

Technology Report for Smart World

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Abstract

NTT Research and Development Planning Department has selected 11 key technologies for realizing a smart world based on social trends for the next 7 to 10 years and published “NTT Technology Report for Smart World.” This article introduces a summary of these 11 technologies and the social changes that will be brought about by such technologies.

Keywords: smart world, technology trend, social trend

The Smart World is Inevitable

The Smart World is not just some imaginary ideal. It is a future that will inevitably arrive. The more that technology advances, the more data, work, people, and industries that were once separate will become intertwined and “smart.” Collaborative connections will enable new co-creation that could not have occurred before, accelerating the Smart World even more.

The term Smart World refers to many different things, as smart technology is introduced in fields including smart cities, smart mobility, smart manufacturing, smart entertainment and smart healthcare. For example in the manufacturing sector, work is underway on an industry-wide platform to tap into the knowledge of skilled workers and construct a connected value chain, and investments are being made in a variety of AI and speech recognition, sensing, and networking technologies.

Building the Smart World is a vital step for solving many of the social challenges confronting society today. Contemporary social issues such as food waste and environmental destruction span a wide range of fields, and cannot be solved simply by reforming one company. In order to solve social issues and create a richer society, we should strive for a smart world that enables co-creation across corporate and industry boundaries.

We have been working for some time on a “B2B2X” business model that will accelerate the creation of the Smart World. This model aims to create new value by having major industry players take advantage of new

technologies that we have developed together with our partner companies. We want to accelerate the necessary transition to the Smart World in order to achieve a more sustainable world and richer lives.

Technology Must Be Natural

In the Smart World, it is essential that people of all ages, genders, occupations and ethnicities benefit from technology. This is why technology must be natural. Using current cutting-edge technologies such as virtual reality (VR) requires clear awareness, and sometimes specialized knowledge. This leads to disparities between those who can benefit from technology and those who cannot. Accordingly, technology must become so natural that people are unaware of its presence.

The advent of natural technology also promises less stressful lives. AI that can converse naturally like human beings would make it possible to communicate beyond simple questions and answers, while more natural everyday devices could eliminate the need to worry about various settings and operations. Natural technology is a crucial concept for eliminating stress in all fields and for people to live comfortably.

In the past, we have understood technology as something in conflict with humanistic things and nature. Accordingly it has sometimes been seen as lacking humanity or warmth. However, as technology grows more natural in the future, it will overcome this opposition and become integrated into what we have thought of as human values and emotions, contributing

to a good environment for both the Earth and human beings.

As technology becomes more natural, it should grow better at supporting human activities on a deeper level. Technology must be natural in order for human beings to display their creativity and increase their own value—to truly expand human potential and unleash groundbreaking innovation.

11 Technologies for the Smart World

We are focusing our energy on 11 technologies that will contribute to natural technology and the Smart World—from maturing technologies beginning to be implemented in a wide range of fields to emerging technologies that should flourish in the future.

Learn how these 11 technologies will bring about the Smart World.

1. Artificial Intelligence

Technology that is tolerant and sincere

The basic abilities of artificial intelligence (AI) to see, listen, and speak are reaching practical levels. However, this only means that separate functions can derive standardized outputs, and are still unsuited to dealing with complex problems. AI is being developed that can handle more complex problems by streamlining learning and creating “white box” algorithms. In addition, we believe that AI needs to be able to process human values. AI that can present a number of options tailored to diverse values will deepen human thought by offering multiple solutions, even for more complex problems. AI that can “think” in accordance with people’s values is technology with the tolerance to accept diversity, and the sincerity to respond to different ways of thinking.

2. Virtual Reality / Augmented Reality

Creating moving experiences across time and space

Virtual reality and augmented reality (VR/AR) have already been released as part of various services, products, and content, but we want to naturally introduce this technology into an even wider range of fields in the future. For that purpose, we are focusing our VR/AR research not only on enriching qualitative expression but also speeding up processing. Our research includes technology that stimulates senses beyond vision such as hearing, touch, force, and temperature, in addition to technologies such as “Kirari!” that can transmit entire spaces over distance via real-

time high-speed data processing. By reducing latency, Kirari! 2.0 will even overcome time. People’s experiences in the Smart World may evolve into something completely different from today.

3. Human-Machine Interface

Deeply understanding humans to naturally integrate with robotics

The Smart World will not only bring updates to products, systems and services. In the future, human-machine interfaces (HMI) will also extend the human body. Brain wave analysis and other methods have unraveled mysteries of brain function, which coupled with much-improved understanding of the mechanisms of the human body, should lead to the creation of more sophisticated and complex interfaces. Through our HMI research such as Point of Atmosphere (PoA), we aim to naturally integrate humans with their environment and robotic devices. With the new technology we envision, people will be able to substitute lost bodily functions and make use of information that natural senses cannot detect. Just as virtual and augmented reality expand the human senses, human-machine interface (HMI) expands the body’s potential—indeed, the very body itself.

4. Cyber Security

Shifting to active defense

As the spread of networks and IoT increases the risk of cyber terrorism, existing passive cyber security technology tends to result in a back-and-forth battle against constantly evolving attackers. In order to overcome this situation, a shift towards active security centered on the use of AI is underway around the world. Stronger security is essential to our vision of the Smart World where everything is networked. In addition to developing security technologies adapted to a wide range of applications including mobility, plant systems, and healthcare, we are focusing on active defense that actively deals with cyber attacks. The Smart World will show its true value only with the establishment of new security technologies that can head off cyber attacks.

5. Information Processing Infrastructure

Making strides in real-time, scalable processing infrastructure

Next-generation information processing technology could be called the infrastructure of the Smart World. Thus, effective utilization of rapidly evolving technology requires building out information processing infrastructure. Attention in this field is

focused on technology that can overcome the trade-offs between performance and flexibility or power consumption. We are also hard at work developing new information processing platforms that surpass conventional limitations. Projects currently underway include scalable data processing technology to process large amounts of information in real time, and highly efficient data management technology to promote use of data across industries. Of course, we are also making efforts to improve hardware itself and develop new technology that can overcome Moore's Law. The fruits of this research are leading to the emergence of new infrastructure.

6. Networks

Creating a breakthrough all-photonic network

New networks are key to realizing the Smart World, where rich flows of data will connect numerous actors and products across industries. We are embarking on the creation of new networks that surpass the 5G technology entering use in the near future. These networks must be higher capacity, lower latency, stronger and more flexible, as well as energy efficient in order to address the explosive increase in energy consumption. That is why we are working hard to convert to an all-optical network and pursuing creation of new networks. We will lead the way to a new world as these new networks spur innovative collaboration.

7. Energy

Realizing an intelligent energy network

As various advanced technologies enter practical use and the world's population increases in the future, the energy needed to power systems in every industry is a key part of the social infrastructure of the Smart World. In order to meet growing energy demand while also managing environmental issues, research institutions around the world are trying to improve high-capacity storage batteries. To create this new social infrastructure, we are also hard at work developing energy that is not only environmentally friendly and high capacity, but able to be freely distributed as if it has intelligence. Accordingly, we are conducting efficient energy distribution through virtual power plants that virtually manage dispersed energy, while also embarking on research into new hybrid energy networks. In the Smart World that we are building, energy will evolve into something smart that can circulate almost as if intelligent.

8. Quantum Computing

Innovation with post-Moore's Law technology

Quantum computing technology, which is expected to vastly outperform conventional computers, is likely to be used in nearly every industry. Quantum computing is often discussed in relation to solving optimization problems that require the testing of endless numbers of choices, but in the future it may also result in breakthroughs in the energy and drug discovery fields. Our quantum computing research has made remarkable progress in recent years, with technologies such as LASOLV introducing new concepts distinct from conventional quantum computing including gate type and annealing type. At the same time, we are also pursuing research on quantum computer hardware utilizing quantum gates, and significant advances in both software and hardware are expected in the future. Quantum computing does not merely provide extremely fast computing technology, but has the potential to transform information processing itself. In the Smart World, quantum technology will change the way information is handled.

9. Biotechnology / Medical Care

Evolution of biosensing leads to precision medicine

Hand-in-hand with advances in biology and chemistry, biotechnology is also steadily evolving. Biotechnology is mainly being introduced in medicine, as well as agriculture, forestry and fisheries, but amid the changing nature of information today, biotechnology actually reveals new possibilities for communication. We are also approaching biotechnology from a number of directions spanning the fields of chemistry, biology and physics. In particular, research is ramping up in recent years in the field of biomedical care. In addition to our development of functional materials such as "hitoe," in 2019 we entered into research partnerships with Australian institutions including Deakin University and Western Sydney University. We will accelerate our activities going forward as part of our vision of "a society where elderly people can live independently and safely."

10. Advanced Materials

Innovative production expands the concept of materials

In the future, instead of conventional fixed materials, multifunctional materials that change flexibly in response to the environment will become commonplace. In fact, research into new materials such as nanomaterials is making steady progress, and numerous

materials are beginning to enter practical use. In order to further advance research and development of new materials, we are using AI and other methods to speed up the development process. In order to build the Smart World, rapid development of materials is essential to meet demand for development of personal functions tailored to people's diverse needs. We plan to pursue development of these new materials, and are already making progress with some technologies such as advanced thin films that will be used to create more flexible and functional materials.

11. Additive Manufacturing

Personalized production in every field

Additive manufacturing, frequently symbolized by 3D printing, will become an indispensable technology in the Smart World by enabling greater personalization. Additive manufacturing makes possible more than just items such as industrial products and building materials. In the future, even parts of the human

body including bones and organs are expected to be manufactured at will. Currently, interest is growing in the field of bioprinting. We are also working on research and development of artificial cells in a layered structure. Another technology to watch is 4D printing, which could incorporate information on changes in time and condition to enable self-healing. As this technology evolves, it will be possible to manufacture more personal products.

A booklet entitled "NTT Technology Report for Smart World" that describes these 11 technology trends and NTT R&D initiatives was published [1]. We hope that this report will be useful in communicating with customers.

Reference

- [1] NTT Technology Report for Smart World, <http://www.ntt.co.jp/RD/e/techtrend/index.html>



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