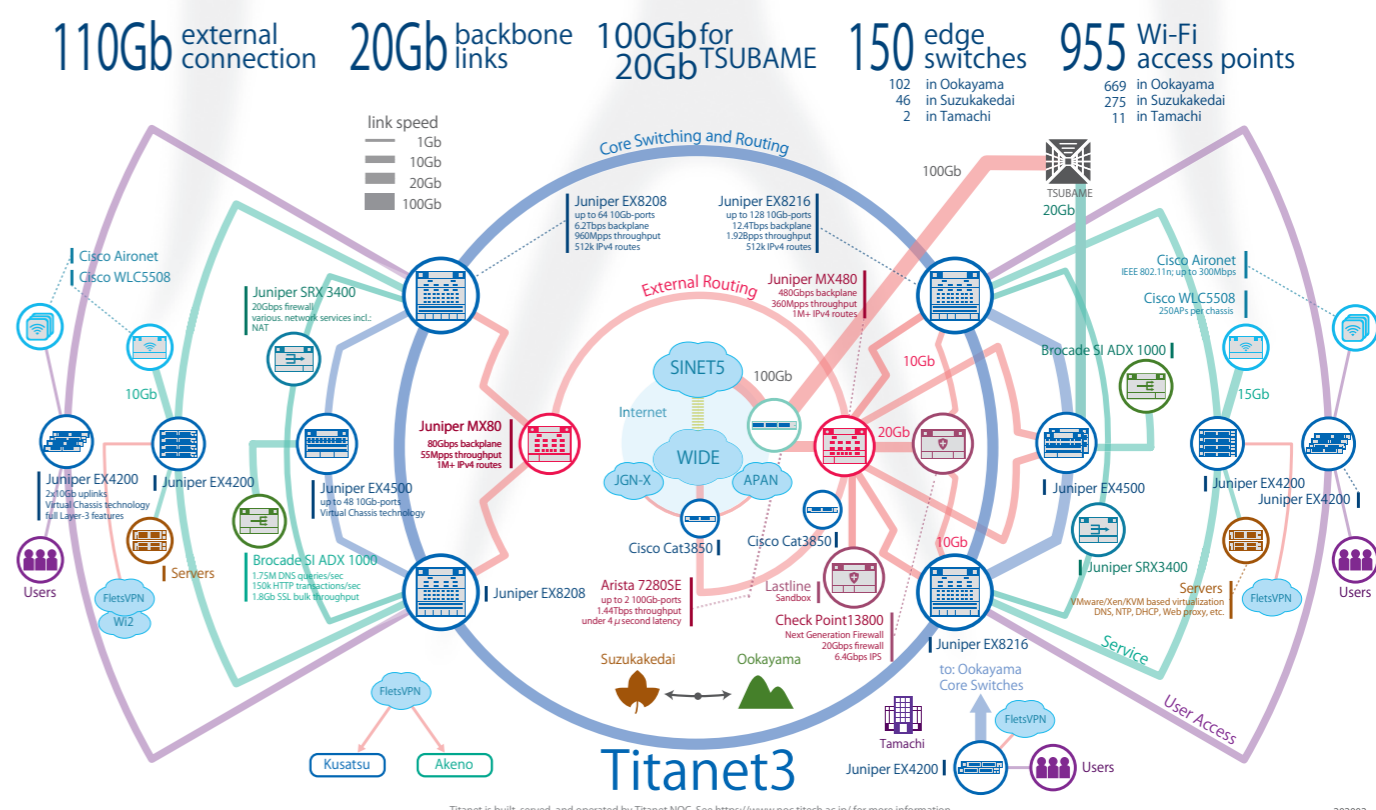
The core switches are setup in the same manner at both of the Ookayama and Suzukakedai campuses, and the bandwidths of the connections between core switches are guaranteed by over 20Gbps. Specifically, the connection between core and edge switches consists of two of the same 10Gbps links and each edge switch provides 1Gbps bandwidth per staff member in each building. At the Tamachi campus, we also introduced WDM facilities and constructed the same network environment as that of other campuses.

In modern society, information communication is essential for human activities. Titanet3, one of the most important infrastructures of Tokyo Tech, not only supports cutting-edge research, educational, and operational activities, but it also provides indispensable services for daily campus life. Additionally, many systems have been designed to support university operations which include campus authentication and authorization systems, campus wireless networks, remote lecture systems, video conference systems, internal telephone lines between campuses, power and water meter-reading systems and a disaster Information broadcasting system, among others. All of the above systems require campus network services in order to operate. Therefore Titanet3 plays a major role as the "foundation" for the infrastructure of the university.

For faraway research institutions such as the Kusatsu Volcanic Fluid Research Center, we introduced FLET'S service to provide access to the Titanet3 internal.

Furthermore, in addition to legacy services such as IPv6 and multicast, several new features such as sampling-based traffic

Network Topology of Titanet3



Titanet is built, served, and operated by Titanet NOC. See <https://www.noc.titech.ac.jp/> for more information.

Campus Wireless Network - Titanet Wireless 2

The wireless network of Tokyo Tech campuses started in 2005, primarily in lecture halls and popular spaces regularly used by students, to provide network services to all laboratories. When we firstly upgraded the wireless network in 2010, it reached to Titanet wireless 2 (TW2), which could accommodate a wide variety of terminal devices with high capacity and reliability and was compatible with high-speed communication standards.

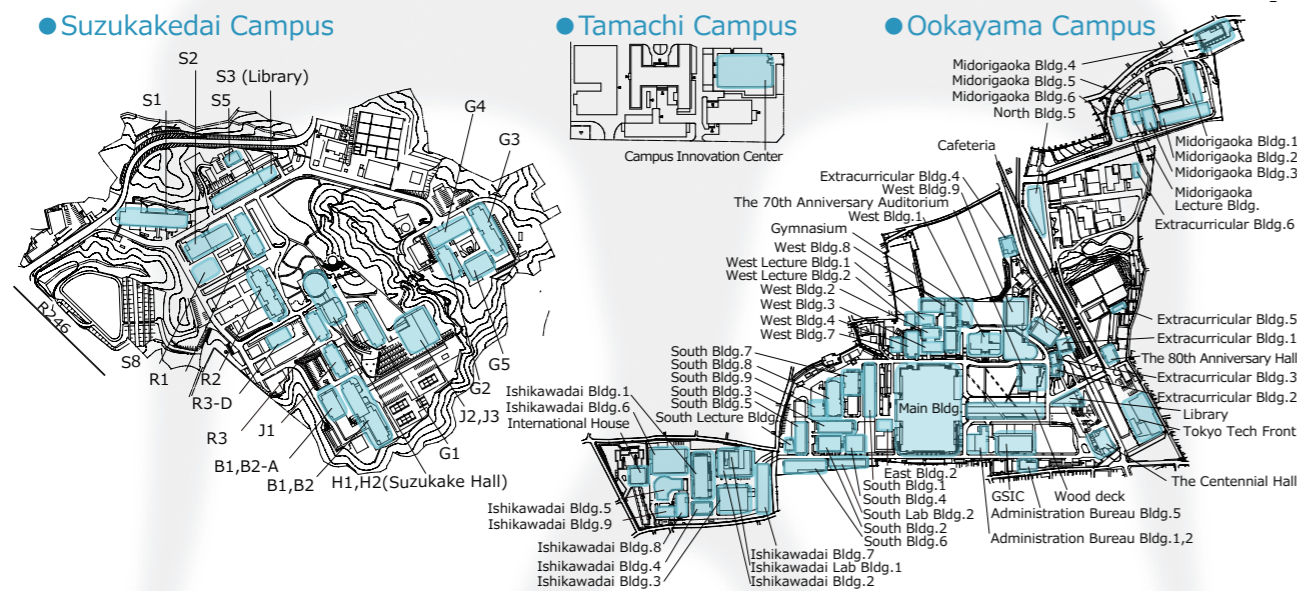
With TW2, in addition to upgrading hardware devices, we also updated the service policies such as allowing simple authentication, and constructed redundant controllers, and we also obtained licenses to increase areas of access. Next, in addition to conventional wireless network service for internal users, we also added tentative wireless network services for conference

guests, access to commercial wireless network services for personal guests of the staff, and we introduced a worldwide educational roaming service - "eduroam".

At the time of Great East Japan Earthquake, we also provided a free wireless network temporarily to those affected, based on the policies of the provider.

As of March 2020, the total number of access points on campus is 955, including the increased access points in new spaces and those introduced in branches. Compared to other educational institutions, this is an extremely large-scale wireless network, and the number of both internal and external users continues to increase.

TW2 Communication Areas



Web Hosting and DNS Hosting Services

To reduce administrative costs for web or DNS (Domain Name System) servers for labs, schools, offices, and projects, we provide web and DNS hosting services. By using the services, each organization is able to publish

information related to research, education and campus life without managing hardware facilities, OS (Operation System) and software.

Upgrades for the Campus Network

The current campus networks, Titanet3 and TW2, have been used for over 10 years.

We have scheduled a step-by-step upgrade in 2019 based on the design of 2018.

The upgraded network plan includes the introduction of high-level adaptive functions for cybersecurity – which is an

important global issue these days – the introduction of IPv6 to the entire campus in response to the IPv4 exhaustion issue, the adoption of new technologies to materialize the virtual laboratory network, as well as the deployment of application services adaptable to support further development of Tokyo Tech.

Campus-wide Authentication and Authorization System

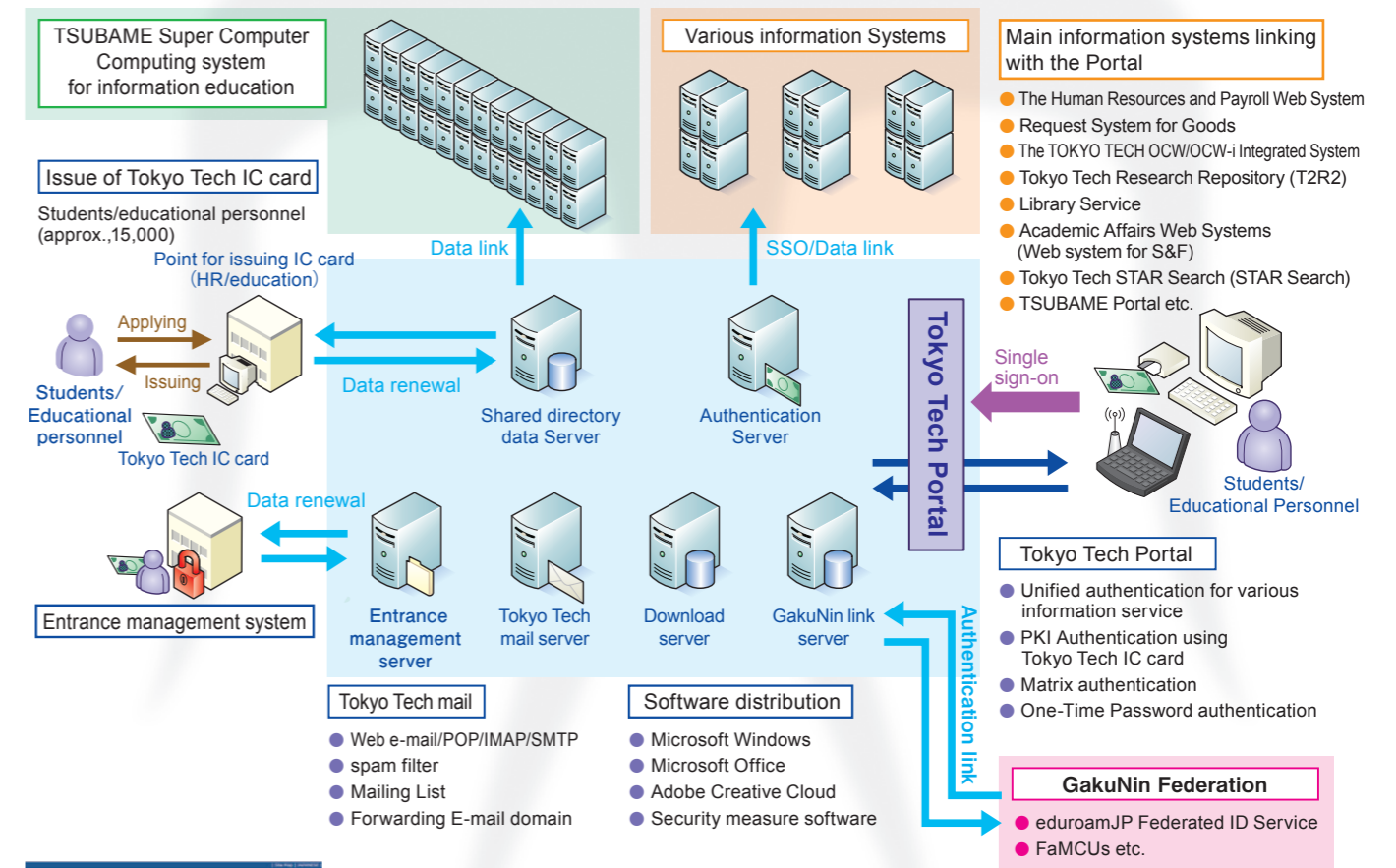
The Campus-wide authentication and Authorization system or the Tokyo Tech Portal is information infrastructure established in 2005. Upon registering for the University, the Members are issued an identification card (Tokyo Institute of Technology IC card) that allows users access to the Portal system. Tokyo Tech members can access to every information service simply by single-sign-on (SSO), so that the Portal system contributes providing a convenient service infrastructure with reduced management and security maintenance costs.

The Members can access to the Portal system by using PKI authentication function equipped on the IC card, when advanced security level is required. For those not using an IC card reader device, access to the Portal system can be

granted using the matrix authentication, where users refer to the random character table printed on the backside of the IC card. In addition, they can access to the Portal system using One-Time Password (OTP) issued for temporary use. Information service systems connected to the Portal are Tokyo Tech email servers, Tokyo Tech OCW/OCW-i, campus network access via SSL-VPN, Purchase Request System, Tokyo Tech Research Repository (T2R2), Library Services, Campus Facility Reservation System, Software Licenses under the campus agreements, and etc..

The Tokyo Tech IC card is also used to allow its holder to enter into buildings/rooms, which contributes to physical security management in the campus.

Outline of the Campus-wide Authentication and Authorization System



Tokyo Tech Mail

The "Tokyo Tech Mail" system began operating in 2006 in order to provide a campus-wide email environment to Tokyo Tech members i.e. students, academic and administrative staffs. Since then, GSIC has been providing a reliable email service, which enables a smooth exchange of information for various activities at the University, such as academics, education, research, administrative management, and etc..

In 2012 and 2017, the system had major updates for further

improvement in convenience, quality of service use, and stability. They included the expansion of email pool size to cope with increasing in numbers of emails and amounts of email data, and a higher performance email filter to prevent unsolicited (junk) emails.

Also, it became possible to access to the server securely from off-campus network, when user communications related to sending and receiving emails were entirely encrypted by SSL.



Campus Software Agreement

Service outline

Tokyo Tech provides softwares that are widely used throughout the University, such as Microsoft Windows (OS), Microsoft Office, security (anti-virus) software, Adobe Creative Cloud, and MATLAB under the campus-wide license agreements. It greatly contributes not only to a reduction in software purchase costs in laboratories (and hence reduction in overall university expenses), but also to preventing the use of illegal software.

Furthermore, students and staffs can also use Microsoft Office and security software on their personally owned PCs, hence contributing to a better study and research environment. In order to ensure the strict and proper license management, we require the user authentication on the campus-wide authentication and authorization system before providing the software.

IT Service Desk

Service outline

The IT Service Desk provides the information desk service by receiving inquiries on telephone and email regarding the content of all the services provided by the Global Scientific Information and Computing Center (GSIC). When inquiries are not about services provided by GSIC, they are transferred to the corresponding sections/departments, so that a one-stop like service is provided. According to the annual survey, the experiences of users have been favorable.

Examples of inquiry contents :

- Email system
- Tokyo Tech Portal
- Connectivity to the campus network
- Software licenses under campus agreement
- Usage of the TSUBAME, education system, and etc.

Tokyo Tech CERT (Computer Emergency Response Team)



With the importance of information security growing, Tokyo Tech CERT (Computer Emergency Response Team) was established as a dedicated information security team in October 2014. It is the role of Tokyo Tech CERT to provide a secure computer environment to accelerate research / education / administrative activities. In addition to security incident response, we conduct a wide range of information security activities, such as sharing security trends / alerts and examining campus vulnerabilities with an emphasis on proactive response.

Our objectives include providing information and alerting through the website (<http://cert.titech.ac.jp>) and using e-mails, flyers and digital signage for Tokyo Tech members. In addition, information security materials are available in Japanese and English (and some in Chinese) in the form of booklets and videos. These security booklets are distributed at various information security seminars. Their content is also provided electronically. For Tokyo Tech members seeking this content, please do not hesitate to contact Tokyo Tech CERT.

Constructing a secure computing environment requires cooperation not only with Tokyo Tech CERT, but also with various organizations and users. We collaborate with staff members of "authentication and networking group" who are in charge of network infrastructure and authentication infrastructure through daily work and regular meetings, as well as members of information security risk management committees and the executive office. We also collaborate with each organization in various situations, such as the revision of university rules, the specifica-

tions for the introduction of large ICT systems, and the management of data in joint research.

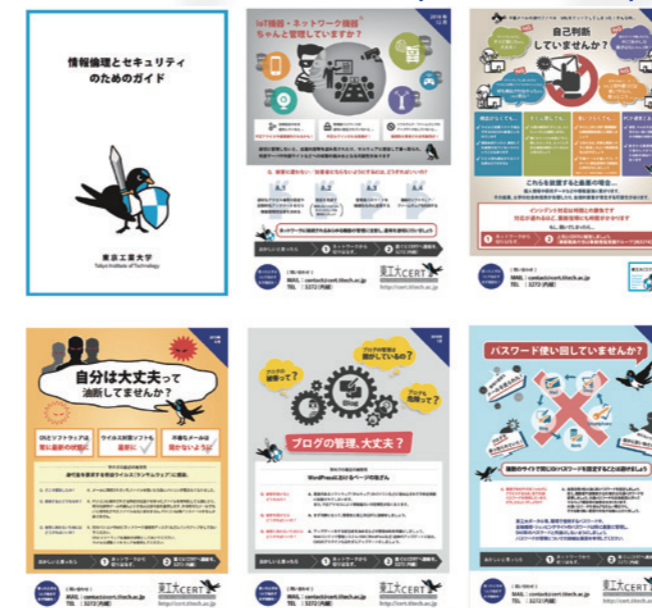
While working on the above security announcement and the university-wide cooperation, we are also working on various technical aspects. As a major initiative, we operate several next-generation security appliances in cooperation with the Network Operation Center (NOC). In addition, in order to fully utilize the detection function of those appliances, we are building a large-scale analysis platform on its own virtualization infrastructure environment. This analysis platform can handle a large amount and various types of logs generated from those security appliances. We are working to improve the quality of incident response by utilizing these security devices and log analysis infrastructure.

Computers and networks improve and innovate all modern jobs. On the other hand, large amount of diverse data and computer resources are very attractive to cyber-attackers. Now, ensuring information security is one of the essential items in all jobs. We have to establish a communication system and a data management system. However, if used properly, these essential measures can lead to the opportunity to review and make improvements on the organization and its communication and teamwork. Tokyo Tech CERT is working to ensure that information security does not stagnate the activities of the organization, that various activities can be carried out actively because of the secure environment, and that each organization can work together to improve more than just ensuring information security.

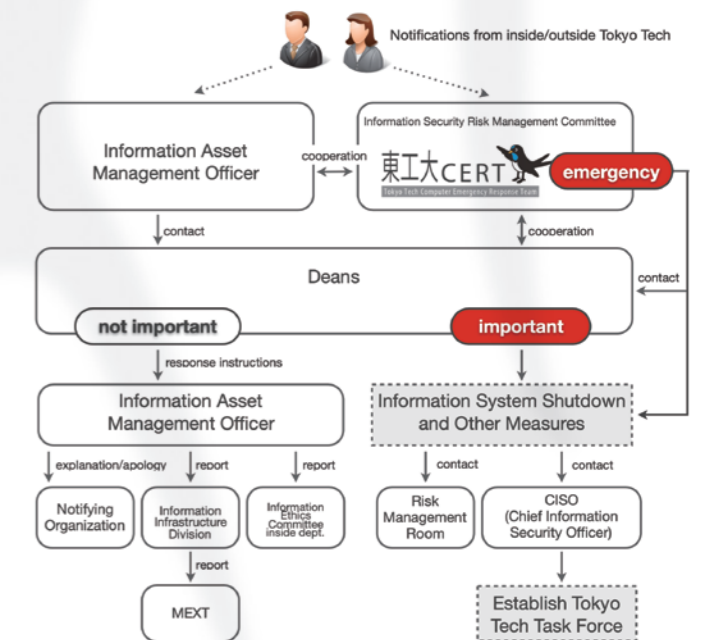
Tokyo Tech CERT System



Information Educational Activities by Guidebooks and Flyers



Flow of Information Security Incident



Cross-departmental Incident Response Training



※Tokyo Tech CERT is a different organization from GSIC, but GSIC staff join Tokyo Tech CERT. Therefore, Tokyo Tech CERT is described as a related organization of GSIC in this brochure.

Computing Systems for Education Use

Objective

Computer systems used for education, as shown below, are used in computer literacy and computer science classes for 1st year students and in classes such as computer skills for 2nd to 4th year and post-graduate students.

Information Literacy I and II

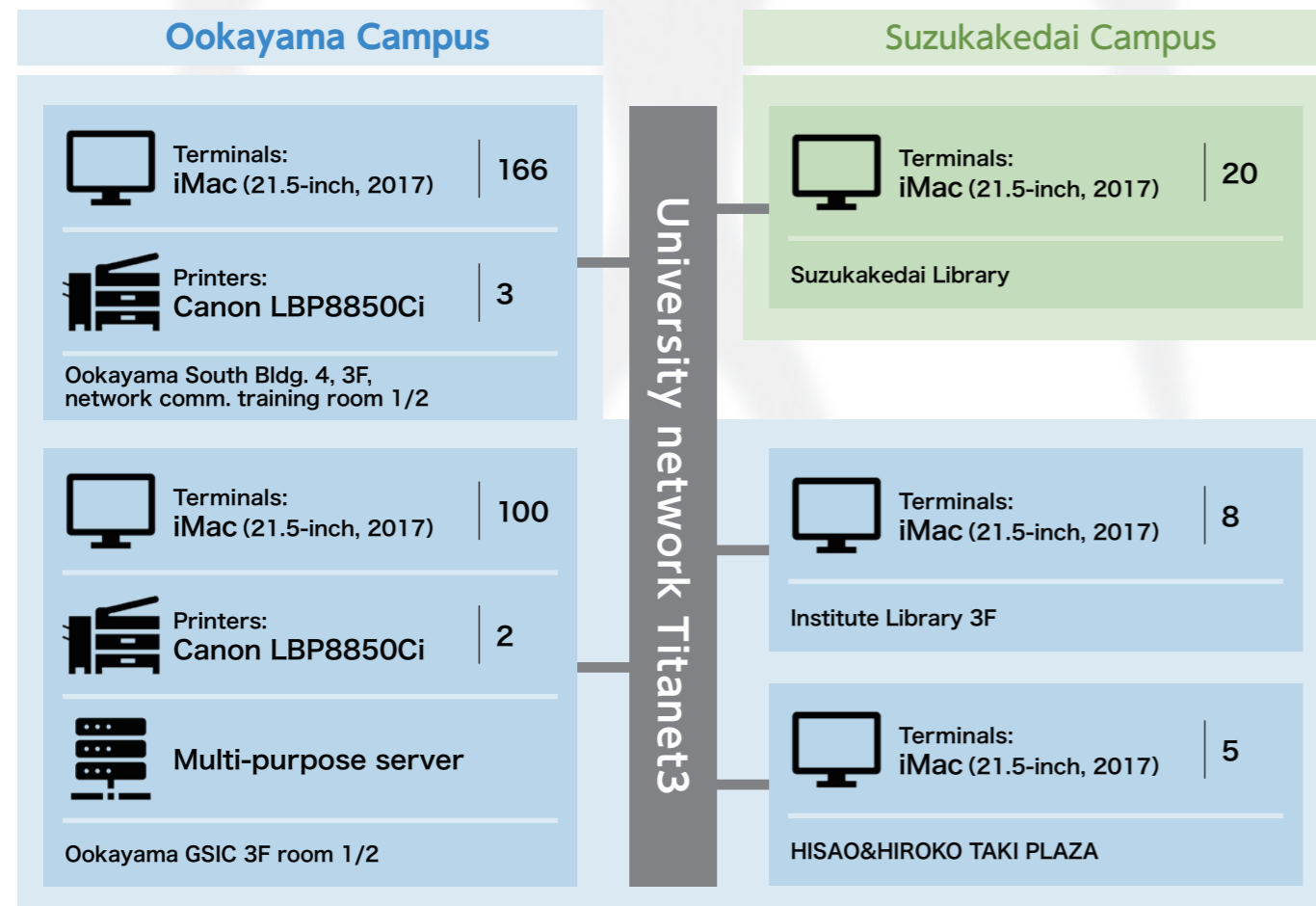
The focus of this study is not simply how to use information devices, but it also covers legal and ethical content and etiquette to prevent using information in the wrong way.

Computer Science I and II

Learn basic knowledge and various principles regarding the concept of "calculation," which is the foundation of computers.

Computer skills

For those who have completed the "Information Literacy I and II" and "Computer Science I and II" courses, this course is based on programming skills and offers the opportunity to learn how to design the interface for experiment equipment and measurement devices, and the methods of numerical calculation related to these fields.



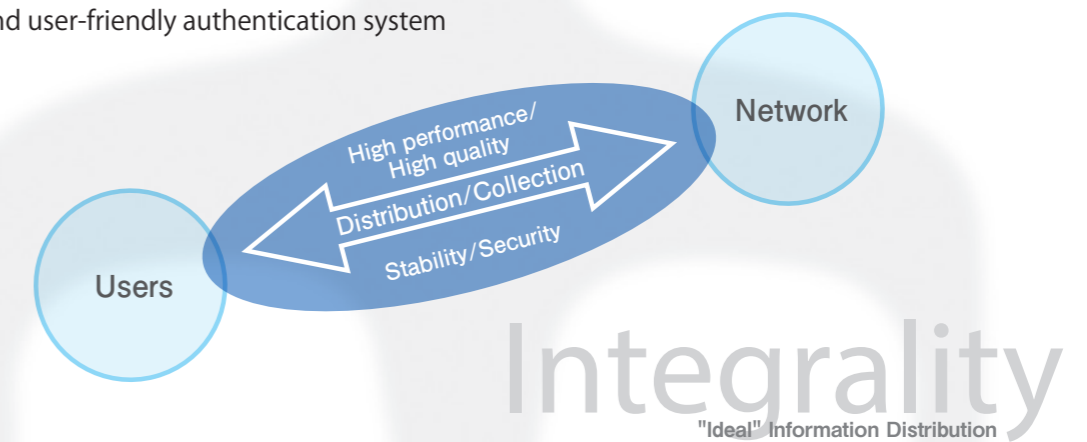
ICT Support Division

Authentication and Networking Group

Ideal Information Access and Distribution

Our group mission is to construct an ideal information and communications technology (ICT) infrastructure, which is integral to our research activities.

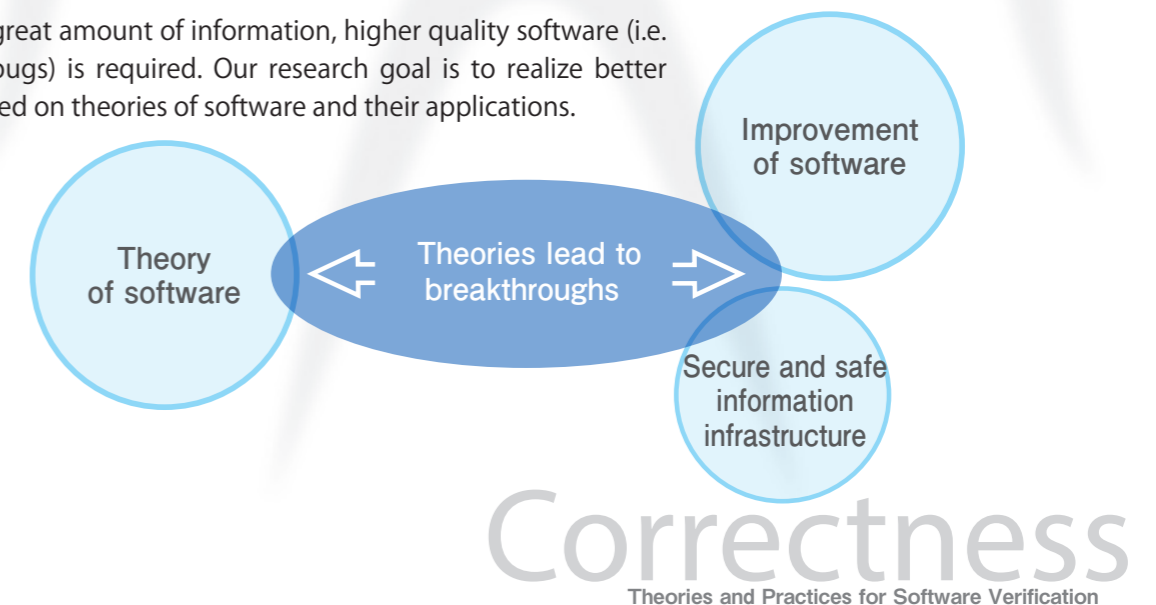
- Reliable network security infrastructure
- High performance and high quality networking
- Stable, secure, and user-friendly authentication system



Information Infrastructure Application Group

Better software development

To utilize a great amount of information, higher quality software (i.e. with fewer bugs) is required. Our research goal is to realize better software based on theories of software and their applications.



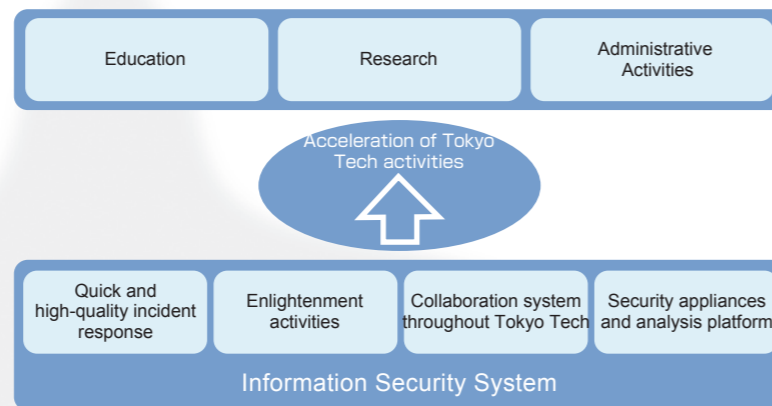
ICT Support Division

Information Security Group

Constructing an information security system to accelerate Tokyo Tech activities

Our motto is "To construct an information security system to accelerate education / research / administrative activities at Tokyo Tech."

With each organization of Tokyo Tech, we are constructing a secure computer networking environment.



Acceleration

Constructing an information security system to accelerate Tokyo Tech activities.

Advanced Computing Research Division

High Performance Computing Systems Group

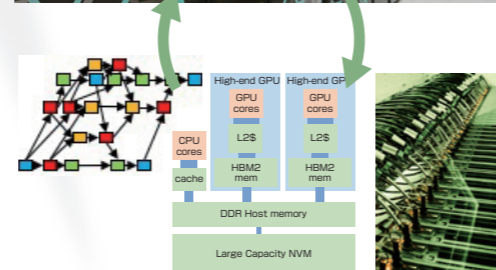
TSUBAME: Everybody's Big-Data Supercomputer

The high performance computing systems group's main mission is the design and operation of the TSUBAME supercomputer series, which became the most energy efficient system in the world*. Also, the outcome of advanced HPC system research is harnessed for improvement of TSUBAME.

*Green500 list in June 2017

Research Topics

- GPGPU/many-core/low-power computing
- Infrastructure software for big data
- Efficient use of memory hierarchy including NVMs
- Power-saving job scheduling technology
- Supercomputing support for interactive jobs
- Highly efficient cooling with warm liquid
- Topology/routing technology for next-gen networks
- Evaluation/design of next-gen supercomputers



TSUBAME

Interaction of operation and advanced research

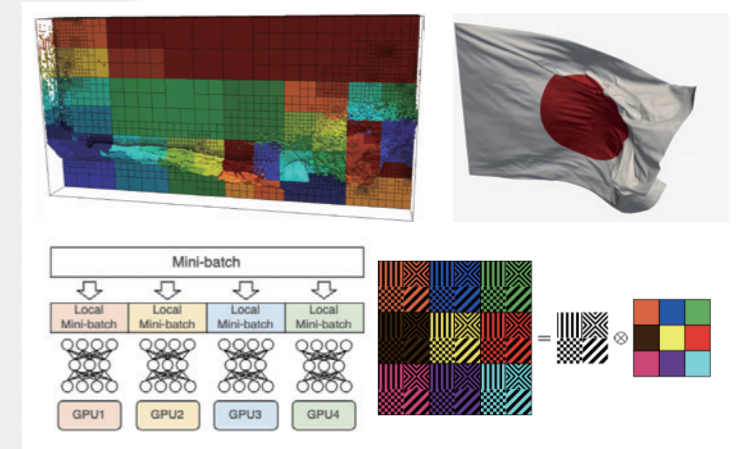
Advanced Computing Research Division

Advanced Applications of High-Performance Computing Group

Scientific and Public Contributions using High-Performance Computing

We are conducting R&D related to advanced applications of high-performance computing on the TSUBAME supercomputer and aiming at scientific outcomes and public contributions.

- New algorithms for GPU computing
- Large-scale HPC applications using GPU
- International research collaboration on HPC applications
- Dynamic load balance
- AMR (Adaptive Mesh Refinement)
- Hierarchical methods for Exascale
- Scalable deep learning on thousands of GPUs
- International collaboration for open source libraries



Applications on TSUBAME

- Large scale simulation for two-phase flows
- Large Eddy Simulation on turbulent flows
- Study on fluid-structure interaction
- Tsunami simulation
- Particle simulation for granular and fluid
- Hierarchical low-rank approximation
- Kronecker factorization
- Hierarchical communication for deep learning
- Second order optimization for deep learning

Application

Scientific and public contributions using TSUBAME

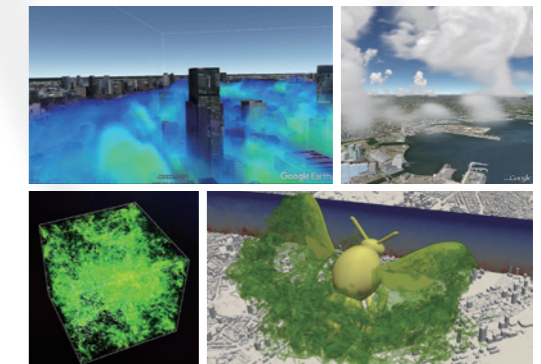
Large-Scale Data Processing Group

Novel Development in Science and Technology through Big Data Processing and Simulation

We aim to develop integrated technologies of simulation and processing of environmental big data utilizing the TSUBAME supercomputer facilities. It will lead to new developments in science and technology that enhance the integration of simulation and data sciences.

R&D themes

- Numerical simulations of environmental fluid dynamics
- Integrated technology of AI and simulation
- Quantification of predictability of environmental chaos phenomena
- Numerical prediction of urban micro-meteorology
- Information technology for a data-driven smart society
- AI-aided applications for the better use of big data



Data Processing

Advancement of Science and Technology using TSUBAME