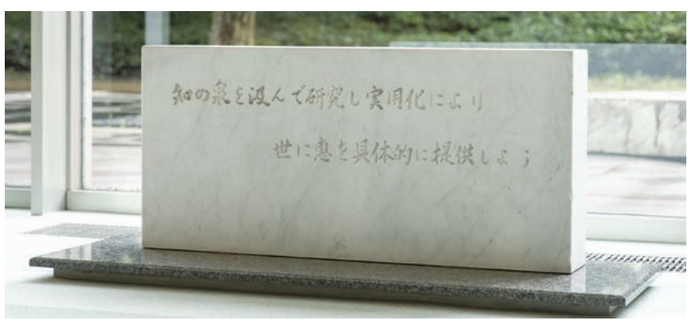

NTT
NTT R&D
NTT Research & Development

Philosophy of NTT R&D

Do research by drawing from the fountain of knowledge and provide specific benefits to society through commercial development

These words, proclaimed in 1950 by Goro Yoshida, the first Director of the Electrical Communication Laboratories under the Ministry of Communications at that time, still live on as the DNA of NTT Laboratories after more than 70 years. They include three important resolutions that NTT Laboratories should have especially in these times.



Monument (December 1950)

1. "Do research by drawing from the fountain of knowledge"

We have entered an era in which all kinds of information can be quickly accessed over the Internet or through artificial intelligence (AI). However, true "knowledge" cannot be so easily obtained. A place with a good, gushing fountain is hard to find, and even if you can find it, it may be located on steep terrain. Good research begins with finding a fountain that is difficult to reach. NTT Laboratories has a history and research team supporting this quest. In other words, the object of this quest is organizational knowledge passed on from senior to junior researchers in an unbroken manner over several decades and collective knowledge arising from exchanges between researchers who have come to inherit this organizational knowledge. Over the years, NTT Laboratories has been discovering and drawing on these two fountains of knowledge to support R&D.

At present, optical communication technology, network technology, speech technology, cryptography, and quantum computer technology are prime examples of fields at NTT Laboratories with world-leading research results. Without superb research, we cannot confront technical issues and social problems that are becoming increasingly complex. Against this background, we aim to further develop our research capabilities and solidify our position as a world leader in research.

2. "Through commercial development"

It is thought that Goro Yoshida, our first Director, was the first in Japan to use the words "JITSUYOUKA", commercial development in English. These words reflect his strong resolve to transform the Electrical Testing Laboratory, which had been a largely academic institution, into the Electrical Communication Laboratories having the responsibility of turning research into practical products. NTT Laboratories took on the responsibility of not only research but also of commercializing research results to support the socially important information-communications infrastructure in unexplored areas such as optical communications technology, voice/image encoding technology, and large-scale computer technology.

At present, the services provided by NTT are undergoing a transformation beyond a communications infrastructure to include social infrastructures and even infrastructures on a global scale. To support this transformation, NTT announced its vision of an Innovative Optical and Wireless Network (IOWN) in 2019. Following this, research, development, and commercialization activities progressed steadily, and in 2023, NTT launched IOWN 1.0 as the first version of IOWN commercial services. At the 2025 Osaka-Kansai Expo, NTT showcased IOWN 2.0, highlighting its potential applications in the computing domain. Furthermore, building on over 40 years of research in natural language processing, NTT launched NTT's Large Language Models 'tsuzumi' as a service in 2024. Looking ahead, NTT remains committed to the practical deployment of IOWN 2.0, the evolution toward IOWN 3.0 and 4.0, continued enhancement of tsuzumi, exploration of next-generation AI technologies, and the realization of quantum computing—all integral to implementing the IOWN vision across society.

3. "Provide specific benefits to society"

Going back in time when the research of communication networks and computers was just starting out, anything that could be faster and lower cost would certainly be purchased and used. In other words, if a researcher's idea of a "good thing" was researched, developed, and commercialized, it would "provide benefits to society."

However, today's society is undergoing dramatic and complex changes, and values are becoming increasingly diverse, so a researcher's idea of a "good thing" and society's idea of a "good thing" may no longer agree with each other. This trend is particularly noticeable on a global scale. In this kind of world, we will steadily promote "research by drawing from the fountain of knowledge" and "commercial development" and provide specific value to society while achieving a good balance between "market-in" research that collaborates with specialists in market analysis and development to plan and drive research forward and "product-out" research in which one sets out to create the future without worrying about the market.

In 2023, the NTT Group announced its new Medium-Term Management Strategy "New Value Creation & Sustainability 2027 Powered by IOWN." To make this a reality, all of the three resolutions of NTT Laboratories described above are extremely important. While revisiting the core objectives established at the founding of Electrical Communication Laboratories and reaffirming that research, development, commercialization, and value provision are all important, NTT Laboratories will continue to carry out world-leading R&D in unison with all NTT researchers based on an action plan of "keeping our researchers excited and ambitious," "helping society in a scalable and sustainable way with powerful technology," "creating the future rather than just predicting it," and "honing our intuition and creativity."

Shingo Kinoshita

Senior Vice President
Head of Research and Development Planning Department
Research and Development Market Strategy Division
NTT, Inc.

At a Glance

Number of Employees

over 300,000

Number of Research and Development Staff

over 2,000

Consolidated Operating Revenues

over 10,000 billion yen

Number of IEEE Fellows (Including those retired)

over 40

Consolidated subsidiaries

over 900

Positioning and Role of NTT R&D

NTT R&D, positioned directly under the NTT holding company, promotes basic and core research and development for the NTT Group and contributes to the business advancement of each group company.

Number of Patents

over 20,000

Number of papers and presentations at academic conferences

over 2,500 /year

Ranking by number of papers

9th in world, 1st in Japan*

* 2020–2024 aggregated rankings among engineering-related corporates, NTT's survey based on Web of Science and InCites Benchmarking

Received IEEE Milestones

4 times

History of NTT R&D

2025
Change the corporate name to NTT, Inc.

2023
Launched the IOWN APN 1.0 service
Developed NTT's large-scale language model 'tsuzumi'

2019
Developed the world's most energy-efficient optical transistor

2017
Developed a multi-core fiber having four optical paths (cores) in one fiber

2005
Developed a free-bending optical fiber cord using a 'holey fiber'

1992
Built Japan's first web page: the "NTT Website"

1988
Achieved Japan's first success in a TCP/IP interconnection experiment with the U.S.

1985
Inaugurated Nippon Telegraph and Telephone Corporation as a result of the privatization of Nippon Telegraph and Telephone Public Corporation

1977
Developed optical fiber base material production technology for mass production of high-quality optical fiber (VAD method)

1952
Established Nippon Telegraph and Telephone Public Corporation

1948
Established the Electrical Communication Laboratory under the Ministry of Commuications

Main Commendations and Prizes Awarded Since 2020

Organization and Award	Items	Year of Award
IEEE, IEEE Milestone	Fiber optic connectors with physical contact connection adopting push-pull coupling mechanism	2020
The Japan Prize Foundation, Japan Prize	Distinguished contributions to global long-distance, high-capacity optical fiber network through the development of semiconductor laser pumped optical amplifier	2022
NeurIPS 2023 Competition, Privacy Preserving Federated Learning Document VQA	Differential Privacy Analysis for DP-CLGECL	2023
The International Association for Cryptologic Research, IACR Asiacrypt Test-of-Time Award	Preimage Attacks on 3, 4, and 5-Pass HAVAL	2023
Nikkan Kogyo Shimbun, Prime Minister's Award of Japan Industrial Technology Award	Cloud launch of ultra-high performance computing platform using superconducting quantum computer for enterprise	2023
IEEE, IEEE Milestone	Silica-Based Arrayed-Waveguide Gratings, 1992-1996	2024
IEEE, IEEE Jagadish Chandra Bose Medal in Wireless Communications	Seizo Onoe, former CSSO of NTT	2024
MMRI Award 2024, Best Award in the Japanese LLM Category	NTT's Large Language Model "tsuzumi"	2024

Organization of NTT R&D

IOWN Integrated Innovation Center	IOWN Product Design Center	Formulation of a development and expansion strategy backcast from market needs and social demands and consistent promotion of technology development, dissemination activities, and implementation support
	Network Innovation Center	Aiming to implement the IOWN concept, research and development on all-photonics networks, network-service infrastructure, network operations, and access-network infrastructure
	Software Innovation Center	Research and development on innovative computing-infrastructure technologies that support a data-centric society and system construction and operation technologies that lead to business evolution
	Device Innovation Center	Research and development on devices and subsystems aimed at evolving and transforming information and communications and pioneering new business fields
Service Innovation Laboratory Group	Human Informatics Laboratories	Research and development aiming to improve the quality of human judgment and behavior, understand and predict changes in the state of people and things in the environment, and respect the thoughts of each individual and support their growth while connecting with society
	Social Informatics Laboratories	Research and development that contributes to the "evolution of society for the better"—from both academic and business perspectives—through an interdisciplinary approach combining the humanities, social sciences, and information science (cybersecurity, cryptology, etc.)
	Computer and Data Science Laboratories	World-leading research and development in computing, media processing, and data science that anticipates transformative shifts in the age of AI to create business value driving social transformation
Information Network Laboratory Group	Network Service Systems Laboratories	Aiming to create future network services, research and development on network architecture and the infrastructure technologies, communications traffic, quality and operations, etc. that support the network system
	Access Network Service Systems Laboratories	Research and development on access systems, wireless access, optical-fiber access, infrastructure and operation technologies, etc. that will create a smart society
	Space Environment and Energy Laboratories	Aiming towards restoration of the global environment and creation of an inclusive and sustainable society, we are researching next-generation energy sources that are extremely clean, technologies that efficiently circulate carbon and energy, and technologies that predict the future of the global environment and society and adapt to environmental changes
Science and Core Technology Laboratory Group	Network Innovation Laboratories	Research and development of innovative optical and wireless transmission and networking technologies to address the rapid growth in communication demands and evolving requirements of future ICT infrastructures
	Device Technology Laboratories	Research and development on materials and device technologies, as well as optoelectronic and heterogeneous materials integration, contribute to realizing a sustainable society, enriching lifestyles, and creating a meaningful impact on society
	Communication Science Laboratories	Discovery and creation of new approaches and concepts in intelligent communication, media information, and human science to revolutionize information communication technologies
	Basic Research Laboratories	Fundamental research in physical science, quantum science, and novel materials with the aim of overcoming the inherent limits of conventional technologies and enabling the advancement and transformation of science

Research Centers in Specific Fields

Innovative Photonic Network Center
Bio-Medical Informatics Research Center
Institute for Fundamental Mathematics
Nanophotonics Center
Smart Data Science Center
Research Center for Theoretical Quantum Information
Digital Twin Computing Research Center

Standardization Activities

Based on its comprehensive range of research and development on information communications, NTT has been active in fora and consortia, which are recently playing leading roles, as well as in standardization organizations such as ITU-T and ISO. These activities also contribute to the orderly development of worldwide information communications.

Annual number of participants in de jure standardization organizations, such as ITU

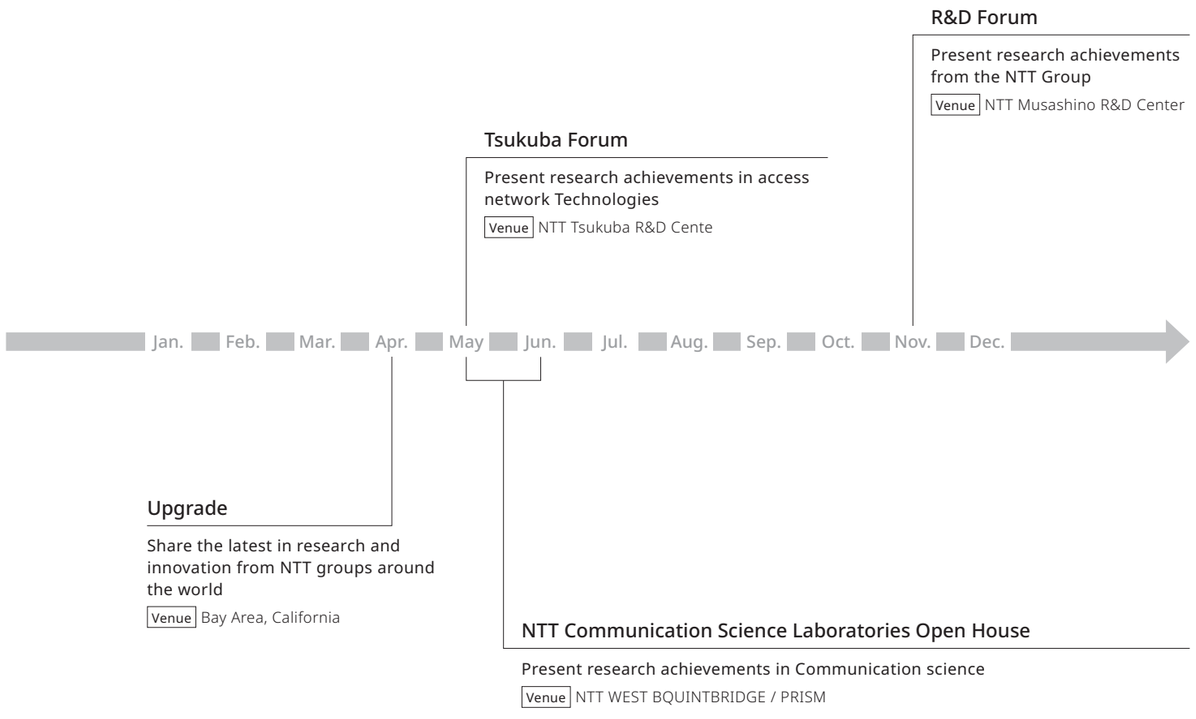
Participants to domestic/ international SDO*	some 200 (cumulative total)
Members of domestic committees	over 300 (cumulative total)
Degree of participation in de jure international standardization meetings	over 500 person-days

Percentage of contributions submitted to ITU-T

Other countries	some 96%
NTT	some 1%
Japan (excluding NTT)	some 3%

* SDO: Standard Development Organization

Key Public Events



NTT R&D Location

NTT R&D Locations

NTT's R&D is undertaken at one integrated innovation center and three laboratory groups, all based in Japan, and at NT Research, Inc., which is a global research hub.

NTT R&D Site in Europe
(Munich, Germany)
- **NTT Research, Inc.**
  Medical & Health Informatics Laboratories

NTT Musashino R&D Center
- **IOWN Integrated Innovation Center**
  Network Innovation Center
  Software Innovation Center
- **Service Innovation Laboratory Group**
  Social Informatics Laboratories
  Computer and Data Science Laboratories
- **Information Network Laboratory Group**
  Network Service Systems Laboratories
  Access Network Service Systems Laboratories
  Space Environment and Energy Laboratories
- **Intellectual Property Center**
- **NTT History Center of Technologies**

NTT R&D Center in North America
(Silicon Valley)
- **NTT Research, Inc.**
  Physics & Informatics Laboratories
  Cryptography & Information Security Laboratories
  Medical & Health Informatics Laboratories
  Physics of AI Group

NTT Tsukuba R&D Center
- **IOWN Integrated Innovation Center**
  Network Innovation Center
- **Information Network Laboratory Group**
  Access Network Service Systems Laboratories

Otemachi First Square East Tower
- **Research and Development Planning Department**

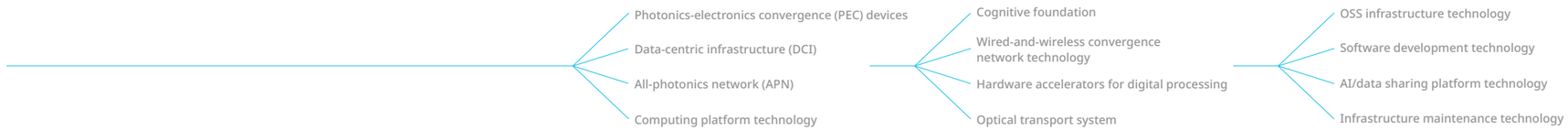
Shinagawa Season Terrace
- **IOWN Integrated Innovation Center**
  IOWN Product Design Center
  Software Innovation Center
- **Service Innovation Laboratory Group**
  Computer and Data Science Laboratories

NTT Keihanna Building
- **Science and Core Technology Laboratory Group**
  Communication Science Laboratories

NTT Atsugi R&D Center
- **IOWN Integrated Innovation Center**
  Device Innovation Center
- **Science and Core Technology Laboratory Group**
  Device Technology Laboratories
  Communication Science Laboratories
  Basic Research Laboratories

NTT Yokosuka R&D Center
- **IOWN Integrated Innovation Center**
  Network Innovation Center
  Device Innovation Center
- **Service Innovation Laboratory Group**
  Human Informatics Laboratories
  Social Informatics Laboratories
  Computer and Data Science Laboratories
- **Information Network Laboratory Group**
  Access Network Service Systems Laboratories
- **Science and Core Technology Laboratory Group**
  Network Innovation Laboratories

IOWN Integrated Innovation Center



Aiming to Build a Sustainable Global Society by Mapping the World using Photonics-Electronics Convergence (PEC) Technology

By combining the IOWN's elemental technologies, such as photonic-electronic convergence (PEC) devices, we aim to implement a "data-centric infrastructure (DCI)," an "all-photonics network (APN)," and a "computing platform" that will achieve extremely low power consumption and low latency. By combining the technologies of the Network Innovation Center, Software Innovation Center, and Device Innovation Center, each with respective strengths in networks, software, and devices, and the IOWN Product Design Center responsible for the development and adoption strategy, we will understand market needs and materialize them in a timely manner as IOWN services and products in a manner that contributes to solving social issues not only in Japan but around the world.

Data-centric infrastructure (DCI) that improves power-usage efficiency for computing

Enormous computing power is needed to support a wide array of applications and finely controlled networks. Using the latest software and photonics-electronics-convergence-based hardware technology, we will create a new computing architecture to provide high computing power while suppressing increases in power consumption.

Innovative computing-platform technology for the IOWN

We are developing AI/data-sharing-platform technology, which collects and analyzes the huge amount of diverse data in the real world and converts it into value, as well as software-development technology. We are also working on supporting open-source software (OSS).

All-photonics network (APN) achieves power-saving, high-speed, and low-latency transmission

By incorporating optical-based technology from terminals to the network, the APN connects end-to-end optical wavelength paths and achieves overwhelmingly low-power, high-speed, and low-latency transmission. It thereby reduces power consumption in the face of ever-increasing traffic volumes and provides new experiences and value, including the fusion of real-world and online services, in response to changing lifestyles.

Photonics-electronics convergence (PEC) devices that dramatically reduce the size and power consumption of optical interfaces

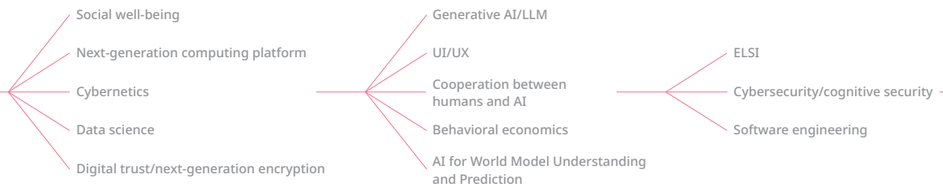
We are developing photonics-electronics convergence (PEC) devices using two technologies: one is silicon-photonics technology, which integrates optical processing and photonics-electronics-conversion functions on a silicon chip; the other is photonics-electronics co-packaging technology, which integrates photonic circuits with electronic circuits, such as digital-signal-processing circuits. These devices will dramatically reduce the size and power consumption of optical interfaces and thereby help to implement economical high-capacity information transmission.

Sustainable World

by Photonics-Electronics Convergence Technology

Hidehiro Tsukano
Senior Vice President of R&D,
Head of NTT IOWN Integrated Innovation Center
NTT, Inc.

Service Innovation Laboratory Group



Realizing a Society in Which Everyone Can Lead a Contented, Safe, Secure, and Healthy Life in Their Own Way

Aiming to respond to increasingly complex social and business issues and to create new value appropriate for diversifying lifestyles, we are working on technical innovation that focuses on humanity, society, and computing. Using an advanced system that integrates cyber and physical spaces (“digital twin computing”), we are aiming to help create a world in which the Earth, society, and individuals are harmoniously interrelated.

Technology that expands the human world of perception and contributes to creativity and intellectual vitality

We are conducting research to improve the quality of human judgment and behavior, understand and predict changes in the state of people and things in the environment, and support growth while respecting the thoughts of each individual while connecting with society.

Computer science that reforms data-processing mechanisms and creates new value

Aiming to achieve dramatic performance scaling, we are researching system architectures for next-generation computers such as optical quantum computers, AI collaboration frameworks that enable complex problems to be solved from diverse perspectives, and the development of fundamental algorithms that transcend the current boundaries of AI technology.

Technologies for supporting transformation and advancement of social systems and human society

From the perspective of society and people, we are researching themes such as “Social well-being brought about by the balance between individual autonomy and collective harmony,” “Digital trust, which builds true trust in cyberspace,” “Cybersecurity for an AI-driven society,” and the “State-of-the-art cryptography” with the aim of supporting development through information technology and addressing various issues.

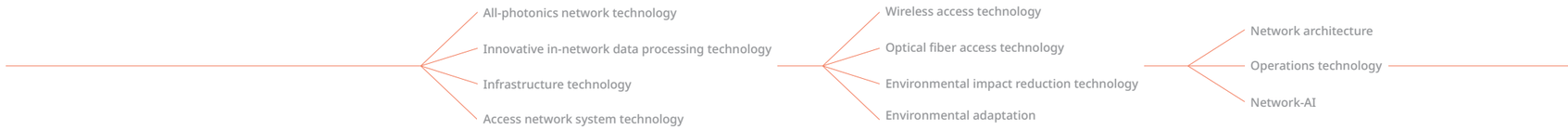
Next-generation AI-application technology that harmonizes sensibility and logic

We are researching how to build a more prosperous society with the aim of creating AI that possesses the intelligence, common sense, emotions, and conversational skills akin to those possessed by humans. To achieve that aim, we are combining various engineering and information-science technologies cultivated at NTT (such as natural-language processing, computer vision, speech, dialogue, and acoustic processing, machine learning, and robotics) with knowledge (e.g., about well-being) from the humanities and social sciences.

Creating New Value
through Digital Twin Computing

Tomoyuki Kanekiyo
Senior Vice President of R&D,
Head of NTT Service Innovation Laboratory Group
NTT, Inc.

Information Network Laboratory Group



Creating Innovative Network Technology with a View to 2030

We are contributing to implementation of the IOWN, an innovative information-processing platform that will reform conventional information and communication systems, break through the limitations of conventional technologies and the barrier of power consumption, and support future societies. Specifically, we are developing technology for maximizing network potential by converting all information transmission and relaying functions into photonics-based ones. We are also working on a self-evolving, zero-touch operation that can promptly provide services in response to user needs; technology for optimizing wireless access; integration of mobile and fixed networks; future network architecture linked with application services; technology that will reduce human impact on the global environment to close to zero; and technology that will make the impacts of changes in that environment tolerable to society.

All-photonics network to achieve smart and reliable transmission

We are researching all-photonics networks to achieve high-capacity, energy-efficient, ultra-low-latency, high-reliability transmission over optical network infrastructure by utilizing cutting-edge photonics devices. By providing dedicated networks optimized for individual services, we will build a stress-free network unconstrained by limitations in bandwidth or latency.

Future wireless-access technology for the 6G/IOWN age

We are studying wireless technology that uses a wide variety of wireless access methods to continue to satisfy quality requirements in the 6G/IOWN age, namely, low latency, high reliability, and high capacity, from end to end. We will achieve “continued connectivity” by utilizing forecast technology that anticipates the future environment and behaviors, intelligent-space-formation technology, and satellite-communication technology, which can build a network that extends upwards.

Robust network and network operation technologies for reliable network services

We are researching and developing robust network and network-operation technologies that continue to provide network services even in the event of natural disasters or system failures. By applying AI technology to the visualization, analysis, judgment, and actions of complex and diverse networks, we will achieve “zero-touch operation” that can respond to unknown events.

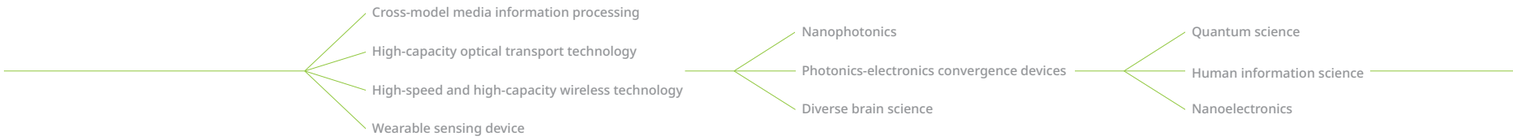
Algae- and plant-breeding technology for reducing oceanic and atmospheric CO_2

We are focusing on algae and plants that absorb CO_2 from the ocean and atmosphere while researching breeding techniques to enhance their functions. By enhancing the CO_2-absorption capacity of algae and plants, we aim to achieve negative greenhouse-gas emissions and contribute to improving the global environment.

Yukari Tsuji
Senior Vice President of R&D,
Head of NTT Information Network Laboratory Group
NTT, Inc.

Flexible, Smart, and Sustainable Network

Science and Core Technology Laboratory Group



Driving Research to Create World-leading, World-first, and Surprising

Toward the realization of a sustainable, safe and secure society that embraces diversity, we are conducting research and development in a wide range of technical fields, including technologies to expand telecommunication capacity to provide innovative information and communication networks; photonics-electronics convergence technologies enabling low-power information processing; new information processing technologies based on quantum science; technologies for realizing a secure and sustainable environment; human-information science that breaks barriers in communication; and basic research in biology and condensed matter physics. With a deep understanding of things and unconventional ideas, we are committed to creating world-leading, world-first technologies and surprises.

Innovative optical and wireless transmission and networking technologies for future ICT infrastructure

To address the rapid growth in communication traffic and deliver new value, we are advancing research and development of innovative optical and wireless transmission technologies that enable world-leading capacity expansion and coverage enhancement, along with networking technologies that fully maximize the performance of these transmission systems.

Exploring and realizing new concepts and technologies for information processing based on quantum science

Aiming to transcend the limits of conventional information processing, we advance research in quantum communication, quantum sensing, and non-von Neumann computing by investigating quantum information theory and quantum-mechanical phenomena in photonic, semiconductor, and superconducting devices.

Innovative optoelectronic device technologies for enhancing network and information processing performance

Engagement in silica-based planar lightwave circuit technologies, compound semiconductor optical and electronic devices, silicon photonics, nonlinear optical devices, and the manufacturing technologies that support them aims to create innovative devices that drive paradigm shifts.

Understanding people and more closely attaining human abilities will enable communication that "reaches the heart."

We are creating innovative technologies that aim to realize communication that "reaches the heart" not only between people, but also between AI and people. Our research includes human information science that deeply understands and explores people, media processing and machine learning to attain human capabilities, and construction of fundamental mathematical theories. Our objective is to develop human-centered AI that collaborates and that co-creates values with humans.

Akira Okada

Senior Vice President of R&D,
Head of NTT Science and Core Technology Laboratory Group
NTT, Inc.

Basic Research

NTT Research, Inc.

Activities of the Global Research Hub

Our mission is to advance fundamental research and develop next-generation technologies that contribute to human progress and make the world more natural and human-centric. To that end, NTT Research, Inc. focuses on fields that build on the proprietary technologies developed at NTT Laboratories and invites leading researchers from around the world to form new teams that collaborate closely with NTT Laboratories. As part of our innovation efforts, we also work extensively with NTT operating companies to enhance the competitiveness of NTT's global businesses.

PHI Lab.

Physics & Informatics Laboratory

PHI Lab explores fundamental principles and novel technologies to advance information processing. Using optical technologies, we investigate the intersection of quantum information science and neuroscience. To solve real- world problems using optical technologies, we are focusing development of an Optical Large Scale Integrated circuit (Optical LSI) using Thin Film Lithium Niobate(TFLN). Our mission is to rethink the fundamental principles of "Computation" and developing hardware and software simultaneously. NTT has a strong tradition of turning basic research into real-world solutions. We foster collaboration among physicists, computer scientists, brain scientists, and engineers to create practical applications from new computational frameworks.

CIS Lab.

Cryptography & Information Security Laboratory

CIS Lab is a world-leading cryptography research center focused on advancing security in our data-driven society. We explore cutting-edge cryptographic technologies and theories to achieve ideal information protection. Our researchers conduct foundational work in areas such as attribute-based encryption, fully homomorphic encryption, and functional encryption. As data exchange continues to grow, cryptography plays an increasingly vital role in securing privacy and trust. CIS Lab addresses long-term challenges through innovation and interdisciplinary collaboration. We also investigate future developments, including how quantum computating might impact cryptography, the implications of program obfuscation, and the evolving role of secure computation in global information infrastructure.

MEI Lab.

Medical & Health Information Laboratory

MEI Lab is dedicated to advancing the medical and health sciences, to promote a more personalized, preventive, and predictive practice of medicine (and wellness). Specifically, we aim to individualize and revolutionize healthcare through the application of Bio Digital Twin technologies. Our initial focus is cardiovascular care, where we aim to combine various information processing technologies to create digital twins - biomedical engineering principles, modeling and simulation, data sciences, and artificial intelligence – with experimental technologies such as Organs-On-Chip to directly examine reactions to administration of drugs on cells. One part of this work is the Autonomous Closed-Loop Intervention System (ACIS) which automatically optimizes drug therapy and mechanical circulatory support for patients in acute cardiac distress (heart failure or myocardial infarction).

PAI Group

Physics of AI Group

Physics of AI (PAI) Group is "rethinking the nature of the mind itself." As AI becomes a partner in our daily lives, building trust demands understanding both who AI is and who we are. We tackle these challenges simultaneously by viewing AI not merely as a tool, but as a mirror that reveals the workings of our minds. In a collaboration with Harvard University's Center for Brain Science (CBS), our interdisciplinary team of physicists, neuroscientists, and psychiatrists applies rigorous scientific methods to uncover how intelligence emerges in artificial neural networks.

Kazuhiro Gomi
President and CEO,
NTT Research Inc.

Let's upgrade reality℠

NTT, Inc.
https://www.rd.ntt/e/