

Introduction

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1. The beginning: Toward future proposals

On September 7, 2013, I was on a business trip to New York with Hiromichi Shinohara, then senior executive vice president and head of the Research and Development Planning Department, when the decision was made to bid for the Olympic and Paralympic Games Tokyo 2020. It seems like only yesterday that we were in a taxi on our way to the airport and I said, “I want to propose a future that will surprise the world at Tokyo 2020.” That utterance was the beginning of the Tokyo 2020 Project at NTT’s research and development (R&D) laboratories.

At past Olympic Games and other world events, NTT has proposed various visions for the future of communications technology. For instance, at the Olympic Games Tokyo 1964, we provided communication technology for the world’s first live broadcast using geostationary satellites and proposed a vision of the future of television broadcasting. At the 1970 World Exposition in Osaka, we experimentally demonstrated the world’s first wireless telephone system (**Fig. 1**) and proposed a vision of the future of personal communications. At the Olympic Winter Games Nagano 1998, Japan, we provided a personal handy-phone system (PHS) multimedia communication system and proposed a vision of the future of wearable communications by experimentally demonstrating the world’s first wristwatch-type PHS (**Fig. 2**). At the Olympic Games London 2012 and the World Soccer Tournament in Brazil in 2014, we provided technical support for live viewing via 8K Internet Protocol transmission and envisioned the future of public viewing. For the Olympic and Paralympic Games Tokyo 2020, we wanted to propose a vision of the future that goes beyond this legacy, and that proposal became our mission.



Fig. 1. The world’s first wireless telephone system tested at the 1970 World Exposition in Osaka.



Fig. 2. Wristwatch-type PHS tested at the Olympic Winter Games Nagano 1998.

2. Challenges

Immediately after returning to Japan from that trip to New York in 2013, we gathered a total of 13 researchers from various NTT laboratories and formed a study team. The ideas we had at that time were dreamy, diverse, and exciting. Now that the Tokyo 2020 Games are over, looking back at the study materials gathered by that team, I'm amazed at how many ideas have been implemented.

The 2020 Epoch-Making Project was established at NTT Service Evolution Laboratories and tasked with the mission of applying these ideas to the Tokyo 2020 Games and proposing a vision of the future. I've been the project leader since 2015. In that year, an ultra-realistic communication technology called "Kirari!", which was envisioned by Katsuhiko Kawazoe, then head of NTT Service Evolution Laboratories, and promoted its research by Akihito Akutsu, was introduced at the NTT R&D Forum. While conducting various demonstrations at events such as *kabuki* (the traditional Japanese performing art) performances at home and abroad, a global technology event in Austin, USA, synchronous performances in three cities around the world by a three-female-member technopop unit, the opening of the new National Stadium in Tokyo, and live viewings of the Japanese professional soccer league and U.S. professional baseball league, we continued to make proposals for the Olympic and Paralympic Games Tokyo 2020.

3. Significance of working on the Olympic and Paralympic Games Tokyo 2020

For NTT, Tokyo 2020 Games were not only a celebration of sports and world peace but also a celebration of technology and other innovations. I believe that the involvement in the Games has resulted in the following three benefits to NTT laboratories.

- (1) As the largest event of its kind in the world, the Olympic and Paralympic Games attract worldwide attention.
- (2) Strict demands and severe constraints are imposed at the Games, leading to improvement and demonstration of not only technical capabilities but also planning and promotion capabilities.
- (3) We can take on bold challenges.

Regarding (1), the Olympic and Paralympic Games are watched by as many as four-billion people around the world, and that about six-hundred million people watched the opening ceremony of the Olympic

Games Tokyo 2020 alone. Moreover, the latest technologies used at various Olympic and Paralympic Games attract attention from the public and are often used at subsequent sporting events as a legacy.

Benefit (2) has not been pointed out much so far, but it is what we felt most through actual experience. Although it is the flip side of the first reason, the more attention it gets, the stricter the requirements must be satisfied. In addition to performance, quality and safety of the technology, the world's highest levels of expression and design are required. Technology, planning, proposal, and coordination skills are also required. In particular, the range of coordination is very wide, for example, planning proposals required coordination with the Tokyo Organising Committee of the Olympic and Paralympic Games (Tokyo 2020 Organising Committee), the International Olympic Committee (IOC), and international sports federations. When providing live viewing of competition videos via technologies such as Kirari!, it is necessary to coordinate with the broadcasting-rights holders. In regard to installing filming equipment, it was essential to coordinate with Olympic Broadcasting Services (OBS), and in regard to system construction and operation, it was necessary to coordinate with those in charge of the technology, venues, and security staff in the Tokyo 2020 Organising Committee as well as with the Tokyo Metropolitan Government, local governments, and police. Each of them has specific roles and responsibilities and thus finding solutions for a breakthrough is necessary. On top of all that, when introducing such activities on the company's website or issuing news releases, we must ensure that we are within our rights as a sponsor, and we need to be creative in devising ways to express ourselves. Although our sponsor category is telecommunication services, the technologies of our research laboratories are not limited to telecommunication services in a narrow sense, such as so-called communication lines, but often cover communication services in a broader sense.

Regarding (3), being able to take on bold challenges is the most important significance for laboratories. Normally, when selecting a theme at our laboratories, we select reasonably convincing viewpoints such as technological advancement, business potential, or public acceptance. The more viewpoints you have, the more likely you are to settle on a mediocre research topic with a high probability of success and a low level of challenge. However, in the case of the Olympic and Paralympic Games, both public and companies become more positive and open-minded,

and that thinking generates a better atmosphere for encouraging challenges. As a result, initiatives that would normally be unchallenged are keenly undertaken, and unexpected results and value may be created. With these three reasons in mind, we worked on various proposals for more than two years and finally obtained more than ten projects of our technology, including live viewing via Kirari!.

4. Postponement, no spectators, and never giving up until the very end: the show went on!

On March 24, 2020, just before the start of the Tokyo 2020 Olympic Torch Relay, our relief, however, was short-lived when the novel coronavirus (COVID-19)—which had been spreading since the beginning of 2020—caused the Olympic and Paralympic Games Tokyo 2020 to be postponed for one year. The postponement led to a major rethinking of the Olympic and Paralympic Games Tokyo 2020 vision, from “the most innovative Games in history, bringing positive change to the world,” to “simplification.” All the projects, including those we had proposed, became candidates for review. Fortunately, the importance of innovation through technology was understood, and all our proposed projects could be continued.

Our next concern became the presence of spectators because many of our projects were designed to be attended. On June 21, 2021, about a month before the opening of the Olympic Games, the policy was announced that the number of spectators should be within 50% of venue capacity and no more than 10,000. At that stage, we were relieved that our projects would be able to proceed without any major effects; however, about two weeks later, on July 8, the policy was changed to not allowing any spectators, except for a few venues. Throughout June, opposition to the public viewing scheduled for Yoyogi Park in Tokyo grew, and eventually most public-viewing sites across Japan decided to cancel their events. We decided to go ahead with our projects without spectators in the hope that our preparations would be complete and that we would be able to communicate with the athletes, officials, and the world through various mass media even if there were no spectators.

The Torch Relay, which started on March 25, was initially often held on public roads; however, in many cases, the relay on public roads was gradually cancelled, and only the ignition ceremony was held. NTT had also planned extended celebration events, in Osaka on April 13 and Yokohama on June 30, to

which 5000 spectators were originally invited. In the end, the invitations to the general public were cancelled, and the events were streamed online only.

5. Impact of the COVID-19 pandemic

The aforementioned three benefits of working on the Olympic and Paralympic Games Tokyo 2020 were greatly changed by the COVID-19 pandemic. Therefore, I’d like to reflect on how the pandemic affected the activities of our laboratories in relation to each of the three above-stated benefits.

(1) As the largest event of its kind in the world, the Olympic and Paralympic Games attract worldwide attention

As the world’s attention grew, so did the negative attention, such as the opposition to hosting the Olympic and Paralympic Games during the pandemic. As a result, the focus of people’s attention became whether the Olympic and Paralympic Games should be held and whether there could be spectators. In contrast, people’s expectations for future proposals based on technology and sports entertainment plummeted.

(2) Strict demands and severe constraints are imposed at the Games, leading to improvement and demonstration of not only technical capabilities but also planning and promotion capabilities

The requirements and constraints that are normally stringent were made even more stringent by the pandemic. For example, when organizing events, it was necessary to take thorough measures to prevent COVID-19 infection among spectators and other people involved as well as to prepare for all possible variations of requirements and constraints. For example, if 100% audience capacity, 50% audience capacity, or no attendance is stipulated, the content of the projects had to be significantly changed. How and when to determine this change was a major issue. In addition, with public opinion changing rapidly, among the stakeholders involved in our projects, there were many differences of opinion regarding the content and timing of external announcements such as news releases, and it was difficult to adjust the content accordingly.

(3) We can take on bold challenges

Owing to the growing criticism of the Tokyo 2020 Games and the busy schedule caused by switching to the no-spectators policy just before the event, the momentum in the stakeholders, such as the Tokyo 2020 Organising Committee, to take on new challenges greatly declined. It would have been satisfying

Table 1. List of initiatives of NTT R&D.

Category	Theme	NTT R&D initiatives
1	NTT R&D technologies for viewing Tokyo 2020 Games	Sailing × Kirari!
		Badminton × Kirari!
		Marathon × ultra-low-latency communication technology
2	NTT R&D technologies that colored Tokyo 2020 Games	Torch Relay photo session × Kirari!
		Torch Relay runner support × communication control technology “Swarm”
		Torch Relay celebration stage × Kirari!
		Torch Relay regional events × speech-recognition communication technologies
3	NTT R&D technologies that supported Tokyo 2020 Games	High-efficiency Wi-Fi
		Network security
		Technologies for supporting athletes
		Technologies for supporting staff
		Technologies for supporting spectators

to see more challenging approaches such as virtual-reality viewing and remote cheering, which are based on the premise of no spectators. Despite this atmosphere, we stressed the importance of real-time, interactive remote cheering via telecommunications and proposed to implement it at the marathon and sailing events. Even though the people involved did not have any spare energy, they accepted that proposal and managed to implement it. When I saw the moment when the cheering of remote spectators reached the athletes, along with the people involved, I realized that it was worthwhile taking on the challenge.

6. Future proposals from NTT laboratories and the structure of feature articles

After the above-mentioned twists and turns, the initiatives of NTT laboratories that were ultimately implemented at the Tokyo 2020 Games fall into the following three categories (as listed in **Table 1**):

Category 1, “NTT R&D technologies for viewing Tokyo 2020 Games,” proposes a future of watching sports through “Kirari!” and other technologies, which were applied to the sailing, badminton, and marathons events.

Category 2, “NTT R&D technologies that colored Tokyo 2020 Games,” proposes a future of staging events by using Kirari! and the communication control technology called “Swarm,” which were implemented at events to celebrate the Olympic Torch Relay.

Category 3, “NTT R&D technologies that supported Tokyo 2020 Games,” introduces high-efficiency Wi-Fi and network security as well as technologies that support athletes, staff, and spectators.

These initiatives will be introduced in NTT Technical Review in the coming months.

NTT is an Olympic and Paralympic Games Tokyo 2020 Gold Partner (Telecommunication Services).



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He received a B.E. from Osaka University in 1991 and M.Sc. with Distinction in technology management from University College London, UK, in 2007. He joined NTT in 1991 and was a senior manager of the R&D planning section of the NTT holding company from 2012 to 2015. He is currently a visiting professor at the Art Science Department, Osaka University of Arts, and visiting executive researcher at Dentsu Lab Tokyo. He has served as a member of the Japan Science and Technology Agency (JST) JST-Mirai Program Steering Committee, member of the All Japan Confederation of Creativity (ACC) TOKYO CREATIVITY AWARDS 2021 Judging Committee, and member of the Broadband Wireless Forum Steering Committee. He has been engaged in R&D of a media-processing technology, user interface/user experience, communication protocols, information security, machine learning, service design, and technology management. Until recently, he had been in charge of NTT's Tokyo2020 initiatives, including sports-watching video technology, inclusive design for social issues, and promoting the use of ICT in *kabuki*, entertainment, and media arts such as live music.

He has been in his current position since 2021, where he manages R&D on information and communication processing of humans based on human-centered principles.
