R&D AND INTELLECTUAL PROPERTY STRATEGY

NEC is promoting R&D activities that are closely linked to intellectual property and standardization strategies with the aim of creating an ongoing stream of innovation to significantly develop current businesses alongside fresh innovation as the source of future businesses.

Main Research Domains and R&D Strategy

NEC aims to realize a society that is safe, secure, efficient and fair by promoting the development of "Solutions for Society" under the "Mid-term Management Plan 2015." R&D activities at NEC focus not only on generating technical innovation to help current businesses supply "Solutions for Society," but also on creating original, innovative technologies for future businesses that can provide new social value. Success in R&D helps support the sustainable development of NEC.

NEC is working to accelerate those R&D activities that can make vital contributions in business domains related to "Solutions for Society," including Big Data analysis, SDN, safety and smart energy. Efforts are also focusing on reinforcing the originality and competitive edge provided through R&D programs involving technical assets such as Big

Data analytics technologies (such as Invariant Analyzer*, heterogeneous mixture learning and text mining), network virtualization technologies, and sensing technologies for environments from the deep sea to space. In addition to developing these technical assets, NEC's R&D activities also seek to create highly innovative technologies that push the envelope and redefine the state of the art.

From a strategic perspective, NEC aims to maximize the commercial potential of R&D activities focusing on such domains by seeking to create new value through the active promotion of programs directed at expanding the range of applications for technologies already developed in-house.

For instance, NEC is developing ways of improving the performance of corporate systems or carrier networks by combining security technologies with

Targeting R&D Domains to Support Business Development

Targeted R&D domains	R&D directly connected to business	R&D for new business creation
Big Data analytics	**Processing and analysis of large-scale complex information** Text mining, entailment recognition	**Creation of customer value through predictions and forecasts** Heterogeneous mixture learning, System Invariant Analysis Technology (SIAT)
SDN (Software-Defined Networking)	**Developing more efficient corporate ICT infrastructure** OpenFlow	**Advanced enterprise systems and carrier networks** ExpEther+SDN, Broadband Remote Access Server (BRAS)
Real-world data and processing	**Real-world information sensing and recognition** Facial recognition, subject recognition	**Real world optimization based on deep understanding and actuation** Behavioral analysis, large-scale video surveillance
Security	**Minimization of system security risks** Encryption technology, autonomous security	**Value maximization via safe data usage** Data anonymity, concealment process
Smart energy	**Efficient use of electric power** Lithium-ion rechargeable batteries, energy management systems (BMU, PCS)	**Combining energy efficiency and quality of life** Power/heat-integrated EMS, energy usage prediction and control
Smart business	**More efficient system integration** Model-based systems integration	**Analytics-based customer business optimization** Data store sizing, battery capacity optimization

* Invariant Analyzer is an analytics-based technology that extracts and models the relationships within large amounts of data to enable the detection of behavior that is anomalous with the model, thus allowing discovery of potential performance issues.

SDN. Other examples of original R&D programs with global development potential include joint research with Imperial College London in the U.K. on the use of ICT in managing "smart" systems to make more efficient use of water resources, and a collaborative research program with SRM University of India into more efficient electricity usage.

NEC also continues to focus on creating new value in partnership with customers. By undertaking R&D activities from more of a customer-oriented perspective, NEC seeks to grasp underlying customer needs and create timely R&D outcomes based on a "Global Open Innovation" approach, thereby maximizing value via the parallel development of such results.

Through its R&D programs, NEC aims to contribute to development of "Solutions for Society" as outlined in the "Mid-term Management Plan 2015," and to create new value to help realize "an information society friendly to humans and the earth" described in the NEC Group Vision 2017.

Main R&D Achievements in Fiscal 2013

Heterogeneous mixture learning technology for automatic detection of recurring patterns within Big Data
Technology for making highly accurate predictions and anomaly detection based on automatic extraction of regular patterns contained in large amounts of data (a task difficult for humans)

High-speed, highly scalable compound event processing technology for analyzing the complexity within Big Data
Technology for efficient collection and processing of large amounts of data taken from sensors and terminals to support the delivery of real-time analytics services

Sensing technology for rapid qualitative differentiation of at least 100 products
Combining image recognition technology for large numbers of products at one time with technology to detect items located in difficult-to-view areas, this technology is applicable to inventory management and demand forecasting solutions

Image sharpening technology for distant objects or viewing at night or under other poor visibility conditions
Round-the-clock real-time monitoring technology based on enhancing clarity of wide-area surveillance images for distant objects or under night or other poor visibility conditions

Joint development with Tohoku University into new device for generating electricity from easily accessible heat sources
Development of new thermoelectric device for power generation based on the "spin Seebeck effect," using coatings applied to various heat sources

Intellectual Property Strategy

The NEC Group owns approximately 65,000 patents worldwide, including approximately 23,000 patents in Japan (as of March 2013). NEC positions intellectual property as "the important management resources for the NEC Group's business competitiveness and stability," and is working to strengthen its intellectual property capability. Specifically, NEC is concentrating on establishing a global patent portfolio, to support quickly achieving an overseas sales ratio of 25% as targeted in "Mid-term Management Plan 2015." In such areas as SDN and smart energy in particular, 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 standardization 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 standards organizations both in Japan and overseas. Also, as part of external engagements with intellectual property, NEC is actively pursuing licensing activities to reduce business risks and expand business opportunities.