R&D AND INTELLECTUAL ASSETS STRATEGY

Based on its three long-term research visions to achieve the NEC Group Vision 2017, NEC is promoting R&D activities that contribute to the Mid-Term Growth Plan "V2012—Beyond boundaries, Toward our Vision," a milestone in this process, while closely tying these activities to its intellectual assets and standardization strategies.

R&D POLICY

In order to create "an information society friendly to humans and the earth," which is asserted in the NEC Group Vision 2017, it is important to increase both human creativity and vitality, while developing a sustainable society. To this end, NEC has established three long-term research visions as the foundation of its long-term R&D efforts, with the aim of realizing this vision. These are: 1) "Symbiosis," defined as harmony between people and society, people and IT, and all people; 2) "Ecology," which

is mutual prosperity and harmony with the earth; and 3) "Dependable," which refers to creating a safe and secure society. (Additional explanation and chart below.)

Over the mid-term, NEC will closely follow this R&D policy, as it establishes key research areas to expand and enhance "C&C Cloud Strategy" related businesses, the Smart Energy and Green business, and other operations. At the same time, we will focus on generating research achievements that support the realization of the goals laid out in "V2012."

ENHANCE R&D ACTIVITIES BASED ON THREE LONG-TERM RESEARCH VISIONS FOR REALIZING THE NEC GROUP VISION 2017
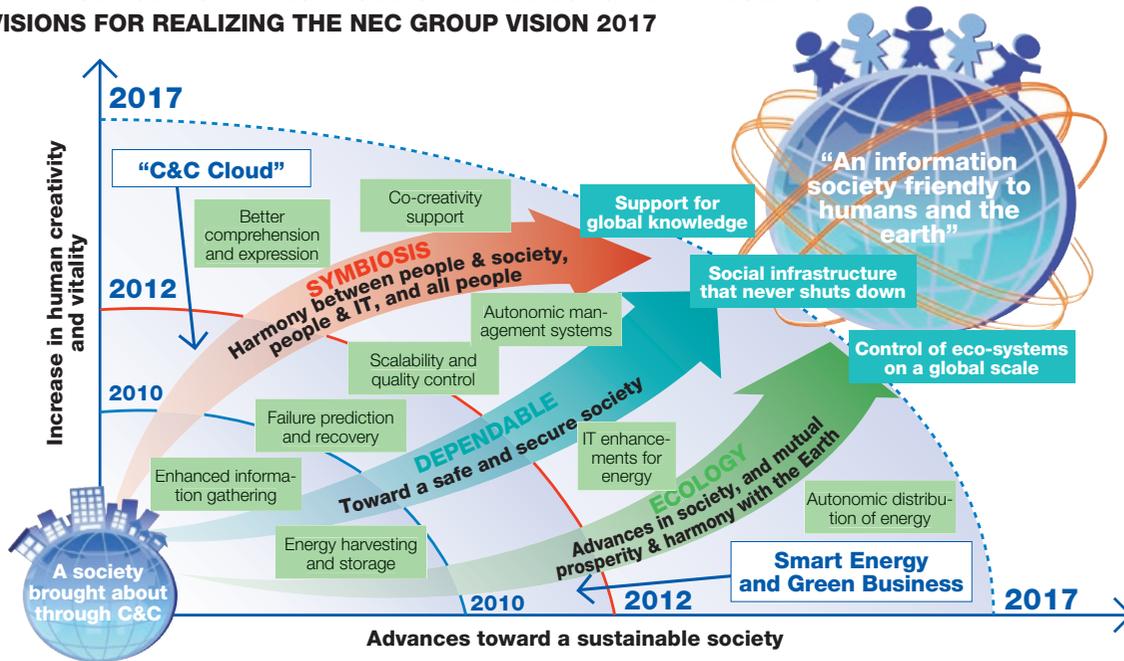
SYMBIOSIS
—Realizing a harmonious coexistence between people and the information society, supporting the use of global knowledge—
This refers to technology that will help people to gather the necessary information from the overwhelming amount of information in the world and assist them in understanding that information. In other words, we will develop technology that will serve as a bridge between people and the information society, and help both to develop and grow. In the future, we aim to develop technology that will support mutual understanding among people, and support co-creation utilizing knowledge from around the world.

ECOLOGY
—Controlling ecosystems on a global scale—
In addition to energy-saving technologies, we will develop technologies to create new energy, store energy, reuse and redistribute energy to ensure its effective use. By applying information technology to energy, we make it possible to ascertain, manage and control its use. We will aim to establish autonomous and diversified technologies for energy that can be applied to the global ecosystem.

DEPENDABLE
—Creating social infrastructure systems that do not shut down—
We are developing technologies that will predict and prevent the failure of social infrastructure systems that require a high degree of reliability, such as energy networks, traffic networks, and distribution networks, as well as make these systems more efficient through coordination among systems. Ultimately, we aim to develop autonomous systems that recover on their own without stopping even if a malfunction occurs.

R&D FRAMEWORK

NEC pursues both technological development activities directly related to product development that are handled primarily by business units, and R&D activities that are in the mid- to long-term horizon, which are handled primarily by Central Research Laboratories.

At Central Research Laboratories, R&D activities are carried out by two core research groups: the Service Research Group and the IT/Network System Research Group. The Service Research Group takes part in the "C&C Cloud Strategy" and engages in R&D for cloud platform technologies, ubiquitous platform technologies and media processing technologies. The IT/Network System Research Group focuses on technologies that integrate IT and networks.

In addition, NEC has three organizations to continue driving innovation for the NEC Group. The Green Innovation Research Laboratories were newly established in April 2010 to help accelerate Smart Energy and Green business. The C&C Innovation Research Laboratories were created to research new forms of information processing and communication from fundamental principles looking ahead to the next 10 to 30 years. The Business Innovation Center was established to promote new business innovation using newly developed technologies.

Overseas, NEC has three research sites located in the US, Europe and China to conduct R&D activities leveraging the local characteristics of each region. These research sites work closely with the research centers in Japan to create globally competitive innovation.

Furthermore, NEC pursues market-oriented R&D, and manages R&D with an emphasis on optimizing R&D efficiency and accelerating commercialization of research achievements. As part of this, NEC engages in Concurrent R&D, in which customer interaction begins at early stages of research allowing for the discovery of inherent needs and enabling flexible response to any changes in the market needs. NEC also actively utilizes Open Innovation, in which R&D activities are accelerated by incorporating external resources. By carrying out these initiatives on a global basis, NEC aims to strengthen its competitiveness in the marketplace by shortening the time required to commercialize R&D achievements.

INTELLECTUAL ASSETS STRATEGY

The NEC Group owns approximately 74,000 patents worldwide, including approximately 27,000 patents in Japan (as of March 2010). NEC positions intellectual assets as "the foundation for the NEC Group's business competitiveness and stability," and is working to strengthen its intellectual assets from both quality and quantity standpoints. Specifically, NEC is concentrating on establishing a global patent network, to support achieving an overseas sales ratio of 50% as targeted in the NEC Group Vision 2017. One key focus is the core areas set forth in "V2012", including "C&C Cloud Strategy" related businesses and the Smart Energy and Green business. In these areas, NEC is carrying out Group-wide strategic patent projects on a global basis to obtain strong patents and patents that are being utilized.

Furthermore, NEC believes that participating in standards initiatives will help create and expand businesses, and will also contribute to the stable offering of products and services. In addition to pursuing a business model that utilizes standardization, NEC is engaged strategically in standardization activities by actively participating in standardization entities both in Japan and overseas. Also, as part of external engagements with intellectual assets, NEC is actively pursuing licensing activities to reduce business risks and expand business opportunities.

NEC WINS GRAND AWARD OF THE 42ND ICHIMURA INDUSTRIAL AWARDS

NEC recently won the grand award at the 42nd Ichimura Industrial Awards. The grand award is a prestigious award that has been conferred to only 16 projects over the course of the previous 41 award presentations.

NEC received the prize in recognition of high marks for making a significant contribution to industry through the development of power control technology for mobile transmission. In 2000, this technology was adopted as the international standard for the third-generation mobile phone system (W-CDMA), which is currently widely used around the world. The technology has contributed to the expansion of wireless transmission capacity, an improvement in communications quality, and the reduction in energy use by wireless base stations for the W-CDMA format.

IMAGE RECOGNITION TECHNOLOGY IN SUPPORT OF PUBLIC SAFETY BUSINESS

Image recognition technology is to analyze a variety of images using a computer to extract the needed information, such as fingerprints or facial images, according to the application, and identify the image. By cross-checking the fingerprints or facial images against registered images in a database, the identity of an individual can be authenticated through fingerprint matching or by face recognition.

NEC has long conducted R&D on image recognition technology. NEC's fingerprint identification technology dates back approximately 40 years, while its face recognition technology has a roughly 20-year history.

NEC commercialized fingerprint identification technology in 1982. Since then, NEC has deployed more than 200 systems, including automated fingerprint identification systems (AFIS) for law enforcement and national ID systems, primarily to government users in 30 countries around the world. Additionally, NEC's fingerprint identification technology is widely used both in Japan and overseas for such applications as room access control systems and personal authentication systems.

Since being commercialized in 2002, NEC's face recognition technology has steadily penetrated the market, with applications in immigration control systems using passport images, as well as facility entrance systems using facial images for entry passes. Going forward, NEC expects growth in the applications for its face recognition technology, including digital signage (electronic advertisements), as well as user interface applications for mobile phones, home appliances, ATMs, automobiles and so forth.

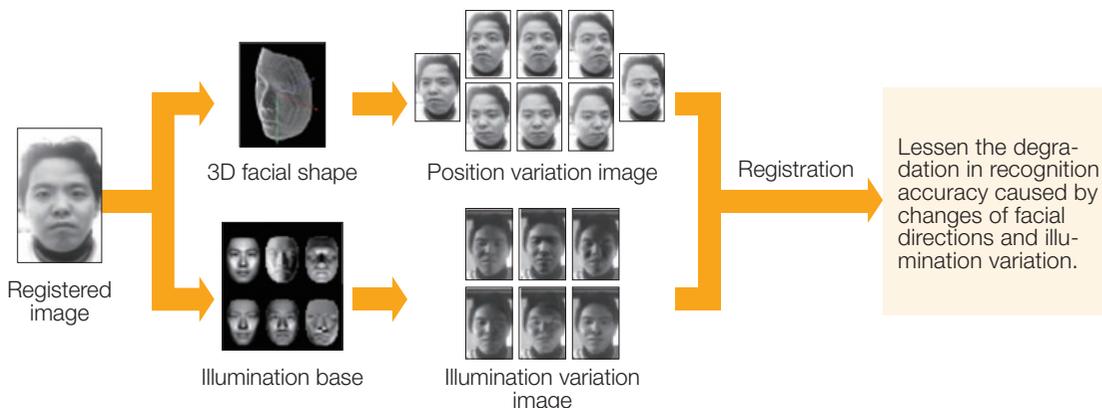Eyeing further growth in opportunities to use these face recognition technologies, Central Research Laboratories are directing research at increasing recognition accuracy while making the technology more resilient to variations in photo-shooting environments. Two methods are currently being developed. One is the Perturbation Space Method. This method generates numerous images from various facial angles and lighting conditions from a single registered image. The generated images are then added to the registered images, in order to realize robust matching against changes in photo-shooting conditions and enhance recognition accuracy. The second method is the Discriminative Multi-feature Fusion Method. Under this method, only the effective features for identifying the individual are selected adaptively from the many image features extracted from the facial image. Using these features, the system is robust with respect to facial changes caused by aging or the effect of wearing or taking off glasses, among other factors.

These technologies, cultivated by NEC through half a century of R&D activities, have received high marks throughout the world. Since 2004, NEC's fingerprint identification technology has ranked first in the world each year in the benchmark test conducted by the National Institute of Standards and Technology (NIST) of the U.S. Furthermore, NEC's face recognition technology placed first in the NIST's biometrics technology benchmark test (still face image recognition) in 2010.

NEC will leverage its globally competitive fingerprint identification and face recognition technologies to proactively expand its public safety business.

PERTURBATION SPACE METHOD
Generate and register various position and illumination variation images from one registered image.

Registered image → 3D facial shape → Position variation image → Registration → Lessen the degradation in recognition accuracy caused by changes of facial directions and illumination variation.

Registered image → Illumination base → Illumination variation image

Developed method: Only one frontal facial image is required.
Conventional method: Each individual must take numerous and accurate facial images under various positions and illumination conditions

R&D INTO IT/NETWORK INTEGRATED CONTROL TECHNOLOGY SUPPORTING THE "C&C CLOUD STRATEGY"

In recent years, cloud services that provide IT over networks are increasingly being deployed by private-sector companies and the public sector. In order to deploy these cloud services, it is necessary to promote cloud infrastructure which is the platform for these services.

However, the current cloud infrastructure requires complex operation and management of IT and network systems. This is because at present IT systems and network systems are configured independently for each individual service provided by the cloud. Furthermore, because cloud infrastructure is designed and operated independently for each service, resources cannot be effectively shared among different infrastructures in response to service usage levels and the number of users. Scalability is also insufficient. For example, infrastructure must be redesigned when services are expanded.

To solve these problems, NEC is pursuing R&D into IT/network integrated control technology using OpenFlow[*1]. This technology can be used to unify the control and management of IT and network resources dispersed globally. Through this technology, NEC aims to increase the competitiveness of the cloud services that it offers by reducing the capital investment needed to build cloud infrastructure and cutting the operating costs.

The application of this technology will enable the automated construction of virtual systems based on service characteristics, and the optimal allocation of resources depending on the usage status of IT and network resources. In other words, the technology will allow cloud infrastructure spread around the world to be treated as if it were a single infrastructure, enabling the efficient operation and management of infrastructure with the necessary resources allocated to the necessary places. Also, by developing control functions for new services as needed, it is possible to quickly and flexibly respond to new services which are expected to expand in the future without redesigning the cloud infrastructure.

NEC has already successfully completed field trials using this technology to automatically construct virtual networks based on service details and to automatically allocate IT and network resources in line with service usage status. NEC plans to develop a commercial OpenFlow technology product for data centers within the fiscal year ending March 31, 2011.

Going forward, NEC will speed up R&D activities focused on rapidly establishing IT/Network integrated control technology for data centers, with the aim of building cloud infrastructure that is highly responsive to changes.

[*1] OpenFlow: Generic name for the technology and interface specifications advocated by the OpenFlow Switch Consortium (http://www.openflowswitch.org/) established primarily by Stanford University (U.S.). NEC has participated in the OpenFlow Switch Consortium since its inception, and is engaged in OpenFlow-related R&D activities.

IT/NETWORK INTEGRATED CONTROL TECHNOLOGY SUPPORTING THE "C&C CLOUD STRATEGY"

Before: Complex operation and management of independently configured IT and network systems

Computers

IT management

Control functions

IT and networks must be managed separately

IP-based networks

Control functions

Network management

Going forward: Simple operations and management based on architecture transformation

Integrated management of IT and networks

IT/Network integrated control functions

OpenFlow controllers | Computer control functions

OpenFlow

Integrated IT and network infrastructure

Router switches
Control middleware (routing, etc.) | Hardware (packet transmission)

Separation of functions

OpenFlow controllers
Control middleware (routing, etc.)

Open protocol

OpenFlow switches
Hardware (packet transmission)