R&D Spirits

Exploring the Possibilities of NTT Technologies Beyond the Framework of Communications

Dr. Kimiyoshi Yamasaki
Chief Producer
Department III, NTT†

NTT's Department III, which aims to generate new business for NTT Group companies, has been applying NTT's Comprehensive Commercialization Functions since their introduction in July 2003. Among the 11 teams that are now active in this system, Dr. Kimiyoshi Yamasaki, Chief Producer, leads the Innovative Device Team and the Strategic Business Creation Team. As a bridge builder between R&D and business, what are his goals and what possibilities does he think lie behind NTT R&D? To get the answers to these and other questions, we asked Dr. Yamasaki to tell us about his R&D philosophy based on his personal experiences and his future outlook for NTT R&D.

Engaged in diverse projects as a bridge builder between R&D and business

—Dr. Yamasaki, could you first tell us about your current duties.

A "chief producer" works to find ways of "outputting" the research results of NTT Laboratories. That is to say, he bridges the gap between R&D and products. In my role as a chief producer, I am in charge of the Innovative Device Team and the Strategic Business Creation Team, which are two of the 11 teams in applying the Comprehensive Commercialization Functions introduced by NTT in July 2003.

First, let me tell you about the Innovative Device Team. Although part of our work here involves electronic devices, our main target is optical components. As you know, NTT is now in the process of converting the subscriber system to optical fiber, and the goal is 30 million optical subscribers by 2010. This, however, will require the provision of highly reliable and inexpensive optical devices. At the same time, converting the subscriber system to optical fiber will increase the amount of traffic on the network backbone, but unlike past networks, it is not easy to predict traffic trends on the Internet. Therefore, there must be enough flexibility to allow network facilities to be moved or added as the need arises after the network has been constructed. The role of the Innovative Device Team is to search out and develop products that can meet these needs. As for the Strategic Business Creation Team, its job is to expand the business domain of the entire NTT Group by selecting promising themes from core technologies coming out of NTT R&D and using them to create completely new lines of business.

—What specific themes are your teams involved with at this time?

The Innovative Device and Strategic Business Creation Teams are now working on about 30 proposals in all. For example, the Innovative Device Team is exploring ways of reducing the size and lowering the cost of optical splitters for the access network and optical transceivers for optical network units (ONUs). They are also working to improve optical-switch chips and wavelength-multiplexing arrayed-waveguide gratings (AWGs) for reconfigurable optical add-drop multiplexers (R-OADMs) with the aim of making nodes and intra-prefecture networks more flexible (**Fig. 1**). The Strategic Business Creation Team is also working on many projects. These include "HORN," a speech synthesis system capable of expressing emotions and nuances; "*RedTacton*," a system for communicating information through the

† Present address: Photonics Business Group
NTT Electronics Corporation
Machida-shi, 194-0004 Japan

human body; "Voice Ubique," an ultrasmall wireless transceiver for short-range communications with no delay; "Digital Cinema," a movie distribution system; and "Mobile Digital Watermarks," a picture-to-Internet link platform using watermarks embedded in pictures (**Fig. 2**).

—As a producer, what kind of things are you concerned with?

I have two main concerns. The first is how to make the things that I manage easier to understand. For example, the results of this work that we call R&D can sometimes be difficult to comprehend. That's because some things that are extremely interesting from a scientific point of view are not necessarily useful in the real world and because the return on R&D investment is not easily quantified. To resolve this problem, I have established a basic guideline that says that we must achieve sales of five times the development cost within a period of three years. This gives me a better understanding of the investment return for the R&D that I manage, and it also helps to give researchers a sense of accomplishment in the work that they do. In principle, development continues if this level of return could be achieved and is temporarily halted if not. Thus, by requiring that results be achieved in a relatively short period of time rather than a span of 10 or 20 years, we can obtain a clear understanding of investment return and make researchers feel more productive and motivated. Of course, the failure to satisfy this guideline does not mean that a researcher's next challenge will be rejected. Some people have said that three years is simply too short. In truth, more than a few technologies in the device research field did not bloom until at least 20 years of basic research had been conducted—research that appeared, at the time, to have no end in sight. With this in mind, there has been a slight increase in the number of themes that have been allowed slightly longer investment recovery periods, say five years.

My other concern is how to expand our markets to fields outside NTT. Although the work that we do is basically research and development for the sake of NTT business, expanding outside NTT's traditional field of communications may reveal technologies or products with the potential of even bigger markets. One example is the replacement of traffic-signal lamps with light emitting diodes. For this reason, we are devoting one-fourth of our resources to the Innovative Device Team for expanding into new markets. However, lest we expand haphazardly without a sense of direction, we have narrowed down our efforts here

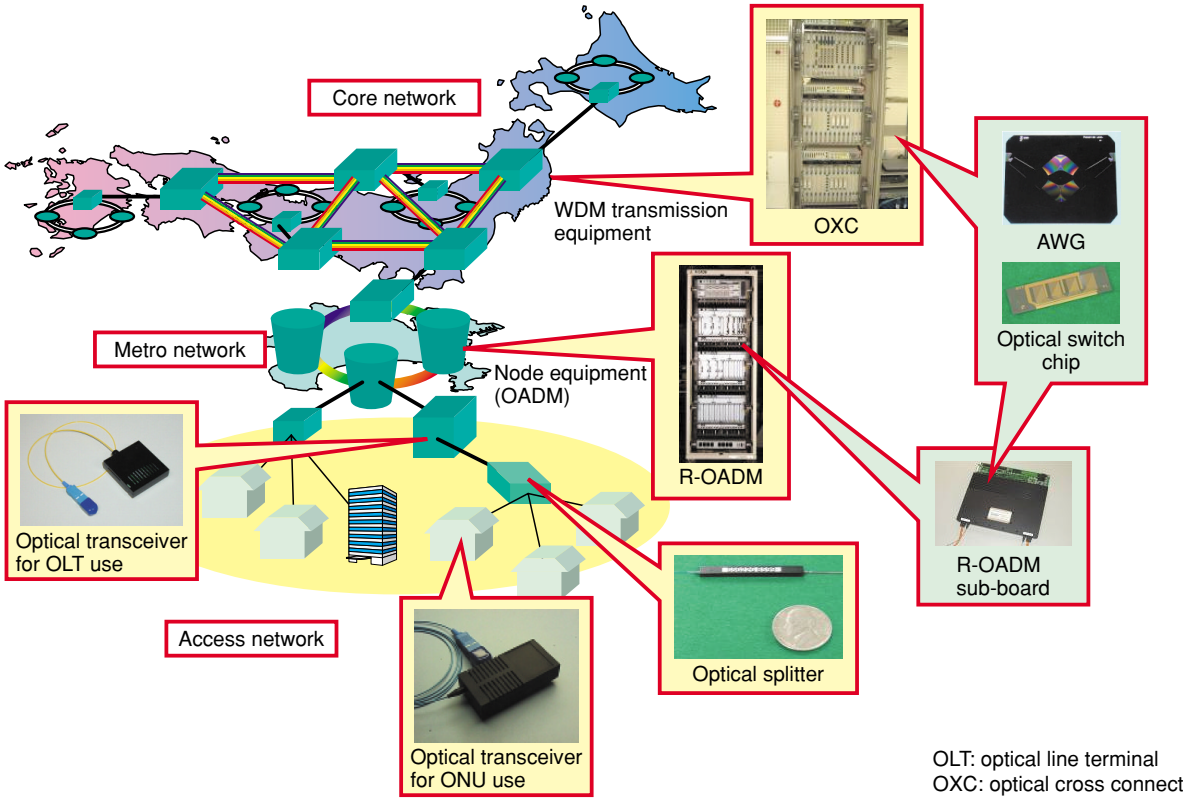


Fig. 1. Optical devices for network support.

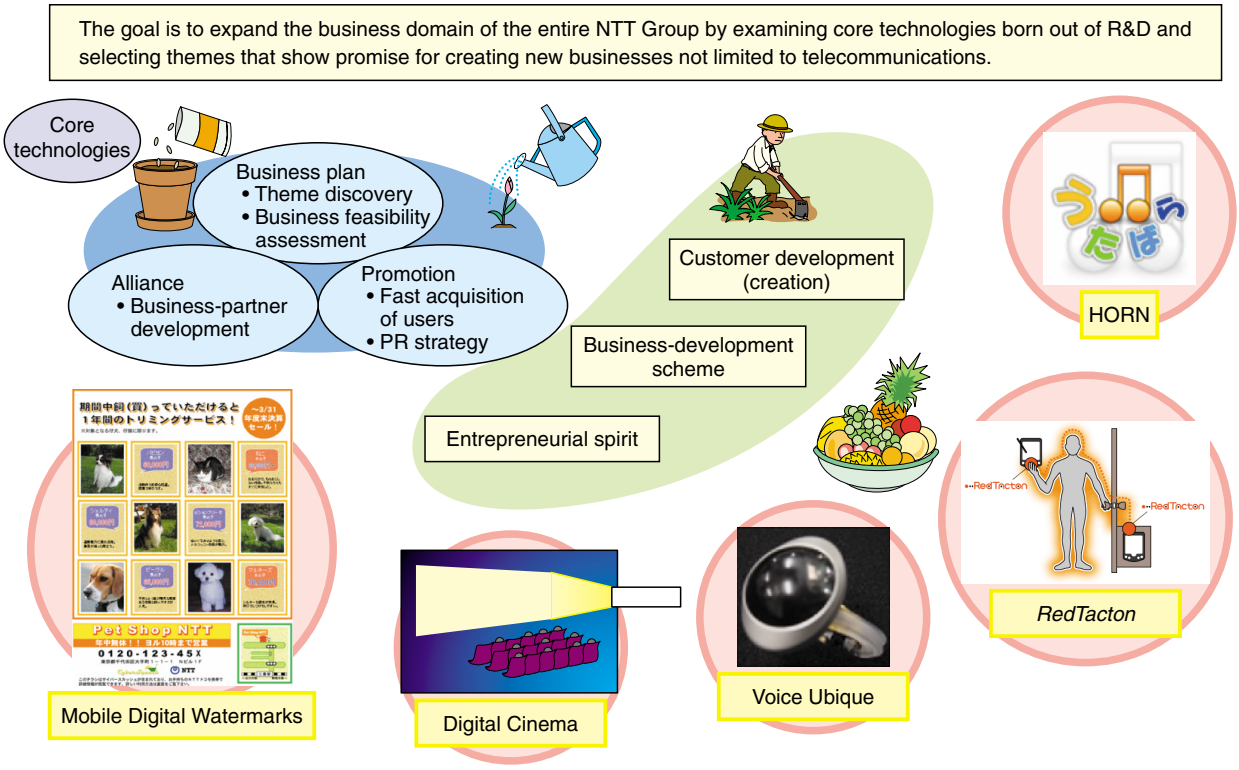


Fig. 2. Business creation activities.

to two fields: “medical care and biotechnology” and “sensing and the environment” (**Fig. 3**).

Promoting borderless alliances with various industries and universities

—In research to date, what kind of response have you received from both inside and outside Japan?

Well, in terms of actual results, the 10-Gbit/s high-speed IC that I developed has come to be used in most international communication networks interconnecting Japan with North America, Australia, and Asia, and in those connecting Europe and the United States. This device has also found considerable use in Japanese and American domestic networks. In fact, at one time, it had held a world-wide share of at least 90% for ICs of this type. But I began research on this device in 1980, and it wasn’t until 1999 that it finally became a major component. That felt like a long time to me. There were times when I thought that I should just bring an end to the whole thing and leave the research where it stood.

—Are you forming any alliances with outside research institutions or enterprises?

Yes, in terms of private enterprises, we are tying up with a number of manufacturers and trading companies here in Japan and North America, and we are also forming partnerships with universities in the public sector.

—Could you give us some specific examples of expanding into new services or forming alliances?

Yes. First, we have formed an alliance with Yoshimoto Kogyo, a major entertainment company in Japan. Using the HORN speech synthesis system that I mentioned earlier, we are now in the process of developing a “ring-tune” type of delivery service that notifies a mobile-phone user of an incoming call by having his/her name called out in the voice of a show-business personality. Next, we are applying Voice Ubique, the ultrasmall wireless transceiver that I also mentioned, in a service that provides audio commentary on works of art at the Chuya Nakahara Memorial Museum in Yamaguchi prefecture. Also, though it’s not yet an actual service, we are solidifying partnerships with the Hollywood movie industry to promote our Digital Cinema system. And back in February of this year, when we issued extensive news releases about our *RedTacton* human-body transmission system and announced a call for partners to further develop the product, we were approached by more than 100 companies and organizations. There

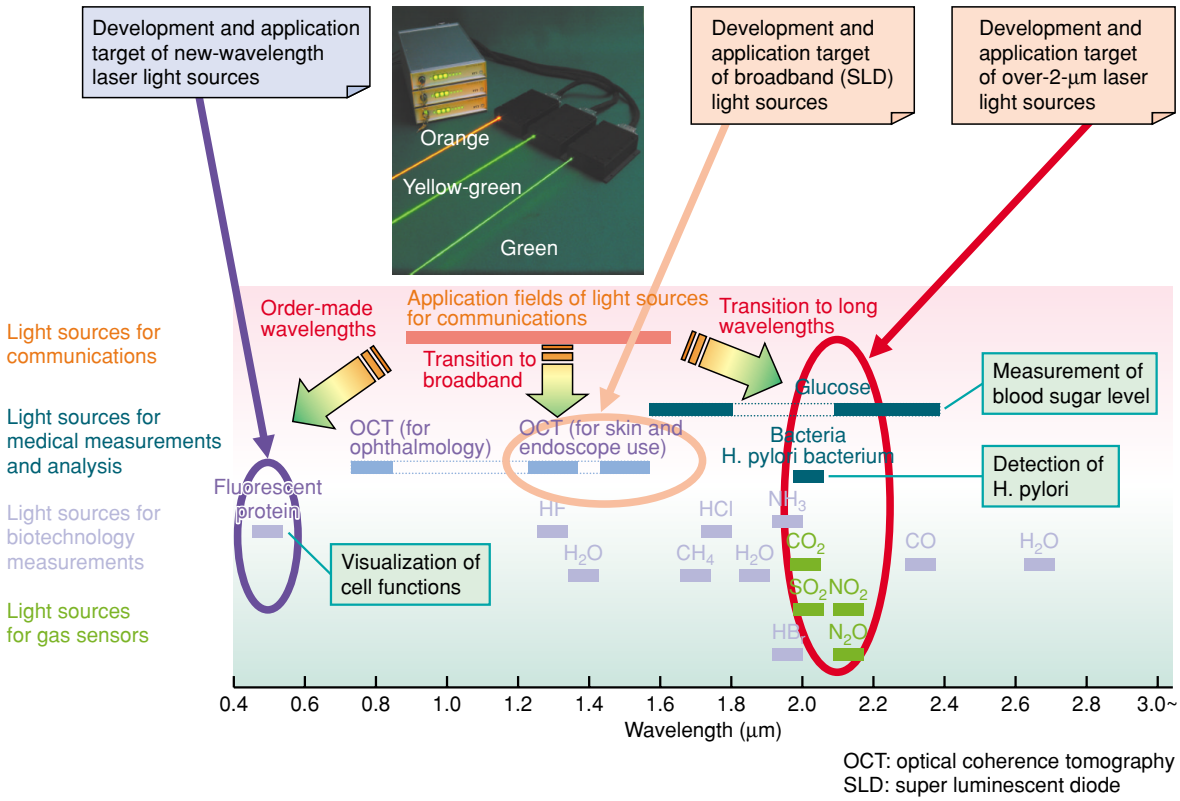


Fig. 3. Developing new application areas for optical devices: biotechnology/medical measurements and gas sensors.

are still other themes and products that we are making progress with, but unfortunately, they are not yet at the stage where I can talk freely about them. But I think you'll be hearing about them in the near future.

The continuous pursuit of new ideas

—Dr. Yamasaki, you have been involved with a wide range of technical areas, but could you tell us what your original specialty was?

During my university days, I researched high-speed transistors made on gallium arsenide (GaAs). After entering NTT in 1980 with a doctorate in electronic engineering, this continued to be my basic research theme. In fact, I spent about 80% of the next 20 years or so at NTT Laboratories working on the development of commercial high-speed GaAs devices.

—Please tell us about specific research themes that you have worked on in the past and the results that you have achieved.

My first project after entering NTT was the development of high-capacity LSI memories. At that time, NTT was playing a role in Japan's development of LSI memories, and our goal was to achieve commercial LSI memories with the world's largest capacity using gallium arsenide instead of silicon, which was felt to have limitations. However, it wasn't long before NTT withdrew from memory development for various reasons, and as a result, research in this area came to a halt. This was a terrible setback for me, but during the course of this research, I came to invent and apply a transistor-fabrication method having excellent conformability.

Then, after about one year looking for a new direction, I finally decided on medium-scale, ultrahigh-speed ICs for optical communications as my main target and I got right to work. In 1992, after committing considerable resources, we made the world's fastest IC at 10 Gbit/s. Today, in 2005, 10-Gbit/s ICs are the most widely used devices in the NTT backbone network, but at that time, they represented a breakthrough in transmission speed. The use of this device also spread beyond NTT during the IT procurement boom that began in 1998. Around this time, I also became involved in research to miniaturize monolithic microwave integrated circuits (MMICs) for 4-, 5-, and 6-GHz fixed microwave repeaters. These devices are also currently being used in NTT's microwave backbone network.

Actually, though I have basically been involved in GaAs device research from the very beginning. There

was a period of about four years that I was away from this area. In 1990 and 1991, I worked at the NTT Research and Development Headquarters, in a management role, where I received a comprehensive view of NTT research. And during the following two years, I was involved in research of optical switching and interconnections. Why would I do something completely different from my field of specialty? Well, I began to realize that for the last ten years I had only been active in the world of small components and had received no exposure to NTT as a whole, much less the outside world. It was therefore important that I obtain some work experience in a department where I could get an extensive view of the research process and in a research area that was applying the results of my original research work. This turned out to be a very beneficial experience. I then returned to device research, but once it was decided that the 10-Gbit/s ICs and modules would be heavily marketed, I moved on to NTT Electronics in 1999 to take charge of that effort. Finally, in July 2003, I took on my present position with the launch of the Comprehensive Commercialization Functions.

—What was the biggest factor behind the great success of NTT's high-speed ICs?

I think it was that we believed in ourselves and targeted a field that no one else was looking at. During the time that we were researching high-speed GaAs ICs, many companies and researchers throughout the world were devoting their efforts to power amplifiers for cell phones. As a result, when it became known around 1998 that various carriers would be using bit rates of 10 Gbit/s for their backbone networks, we were the only research institution in the world that had something that could meet this need. Around 1990, when we were struggling with 10-Gbit/s research, the usual line speed in NTT circuits was 600 Mbit/s, and we received some criticism to the effect that we were wasting our time setting such high specifications. Nevertheless, we were convinced that the 10-Gbit/s era was coming and we simply continued with our research. At last, 1998 brought us vindication, but to be honest, I actually expected the 10-Gbit/s era to arrive sooner—1998 was a bit late.

—What motivates you to be involved in R&D activities?

One thing is the chance to be creative. I have always wanted to create something using a new idea. For example, I might incorporate a new idea into the way that a device is made in order to achieve a very stable manufacturing process, or I might apply a new idea to a mediocre memory device to make it an indispensable component to networks. I have always aimed to create as many things as possible that could play a new role in both technical and practical terms. This job of being a producer is therefore right up my alley, I believe.

—What do you find particularly interesting about being a producer?

Finding supporters in unexpected places. There are people or companies that have not been associated with NTT in the past but that nevertheless take a strong liking to our technology and say "Let's do it together" with a look of excitement in their eyes. A typical example would be representatives of the Hollywood movie industry with which we are forming alliances to promote Digital Cinema as I mentioned. Encountering such support is very satisfying, and we are doing as much as we can to form alliances of this type. Of course, increasing sales as a result of such an alliance would be even more satisfying.

Making an even greater impact with NTT technology

—Dr. Yamasaki, what are your plans for the future?

I would like to give society as many things as possible that can be easily used by anyone. One of the fruits of my research, the 10-Gbit/s device, is being used in telecommunication networks around the world and is providing many benefits to people's lives. Unfortunately, it is not something that people can easily notice and appreciate. I would therefore also like to create things that are used frequently in everyday life and that the ordinary consumer can purchase, and that I can develop big markets for.

—What is your dream as a technical researcher?

I think that NTT technology should be able to have an even greater impact on the world. I think that it should be applied to a diverse array of fields above and beyond NTT's traditional field of communications. And I believe that it has the potential to produce genuine profits. That is something that I would love to demonstrate. In this sense, I am quite passionate about my work as a chief producer.

—What is your personal view of NTT Laboratories?

It's a very understanding and tolerant research institution. I have spent 25 years in research activities at NTT Laboratories, and the freedom that was given to me in my work made that a very enjoyable time for me. New proposals that I made or new challenges that

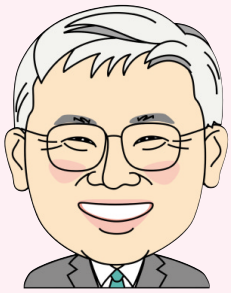
I wanted to take on were always met in a positive way and budgeted as needed. And that's not all. To give a research seed that I had planted time to sprout, my work was looked at with a relatively long view. Without this kind of understanding, my research would have amounted to nothing. I truly feel lucky to have entered NTT Laboratories. I don't believe that there are any other private research institutions today with such a depth of understanding. I feel that one role of us veterans here is to maintain and convey this positive quality of NTT Laboratories.

—Please give us a message for young researchers.

Certainly. Based on personal experience, I would like you to pursue R&D with a strong awareness of customer needs. To achieve something that no one has done before, it is imperative that you approach it with enthusiasm and focus. However, it is not enough to simply invent or create something. It will be difficult to develop a market for your research achievements on conviction alone if there are no existing needs. In other words, it is equally important to research and develop technology and services with the customer or user in mind. It is essential that you give importance to what you believe in while at the same time developing a world view with a broad outlook. I myself gave no thought to the customer during the time that I researched the devices for memory LSIs. Believing only in my own theories, I conducted research with the conviction that "this device, being the amazing thing that it is, cannot help but find widespread use." Well, in the end, my devices were well received, but that was only after many twists and turns. Perhaps I was just lucky. I believe that keeping the customer and user in mind will give you a greater chance at R&D success.

But please don't misunderstand me. Simply thinking about the customer or user during R&D without actual experiences is not going to lead to much. To all young researchers, I emphasize that a life spent only in the research laboratory is not going to work. I recommend that you also get out into the world and experience the viewpoints of manufacturers and users firsthand. That is the sure way to grow as a researcher. Today's research environment is much more open than it was in my time, so I urge you to take advantage of the opportunities given you and train yourself well in various areas. This does not mean that your experiences should be aimless. Take on serious challenges for which failure could mean, for example, the damage of your business unit. The NTT Group is a huge enterprise, and while it might be thought of as rigid for that reason, in truth, it can be a very challenging environment. I would like to see you become top-notch researchers by taking advantage of what this great enterprise has to offer.

Interviewee profile



■ Career highlights

Kimiyoshi Yamasaki received the B.E., M.E., and Ph.D. degrees in electronic engineering from the University of Tokyo, Tokyo in 1975, 1977, and 1980, respectively. In 1980 he joined the Electrical Communication Laboratories of Nippon Telegraph and Telephone Public Corporation (now NTT). From 1980 to 1987, he was engaged in R&D of GaAs high-speed device and process technologies. He invented a novel self-aligned technology, called self-aligned implantation for n+-layer technology (SAINT), which was suitable for high-speed ICs as well as monolithic microwave ICs (MMICs). From 1987 to 1988, he spent a year at Cornell University, Ithaca, NY, as a Visiting Scientist, where he researched ballistic electron devices. In 1991–1992, he was engaged in research on ATM switching systems with optical interconnection. From 1993 to 1997, he was responsible for the development of advanced GaAs IC technology for ultrahigh-speed optical fiber communication systems and three-dimensional MMICs. From 1997 to 1999, he was the Executive Manager of the High-Speed Devices and Technology Laboratory at NTT Photonics Laboratories, where he led research on InP-based ultrahigh-speed ICs and photodetectors. From 1999–2003, he worked at NTT Electronics Corporation, where he was responsible for the business of high-speed modules for 10-Gbit/s submarine as well as terrestrial optical fiber communication systems. Then he directed the Product Development Center for optical and electrical components. Since 2003, he has been Chief Producer of the Innovative Device Team and Strategic Business Creation Team at Department III (R&D Strategy Department) of NTT. He served as Overseas Advisor for the IEEE GaAs IC Symposium from 1996–1999 and as General Secretary for the 1998 International Symposium on Compound Semiconductors. He is a member of IEEE, the Japan Society of Applied Physics, and the Institute of Electronics, Information and Communication Engineers of Japan.