

Orchestrating a brighter world

NEC

NEC Vision 2018

for Social Value Creation

Realizing NEC Safer Cities through digital technology



\Orchestrating a brighter world

In a society undergoing diversification and globalization, various issues are tightly intertwined. Under such circumstances, the market environments have rapidly changed. Under the brand statement "Orchestrating a brighter world," NEC solves the social issues that the world faces using information and communication technology (ICT) and aims to achieve safety, security, efficiency, and equality to enrich people's lives. Today, Digital Transformation creates new business models and schemes, and the world is now at a major turning point. NEC will continue co-creation with stakeholders and customers and keep working on cross-boundary challenges with the goal of creating social value that fuses people and the digital from the customer and social points of view. This booklet presents NEC's initiatives through Digital Transformation, customer case studies, and co-creation case studies for social value creation. It is our pleasure to invite you to read this booklet.

\Orchestrating a brighter world

Established as NEC's brand statement in July 2015 across the group throughout the world.

Brand story

NEC brings together and integrates technology and expertise to create the ICT-enabled society of tomorrow. We collaborate closely with partners and customers around the world, orchestrating each project to ensure all its parts are fine-tuned to local needs. Every day, our innovative solutions for society contribute to greater safety, security, efficiency and equality, and enable people to live brighter lives.

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At a glance

Top message

NEC considers Digital Transformation as not just a trend but a movement with a strong enough influence to change the industrial structure. Social and business values increase when things and contexts are digitally connected, digitalized knowledge becomes common assets, and artificial intelligence (AI) yields new findings.

NEC published the "Mid-term Management Plan 2020" in January 2018. In this plan, we make a firm statement that we accelerate the realization of safe and secure society by concentrating our efforts on global safety business, as a growth engine, while advancing Digital Transformation powerfully. We strive to offer the value of safety, security, efficiency, and equality, which is essential for substantializing our slogan, "For all people, an abundant society."

Working closely together with our customers and partners around the world, and leveraging the power of ICT, we, at NEC, are committed to achieving a sustainable society.

May 2018

Takashi Niino,
President and CEO



Global megatrends

By 2050, human society will require two times the Earth's resources

According to United Nations' estimates, the global population will reach 9.8 billion by 2050. In addition, the population will continue to concentrate in urban areas, and the global urban population will reach 6.3 billion (1.8 times more than the current^{*1} population). As a result, the consumption of resources in urban areas will increase even further, and it is assumed that greenhouse gas emissions may increase by 1.5 times, and the demand for water, food, and energy may increase by 1.6 times to 1.8 times. If today's urban lifestyle continues, by 2050, we will need twice the resources that the Earth can supply. In addition, many issues face the world, including natural disasters from global warming, economic disparities during the economic development process, increased terrorism, and crimes in the cyber and real worlds.

In order to build a sustainable society while coexisting harmoniously with the Earth, we must resolve these issues; ICT can help to resolve issues in many areas.

^{*1} From 2000 to 2010

Evolution of digital technologies leads to a revolution

In recent years, technologies have rapidly advanced in the fields of robots, drones, medical technologies, and biotechnologies. In the field of ICT, the digital technologies of AI and IoT are attracting attention. These technologies are major factors in promoting efficiencies, creating new value, and resolving issues by closely interconnecting the different information resources. In Japan, efforts have been made to realize *Society 5.0*, which will create new life value by merging the real world (physical world) and the cyber world. Thus, a Digital Transformation is taking place, which is accelerating the drastic changes in the essence of societies, economies, and the industrial structure through innovations achieved by digital technologies.

Efforts for the realization of secure, safe, efficient, and equal societies

NEC classified the global and social changes to be expected in the next ten years into six megatrends. These megatrends affect each other as a series of chain reactions. Because of the increasing complexity of the details and the increasing speed of the changing trends, it has become more difficult to predict the future. However, we consider it important to prepare for the future by grasping global-scale megatrends on a mid-to long-term basis and by identifying risks and opportunities.

Based on these megatrends, NEC devised *The seven themes for social value creation*, which are embodied in our Solutions for Society. These themes are harmonized with the Sustainable Development Goals (SDGs) formulated by the UN in terms of the establishment of goals based on social issues, and they have many components in common. Through co-creation with our customers and partners, we will work on these themes to realize secure, safe, efficient, and equal societies.



Reference: Based on the data from OECD, IEA, the Ministry of Agriculture, Forestry and Fisheries, and the United Nations.

Global trend for the resolution of social issues

There has been a growing trend for the resolution of social issues across the world, including the UN. In the UN summit held in 2015, the Sustainable Development Goals (SDGs) for 2030, which consists of 17 objectives and 169 targets for the social issues of poverty, hunger, energy, climate change, and a peaceful society were formulated.



-The future and world trend-

01 Chain of resources and environmental issues
The sustainability of resources and the environment is reduced because of the increased consumption of water, food, and energy as a result of increased population and urbanization.

04 Changes in power balance
Countries, cities, companies, and individuals have almost equal power forming an unconventional, new social order.

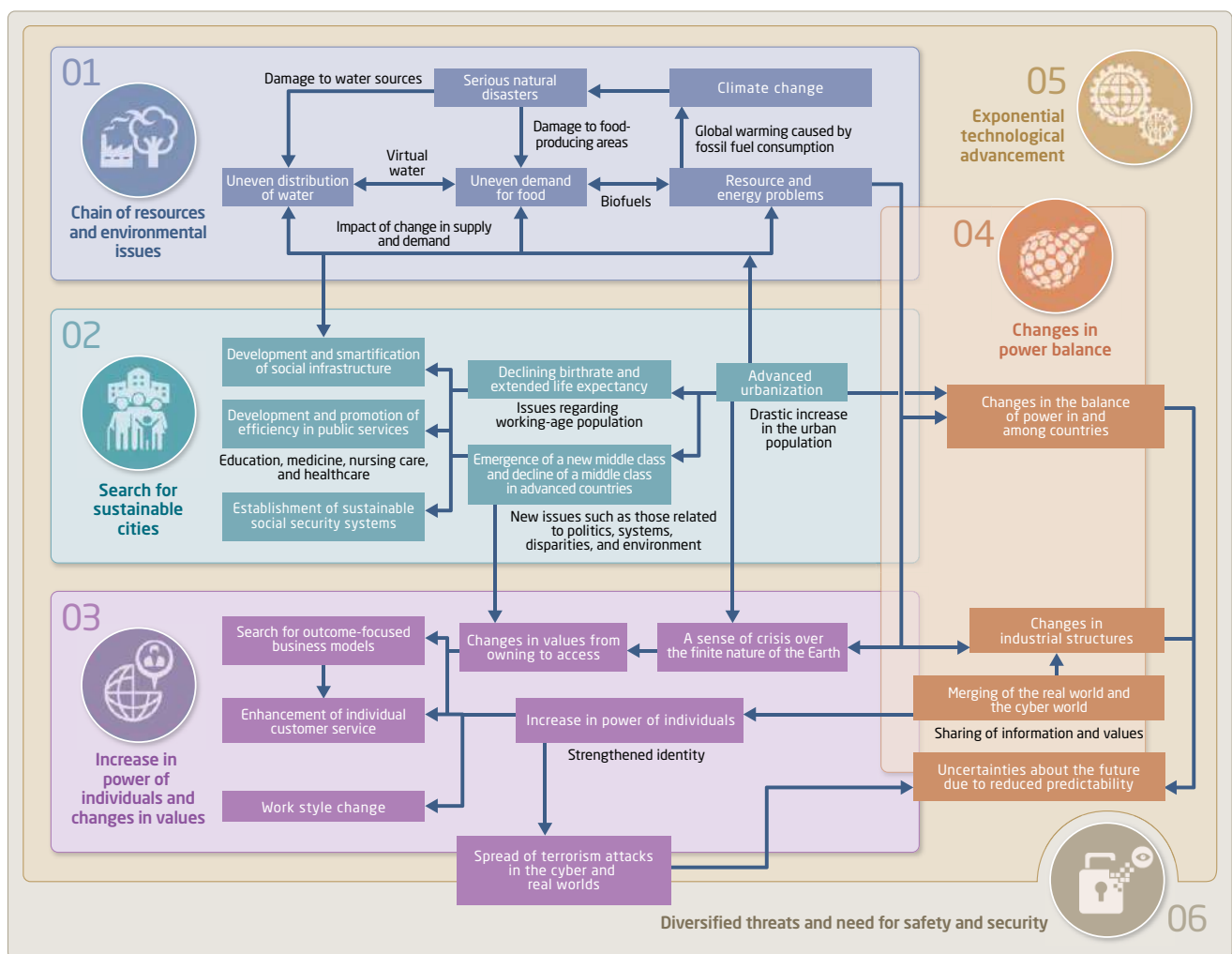
02 Search for sustainable cities
Urbanization, which drastically changes society and life, progresses across the world, and a review of conventional systems and infrastructure is required.

05 Exponential technological advancement
The exponential technological advancement contributes to the resolution of various social issues but creates new challenges.

03 Increase in power of individuals and changes in values
Because of the advances in ICT technology, individual information is more frequently used for various services, which lead to changes in the values of people and society.

06 Diversified threats and need for safety and security
The need for safety and security increase both in the real and cyber worlds from diversified threats as a result of environmental, social, and technological changes.

Chain of six megatrends



Co-creating the future thro

Rapid population concentration into cities energizes moves of people and things to develop the economy while increasing risk of crimes and terrorisms. NEC realizes NEC Safer Cities where people can live more securely and freely and exercise their abilities to the fullest.

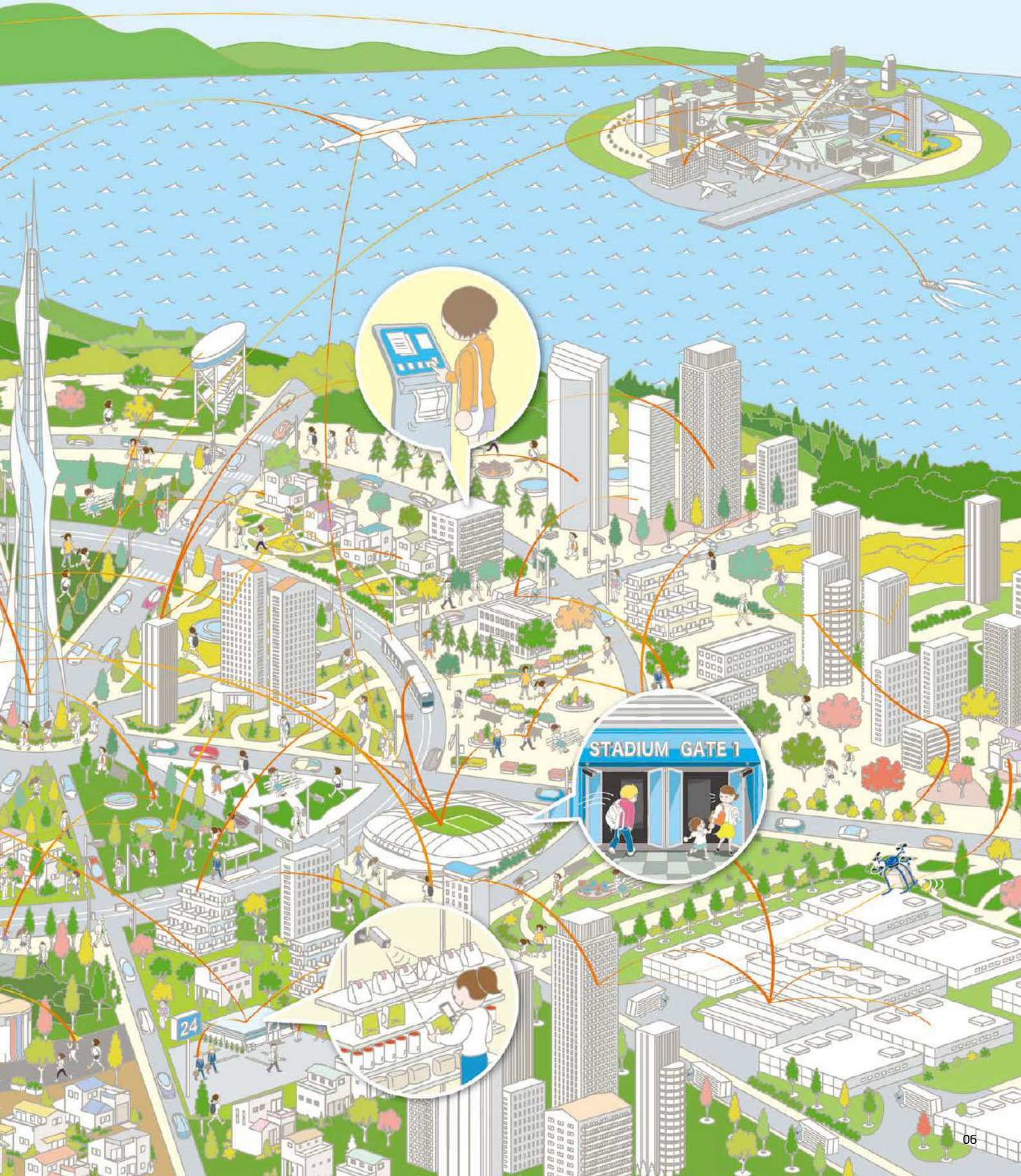
It is the Digital Transformation that is essential to realize NEC Safer Cities.

NEC leverages diversified digitalized information in the real world, creates new connections for the resources required for next-generation management, achieves a sustainable society, and energizes companies, industries, cities, and people.

In this chapter, we introduce "NEC Safer Cities" and "The Digital Transformation that NEC envisions".



ugh Digital Transformation



NEC Safer Cities creates new social value globally

What are the cities NEC envisions with the NEC Safer Cities?
Masakazu Yamashina, in charge of the project,
explains the vision as announced in the
"Mid-term Management Plan 2020".

Masakazu Yamashina

Executive Vice President

After joining NEC, he engaged in R&D of high-performance LSI at NEC's Central Research Laboratory. He then took charge of businesses for semiconductors, mobile phones, PCs, and tablets. Since 2016, he superintends global safety business, assuming a leading role in NEC Safer Cities.



What NEC Safer Cities provides is the value of safety, security, efficiency, and equality

- Tell us about the concept of NEC Safer Cities.

Yamashina: As the world population increases, the concentration of population into urban areas proceeds rapidly. A big challenge cities are facing is how to conduct government services efficiently in a sustainable way while protecting people's safety. Solving all kinds of problems that occur in the cities by using digital technology, this is the key concepts of NEC Safer

Cities. NEC strives to realize the cities where people live safe and secure lives and provide them with efficient and equal service and the freedom of movement.

NEC Safer Cities helps solve social problems in the urban areas

- What value does NEC provide specifically?

Yamashina: The SAFE CITIES INDEX 2017 report, sponsored by NEC, describes safety issues of cities and what efforts the cities need to make, as there are a good number of countries or cities that

are not safe. It is a primary social agenda how to secure safety in such countries and cities. NEC can help solve the safety and security issues with its advanced AI and biometric authentication technology. Specifically, NEC delivers value in three major fields, Public Safety, Digital Government and Smart Transportation. In the field of Public Safety, for example, law enforcement agencies in North America are utilizing NEC's biometric authentication technologies such as fingerprint and face recognition for criminal identification, which contributes to the faster resolution of crimes and securing people's safety.



SAFE CITIES INDEX 2017

As urban populations continue to rise, the issue of city safety is as important as ever. SAFE CITIES INDEX 2017, a report from The Economist Intelligence Unit sponsored by NEC, ranks the safety of 60 cities worldwide based on the following four categories: digital security, health security, infrastructure security and personal security.

The report is expected to help foster a better understanding of the importance of addressing the challenges cities are facing, such as population increase and the threat of terrorism. It also helps improve the safety of the cities through learning from the success of other cities. In considering the sustainable development of cities, the report states the need for a holistic approach toward safety and security while also highlighting the effectiveness of utilizing technology.

NEC also creates value in the field of Digital Government. For example, by transforming paper-based government procedures into digital transactions, NEC makes a contribution to streamlining the customers' operations. In the UK, application procedure for benefits has already been digitized, yet fraudulent applications become a problem. By using NEC AI to analyze the patterns of fraudulence, the government can prevent such frauds.

Lastly, in the field of Smart Transportation, border security between countries is another big challenge. In fact, there is a problem that airport security check takes up so much time. For example, NEC's face recognition system helps build an environment where people can move around efficiently, safely and securely, with shorter waiting time. Thus, frictionless travel or stress-free travel becomes a reality. Not only to safety and security of cities, NEC Safer Cities also contributes to inter-city safety and security.

Realizing NEC Safer Cities utilizing of 3 platforms

- How can NEC Safer Cities be realized?

Yamashina: To realize NEC Safer Cities, we must be able to provide the solutions to more customers. To achieve this, NEC is required to change its business model to a service-based model utilizing platforms. Leveraging three platforms, Data platform, Analysis platform and Common business platform, NEC efficiently delivers highly value-added service to customers. In January 2018, NEC acquired Northgate Public Services (NPS), a UK IT service company, to increase the value provided by the platforms. NPS has a robust common business platform as well as a built-in customer base in the fields of law enforcement, tax collection, social security benefits, and public housing management. The new value is to be created by using the data platform to collect and integrate data from the common business platform and by utilizing the analysis platform that embraces NEC AI and biometric authentication. The customers who use NEC platforms can make their business more efficient but also provide equal and high value-added services.

Leveraging experience and expertise accumulated through UK operations,

NEC deploys platform-based service to North America and the Commonwealth countries, Australia, New Zealand, Canada, and India, where public administration systems are highly compatible with those of UK. Thus, NEC delivers value to much more customers in the world.

NEC Safer Cities creates new social value globally

- Lastly, give a message to customers.

Yamashina: With NEC Safer Cities, we intend to make people's lives more affluent across the world through resolving social issues in the urban areas by using NEC's technologies and solutions. Together with our customers and partners NEC will continue to co-create service platforms that enables the enhancement of customers' services at a low investment, by taking in global best practices.

This is the way we, at NEC, make a contribution to a better world, I believe. We strive to realize NEC Safer Cities to create new social value globally. Look forward to good progress NEC makes with NEC Safer Cities.



Northgate Public Services CEO **Steve Callaghan**

The acquisition of NPS by NEC delivers significant benefits for our customers and colleagues. Being part of NEC delivers significant financial backing and commercial differentiation. Our business vision includes integrating NEC's biometric and analytic technologies with our existing software solutions, and leveraging NEC's expertise in safer cities to strengthen our market position with government and law enforcement agencies. With NEC's global credentials we also expect the transaction to enable our business to expand into new geographies, and business verticals.

Point

- ▶ Solves various social issues that occur in the cities utilizing digital technology.
- ▶ Enables customers to provide everyone with equal and highly added-value service.
- ▶ Provides globally platform-based service of highly added-value with less investment cost.

NEC Safer Cities realizes safety, security, efficiency, and equality

Rapid population concentration into cities energizes moves of people and things, develops the economy, and diversity accelerates to create new value while increasing risk of crimes and terrorisms. NEC provided solutions for diverse social issues in the urban areas utilizing advanced AI and IoT technology including biometric authentication and image analysis. NEC, working together with its customers, strives to realize NEC Safer Cities, where people can live more freely and securely to exercise one's ability to the fullest, through providing people with safe and secure lives, efficient and equal services and the freedom of movement.

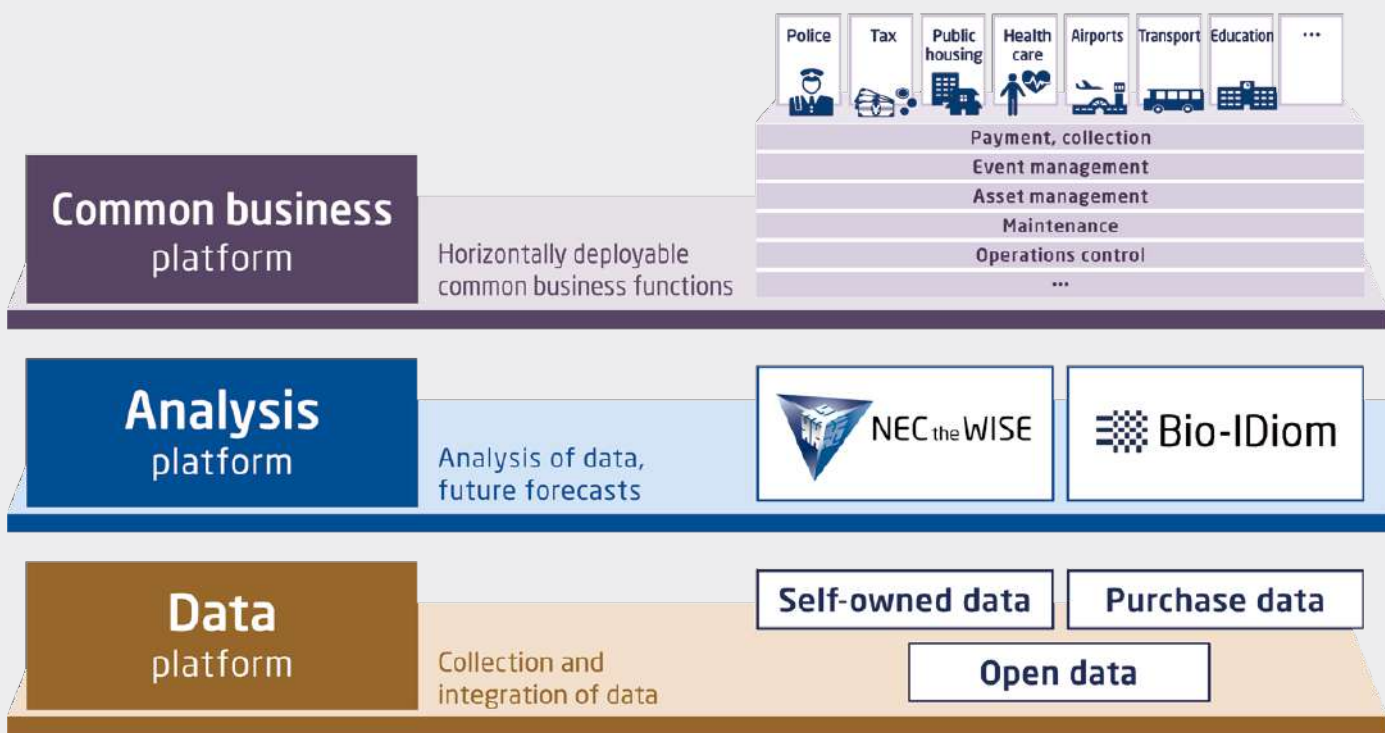


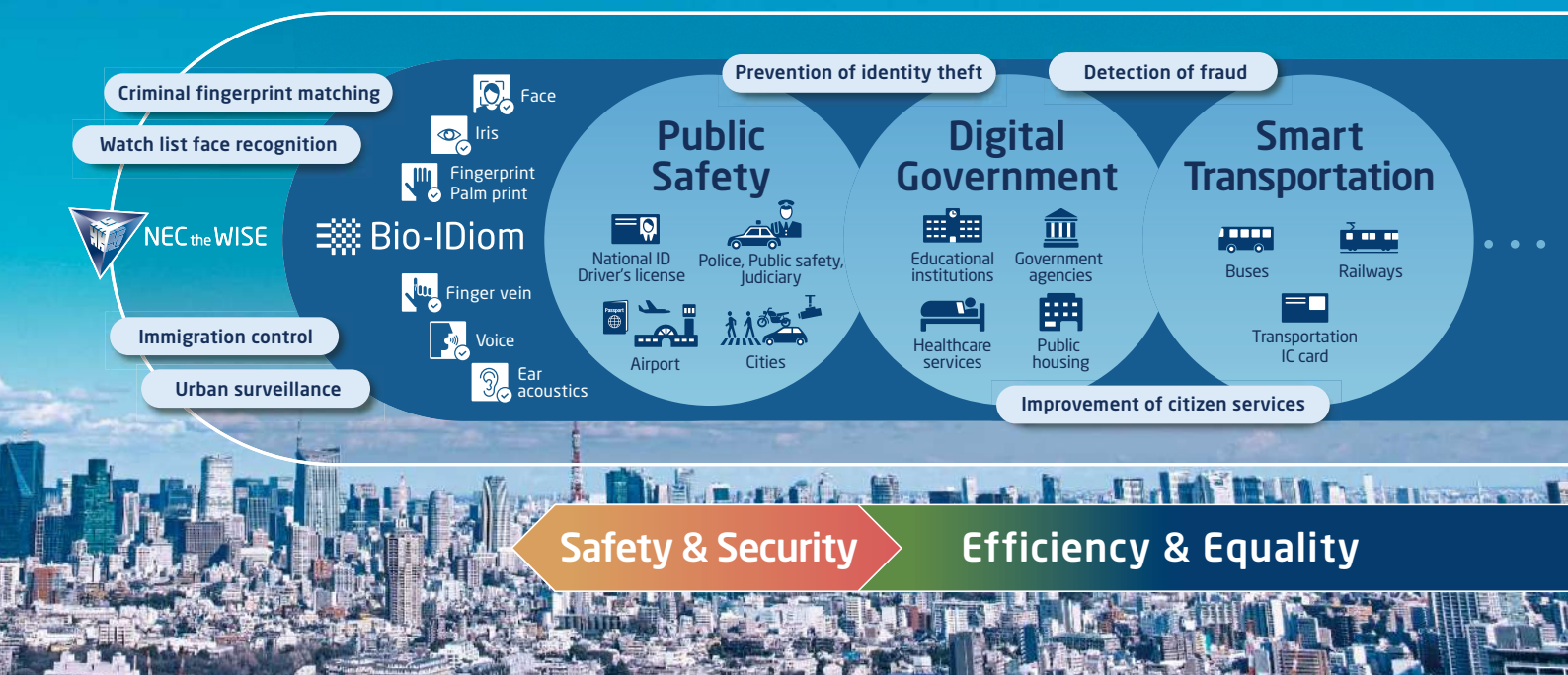
3 platforms for providing value by connecting together

To realize NEC Safer Cities, NEC changes its business model into a service-based model with 3 platforms. Rather than system integration service that delivers one-of-a-kind value for each customer, NEC provides more customers with higher value by coherent and consistent data throughout 3 platforms connected together.

3 platforms are *Data platform* for data collection and integration,

Analysis platform for analysis of data and future forecasts, and *Common business platform* built with horizontally deployable common business functions. The Analysis platform, in particular, is comprised of NEC's leading edge AI technologies, *NEC the WISE*, and *Bio-IDiom*, NEC's world-class and unique biometric authentication technologies. NEC delivers greater value with the highly accurate analysis using the Analysis platform.





NEC the WISE

NEC the WISE is a cutting-edge AI technology complex comprised of multiple technology units. It is unrealistic to use a single generic AI for addressing complicated and perplexed social agendas of nowadays.

Combining a range of the world's No. 1 and only one AI technologies, NEC the WISE delivers flexible and quick solutions in every scene and creates value.

NEC the WISE visualizes a wealth of real-world information for the use of AI's analysis, interprets the intent and background of real-world phenomena by utilizing the data generated through *visualization*, and analyzes the data to forecast what's going to happen. Based on the *analysis*, it seeks an optimal approach to solve a problem, and offers value in the domain of formulating *prescriptions* for equipment control and supporting people's action.

The word "AI" may remind you of a human brain. NEC's AI, in addition to making analysis, is characterized by "Five-senses AI", taking advantage of image analysis techniques including face recognition and fingerprint recognition.

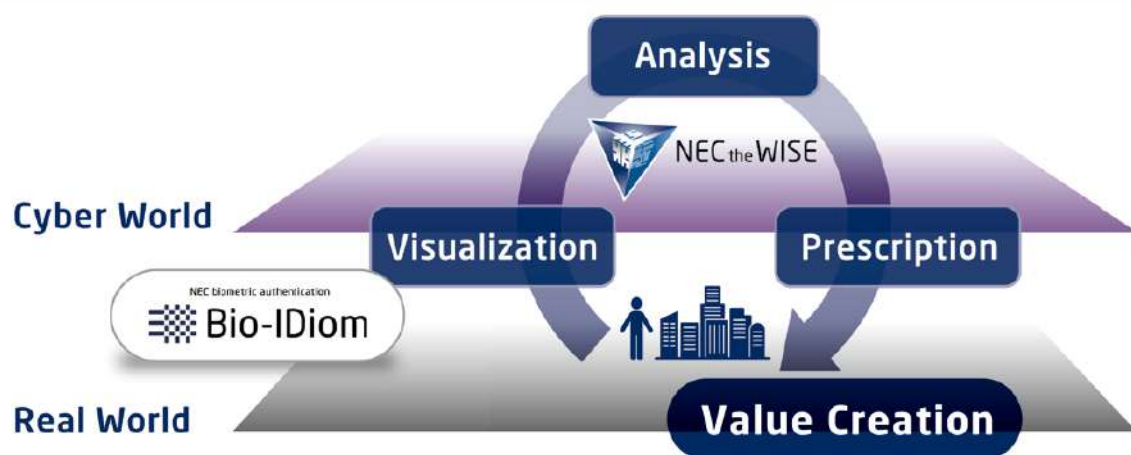
By distinguishing people and things, just like human being uses five senses, it provides highly accurate analysis and identification of the most desirable prescription.

Bio-IDiom

For the last half-century, NEC has been engaged in the R&D of biometric authentication technology. So far, over 700 fingerprint, face recognition and related systems were installed in more than 70 countries.

Bio-IDiom, NEC's biometric authentication technologies, is comprised of 6 authentication technologies, face, iris, fingerprint and palm print, finger vein, voice recognition and ear acoustic authentication. The technologies are world-class or unique technologies of NEC.

In the cyber world, there exist all kinds of risks like spoofing and ill-willed cyber attacks. Using individual's biometric information as a key, NEC builds an entrance gate to the cyber world, a sophisticated authentication process based on multiple biometric authentication technologies as needed, NEC's Bio-IDiom contributes to realizing a *safe digital environment for all people* by eliminating risks from such as ill-willed attacks.



Connect, create, and change through Digital Transformation

What is NEC's understanding of Digital Transformation and how will it be used in resolving issues? Kumi Fujisawa of the Think Tank, SophiaBank, Co-Founder, which conducts international critiquing activities, spoke with NEC's Makoto Enomoto and Hiroshi Kodama.

Makoto Enomoto
NEC Senior Vice President and
CMO (Chief Marketing Officer)

**Kumi
Fujisawa**
Moderator
Think Tank
SophiaBank
Co-Founder

Hiroshi Kodama
NEC Executive Vice President
in charge of the Enterprise Business Unit

Digital Transformation is an opportunity for improvement

Fujisawa: During last year's NEC Vision, I asked you about how NEC will respond to the spread of AI and IoT and the digitalization of companies. This year, the theme is "Digital Transformation (DX)," and I am getting a sense beyond this change in your keyword that the speed of change throughout the world is accelerating. First off, tell me about NEC's understanding of the changes in the business environment arising from the shift from digitalization to DX.

Enomoto: As you can tell from another keyword that we hear more of, *Society 5.0*, this wave of change through DX is much more significant than any industrial revolution that we have experienced in the past, and it is progressing at unprecedented speed. Companies are rushing to keep up and create businesses and make changes, but I think the situation is like in a marathon where the leading group and the different groups follow them in a long line. The top runners in DX have created new business rules through DX and built the market from scratch. NEC is supporting the business transformation of our customers by working with them to co-create

while taking on the challenge of creating our own business as a member of the leading group in the race.

Kodama: Digitalization was a game changer. The axis of time has shifted, and this has changed business rules. With improvements in digital technology, everything is getting done over a much shorter time frame. By connected people digitally, the premise of business suddenly changed, and new players are creating a market using new rules. We are aware that the area in which ICT can demonstrate its value is expanding widely, and we are no longer limited to the conventional scope of IT. NEC has strong computing power and network technology, so we will create our ecosystem in these areas and work to resolve social issues. For NEC, this change in the business environment is an opportunity for growth.

Actively making changes for better rules for society

Fujisawa: Listening to the two of you, I get the strong sense that the rules are beginning to change. In the business world today, I suppose you can say that it is almost as if you were playing baseball, but then suddenly you were playing soccer with its fast passes. In this age

where business rules are changing because of DX, will NEC be in a position to create those rules?

Enomoto: I think we need to actively change the rules to ones that are better for society rather than being at the mercy of those rules. NEC needs to make proposals for these changes.

Kodama: This case is from a while back, but there was a convenience store that had 70 trucks a day delivering products. A new rule was adopted that called for cooperative distribution. As a result, the number of trucks delivering products dropped to seven a day, and created new value in the reduction in the burden on the store, conservation of energy for the distribution company, resolution of the shortage of drivers, and reduction



in traffic congestion in the surrounding area. In this way, it is quite natural to change business rules when thinking from the perspective of value. In an age where people are connected, and systems are easily accessible, NEC is no longer just an ICT vendor. As a company that creates social value, we will actively participate in efforts with our customers to change the rules from the perspective of value and create new rules.

Earnest attitude of management and possibilities of the digital native generation

Fujisawa: How should management and business owners see DX and what do they need to prepare for it?

Kodama: Say for example, in the Japanese market, one urgent social issue is how to prepare for the labor shortage. Now, everyone is exploring possibilities for using AI and cloud technology and considering how we should face these issues and how we need to change ourselves. We will work with our customers to prepare for this.

Enomoto: It is very normal for people to resist change. The important thing now is to manage change. This is when the true intentions of management will be tested. DX can mean trouble for some people and opportunity for others, but regardless, the tide is rising for this current change. It is also important to give the digital native generation opportunities to play an active part if we want to realize DX. Having the courage to leave things in the hands of this generation means that as a result, we can accelerate the speed of innovation.

NEC will also keep changing

Fujisawa: Looking at things objectively, NEC has sufficient capabilities with regard to our



experience and knowledge in a wide range of industries, but I sometimes think you are too modest. This can make your customers uneasy, so I think you need to show off your abilities more. So, tell me how NEC is going to change, including how you present yourselves to your customers.

Kodama: We will work to resolve social issues and contribute to a new area of creating social value. There are many areas where we can create value using ICT that go beyond the conventional scope of IT. NEC has the technology assets, specifically AI and security, methods, such as the cloud, and an abundant pool of human resources to realize this. We will combine these assets to create new value and resolve the issues of our customers and society.

Enomoto: NEC has also undergone significant change internally. From the perspective of the distribution of knowledge, we are seeing communities form organically within the company where participants use our internal SNS to share their experiences. Since the information doesn't go through the conventional process of documentation to turn them into explicit knowledge before sharing, it is fresher and more relevant. Both in the sense of spreading knowledge and from the perspective of expanding the community, I feel that this is changing our old corporate culture. Digital is something that changes the awareness of the people working in the organization.

Change the business model, change society, and bring out the potential in people

Fujisawa: Tell me about NEC's vision for the future with regards to DX.

Enomoto: Japan is often called an advanced country with challenges. Take the issue of population decline.

This is an issue that each country will eventually face. Japan is facing a decrease in tax revenue, and an important issue is how the country is to maintain its infrastructure. NEC is working to resolve this issue. The know-how for maintaining a high level of safety and security in a super-aging society with a declining population is something that



can be exported to other countries. In the future, as outcome-based business becomes the mainstream, the types of contracts and compensation will change, so it will be necessary to also consider the transformation of our business model.

Kodama: Many social issues are born out of contradictions. There is the contradiction that we are using energy and labor to generate food when one-third of it is disposed of worldwide.

The contradiction at the same time is that there are people who cannot get enough food. The point here is that we connect the wisdom of many people with digital technology to resolve these contradictions. In the process of resolving these social issues, the true power of digital is its ability to draw out the potential and motivation of the people. This has already started internally, and as with crowd sourcing, we are now living in a world where we can gather people with the necessary wisdom and skills virtually, and everyone can work to their full potential to resolve the issue. This is also an example of the realization of work style reform. This allows workers to maintain high motivation and makes it possible to continuously work to create a prosperous society. With the idea of people living and also living prosperous lives in mind, our commitment to realizing a prosperous society that ensures safety, security, efficiency, and equality remains unchanged.

Fujisawa: It was often said that resolving social issues is something difficult to grasp as a business, but I feel like we have entered an age where companies can resolve these social issues and turn them into business opportunities. I'm filled with hope after hearing not only about DX but also NEC's vision for the future beyond DX.

Point

- ▶ We will create social value with customers using the power of digital technology.
- ▶ We will continue to promote the change that maximizes customer value.
- ▶ We will realize a prosperous society that ensures safety, security, efficiency, and equality beyond DX.

The Digital Transformation that NEC envisions

NEC will connect the resources required for the next generation of management to achieve a sustainable society that brings vitality to companies, industries, cities, and people.

Why do we need Digital Transformation now?

Initiatives have been implemented throughout the world to solve global social issues and achieve a sustainable society. In the process of establishing such a sustainable society, technology is an important component in resolving social issues. Advances in technology accelerate productivity growth and efficiency in industries, hasten the arrival of the Zero Marginal Cost Society,^{*1} where the costs of

information, energy, and transportation are significantly reduced, and lead to a future where you can use as much as you need, when you need it.

In such future management, a business is not differentiated simply by having advanced technologies. We must leverage the application and scope of use of the technologies to create new services, products, business models, and value. This commitment will greatly streamline corporate and industrial business activities and city operations, transform all aspects of

people's lives in a better way, and achieve a sustainable society. This social change is Digital Transformation (DX). Together with customers, NEC would like to take the emergence of DX as the opportunity to work for the development of our business and to solve social issues.

*1 The society advocated by Jeremy Rifkin in *The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism* is where efficiency and productivity increase to the ultimate level from advances in technology, such as IoT, and consequently objects and services will be free.

What is the Digital Transformation that NEC envisions?

Digitize events in the real world, incorporate them into the cyber world, and connect people, things, and contexts at deeper levels to create new value. Consequently, doing so will change our lives and business for the better. This is the Digital Transformation that NEC envisions. For example, in enterprises, DX can connect business needs and information on the ability, aptitude, and interest inherent in people so that people can freely select their working style; consequently, they can

achieve a work-life balance where people feel a sense of fulfillment and vitality. At the same time, DX enables management to apply human resources in the right place at the right time, thus eliminating the labor shortage. For example, in the industrial sector, DX can connect information from manufacturing, logistics, and retail in real time to optimize the workforce across workplaces and balance supply and demand. As a result, the loss of food and disposal of products will be reduced. In cities, DX will make operations more efficient by connecting public service sites with a wide variety of information possessed

by management, and it will optimize all public services from the perspective of the entire city based on the concept of city management. In addition, by connecting people to medical institutions and medical services, personalized medical care is optimized for individuals to maintain health and improve the quality of our lives. In this way, NEC creates vitality for companies, industries, cities, and people, and achieves a sustainable society.

Case study

JGC Corporation

Aiming to enhance stability, safety and efficiency
Deploying digital data in plant operations

Oil refineries, natural gas plants and other such industrial facilities face the issue of how to operate safely and efficiently with aging infrastructure and workforces.



JGC Corporation and NEC are working together to resolve this challenge by synergistically combining JGC's plant construction know-how with NEC's "System Invariant Analysis Technology," a form of AI. System Invariant Analysis Technology detects signs of abnormalities in plant operations based on correlations among various sensors installed throughout the plant. Such abnormalities are treated as a sign of impending malfunction and promptly addressed. Early rectification of deviations from the norm prevents emergency plant stoppages and helps to alleviate environmental burdens.

Kitahara Neurosurgical Institute

AI supports hospital management reforms
as the goal to be achieved by the Kitahara Neurosurgical Institute.

In Japan, the quality of healthcare and operational efficiency should be improved in order to respond to the increase in the number of patients due to a super-aging society and the declining birthrate, as well as the diverse needs of those patients, with limited human and financial resources. Mr. Shigemitsu Kitahara, president of the Kitahara Neurosurgical Institute (KNI), aims to transform the hospital into a digital hospital^{*1} that enhances the quality of healthcare and promotes operational efficiency by redefining healthcare as an integrated life industry related to overall life, enabling full digitalization of the hospital, and providing appropriate support for diagnosis and treatment using AI-based data. As a partner of KNI in healthcare reforms, NEC carries out joint research on AI to promote efficient hospital management. NEC has worked together with hospital personnel to identify areas of improvement in the field and supports the early discharge of inpatients and the detection of signs of problem behavior using AI. With these efforts, NEC encourages patients to return to daily activities as soon as possible, reduce the burden on medical practitioners, and promote the efficiency of hospital management. As a co-creation partner in healthcare reforms, NEC proceeds with the establishment of a system that supports future healthcare and people through advanced ICT.



*1 A fully digitized hospital is equipped with cameras and sensors to enhance the quality of healthcare and promote operational efficiency through appropriate diagnosis and treatment using AI. In the future, KNI will develop a system that the facility grasps the conditions of each patient and automatically and appropriately stimulates the senses of sight, smell, and touch to treat and care for patients.

Connecting together people, things and contexts, wisely

Newly, connecting people, things, and contexts that have not been connected until now and adding new meaning to people, things, and contexts that have already been connected are two ways to reconnect wisely. This is called "connecting together" by NEC. NEC is able to visualize a wide range of digitized data using IoT technology and communications infrastructure and to analyze a large volume of data that exceeds human processing capability using AI technology in order to accumulate and share deep

knowledge and wisdom. In that case, NEC will provide value in being connected together by returning easy-to-understand prescriptions to the real world. NEC offers the ICT platform, NEC the WISE IoT Platform, and the AI technology, NEC the WISE, to perform these processes efficiently and effectively. NEC is continuously working on the research and development of technologies for vector computers with high-speed processing of a large volume of data and dedicated hardware and accelerators that dramatically improve the speed of face recognition in addition to strengthening AI technologies. NEC has many applications that have been developed from

its performance and expertise used in a wide range of enterprises, industries, and urban areas, thus talented people from NEC can be involved in problem discovery to resolution and follow through with developed processes. We offer a combination of these elements to meet customer needs efficiently and effectively to achieve the customer's DX. NEC will connect the new resources needed for the next generation's management using a wide variety of information from the digitized real world in order to create vitality for enterprises, industries, cities, and people and achieve a sustainable society.

Orchestrating a brighter world

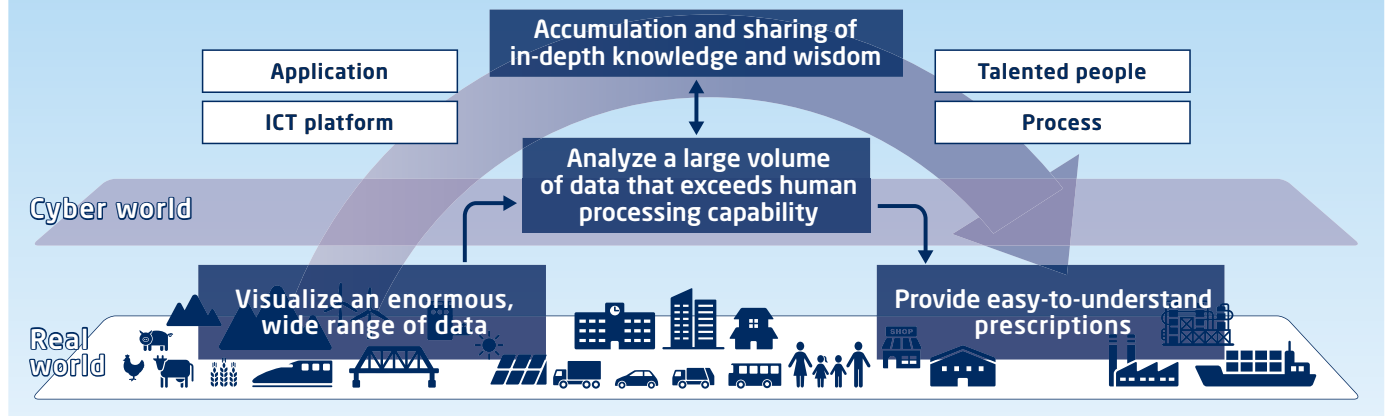
NEC creates vitality for enterprises, industries, cities, and people, and achieves a sustainable society through Digital Transformation

Transform to sustainable growth in both enterprises and industries



Transform city operations to city management

Add new meaning to people, things, and contexts, wisely connecting together



NEC face recognition technology achieves the safety and security of individuals and society

NEC has the newly developed NeoFace Accelerator Platform, a dedicated server for face recognition. This server can significantly accelerate NeoFace, which is the world class^{*1} face recognition AI engine. The NeoFace Accelerator Platform has a hardware accelerator, NeoFace Accelerator, that reduces cost and power consumption compared to traditional software processing. In addition, real-time face recognition using a high-definition 4K camera^{*2} is also achieved.

^{*1} The performance of NEC's face recognition technology has been determined as the best technology in the world in the first video face recognition evaluation program by a global authority, the National Institute of Standards and Technology (NIST) in the United States. Following the still image evaluation, NEC received the world's first ranking in four consecutive evaluations.

^{*2} 4K: 3840 × 2160 pixels, four times 2K = Full HD: 1920 × 1080 pixels



Evolution of “Connect” to support Digital Transformation

NEC will transform existing information and communication networks to next-generation information and communication infrastructures that support the Digital Transformation underway in all industries. Using these next-generation information and communication infrastructures, we will co-create new social value with telecom carriers and industry partners.

Co-creation with customers by connecting people, things, and contexts

With the development of digital technology, we are seeing the appearance of a series of new services that start with the customer experience (contexts) connected through networks. In response to this, we will provide the optimal network environment for each service through solutions that use technologies, such as 5G (fifth generation mobile communication system), AI, IoT, and ecosystems. Moreover, we will provide the value of speed to accelerate the cycle from the startup of the service to its expansion. In addition to the know-how of IT and networks, NEC has the capability to create services, and we will co-create new businesses with our customers and support the Digital Transformation arising in all industries. We will connect people, things, and contexts in a productive way and contribute to the creation of new social value.

Atsuo Kawamura

Executive Vice President

After experience in developing software for digital telephone exchanges, he was put in charge of voice and data communication services and technical development for mobile carriers. In 2012, he was assigned general manager of the 1st Carrier Service Division, and in 2014, he was appointed senior vice president and supervised the SDN/NFV business. In 2017, he was promoted to executive vice president and is now head of NEC's network service business unit.



Connect as a partner through the next generation of information and the communication infrastructure

We are seeing innovative services using IoT and AR/VR,^{*1} and these are new customer experiences (contexts) made possible by connecting to the network, and the startup of new services and businesses in response to these changes is accelerating in every industry. At the same time, by connecting everything and combining businesses across different industries, we are seeing a rapid increase in the volume of information incomparable to what we have seen thus far, and networks are becoming more complex.

In preparation for the trend of such Digital Transformation and in addition to realizing the flexibility and efficiency of networks, NEC is working to create a network that can comfortably handle enormous volumes of data at high speed in high volume at ultra-low latency with multiple terminal connections through 5G. NEC is also working to provide solutions for the operation of networks using cutting-edge AI and verification technology to provide service platforms for realizing an optimal network and IT environment. Thus, working with telecom carriers and partners from a variety of industries, NEC is co-creating advanced services through intelligent networks leveraging 5G, AI, and IoT and creating new value.

Flexibly and efficiently connect for the speedy provision of a variety of services

With the rapid increase in the volume of information due to the use of smartphones, the adoption of cloud services, and the diversification in workstyles, lifestyles, and business models, the need to reinforce networks, maintain and use of network infrastructure, as well as the increasingly complex service processes, has already become evident.

In response to these issues, NEC leads the competition of hybrid network operations and management by end-to-end orchestration and management of resources and services in entire network in order to release telecom carriers from complicated network operations and management and as a result, improve the service level of end users. NEC has virtualized the network by linking SDN/NFV^{*1} to network operation and management system (OSS/BSS^{*2}), and provide network operations and management solutions and Network-as-a-Service solutions which realize a variety of services with flexibility. We have received favorable assessments for the ease of adoption into existing networks, and the speedy startup of services, and this service is being introduced globally to commercial networks. Additionally, by pursuing flexibility and efficiency through efforts, to automate solutions using AI, we can realize the speedy provision of services.

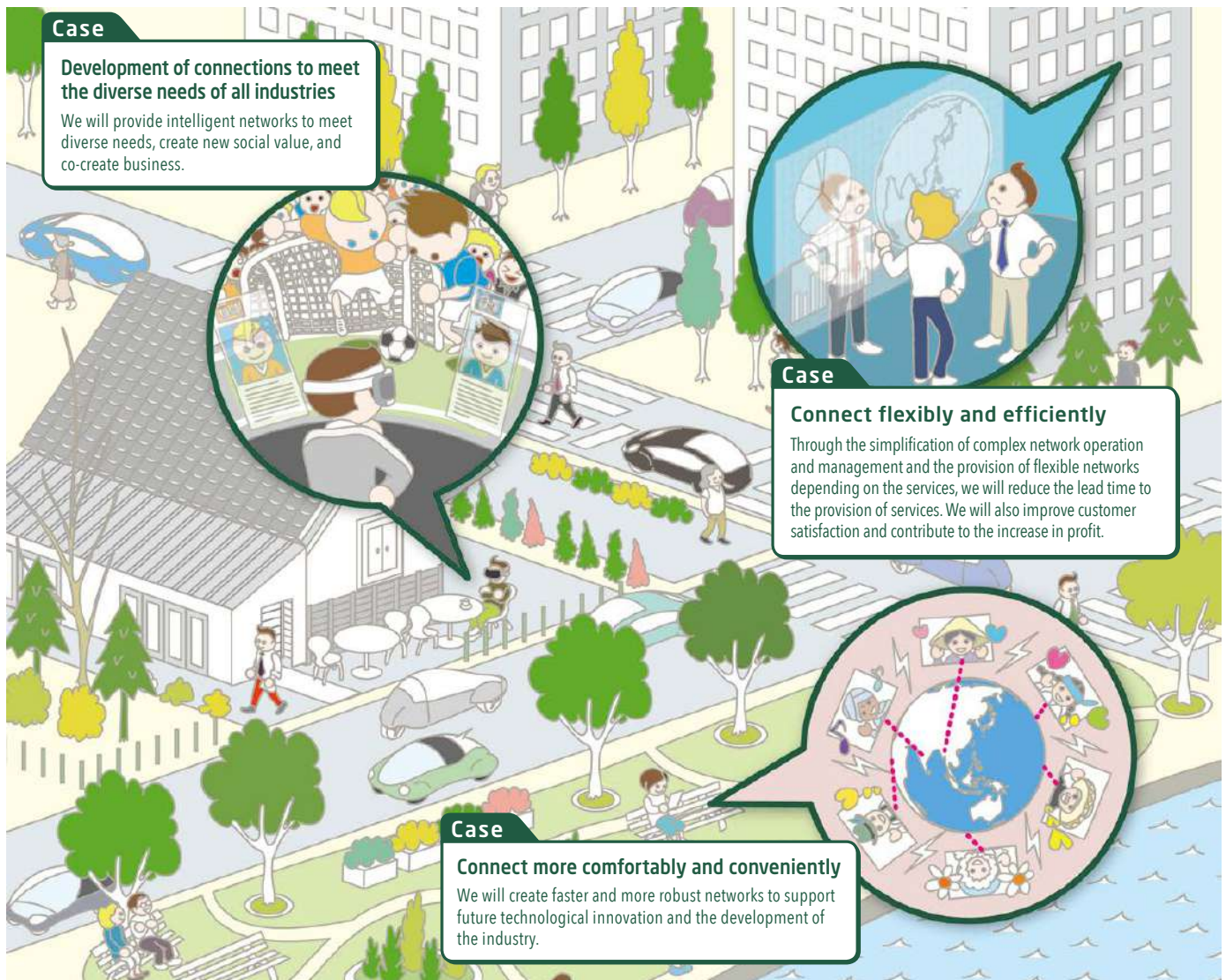
Connect in networks with a global track record

NEC has established a track record that serves as the basis for providing such connections. For example, in the areas of communications infrastructure, NEC's high-quality, highly trusted ultra-compact microwave radio system "PASOLINK" which has long been used as a mobile backhaul for telecom carriers, has been adopted in over 150 countries worldwide. Moreover, with our submarine cable system, NEC can handle the entire project from production to installation, and we have a track record of laying more than 250,000 km of submarine cable, which is the equivalent of six trips around the Earth. In the areas of service infrastructure, NEC has high ratings for OSS/BSS. Together with its US affiliate Netcracker Technology, we have provided services to more than 250 client companies worldwide in the past twenty years. NEC has continuously provided value that connects through our network, which is highly regarded worldwide.

Through the establishment of communications infrastructure networks and service platforms, NEC will continue providing value that connects people, things, and contexts in a productive way throughout the world. As a partner responsible for the next generation of information and communication infrastructure that will continue to support Digital Transformation, NEC will work with our customers in a variety of industries to create new social value and co-create business that will lead to the realization of these values.

^{*1} Augmented Reality/ Virtual Reality

^{*1} Software-Defined Networking/Network Functions Virtualization
^{*2} Operation Support System/Business Support System



Case study

Vodafone

Vodafone selects NEC/Netcracker's Hybrid Operations Management for domain orchestration

Vodafone Group has selected NEC Corporation and Netcracker Technology's Hybrid Operations Management (HOM) solution to support its transition into a telecommunications cloud provider. Vodafone will leverage NEC/Netcracker's HOM solution to provide domain orchestration as part of its groupwide cloud transformation program. This virtualization initiative will use cloud-native, SDN and NFV technologies to evolve operational and business systems and processes. NEC/Netcracker's HOM will support this initiative by orchestrating and managing end-to-end resources and services within Vodafone domains. "As we accelerate the transformation of our network and services to fully leverage cloud and virtualization, Orchestration and Automation plays a critical role in how we build and operate both the infrastructure and our business," said Fran Heeran, Head of Network Virtualization, SDN and NFV at Vodafone Group. "We selected NEC/Netcracker due to its deep understanding of both physical and virtual domains and its unique capabilities for hybrid operations across physical and cloud environments."



Services enhanced with 5G

Initiatives for the co-creation of advanced services leveraging 5G

NEC is collaborating with telecom carriers and industrial partners to create new services and businesses that capitalize on 5G. Together with NTT DOCOMO and ALSOK, NEC is conducting a trial^{*1} to provide advanced 5G security services.



This trial will verify the implementation of security services for preventing crimes and accidents in combination with ALSOK Zone Security Management®, featuring image analysis and AI-based security, as well as the advantages of 5G, including ultra-high-speed, large-capacity, low-latency communications.

In addition, NEC, KDDI Corporation, and Obayashi Corporation are conducting a trial^{*1} to carry out remote operation of construction machinery through 5G technologies. This trial aims to verify improvements in the efficiency and quality of remote construction when combining existing systems for remote control construction machinery with the large-capacity, high-speed transmission of high-definition video with low-latency.

Going forward, NEC will continue to develop and provide 5G solutions that enable enhanced transmissions and a diversified range of sophisticated services.

^{*1} These 5G trials are being conducted for the Ministry of Internal Affairs and Communications.

Point

- ▶ As a partner responsible for the next generation of information and communication infrastructure, we will co-create with our customers to achieve new social value and business.
- ▶ Realize the swift provision of a variety of services, improve customer satisfaction, and contribute to the increase in carriers' profits.
- ▶ Rated highly for the value we provide that connects people to other people, things, and society on a global scale.

Change driven by Digital Transformation- Transition from city operations to city management

We aim for the creation of people-centered societies and changes in societies based on the idea of city management through the merging of the real world and the cyber world.

Case

Contributing to disaster prevention and a reduction in disasters through information services provided in a timely and appropriate manner

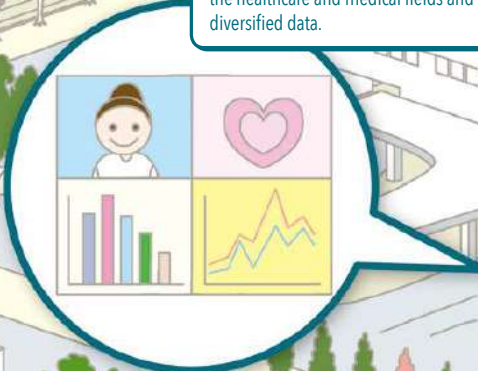
We contribute to the prevention and reduction of damage from disasters by providing an information service environment for community-based disaster prevention, such as an emergency radio communication system and a municipal radio communication system, to provide residents with information in a timely manner.



Case

Contributing to health promotion and the optimization of healthcare costs

We promote health, reduce the burden on medical staff, promote efficiency in hospital management, and optimize healthcare costs by using AI technology in the healthcare and medical fields and by connecting diversified data.



Case

Realizing a safe, secure living environment through the use of biometric identification

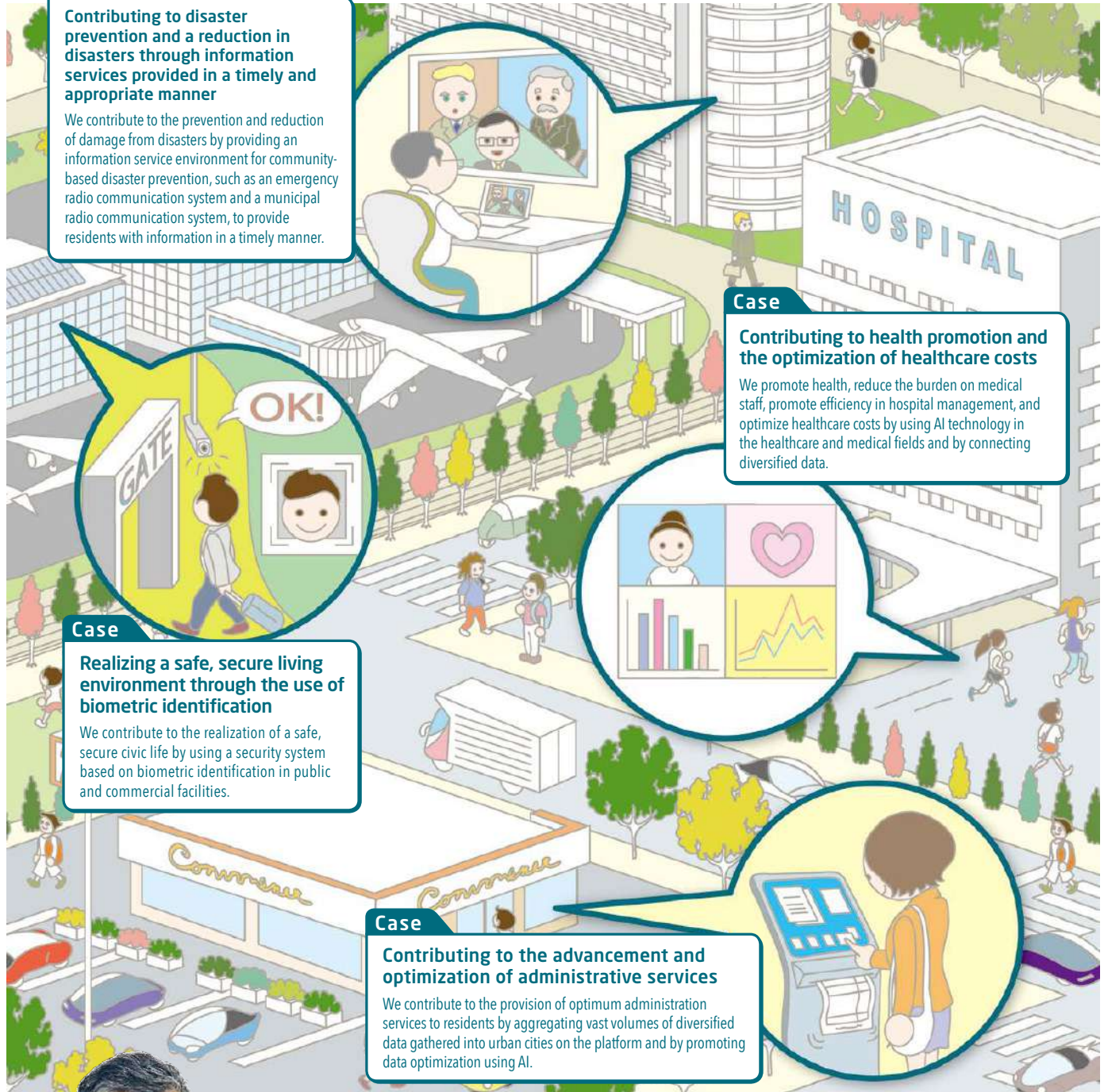
We contribute to the realization of a safe, secure civic life by using a security system based on biometric identification in public and commercial facilities.



Case

Contributing to the advancement and optimization of administrative services

We contribute to the provision of optimum administration services to residents by aggregating vast volumes of diversified data gathered into urban cities on the platform and by promoting data optimization using AI.



Promoting co-creation by self-assessing value

Chikara Nakamata

Executive Vice President

He was engaged in sales in the public sector, including government ministries and agencies, municipalities, healthcare facilities, and education. He was later appointed a Government and Public Sales Division general manager in 2013 and an executive vice president in 2017. He is currently responsible for domestic regional sales and business operations intended for public organizations.

We have provided government ministries, public agencies, and municipalities with mission critical systems. In a rapidly changing society, we must create new value by combining the data possessed by public and private organizations and, accordingly, by promoting co-creation beyond the existing boundaries of each organization. We also proceed with changes to promote the shift to new value by objectively assessing technologies, expertise, and networks of contacts. We create the value that meets the diversified needs of society, which ranges from policy proposals to services, in order to realize the shift from city operations to city management.

Realizing prosperous societies through the safe, secure social infrastructure connecting people and society

Connecting information in a people-centered way

Japan faces an increase in social security expenses due to the declining birthrate and aging population, and the provision of services through the efficient use of limited resources is required to meet diversified individual needs. In order to manage urban areas and cities in a safe, secure, people-friendly, and sustainable way, we must prosper urban city life by providing a variety of information related to urban areas and cities and connecting such information in a people-centered way. Over the long term, we have provided solutions for various industries, public sectors, and the field of education. We believe that we can solve the variety of issues related to urban areas and cities by connecting the information from each entity and creating new value using our experience, knowledge, and expertise. We strive to build a safe, secure, and efficient urban city infrastructure through co-creation with our customers and partners based on our long-standing experience in providing a full range of ICT solutions combining IT and networks.

Connecting real-world information in the cyber world through digitalization

Because of the large volumes of data and different data formats, connecting information is very complicated and difficult. Accordingly, a common platform for connecting information is essential. NEC can digitize a large volume of information using NEC the WISE IoT Platform and then visualize and analyze data and identify prescriptions through NEC the WISE. Moreover, NEC is the first and only Japanese company^{*1} to join the FIWARE Foundation, a non-profit organization promoting the dissemination of FIWARE Future Internet WARE (software suitable for public service collaboration) as a platinum member. NEC contributes to the efforts towards the acceleration of smart cities.

NEC can realize both people-centered and individually and socially optimized environments by enabling cross-organizational service collaborations through digitalization and connection to the real world using a common platform.

^{*1} As of September 2017

Creating what will become standard in the future through value chain and co-creation of value

Through the repetition of the value chain and co-creation of individually optimized services, unprecedented value that maintains a compatible balance between individually and socially optimized services will be created in urban areas and cities. NEC has the three aspects required for promoting a new value chain and co-creation. (1) We can create relationships to connect the various stakeholders using our experience of providing urban areas and cities with mission critical systems. (2) The relationships are based on trust in our company, which has contributed to the creation of safe, secure urban areas and cities through security solutions and other solutions. (3) We have the technologies and knowledge required to connect stakeholders through biometric identification technology^{*1} that is considered the best in the world for identification accuracy. We contribute to the shift from city operations to city management through Digital Transformation. We are creating what will become standard in the future through the promotion of the value chain and co-creation beyond connections.

^{*1} Based on the National Institute of Standards and Technology (NIST) Benchmark Testing of fingerprint identification and still image and video face recognition technologies.

Lisbon City, Portugal

To build a smart city infrastructure that centrally manages urban functions across Lisbon City.



NEC has been awarded a contract with Lisbon City for a Smart City Infrastructure Project, whose goal is to improve the quality of life of the citizens and enhance urban security. NEC will establish a smart city infrastructure, by using the Cloud City Operation Center^{*1} and integrating data collected from external entities and several departments of the city. NEC will support the process of Digital Transformation of the city by contributing to the achievement of a smart city through cross-integration of environmental data, data from various external entities, data from numerous municipal departmental applications, and data collected using IoT devices.

^{*1} A common platform system developed by NEC to visualize the network status and provide data analysis and simulation for industry-based smart services.

Case study

Case study of prefectural police agencies

Crime forecasting with ICT ensures safe, secure cities.



In March 2017, the Japan Tourism Agency announced the cabinet approval of a new Tourism Nation Promotion Basic Plan to realize a tourism-oriented nation.^{*1} Japan needs to promote urban planning for safer, more secure cities in pursuit of a plan to make the country more attractive to international tourists. NEC provides solutions by capitalizing on big data and cutting-edge technology to ensure safer, more secure cities. For example, NEC offers a crime forecasting system to Japan's police agencies, which prevents crimes by analyzing the combination of data associated with past crime situations and crime theory to forecast crime types as to when and where crimes are likely to take place. Based on the forecasts, the system suggests patrol routes so that police officers can allocate resources efficiently. NEC will continue to improve the accuracy of crime forecasting by combining different kinds of data, such as weather, temperature, and geographic information, with the goal of further promoting urban planning by means of ICT for safe, secure cities around the world.

^{*1} The Japan Tourism Agency website (http://www.mlit.go.jp/kankochu/news02_000307.html)

Point

1

We have a long-standing and proven track record of mission critical systems in different business fields and the public sectors.

2

We contribute to the creation of safe, secure urban areas and cities through the use of the world's No.1 biometric identification technology^{*1} and security solutions.

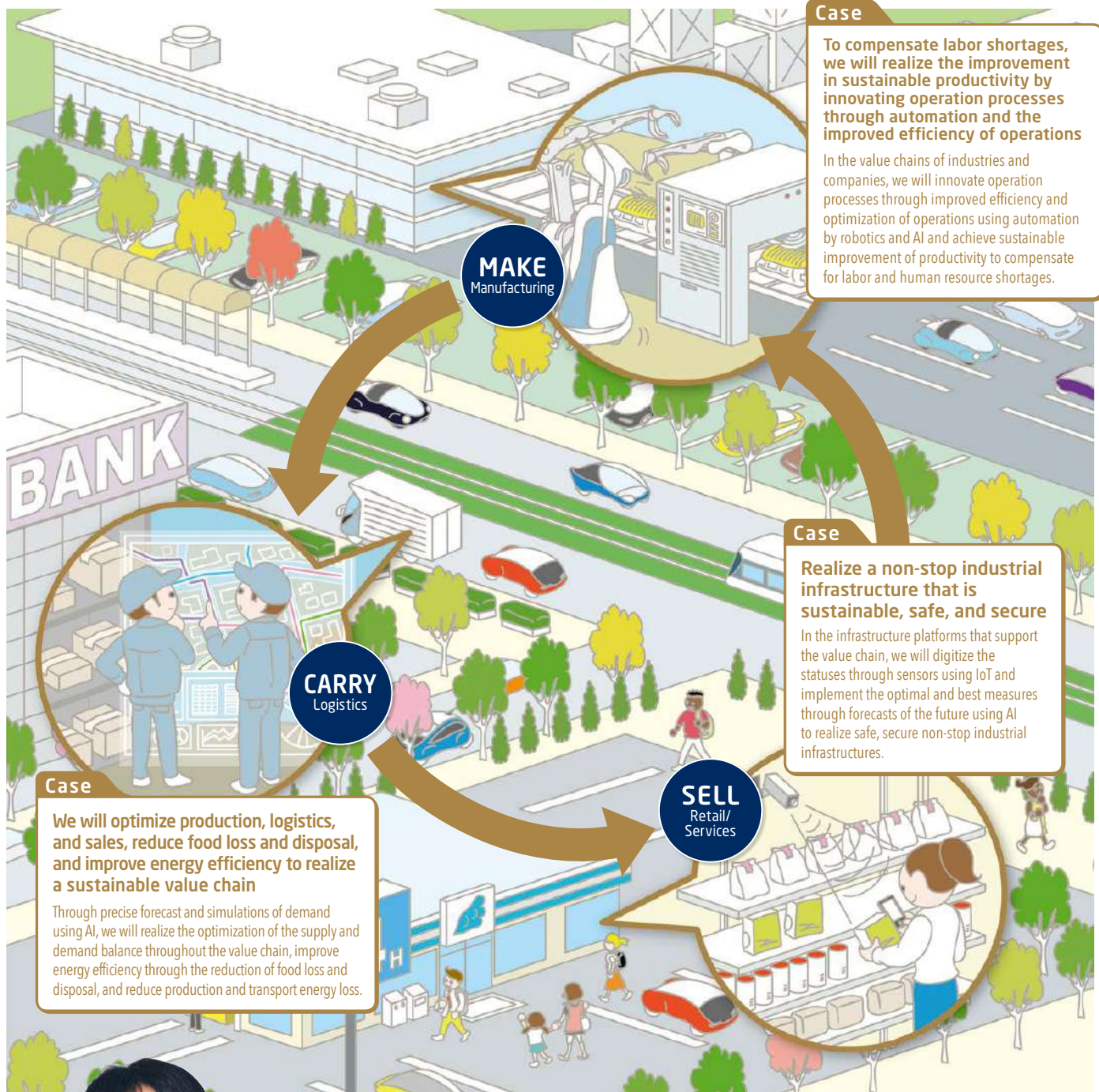
^{*1} Based on the National Institute of Standards and Technology (NIST) Benchmark Testing of fingerprint identification and still image and video face recognition technologies.

3

We contribute to a shift from city operations to city management by promoting value co-creation and the value chain through Digital Transformation.

Change driven by Digital Transformation- Transformation into a company and industry with sustainable growth capabilities

Through Value Chain Innovation, which creates social value by connecting people, things, and processes, we will realize the transformation into sustainable companies and industries.



Learn from the past, support the present and create the future

Hiroshi Kodama

Executive Vice President

Started his career at NEC with system integration services for retailers. In 2015, he was appointed senior vice president in charge of retail, service and transportation industries, and in 2017, assumed responsibility for digital strategy of the above territories. In 2018, he was appointed to be executive vice president supervising private-sector market including manufacturing, retail, service, and finance industries.

Learn from the past, support the present and create the future.

Through progress in the digitalization of AI and IoT, new businesses are being created. Through our high capabilities in computing, networks, security, and AI technology, as well as through cooperation with our partners, we can co-create solutions with our customers, and that is our strength. We at NEC will foresee social issues that will occur in the future and changes in the tides, support the entire value chain, resolve social issues as a provider of transforming platforms, and contribute to the development of a sustainable industry.

Resolve social issues through Value Chain Innovation and create new social value

Resolve social issues and create new value through Value Chain Innovation

In the industrial world, issues that must be handled from diverse perspectives, such as the issue of food waste, globalization of production, diversification of consumption styles and values, and the drop in the labor force from rapid changes in the population structure, are beginning to accumulate. To resolve these issues, it is necessary to transform the entire value chain formed by the cooperation between companies. This means, we must share information and the status on people, things, and processes throughout the value chain that were previously not connected and create Value Chain Innovation to create new value. To realize this requires broad knowledge and experience in the entire industrial world. NEC has the experience and know-how gained from providing a variety of solutions to the domestic and overseas manufacturing, logistics, retail and service, and financial industries over many years, and we believe we can realize Value Chain Innovation that will transform the industrial structure and create new value to resolve social issues.

Create new social value in MAKE, CARRY, and SELL

At NEC, we provide solutions for realizing Value Chain Innovation for companies in MAKE (Manufacturing), CARRY (Logistics), and SELL (Retail/Services) that form the value chain based on our past performance over many years and our cutting-edge AI and IoT technology. NEC will lead the way to Digital Transformation in the manufacturing industry using the knowledge gained from our own manufacturing innovations, and the verification and implementation of IoT. For the logistics industry, we will implement the visualization and optimization of transport, improve efficiency, and save labor in the delivery inspection processes to realize improved efficiency in energy consumption. For the retail industry, we will provide innovative customer experiences through future stores realized through Digital Transformation. We will also improve the efficiency of store operations, reduce loss, and build non-stop store infrastructure to create new value in store operations. Through Value Chain Innovation, NEC will create new value for the industrial world and resolve social issues.

Create connections with customers and realize a society to enrich people's lives

NEC aims to realize a society to enrich people's lives through Value Chain Innovation. We believe that being the first to catch changes in needs, responding to diversifying threats, creating a safe and rewarding environment where diverse human resources work in harmony with robotics and AI, and building non-stop industrial infrastructure will support the sustainable growth of companies. At the same time, Earth's resources are limited, so it is the responsibility of the industry to realize production and sales in the appropriate volume and optimal logistics and work to reduce resource and energy loss. For the sustainable growth of companies and coexistence with the environment, NEC is utilizing cutting-edge ICT, such as AI and IoT to co-create new social value with our customers. We believe that the sustainable growth of companies protects the safe, secure basic infrastructure of daily life and provides optimal tools for a variety of lifestyles to support a prosperous and fair society.

Case study

Godfrey Phillips India

NEC provides the headquarters and store systems for one of the largest convenience store chains in India.



NEC developed the Enterprise Resource Planning (ERP) system and POS terminals designed to support the headquarters and store operations of Godfrey Phillips India (GPI), an operator of one of the largest convenience store chains in India, Twenty Four Seven. NEC leveraged the knowledge it accumulated through system development for convenience stores in Japan to develop additional applications and functions for more efficient store operations and to further streamline operations. The Microsoft cloud-based ERP, Microsoft Dynamics 365 for Retail, was used as the base system. Moving forward, NEC accepts contracts for the planning, development, introduction, and maintenance of ICT systems for retail stores from start to finish to underpin non-stop services for every day of the year. NEC is committed to the business growth of overseas retail corporations for a more affluent, efficient society.

Building Book Center Co., Ltd.

NEC's high-speed, high-precision image recognition technology helps streamline and speed up shipment inspection operations.



Building Book Center Co., Ltd., (BBC) is a distribution company that handles the publications of the KADOKAWA CORPORATION Group. BBC receives freight, manages inventory, and ships orders for several websites that handle nearly 15,000 publications, anime, and popular idol merchandise. Although it has been difficult for the distribution industry to secure human resources, the challenge is to ship orders promptly while raising the precision of product inspections. To overcome this challenge, BBC introduced the NEC Warehouse Product Inspection System. This solution allows users to automatically inspect multiple products at the same time. The system is constituted by verifying preregistered product information with the images captured by a camera set up at an inspection line along with weight information on products. The automation of inspections enabled smooth operation by one staff member, which allows allocation of the work force for manual operations. NEC is committed to providing IoT solutions to support the next generation of logistics in the future. Our goal is to help corporations increase competitiveness and create new value for consumers.

Point

1

We will resolve social issues through Value Chain Innovation.

2

We will transform the value chain for MAKE, CARRY, and SELL for the future.

3

We will work with our customers and co-create a society to enrich people's lives and contribute to the development of the industry.

Co-creation of social value

Introduces NEC's co-creation approach from issue identification and solution development to value creation together with customers and partners.

Social Value Creation processes

Co-creation at NEC

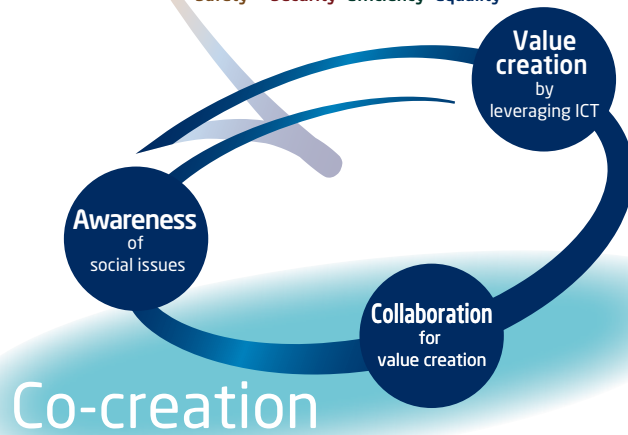
NEC focuses on Solutions for Society to solve the issues that the world faces to create a brighter and more prosperous society. We are positively engaged in generating new business models, and we aim to create social value that makes maximum use of ICT strength through co-creation with customers, business partners, citizens, government, and international organizations.

Social Value Creation processes through Co-creation

In co-creation, NEC pursue with customers and business partners the *Awareness* of social issues, where we start by identifying substantive social issues; *Collaboration* for value creation, where we connect to the people we need to solve the issues; and *Value creation* by leveraging ICT, where we generate new business models with advanced ICT to create social value.

Orchestrating a brighter world

Social values achieved by co-creating with customers



Co-creation

Social Value Design
Lean startup
Open innovation
Partnering, etc.

System integration services

Consulting
System integration
Operation and maintenance services
Financing, etc.

ICT assets

Computing
Networking
Security
AI and IoT, etc.

How to create value

Social Value Design, which supports NEC's Co-creation

Social Value Design is NEC's design policy for social value creation. It leads to innovation in customers' businesses and the future society from two points of view: *User Experience*, which considers the experience of the people, and *Social Experience*, which explores an ideal society.

Social Value Design



User Experience

Improving value from the point of view of people



Innovation

Creating value from the point of view of people and society



Social Experience

Improving value from the point of view of society

Universal design

Co-creation

Design thinking
Human centered design

"Creating New Value" for societies and for customers

Joint initiatives between NEC and customers for the future

We achieved results from co-creation challenges in fields beyond the borders of industries.

GE Digital

GE Digital and NEC collaborate to drive digitization

In the infrastructure and industrial areas, which support society, improvements in productivity and operational efficiency are vital for sustainable growth. To fully utilize the power of IoT in improving operational efficiencies, NEC considers enough knowledge of physics and industrial operations is essential.

Therefore, we partnered with GE Digital who has extensive knowledge of industrial equipment and field operations cultivated in GE's wide range of industrial business experiences.

NEC now offers an Image Recognition Services using Fingerprint of Things recognition, one of the cutting-edge AI technologies in NEC the WISE, as a micro- service for GE Digital's industrial IoT platform Predix.^{*1} This service manages

even the small parts that have been difficult to attach barcodes and install RFIDs to improve the production efficiency of manufacturers. NEC and GE will keep demonstrating new value by integrating industries and ICTs, improving the productivity of companies, and helping achieve sustainable growth in infrastructure and industrial areas to support society.

Julian Loren

GE Digital Director of Strategy & Innovation for Ecosystem and Channels

GE has a strong partnership with NEC, which has in-depth expertise in system integration and vast experience in the advanced technologies of AI and IoT. By linking the identification data

collected with NEC's sensing technology and image recognition technology to the data obtained with GE's IIoT (Industrial Internet of Things) platform Predix, a new possibility has been created for further cost reductions by manufacturers. We will use the partnership with NEC and lead the efficiency and productivity of industrial areas to a new and higher level on a global scale.



^{*1} Predix connects devices to GE Digital's applications to collect and analyze data. This cloud-based platform for industrial applications increases the performance of devices and optimizes the overall production process.

Kagome

Co-creation with Kagome to expand the possibilities of agriculture

The tomato is the most consumed vegetable in the world; however, producers and processors are currently facing a major challenge as to how they can predict yields in order to respond to increasing demand due to rapid population growth and drastic climate changes.

In order to respond to this challenge, NEC Corporation and Kagome Co., Ltd., have jointly developed the "Overseas Large-Scale Farming Analysis Solution", which creates virtual fields on computer based on a vast amount of farmland information, such as data obtained from various sensors, as well as farming activity data, and then carry out growth simulations to predict yields and appropriate harvest times. The results of the tests conducted utilizing this solution include the development of optimized

cultivation methods for each field and the accurate prediction of yields and appropriate harvest times. It leads to the maintenance of stable production, the reduction of crops to be disposed of, and the optimization of the supply chain where consumers can obtain the required products in the required quantity at the required time.

We strive to promote the global deployment of the solution jointly developed by NEC and Kagome to realize sustainable agriculture and contribute to the optimization of the supply chain to build a sustainable society.

Kengo Nakata

Head of KAGOMEAGRI-BUSINESS RESEARCH AND DEVELOPMENT CENTER, UNIPESSOAL LDA
General Manager, Global Tomato Company, Kagome

NEC's proprietary big data analysis technology offers the broad knowledge required for agricultural development. It enables the visualization of farmland information utilizing data obtained from sensors, drones, and satellites, carries out growth simulations and proposes optimized cultivation methods. The most recent test resulted in a 10% increase in crop yields through the utilization of cultivation methods based on the analysis. In the future, we plan to increase crop yields by 10% or more while reducing the amount of fertilizer and water used.



Kochi University

Efforts for the development and application of therapeutic cancer peptide vaccines

NEC is engaged in the drug discovery business using AI technology in the medical and healthcare field. In 2016, NEC established a venture company called Cytlimic Inc. in order to promote the clinical development and application of therapeutic cancer peptide vaccines discovered through collaborative research with Yamaguchi University and Kochi University.

In the process of developing therapeutic cancer peptide vaccines, the efficiency of discovering peptides binding to HLA types, which are different for each person, from among approximately 500 billion combinations of amino acid sequences is expected to improve through the use of machine learning. Accordingly, co-creation between NEC,

which has leading-edge expertise in machine learning, and Keiko Udaka, a professor of Kochi University, who is researching the immune functions of T cells (T-lymphocytes), has commenced. The key data on binding has been measured according to a comprehensive and exhaustive experiment plan using machine learning, and high-quality data has been provided by Professor Udaka. As a result, we successfully achieved predication accuracy of 93%. NEC will accelerate cancer drug discovery research in collaboration with Kochi University.

Keiko Udaka

Professor, Department of Immunology, Kochi Medical School

In the process of developing therapeutic cancer

peptide vaccines, I have thoroughly focused on obtaining accurate data from experiments on binding peptides. NEC's machine learning allows me to produce highly accurate results faster than ever before; accordingly, I have successfully made significant progress in the development of the vaccines. In the future, I will work with NEC to realize the provision of next-generation peptide-immunotherapies as soon as possible in order to deliver new treatment to patients and build a mechanism for enriching medical information resources in Japan.



The seven themes for social value

Sustainable Earth

NEC is working on the realization of a sustainable society through efficient and equitable distribution of limited natural resources and by preparing for potential threats to living in harmony with the Earth.

For example

Social challenges:

Depletion of natural resources due to forest fires.



NEC's approaches / solutions:

Fire alarm and rapid-response support system by capitalizing on the temperature monitor technology of infrared cameras.



Customer value:

The realization of extensive measures against forest fires that are invisible to the human eye.

Quality of Life

NEC promotes an equal and prosperous society that embraces diversity to support all individuals to play an active role through preventive medicine and by constructing educational environments.

For example

Social challenges:

A lack of medical personnel.



NEC's approaches / solutions:

Cloud-based medical interview and diagnostic support services.



Customer value:

Streamlining operations of medical personnel and balancing a high level of patient-oriented medical services.

Work Style

NEC will design diverse work styles that are free of the boundaries of generation, gender, nation, and organization, and people will cooperate even with AI and robots to create high-quality jobs and employment.

For example

Social challenges:

Enhanced productivity for each person.



NEC's approaches / solutions:

NEC Software Robot Solution for promoting the replacement of routine tasks.



Customer value:

Humans and robots work in harmony to allow humans to shift to high-value-added tasks to improve productivity.



Industry Eco-System

For example

Social challenges:

Food loss and waste reduction.



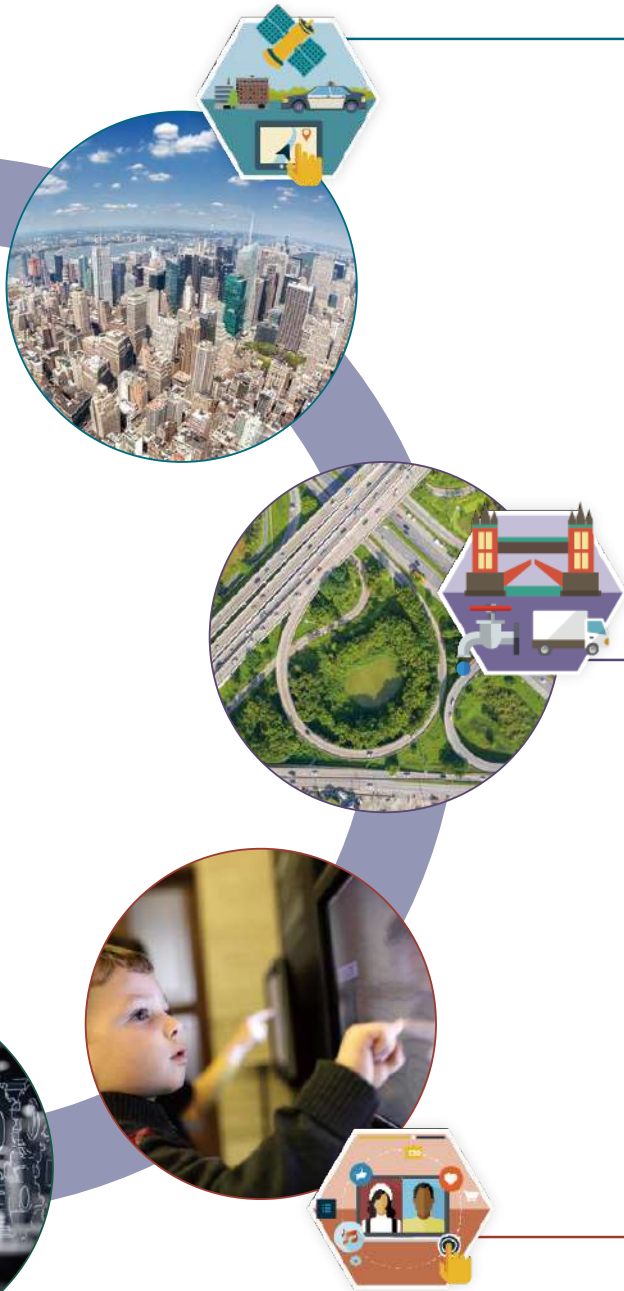
NEC's approaches / solutions:

Demand forecasting solutions by utilizing NEC the WISE.



creation -To achieve sustainable society-

On this website, you will find what steps we are taking for social value creation in detail according to theme.



Safer Cities & Public Services

NEC joins hands with citizens, industry, government, and academia to realize safer cities and public services and contributes to sustainable city management that allows the cities to demonstrate their regional appeal.

For example

Social challenges:

Protection of public safety.



NEC's approaches / solutions:

The automated border control system using our biometric identification technology*¹ with the world's No.1 accuracy.

*1 Based on the National Institute of Standards and Technology (NIST) Benchmark Testing of fingerprint identification and still image- and video- based face recognition technologies.



Customer value:

Realizing increased efficiency with smoother border control while enhancing security and crime prevention.

Lifeline Infrastructure

NEC leverages its advanced and flexible ICT system to close the gap between regions to realize an uninterrupted infrastructure 24 hours a day, 7 days a week.

For example

Social challenges:

Stable supply of energy.



NEC's approaches / solutions:

Malfunction prediction monitoring system by utilizing NEC the WISE.



Customer value:

Monitoring 24 hours a day, 7 days a week ensures uninterrupted services and stable energy supply.

Communication

NEC contributes to the construction of a value creation network that supports the distribution of information and knowledge with increasing importance as society becomes more advanced.

For example

Social challenges:

Response to sophisticated and diversified services.



NEC's approaches / solutions:

SDN/NFV solutions for operating and managing the entire network at once.



Customer value:

NEC offers various swift services by providing a flexible and highly efficient network and an array of solution menus that uses partnerships.

By creating a platform for the sustainable growth of corporations and promoting co-creation, NEC is working on the realization of Value Chain Innovation.

Customer value:

Through elaborate demand forecasting in the food value chain, production volumes and order quantity are optimized to address food loss and waste reduction.

What's **Technology Vision**?

Continuously seeking technologies to create social value

NEC will provide new value through Digital Transformation while resolving the problems facing the world, society, and customers. In the past, NEC promoted the creation of social value based on ICT, but taking advantage of digital data has become even more important for the future. We identified three major processes in the use of digital data. The first process is digitizing the real world and visualizing

it in the cyber world. The second is to analyze the problems of the real world using the captured digital data. The third is to apply prescriptions based on the analysis results to the real world in order to achieve new value. The three types of AI that support this series of processes are recognition AI, prediction and optimization AI, and reasoning AI—NEC will strengthen AI technologies to a level that exceeds human capabilities to

solve particular problems. For example, the technologies of recognition AI help to understand the real world by employing a wide range of information that humans cannot perceive from infrared or millimeter waves that are outside the five human senses to vast amounts of advanced information from high-speed camera imaging. In addition, we develop secure ICT platform technologies that execute

Technology Vision

Data science



Recognition AI

Realizes a deep understanding of humans and things by combining a wide variety of sensors

Today, sensor technology is growing; therefore, it is possible to bring together a space that humans cannot recognize directly with information that far exceeds the five senses or human cognitive abilities into the cyber world. By applying advanced AI to this vast volume of information, NEC makes it possible to capture information that people cannot grasp at a deep level inside a thing or a human. NEC's face recognition technology is capable of reconciling a picture taken ten years ago with a current image for authentication that is independent of race and age, as well as identifying individuals hidden by makeup or a malicious disguise. This technology has been evaluated as the best performance in the world by the National Institute of Standards and Technology (NIST) in the United States. In the future, we will further develop recognition AI technology to recognize more in-depth information, such as a person's psychological state. This will help to prevent crimes instead of just finding a suspect after an incident.



Prediction and optimization AI

Automated technology achieves complex data analysis that does not rely on experts

NEC is focusing on the social solutions business, but it cannot solve many problems at the same time because of the limited number of data scientists who can analyze the data with customers. Thus, NEC will develop advanced automated technologies that can easily perform the data analysis without the support of experts. We will also develop optimization technology to control the system while predicting the changes required in the target system. These technologies enable dynamic prediction and optimization in response to ever-changing situations. For example, AI automates order processing by efficiently generating the demand forecast model of thousands of products in a retail store in a short period of time in order to increase the overall profitability of the store.

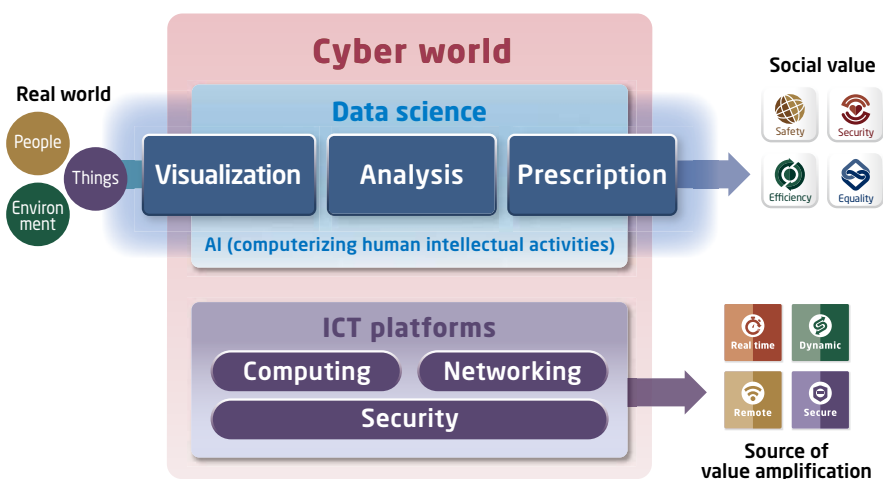


Reasoning AI

Supports decision making by presenting appropriate suggestions and reasons based on fragmented information

Many social issues are unknown problems without big data or complex problems that could have several possible answers. To solve such problems, the final decision must be made by humans based on the advanced assistance of AI. NEC will develop reasoning AI that learns while taking associations among information into account to create and validate huge numbers of hypotheses at high speed. This enables AI to solve complex problems by presenting appropriate suggestions or reasons to people even if the AI only has fragmentary knowledge or observational information. For example, even in the event of an unprecedented cyberattack, reasoning AI can offer appropriate suggestions to security analysts for a rapid response to the attack.

these AI processes at low cost. In order to commercialize these technologies as useful solutions for society, global value co-creation is essential. Through these research and development activities, NEC aims to realize a prosperous, bright society in which AI and people can cooperate to provide greater value.



Technology Vision

ICT platforms



AI platform

Streamlines the learning process while managing hardware

AI processing is broken down into two phases: learning and inference (execution), and in many cases, the computational load of learning is enormous. For example, image recognition requires learning about 10 million images in a week in advance; actual recognition processing takes approximately 0.1 seconds to complete. NEC will accelerate the learning process in AI using a variety of appropriate hardware, including a GPU that is suitable for high-speed deep learning, a vector processor with wide memory bandwidth suitable for machine learning other than deep learning, and a FPGA with a performance per unit power consumption that is about 100 times better than a CPU. This improves the processing capacity by two digits and allows the learning processes to take place on a single server that previously required dozens of servers.



Security

AI and the digital twin ensure the safety and security of life

Cyberattacks are becoming more sophisticated, and the attacks extend to the physical systems, such as commercial facilities, in addition to public services that provide electricity, gas, water, and sewerage. The attacks are diversified and often use internal crime. In order to protect a system that must not have its supply terminated against a variety of attacks, it is important to take advantage of the digital twin, including the physical system and people, to enhance security measures by continuously implementing a huge number of simulated attacks as predicted by AI and simulated defenses as created by AI. In addition, it is critical to encrypt the communication and authenticate the IoT device to prevent the invasion of a virus. NEC will take advantage of AI and the digital twin with authentication encryption technology that passed the second screening in an international competition. As a result, perfect security measures are being implemented that would be impossible to implement manually in a system.



Data sharing platform

Shares a wide variety of data to make the entire society more efficient

The sharing of data to promote the use of public data will become increasingly more important as the driver in transforming society in the future. However, most private data cannot be easily shared because of privacy protection or conflicts of interest. NEC has achieved computation technology that can conceal the original data, which is more than ten times faster than any other company's method. The combination of this computation technology and a system to ensure the safety of programs makes it possible to leverage private data without worrying about data leaks. We will provide this system as a data-sharing platform so that efficiency across the entire society can be improved for the development of new pharmaceuticals, efficient transportation solutions, and reduction of losses in manufacturing and logistics.



The future of corporate wellness - a healthtech perspective

- Please tell us about the circumstances that led to this collaboration between FiNC and NEC in the healthtech sector.

Nakano: NEC was considering collaborations with companies that have superior know-how regarding health risks with the aim to improve efficiency and quality in medicine utilizing AI and IoT technology in the healthtech sector. FiNC has B2C channels in this area, so they are an ideal partner.

Mizoguchi: Improving the health of individuals will surely lead to improvements in productivity. We believe it is necessary for a company to create a system for supporting the health of their employees as an important part of their management strategy.

Nakano: What can we do to maximize the performance of employees? This is an issue that NEC is also facing.

- Are there currently any obstacles for the spread of corporate wellness in society?

Mizoguchi: We do not yet have a clear index for corporate wellness. Our first step must be to construct this management index. By collaborating with partners and conducting verification studies based on common metrics, we will be able to explore future possibilities from all angles.

Nakano: The actual solutions provided by FiNC have extremely high utilization rates. By combining this with the cutting-edge AI technology of both companies, we can expect an even higher synergistic effect. When each



employee improves their mental and physical health, the effects will spread to their families and the local community. By expanding corporate wellness, we hope to contribute to the spread of more diverse lifestyles and workstyles.

Left : Yuji Mizoguchi

Began working as a fitness trainer while still in high school. In addition to working as a trainer, he was also the youngest consultant in the fitness industry. Founded FiNC in April 2012. Board member of the Japan Society of Anti-aging and chosen in Nikkei Business's "Best CEO as Selected by Young CEOs" and "Top 30 People Creating Japan's Tomorrow."

Right : Hiroaki Nakano

After joining NEC, he experienced the planning and development of new businesses in the financial market, he is currently in charge of the expansion of the healthcare business in Japan and overseas. He is also currently juggling parenting responsibilities at home.

**Creating social
to contribute
to the**

NEC employees
various fields
creation of



Hearable devices open the way to new user experiences

- What are hearable devices?

Furutani: The concept of these devices is a *hands-free and eyes-free computing style*. Since they can be worn in the ear like a wireless earphone, both hands are free, and since there is no operation screen, nothing occupies your line of sight and prevents you from living your life. Additionally, it is possible to conduct personal authentication using the acoustic characteristics of the ear and to maintain a continuous internet connection, so you can constantly sense the conditions of a particular user.

Ando: When you think of interface as speaking and listening, we must think about how accustomed to the technology the individual is and the culture and how it might affect the experience. Nowadays, we see more people using earphones and a mic when talking instead of holding the phone up to the ear. Perhaps the foundation for the spread of hearable devices is already in place.

Left : Masaya Ando

PhD (Doctor of Philosophy). He teaches and conducts research in the areas of user experience, human centered design, and ethnographic design approaches. Chair of the draft committee for JIS standards relating to human centered design.

Right : Satoshi Furutani

After joining NEC, he was involved in the planning and social implementation of products and services to connect people and cyber technology, and he is currently in charge of expanding business in Japan and overseas as the manager of the hearable business. His hobby is traveling solo on his motorcycle.

- Please tell us about the potential of hearable devices?

Furutani: Since the devices can read the context of the user and provide information at the appropriate time, we believe this will expand the scenes in which services can be used.

Ando: To prevent users from feeling the information is an unwelcome favor, it is necessary to understand the user's attitude towards everyday actions. Services provided on hearable devices

can continuously monitor the user's behavioral characteristics, so I see high potential for these services.

Furutani: Eventually, we would like to establish an optimized computing style to connect the real world with the cyber world. Hearable devices that can give users free use of both hands and eyes and provide timely and personalized information will bring about innovation in services and workstyles.



- Please tell us about the circumstances leading to the adoption of NEC's AI technology.

Yamamoto: In the past, we relied heavily on the experience and intuition of experienced personnel, but this was not the type of know-how that anyone could easily pick up. We considered the adoption of AI to make it possible for personnel with limited experience to make forecasts, enable rapid decision-making, and optimize product plans and inventory.

Kanie: With the forecasting of demand and price optimization based on NEC's big data analysis, it is now possible to make proposals for optimal price sales promotion solutions and measures for retail chains that are more

persuasive. The team has conducted various discussions to give shape to ideas about how this can be used to achieve results. In addition to helping them adopt the technology, we must understand the issues with the customer's operations, and we rack our brains every day trying to make improvements.

Yamamoto: I believe that the key to the future of this project is seeing how far we can maximize value by combining our knowledge. We hope that everyone at NEC will continue to give us their frank opinions and proposals as part of this team. We are still working on individual optimization, but in the future, we hope to expand the utilization of AI technology to the entire Group from the perspective of

overall optimization.

Kanie: We are experiencing for ourselves the difficulties everyone in the operations departments face in utilizing the technology, and the entire team is working together to take on this challenge. The project for forecasting demand for new products with the aim of optimizing inventory levels and the project for demand forecasting and price optimization aiming to contribute to the increase in sales in the retail chain are currently underway. In the future, we will link and develop these two projects so that NEC's technology and knowledge can contribute to business expansion for the entire Asahi Breweries Group.



Accurate demand forecasting through AI technology

Left : Kaoru Yamamoto
Deputy Manager, Digital Strategy Department, Corporate Planning Headquarters, Asahi Breweries, Ltd.
After working in a variety of departments, including marketing research, corporate planning, and being sent on loan to the Cabinet Office, she was appointed to this current position in September 2014. She is mainly in charge of efforts to use AI and big data and is involved in the planning of the entire digital strategy. Member of the Data Analytics Study Group of the NEC C&C System Users Association.

Right : Shizuka Kanie
Since joining NEC, she has been in charge of the Asahi Breweries account. She is responsible for proposing improvements for the customer's management and operation issues and aims to act as a bridge to connect them to NEC's technology and human resources. In the future, she aims to contribute to the commercialization of NEC technology globally. A hobby that she shares with Ms. Yamamoto is nail art.

Read entire article



Toward the realization of a resilience city

- Could you tell us about the Wellington Resilience Strategy?

Hamilton: So that Wellingtonians can better prepare, respond, and recover from disruptions,

Julia Hamilton
She is part of the Community Services Team, Wellington City Council and is focused on improving community wellbeing. She is a specialist in CPTED (Crime Prevention through Environmental Design) and leads a number of strategic and collaborative projects across the city in which integration of data and informed decisions are essential to improved community outcomes.

we co-designed the strategy by working with hundreds of them.

The strategy has three important goals - that people are connected, empowered and feel part of a community; that decision making is integrated and well informed; and that our homes, natural and built environment are healthy and robust.

Packer: Wellington City and NEC developed a partner relationship to make the city more resilient by addressing the latest challenges faced by the city and learning together to create a smart city for the future.

- How do you make Wellington smarter and safer by using IT?

Hamilton: We are developing an online information hub with a wide range of data on Wellington that can be used by citizens to make decisions. We are also developing a VR model to provide information on the status

of the city using the technologies of 3D and AR and VR. NEC's technologies, planning, and support are invaluable in making Wellington City more resilient.

Packer: Using new modeling and visualization technologies and other ICTs, NEC helps citizens, cities, and central governments make more informed decisions. The efforts in Wellington City can be applied to other cities as well, and with the base established here, we anticipate many more innovations.

Tim Packer
NEC head of smart city solutions. Based in Wellington, New Zealand, Tim and his team are working with cities, as partners and co-designers, to develop solutions that advance City livability and sustainability. By providing a more holistic view across the social, economic and ecological environments Tim's team help cities make more informed decisions.



NEC's history of innovation

1899	Nippon Electric Company, Limited is established. (July 17)	 Kunihiro Iwadare, the founder of NEC	2007	The PASOLINK ultra-compact microwave communications system achieves the world's top share.	
1928	NE-Type phototelegraphic equipment transmits Emperor Hirohito's Imperial Accession Ceremony from Kyoto to Tokyo.		2008	Trans-Pacific (Japan - US) demonstration of programmable flow switch succeeds.	
1964	Trans-Pacific TV broadcasts of the Tokyo 1964 Olympics using NEC-supplied ground facilities for satellite communications.		2010	Asteroid explorer <i>HAYABUSA</i> returns to Earth.	
1970	Japan's first experimental satellite, <i>Osumi</i> , is developed (for the Institute of Space and Astronautical Science of Tokyo University).		2014	NEC's Solutions for Society brand message "Orchestrating a brighter world" is released.	
1974	The ACOS Series 77 mainframe computer family is announced.			Asteroid explorer <i>Hayabusa2</i> is launched.	
1977	C&C, the integration of computers and communications, is first announced at INTELCOM '77.	 Koji Kobayashi, then-chairman of NEC, giving a lecture at INTELCOM '77	2015	NEC's Face Recognition technology wins the Education, Culture, Sports, Science and Technology Minister's Award at the 3rd Technology Management & Innovation Awards.	
1979	The PC-8001 personal computer is announced.	 Demonstration at Bit-INN		NEC develops the world's first interface supporting the ONF's Real Time Media NBI REST Specification. ONF: Open Networking Foundation	
1991	NEC discovers a unique graphite crystal structure and names it "carbon-nanotubes."		2016	NEC's artificial intelligence (AI) technology brand "NEC the WISE" is established.	
1995	The world's first 1G bit DRAM is developed. (The world's first 4G bit DRAM is developed in 1997)	 NEC 1 Gbit DRAM		Construction on Angola Cables' South Atlantic Cable System (SACS) commences.	
2002	The world's fastest supercomputer, the Earth Simulator, is completed (for evaluating global environmental issues).			World-first development and verification of SDN technologies to provide a stable telecommunications environment within a wide area network.	
			2017	Face recognition technology obtained first place for four consecutive years in the evaluation task sponsored by the NIST. (National Institute of Standards and Technology)	
				Received Cutting-Edge Technologies to Pioneer Creativity Award for eight consecutive years.	
				Participated in FIWARE Foundation as a platinum member.	
			2020	Asteroid explorer <i>Hayabusa2</i> scheduled to return to Earth.	

NEC named to the "Global 100 Most Sustainable Corporations" list for 2017

NEC was selected as the "Global 100 Most Sustainable Corporations in the World," an index listing the world's 100 most sustainable corporations. This marks the third time NEC has been selected as one of the Global 100, following an announcement at the World Economic Forum held from January 2017 in Davos, Switzerland. The Global 100 index has been published annually since its establishment in 2005 by Canadian publisher Corporate Knights Inc. The Global 100 were

evaluated and selected from among approximately 4,900 corporations around the world based on efforts made on twelve quantitative key performance indicators related to sustainability. NEC is one of four Japan-based corporations selected for the list. As a social value innovator, NEC will continue leveraging ICT to resolve challenges facing society as it aims to achieve the Sustainable Development Goals (SDGs) adopted by 193 UN members in 2015.

NEC Future Creation Forum

NEC Future Creation Forum is a venue in which intelligent minds and experts from around the world gather to conceive and discuss about the ideal future and how to solve the challenges for its realization based on the development of future technologies.

<https://future.nec/en/>



Dr. Michio Kaku,
Professor of Theoretical Physics,
City College of New York



Ryojun Shionuma,
Chief Priest,
Jigenji Temple



Kevin Kelly,
Founding Executive Editor of
Wired magazine



Yoshiharu Habu,
Professional
Shogi Player



Yutaka Matsuo,
Project Associate Professor,
Graduate School of Engineering,
The University of Tokyo



Chiki Ogiue,
Commentator



Chiaki Hayashi,
Co-founder and Representative
Director Loftwork Inc.


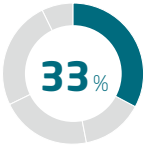

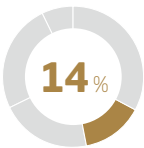

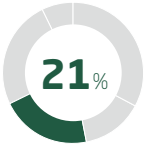

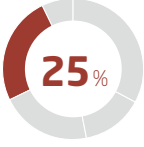

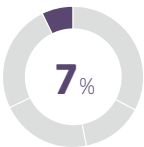


Katsumi Emura,
Chief Technology Officer,
NEC Corporation

At a glance

NEC Corporation and Consolidated Subsidiaries

Revenue, operating profit (loss), and composition of revenue are financial results for the fiscal year ended March 31, 2018 (IFRS).

Public Business				
	Revenue	939.1 billion yen	Composition of revenue	
	Operating profit	54.4 billion yen		
	Public Solutions		Main customers	Public, healthcare and regional industries
	Public Infrastructure		Main customers	Government and media
Enterprise Business				
	Revenue	408.7 billion yen	Composition of revenue	
	Operating profit	35.7 billion yen		
	Main customers	Manufacturing, retail and services, and finance		
			Key Initiatives	<ul style="list-style-type: none"> Expansion of applicable fields for My Number system utilization Business creation for regional revitalization through industry, government and academic partnerships
Telecom Carrier Business				
	Revenue	579.7 billion yen	Composition of revenue	
	Operating profit	2.0 billion yen		
	Main customers	Telecom carriers		
			Key Initiatives	<ul style="list-style-type: none"> Business expansion based on TOMS^{*1}, SDN^{*2}/ NFV^{*3} Acceleration of development and service proposal ahead of full-scale 5G adoption
System Platform Business				
	Revenue	714.3 billion yen	Composition of revenue	
	Operating profit	31.4 billion yen		
			Key Initiatives	<ul style="list-style-type: none"> Maximizing the profit of existing businesses Acceleration of establishing an IoT^{*4} platform Strengthening key business areas
				<small>*4 IoT: Internet of Things</small>
Others				
	Revenue	202.6 billion yen	Composition of revenue	
	Operating loss	-11.9 billion yen		
			Key Initiatives	<ul style="list-style-type: none"> Sales expansion in international safety business



NEC Vision website

Introduces NEC's vision for social value creation and our initiatives for realizing this vision.



NEC Innovation World

A showroom to co-inspire the future.



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