

National Institute of Information and Communications Technology
Network Research Institute



Sendai City, Miyagi Prefecture
Resilient ICT Research Center



Kashima City, Ibaraki Prefecture
Kashima Space Technology Center



Kobe City, Hyogo Prefecture
Advanced ICT Device Laboratory



Yokosuka City, Kanagawa Prefecture
Wireless Networks Research Center



Koganei City, Tokyo
Photonic ICT Research Center
 Space Communication Systems Laboratory
 Network Architecture Laboratory
 Advanced ICT Device Laboratory



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Network Research Institute

<https://www.nict.go.jp/en/network/>



Director General
HARAI Hiroaki

Photonic ICT Research Center

- Photonic Network Laboratory
- Optical Access Technology Laboratory

Wireless Networks Research Center

- Wireless Systems Laboratory
- Space Communication Systems Laboratory

Resilient ICT Research Center

- Sustainable ICT Systems Laboratory
- Robust Optical Network Laboratory
- Planning and Collaboration Promotion Office

- Network Architecture Laboratory
- Advanced ICT Device Laboratory



In the Beyond 5G era, building innovative networks to realize the digital transformation of advanced social systems for Society5.0 is necessary. Innovative networks should respond to the rapid growth in communication traffic, dynamic changes in communication quality, and various network services.

In the Network Research Institute, we conduct R&D on computing and AI-enabled networking technology, next-generation wireless technology, photonic network technology, optical and radio convergence technology, space communication fundamental technology, and resilient information and communication technology (ICT), as key technologies of innovative networks. In addition, we promote standardization activities, dissemination of R&D results, and their implementation in society.

Photonic ICT Research Center

<https://www.nict.go.jp/en/photonic-ict/>

We conduct R&D on ultra-high-capacity photonic networks to support the rapid growth in communication traffic, access technologies that harmoniously integrate optical and wireless communications, and flexible network technologies for the Beyond 5G era.

Director General
AWAJI Yoshinari



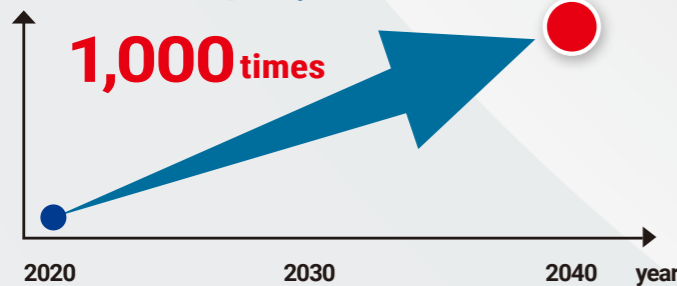
Photonic Network Laboratory

We conduct R&D on ultra-high-capacity photonic networks to support the increasing communication traffic of the Beyond 5G era.

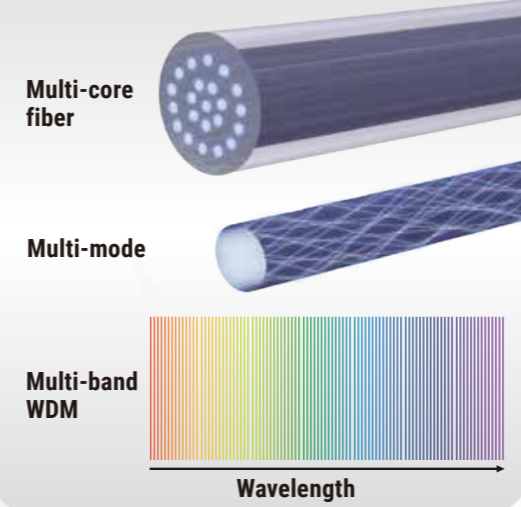
- **Massive channel optical network technologies**

Optical fiber transmission technologies with massive channels
Optical switching node technologies for several 10 peta bps
Ultra-fast optical signal processing technologies

Transmission Capacity



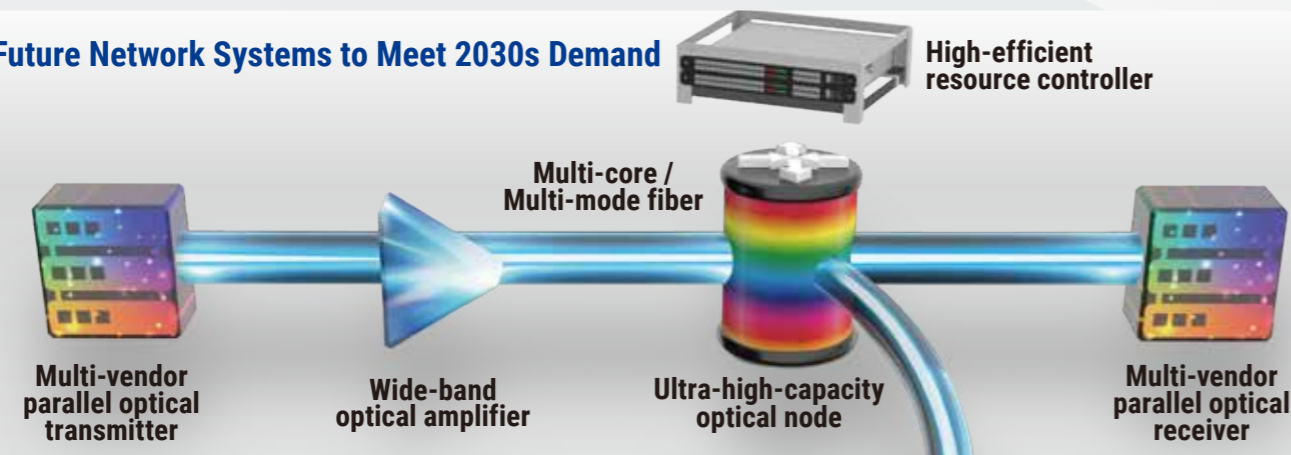
Technologies to Increase Transmission Capacity



- **Dynamic and flexible reconfiguration technologies of optical networks for efficient provision of network resources**

Technologies to utilize optical network hardware and wavelength resource efficiently
Advanced analytical and control of optical network technologies

Future Network Systems to Meet 2030s Demand



Optical Access Technology Laboratory

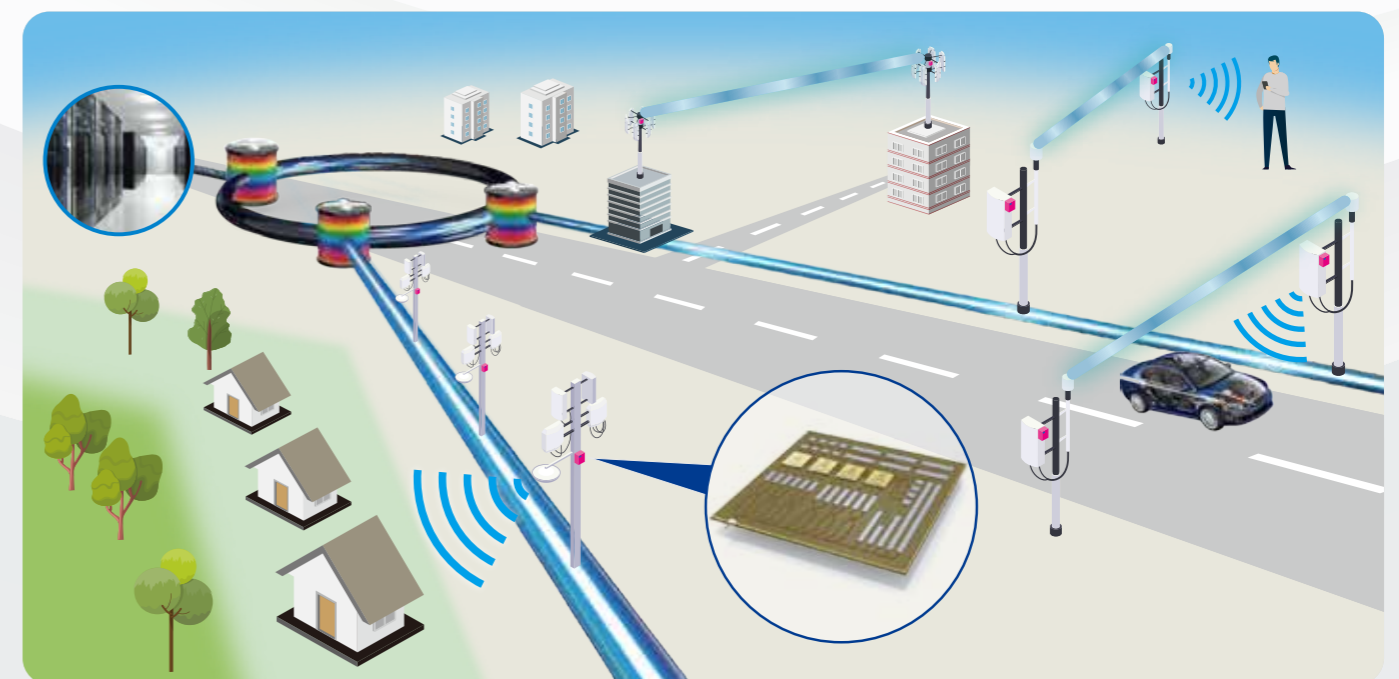
We conduct R&D on physical layer technologies in innovative and flexible communication systems in the Beyond 5G era.

- **Massively integrated all-band ICT hardware technology**

Flexible and scalable integrated devices for converged optical and radio systems
Massively photonic integration technology
Optoelectronic conversion technology with high coherency
Highly robust optical device technology

- **Harmonized seamless access system**

Sub-tera bps-class converged optical and radio transmission technology
Low-noise optoelectronic signal generation and distribution technology
Uninterrupted cascaded/hybrid connections using optical and radio technologies



Expected Use of Access Network in the Beyond 5G Era

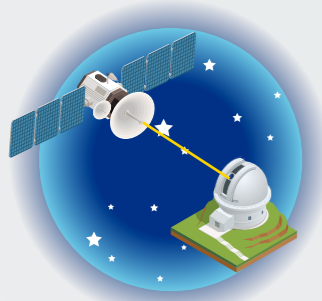
Wireless Networks Research Center

<https://www2.nict.go.jp/wireless/en/>

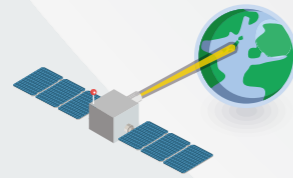
Looking ahead to the Beyond 5G era, we conduct R&D and disseminate results thereof, targeting wireless network technology that will globally extend three-dimensional seamless communication networks including the ocean and space through the integration of terrestrial and non-terrestrial networks, and ensure connectivity in all circumstances and environments.

Space Communication Systems Laboratory

By implementing an integrated space-ground network that enables the use of big data in the future by utilizing optical and radio wave satellite communications, we aim to create helpful space communication technologies and a future where people can enjoy ICT even on remote islands or the moon.



Optical Satellite Communication System



Small Optical TrAnsponder (SOTA) Project



Precise Orbit Determination Technologies



ETS-9 Satellite Communications Project



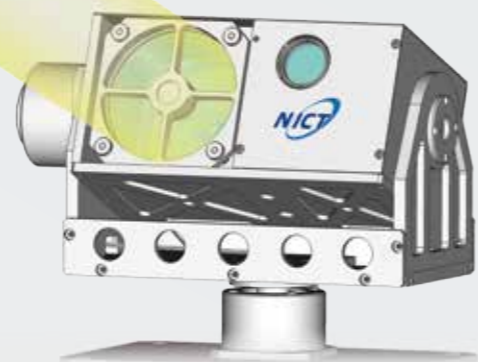
Prospective Utilization of High Throughput Satellite Technologies



Satellite-Terrestrial Integration Project



High Throughput Satellite



Ultra-Compact High-Speed Optical Communication System Technology



Director General
TOYOSHIMA Morio



Wireless Systems Laboratory

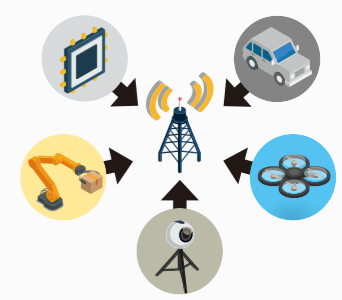
The potential of wireless communication is increasing substantially in the 5G/Beyond 5G era. We focus on developing infrastructure, terminals, and related environments to ensure connectivity in all circumstances, even in the sea or in the factory. Towards a safe and secure society, our R&D focuses on terrestrial/mobile radio communications, and the practical application of research results.



Local 5G System



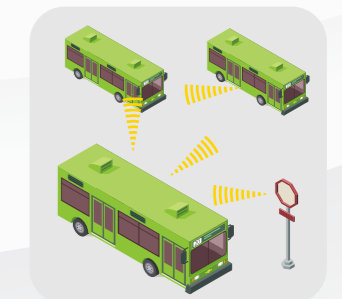
Wireless Grid



Simultaneous Transmission Access Boosting Low-Latency



Wireless Emulator



Device-to-Device Communications



Flexible Factory Project



Command Hopper & Drone Mapper



Challenges to Use RF Signals in Underwater



Impulse-Radio Ultra-Wide Band



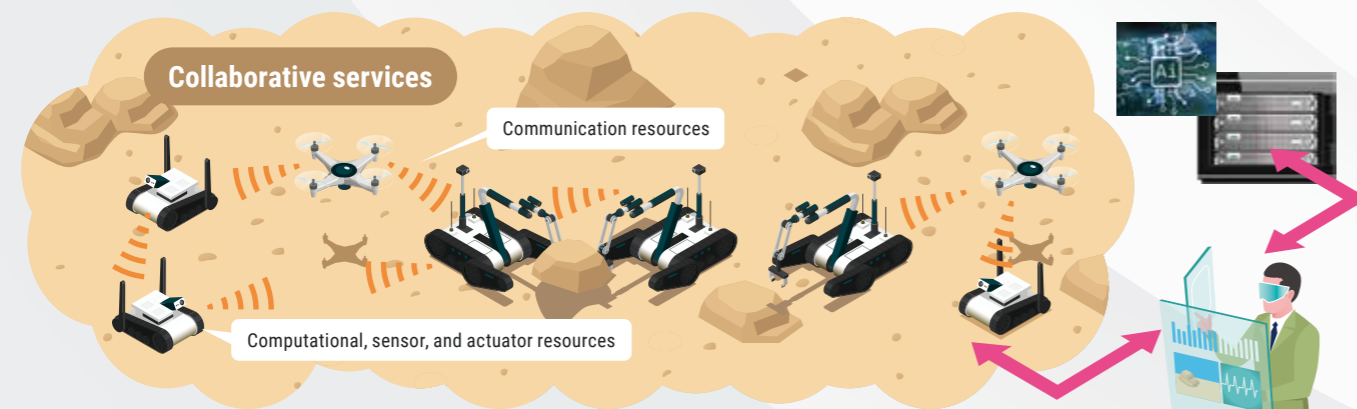
We focus on ICT that is resilient to disasters and failures, and useful in such times, for example, pandemics. These technologies are used to communicate in severe physical environments, measure natural environments, and detect signs of failure in optical networks and restore their functions. We conduct R&D in these areas and promote their implementation in society to improve resilience on a global scale.

Sustainable ICT Systems Laboratory

We conduct R&D on fundamental, resilient ICTs that immediately adapt to the disruptive changes of deployed networks due to disasters or serious communication failures.

• Fundamental technologies to build information and communications infrastructure for severe physical environments

It allocates information and communication resources appropriately and reconfigures them autonomously to maintain services and applications over networks even in the event of sudden network changes.

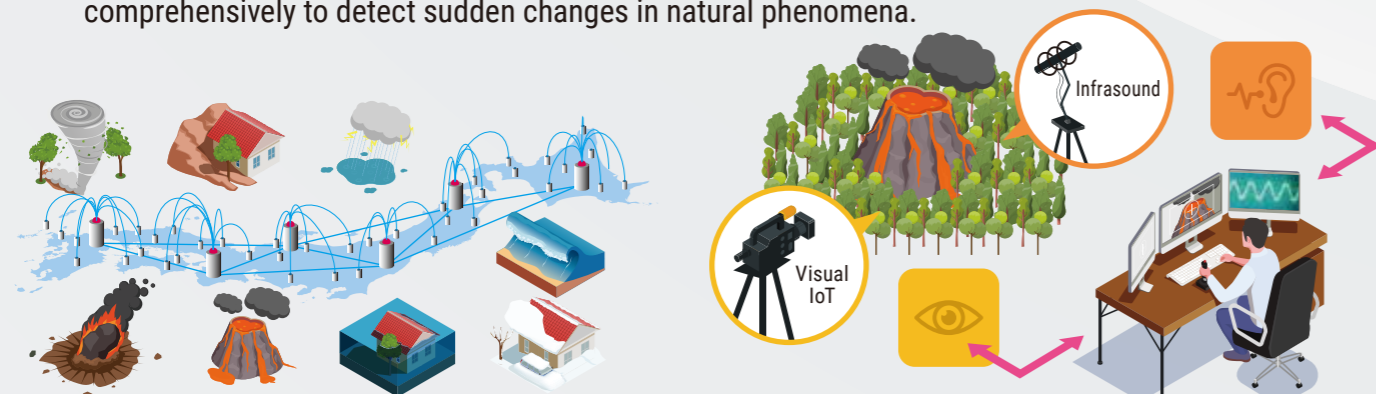


Discovering available resources and reconfiguring services autonomously
Autopoiesis Edge Cloud Systems

Network configuration based on "Make-before-break"
Wireless Access Network for Severe Physical Environments

• Resilient ICTs for natural environmental measurement

It collects data from environmental measurement sensors and visualizes and analyzes it comprehensively to detect sudden changes in natural phenomena.



A Sensor-array Spanning the Whole Japan

Visualization and Analyzing of Data from Natural Environmental Measurement Sensors

Robust Optical Network Laboratory

We establish the fundamental technologies that enhance the resilience of optical networks against large-scale failures and disasters. These include detection/analysis of potential failures, adaptive control/management to prevent the deterioration of networks, and swift emergency recovery in case of large-scale failures and disasters.

• Advanced technologies for Telemetry/Control/Management of optical networks

Technologies for telemetry, detecting, analyzing, and predicting signs of network failures and other incidents
Adaptive control/management preventing the deterioration of networks

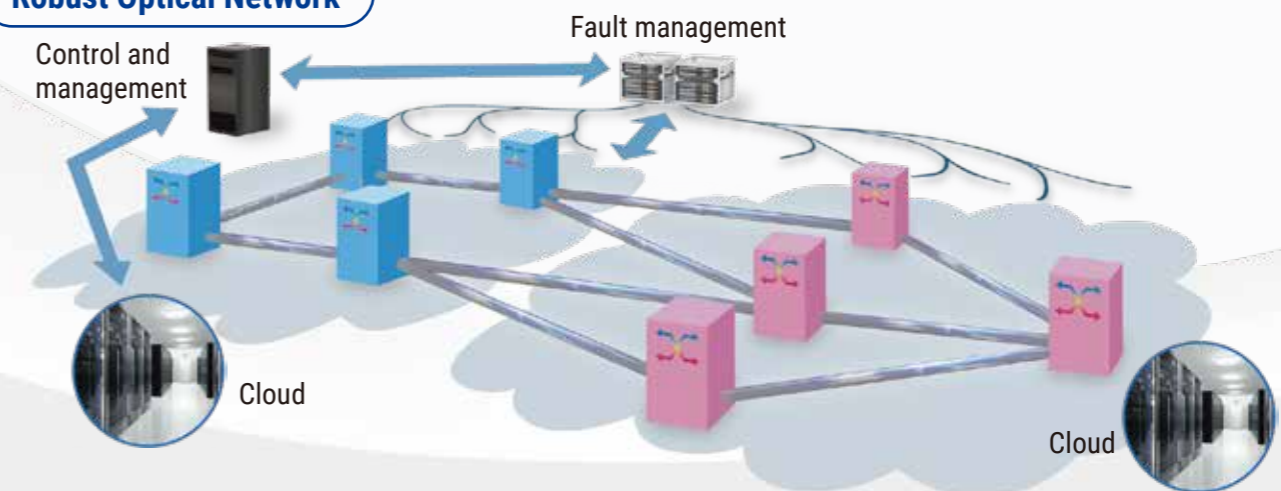
• Multi-integrator interoperability in open and disaggregated optical networks

Enhancing the interoperability among different network integrators' systems with openness and disaggregation

• Linkage between communication and computing resources

Collaboration between communication and computing systems contribute to flexible adjustments in the network/cloud ecosystems and enable swift recovery from large-scale failures and disasters

Robust Optical Network



Planning and Collaboration Promotion Office

Our main goal is to share the benefits of research outcomes on resilient ICT to support society in the event of a natural disaster. To implement our technologies in society, we conduct trials and disaster drills that use R&D results with cooperation from various organizations. We also organize symposia and technology expositions to promote these results.



Network Architecture Laboratory

<https://www.nict.go.jp/en/nalab/>

We conduct R&D on innovative network architecture for the timely delivery of highly reliable information through high-quality network services, while optimally utilizing the computing resources of network infrastructure when a variety of network services coexist in the Beyond 5G era.

- **Large-scale network control automation technology**

Technologies to adjust and control networking and computing resources based on the analysis of network telemetry data by AI and machine learning techniques

- **Router framework based on deterministic architecture**

Programmable routers to realize advanced network services requiring ultra-low latency communication

- **Information-and-attribute centric communication with decentralized control**

Technologies to create trustable networks that ensure the reliability, integrity, and security of information delivered through communication services

Federated Computing Network Technology

Network management and control by distributed ledger technology

Network configuration and control

In-network computing

Reliable real-time distance learning / telemedicine

Digital Twin

Autonomous mobility city

Network Services in the Beyond 5G Era

Advanced ICT Device Laboratory

<https://pdl.nict.go.jp/english.html>

The Advanced ICT Device Laboratory is an open innovation platform for industry-academia collaboration supporting information and communication device technologies. We promote R&D based on advanced hardware development technologies such as designing, manufacturing, implementation, and evaluation of devices aiming to invent functionally integrated ICT device technologies for using all wavebands including light wave and radio frequency.

- **The latest research across technologies of materials, devices, and systems**
- **Advanced Processing Equipment is available for researchers, engineers, and students.**
- **Contribution to returning social benefit through academic research**

ICT Device Research and Development

Lithography Technologies

Electron beam lithography
Laser direct patterning
Photo-lithography

Etching Technologies

Dry etching
Wet etching
Polishing

Advanced ICT Device Technologies

Optical and radio-wave convergence device technologies
Device technologies for millimeter and terahertz waves
Advanced novel materials for devices
Quantum devices for ICT

High-speed and High-precision Measurement Technologies

Scanning electron microscope
High-speed optical and electrical data detection
Optical and radio frequency measurement

Growth and Deposition Technologies

Molecular beam epitaxy
Plasma-enhanced chemical vapor deposition
Vapor and sputter deposition