

Message from the CTO

A World of Well-being Made Possible by NTT's Technology

- IOWN is finally becoming a reality -



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The NTT Group's Ideal World - Well-being -

Since I became CTO, I have repeatedly stated that the ultimate goal of the NTT Group is to maximize well-being. "Well-being" does not refer to momentary gladness or pleasure—commonly known as "happiness"—but rather the cumulative total of these things for society as a whole over time. By breaking through the current limitations of technology by utilizing NTT's technology, including IOWN, we will achieve both value creation for a world where human beings can live happily

and sustainability of the Earth.

For this to happen, we will continuously invest in intellectual property, such as R&D and service development, and human capital, which are sources of new value creation for the Group. At the same time, we will promote global collaboration and market-oriented thinking to expand the NTT Group's businesses and generate returns commensurate with investment.

Research and Development at NTT - The Source of Value Creation -

Research and development is the source of the NTT Group's value creation and is inseparable from the company's history and culture.

We began researching optical fiber in 1966. Approximately 50 years later, it led to the announcement of the IOWN concept in 2019. The technology we developed to connect people to people will connect people to information, people to things, and the real world to the virtual world, making it possible to transmit not only sounds but also images, data, skills, experiences, and spaces. We were also able to independently develop "tsuzumi," our own generative AI model, thanks to four decades of research into natural language processing technology.

NTT employs roughly 2,300 researchers and developers (680 of whom hold PhDs) at 14 laboratories specializing in four fields in Japan and at three laboratories in Silicon Valley, United States. In addition, NTT holds about 21,000 patents and conducts about 2,400 research presentations and lectures annually. In particular, NTT is a world leader in research and development in

the fields of optical communications, information security, voice recognition, and quantum computing. As a result, in the field of information security, for example, around 15% of the papers presented at top-level international conferences on cryptography involve members of NTT laboratories.

In the future, continuing to promote NTT's research and development and fostering our human resources will be essential to supporting a sustainable society. Our Medium-Term Management Strategy includes a plan to continuously invest roughly 100 billion yen overall in research and development for technologies such as IOWN and 6G.

Characteristics of "tsuzumi"

- Lightweight** Operable with 1 GPU/1 CPU
- Customizable** AI with industry/organization-specific knowledge
- Multimodal** Supports various use cases other than text input
- Proficient in Japanese** World class performance, especially strong in Japanese

IOWN-Driven Creation of New Value -From Concept to Commercialization-

All sorts of values exist in the world, but they are not universal.

The COVID-19 pandemic has changed the way we live in profound ways, and some of these changes are now called the "new normal." In the same way, our lives have begun to change significantly as a result of AI. Society will keep changing in the years to come.

Digitalization thus far has largely focused on increasing efficiency. From now on, however, digitalization will need to create entirely new value. By creating value that meets the needs of the time, place, society, and people through IOWN, NTT will continue to maintain the sustainability of global society.

Since the announcement of the IOWN concept in 2019, the NTT Group has been working to develop new network and

computing infrastructure in order to transition from information processing based on electronics to photonics-electronics convergence technology, and we have been conducting demonstration experiments and implementing this technology in various fields, such as entertainment and healthcare. Furthermore, by collaborating with many partners in Japan and around the world, we continue to tackle initiatives to make the concept work not only for us, but to create a major movement for society as a whole.

The IOWN concept is finally becoming a reality. Going forward, we will continue to pursue innovations that overcome existing limitations in order to solve myriad social issues and realize a sustainable society through the creation of new value.

Acceleration of IOWN Commercialization

To promote the implementation of IOWN in society, we are accelerating efforts to commercialize the technology.

IOWN is characterized by its high capacity, low power consumption and low latency, and it is supported by two pillars: networks and computing.

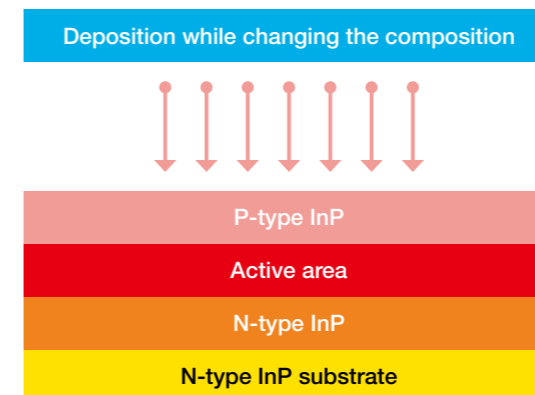
"Networks" refers to the All-Photonics Network (APN), which connects everything with light. By using optical communications technology that minimizes the need for light-to-electricity conversion, APN makes it possible to substantially enhance data transmission speed and significantly reduce communication latency. As the backbone for next-generation data centers, The NTT Group is promoting the introduction of APN in various fields that can benefit from its performance, including global fields.

We are currently in discussions with dozens of companies in various fields, including broadcasting, data centers, real estate, education, finance, and entertainment, aiming to put the technology to commercial use. Among these, we are already seeing cases where customers are using APN in fields such as broadcasting, real estate, and entertainment. In addition, in fiscal 2023, we connected the NTT Group's major data centers using APN equipment. From fiscal 2024, we will expand this initiative to regional data centers and build a distributed data centers. Going forward, we will continue to accelerate our efforts to expand APN, both in Japan and internationally.

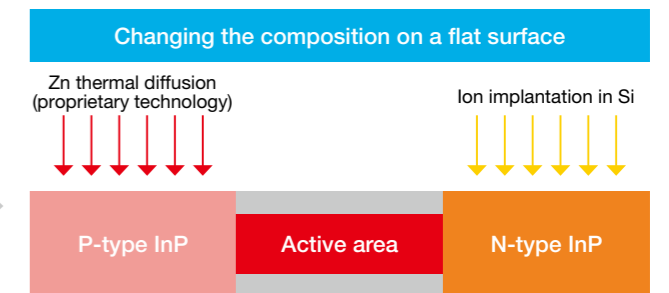
"Computing" refers to the development of photonics-electronics convergence devices. Photonics-electronics convergence devices integrate electronic and photonic elements into a single system to increase the speed of data transfer and improve energy efficiency. These devices are an essential part of the IOWN concept—not only do they reduce the latency of APN, but increase capability and lower power consumption.

In June 2023, we established NTT Innovative Devices Corporation to accelerate the product development and market launch of photonics-electronics convergence devices, which are key to the IOWN concept, and to expand the business. NTT has succeeded in developing membrane photonics, a proprietary thin film forming technology that achieves ultra-low power consumption, for photonics-electronics convergence devices that are key in optical communication. We have applied for over 100 patents, half of which have been granted. In April 2024, the NTT Act was revised, removing the obligation for NTT to promote and disseminate research and development. Prior to this revision, the obligation placed on NTT to disclose information made it difficult for us to develop strategies with partners. This revision of the NTT Act has created a more conducive environment for technology-based collaboration with partners. We look forward to engaging in future research and development while flexibly collaborating with partners.

Conventional compound semiconductor device fabrication method



Membrane (thin film) fabrication method devised by NTT



Conventional compound semiconductors are fabricated by depositing layers vertically, which makes it difficult to produce thin films. NTT developed a technology that enables composition changes on a flat surface.

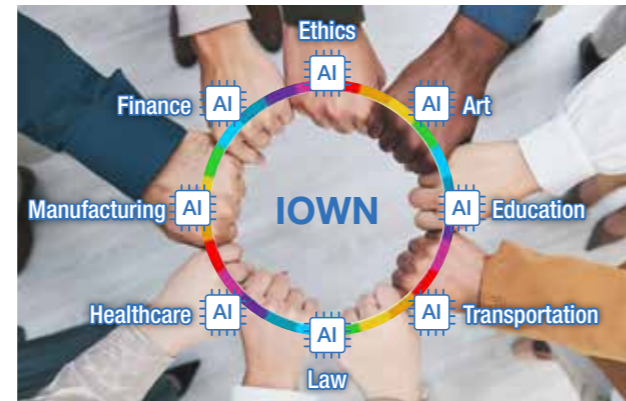
A Sustainable AI-Assisted Society Powered by IOWN

IOWN supports AI and drives its evolution. It is no exaggeration to say that IOWN is essential for the widespread use of AI.

Large language models (LLMs) and other forms of generative AI are expected to streamline a variety of tasks and lead to the creation of new businesses. At the same time, a massive amount of electricity is needed to process the rapidly increasing amount of data due to the proliferation of AI and other factors. By 2030, the amount of data being transmitted in data centers around the world is projected to grow to about 16 times the 2018 level, requiring 13 times the amount of electricity as in 2018. We will support the development of AI and achieve sustainable innovation through photonics-electronics convergence technology, which is characterized by its low power consumption, high capacity, high quality, and low latency.

Besides reducing power consumption through advances such as photonics-electronics convergence technology, it is also important to minimize the environmental impact through the use of AI models with a low computational load. In March 2024, The NTT Group launched commercial services for “tsuzumi,” a compact and lightweight generative AI model developed by NTT that maintains high performance with a significantly reduced number of parameters.

To make AI services more effective, we will create a future where multiple compact AIs work together through IOWN to bring about a new collective intelligence that cannot be achieved by a single, large AI. Building so-called “chained AI,” in which AI systems work together across different industries and operations, means that overall optimization will be more important than optimization of individual parts of the system. This will significantly reduce human labor, and will lead to enhanced productivity and strengthened competitiveness in client companies.



Deploying IOWN in Space

IOWN technology will extend into outer space and expand communication coverage from a percentage of the population to nationwide coverage.

At the NTT Group's, we view the expansion of space communications as one of the pillars of the IOWN concept. In June 2024, we launched NTT C89, a brand in the space business field, to realize the “Space Integrated Computing Network.” The aim of this network is to build new ICT infrastructure in space by integrating HAPS, geostationary satellites, and low-orbit

satellites and connecting them to the ground with an optical wireless communication network, thereby enhancing various forms of data processing through distributed computing. We intend to strategically divide the areas that we aim to develop in-house, leveraging our technological strengths, from the areas where we will accelerate the commercialization of services with partners while developing new technologies. Then, we will engage in business and technological development to drive market creation and expansion in each area.

IOWN Global Forum Initiatives to Promote IOWN

IOWN is made possible through global partnerships. In order to spread IOWN technology throughout the world in both developing and developed countries, we have been working to promote standardization through the IOWN Global Forum since the announcement of the IOWN concept.

The IOWN Global Forum, for which I serve as President and Chairperson, establishes de facto standards for IOWN

technology. Since its establishment by three companies in January 2020, participating groups have continued to grow. As of September 2024, 150 organizations and groups, including those from Asia, the Americas, and Europe, participate in the forum.

For IOWN to become widespread, de jure standards set by international organizations are also important. In December 2023, at the CxO Roundtable organized by ITU-T, the United Nations specialized agency for ICT standardization, NTT made a proposal on behalf of the IOWN Global Forum regarding the importance of ensuring IOWN's international connectivity and formulating de jure standards for global deployment, including in developing countries. The proposal was approved by the CxOs and ITU-T leaders at the roundtable, and it was agreed that official standards would be made for IOWN technical specifications. Attendees also agreed to strengthen collaboration between the IOWN Global Forum and ITU-T. I believe this is a massive step forward for the future deployment of IOWN. Seizo Onoe, formerly a member of NTT, has served as Director of the Telecommunications Standardization Bureau



(TSB) at the International Telecommunications Union (ITU) since January 2023. Going forward, we will continue to strengthen collaboration with international standardization organizations, particularly ITU-T, in order to promote the spread of IOWN.

Additionally, on the topic of semiconductors at the Japan-U.S. Summit Meeting held on April 10, 2024, the two leaders stated that they welcome robust Japan-U.S. private sector cooperation, especially in next-generation semiconductors

and advanced packaging, and confirmed that Japanese and U.S. companies are exploring the wide range of possibilities available through optical semiconductors through partnerships like the IOWN Global Forum. The NTT Group's has been making repeated calls for Japan to work together on the IOWN concept ever since it was announced, so it is truly significant that IOWN has been included in a joint document issued by the leaders of Japan and the United States.



Market-oriented R&D

Market-oriented R&D is essential as societal issues become more complex and problems such as the environmental and energy crises, the low birth rate and aging society, and labor shortages become more acute. We will work to strengthen services that emphasize the customer experience (CX) in all kinds of situations, including the creation of new value through IOWN, the creation of new value through data-driven approaches, and the realization of a recycling-oriented society, by incorporating a market-oriented perspective into conventional product-oriented

research and development. By taking a market-oriented approach, the ICT infrastructure that was created in the past with a product-oriented approach will shift to social and industrial infrastructure that supports peoples' lives. In June 2023, we established the Research and Development Market Strategy Division, an R&D organization that includes marketing functions, and have been working on this type of market-oriented R&D. Results are already starting to emerge in fields such as food, agriculture, and healthcare.

Further Strengthening of Business Foundations

Building a resilient network system and strengthening measures to reduce damage from increasingly severe natural disasters are important initiatives that align with NTT's roots and the concept of “Connect.” In fiscal 2023, four large-scale failures occurred. The NTT Group will invest 160 billion yen by fiscal 2025 to improve network reliability and work to enhance our ability to respond to severe disasters.

Regarding the data leak incident at NTT West, we sincerely apologize for the great inconvenience and concern this has

caused our customers and shareholders. I believe this incident was caused by insufficient management regarding information security. The NTT Group plans to invest around 30 billion yen by fiscal 2027 to implement comprehensive measures related to overall management, not just technical measures for information security. These measures include human resource development and assignments, risk assessment when entering into contracts, and strengthening internal audits.

At NTT, we aim to tackle research and development with determination and enthusiasm, viewing it not only as a source of value creation for our business, but also as something that will help Japan to develop, lead the world, and ultimately lead to

maximizing well-being. The NTT Group will move forward as a single united entity to meet the expectations of our shareholders and investors.