

\Orchestrating a brighter world

**NEC**



Looking ten years ahead

# NEC Vision 2017 for Social Value Creation

# Orchestrating a brighter world

## Co-creating social value through human-digital integration

NEC is committed to realizing a society that embodies the values of Safety, Security, Efficiency, and Equality. This is why we are focusing our efforts on solutions that leverage information and communications technologies (ICT) to create advanced social infrastructure. These solutions are known as NEC's Solutions for Society.

This booklet—NEC Vision 2017 for Social Value Creation—describes the vision that we at NEC have for creating social value through our business activities.

This vision contains two key messages.

The first concerns the huge changes that the world is experiencing here in the early 21st century. As the world's population continues to increase and concentrate in urban areas, demands for energy and food are skyrocketing and the movement of people and things is accelerating at an unprecedented pace. In order to build a sustainable society, we must use our ICT assets to develop new social infrastructures.

The second message concerns the three processes that we are using to create social value: *awareness* of fundamental issues of customers and society, *collaboration* for generating value such as open innovation, and *value creation* that leverages leading-edge ICT including artificial intelligence (AI) and the Internet of Things (IoT). Through these processes, NEC is committed to providing value to our customers and working together with them to create a brighter future.

We have also issued "NEC Vision 2017 Case Studies and Highlights," which introduces some of the Solutions for Society businesses that NEC is involved in and examples of how we are working with our customers to create value for society. We invite you to read this booklet also.



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NEC Vision 2017 for Social Value Creation

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# Top Message



The rapid evolution of information and communications technologies (ICT) is driving the utilization of advanced artificial intelligence (AI) and Internet of Things (IoT) technologies. The collection of digital data on all sorts of events and phenomena and the use of AI in their analysis and utilization have ushered in a "Digital Transformation" that is bringing about dramatic changes to the structure of society and entirely new business models. The pursuit of total optimization will further drive the advancement of collaborations between different industries to an unprecedented scale.

In 2014, NEC announced a new brand statement, "Orchestrating a brighter world." This message represents NEC's firm determination to be a social value innovator and integrate its leading-edge technologies, knowhow, and ideas, while working together with our customers and partners around the world, to realize abundant lives and a brighter society and future for all.

To ensure the realization of this message, NEC collaborates with customers and partners around the world to strongly drive the Digital Transformation by fully leveraging the power of ICT across all of society's value chains. By enabling high quality and secure value chains, NEC can globally provide the values of "safety," "security," "efficiency," and "equality," all of which are essential for people to live abundantly.

This booklet represents "NEC Vision 2017," which brings together NEC's future visions, including our technology vision for ten years from now, 2027, and initiatives for realizing the future we hope to build with our customers and partners. The year 2027 will mark the 50th anniversary of the "C&C Declaration," which was made in 1977 by then-chairman of NEC Koji Kobayashi, declaring "early in the 21st Century, it will be possible to talk to each other and see each other anytime, anywhere. This will require an integration of technologies for communications, computers, and television."

It is my pleasure to invite you to read this booklet and experience our future vision.

October 2016

Takashi Niino, President and CEO



**Orchestrating a brighter world**

# Chapter 1 Global megatrends



(Source: Data from OECD, FAO, PwC, and the United Nations)

## Our future earth and global trends

The transformation of our world is increasing at an unprecedented pace. Wider perspectives, greater flexibility, and new ICT-driven social infrastructures are called for in order to build a sustainable society.

### In 2050, human society will require two times the earth's resources

According to the United Nations' estimate, the global population will increase to 9.6 billion from the current 7.3 billion by 2050. Population will continue to concentrate in urban areas and the breaking down of borders will accelerate. Transportation of goods and movement of people will also increase, as will consumption of energy, water, food, and other resources. And if today's urban lifestyle continues, in 2050 we will need twice the amount of resources the earth can supply.

In addition, there are also many social and political problems facing our world, such as natural disasters and abnormal climates brought about by global warming, population problems that differ from country to country, political matters caused by terrorism, and many other issues.

To overcome these problems and build a sustainable society while coexisting harmoniously with the earth, we must use the

earth's resources more efficiently and make social systems and lifestyles more agile and responsive to change. Information and communications technologies (ICT) are being increasingly looked to as a means of resolving the diverse social issues we are facing.

### ICT can help to change society and address the world's problems

The evolution of a wide array of technologies and other advanced ICT such as artificial intelligence (AI) and the Internet of Things (IoT), as well as robots, drones, and medical technologies/biotechnologies will play a central role in creating new social frameworks and unprecedented value for the future. In Japan, a national initiative called "Society 5.0" was approved by the Japanese Cabinet in January 2016. The goal of this initiative is to realize a "super-smart society" that will create new value and bring prosperity to people through the merging of



the real world (physical world) and the cyber world. A Digital Transformation that will accelerate changes in the industrial structure as well as the essence of economies and societies is about to take place. This transformation, spurred by the innovations achieved through digitalization, will lead to changes in society and will drive the resolution of the problems the world is facing.

## Global megatrends for the future that we must address to create a better society

The problems and changes that we face, such as the explosion in global population and the accompanying depletion of the earth's resources, natural disasters caused by global warming, the increasing complexity of economies and political systems, and rapidly advancing technology, are complex and intertwined. NEC has classified the major social and global trends for the next 10 years into six megatrends. These trends are intricately connected and affect each other as a series of chain reactions. As these chain reactions increase in speed, we begin to reach the limit of how accurately we can predict the future. However, it is precisely because of these rapid changes that we must correctly identify global-scale megatrends and understand their essential qualities in terms of long-term impact. Awareness of the long-term impact of megatrends will also help us imagine, and prepare for, various scenarios concerning what might happen in the future.

Based on these global megatrends, NEC is working together with its customers and partners to plan and realize new social infrastructure for the achievement of an inclusive society in the Digital New Age in which we will be addressing myriad social problems and diversified threats.

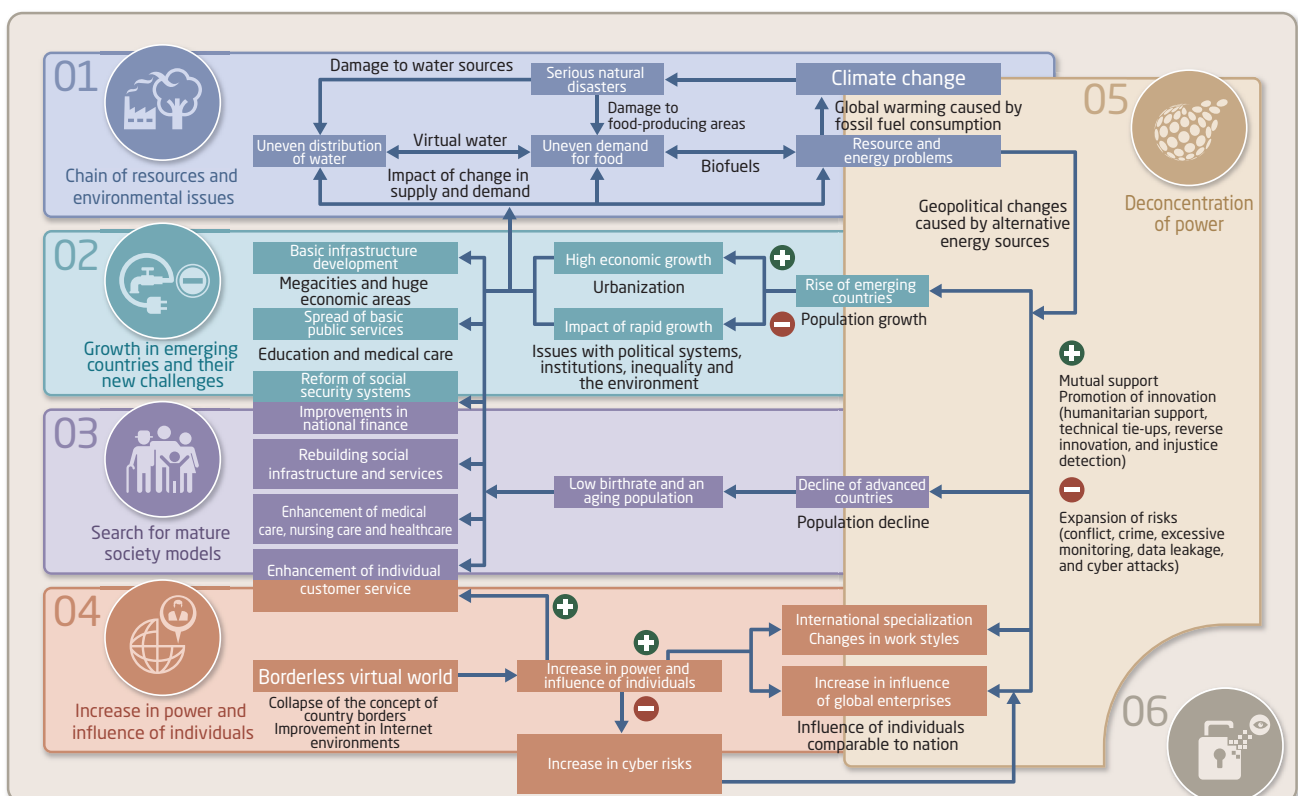
## Global initiatives for solving social problems

Initiatives for solving these problems are being taken all over the world, led by the United Nations. At a United Nations summit held in September 2015, the Sustainable Development Goals (SDGs) for 2030 were adopted. These consist of 17 goals on issues such as poverty, hunger, energy, climate change, and peace that are further broken down into 169 specific targets.

Realization of these SDGs, which include disparity and inequality issues in addition to environmental, social, and economic problems, necessitates that all nations—emerging and developed alike, governments, companies, and citizens around the world adopt these SDGs as common goals in carrying out their roles as citizens of the earth, in this increasingly diversified international community.



## Chain of 6 megatrends



Diversified threats and needs for safety and security

## The promise of better societies and a brighter future through co-creation initiatives with customers and partners

### Six Megatrends

01

Chain of resources and environmental issues



02

Growth in emerging countries and their new challenges



03

Search for mature society models



04

Increase in power and influence of individuals



05

Deconcentration of power



06

Diversified threats and needs for safety and security



### Sustainable Earth

Establish a sustainable lifestyle base by utilizing limited resources effectively and taking measures to prevent damage to the global environment in order to live in harmony with the earth.



### Quality of Life

Build a diversified and equal society to support people's enriched and active lives through contributions to education, healthcare, and medicine.



### Work Style

Create new work styles and relationships with society in which people collaborate with AI and robots regardless of gender, generation, and region.



The cornerstone of our business—"Orchestrating a brighter world." NEC is bringing together technologies, expertise and ideas and orchestrating projects with people around the world to "co-create" a society that is filled with hope and offers a brighter future for everyone.

## For People, Society and Our Future Seven themes for the co-creation of new social value

NEC has devised seven themes from wide-ranging perspectives, including the environment, society, industry and daily lifestyles, by identifying six megatrends. These themes are embodied in our Solutions for Society business, through which we aim to solve the issues facing society by maximizing the benefits of information and communications technologies (ICT).

In the megatrends we have identified, it is forecast that we will be consuming two planets' worth of resources by 2050. But this estimate assumes that we will not change our present lifestyles. When we take a renewed look at the way society and industry work today, we can identify countless ways in which we are wasting our precious resources.

For example, it is estimated that about one third of the 3.9 billion tons

of food produced annually in the world is wasted. Also, while safe potable water accounts for only 0.01% of all water on earth, between ten and forty percent of potable water in many cities is wasted through leakage.

To address these issues, we believe that we can drastically decrease waste and achieve a sustainable society by leveraging ICT to overhaul entire systems, including our systems of distribution and consumption, without increasing production.

Based on our Seven Themes for Social Value Creation, we will continue utilizing our ICT assets to organically integrate social infrastructures while working together with our customers to create new value that will lead to a better society and a brighter future in which safe, secure, efficient, and equal services are widely available to everyone.



# Orchestrating a brighter world

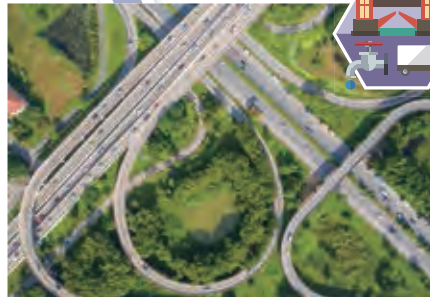


## Safer Cities & Public Services

Help emerging countries build safe and secure cities, and help developed countries mature their societies. Establish a “glocal” administrative service platform through joint initiatives between the public and private sectors.



## The Seven Themes for Social Value Creation



## Lifeline Infrastructure

Establish ICT systems that resolve disparities of area and delivery time, and build safe and efficient lines for travel, utilities, etc. that can support around-the-clock activities in society.



## Industry Eco-System

Innovate a new industrial ecosystem including connection of industrial machinery with the Internet, 3D printers, crowdsourcing, and reverse innovation.



## Communication

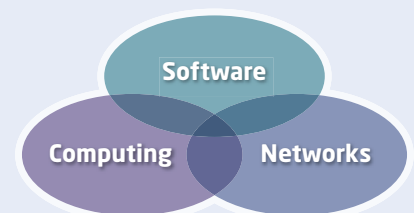
Build a platform for information and communications infrastructure to support the distribution of information and knowledge, which becomes more important as society advances.

## 50 years from the C&C declaration: Towards the society of 2027

In 1977, the then-chairman of NEC Corporation, Dr. Koji Kobayashi, expressed the idea that by the turn of the new century it would be possible for people to see and converse with each other at any time and from any place on the earth, and to achieve this he proposed the “C&C” concept of integrating computer and communications technologies.

**C&C** for Human Potential

With this visionary declaration, NEC has built up an extensive track record of success in a diverse range of fields by employing advanced technologies in all areas of computing, networks and software and demonstrating reliable performance capabilities. Our commitment to the principles of this declaration—that technology will drive the creation of a better society—remains unchanged. We now embark on a new journey with our customers towards the society of 2027.



## What technology will drive social value creation ten years from now?

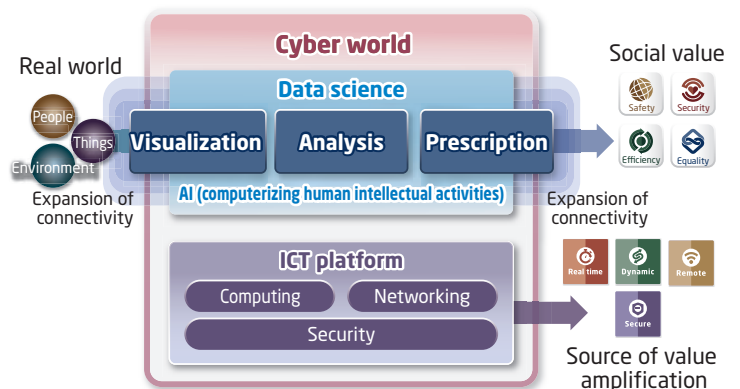
In the world of ICT, the latest technological innovations go from conception to reality in the blink of an eye, spreading rapidly through society and becoming an indispensable part of life. NEC is developing systems and technologies that will resolve the issues the world will be facing ten years from now.

### Creating more value from data by using AI and IoT to further our understanding of “contexts”

To create a brighter future, we must understand the global megatrends that will shape the world’s economies and the society of tomorrow. We also have to consider the impact that technological evolutions will have on the way we live. Artificial intelligence (AI) and the Internet of Things (IoT) are driving a Digital Transformation that will revolutionize our social structures and give rise to new business models. At NEC, we are looking ahead to the future and attempting to understand how information and communications technologies (ICT) will evolve over the next 10 years so that we can continue to create value for our customers and society as a whole.

As IoT becomes embedded in society, many different things and contexts will be connected to networks. Analysis of the data gathered in those networks will deepen our understanding of contexts in the real world (physical world) and in the cyber world. By helping us understand these contexts, ICT becomes an ideal tool for the analysis and resolution of challenging social issues. For example, integrated analysis of images from cameras installed on the streets combined with data from the cyber world can help prevent crimes by detecting suspicious activity. NEC’s social value creation process consists of three main components: *Visualization* of real world contexts in the cyber world, *Analysis*

### Social value created by ICT and sources of value amplification



to support decision-making as well as a means for solving the social issues arising from those contexts, and *Prescription* through which we can supply services and solutions to the real world. Going forward, NEC will focus on the development of data science technologies to facilitate the social value creation process and ICT platform technologies to execute the process securely and efficiently.





## Developing technologies from a social standpoint

Analysis plays a central role in the social value creation process and will be handled by AI. This field is one in which NEC excels. “NEC the WISE” is a lineup of AI technologies that leverages NEC’s advanced wisdom to solve the increasingly complex and sophisticated problems confronting society.

Most AI systems learn from Big Data. Unfortunately, many of the social issues we face today are not only not well understood, they are largely bereft of Big Data. Many other problems are so new we have no past examples to guide us. Beyond the lack of data, there are technological problems as well. Decision-making and control must be performed in real time when dealing with live problems in the real world; however, current AI technology must process huge volumes of data, which in turn consumes a huge amount of power, making it all but impossible for it to perform as required.

To take one example, in cyber security, measures must be rapidly developed to counter the new forms of cyber attack that occur daily. The problem is that it is impossible to defeat unknown attack patterns using measures and rules based on known attack methods. Currently, the only way to handle these unknown attacks is to rely on human security analysts with advanced expert knowledge. NEC will develop “reasoning AI” that will be flexible enough to respond creatively to even unknown problems such as new forms of cyber attack and work

collaboratively with humans to solve new problems as they arise. One of the challenges that we face is that an enormous amount of processing is required for AI to learn something, and all that processing sucks up a lot of power. This makes effective power management critical to the achievement of real-time control in the real world. Compared to the human brain, a computer is incredibly inefficient when it comes to power consumption. Google DeepMind’s AlphaGo that became the first Computer Go program to beat a professional human Go player is estimated to use several hundred kW for learning. The power consumption of the human brain, on the other hand, is roughly estimated as a mere 20 W. To overcome the power consumption barrier, it will be necessary to develop computers that can perform advanced intelligent processing with maximum power efficiency by adopting a processing mechanism that is similar to that of the human brain. Moreover, when real-time control is required—for example, in driving automobiles—the computers that perform this processing will have to be installed in edge devices close to the real world. In other words, functionality and processing will need to be optimally distributed between clouds and edges in order to cope with real-world problems in real time. In the following pages, we introduce seven technological evolutions that we believe will have a major impact on our lives and give rise to dramatic changes in society.

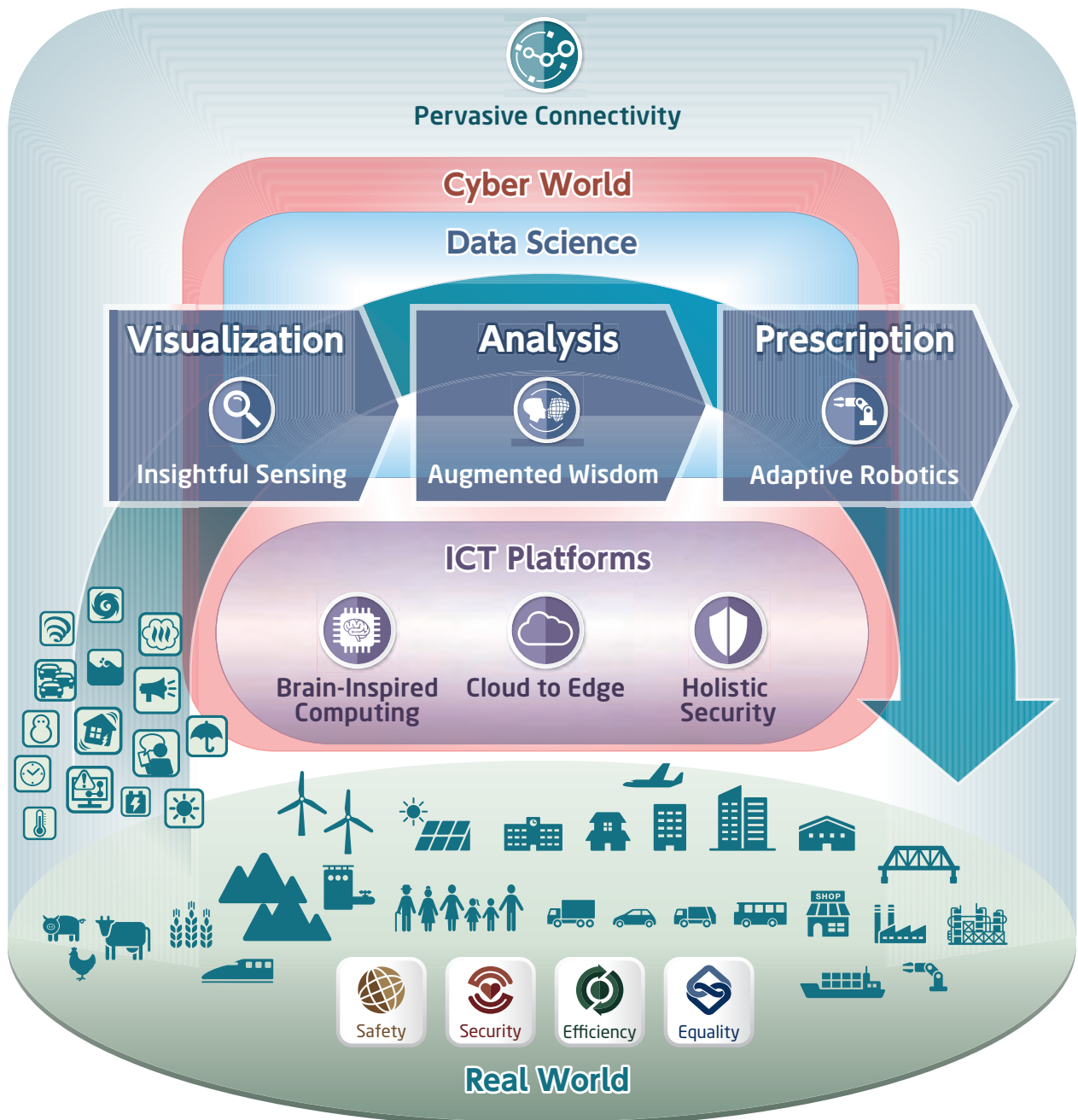


# What is NEC's Technology Vision?

How should technology evolve? What innovations should we introduce to society?

NEC is creating new value by considering these questions and developing innovative new solutions utilizing AI and IoT. Here is a glimpse of the shape of technology to come, zeroing in on the technology we expect to see ten years from now—technology that we believe will help sustain the brighter, more prosperous future that we are working toward.

## Technological evolutions that will drive social change





## Pervasive Connectivity

Today we are fast getting to the stage where not only will *you* always be connected to the Internet no matter whether you are indoors or outdoors, but so will just about everything else. As communications technologies become ever more sophisticated and efficient, humans and “things” will merge seamlessly with the network. Contexts in the real world generate data that will manifest in the cyber world where it can be processed, analyzed, and interpreted. Interconnection and comparison of events will help create new value. Similarly, by providing a transparent and secure means for tracking transaction data related to the ownership of things and transfer of digital assets, Blockchains will make it possible to safely and efficiently track transaction data with no need for a central authority—something that will revolutionize the way we do business in the future.

## Data Science



## Insightful Sensing

Thanks to advances in sensor technology, real-world events will be able to be transferred in detail to the cyber world. Sensing technology will continue evolving—expanding the dimensions of observation areas, increasing the depth of observation, and improving the ability to detect changes. For example, wide-scope observation using multiple cameras and change detection using image analysis will facilitate identification and profiling of suspicious individuals who appear in multiple locations, while observation and analysis of facial expressions and the way people walk will support assessment of health and psychological conditions.



## Augmented Wisdom

The ability of artificial intelligence (AI) to learn rules and propensities from large-volume data is enabling it to take over increasingly complex tasks conventionally performed by humans. This makes it ideal in many business and industrial applications. When dealing with social issues, however, the complexities and unknowns of a given problem and the lack of simple solutions challenge even the most powerful AI. Humans will remain an integral part of the decision-making and problem-solving process with AI expected to evolve into a “partner” that will work closely with humans to solve complex problems. The integration of AI and simulation technology will be of particular importance in this regard, providing critical support for decision-making in unknown situations.



## Adaptive Robotics

Once confined to factories, robots are now beginning to show up in everyday life. Designed to adapt to unknown objects and changing environments, these robots take many forms, including self-driving vehicles, robot assistants that expand or support human physical capabilities, and robots that can communicate with humans. The latest concept in adaptive robotics is “cloud robotics.” Just as the Internet increases human intelligence and connectivity by an order of magnitude, so cloud robotics will give robots access to vast amounts of processing power, enabling them to perform tasks and learn skills that would be impossible for a self-contained, non-connected machine to do on its own. This means that robots will be a key part of any information and communications technology (ICT) systems that interface with and directly control activities in the real world.

## ICT Platforms



## Brain-Inspired Computing

AI requires a massive amount of processing. However, with computers based on conventional von Neumann architecture, power consumption increases in proportion to scale, meaning that as a computer approaches a human-level scale of processing, it uses an inordinate amount of power. The human brain, on the other hand, is much more efficient, performing extremely sophisticated processing, while consuming the equivalent of only 20 watts of powers. Today's challenge is to develop a new computer architecture that adopts a processing mechanism similar to that of the human brain. Going forward, we will need to use systems that combine conventional von Neumann architecture—which is good at accurate calculations—and a new style of architecture which replicates the architecture of the human brain.



## Cloud to Edge

As the Internet of Things (IoT) continues to evolve, network edges—including sensors, actuators, and various network devices—will be provided with computing and processing functions. In the future, IoT systems will consist of both cloud and edge components. Each component's role will be allocated according to data volume and real-time properties, enabling flexible processing and dynamic control. Because real-time information will be processed in the locations where the events actually take place, this converged system will help create value that will enable immediate response to emergent events.



## Holistic Security

With the proliferation of IoT, the target areas for security will expand into physical systems. In addition to protecting itself from cyber attacks, an IoT system that interfaces with the real world must take into account the risk of human intrusion into and physical destruction of facilities. This requires development of a holistic security system that integrates real-world security measures such as intrusion detection by video surveillance with enhanced cyber security protocols. This type of converged security system can provide a certain level of pre-crime detection by collating and analyzing crime-related data and connecting that data with real-world events, using observed correlations to help prevent crimes from occurring.





## Realizing “a brighter world”

NEC seeks fundamental solutions to social issues by looking at the world from a wide perspective that includes the global environment, society, industry, and people’s lifestyles.

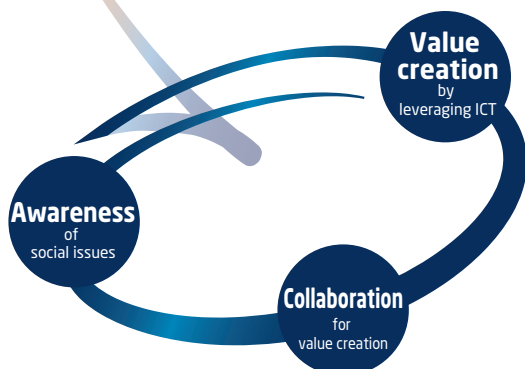
Through co-creation with customers and partners, NEC aims to realize a brighter and more prosperous future that maintains a compatible balance between customer values and social values.

In this chapter, we look ten years ahead and introduce the initiatives NEC is taking for the future based on the Seven Themes for Social Value Creation NEC is engaged in. Through value creation that focuses on the three processes of *awareness* of fundamental issues of customers and society, *collaboration* for generating value such as open innovation, and *value creation* that leverages leading-edge information and communications technologies (ICT) including artificial intelligence (AI) and the Internet of Things (IoT), NEC is committed to providing value to our customers and working together with them to create the social values of Safety, Security, Efficiency, and Equality.

### Social Value Creation processes

#### Orchestrating a brighter world

Social values achieved by co-creating with customers



### How to create value

#### Co-creation

● Social Value Design™



Social Value Design represents NEC’s original way of creating value through co-creation with customers. Social Value Design leads to innovations for business and future society by focusing on two perspectives: the User Experience perspective—considering how to improve the value of human experience, and the Social Experience perspective—considering the way society should be.

● Lean startup ● Open innovation ● Partnering, etc.

#### System integration services

● Operation and maintenance services  
● Consulting ● System integration ● Financing, etc.

#### ICT assets

● Computing  
● Networking  
● Security  
● AI (data science), etc.



NEC the WISE





# Sustainable Earth



## Creating a society that lives in harmony with the earth by reducing resource consumption and environmental impact

In the next 30 years, world population growth and urbanization will bring about various threats arising from the increased burden on the environment and the rise in natural disasters. NEC will visualize the continually changing conditions of the earth and contribute to the realization of a society that coexists harmoniously with the earth, through the efficient and equal distribution of limited resources and measures to preempt the effects of threats to the earth.

### A society that already consumes resources equivalent to 1.5 times the earth's capacity

Present calculations indicate that by 2050, we will need resources equivalent to twice what the earth can produce. According to the Ecological Footprint published by the World Wide Fund for Nature (WWF), humans are already consuming resources equivalent to 1.5 times the earth's biological capacity. This means that we have overused resources by 0.5 of the earth's capacity and are using up our natural capital for the future.

Also, the report by the United Nations Intergovernmental Panel on Climate Change (IPCC) has pointed out that climate changes caused by global warming pose various major risks.

What should we do, therefore, to address these resource and climate change issues in order for us to coexist harmoniously with the earth and create a sustainable society?

### Global scale sensing and other contributions that ICT can make

Information and communications technologies (ICT) can make major contributions to enable the optimum use of resources and prepare for risks due to climate change. Real-time collection of various kinds of environmental data through sensors located in different places, such as satellite, above-ground, and underground sensors, enables monitoring environmental changes on a global scale. Further, the evolution of artificial intelligence (AI) and simulation technologies and the improvement in performance of supercomputers will facilitate the instantaneous analysis of massive environmental data. This will enable measures to optimize how we use resources and to prepare for and minimize damage from natural disasters. NEC will leverage ICT to contribute to the realization of a sustainable society that coexists harmoniously with the earth.

### NEC initiatives for the future

NEC will provide support in elucidating causal factors and in formulating countermeasures for various environmental problems in order to realize a sustainable society in harmonious coexistence with the earth.

#### Earth Simulator: Monitoring the earth and predicting the future

The Earth Simulator (built for the Japan Agency for Marine-Earth Science and Technology), which uses NEC's vector supercomputer, SX-ACE, is widely used for complex and large-scale simulations on climate change. The Earth Simulator is contributing to many areas related to the environment and environmental risks. It has the potential to provide a detailed evaluation of the effects of global warming, predict future climatic changes, simulate and predict typhoons and torrential downpours, elucidate earthquake mechanisms, and enable wide-area and high-resolution predictions of flooding from tsunamis.

(Photo from JAMSTEC: Japan Agency for Marine-Earth Science and Technology)



#### Fire warning and immediate response system for protecting our valuable forests

NEC supports measures to prevent forest fires across a wide geographical area through its temperature-surveillance technology for infrared cameras. Alerts for forest fires too small to be monitored with the naked eye can be issued upon detection of abnormal temperatures, enabling foresters to immediately verify the status of fire occurrence from infrared camera image monitors. Alerts also include position information on the location of the fire, allowing accurate and rapid instructions to be issued to firefighters, thereby minimizing damage to our valuable forests.







# Safer Cities & Public Services

## Creating safer and more secure societies through cyber-physical security solutions

As globalization and the concentration of populations in cities progress, new safety risks from cyber attacks are increasing. In addition to detecting potential crimes and disasters before they occur, NEC will contribute to the realization of a global administrative platform that demonstrates regional appeal by making use of the power of local residents in addition to support from industry, government, and academia.

### Confronting threats that target both the cyber and physical worlds

The world today must confront various risks to cities and societies, such as cyber attacks, natural disasters, and terrorist attacks. Developments in the Internet of Things (IoT) will continue to erase the borders between the cyber world and the real world (physical world), further fueling the sophistication of cyber attacks, and magnifying the threats from organized crimes that target physical systems as well. Targets for these threats have extended from particular individuals and organizations to include financial, industrial, as well as social systems that exceed national and regional borders, making the damage from attacks more extensive and severe. It has become more important than ever to develop security solutions that integrate cyber and physical measures to be able to protect cities and societies from such threats.

### Utilizing AI and IoT to realize advanced security services

Handling sophisticated cyber attacks requires collaboration with expert partners—these attacks cannot be dealt with individually by companies and organizations. To protect important information systems from cyber attacks, we must use artificial intelligence (AI) to detect unknown cyber attacks, as well as implement measures that preempt attacks, guaranteeing certainty of information, and carrying out secure hardware development. Also, in the area of physical security, NEC's advanced biometrics, AI-driven image analysis, and IoT-based system abnormality detection technologies enable reliable personal identification and early discovery of unusual phenomena. It has become imperative to utilize advanced AI and IoT to strengthen security in both the cyber world and the physical world, and realize advanced security services that integrate measures for both these worlds.

### Enhancing convenience through collaboration in delivering a wide variety of services

Security services built through the utilization of AI, IoT, and Big Data not only reinforce security, but also play a major role as a platform for delivering services with higher added-value to enhance people's lives and society as a whole. Delivery of diverse and highly convenient services is made possible through collaborations between different industries beyond national and municipal boundaries, such as collaborations among government, education, economy, finance, welfare, and medicine, inter-agency collaborations, and industry-government-academia partnerships. As an information and communications technology (ICT) vendor possessing advanced technologies in all areas of computing, networking, and security, NEC will continue to pursue the creation of new social values both in terms of providing safety and security through cyber-physical security measures, and providing efficient and equal services through the realization of city and government infrastructures fit for future generations.







**Toshio Nawa**  
Executive Director /  
Senior Security Analyst  
Cyber Defense Institute, Inc.

## The security measures taken by managers can make or break a company

We have now reached a point where cyber attacks are seriously affecting the business activities of corporations and the administration of organizations. Managers today need to change the way they think about security, from viewing it as merely another “cost” to recognizing it as an “investment”—in the creation of safe and secure products and the maintenance, and improvement, of corporate brand value and international competitiveness. Keeping your company safe and secure requires effort and planning. Most companies on the global stage are aware of this and see security as a cornerstone of business activities.

A key element in boosting international competitiveness is for companies to ensure that they, and their products, are sufficiently secure.

The Cybersecurity Management Guidelines issued by the Ministry of Economy, Trade and Industry and the IPA (Information-technology Promotion Agency, Japan) state that companies absolutely must implement proactive cyber security measures if they want to become more competitive in international markets.

It is fair to say that that we are now at the point where the leadership shown by managers in adopting security measures will make or break their company.

## NEC initiatives for the future

NEC pursues advanced initiatives for both the cyber and physical worlds in order to maintain the safety and security of cities and societies.

Cyber  
Security



### Cyber Security Factory:

Reinforcing domestic and overseas security support systems

The Cyber Security Factory, NEC’s core facility for security support, consolidates human resources, information, and technologies and formulates security measures against increasingly sophisticated cyber attacks, while sharing the latest trends in attack methods, malware, and knowhow on countermeasures.

NEC is also further strengthening its global operation framework for contributing to safer and more secure cities by establishing a Security Operation Center (SOC) in six countries including Singapore, Australia, and Brazil.



Physical  
Security



### Multimodal Biometrics Identification:

Improving reliability and convenience of identification through a combination of multiple biometric solutions

In addition to its Fingerprint Identification and Face Recognition technologies that are ranked as the world’s most accurate\*, NEC is also developing a variety of other biometric solutions based on palm print, finger vein, iris, ear cavity shape, and DNA. NEC has a strong track record in combining multiple biometrics technologies into multimodal identification solutions such as a Hybrid Finger Identification solution based on fingerprint and finger vein features and national ID services that use face, iris, and fingerprint authentication. These and other solutions are part of NEC’s efforts to further improve reliability and convenience of security measures.

\* Ranked No.1 in National Institute of Standards and Technology (NIST) benchmark testing.





# Lifeline Infrastructure

## Infrastructure supporting the “multiservice” “uninterrupted service” evolution

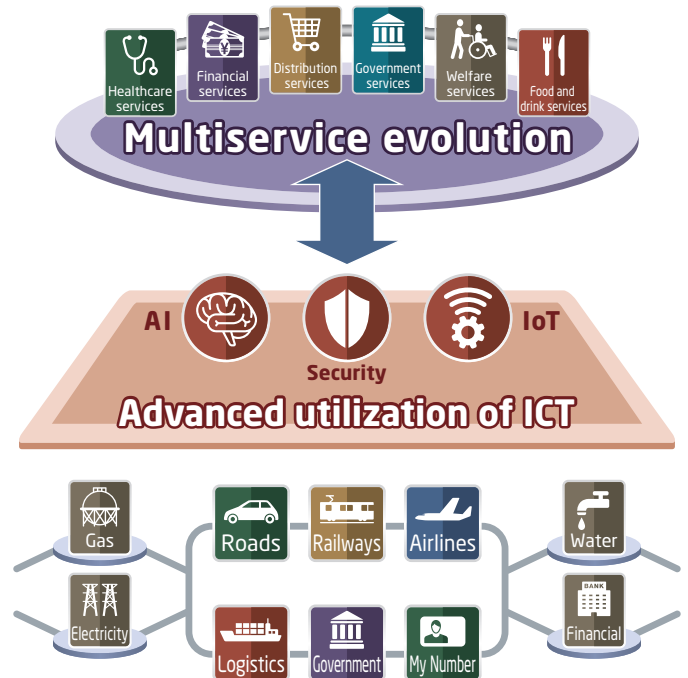
Global urbanization is accelerating the diversity and complexity of production and daily life infrastructures. Using advanced and flexible ICT systems to reduce differences between regions and time zones and realize 24/7/365 uninterrupted infrastructures, NEC is continuing to provide important resources safely and efficiently.

### What is the “multiservice” evolution?

As lifestyles and customer needs diversify, the services required are also diversifying. For example, convenience stores now not only just sell products, they also provide a variety of services. Customers can use financial services on ATMs, pay utility bills, and make and receive home deliveries at store locations. By increasing the range of services, such stores have become sites where people gather. And, as a result, they are being transformed into “sites where services gather.” Thanks to the “multiservice” evolution, services will play an even greater role as daily life infrastructure. The “multiservice” concept whereby diverse services such as logistics, finance, government, healthcare, and welfare are flexibly and seamlessly connected will further accelerate.

### Realizing “uninterrupted” services with “uninterrupted” infrastructure

Advanced technologies and unquestionable reliability are being demanded for “uninterrupted” infrastructure. For critical infrastructure facilities such as airports and power plants, for example, this means utilizing information and communications technologies (ICT) such as artificial intelligence (AI) and the Internet of Things (IoT) for surveillance systems and preventive maintenance that detects anomalies in facilities and equipment. For transportation systems such as railways, this means safe and secure operations based on traceability of inspections and repairs through IoT technologies like RFID. By leveraging its track record and knowhow cultivated from operating critical infrastructures, NEC will make “uninterrupted” services in daily life infrastructure a reality. NEC is developing AI technologies for preventive maintenance that automatically detect system anomalies and creating IoT technologies to enable visualization that allows users to comprehend store systems in their entirety. Our diverse “uninterrupted” services realized in response to Japan’s rigorous demands will be expanded globally in the future. Meanwhile, when we turn our eyes to the world, we see a variety of challenges related to infrastructure facilities. Visualization of



Flexibly and seamlessly connect diverse services through use of ICT such as AI and IoT to achieve a “multiservice” evolution

logistics systems, measures against traffic congestion and increased energy consumption that occur as people concentrate in urban areas, and infrastructure facilities such as financial systems that the poor can also use are becoming urgent issues in newly developing countries. ICT will contribute greatly to addressing these issues faced by countries around the world.





## Advanced biometrics technologies contributing to the creation of new services

Going forward, a variety of new services will arise. These include the use of public transportation without physically paying each time; the use of Blockchains that allow buyers and sellers to do business directly without a middleman; and the use of the My Number\*<sup>1</sup> card to expand services. Establishing reliability and convenience for such advanced services is becoming even more critical.

In addition to improving the efficiency and convenience of services, NEC is applying its biometrics technologies such as

Fingerprint Identification and Face Recognition, ranked No. 1\*<sup>2</sup> in the world, to create safe and secure user environments. Through the use of its ICT technologies, NEC will continue to contribute to realizing “uninterrupted” infrastructure that supports society and “uninterrupted” services that support people’s lives.

\*1 An individual identification number assigned to residents in Japan under the Social Security and Tax Number System.

\*2 Ranked No.1 in National Institute of Standards and Technology (NIST) benchmark testing.

## NEC initiatives for the future

NEC is engaged in realizing highly reliable and convenient services and creating new value in diverse fields such as efficient infrastructure facilities.

Utilizing My Number card safely and conveniently  
**Expanding use of My Number card to government, private-sector, and financial services**

By combining My Number cards and biometrics technologies such as Face Recognition, services that increase reliability and convenience can be realized. These include payment of public fees that accompany an address change and user authentication for shopping online and opening banking accounts. NEC is engaged in cutting-edge efforts to expand the use of the My Number card, such as linking it to next-generation terminals (photo, right) and wearable devices.



Contributing to infrastructure-building in newly developing countries  
**Providing logistics and transportation systems globally**

In India, NEC is supporting the development of an integrated platform that uses IoT to gather in the cloud location information of items being transported and enable visualization of the entire logistics system. In addition, NEC is deploying transit smart card systems that help reduce traffic in urban areas in several countries around the world. From here on, NEC will continue to use its advanced ICT technologies to expand safe and efficient infrastructure facilities to each region of the world to meet their needs.





# Communication

## Supporting diverse services with next-generation information and communications infrastructure

As digital networks connecting people, things, and contexts evolve and society becomes more advanced, the importance of information and knowledge increases. NEC is creating information and communications infrastructure from technological assets found everywhere from the ocean floor to outer space. This infrastructure will allow people and companies throughout the world to utilize information safely, securely, and equally.

### New social value spread by IoT

The expansion of mobile networks and the Internet of Things (IoT) is expected to bring about 5.5 billion Internet users around the world and 1 trillion connected IoT devices. By freely connecting “people, things, and contexts,” we are creating new experiences and social value—such as personal interactions using multilingual speech translation and automation of transportation systems—that will lead to a more prosperous society. Furthermore, by integrating cutting-edge artificial intelligence (AI) technologies with these connections, unprecedented experiences, including cooperation with robots, will unfold. To realize these new experiences and value, high-speed and high-capacity communication as well as security that enables safe and secure connections are becoming critical. The role of information and communications infrastructure is also undergoing a major transformation from “connecting information and data efficiently” to “supporting diverse services.”

### Toward information and communications infrastructure that can be used “like the air we breathe”

To realize information networks that allow diverse services to be freely used by anyone, anytime, developing information and communications infrastructure with outstanding stability and reliability is essential. Toward this end, NEC is integrating its flexible communication assets such as Software-Defined Networking (SDN) with AI technologies to enable Visualization, Analysis and Prescription of networks. NEC is focusing on IoT and 5G communication to further advance information and communications infrastructure so networks can be freely and conveniently—and safely and securely—used without users being conscious of them.

### NEC initiatives for the future

NEC is working to realize convenient and secure network environments to develop information and communications infrastructure for the IoT and 5G era.

#### Developing next-generation information and communications infrastructure by cooperating with telecom carriers

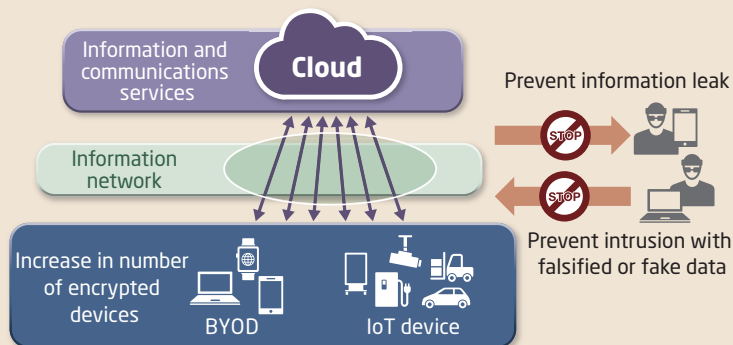
NEC is working with telecom carriers to improve social infrastructures and realize a smart society. One example is a jointly developed SDN/NFV\*1 information and communications infrastructure that dynamically allocates resources to support a variety of applications on multi-layer/multi-domain wide area networks.

\*1 NFV: Network Functions Virtualization

#### Protecting IoT/5G-era information and communications with high-speed lightweight encryption technology

Information security is essential to protect the volumes of mission-critical information generated by IoT and 5G. NEC combines its proprietary TWINE high-speed, lightweight encryption technology with OTR\*2 data falsification detection technology to enable security technologies to be incorporated in a wide range of devices. This is one of the many ways NEC is advancing information and communications for the IoT era.

\*2 OTR (Offset Two-Round): Encryption scheme developed by NEC. It was submitted to the Competition for Authenticated Encryption funded by the United States National Institute of Standards and Technology (NIST), and cleared the second round. NEC is aiming for OTR's selection as the next-generation technology at the final selection in 2017.







# Industry Eco-System

## A digital revolution creating new value to drive growth and global competitiveness

Organic integration of people, things and processes through IoT, the rapid digitalization of production and sales activities, the emergence of new business offerings in response to diversified consumer experiences and high-level needs, and many other factors are driving ongoing structural changes in our industries. NEC is delivering next-generation eco-systems for industry through the creation of new digital platforms.

### How do we cope with game changing events?

Game changing events that ripple out into multiple fields across industry boundaries are occurring more frequently due to rapid changes in market structure driven by maturing markets and advances in information and communications technologies (ICT). Today, how to create—and respond to—game changing events are not only topics for venture startups; they must be on the agenda of all enterprises. To lead the competition in the coming age we need to devise new business models, such as product-as-a-service, to create new value from Big Data. The creation of flexible ecosystems that can respond to a multitude of changes continues to emerge as a key element in maintaining a competitive edge.

### Innovating the value chain to create new value

Digitalization driven by advanced ICT such as artificial intelligence (AI) and Internet of Things (IoT) gives enterprises a new degree of competitiveness. From now, we will see further advances in products and services that utilize AI technologies and value chains made visible by IoT. However, businesses will not succeed through technology alone: we will need highly skilled human resources who have the vision and ability to conceive of new business models that surpass traditional frameworks. In other words, we need people who can “think outside the box.”

NEC is driving Value Chain Innovation by actively adopting “design thinking” to create a picture of how our society, and our future, should be. To turn this picture into reality, NEC fuses knowledge and skills to efficiently connect people, things and processes, leading to innovations such as an IoT platform that leverages cutting-edge AI technologies. These innovations are then applied in various areas of industry to create new value and to support the growth of enterprises, and society, into the future.

## NEC initiatives for the future

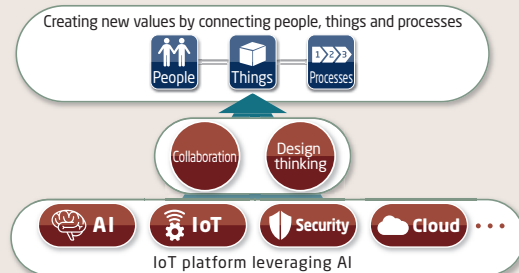
NEC promotes Value Chain Innovation that creates new value by connecting people, things and processes.

Giving birth to new innovations

### Collaborating with customers and fostering bold and enterprising human resources

NEC actively promotes “design thinking” whereby a picture of the ideal society and the ideal future is created and incorporated in products and services from the initial stages of design. NEC also prioritizes the fostering of human resources who can think innovatively and works together with customers through initiatives such as the NEC Manufacturing Co-creation Program to identify social and market issues and create the values required to resolve them.

#### Value Chain Innovation



Systematization of experience and best practices in production innovations

### NEC Manufacturing Co-Creation Program

From microwave radio systems to satellites, NEC has systemized its experience and best practices in production innovations and supply chain reforms for its diverse range of manufacturing activities. The best practices and assets for strengthening supply chains and reforming work processes are delivered through four main concepts. At present NEC is engaged in a concerted effort to improve the Japanese manufacturing industry through a wide range of exchanges with 1,149\* companies and approximately 3,500\* members.

\* As of the end of July 2016.



# Work Style

## Work styles attuned to people's diverse and individual capabilities

An era has come where co-creation with people having diverse backgrounds makes countries, regions, and organizations stronger. Eventually the time will come when people will work without boundaries of generation, gender, nation, and organization, and even cooperate with AI and robots. Through ICT, NEC will design diverse ways of working to create high-quality work and employment.

### AI and IoT are transforming work styles

Advances in artificial intelligence (AI), the Internet of Things (IoT) and robots have given rise to dramatic improvements in productivity as robots and AI take over work traditionally done by people. In a paper entitled "The Future of Employment: How Susceptible are Jobs to Computerisation?", Professor Michael Osborne of the University of Oxford pointed out that around 47 percent of total US employment may be automated over the next decade or two. Japan's Ministry of Economy, Trade and Industry (METI) also announced an estimation\* that by 2030, more than 4 million people will have shifted to the services industry, in which higher value can be obtained through direct handling by humans, or to core activities for creating new businesses. In this future, people will primarily be engaged in work that allows them to make full use of their areas of speciality or individuality or in activities that lead to new business generation.

At the same time, advances in information and communications technologies (ICT) will eliminate restrictions in space, time and movement. This will contribute to a more diverse society in which everyone, including people who live in rural areas or

overseas, people who face time constraints due to childcare or nursing commitments, and people with disabilities can work to their full potential.

\* Source: "New Industrial Structure Vision"

### Leveraging ICT to create new value for both workers and businesses

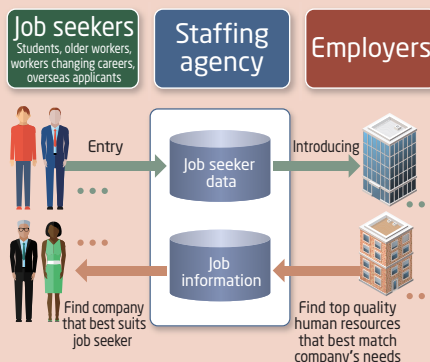
ICT also empowers individuals. It enables work styles that reflect people's sense of values so that someone who wants to start a new business using AI, source international experts for a project, or make a prototype quickly using a 3D printer can easily do so. Enhancing the fluidity of work by crossing the boundaries of enterprises and organizations will open up more ways of working. This kind of society needs new platforms to support the work styles of individuals and also to connect working people with growth-seeking enterprises. NEC is leveraging its ICT assets to create a society where every person can work with energy and enthusiasm through initiatives such as a human resources "matching platform" that uses AI to flexibly connect people and enterprises based on more than the traditional criteria of qualifications, skills and track record.

### NEC initiatives for the future

NEC is working towards the realization of next-generation work styles where each and every individual can exert his or her individuality and capabilities.

#### "Matching platform" that favors both employers and job seekers

NEC's Human Resources Matching solution carries out real-time matching of suitable human resources by learning job-information and job-seeker patterns from massive and diverse human resource data, including numeric data, as well as text and image data. Sophisticated analysis and decisions conventionally performed by data scientists are carried out through advanced deep learning technologies developed by NEC. This enables finding the best combination that satisfies the requirements and needs of both employers and job seekers, contributing to improvement of employment success rates and streamlining of recruitment processes.



#### "Work style innovation for 100,000 workers"

Aiming for reforming and optimizing operations across the entire NEC Group

Starting in fiscal 2016, the coverage of NEC's business transformation project, initially targeted for human resources, accounting, and procurement divisions, is being expanded to include subsidiaries inside and outside Japan. In addition to methods for quantitatively measuring and assessing the results of reforms, AI is being used in extracting problems and sharing knowledge gained. Further, through initiatives aimed at reducing operation man-hours and achieving paperless workflows while leveraging workplace knowhow, NEC will fast-track work style innovation for the 100,000-strong workforce of its Headquarters and Group companies.





## Education for our children's future and healthcare for a prosperous life



Infrastructures for high-quality education and medical care need to be improved all over the world. Through ICT, NEC promotes an equal and prosperous society that embraces diversity and allows all individuals to play an active role. We are constructing educational environments that overcome barriers of location and time, and enabling diverse healthcare services that include preventive medicine.

### Providing an equal learning environment to children around the world

As social issues continue to become more complex and lifestyles of individuals more diversified, a society where there is no one correct answer is emerging—a society in which people acknowledge and respect each other's differences. There is increasing awareness that to prepare our children—the future leaders and caretakers of our society—for this new world, we will need to adopt an active learning (student-led, cooperative) approach that respect students' diversity while enabling them to find problems and solutions on their own through group work and practical training. Around the world, however, there is still a lack of infrastructures for receiving high-quality education. NEC will provide support through information and communications technologies (ICT) to realize environments that allow children around the world to equally and efficiently avail of active learning programs by providing EdTech (Education×Technology) solutions, such as deployment of remote classrooms in many different countries.

### Creating a new healthcare system that integrates humans and ICT

Aging populations, increases in lifestyle-related diseases, ballooning healthcare costs and lack of medical personnel: To address these issues, we need a shift in mindset from treatment to prevention. By utilizing ICT such as artificial intelligence (AI) and the Internet of Things (IoT) we can solve these problems and realize a more proactive healthcare approach. With AI-based interactive diagnosis that visualizes stress conditions and subtle changes in daily physical states, we can enable very early detection of disease and provision of appropriate health advice. Wearable devices can also be used to analyze vital signs and lifestyle data to provide more personalized and optimized healthcare solutions.

NEC is providing personalized healthcare services that integrate humans and ICT to create a society where every person can live an active, healthy and prosperous life.

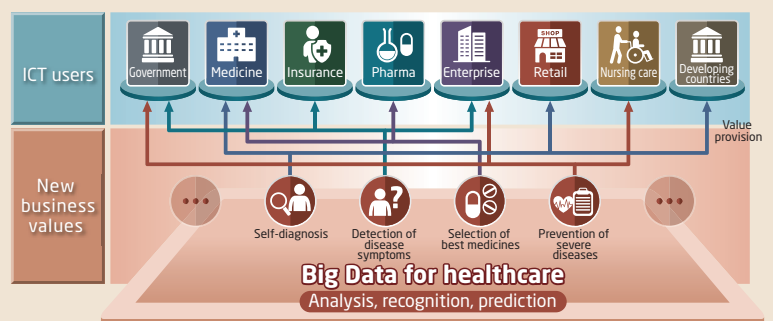
### NEC initiatives for the future

NEC has been pursuing advanced initiatives aimed at solving problems in medicine and improving healthcare services.

#### Healthcare Strategy Office: focus on next-generation healthcare

NEC aims to leverage the power of AI to reduce the burden of medical staff and improve patient quality of life (QOL), as well as create social values, such as the optimization of healthcare costs and extension of healthy life expectancy. NEC is already participating in a project to create a collaborative platform for medical institutions throughout the country to collect and utilize medical information for detecting adverse effects of drugs. We are also working with medical institutions to deploy "Japan-style" medical services globally. Our ultimate goal is to realize high quality healthcare services that are equally available to all people. To achieve this, NEC will collaborate with medical institutions, governments, other companies, and organizations from various disciplines, using ICT to create new values in the field of healthcare.

#### Creation of values through new healthcare ICT models





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### NEC Vision Website

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



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