

Orchestrating a brighter world

NEC



NEC Vision

Case Studies and Highlights 2015-2016



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NEC Vision for Social Value Creation

One of the most important challenges mankind faces today is addressing social issues that have become intertwined globally and, which must be solved by cooperation among members of the international community. Many governments and companies are already beginning to adopt such a point of view in policy and management—that business activities can be used not only to raise economic value but also to create social value.

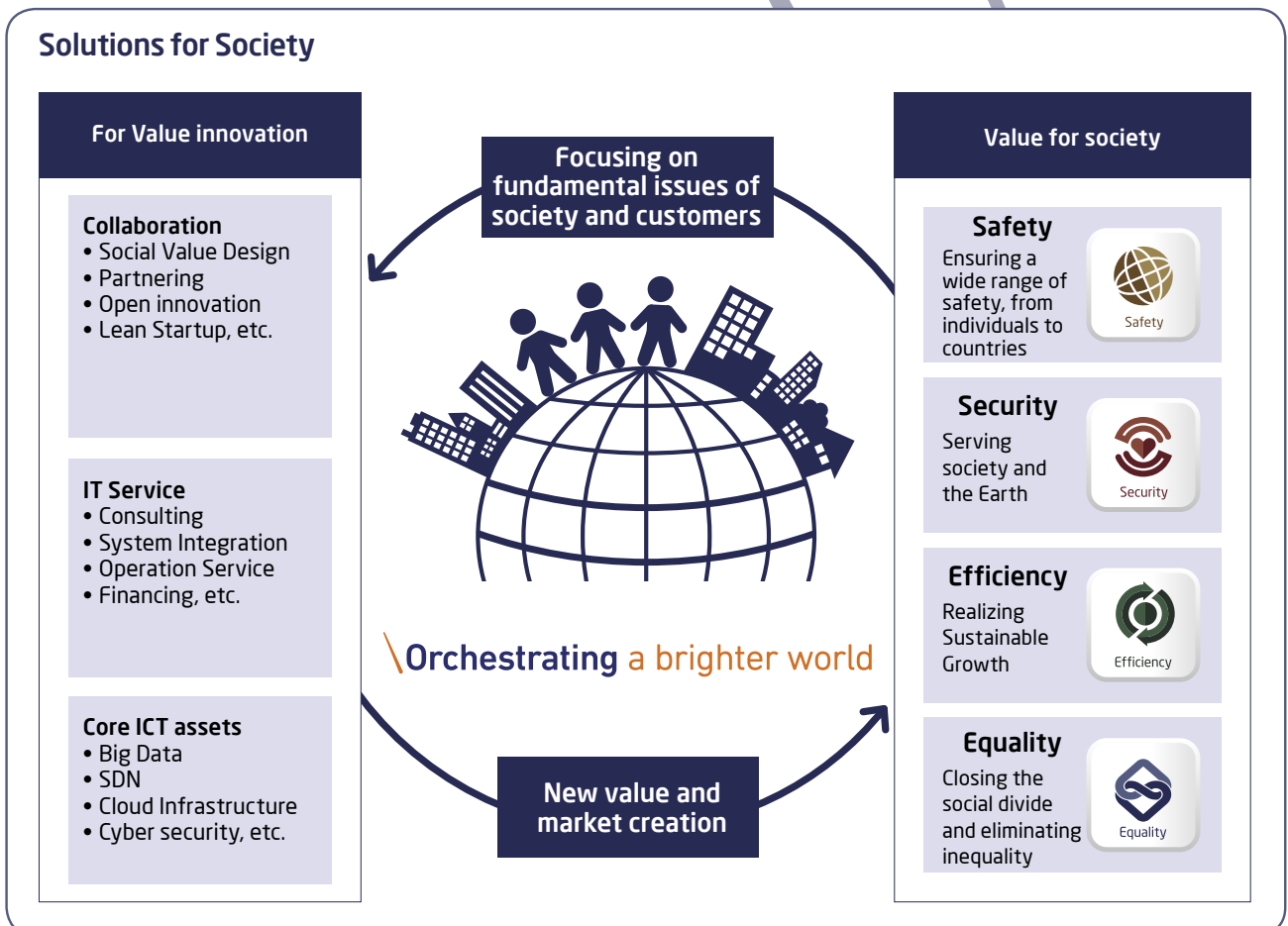
NEC Group is focusing its efforts on delivering “Solutions for Society” through social infrastructure with ICT which ensures the safety, security, efficiency, and equality of society and enables people to live abundant lives. In this booklet, *NEC Vision for Social Value Creation*, we describe our thinking how social value can be created through our business endeavors. ICT will continue to develop in the future and contribute to society, business, and daily life. While there are certainly great challenges to take on, we consider them to be opportunities to create innovative social infrastructure together with our customers.

In this booklet, we have two key messages.

First, amid the concentration of the increasing world population, cities will find the demand for energy and food will outpace the current supply. The development of a new society infrastructure driven by ICT is called for in order to make the best use of our limited resources and ensure that our resources are not wasted on our path to building a fair, sustainable society.

Second, NEC has set out 4 steps as the process of social value creation: the process of social value creation can only be completed via (1) identification of the fundamental issues, (2) collaboration in value creation, (3) creative design and implementation of business models and the utilization of ICT, and (4) provision of value to customers and co-creation of social value. NEC announced its new corporate brand statement, “Orchestrating a brighter world” along with the seven themes to represent this approach of social value creation. Collaborating closely with customers and partners, NEC will continue to create new value and a prosperous and brighter future.

This booklet, issued as an accompanying volume to *NEC Vision for Social Value Creation*, introduces some of the Solutions for Society businesses that NEC is involved in and examples of how we are working with our customers to provide value for society.





Creating social value in the era of IoT

New value produced through the integration of Real and Cyber

Gartner, Inc. defines IoT as “the network of dedicated physical objects that contain embedded technology to communicate and sense or interact with their internal states or external environment”. In the business field, IoT is attracting attention as a new concept whereby things are connected to the network, and information is exchanged mutually, including with people, to produce value. The global IoT market is forecast to grow an average of 30% annually.*1

In the near future, we are likely to see a scenario whereby a large quantity of broadly scattered “Things” are connected to the network, and data from all possible “Things” can be acquired. By 2020, the volume of data in the world is expected to increase by about 10 times that of 2013.*2 Acquiring this “big data” in real time and immediately analyzing it will transform the data into information and new knowledge. For example, if we gather data concerning conditions such as the wear and tear of equipment or buildings, the position of people and vehicles, air temperature, traffic congestion, and body temperature and heartbeat rates, and then

compare and analyze this data, we can turn it into information and knowledge such as optimal distribution routes and evacuation routes during a disaster. If this newly discovered information and knowledge is utilized in the real world, IoT will change the people’s livelihoods, society, and corporate management, like an economic effect.

NEC does not merely regard IoT as an exchange of sensor information and analysis results. We believe that IoT is an evolution in information and communication that will create a social infrastructure in which the cyber world is integrated with the real world. NEC foresees a future where industry and the social systems that have been developed in the cyber world will be incorporated into the real world, and will continue to develop autonomously through interaction. IoT, once confined to the manufacturing industry, is now expanding into all fields, from distribution and transportation, to energy, medicine, public services, and agriculture.

*1 Source : NEC

*2 Source : IDC; 4.4 ZB in CY2013, 44 ZB in CY2020
ZB (zettabyte): 10 to the power of 21

NEC's IoT architecture 5-layer model

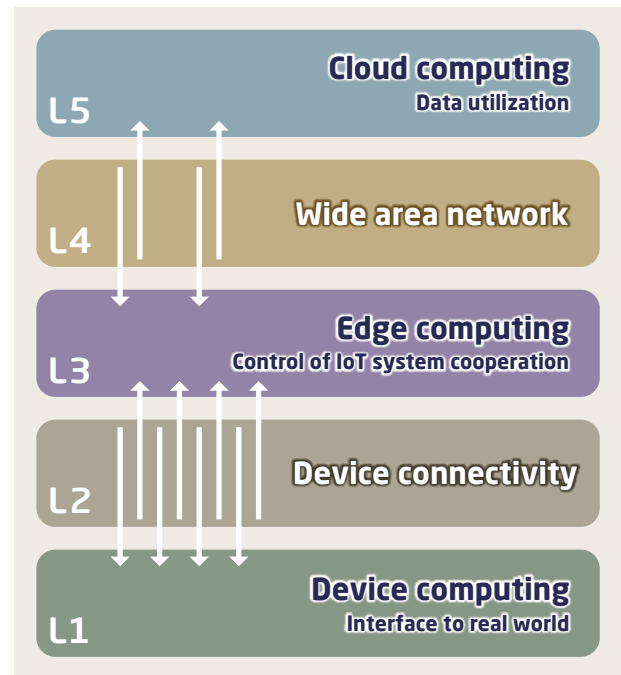
To support the introduction of IoT systems for customers, when building complicated IoT systems, NEC compares them against the IoT architecture 5-layer model.

The key to creating value through IoT is accurately capturing the real world, which contains many variations. Flexibility, robustness to change, and the ability to maintain accuracy across the entire system are the key features of the 5-layer model concept.

NEC proposes a 5-layer structure in which the edge layer is inserted as the 3rd layer (L3) in the middle of the conventional 3-layer structure of cloud, network (wide area/short distance), and device (client).

L3 provides seamless development from existing ICT systems, overcomes current technical issues and economic obstacles, and guarantees real-time performance. Moreover, the introduction of the

IoT architecture 5-layer model



concept called a layer improves the connectivity with other systems, which makes it easier to realize linking, and supports the gradual growth of the system to achieve the means of creating new value.

Creating new social value through IoT utilization

Towards 2020, a banner year for growth strategies in Japan, NEC is creating Solutions for Society to bring the value of "safety," "security," "efficiency," and "equality" to people throughout the world. In 2020, we will see people enjoying their lives supported by social infrastructure that leverages IoT—in fact, this is already happening. In Singapore, Argentina, Spain, and other countries, NEC has provided IoT smart city solutions in fields such as safety, traffic, and urban infrastructure.

In the enterprise market, with the tremendous activity surrounding Industry 4.0 in Europe, IoT has been receiving intense attention from manufacturing companies around the world. To support manufacturers in Japan, NEC has launched "NEC Industrial IoT", our next generation manufacturing

solution through which we aim to help our manufacturing customers and partners grow their businesses by connecting them with their products. We are confident that our society is a capable of dynamically changing itself by utilizing IoT. NEC's IoT solutions provide people with benefits in many different vertical domains. Our technologies cover vast areas from the ocean floor to outer space, and we have many years of experience in working together with our customers and helping them overcome their system integration challenges. This means that we are experts at realizing high performance, highly reliable social infrastructure systems. We at NEC strive to orchestrate a rich and brighter future by solving the issues facing society through IoT.



Takaaki Shimizu
Executive Vice President,
CMO (Chief Marketing Officer) and Member of the Board,
NEC

Interview

Case Study **City of Santander, Spain**

Costs and CO2 emissions reduced by using sensors for garbage collection operations

Santander is a city that proactively adopts IoT deployment for its social infrastructure. Since February 2014, as part of the smart city project, the city has performed verification tests in an attempt to visualize the actual conditions of the city by collecting data through sensors like city temperature, vehicle speed and noise, and the like. The garbage collection management service conducted by NEC is a consequent initiative of the tests.

Santander city originally collected garbage following a specific route and time. If amounts of garbage happen to increase or decrease unexpectedly, pre-scheduled collection doesn't work well.

So we have attached sensors to garbage containers located around the city and collected real time data of accumulated garbage amounts and the containers' location. Such data is analyzed at the management center and the most appropriate

route will be informed to garbage collectors.

As the expected results, the operation will realize efficient collection; sprawl of garbage will be eliminated. Additionally, shortening route helps to decrease exhaust fumes. NEC continues to work with Santander and other cities in global basis to create social value through utilizing IoT.



The huge amount of data which comes from sensors installed all around the city are analyzed by NEC's total ICT solution such as M2M (Machine to Machine) sensing, big data analysis technologies, visualization software.

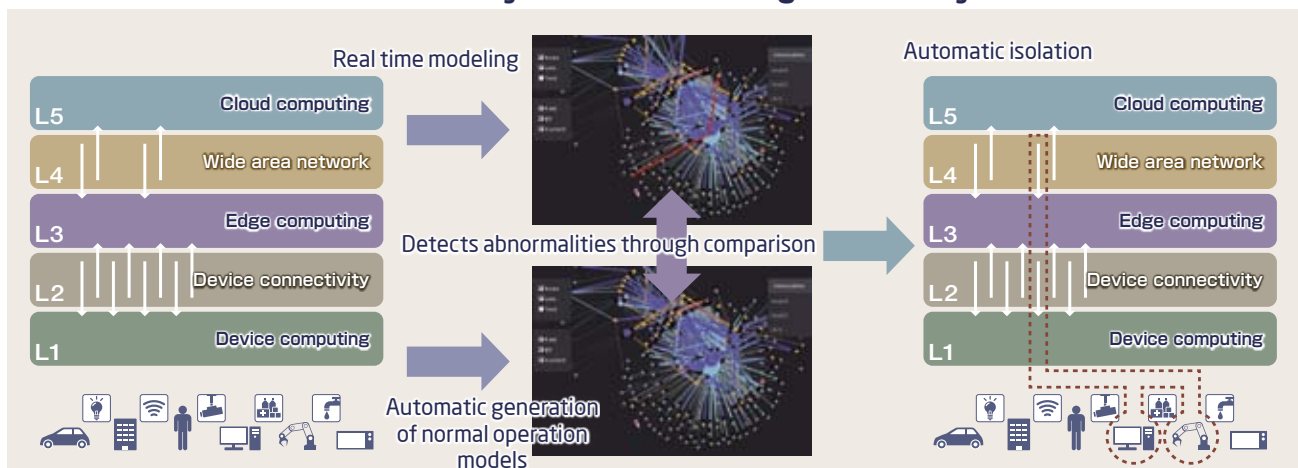
Protecting IoT systems in both the real world and cyber world

The spread of IoT has brought about an increase in the scale and complexity of systems, leading to increased security risks. Conventional measures cannot sufficiently protect IoT systems, which change dynamically, including in the real world.

NEC is researching ways to provide safe and secure IoT systems that are robust against cyber attacks by

combining proactive security solutions with big data technologies in which models of dynamic changes in a system are created in real time and compared with normal conditions to detect errors and Software-Defined Networking (SDN) technologies that can be used to automatically isolate abnormalities.

Detection of unidentified attacks by real-time modeling of overall system



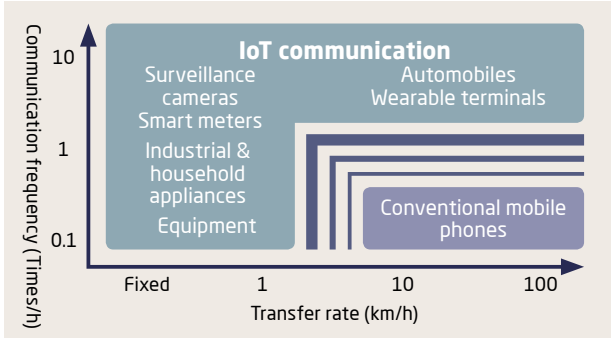
Connecting IoT devices to a mobile network without generating an excessive load

Huge volumes of control signals are exchanged between the mobile networks of communication service providers and IoT devices. NEC has developed the world's first technology to reduce this load to 1/10 that of a conventional load. This technology has been adopted as an international standard for mobile networks by the standards development organization 3GPP (Third Generation Partnership Project). The realization of highly reliable mobile networks that are not subject to overloading will accelerate the provision of

Creating value through advanced analysis

The large volume of information acquired from sensors can be transformed into accurate predictions by using machine learning analysis and other technologies. These predictions can then be used to create value for society. For example, NEC's water demand prediction solution reduces maintenance costs for antiquated city water networks, and helps municipalities realize optimal water distribution that satisfies the diversified demands of residents. This solution uses NEC's unique learning theory to automatically separate data with totally different formats, attributions and rules, such as changes in the weather, time of the year, dam water levels, and water usage conditions, and extract and analyze complicated information structures, including intermingled patterns and rules, to predict water demand. By using cutting-edge technologies such as

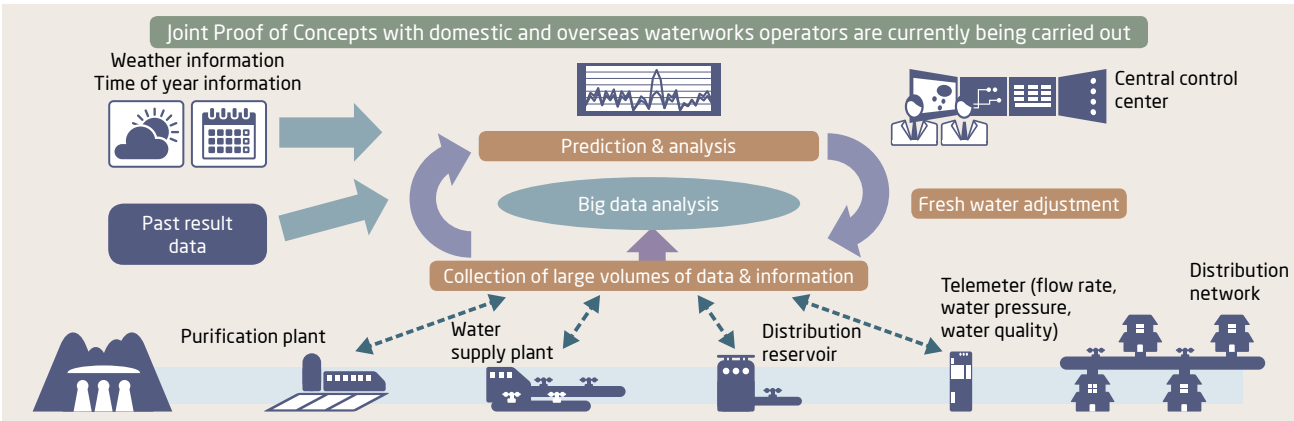
Benefits of IoT communication



more diverse solutions in a wide range of fields. NEC is a major contributor to international standardization activities aimed at promoting IoT.

vibration sensing to improve facility maintenance and applying prediction control technologies to optimize management of city water infrastructures, municipalities can achieve a fair and stable supply of limited water resources. IoT enables the collection of large volumes of different information from various sensors. However, it is difficult to produce results only by using sensor data. In order to create value it is necessary to combine, for example, vibration sensor data with maintenance management system data so that hidden dependencies can be identified and root causes extrapolated. The purpose of IoT is not the collection of data; rather it is a means by which data can be analyzed with a high degree of precision to create new value. NEC continues to contribute to the creation of new social value by providing structures that enable advanced analysis, and systems that can be used safely and securely.

High-precision water demand prediction contributes to reduction in power usage and the more effective use of water resources





Providing safety and security in cyber world and the real world through cutting-edge technologies

NEC has been involved in the safety business for many years, helping to protect people around the world from threats to their lives and livelihoods. We respect all the world's cultures and diversity, and strive to provide the safety and security that are the foundations of a bright and prosperous society.

For the safe and secure lives of people

Today, the world is facing the spread of various threats and dangers, including natural disasters caused by climate change and the diversification of cyber attacks that impact society as a whole. NEC provides services and solutions for creating a safe and secure society to cope with these threats at all levels, from individuals to families, organizations, societies, and governments; on Earth as well as in outer space. We have also expanded into new cyber security areas, striving to secure the safety of customers in both the real world and cyber world.

We believe that the key to this is preventing crises before they happen, while at the same time providing solution suites that leverage advanced technologies for enhancing emergency response capabilities. This is demonstrated by our globally deployed Safer Cities solution suite that features 7 domains optimized for the safety field.

In the biometrics field, for example, NEC has provided more than 500 systems, mostly for automatic fingerprint recognition systems, in about 40 countries around the world the past 30 years. This technology

has continued to garner top rankings in various contests sponsored by the U.S. National Institute of Standards and Technology*¹.

NEC is also responsible for developing the world's first*² "Crowd behavior analysis technology", which quickly detects unusual behavior in congested environments from camera images so as to circumvent accidents or incidents that might occur in places where many people assemble, such as stations and stadiums. The system is equipped with a combination of advanced technologies, such as high-sensitivity imaging technology that enables images of subjects in dark locations to be captured in bright color, and an ultra-high sensitivity color camera with a haze reduction feature that allows images to be projected even in bad weather. It is through these and other cutting-edge technologies that NEC is helping to create safe and secure cities.

Global implementation of safety solutions

To combat increasingly complex and escalating threats, it is essential to accurately understand the security needs of customers at a global level, and efficiently implement optimal solutions in a timely manner. In 2013, NEC established a Global Safety Division (GSD)

Safety solutions “Safer Cities”



Citizen Services & Immigration Control

Citizen services and immigration control solutions that leverage as core technologies top-level accuracy fingerprint identification, facial recognition, and other biometric identification technologies widely used in Japan, the U.S., and many countries around the world.



Law Enforcement

Solutions that support law and order, such as solutions for detection of blacklisted persons using surveillance cameras, coastal security, and intelligence solutions for crime prevention, based on the world’s most accurate “Biometric identification technologies” *1



Public Administration Services

Solutions that underpin public administration services to promote public safety and security, such as solutions for prevention of infection and manpower management through the use of IT and network technologies nurtured over many years at NEC.



Critical Infrastructure Management

Solutions for preventing occurrences of crime in critical infrastructure, such as airports, harbors, power plants, gas facilities, water treatment facilities, and stadiums, where disruptions can have a massive impact on society.



Information Management

Solutions for cyber security in an information society where hacking and other cyber attacks pose a major threat to people’s lives.



Emergency & Disaster Management

Solutions for preventing disasters through early detection of disaster threats, as well as for minimizing damage and facilitating recovery from natural disasters, such as earthquakes, tsunamis, floods, fires, and typhoons.



Inter-Agency Collaboration

Network infrastructure for sharing information among municipalities, government agencies, and relevant institutions and solutions for extracting useful information from big data obtained through information sharing and for analyzing and visualizing data for presentation.

based in Singapore. With GSD as the core, our safety business has expanded to a total of 1,000 members working in Regional Competence Centers and other locations not only in Japan but also in North America, Europe, South America and China.

NEC has also established NEC Laboratories Singapore (NLS)—our fifth laboratory outside Japan—as a research base for global solutions in the Asian region. We will build a flexible joint research structure with local research institutes and customers through which we can promote active participation in demonstration tests and create new solutions using unique advanced technologies. NEC solutions established in one country or region can

be quickly deployed on the global market because solutions are developed with a view to global implementation. To deliver a global solution to as many customers as possible, NEC promotes the standardization of product development processes and the unification of architectures.

NEC has also established an enhanced, global training system to provide training to overseas subsidiaries so that we can deliver high-quality solutions that give the customer what they want, when they want it—anywhere in the world. It is by resolving our customers’ security issues in this way that we live up to our promise of orchestrating a brighter world that is both safe and secure.

Why NEC

- ✓ Best biometrics authentication technology in the world*1 which has been provided to more than 40 countries
- ✓ Some of the most accurate media processing technologies in the world, including facial recognition and crowd behavior analysis technologies
- ✓ Sales of the world’s first*2 SDN products, wide-ranging application know-how, and specialized staff
- ✓ Organizational structure to quickly provide the latest solutions to meet the diverse needs of different regions

*1 Ranked 1st in United States’ NIST (National Institute of Standards and Technology) testing.

*2 Source:NEC

Case Study **Toshima City, Tokyo**

The world-first*1 total disaster prevention system with “Crowd Behavior Analysis technology”

The Great East Japan Earthquake struck the country in March 2011. On the day of the disaster, Toshima city were not able to make swift decisions since there was no way to promptly gather and grasp the information related to the disaster and the situations of the stranded commuters. Thus, Toshima city decided to implement NEC’s “comprehensive disaster control system” which provides integrated management for collecting, managing and distributing disaster information.

The city installed 51 disaster prevention cameras in the emergency relief centers such as temporary shelters and schools, near major transport facilities, and on major roads to collect real-time information on damage caused by natural disasters. NEC’s indigenous technology “Crowd behavior analysis technology” detects overcrowding or stagnation on disaster prevention camera footage. In addition, emergency alerts, accidents, relief center preparation and other information can be compiled centrally on a geographical information system (GIS), and then displayed visually using maps.

By collecting real-time information and offering an integrated visual representation of the overall situation, the comprehensive disaster control system enables Toshima City to make swift decisions in the event of a natural disaster. With advanced ICT, Toshima City is now able to form appropriate disaster responses for residents and visitors, such as distributing pertinent information and formulating measures to help stranded commuters.



The crowd behavior analysis technology enables to perform highly precise analyses and issues an alert if predetermined threshold levels are exceeded. Without overlooking, initial response can be delivered timely.

Interview



Yukio Takano
Mayor of Toshima City

The comprehensive disaster control system enables safe and reliable city

Toshima city, Tokyo has been focusing on disaster prevention measures striving to create a safe and reliable city for past many years. In March 2011, the Great East Japan Earthquake struck. On the day of the earthquake, transportation facilities had halted and we saw many commuters were stranded around Ikebukuro station. Though we had tried to follow ever-changing situation and grasp the information, our conventional methods, which were a sort of dispatching personnel to the sites, didn't work for such a large scale disaster. In the result, we were unable to guide stranded commuters to evacuate. Through this experience, we had realized that, in order to protect the safety and reliability of residents, to furnish a system that could rapidly gather and manage information in urgently needed.

Upon the opening of the new government office in May 2015, we launched the comprehensive disaster prevention system equipped with NEC’s “Crowd Behavior Analysis technology” Through 51 cameras installed around the city, information can be gathered in the real-time and data is automatically analyzed allowing us to grasp the changing actions of people and information such as unusual levels of congestion and delay statuses. With this information, we can now take rapid action to respond to such accidents. We distribute precise information such as the location of evacuation sites and transportation status updates when disasters occur. We continue to make our best effort to build a “disaster-resistant city”, along with making Toshima city safe and secure for residents and visitors.

Case Study City of Tigre, Argentina

NEC "Facial Recognition technology" Incorporated into the monitoring system to detect suspicious activities

NEC provides the world's fastest ^{*2} and most accurate face recognition technology which is used in the urban surveillance system in the City of Tigre, Argentina. The video feeds from network cameras installed in railway and river stations are checked against a massive database of enrolled photos in real time, to allow prosecutors, judicial institutions, and public welfare organizations to search for missing persons.

NEC has also developed and provided unique technologies such as detection of double riding on a motorcycle, a common method of purse-snatching, detection of riders without a helmet for safety purposes, behavior detection for spotting suspicious behavior (including vehicles), and license plate recognition to identify suspicious or stolen vehicles. NEC has also delivered advanced solutions such as the crime area mapping, to plot the locations of past crimes on a map for better visualization. These latest technologies are incorporated

into the urban surveillance system, contributing to safety measures across the city.

With a track record of global deployment of Safer Cities solutions, NEC will continue to contribute to the safety and security of cities through development of technologies, products and services, and enhanced partnerships.



Operation center that integrates the urban surveillance system in the City of Tigre, Argentina. NEC ICT solutions are actively used to improve safety.

Case Study City of Surat, India

The first safe city project in India to use advanced face recognition technology

NEC, together with Innovative Telecom & Softwares Pvt. Ltd., has deployed a face recognition analytics for Surat City (Gujarat). The city with a population of approximately 5 million, is a major diamond cutting and processing hub in the world. The Surat Safe City Project is a project led by Surat City Police and Surat Traffic Education Trust. The video feeds taken from the 604 cameras deployed around 113 key locations in the city, are sent to the integrated Command and Control Center to be monitored. The number of cameras is expected to increase to over 5,000 in the coming days.

To enhance the city security, Surat City Police has decided to implement a Picture Intelligence Unit (PIU) for both urban surveillance (facial & license plate recognition, and vehicle speed

violation) and forensic investigation. NEC's NeoFace® Watch for Live CCTV surveillance is currently used with 7 cameras, matching the captured face images against a watchlist of 20,000 to search for persons of interest. NeoFace® Reveal for forensic criminal investigation is used to reduce investigation time and workload.



The facial recognition system was introduced, for the first time, to the Indian police, enabling them to handle crimes before they happen, providing the citizens a sense of security

*2 *Ranked 1st in United States' NIST (National Institute of Standards and Technology) testing.

Evolved cyber security measures that predict cyber attacks

To protect companies from cyber attacks, information and speed are vital. NEC combats cyber attacks with solutions that allow companies to predict and take measures against attacks before they happen.

Quick response is the key to fighting today's advanced and increasingly stealthy cyber attacks

Cyber attacks continue to increase every year. Attack methods, including targeted email attacks, are also becoming stealthier. The effects on companies that are attacked is immeasurable—not only are they faced with losing the trust of their customers and of society, but they may also face punishments such as the suspension of their business activities. In the worst case, they may be driven out of business. This is not only true for companies, but also applies to governments and municipal offices, including municipal governments, which hold large volumes of information related to privacy. The need for enhanced measures is greater than ever.

The vulnerabilities exploited by cyber attacks do not reside only in relatively easy to manage applications, plugins and even middleware libraries are all vulnerable. A feature of cyber attacks today is the stealth of the attack—once the malware has infiltrated the ICT system and done its deed, it erases itself, leaving no easily identifiable trace.

Understanding that information and speed are key to protecting systems against these advanced, stealth-like

cyber attacks, NEC has developed "NEC Cyber Security Platform," a proactive cyber security solution that predicts the occurrence of attacks and takes measures to prevent them before they happen.

Leveraging NEC's more than 20 years of experience as a vendor of comprehensive ICT solutions and the cyber security know-how we have accumulated over that time, this platform allows customers to protect their ICT systems with cyber security equivalent to that of employing a security expert.

The platform consists of a security integrated control and management solution and a threat and vulnerability information management solution. The first solution visualizes the detailed security risks hidden in ICT systems in real time, allowing investigations and measures to be implemented by remote operation if a security incident occurs. The second solution provides up-to-date information about the latest announced threats and vulnerabilities spreading around the world, along with appropriate measures based on the practical knowledge of cyber security specialists.

Adopting this platform eliminates the need to identify servers and PCs for which advanced measures are required and devise and implement attack countermeasures, leading to a considerable reduction in outlay when a new vulnerability is detected.

Why NEC

- ✓ More than 20 years of accumulated technologies and experience in security measures that utilize ICT
- ✓ Development of human resources based on international cooperation with police agencies, government agencies and academic organizations
- ✓ Concentrated attack information and results of measures in security intelligence leveraged as knowledge
- ✓ State-of-the-art solutions that can "predict" cyber attacks before they occurs so that proactive measures can be taken

Supporting the safety of social infrastructures with outstanding human resources possessing expertise fostered over many years

The most important tool in cyber security is human resources. In recent years, hackers are rewarded for their "achievements," thus persuading them to hone their skills and persistently execute cyber attacks. Therefore, it is vital that cyber security agents are trained with higher level skills compared to those of the attackers. It is also

necessary to cooperate with partner companies to gather more technical knowledge.

NEC started human resource development from an early stage, and has been acquiring security specialized companies as our subsidiaries. We are enhancing our organization in order to train up to 1,200 security staff members by 2017, yet another example of our forward-thinking and pioneering actions.

NEC regards the cyber security business as one of the cores of our "Solutions for Society," through which we aim to promote enhancements and realizes advanced social infrastructures through the utilization of ICT.

Established SOC as Our Cyber Security Business Foundation in the APAC Region

NEC has established a new Security Operation Center (SOC) in APAC. SOC will become the business foundation for cyber security in the APAC region, utilizing the advanced operational know-how accumulated by providing security operation and surveillance services in Japan.



"Know thy enemy" - Proactive cyber security that predicts cyber attacks and implements measures in advance

One of the greatest challenges facing corporate management teams today is how to handle hidden security risks. One major problem is that it is almost impossible to devise the right countermeasures without a complete picture of the security situation, including the actual form cyber attacks might take and the impact of system vulnerabilities.

However, obtaining this big picture is not easy and involves gathering information and making decisions on a wide range of issues, such as the types of new attacks appearing, the best methods for handling these new attacks, and whether it is safe or appropriate to apply provided patches to one's own ICT system.

To overcome these difficulties, NEC has been implementing "Count Management" as a means of quantifying and visualizing its ICT systems to identify security threats and system weaknesses. Using this method, NEC has already successfully

identified all servers and terminals in the NEC Group connected to the company network.

Currently, NEC is constructing a platform that can be used to visually identify hidden vulnerabilities within the group's 180,000 servers and terminals and evaluate security risks in just one hour. NEC's proactive cyber security solution also makes it possible to predict methods of attack based on information on new threats and vulnerabilities as well as cyber attacker behavior patterns by using advanced security intelligence and implement countermeasures before an attack even happens. The biggest benefit of this solution is that its capabilities and effects have already been verified and proven within the NEC Group. NEC is now committed to delivering this solution—a solution that only we can provide—to our customers as their cyber security partner of choice.



Jun Goto
Senior Manager
Cyber Security Strategy Division
NEC

Interview

Case
Study

INTERPOL

Strengthening International security against cybercrime

In a bid to strengthen the global fight against cyber crimes, NEC signed a partnership agreement with INTERPOL which is the world's largest international police organization, with 190 member countries. INTERPOL has established the INTERPOL Global Complex for Innovation (IGCI) in Singapore, a cutting-edge research and development facility for the identification of crimes and criminals, innovative training, operational support and partnerships. NEC delivered a digital forensic platform and various other technical resources for the center, which began full operations in 2015. A driving force in the ICGL, the center offers essential assistance for national authorities in terms of investigating and identifying cyber crime and criminals, research and development in the area of digital crime, and digital security. NEC is keen to participate in further

collaborations between law enforcement and the internet security industry to contribute to the stability of security for businesses and communities throughout the world.



INTERPOL and NEC Corporation today signed a partnership agreement in December, 2012.

Interview



Douglas Tang
Business Leader
Global Safety Division
NEC

Distribute innovative managed cyber security services from Singapore

I have 3 different roles in the "Global Safety Division (GSD)", which is based in Singapore. First, I create cyber security solutions that help drive sales globally. Secondly, I develop and grow the local cyber security project delivery team in Singapore. Lastly, I help build up the team in RCC (Regional Competency Center – Public Safety) in APAC that offers technical support for NEC's cyber security solutions and also professional services in cyber security. It is important to note that the localization effort is not limited to language translation, but also to adapt to the laws and regulations of each country.

I am also putting in significant efforts in developing the cyber security skill-sets of NEC's manpower in order to handle the growing needs of our customers.

Collaborating with EDB Singapore under the STRAT (Strategic Training and Attachment Program), NEC is able to hire additional headcounts in Singapore and train them up as cyber security analysts. Part of the training includes sending them to Tokyo for a 5-month intensive training at NEC's Cyber Security Factory.

In APAC, GSD has set up SOC, similar to the Cyber Security Factory in Japan. By showcasing our solutions and capabilities in our APAC SOC, we gain a competitive advantage by being able to quickly engage with our customers as well as to offer them our latest innovative cyber security solutions. In the near future, we plan to build up such similar facilities in Europe, Africa, Latin America and other countries.



Safe Cities Index 2015

The standards used to assess urban safety

The Safe Cities Index 2015 is an Economist Intelligence Unit (EIU) report, sponsored by NEC. The report is based on an index composed of more than 40 quantitative and qualitative indicators. These indicators are split across four thematic categories: digital security; health security; infrastructure safety; and personal safety. Every city in the Index is scored across these four categories. The

Index focuses on 50 cities selected by EIU, based on factors such as regional representation and availability of data. Tokyo was selected No. 1 in the overall ranking. Tokyo received the highest score in the cyber security category, and measures through technology became the key for improvement of safe cities.

Assessing the relative safety of cities based on each category



Overall Index

Tokyo comes top in the overall Safe Cities Index 2015. The Japanese capital performs most strongly when it comes to the security of its technology assets: it tops the list in the digital security category, three points clear of Singapore in second—the widest gap at

the top of any of the four categories. Tokyo also ranks in the top five for personal safety and infrastructure safety, despite suffering regular earthquakes and being home to the world's largest urban population (38m, according to the UN).



Digital security

This category measures a city's digital security based on factors such as dedicated cyber security teams and the frequency of identity theft. North American and East Asian cities dominate the upper echelons of the list, with four US cities (New York, Los Angeles, San Francisco and Chicago) in the top ten and four Asian cities (Tokyo, Singapore, Hong Kong and Osaka) in the top five.



Infrastructure safety

This category measures the safety of a city's infrastructure, based on factors such as the quality of its roads and the number of deaths from natural disasters. High- and upper-middle-income cities dominate the top ten for this category of the Index.



Health security

This category measures a city's health security based on factors such as the ratio of hospital beds to population size and life expectancy. Zurich is in top position for this category of the Index. European cities—with their universal healthcare systems—generally perform well.



Personal safety

This category measures the more traditional aspects of a city's safety in terms of its levels of crime and illegal activity, relying on factors such as the level of police engagement and the prevalence of violent crime. Singapore was ranked in the top position for this category of the Index. Stockholm is the only non-Asian city ranked in the top five.

Safe Cities Index 2015 General Rankings Top 20

| Rank | City |
|------|---------------|
| 1 | Tokyo |
| 2 | Singapore |
| 3 | Osaka |
| 4 | Stockholm |
| 5 | Amsterdam |
| 6 | Sydney |
| 7 | Zurich |
| 8 | Toronto |
| 9 | Melbourne |
| 10 | New York |
| 11 | Hong Kong |
| 12 | San Francisco |
| 13 | Taipei |
| 14 | Montreal |
| 15 | Barcelona |
| 16 | Chicago |
| 17 | Los Angeles |
| 18 | London |
| 19 | Washington DC |
| 20 | Frankfurt |

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Supporting the safety and security of people's livelihoods and industry through ICT

NEC takes a variety of approaches to supporting traffic and urban infrastructures. NEC provides monitoring, control, and communication solutions for airports, roads, railroads, dams and rivers, and solutions to manage water and sewage systems.

Safeguarding lifelines and improving efficiency

An overwhelming swell of worldwide events—changes in the global environment, world population explosion, globalization of human activities, shifts in the international power balance associated with the development of emerging countries, and much more—is influencing our daily life. Social problems caused by devastating natural disasters, a tight supply of energy and water resources fueled by high demand related to urban population concentration, increases in traffic jams and accidents, and a number of other factors also continue to intensify. It is imperative that the lifelines that support human life, such as energy, water, transportation, logistics, broadcasting, and telecommunications, continue to operate stably.

NEC believes that people's everyday lives can be made more secure and comfortable, and people's safety assured in the event of a disaster, by using and combining state-of-the-art ICT.

For water and energy lifelines, for example, NEC combines sensors, networks, and data analysis technologies to provide a more efficient and stable supply of water and energy, and enable it to be used more productively. For instance, NEC's technologies can be used to "identify" problematic areas and "sense"

current conditions by using information acquired from security cameras and vibration sensors, raising the effectiveness of the inspections and maintenance that are critical to maintaining and preserving lifelines by removing human error and oversight. The data used in these systems is collected in real time via networks, analyzed by using big data analysis technologies that draw on machine learning, and output as forecasts and estimates. Combining the latest ICT in this way makes it possible to prevent unplanned outages by detecting anomalies that lead to failure before they occur.

The application areas for this technology are varied and include power plants, manufacturing plants, railroads, roads, airports, bridges, tunnels, and large-scale buildings. Additionally, by leveraging autonomous robot technology, the equipment control cycle—collection of information through monitoring sensors, big data analysis, and problem identification—can be automated and systemized.

Similarly, in the area of transportation and logistics, by analyzing data collected from sensors mounted on traveling vehicles, and analyzing images of cameras installed on roads, traffic jam information can be provided in a timely manner and road construction can be implemented at the most appropriate timing. This allows transportation lifelines to be operated safely, securely, and economically based on accurate city planning.

Traffic and urban infrastructure solutions



Roads, Railroads and Airports

Contributing to the realization of a society where citizens are able to live safely and securely by providing solutions that support public administrations, such as traffic control systems, ETC systems, train radio systems, air traffic control systems, and flight information display systems.



Local Public Entities, Fire Departments Waterworks Bureaus, and Other Comprehensive Facilities

Contributing to the creation of places where people can live safely and securely by providing solutions such as municipal government systems, fire-fighting command systems, fire-fighting digital radios, dam and river remote surveillance systems, and comprehensive facility surveillance and energy management systems.



Hospitals and Clinics

Contributing to the realization of a society where people are able to live healthy lives by providing solutions in many fields including medical care, nursing care, and health care, such as electronic medical recording systems, and regional healthcare information networks.



Banks, Insurance and Security

Contributing to creating an environment in which people can use financial services without fear or anxiety by providing highly reliable and accessible solutions such as large-scale mission critical systems for financial institutions, sales office systems, ATMs, and Internet banking.



Broadcasting Stations, Newspaper Publishing Companies and Publishing Companies

Contributing to enriching and improving the convenience of people's lives and their access to broadcasting and media services by providing solutions for quickly and reliably transmitting broadcasts and information via the television and newspapers. These systems include TV program production, news reporting and transmission systems, digital TV transmitters, and content management systems for newspapers.

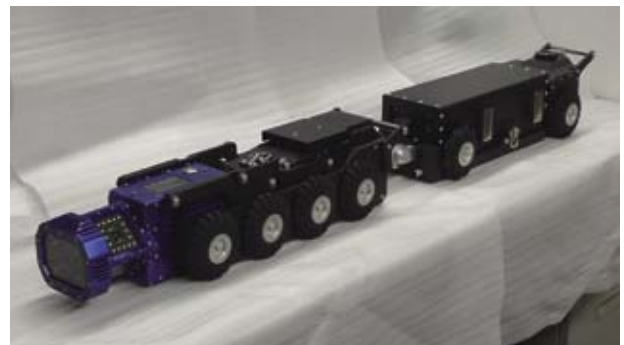
Comprehensive ICT for core infrastructures

Annual investment in social infrastructures is expected to reach several hundreds of trillions of yen on the back of booming investments by emerging countries. This scale of investment indicates that there are many different needs that must be met in this field, and many issues to be resolved.

When needs are diversified in this way, it can be effective to use a combination of technologies such as sensors, networks, IT, and robotics. However, stability is not necessarily achieved by a simple collection of technologies. The key to stable operation is the ability to integrate these systems, and implement outstanding project management.

For example, in the development of robot technology, NEC

Dedicated Sewage Pipe Inspection Robot



The inspection robot uses NEC's unique image recognition technology and state-of-the-art analysis and sensing technologies to enable high-precision inspections, and is also mobile enough to travel long distances through pipes.

Why NEC

- ✓ Have accumulated absolutely reliable and advanced technologies through our involvement in social infrastructure business for more than 50 years
- ✓ Abundant track record in major transportation systems, such as airport solutions, which are currently operating in more than 50 countries and regions around the world, and road traffic control and railroad communication systems, where we hold the top market share in Japan.
- ✓ Highly reliable broadcast and video systems that provide high quality videos

has succeeded in using dedicated inspection robots to efficiently maintain and extend the life of sewage pipes. The robots are sent into dirty pipes to photograph the condition of the pipes from the inside. By using a combination of state-of-the-art technologies including NEC's unique image analysis technology the robots can efficiently detect faults (damage, etc.) in underground, long-distance pipes that could not otherwise be detected. This not only reduces the time and costs involved in inspecting and evaluating the conditions of sewage pipes, but also contributes to the safe and secure operation of important infrastructures.

Realizing total management of water resources

According to Global Environment Outlook-5 (GEO5) published by the UN Environment Program (UNEP), the population under water stress and people who suffer water scarcity or unstable availability of water is estimated to reach two-thirds of the world's population by 2025. Water pipe leaks are a serious problem in Europe and the U.S., where antiquated water pipes are showing significant signs of aging. For underground water pipes, it is extremely difficult to identify the location of a leak, or perform visual inspections and water leakage monitoring with cameras.

Although water leaks are generally checked by experienced technicians who use special detectors to check for leaks by sound on the street, there are still many serious leakage incidents that occur. The water leakage detection solution that NEC developed in collaboration with Gutermann AG based in Switzerland, which combines high-precision sensors that detect the sound of running water, networks to transmit the collected data and a cloud, identifies water pipe leaks with pinpoint accuracy based on the analysis results. This solution contributes to reductions in infrastructure maintenance costs, as the water leakage status can be checked accurately from a website where leakages can be detected efficiently at an early stage to minimize damage from water leakage.

Moreover, in research conducted with the Imperial College London, water pressure and vibration data are collected by sensors, and modeling is performed by using big data technology in order to electronically control the pumps and valves. This technology prevents the bursting of antiquated water pipes during the construction of highly efficient city water infrastructures, leading to the creation of city water infrastructures that can deliver water to meet demand, without waste.

NEC will continue to enhance its cooperation with partners who possess excellent technologies to solve water related issues.

Case Study Chugoku Electric Power Company

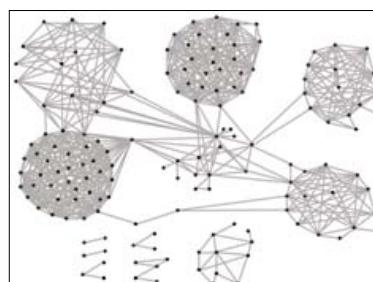
Early detection of anomalies using big data analysis in a large-scale plant

The Shimane Nuclear Power Plant, run by Chugoku Electric Power Company, has adopted NEC's Prediction Monitoring and Diagnostic System, which uses a massive amount of operation data (big data), including output, temperature, and pressure, to detect abnormal operation at an early stage.

The failure prediction monitoring system is the world's first system that uses data gathered from a large number of sensors installed in factories, power plants, and other large-scale industries for analysis using NEC-unique Invariant Analysis technology to discover any anomalies before they result in failures.

Three years of research with Chugoku Electric Power Company proved that it is possible to detect failures at several hours earlier stage than before by analyzing data from the past. By discovering failures at an early stage, damage to plants can be minimized and switching to a backup unit and repairs are made possible.

Invariant Analysis technology



Automatically mapping the depth of relationship among all sensors during normal operation helps discover any abnormal relationships in operation.



Case Study

Airport Solutions

Global development of airport solutions

As demand for air transportation increases year after year, it leads to excessively dense and crowded airports and air routes, and demands system development for achieving efficient and safe air navigation. Additionally, because system failures may have great effects on society, an absolutely reliable system is essential.

For over fifty years, NEC has continued to provide airport solutions across the world, with a focus in Japan and other parts of Asia. NEC's air traffic control radar uses the latest semiconductor circuit technology and signal processing technology to accurately detect aircraft in the airspace. Secondary monitoring radar can acquire aircraft information even in congested airspace, improving the effectiveness of air traffic control services, and contributing to smooth, safe air traffic control.

NEC's track records of commercial contracts include air traffic control radar from the Civil Aviation Authority of Taiwan for the

Taoyuan International Airport and Taichung International Airport, and Civil Aviation Authority of Nepal for the Tribhuvan International Airport modernization project in Kathmandu. From here on, NEC will continue to enhance air traffic control related solutions, and accelerate activities to meet regional needs.



Supporting the entire airport with the latest technologies and connecting the world's skies safely and comfortably

Countless numbers of people travel by plane and the number of passengers are expected to double by 2030. With that in mind, what are expected in airports? Highly precise and smooth procedures that lessen passenger waiting time, high quality services that respond to their various needs. Furthermore, management of security risks, growing and evolving by the years, is essential. For example, NEC provides a system comprised of the Integrated Biometric Clearance Gate as well as the Self-Boarding Gate. This system allows passengers to proceed with one-step airport departure travel document checking, flight details checking, and immigration clearance, as well as self-boarding at their own convenience in a set of automated gates. It takes merely

25 seconds to clear, and the reduced waiting time will provide passengers more time to relax and enjoy the entertainment services at the airport. Highly reliable and accurate biometric algorithms are used for this system. Safeguarding passenger identities and flight bookings will enhance aviation security. Also, with the world's first "crowd behavior analysis technology" developed by NEC, we will be capable of assisting in the early detection of accidents and incidents. With its highly reliable and advanced ICT, NEC supports systems of the entire airport, ranging from air traffic control to service facilities, thus achieving safe and smooth operations. Actual operation results cover over 50 countries worldwide, contributing to the realization of airports that can be used safely and comfortably.



Magdalene Tan
Senior Sales Director
NEC Asia Pacific Pte Ltd.

Interview



Next generation network solutions enabled by NEC's ICT

The fusion of IT and network technologies accumulated by NEC over many years has evolved into solutions which enable simple and flexible network development, customer operations and swift service deployment.

Solution for telecom carriers that contributes to the establishment of social infrastructure

In recent years, the business environment surrounding telecom carriers has become increasingly severe. Reductions in capital investments and operating costs, as well as increasing profits, have become vital management issues for telecom carriers with the upsurge of global data traffic associated with the popularization of smartphones and increased use of the cloud. With accomplishments in the global market for meeting the demands and needs of telecom carriers, NEC offers the following seven major solutions: (1) Wireless broadband access, (2) Mobile backhaul, (3) Core and metro networks (Optical & IP), (4) Submarine cable systems, (5) Service platform, (6) Telecom Operation & Management Systems (TOMS*1), and (7) Carrier SDN. The highly reliable, high-quality microwave radio system "PASOLINK" was developed over the long history of NEC's radio communications business, and is widely adopted

in more than 150 countries worldwide.

NEC is also a top-class vendor that has been dealing with the development of submarine cable systems for more than 40 years, and has established a stable supply system to support the production, installation, and laying of all system elements, from terminal equipment for cable stations to submarine cables and optical repeaters. NEC has a track record of laying more than 200,000 km of submarine cable, which is equivalent to approximately 5 times around the globe.

NEC is also dedicated to the delivery of TOMS in collaboration with NetCrackerTechnology (NetCracker) a U.S. subsidiary of NEC, which offers business and management support solutions to telecom carriers worldwide. We have a history of providing industry-leading services to more than 200 telecom carriers around the world in the past 20 years. Furthermore, in the field of network virtualization and control, specifically SDN and Network Functions Virtualization (NFV), NEC contributes significantly to the diversification and sophistication of the telecommunications business.

*1 TOMS: Telecom Operation Management Systems

Network & Service Solutions



Wireless broadband access

NEC's wireless broadband access solution provides a reliable and high-performance wireless broadband environment indoors and outdoors. Using various communication methods such as 3G, LTE and Femto, we are able to respond to accelerating needs for high-speed and diversified mobile communication services.



Mobile backhaul

NEC's mobile backhaul solution efficiently transfers large volumes of mobile data traffic, which continue to increase due to the proliferation of mobile terminals, to a core network by an advanced radio microwave communication system that integrates wireless and optical IP technology.



Core & metro networks (Optical/IP)

NEC's core & metro networks (Optical/IP) solution enables large volume data traffic to be economically transported at high speeds via fixed and mobile communication services that use network products such as routers, switches and optical transport.



Submarine cable systems

NEC's submarine cable systems solution supports societies across the globe by using long distance and large capacity optical submarine cable systems that serve as the foundation of global networks. Furthermore, NEC provides submarine earthquake observation systems which quickly report the occurrence of oceanic earthquakes.



Service platform

NEC's service platform solution provides a combination of solutions to realize an array of communication services that utilize smartphones, tablets and IoT device terminals. These range from constructing network service platforms to organizing communication lines and consulting.



Telecom Operation & Management Systems (TOMS)

NEC's TOMS solution implements Operations Support Systems (OSS) and Business Support Systems (BSS) to support the business operations of telecom carriers. This solution provides access to end-to-end services, from network communications management to automatic charging and billing.

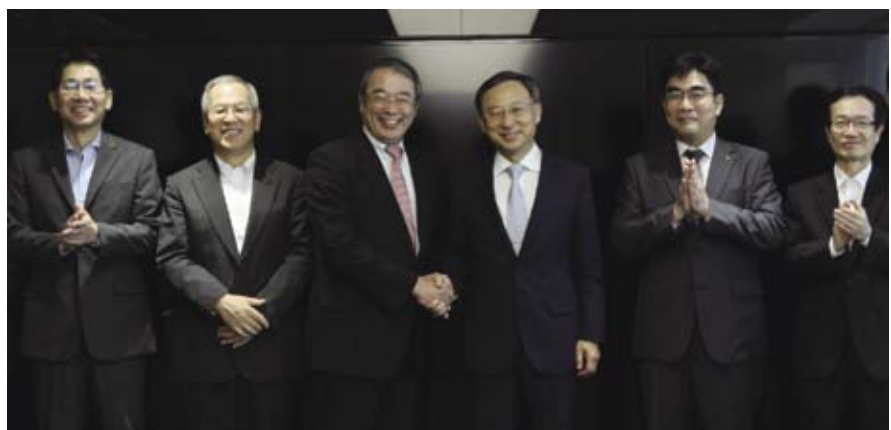


Carrier SDN

NEC's carrier SDN solution realizes improved profitability through increased equipment efficiency, reduced operating costs, and new service creation. This is achieved by applying virtualization technologies integrated with IT and network technologies, to all network systems including network and service nodes.

Collaboration with Korea Telecom (KT), a leading South Korea-based telecom carrier, in the field of SDN/NFV and 5G next-generation mobile telecommunications networks

NEC concluded an agreement for collaboration with KT in the field of SDN/NFV and 5G next-generation mobile telecommunications networks. Both companies are promoting research and development in extensive areas of the future network, utilizing SDN/NFV and 5G technologies.



Why NEC

- ✓ Developed the world's first*² vCPE solution product, which was adopted by Telefonica Brasil (Vivo)
- ✓ Provide management and operation support for more than 200 telecom carriers worldwide in the TOMS area
- ✓ Proven reliability and expertise as a major provider of infrastructure for telecom carriers in about 170 countries worldwide
- ✓ Track record in the laying of more than 200,000 km of submarine cable equivalent to approximately 5 times around the globe

*2 Source: NEC

Case Study

Ultra-compact microwave radio system "PASOLINK"

Highly reliable wireless transmission radio system used in 153 countries

NEC has an accomplished history of providing highly reliable wireless transmission radio systems that operate without fail. NEC's wireless transmission technologies are highly evaluated by our customers for successfully supporting long-distance wireless transmission under a wide range of conditions where optical cables are difficult to install, including metropolitan areas, deserts, mountainous regions and wetlands. NEC's ultra-compact microwave radio system, "PASOLINK," features a wide variety of advanced wireless technologies cultivated under challenging environmental conditions. PASOLINK has been adopted by telecommunications businesses throughout 153 countries worldwide, boasting more than 2.55 million shipments* since its development in 1984.

In recent years, in addition to mobile and data-circuit services, NEC's PASOLINK technology is contributing to the urban security field, where video data from high-definition

surveillance cameras can be transmitted wirelessly. NEC aims to continuously respond to the evolving needs of society with communications infrastructure that is essential for supporting the safety, security and comfort of society.

* as of September 2015



NEC supported Telefonica Peru in the maintenance of essential infrastructure for the city of Iquitos in the Amazon river basin.



In the city of Liverpool, Australia, PASOLINK has been adopted as the data transmission infrastructure for surveillance cameras and other systems.

Case Study

FASTER Submarine Cable System

Optical Submarine Cable Systems Supporting the Ever-increasing demand for Global Communication

NEC is currently constructing "FASTER", an optical submarine cable system that will connect the west coast of the United States and Chikura (Chiba prefecture) and Shima (Mie prefecture) in Japan. The cable is expected to be ready-for-service in April 2016.

A consortium of six global companies (China Mobile International, China Telecom Global, Global Transit, Google, KDDI and SingTel) signed an agreement with NEC in August 2014 to build this new Trans-Pacific cable system.

The FASTER cable is the first Trans-Pacific cable to feature the latest 100Gb/s DWDM (Dense Wavelength Division Multiplexing) technology. It has an initial design transmission capacity of 60Tb/s, which is an equivalent to transmitting roughly 1,600 DVDs per second.

FASTER will inter-connected to the SJC (Southeast-Asia Japan) Cable, another NEC built optical submarine cable, which connects Japan and Southeast-Asia. Together with the SJC

cable, FASTER will answer to the every-expanding needs of the Asian economies to connect with the United States.

In the coming years, major international events will be held in Japan, which we hope the FASTER cable will become the essential communication network to distribute the contents to the global communities.



FASTER will serve as a vital communication network for the G7 Summit in May 2016 (at Ise-Shima), and other global events.

Orchestrating IT and network technologies to create value for the next generation

Committed to supporting next-generation telecom carrier networks, NEC is an active member of international standardization organizations working in the telecom field. In addition to SDN/NFV based networks, we are also promoting the development of wireless broadband solutions such as 5G that are targeted for rollout in 2020.

IT virtualization technologies are being applied ever more frequently in network areas, as evidenced by SDN/NFV, and NEC is at the forefront of technological evolutions that will lead to the development of a simple and flexible next generation network infrastructure. SDN/NFV will enable ideal traffic handling by using automatic coordination control technology to reduce the total operation costs.

NEC has already started providing virtualization solutions for communication networks and data centers

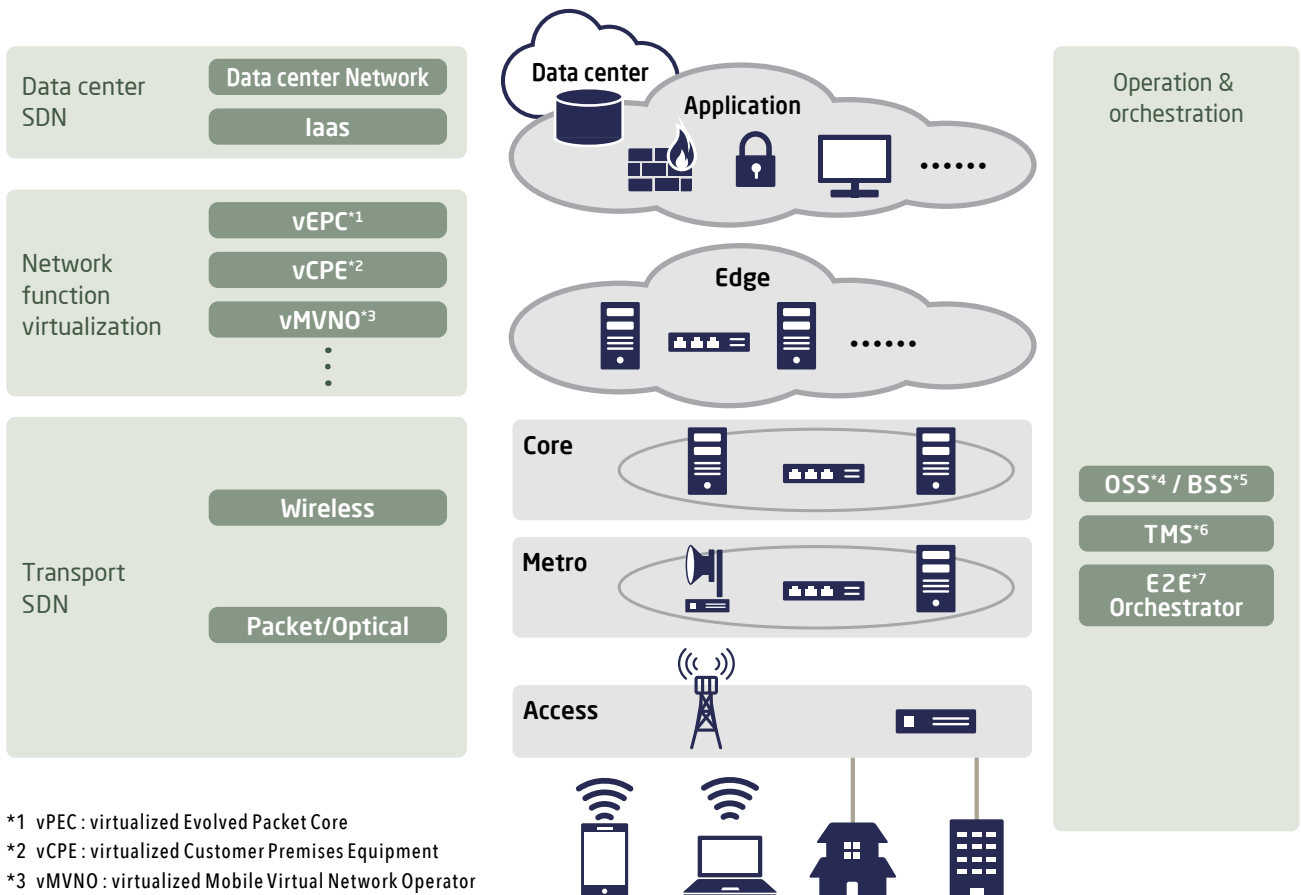
in the form of “virtualized Evolved Packet Core (vEPC),” “virtualized Mobile Virtual Network Operator (vMVNO),” “virtualized Customer Premises Equipment (vCPE),” and the “UNIVERGE PF series.” Not only do we have a record of market-proven accomplishments, we are also ahead of the competition.

SDN/NFV meet the need for sophisticated and diversified telecommunications services

With the rapid growth of mobile terminals, many companies have entered the video and message distribution business. However, demands in this market have become increasingly diversified, with users requiring secure networks, bandwidth guaranteed networks, and even IoT connectivity to connect their various devices to the network. Telecom carriers, who operate the communications infrastructures, will not be able gain the revenue they need to justify investments simply by building an individual network for each different requirement.

NEC’s Carrier SDN and NFV Solutions

NEC provides solutions for carrier networks divided into four major areas



*1 vEPC : virtualized Evolved Packet Core
 *2 vCPE : virtualized Customer Premises Equipment
 *3 vMVNO : virtualized Mobile Virtual Network Operator
 *4 OSS : Operation Support System
 *5 BSS : Business Support System
 *6 TMS : Traffic Management Systems
 *7 E2E : End to End

There are many cases where a few months are required to respond, which may lead to opportunity losses. SDN /NFV are being viewed as a solution to this issue. With NEC's SDN/NFV solutions, virtualization technologies are applied to not only networks, but also service control nodes. Resource deployment that matches the requirements of users and service providers is dynamically performed across the entire network system, allowing an efficient response to traffic increases and fluctuations and more effective use of network equipment. NEC has been working together with NetCracker to address the potential growth of the SDN /NFV markets and provide SDN/NFV solutions to our global customers. A true pioneer, NEC has already launched a range of innovative SDN/NFV solutions on the market ahead of all competitors. By joining forces with NetCracker, who has a strong customer base in the

global deployment of TOMS as well as advanced development know-how in the field of management and orchestration (MANO) solutions, we will be able to accelerate coordination between SDN/NFV and enhance our solution response capability. While utilizing the advantages of NetCracker to the utmost, NEC will arrange the optimal resources, such as development, sales and marketing engaged in the SDN/NFV domains worldwide, under a new organization to further promote cross sales and maintenance support. We will provide solutions and services to telecom carriers that precisely meet their specific and advanced needs, and promote the creation of new customer-oriented business models. In fact, NEC has already made a major contribution in the global deployment of virtualization technologies in the telecom field by providing the world's first vCPE service to Telefonica Brasil (Vivo).



Andrew Feinberg
President & CEO
NetCracker Technology

Combining NEC and NetCracker Strengths to Drive SDN/NFV Success

In 2015, NEC and NetCracker joined forces in order to help communications service providers (CSPs) address the most daunting operational task facing them today: migrating from the physical world to one that is virtualized and built in the cloud. Delivering cutting-edge SDN/NFV solutions that empower operators with the ability to operationalize and commercialize new and innovative business models marks a major opportunity for NEC and NetCracker. Today, CSPs are working with vendors that have the tools and expertise in bringing virtualized technologies out of initial testing phases and into real-world deployment, introducing new capabilities that make them more competitive with Over The Top (OTT) players, cloud providers and other operators. By leveraging network and service virtualization, CSPs can tap into previously uncharted markets, such as those presented by IoT and cloud-based applications for business and residential users.

In order to correspond to these business environment, NEC/NetCracker's SDN/NFV solutions empower CSPs with highly flexible, customizable and scalable products and services that can bring network virtualization objectives into reality. NEC and NetCracker have already taken great strides in validating their ability to bring virtualized solutions beyond testing phases and into real-world deployment (operationalization), as seen with customers such as Telefonica Brazil (VIVO). NEC and NetCracker have also collaborated on several other successful proofs of concept, including projects at Portugal Telecom, Swisscom and Telekom Austria Group. So what's the bottom line? Virtualization is the communications industry's future. NEC's and NetCracker's well-positioned partnership in SDN/NFV is critical, as the joint business brand promises CSPs access to two experienced vendors with a focus and strength in operationalization, allowing operators to get started with virtualization faster and fundamentally transform their businesses.

Case
Study

Telefonica Brasil

Contributed to the world's first* vCPE (virtualized Customer Premises Equipment) service

NEC contributes to the world's first "virtualized Customer Premises Equipment" (vCPE) service, initiated by "Telefonica Brasil (Vivo)," a subsidiary of Telefonica, one of the world's leading telecom carriers.

NEC's vCPE solutions will enable network functions such as IP address allocation, security and others to be shifted away from the residential gateways and towards Telefonica Brasil's own network. This will improve Telefonica Brasil's broadband access network service through better and stronger operability and safety, as well as network simplification.

The virtualization of network functions enables Telefonica Brasil to reduce the hardware use rate of the network system, raise the efficiency of operations, and quicken the development and distribution of new services, thereby allowing end-users to

enjoy a wide variety of services while promoting convenience and customer satisfaction.



Operation and maintenance of the broadband access network services has been improved and creation of new services for end users on various household terminals are expected.

New value creation expands our customers' profit - NEC's SDN/NFV solutions for telecom carriers

ICT such as IoT and 5G next generation mobile networking will create new services in many industries including transportation, logistics, healthcare, and manufacturing.

Networks are a critical element of social infrastructure. Today's networks, however, are required to execute massive amounts of connection processing, provide broadband and extreme low latency connectivity, operate highly efficiently to implement services faster, and ensure security.

NEC not only helps telecom carriers build networks, we also provide customers with the flexibility they need to respond to changing demands by enabling automated, sophisticated orchestration and control of complex networks, thereby achieving operational efficiency without sacrificing quality. SDN and NFV are

effective solutions for transforming our customers' businesses through the rapid delivery of services. In fact, our vEPC and vCPE solutions have already been adopted by telecom carriers for their services.

Moving forward, NEC will be accelerating distribution of solutions that use SDN and NFV so as to deliver new services rapidly and efficiently by proactively forming business partnerships, including with global vendors, and distributing an open eco system to link various components through End-To-End orchestration.

NEC uses its pioneering SDN/NFV solutions to take the lead in creating business models in all environments—including IoT—that will satisfy both end users and telecom carriers.



Atsuo Kawamura
Senior Vice President
NEC

Interview

* Source: NEC

Manufacturing / Logistics / Distribution / Services (NEC Global Enterprise Solutions)



Transform your potential into business growth

Enterprise business today requires value chain innovations that connect people, things, and processes to overcome challenges and create new value.

Why is value chain innovation required now?

The enterprise market, encompassing the manufacturing, logistics, distribution, and service industries, is facing great changes in business environment. The causes are varied, but include a number of modern phenomena, such as multipolarization of the global market accompanying the growth of emerging market economies, intensified global competition, sophistication and diversification of customer needs in mature markets, and reductions in labor forces due to low birthrates and aging population.

To succeed in the global market, limited resources must be used effectively to improve productivity and increase the efficiency of all processes along the supply chain, from manufacturing to logistics and sales. However, as the market has transformed and diversified, the service and process innovations required to make these improvements can no longer be achieved by individual companies.

What is required is value chain innovation, through which new value is created by connecting people, things, and processes along the supply chain that links "MAKE" (the manufacturing industry), "CARRY" (the logistics industry), and "SELL" (the distribution and service industries).

By connecting the value chain where things are manufactured, transported, and delivered to consumers to the information and knowledge obtained by using advanced ICT, new social value emerges that helps people live more prosperous lives. This is the value chain innovation that is proposed by NEC, which we

continue to cultivate as we pursue innovations in ICT. NEC strongly believes that a process of innovation by which new value is created can be constructed by incorporating ICT, such as IoT, big data, and SDN into the value chain.

This process consists of three steps: collection, whereby behaviors and actions in the real world are translated into data by IoT; analysis, whereby the value of the collected data is enhanced by big data analysis technologies and transformed into information that can be used for services; and operation (or control), whereby the information is used to achieve seamless coordination along the value chain. Incorporating the new awareness and added value discovered through these steps leads to innovations in business processes and the value chain itself, giving rise to new products and services that deliver a high degree of added value.

NEC solutions provide total support for "MAKE", "CARRY", and "SELL"

Customers in the enterprise market—and the manufacturing industry in particular—are in urgent need of innovations and enhancements that will enable them to pursue growth and resolve issues such as how to reduce inventories, shorten lead times, adapt to change, and optimize global supply chains.

In 2012, NEC established the NEC Manufacturing Co-Creation Program to provide support for our enterprise customers and share the benefits of our achievements in

NEC Global Enterprise Solutions



Manufacturing

NEC provides global business systems that leverage our extensive experience in developing production innovation and creating business platforms as a leading supplier of business management, design, production, supply chain reform, and after-sales service solutions. With a service portfolio that features both on-premises and service solutions, NEC's business systems can be tailored to meet the individual needs of customers who are looking to build or standardize their global business platforms.



Logistics

For customers facing issues in logistics, NEC provides solutions that introduce visual insight into global logistics operations. By providing information on "what, where and how much" in realtime, customers can control inventory, manage operations more efficiently, and optimize supply chains, leading to improved shipping quality and higher customer satisfaction.



Retail

For retail industry customers, NEC provides diverse packaged solutions built by leveraging expertise and decades of knowledge accumulated through supporting the world's leading retailers. NEC offers one-stop support processes that include: IT Consulting, Implementation and Deployment of Solutions, and Store System Operations and Maintenance. Our innovative retail solutions utilize cutting-edge ICT to help chain stores to expand, and fuel business growth by improving the efficiency of store system operations, aligning the organization's selling spaces with consumer's needs, and providing an ideal customer experience.

developing and implementing production innovations. With this concept, we are not only providing a range of solutions, but are also working closely with more than 1,700 members from 600 companies (as of September 2015) in the manufacturing and other industries to "co-create" Process Innovations (Smart Factories) and Product Innovations (Service-Oriented Hardware) based on global production process innovations and state-of-the-art IoT. NEC also provides unique image recognition



Hospitality

NEC delivers a comprehensive hospitality solution that supports all aspects of our customers' hotel business, including a telephony system used by many global hotel chains, a mission-critical PMS that combines global standards with Japanese-style hospitality services, and digital signage, face recognition and other state-of-the-art technologies.



Automotive

NEC offers the production, sales, and after-sales services crucial for global business. The efficient business systems and cloud-based services offered by NEC allow automotive dealers to expand their sales networks quickly and easily. NEC's automotive solutions also include services that allow sales companies to see and analyze frontline sales and maintenance data in real time, contributing to global sales expansion.



Transportation and Traffic

NEC provides public transportation solutions that improve management stability by enabling the accurate and reliable collection of fares, and contribute to the establishment of safe and secure urban infrastructure that is easy and convenient for people to use, thereby creating safe and efficient lifelines that improve people's lives.



Cross Industry

NEC provides an extensive cross industry portfolio including ERP solutions that support global business management, business consulting services to help customers expand their business, and ICT-LCM services to enable smooth business administration.

technologies for transportation that increase the efficiency of shipping inspections, and we have improved logistics quality by developing a solution visualizes the status of products during transportation, thereby letting the customer know the location of their goods at any given time. These are just some of the steps we are taking to provide our customers with an increased sense of security and satisfaction. In the retail industry, NEC leverages capabilities honed

Why NEC

- ✓ Providing solutions with the Japanese stamp of quality and value cultivated by supporting convenience stores and automobile manufacturers
- ✓ Experience and know-how in manufacturing innovations and supply chain innovations within NEC
- ✓ IT Service LCM Model which offers round-the-clock store management and service
- ✓ An innovation process supported by unique technologies that produces value for customers

by providing IT support to multi-store customers, such as convenience stores to offer store management and service solutions that enable round-the-clock operations on a global scale. We also help our customers achieve increased efficiency and functional enhancement by using our unique big data analysis technologies to enable accurate demand forecasting, thereby improving automatic ordering, and our sensing technologies for improvements at the sales counters.

A suite of solutions that enhance and optimize business foundation, leading to increased business efficiency

NEC provides a suite of solutions in the form of NEC Global Enterprise Solutions for customers who are expanding their business globally.

This solution suite is centered on providing four important value. The first is leveraging our expertise accumulated by supporting the world's leading companies—from convenience stores to automobile manufacturers—in Japan and across the globe, as well as through our position as a leading global manufacturer.

The second is our ability to provide step-by-step solutions tailored to the business expansion and growth aims of our customers, which differ by country and region. The third is providing of one-stop LCM (Life Cycle Management) that utilizes IT in all stages, from system planning, consultation, and development, to deployment and support. The fourth is our extensive service portfolio of state-of-the-art authentication solutions that feature some of the best technologies in the world, such as our unique face and fingerprint recognition technologies*. As a social value innovator, NEC offers solutions to enterprise customers in industries such as manufacturing, logistics, retail, hospitality, automotive, and transportation and traffic, in locations throughout the world.

As a social value innovator, NEC offers solutions to enterprise customers in industries such as manufacturing, logistics, retail hospitality, automotive, and transportation and traffic, in locations throughout the world.

Our goal is to achieve value chain innovations that create new value across all processes that link the making, carrying and selling of goods, and by doing so, help people live more prosperous lives.

Case Study

TOSHIBA MACHINE CO., LTD

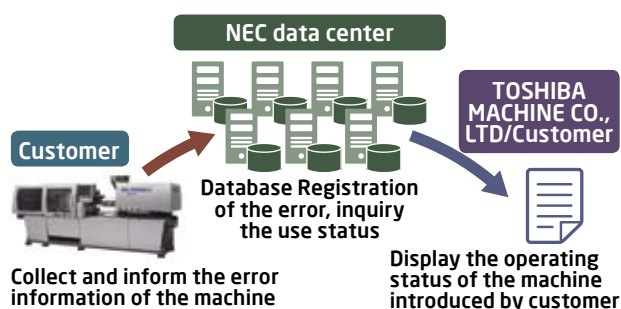
Preventative maintenance leveraged by IoT brings new business

TOSHIBA MACHINE distributes various industrial machines to manufacturing factories of automobiles and electronics. The company, in recent years, has faced challenges to survive the intensifying global competition and tried to deliver new services of higher added value. NEC had been chosen as a partner and provided TOSHIBA MACHINE with entire system consulting services from the business planning, system design and implementation to the final service deliveries.

The main challenge was agile maintenance services. It was conventionally delivered upon receiving a failure report so that it used to take long time to recover the machine. In the meanwhile the user was unable to operate its business with the machinery. NEC proposed preventative maintenance service leveraged by IoT. It enables to precisely grasp the conditions of parts and consumption articles by analyzing data from equipment. The new service makes the repairing work more efficient by preparing analysis of cause before on-site handling and

reduces day-long repairing work to one hour. Such efficiency enables to decrease 15% of on-site travel cost by cutting frequency of visit. It also improves machine utilization by predicting a failure. Parts maintenance and replacement services are delivered at appropriate timing, users' businesses are smoothly operated.

Preventative maintenance system configuration



In TOSHIBA MACHINE, failure and operating information from injection molding machine controllers is collected and stored in a cloud service. Such data is utilized for troubleshooting, preventive maintenance, and proposing service parts and consumption articles.

* Ranked 1st in United States' NIST (National Institute of Standards and Technology) benchmark testing.

Case Study **YAMATO SYSTEM DEVELOPMENT CO.,LTD.**

Reduces time and costs with a product inspection support system that uses high precision image recognition technologies and gravimeters

YAMATO SYSTEM DEVELOPMENT (YSD) was established following its split from the computer section of Yamato Transport. Apart from sustaining the Yamato group with information system, YSD also distribute IT solutions to customers of various business industries, through their abundant lineups of businesses.

The logistics outsourcing business, in particular, handles a large amount of pamphlets and manuals without barcodes and product identification information. In order to maintain a high shipping quality, it is necessary to conduct visual and manual product inspection daily, hence YSD was seeking for solutions to improve efficiency in terms of manpower and time.

NEC, having corresponded in creating labor saving mechanisms using its image recognition technologies and gravimeters, developed an image and gravimeter inspection system that instantly detects product types and numbers, reducing the burden of inspection work performed by workers. Furthermore, with YSD's know-how in logistics and inspection, as well as their system integration function for warehouse management system, a total

management of product master, shipping instruction data, inspection results and the like is now made possible.

This inspection support system, an industry first to be fully operated in the logistics industry, is aimed at optimizing the inspection work in YSD and achieving a 20% reduction in the overall cost, realizing a highly accurate shipping quality, to support a society that allows its citizens to live comfortably.



Realizing high efficiency and cost reduction by introducing the inspection support system into the YSD warehouse located in "Haneda Chronogate," Yamato group's total logistics terminal, and contributing to our comfortable lifeline.

Case Study **President Chain Store Corporation (7-Eleven)**

The ICT partner that supports non-stop operations 24 hours a day, 7 days a week

7-Eleven, open 24 hours a day, 7 days a week, is a franchise chain of convenience stores expanding worldwide. In Taiwan, with over 5,000 stores run by local partner President Chain Store Corporation and located across the country, it is a social infrastructure that is essential for daily life.

NEC supports its client companies through total storefront solutions that enable non-stop operations and provide prompt failure handling if the need arises. NEC provides solutions that are flexible enough to meet the needs of individual stores in all phases of operation, including single-unit control operations, rapid deployment of new stores, and quick startup of new services on a nationwide scale.

NEC also provides robust support for product delivery through an ICT infrastructure that allows products to be supplied in ways that meet the specific needs of customers, and implements improvements by running PDCA (plan, do, check, act) cycles on an ongoing basis. Furthermore, by providing call centers that respond rapidly to problems that may occur in stores and

offering onsite maintenance services where engineers directly perform maintenance work at the store, NEC demonstrates its breadth of commitment to its retail customers.

As local infrastructure becomes increasingly complex and diversified to meet demands for services to be available around the clock, NEC's advanced logistics and distribution systems will play a major role in creating a society that is highly efficient, safe, and secure.



NEC has gained trust from local people with our deep knowledge about the convenience store industry, hardware and software support, and quality after-sales services.



Yutaka Matsushita
Senior Vice President
NEC

NEC Industrial IoT: Responding to change and revitalizing the manufacturing industry

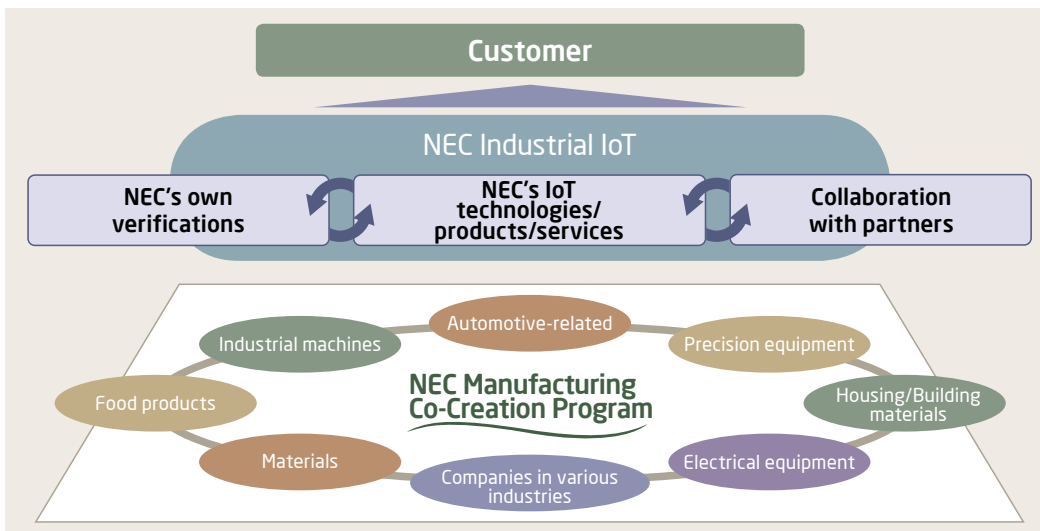
After the collapse of the Lehman Brothers, the Japanese manufacturing industry has been hit by a series of crises, including natural disasters such as the Great East Japan Earthquake and major floods in Thailand. We are facing difficulties that, unlike in the past, cannot be overcome by improvements and reforms implemented by a single company.

As a manufacturer, we at NEC felt that our own initiatives could benefit others, and with this thought, we decided to launch the NEC Manufacturing Co-Creation Program in 2012 to provide a platform for everyone to share their issues, and build a vast knowledge base that could be tapped when needed.

Currently, we are seeing strong waves of innovations in IoT-based products and services, and transformation of business models and entire industries, particularly in Germany and the United States. Even in the Japanese manufacturing industry, the use of IoT has been gathering momentum as a means of developing a competitive advantage, and responding to customer needs.

At NEC, we believe that the two key points for using IoT in the manufacturing industry are Process Innovation (Smart Factories) through which we can provide expanded flexibility to respond to changes by optimally controlling equipment in real time, and Product Innovation (Service-

Oriented Hardware), through which we will be able to demonstrate new ways of using products and deliver new and innovative services. In June 2015, we announced the launch of NEC Industrial IoT. This concept allows us to offer new value to our customers in the form of production process innovations that enable immediate response to market needs on a global scale; individual management of products right down to their components thereby improving both traceability and quality; and an enhanced ability to create new products and services. At the core of NEC Industrial IoT is co-creation with our customers and partners, which is the objective of the NEC Manufacturing Co-Creation Program. The equipment and technology in the wide range of fields that encompass IoT can only be provided by collaborating with companies that have different strengths in varied fields of expertise, to seamlessly build an advanced IoT environment that supports all manufacturing-related fields. We believe that this is vital for enhancing the global competitiveness of manufacturing companies. Going forward, we will use NEC Industrial IoT to adapt to industry changes, and further revitalize the manufacturing industry.



NEC Industrial IoT connects the ideas of customers in the NEC Manufacturing Co-Creation Program to the development of new technologies, solutions and services.

Supporting the year-round 24/7 non-stop operations of social infrastructures for the people

NEC always focuses on how it can contribute to the society through the value chain that links the product processes of "MAKE", "CARRY", and "SELL." We tailor our solutions to wide range of domains and to our customers' needs, and offer these solutions on a global scale. For example, in the "SELL" domain, we propose solutions for our customers in the small scale multi-store deployment industry as convenience stores. This is a model that enables non-stop store operations by providing a cycle of services including planning, consulting, development, system implementation, deployment and store management support. Convenience stores are a social infrastructure that is indispensable to our everyday lives. Our experience proved that we were capable of operating convenience stores 24 hours a day, 7 days a week even during disasters by leveraging our accumulated ICT know-how. With IT Service LCM Model, know-how keeps accumulating with each cycle. For example, it takes a considerable amount of time to implement and deploy new services in the case of chain franchises with over 20,000 storefronts.

Initially, it took us a full year, but now we are capable of implementing the model in 6 months. Due to this, we believe we are capable of contributing to reducing regional disparities for our customers with storefronts in nationwide locations. In terms of support, we have a call center that can handle inquiries from shop managers not limited to IT issues. Furthermore, by looking at accumulated data concerning failure of in-store facilities such as coffee servers, refrigerators, and even toilets, we can identify areas requiring improvement and devise solutions that can be implemented in the next cycle. The latest system also offers maintenance service that includes symptom identification of impending failure and remote maintenance. NEC continues to enhance business system platforms that enable equipment management, fault detection, automatic notifications as well as image-based monitoring to support "non-stop store operations", this is one of the ways to contribute to lifeline infrastructure by creating a safer and more secured

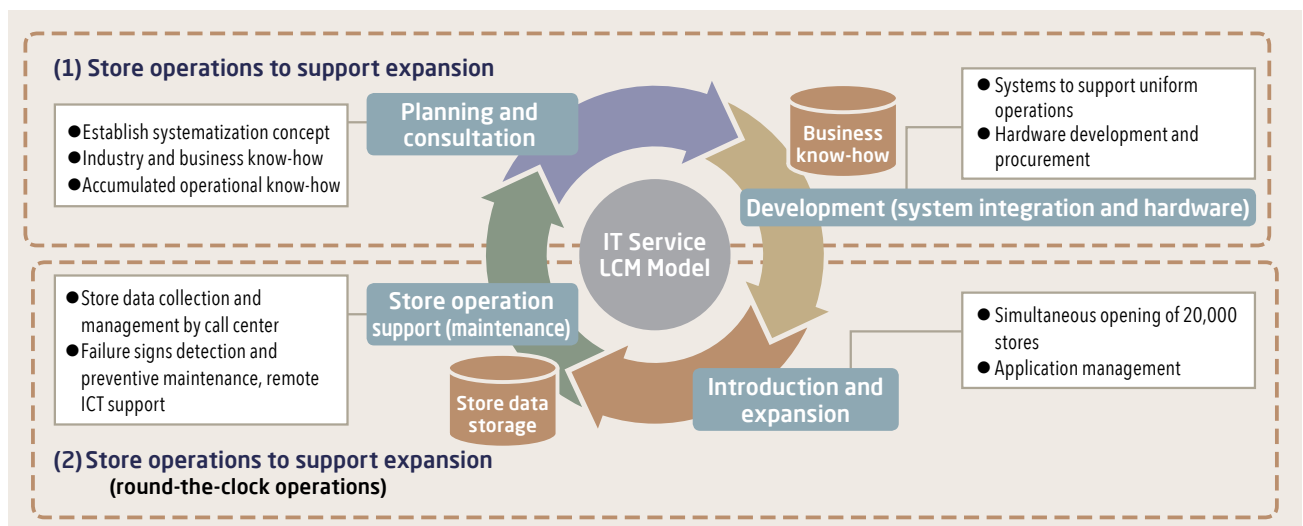


Interview

Hideki Kawami
Deputy General Manager
Global Retail Solutions Division
NEC

environment for people.

IT Service LCM Model for Multi-location Retailers



Integrating ICT and Energy Technologies to help people live in comfort

Globally, grid systems are shifting from “centralized” to “distributed.” NEC helps people live in comfort through ICT integrated with advanced energy management technologies.

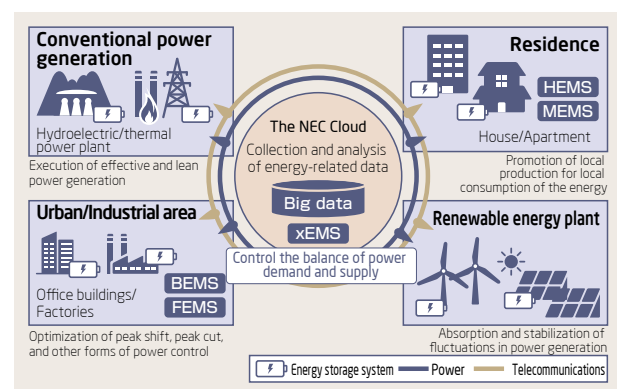
Grid systems worldwide are evolving from “centralized” to “distributed” system

Many countries throughout the world are starting to break away from their dependence on fossil fuels—Japan being an exception. Japan succeeded in generating just 10% of its required energy from renewable energy sources in fiscal 2014. The remaining 90% was generated by thermal power, with 55% coming from natural gas, 32% from coal, and 12% from petroleum. Most of these fuels are dependent upon import. Aware of the need for change, the government has set a target to increase energy generated from renewable energy sources to 22-24% by fiscal 2030. *1

The global trend is also shifting towards renewable energy, with energy that was once generated in a concentrated and unidirectional fashion now being generated more and more in a distributed and bidirectional way. Due to the growing popularity of renewable energy, today’s pattern of power generation and supply by power companies is being diversified by power supply systems that include solar power, wind power, geothermal energy, and biomass energy. The supply side is moving, with the demand side, which now includes non-power companies and individuals, also

being able to generate power on their own. Though this new style will lead to more local supply and local consumption of energy, power generated from renewable energy sources remains unstable due to their nature. Accordingly, what is required is comprehensive linkage and stabilization of all types of distributed energy. The key to achieving this kind of comprehensive, integrated control is the development of advanced energy management technologies. NEC utilizes cloud networks and energy storage systems to increase the use of energy generated from renewable sources, which then helps stabilize the electric power grid as a whole.

Advanced energy management technologies that utilize the cloud



*1 Source: Agency for Natural Resources and Energy

Smart Energy Solutions



For Power Companies (Power Stabilization)

As the integration of renewable energy spreads throughout the world—in both emerging and developed countries—large volumes of renewable energy is flooding into the power grid. This solution helps stabilize the quality of power supplied from the grid by providing solutions such as the large-scale energy storage systems to power companies around the world.



For Power Companies (Stable Operation)

This solution contributes to the stable, safe, and secure supply of power by providing telecommunication network for electric power system and core network, household power consumption digitization technologies and plant failure signs monitoring systems, and visualization technologies to ascertain plant operating conditions.



For PPS (Power Producers and Suppliers)

This solution supports new entrants into the power generation market following the deregulation of the industry by providing tools that manages power supply & demand and power customers, and produces power demand predictions by using big data analysis.



For Municipal Governments

This solution supports cities that supply and consume power generated by themselves. These cities are structured with advanced technologies that enable centralized control of storage batteries using ICT, integration of renewable energy, are robust against disasters and can provide their residents with a stable supply of power.



For Manufacturing and Distribution Companies

This solution helps companies reduce energy costs, optimize business processes, and improve customer loyalty by providing cloud-based EV charging infrastructures. It enables forecast of power consumption demand in each business office, constant monitoring for abnormalities, and customer management, making full use of big data analysis technology.



For Households

This solution supports smart usage (flexibility for different lifestyles) and increases power saving awareness. It includes compact energy storage systems linked with solar power generation, which is becoming more popular for households, and home energy management systems (HEMS) that help people visualize power usage in their household.

Resolving the Issues of Stable Supply, Optimization, and Economic Efficiency

Climate change is occurring around the world due to global warming caused by an increase in greenhouse gas (CO₂) emissions. This not only affects the harvest of agricultural products, but is also the catalyst for numerous natural disasters, including floods, that are causing severe damages. Japan's target for 2030 is a 26% reduction in CO₂ emissions from 2013 levels, and in order to achieve this target, increased integration of renewable energy is indispensable.

However, there are a number of issues preventing the easy introduction of a large volume of renewable energy into the power grid. First, since the supply of renewable energy is unstable, it is necessary to stabilize the amount of power to be supplied for the demand side, including companies and households. Moreover, if demand and supply cannot be predicted or controlled with high precision, it will lead to a great

loss of energy, massive blackouts and other problems that would prevent the demand side from enjoying the benefits of the electricity generated from renewable sources. In terms of economy, high power charges will not be accepted just because the energy is from a renewable source. To reduce grid costs, it is also necessary to suppress the maximum amount of power consumed.

NEC integrates ICT with a range of proven energy technologies to resolve these issues. Our solutions are centered on the energy cloud. Data about all types of energy is collected, visually represented, analyzed and used to calculate predictions by linking energy generation systems to the cloud to perform optimal energy control of the required assets such as energy storage systems. Achieving this requires technologies to analyze big data, including meteorological data and energy consumption, and energy storage systems that can function as a buffer to stabilize power supplies. With our energy cloud and energy storage systems, we are making a major contribution to energy optimization.

Why NEC

- ✓ Track record of supplying large-scale energy storage systems with a total output of more than 110MW to 11 companies worldwide.
- ✓ Visualization technologies to represent energy related data for real-time decision making
- ✓ Advanced energy analysis and prediction technologies based on big data analytics
- ✓ Advanced and optimal energy management technologies*² that support the whole of society, from households to companies and governments

*2 Received CEATEC 2014 AWARD

Providing Solutions that Integrate ICT and Energy Technologies

To promote renewable energy, NEC has developed a range of solutions based on our extensive ICT assets. Through these solutions, we can provide value to many customers, from large-scale electric power plants to regular households.

First is the visualization technologies that can be used to visually represent a range of data. Varied and uncertain real-world data, such as renewable energy amounts, crude oil prices, power demand forecasts, energy storage amounts, and electricity charges, is collected and visualized in real time by utilizing smart meters and power indicators. Next are technologies to analyze and generate predictions from the collected data. By creating mathematical models of energy systems based on big data analytics, which feature NEC's unique "Heterogeneous mixture learning technology", we can propose ways to optimize management of energy storage systems and heat utilization based on requirements and costs, perform

battery life and power demand predictions, and analyze charging and drive patterns. Last but not least are optimization technologies, which enable advanced management of peak shift and peak cut energy. NEC realizes energy optimization by integrating state-of-the-art ICT technologies with energy storage systems equipped with various power stabilization functions, such as frequency regulation, pre-adjustment capability, renewable energy linkage, and grid operation voltage adjustment functions. Furthermore, NEC is also actively developing new technologies including integrated surveillance and control solutions that can be used to control the charging and discharging of energy storage systems in real-time on the demand side, thereby creating virtual large-scale energy storage systems for users scattered in areas where large-scale energy storage systems cannot be installed.

NEC will continue to contribute to the realization of an energy society that is friendly to both people and the environment through solutions that integrate cutting-edge ICT with the latest energy technologies.

Case Study

NEDO*

*New Energy and Industrial Technology Development Organization

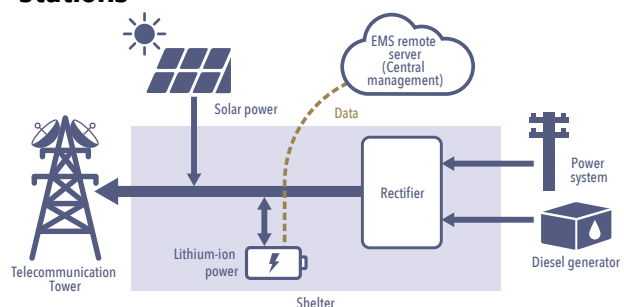
Demonstration testing an energy management system that improves fuel efficiency and reduces CO2 emissions from mobile base stations

Due to the sharp rise in mobile phone subscribers in India, mobile base stations are being installed not only in the city, but in rural regions as well. Since there are many regions in India with fragile power supplies where power outages occur frequently and or whose power supply is insufficient, telecom carriers use diesel generators to ensure the continuous operations of base stations when power outages occur. For this reason, in India, over 2 million kiloliters of diesel fuel is consumed and over 11 million tons of CO2 is emitted annually. This is a major environmental concern.

To help address this issue, NEC has introduced an energy management system for mobile base stations that controls renewable energy and lithium-ion power storage systems by using ICT, thereby reducing the consumption of diesel fuel in each region and enabling a stable supply of power. NEC has already started demonstration testing the system in 20 locations in India. NEC estimates that if the system is used in approximately 400,000 mobile base stations in India, it will be possible to achieve energy savings (reductions) of approximately 50%,

and a 1 million kiloliter reduction in diesel fuel consumption. By promoting the global development of energy businesses such as these, NEC will contribute to the delivery of important resources that allow people to live in safety and comfort. Reduces diesel fuel consumption by prioritizing the use of renewable energy and by using power from power storage systems during power outages. Also enables base station energy to be centrally controlled via networks, allowing more precise energy management.

Energy Management System for mobile base stations



Reduces diesel fuel consumption by prioritizing use of renewable energy and using power from power storage systems at times of power failures, and accurately controls base station facilities through networks.

Contributing to the stabilization of electric power supply by using ICT and energy storage systems

In the past, all forms of electric power were generated and transmitted by power companies, but the times are changing. Due to an increase in renewable energy such as solar power and changing market regulations, power can now be supplied independently by consumers such as regular households. In other words, the source of energy supply has shifted from a centralized system to a distributed system. There has also been a change in the way electricity is used due to the vast diversification of consumer lifestyles. The way we predict for power demand must also be more flexible, which requires a higher level of energy management. In response, NEC has been using its proprietary ICT to enable visualization, analysis, prediction, and optimization of energy supply. By providing technologies that allow energy storage systems—which form a buffer against energy shortages—to be accurately controlled, NEC is contributing to the establishment of a

society that realizes an autonomous, distributed but coordinated, stable supply of energy.

From problems in stabilizing the supply of power to the energy grid and aging power generation facilities in advanced countries to the expanding need for infrastructure maintenance in emerging nations, the entire world is facing major issues concerning energy supply. NEC intends to tackle these issues by collaborating with the people in each region for a more localized solution.

Energy problems are not going to go away. NEC therefore requires the skills and expertise of excellent minds from across the world. To attain these skills and expertise, NEC will collaborate with businesses that possess the latest technology and work together to create a society where people have stable and secure access to the energy they need.



Takemitsu Kunio
Senior Vice President
NEC

Case Study Southern California Edison (SCE) "DESI Project"

An electricity distribution grid is designed to carry the single largest peak demand of electricity, which typically occurs for only a few hours for a few days of the year. Most of the time, the grid is not utilizing its full capacity. If peak demand grows past the capacity, the utility must upgrade it. However, in some cases, especially urban locations, upgrading the grid infrastructure which includes substation equipment and cables can be costly and difficult since there is little space available. In addition, this infrastructure upgrade further decreases the utilization of the grid capacity. Energy storage can be used instead to upgrade the distribution grid, by taking the peak demand and shifting it to a different time. This can both increase the capacity utilization of the grid as well as defer the grid infrastructure upgrade, which can save money for the utility and the rate-payers (end use customers). In July 2015, NEC supplied an energy storage system with an output of 2.4MW and capacity of 3.9MWh to Southern California

"Utility-scale energy storage system" to reinforce the existing distribution grid and increase its capacity utilization

Edison (SCE), a major electric utility in California. NEC was able to fit the entire system, including energy storage, power conversion, switchgear, and transformer in a small 1600 sq. ft.* space in an easement in a parking lot. The system is used as an effective foundation for the future, aimed at reducing the load of the distribution network and is the first to its kind that supports the stabilization of SCE's distribution network.



Large-scale energy storage system installed on saved space. NEC contributes to the stabilization of power grids owned by various electric utilities in California, where there are strict regulations concerning the mandatory introduction of renewable energy.

* 1 square feet = 0.09290304 m²

From applications to platforms—providing total support for the evolving Cloud

With the continued mainstreaming of IoT, a cloud environment that is highly reliable and efficient is vital. NEC leverages proven cloud technologies and comprehensive integration and operations capabilities to provide innovations that will transform society and business alike.

A full spectrum of solutions that meet all needs, from mission-critical tasks to new business development

As IoT continues to enter the mainstream, the cloud is becoming more popular than ever, and is being used in corporate ICT environments with increasing frequency. Conventionally, the cloud was used for data produced by people, and for mission-critical tasks or jobs in specific industries. This is no longer the case. From now, data disseminated from things—including sensors and devices—will be linked to existing work and processed and analyzed in the cloud, leading to the creation of new value and the transformation of business.

NEC offers a service menu with over 100 items including applications and platforms to meet a variety of customer needs, as well as all the products required to build a cloud platform—including SDN technologies—and a range of services to support the introduction and operation of a cloud. These products and services cover various types of industries, businesses and sizes from the private sector to public organizations, allowing us to tailor solutions to the needs of our customers. NEC's cloud platforms also utilize OpenStack open source

software (OSS) and we are an active participant in open source community activities. We also use other OSS to provide total support from design and building to technical support and operations so that our customers have access to a reliable open cloud environment that integrates the latest technology. NEC additionally supports the secure linkage and integrated operation of hybrid cloud environments, including on-premises clouds built in the customer's facility and clouds from other companies, to meet the specific business and security requirements of our customers.

In April 2016, we will open the new NEC Kobe Data Center, which can provide both cloud and housing services, as our flagship data center in Western Japan. This data center offers a level of security that delivers convenience without compromising safety, uses green energy to reduce environmental impacts, and leverages a unique cooling technology to save power and reduce facility costs. It is through state-of-the-art facilities such as these that we deliver on our promise to provide secure and efficient ICT environments that showcase NEC's value of safety, security and efficiency. NEC will continue to work together with our customers to help transform society and business by providing enhanced cloud environments and application services, and promoting overseas expansion.

Why NEC

- ✓ Over 100 service menu to meet a variety of needs
- ✓ Efficient, safe, secure data centers in more than 50 locations
- ✓ Integration and operation support including on-premises and third-party clouds

Case Study National Fire Agency of the Ministry of the Interior, Taiwan

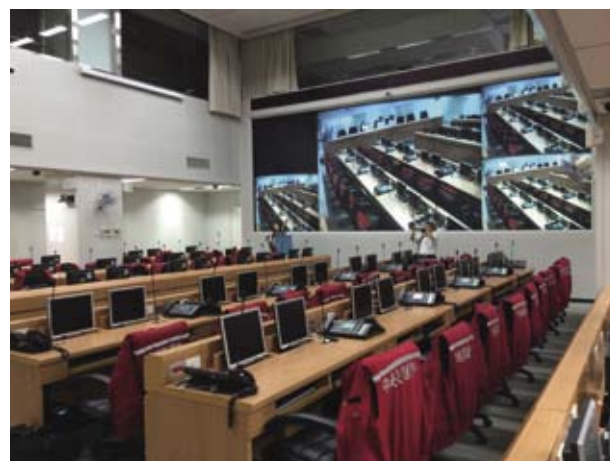
Taiwan has implemented a cloud computing-based disaster prevention and management system that merges disaster information systems installed and operated by each self-governing body on a single platform from which services can be distributed throughout the entire country (22 prefectures and cities, and 268 municipalities).

NEC built the application services on this system's cloud platform, providing the National Fire Agency with a disaster prevention system that was highly convenient, reliable, and high performing. The new system provides enormous benefits such as the use and linking of a Geographic Information System (GIS) that covers the entire country, enhanced information sharing between the central region and other regions, faster decision making and on-site support for disaster response measures, and the ability to receive information from citizens via the Internet. As a communication infrastructure, it also helps considerably in relieving the anxiety of citizens during a disaster.

NEC already has a proven track record in the crisis management

Cloud-based information sharing: Distributing disaster information to citizens in real time

field—where high reliability is an absolute requirement—in Japan, a country where many natural disasters occur. By leveraging its strength in building highly reliable and secure cloud infrastructure, NEC contributes to creating a safe and secure society for people throughout the world.



The disaster prevention center, where emergency information is collectively gathered, aims at providing highly advanced and convenient disaster prevention system services, based on know-how that NEC has cultivated in the fire prevention and disaster prevention fields.

Providing wide variety of cloud environments to meet the diverse needs of our customers

IoT and businesses based on it are currently drawing a lot of attention. Ahead of the field, NEC is already working on a cloud solution to realize IoT. The manufacturing industry is starting to move away from the concept of total in-house production, and is embracing a way of thinking whereby everything is connected by IoT, from parts suppliers to customers, and entire business processes are realized in a cloud environment. The term cloud covers a wide range of functionalities that include IoT-based big data analysis, data collection, and edge computing, so being able to respond flexibly to changes in this diverse business environment is of utmost importance. NEC's goal is to reliably provide our customers with optimal functions at the best timing, using our state-of-the-art SDN and security technologies.

One way we are responding to the diverse needs of our customers is by providing a range of services and service combinations that include customer on-premises cloud environments, NEC cloud services, and third-party cloud services. As we enter the era of IoT in which systems will become increasingly complex, it is more necessary than ever to be able to manage entire systems. Our strength lies in the fact that we are capable of providing proposals for solutions that cover all process, right up to system operation, and that we have accumulated an abundance of know-how. From now on, the cloud environment will play an increasingly important role as a vital part of our social infrastructure. NEC is committed to creating value for society by providing safe and reliable cloud environments.



Hidenobu Azeta
NCP* Chief Service Organizer
Executive Specialist
C&C Cloud Infrastructure Strategy Division
NEC

* NCP: NEC Certified Professional

Simple and Flexible development of highly evolving ICT systems

SDN creates advanced ICT systems required to enhance our social systems. NEC SDN Solutions solve the management issues.

Using SDN to resolve management issues and create flexible ICT systems

The key to improving a company's ability to adapt to changes in the business environment is an advanced, highly flexible ICT system. However this need is often not being met by conventional networking equipment and technology. NEC provides SDN (Software-Defined Networking) solutions for customers who want to solve their ICT issues and introduce or change to a flexible ICT environment.

NEC defines SDN as the "dynamic control of networks by software as well as the mechanism, concept and architecture of such networks". SDN decouples network control from data transfer processing, which previously were both performed by dedicated network devices. This allows networks to be controlled dynamically, thereby realizing a flexible ICT system. Rather than the traditional bucket-relay type network with individual devices making individual determinations, SDN uses software to enable dynamic control, which leads to flexibility, efficiency, and robustness.

SDN is already starting to play an important role in the ICT systems of companies. By reducing the occurrence of failures, increasing efficiency, providing system

visualization, improving the security of ICT systems, and optimizing ICT resource distribution, SDN technologies will help create highly advanced ICT systems upon which even more sophisticated and robust social infrastructures can be built.

Expanding solutions based on a proven track record

NEC was one of the original members of Stanford University's Clean Slate Program when it was established in January 2008. NEC subsequently became the world's first vendor to market SDN products and we have already delivered more than 250 systems.

We are currently expanding our NEC SDN Solutions by integrating our highly reliable network and virtualization technologies with the proven communications and ICT technologies that we have cultivated over many years. We have also set up a department that specializes in sharing the know-how essential for implementing SDN, allowing us to develop and deliver solutions tailored to the specific needs of our customers. NEC will continue to develop, implement, and propose advanced SDN solutions to customers throughout the world.

Why NEC

- ✓ Promoted research, technological development and industry standardization through early participation of SDN the early stages of SDN
- ✓ First in the world*¹ to commercialize SDN products, wide-ranging application know-how and specialized staff
- ✓ Track record of delivering more than 250 SDN systems to companies, government and municipal offices, and telecom carriers

*1 Source: NEC

Case Study **JR EAST**

Greater convenience, safety, and comfort in stations: Acceleration of new service deployment through SDN

East Japan Railway Company (JR EAST) used to operate several separate networks to manage train service reporting, security camera footage, and other data dependent services. This made managing of operations complicated and time-consuming, and provided an obstruction to introduce new services.

JR EAST addressed this issue by adopting NEC's integrated common station network solution that utilizes SDN technology.

Tokyo Station and other stations in the Yamanote Line area can

now launch station services that better meet the needs of station users, such as smart wireless LAN connectivity and information concerning the availability of luggage lockers, quickly and effortlessly.

All visitors and the JR EAST staff will have the ability to access a wider variety of the station's Information services in a timely, convenient, and equal manner.

NEC SDN Case Studies as of October, 2015

| Market | Customers | | |
|-------------------------|--|---|---|
| Enterprises | <ul style="list-style-type: none"> - East Japan Railway Company - West Nippon Expressway Company Limited - TV Asahi Corporation - Kanazawa University Hospital - Nagoya City University Hospital - Toyo Seikan Group Holdings Ltd. - NS Solutions Corporation - EHIME BANK, LTD. | <ul style="list-style-type: none"> - Minaminihon Information Processing Center Co., Ltd. - Minato City Board of Education - Shinagawa City - Nishihara-cho, Okinawa Prefecture - Nippon Jimuki Co., Ltd. - Nippon Express Co., Ltd. - BIGLOBE Inc. | <ul style="list-style-type: none"> - GenesisHosting (USA) - NDDI (USA) - Stanford University (USA) - Marist College (USA) |
| Telecom Carriers | <ul style="list-style-type: none"> - NTT Communications "Biz Hosting" (Japan) - Myanma Posts and Telecommunications (Myanmar) - Telefonica Brasil (Brazil) - Portugal Telecom (Portugal) * | <ul style="list-style-type: none"> - Swisscom AG (Switzerland) * - Telekom Austria Group (Austria) * - Etisalat (UAE) * | |

* : Undergoing Operation Test

Over 250 systems in operation globally

A simple and flexible network achieved through SDN technology and open innovation

SDN, one of NEC's focus business areas, has demonstrated clear benefits: implementing SDN after virtualizing an entire system can shorten processing operations that originally took several weeks to just a few minutes.

I believe that we can create applications and services that provide our customers with ideas for new businesses through the development and production of SDN controllers that enable networks to be controlled centrally. My mission is to achieve this by developing an open interface and popularizing SDN as an industry standard.

NEC is currently involved in the establishment of the "OpenFlow" open interface standard and is developing

product lineups based on OpenFlow technology. Our goal is to achieve industry standardization of the OpenFlow application interface that enables the use of SDN features such as visualization and virtualization. We are also engaged in forming alliances with business partners and achieving technological collaborations.

I am participating in the OpenDaylight project, a project that is aimed at developing an open source SDN controller, and am engaged in a range of promotion activities to this end. Through these activities, I intend to pursue how we can use SDN to further provide solutions with value for our customers.



Masashi Kudo
OpenDaylight Ambassador
NCP Chief Advanced Technologist (Software)
Executive Specialist
Smart Networks Division
NEC

*2 NCP : NEC Certified Professional

Interview

Extracting new value from big data through unique artificial intelligence technologies

As we enter the IoT era, big data utilization will be the key to creating social value and overcoming business challenges. NEC leverages world-beating analysis technologies to contribute to this field, taking a "trinity" approach to big data utilization.

The trinity approach and the analysis technologies and support capabilities that realize it

With the spread of IoT, a vast number of things are now connected to the Internet. This has led to an explosive increase in the amount of data generated, ushering in the era of "big data." Data is now regarded as an "asset" all over the world, and its value is increasing. However, data has no value if it is simply collected and stored. It is also important to utilize the data to solve issues and create value for society and companies.

To create value from big data, the three processes of "sensing," "analytics," and "actuation" are essential. An approach that encompasses this "trinity" is therefore required.

"Sensing" is used to visually represent various phenomena that exist in the real world as digital data.

"Analytics" are then used to analyze this huge volume of data, and extract knowledge and laws hidden in the data in order to make predictions and forecasts. Finally, "actuation" applies the knowledge and principles acquired by the analytics to businesses and systems, where it is then fed back to the real-world to create value.

NEC utilizes cutting edge technology to firmly support this

"trinity" of big data utilization. In the especially important field of analytics, we will be making use of our own world-beating analytical technologies which are based on our research of artificial intelligence (AI) and machine learning accumulated over many years. Our "Invariant analysis technology" can be used to discover signs of failure at plants, etc., at an early stage. Regularities that cannot be detected by humans are extracted from a wide variety of data and advanced predictions of demand, etc., can be made by using our "Heterogeneous mixture learning technology". And our "Recognizing Textual Entailment (RTE) technology" understands even the meaning of an immense amount of text information and categorizes this on its own. Together with an optimal platform, these technologies will create an impressive range of value that we call "NEC Big Data Solutions."

Furthermore, through the provision of our "Big Data Discovery Program" consulting service, we will support the establishment of methods for analyzing data required to achieve the objectives of business.

From as early as the stages of securing human resources and designing organizations, our staff with rich know-how will provide careful assistance.

Together with our customers, NEC will realize value creation with big data.

Why NEC

- ✓ "Media processing technologies" featuring the world's highest level of accuracy, such as facial recognition and crowd behavior analysis
- ✓ Abundant solutions and implementation track record utilizing our unique "Artificial intelligence (AI) technologies", such as "Invariant analysis", "Heterogeneous mixture learning", "Recognizing textual entailment technology"*, and "Rapid machine learning"
- ✓ Support system complete with discovery program and access to expert data scientists

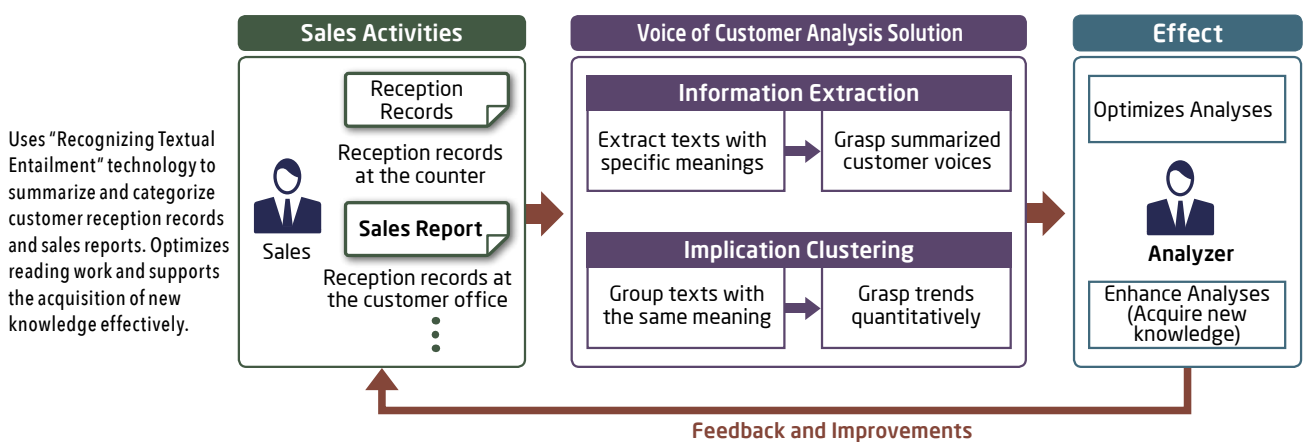
* World No. 1 in PTP (Penn Treebank Project) 2011—the world's most well-known language processing algorithm contest

Case Study **Sumitomo Mitsui Banking Corporation**

Promoting activities to improve customer support and exceed customer expectations by instantly analyzing and visualizing large amounts of “Voice of Customer” data

At Sumitomo Mitsui Banking Corporation (SMBC), one of Japan’s major banks, “Voice of Customer (VoC)” data is delivered daily and checked manually to improve services. However, with volumes exceeding 35,000 inquiries per year, SMBC was looking for a faster and more efficient way to analyze and organize this data. NEC provided SMBC with a VoC Analysis Solution that uses “Recognizing Textual Entailment”

technology to summarize and categorize customer reception records and sales reports with high precision. As a result, a more detailed understanding of time line transitions and task contents is now possible. Moreover, thanks to the optimization and increased sophistication of data analysis, SMBC can pinpoint areas of service quality that can be enhanced, leading to improved customer support.



Highly precise data analysis using NEC’s proprietary heterogeneous mixture learning technology

As a data scientist, I participate in our customers’ data analysis projects and perform prediction model construction and management of the analysis team using NEC’s proprietary heterogeneous mixture learning technology. This can be used to find specific patterns or regularities among various types of data. This allows us to overcome conventional problems such as having to perform case analysis to derive appropriate predictive formulas. This technology also enables highly precise predictions for data where regularities change. Heterogeneous mixture learning technology is achieving results in a range of applications such as power demand projections for the energy industry and

product demand projections for the distribution and retail industries. People usually assume that data scientists like me are constantly working with data, but that is not the case. I am in charge of product demand projections and even when I am not working I tend to observe new products and the variety of products at convenience stores. In fact I often come up with ideas related to services and analysis in my daily life. By sensing the trends in the industry I hope to contribute to solving social problems and helping NEC’s customers overcome challenges they face in their business by making proposals that match the needs of our customers and consumers.



Interview

Sawako Mikami
Assistant Manager
Big Data Strategy Division, Knowledge Discovery Research Laboratories
NEC

At a Glance

NEC Corporation and Consolidated Subsidiaries

Net sales, operating income and composition of sales are financial results for the year ended March 31, 2015.

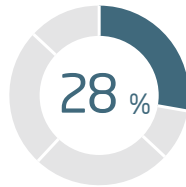
Public Business

Net sales **821.9** billion yen

Operating income **74.8** billion yen

Main customers
Government, public, healthcare, finance and media

Composition of sales



Major Products and Services

► Systems Integration (Systems Implementation, Consulting), Maintenance and Support, Outsourcing/Cloud Services, System Equipment

Examples of Solutions by Business Sector/ Industry

Government : Social Security and Tax, Fingerprint Identification, Air Traffic Control, Satellite Communications/Earth Observation, Outdoor Communication

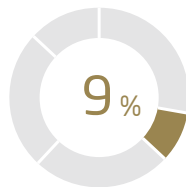
Enterprise Business

Net sales **270.5** billion yen

Operating income **8.3** billion yen

Main customers
Manufacturing, retail and services

Composition of sales



Major Products and Services

► Systems Integration (Systems Implementation, Consulting), Maintenance and Support, Outsourcing/Cloud Services

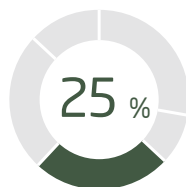
Telecom Carrier Business

Net sales **740.2** billion yen

Operating income **62.0** billion yen

Main customers
Telecom carriers

Composition of sales



Major Products and Services

► Network Infrastructure

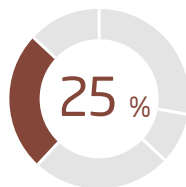
Core Network, Mobile Phone Base Stations, Submarine Systems (Submarine Cable Systems, Ocean Observation Systems), Optical Transmission Systems, Routers/Switches, Mobile Backhaul ("PASOLINK")

System Platform Business

Net sales **728.9** billion yen

Operating income **31.4** billion yen

Composition of sales



Major Products and Services

► Hardware

Servers, Mainframes, Supercomputers, Storage, Business PCs, Tablet Devices, POS, ATMs, Control Equipment, Wireless LAN Routers, Displays, Projectors

► Software

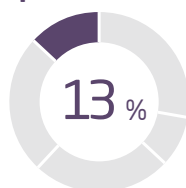
Integrated Operation Management, Application Servers, Security and Database Software

Others

Net sales **374.1** billion yen

Operating income **4.0** billion yen

Composition of sales



Major Products and Services

► Smart Energy

(Electrodes/Energy Storage Systems, Energy Management Systems, EV/PHV Charging Infrastructure, AMI*, Solutions for Utilities)

► Mobile Phones

► Lighting Equipment

* AMI (Advanced Metering Infrastructure):
A communications unit for smart meters

Public : Local Government, School/Education, Postal Tracking, Firefighting Command, Firefighting Emergency Radio Systems, Disaster Prevention, Traffic Control, Railroad Communication, Infrastructure Surveillance/Energy Management

Healthcare : Electronic Medical Record, Regional Healthcare Information Network

Finance : Banking, Business Branch Systems

Media : TV Program Production/News Production/Transmission Systems, Digital TV Transmitters

Examples of Solutions by Business Sector/Industry

Manufacturing : Global SCM, Product Lifecycle Management, Production Management, Sales Management

Retail and Services : Retail Systems for Stores and Head Offices, Logistics Management

► **Services & Management**

Telecom Operations & Management Solutions (TOMS), Services/ Solutions

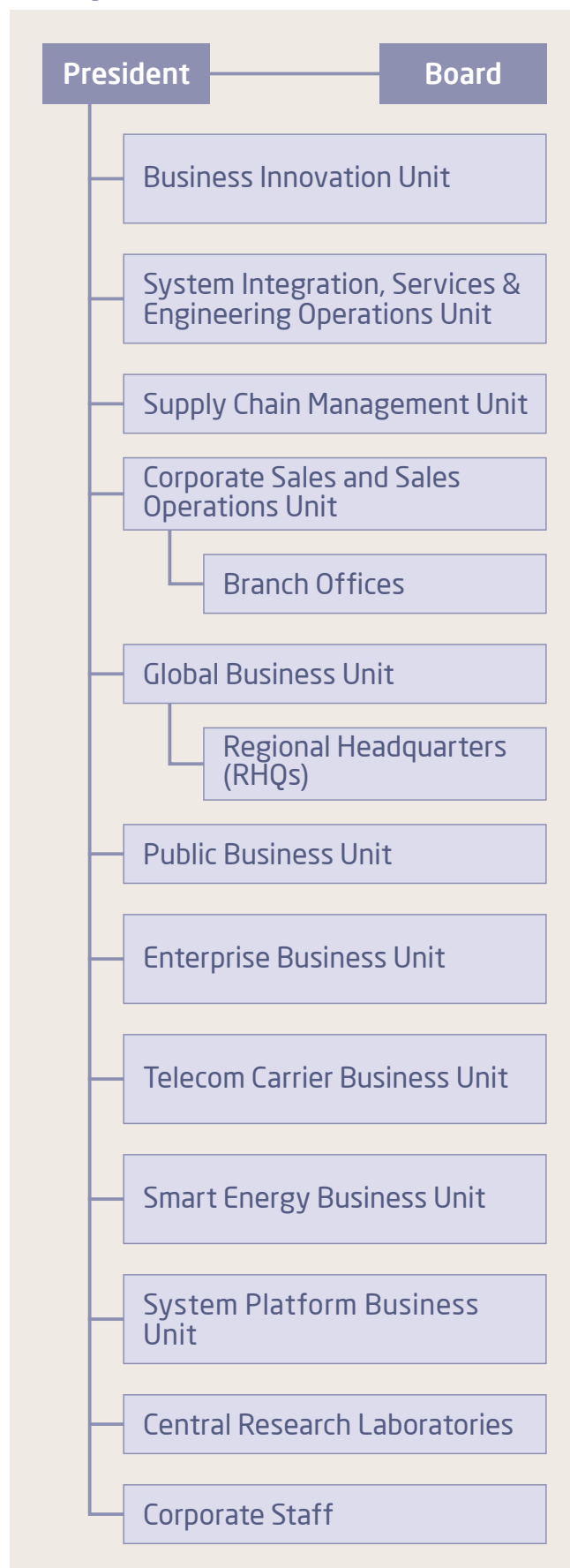
► **Enterprise Network Solutions**

IP Telephony Systems, WAN/Wireless Access Equipment, LAN Products

► **Services**

Data Center Infrastructure, Maintenance and Support

Organization Chart



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<http://www.nec.com/en/global/about/vision/>

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