

NWGN

Diversity & Inclusion Networking the Future

New-Generation Network Vision

<http://nwgn.nict.go.jp/>

NiCT National Institute of
Information and
Communications
Technology

4-2-1, Nukui-Kitamachi, Koganei, Tokyo 184-8795, Japan
TEL: **+81-42-327-6993** FAX: **+81-42-327-6128**
E-mail nwgn-pub@ml.nict.go.jp

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NiCT

Foreword

Dramatic advances in telecommunications technology in recent years have sparked a new information revolution that ranks alongside the industrial revolution. Today, the Internet is an essential part of our social infrastructure not only in the world of business, but also in our everyday lives. But we still have some way to go before networks can become a platform for the creation of new businesses and the construction of a secure and safe society.

The National Institute of Information and Communications Technology (NICT) is promoting the research and development of new-generation networks (NWGN) that will form the ICT infrastructure over the coming decades. A new-generation network is a more far-reaching concept than a next generation network (NGN) in that it aims to completely resolve difficult technical issues and limitations not by simply reforming the Internet within the constraints of existing technology, but by redesigning it from scratch.

New-generation networks should not only contribute to solving the problems of modern society, but should also contribute to the further development of global culture in the 21st century. To achieve this goal, we need a challenge and aggressive R&D strategy. In line with this strategy, we first need a vision of how to go about realizing the society of the future and what sort of role new-generation networks should play in this society. This vision will navigate the further step towards realizing an R&D strategy for new-generation networks.

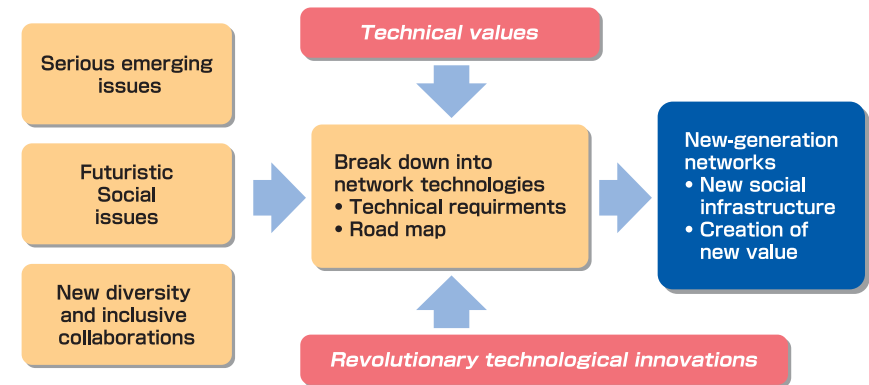


Hideo Miyahara
President of NICT

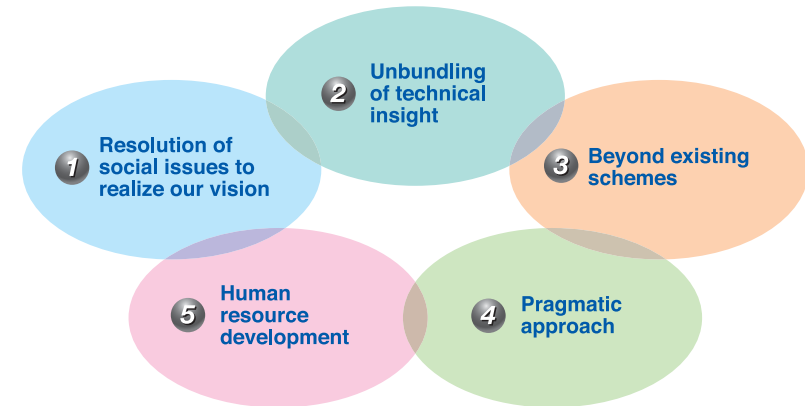
Selection of a new-generation network R&D strategy

The Strategic Headquarters for NWGN R&D was established by the National Institute of Information and Communications Technology (NICT) on October 1, 2007 to strategically promote the research and development of new-generation networks. Its mission is to draw up a medium-term strategy for Japan to seize the initiative in the R&D of new-generation networks in a climate of international collaboration and competition. In this way, we hope that the NICT will add momentum to R&D in this field in Japan.

The Strategy Headquarters has set up a Strategy Working Group to conduct focused strategic studies. At the Strategy Working Group, we are devising this strategy by identifying the requirements of new-generation networks that are capable of addressing the emerging issues of modern society and realizing the sort of society we hope to see in the future. These requirements are then broken down into the technologies where further research and development are required.



The following five view points are focused:



At the Strategy Working Group, we have conducted focused discussions on issues such as the technical demands of and policies for the resolution of social problems with new-generation networks, and the vision of a future society based on these networks. In the future, we are designing strategies for technical development, testbed development, technology transfer, R&D funding, standardization, internationalization and the fostering of human resources development.

Diversity & Inclusion : Networking the Future

Our new-generation network vision

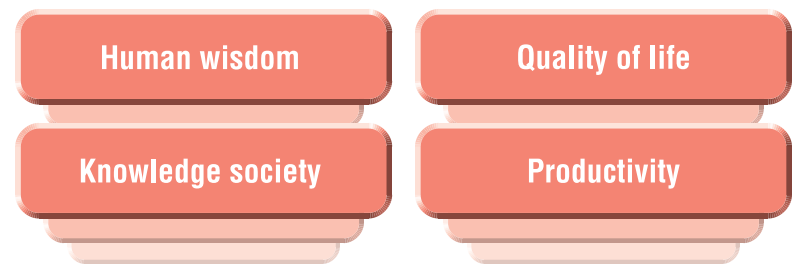
New-generation networks will maintain the sustainability of our prosperous civilization by looking beyond the next generation network and solving various social issues and problems through using information and communications technologies.

Further, by unfolding the potential ability of the individual and the society, these networks will realize an affluent life of higher quality. Furthermore, by accepting their diversity, new-generation network will aim to lay the cornerstones for information and communications which perpetually promote the human society.

Inclusion

As globalization progresses, disparities are becoming manifest in forms such as regional disputes and confrontations, urbanization and depopulation, clashes between different generations, and the technology gap between the “haves” and “have nots.” It is hoped that future societies will permit the coexistence of cultural, geographical, and individual diversities in order to help the world culture to develop in new ways.

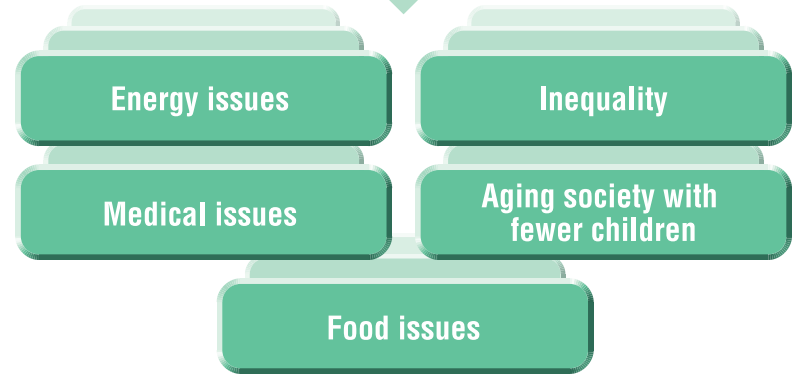
New-generation network aim to support the construction of an inclusive society where such diversity is respected and new cooperation is promoted.



Maximize the Potential

New diverse and inclusive collaborations

Minimize the Negatives



Creation of new world *(Maximize the Potential)*

If humankind is to have a bright future, it is essential that new values be created by improving industrial productivity and the quality of life and by empowering the latent potential of humans and society. Do we truly comprehend the importance of individual knowledge, the wisdom of regional communities, or the untapped latent knowledge of organizations and societies?

The aim of new-generation networks is to create new values accommodating all these latent abilities, i.e., Maximizing the Potential.



Solving emerging social issues *(Minimize the Negatives)*

Serious issues such as energy shortages and aging demographics have left people increasingly concerned about their future safety and wellbeing. Communications technologies should contribute to resolving these serious issues.

New-generation network aim to help in solving challenging issues, such as energy shortages, aging demographics, and natural disasters, i.e., minimizing the negatives of society, both at the domestic and global levels.



1 Energy issues and New-generation network

Overview of emerging problems

- The power consumption of ICT equipment accounted for about 5.8% of Japan's total annual consumption in 2006 and is still growing.
- 15 to 20 years later, traffic levels are likely to be 1,000 to 10,000 times higher than they are presently.
- The reduction of CO₂ emissions through use of networks by the society is also an important issue.

Approaches to solving these problems

- Develop energy-saving network equipments
- Promote reduction of energy consumption by social activities using new-generation networks
- Environmental management using sensing technologies
- Contribute to reduction of CO₂ emissions through network technology at the global level

Impacts on society

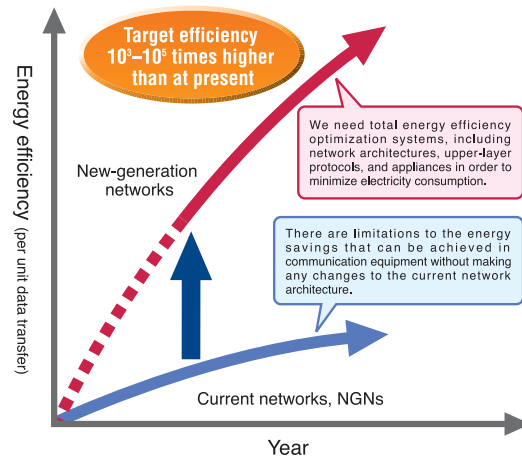
For a sustainable low-carbon society

Reduction of CO₂ emissions
New-generation networks will reduce CO₂ emissions from ICT systems themselves and achieve high energy-efficiency against the growth in traffic.

Reducing the carbon footprint of social activities
Large reductions in CO₂ emissions can be achieved by increasingly using networks for social activities.

Environmental management based on environmental sensing
Actively utilizing new-generation networks for environmental sensing will create the possibility to accurately ascertain and verify environmental impact, thereby contributing to a safer and more secure society.

International contributions
The reduction of CO₂ emissions on a global scale will be promoted by using frameworks such as CDM to enable ICT technology to be used internationally.

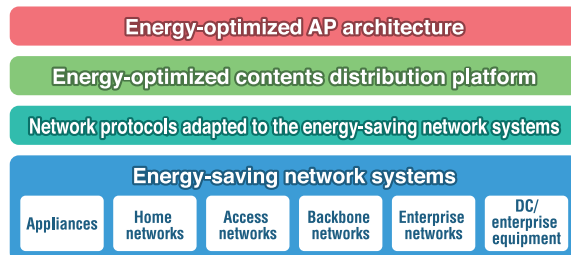


Advanced Technologies in Japan

- Photonic network technology
- Power management technology for communication equipment and appliances
- System design and development technology under power restrictions

Technical requirements of new-generation networks

- Energy-optimized network architecture (see figure on right)
- Technologies of reliability, dependability, safety, low delays, etc. necessary to promote the transformation of social activities into network-based activities



2 Natural disasters and New-generation network

Overview of emerging problems

- In recent years, large earthquakes were responsible for the overwhelming majority of cases where people were killed or went missing as a result of natural disasters. For example, 6,437 people were killed or missing in the 1995 Kobe earthquake.
- It is becoming increasingly likely that there will be a major earthquake in the next 30 years—Nankai: 50%, Tonankai: 60–70% .
- Strong demand for ICT disaster warnings and disaster reduction

Approaches to solving these problems

- Infrastructure facilities for large disasters are very costly; therefore, in times of disaster, networks for monitoring, disaster recovery, commercial use, and so on are linked together to implement a highly disaster-proof network infrastructure that is low-cost and allows the remaining network resources to be used cooperatively.
- By dynamically reconfiguring network resources around the time of a disaster, it is possible to comprehend the status of humans and transportation networks with equipment such as large-scale sensors, and to protect people, equipment, and data based on advance warnings.

Impacts on society

Evolution of disaster countermeasures from informational to interactive

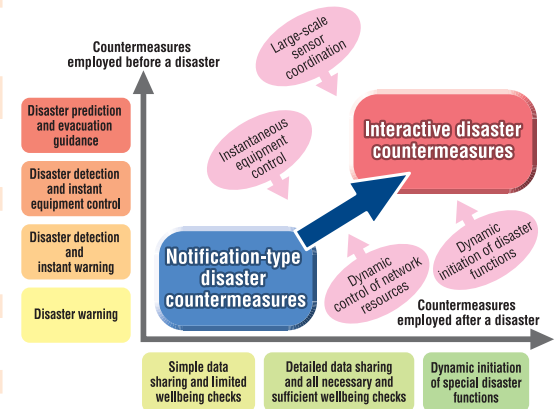
Eliminating anxiety after a disaster has occurred
The required amount of network resources are automatically secured to check on people's wellbeing after a disaster has occurred.

Protection of equipment and data in disasters
Directly before and after the outbreak of a disaster, equipment and data that are believed to be at risk of damage are automatically protected.

Ensuring safety
Issuance of warnings immediately before a disaster, automatic disaster detection and evacuation guidance when a disaster has occurred, and transportation and supply of disaster relief depending on the state of evacuation are realized

Preliminary measures
Preliminary measures are implemented based on disaster warnings before a disaster occurs.

Cost reduction
Emergency networks can be set up dynamically by linking together different types of wireless and wired networks by using satellites and airships, if required.



Advanced Technologies in Japan

- Fast earthquake detection technology
- High performance radar technology
- Terahertz sensing technology
- Technology for providing advanced functions through networked robots
- Technology for gathering data using a diverse range of sensors

Technical requirements of new-generation networks

- Control technology that can reliably provide network functions and alerts on earthquakes detected before the arrival of S-waves, even in the case of a large-scale earthquake
- Technology for controlling diverse network resources to allow the dynamic coordination of multiple network resources such as monitoring, disaster, and commercial networks
- Technology for guaranteeing the reliability of data such as sensor data
- Technology for dynamically initiating disaster functions using suitable resources and the selection of special functions according to the nature of the disaster

3 Medical care and New-generation network

Overview of emerging problems

- Soaring medical costs — total medical costs of ¥41 trillion in 2004 are estimated to increase to ¥90 trillion by 2025
- Mortality rate of lifestyle diseases (malignant growths, heart disease, cerebrovascular disease) exceeds 60%
- Specialist doctors tend to live near prefectural capital cities
- Ambulances are taking longer to arrive—up from 6 minutes to 6.6 minutes
- Incidents connected with medical errors are occurring frequently

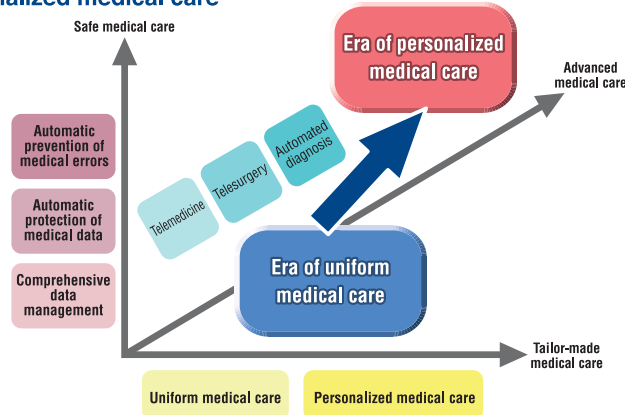
Approaches to solving these problems

- Individual management of health information, individualized healthcare, and healthcare based on evidence (tailor-made medicine)
- Construction of a network that supports advanced, safe, and secure medical care

Impacts on society

From standardized to personalized medical care

- Tailor-made medical care**
Optimal medical care is implemented at any time and place, suited to the individual patient's medical history and characteristics.
- Advanced medical care**
Remote medical care and surgery will be implemented to produce an environment where a large number of people can receive high quality medical care at any time and place.
- Safe medical care**
Safe medical care can be implemented by automatically protecting personal data and suppressing medical faults with equipments such as sensors.
- Suppression of medical costs**
The abovementioned achievements will result in reduced mortality of lifestyle diseases, prolonged healthy life expectancy, and suppressed medical costs.



Advanced technologies in Japan

- Technology for medical equipment
- High-resolution and 3D video technology
- Optical networks and broadband access networks technology
- Encryption-related security technology
- Technology for industrial robots and human interfaces
- Technology for data gathering using a diverse range of sensors

Technical requirements of new-generation networks

- Technology to allow continuous logging of medical status etc. for the implementation of personalized healthcare, even across non-continuous network connections
- Technology to guarantee low delay and jitter that allow international telesurgery, even highly complicated surgery
- Technology for the maintenance and management of unique personal data and the coordination of sensors to automatically prevent medical errors

4 Food issues and New-generation network

Overview of emerging problems

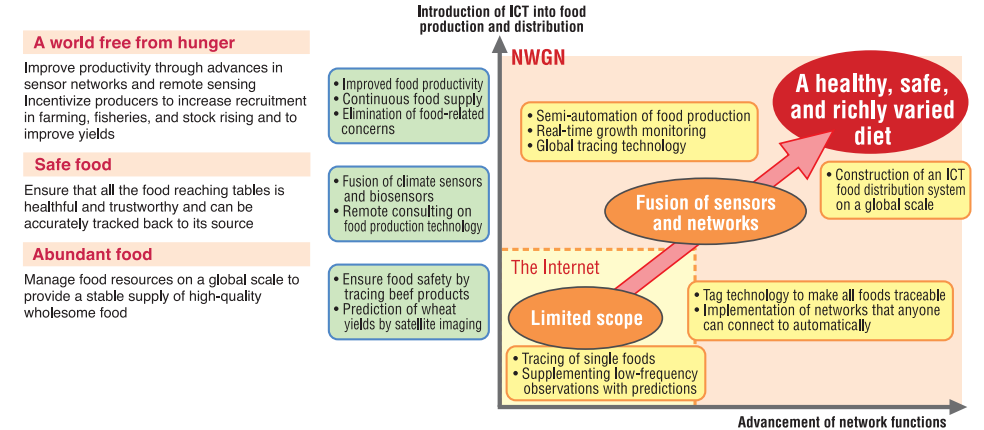
- By 2050, the world population could reach 9.37 billion, leading to food shortages.
- Unfair distribution of food due to political and economic instability
- Collapse of safe reputation, loss of trust in foods due to falsified place of origin, toxic contaminants, etc.

Approaches to solving these problems

- Make it easier for people to work in and profit from the food industry by developing an ICT technology platform that can be used by anyone.
- Establish food production management techniques using sensor network technology (which is energy saving, of higher quality, higher yield, and more stable)
- Construct a forge-proof traceability system by combining advanced security and network technologies
- Construct a global scale ICT food distribution system by combining resource management and traceability

Impacts on society

Safe and secure tracking of food from the point of production to the table



Advanced technologies in Japan

- Broadband infrastructure
- Low-power devices
- Sensor technology and sensing technology
- Embedded systems
- RFID technology

Technical requirements of new-generation networks

- Networks that anyone can connect to automatically
- Network and tag technology capable of tracking all foods to the table (over 10 trillion items per year)
- Advanced security to make it impossible to falsify a product's production history
- ICT distribution systems combining resource management and traceability
- Health management with edible IC tags and body area networks

5 Crime prevention and New-generation network

Overview of emerging problems

- Crime has become increasingly common over the last decade, with cases of street assault, burglary, and breaking and entering having increased by 400%, 190%, and 250%, respectively
- Cases of street assault and breaking and entering have reached an all-time high—up from 1.3 million in 1978 to 2 million in 2007
- Local community activities are on the decrease due to increasingly nuclear families, growing numbers of single-occupancy households (unmarried or elderly), and greater numbers of dual income families

Approaches to solving these problems

- Suppress the number of criminal incidents by improving the reliability and precision of crime prevention systems
- Increase detection rates by improving the precision of crime detection systems
- Ensure that both security and privacy are protected
- Support crime prevention and detection through community activities

Impacts on society

Protect ourselves

Watching over the elderly

Create an environment where the elderly can live peacefully in their own homes

Watching over children

Prevent children from getting involved in crime or unforeseen accidents

Crime suppression

Reduce the number of cases of street crime and breaking and entering

Protect privacy

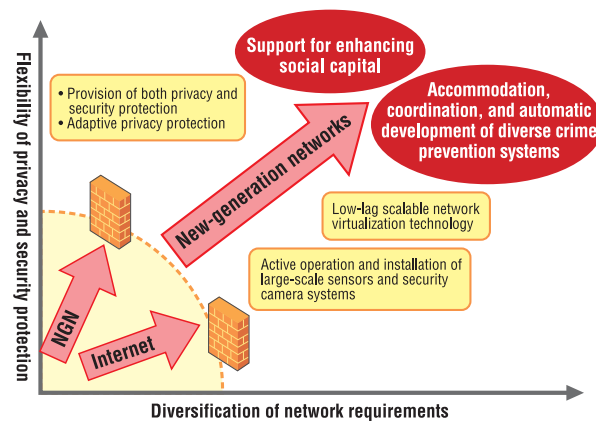
Provide users with a sense of security by automatically acquiring personal information using equipment such as cameras and sensors without violating privacy

Promote local community activity

Use ICT technology to support integrated local crime prevention activities and foster and promote regional communities

Expansion and creation of markets

Create and foster internationally competitive crime prevention industries



Advanced technologies in Japan

- Broadband network installation and network management technology
- Technology for incorporating multifunctional capabilities into compact, lightweight mobile terminals
- Technology for the integrated management of wide-area and short-range wireless access systems (cognitive radio technology)
- Technology for the operation and practical implementation of sensor and mesh networks
- Large-scale RFID system management technology

Technical requirements of new-generation networks

- Self-organization technology for wide-area or high-density large-scale sensor networks
- Network virtualization technology to allow multiple networks with diverse requirements to be simultaneously accommodated in a single platform
- Dynamic network resource sharing technology to facilitate instant on-demand configuration of secure private networks in user units
- Adaptive privacy protection technology that can be modified according to user's presence or context

6 Accidents and New-generation network

Overview of emerging problems

- From among all accidents, traffic accidents account for the overwhelming majority—approximately 950,000 cases in 2004, with 1.19 million people being killed or injured.
- The number of deaths among car passengers is decreasing slightly, but it remains unchanged among motorcyclists and pedestrians.
- The number of deaths in the 65-and-over age bracket remains unchanged

Approaches to solving these problems

- Split the existing data provision functions into three levels and implement traffic accident prevention measures by linking roads, vehicles, and the networks that connect them.

〈Step 1〉 Provide data and support systems for warnings and alerts

〈Step 2〉 Implement some driving operations with ICT

〈Step 3〉 Use ICT to automate the collection of data and for driving operations

Impacts on society

Reduce potential accident factors and implement a platform that creates new value

Dealing with Japan's emerging issues

Reduction of traffic accidents, environmental impact, and road congestion

Ensuring the mobility of the elderly

Facilitate the formation of societies where the elderly and handicapped can move around safely

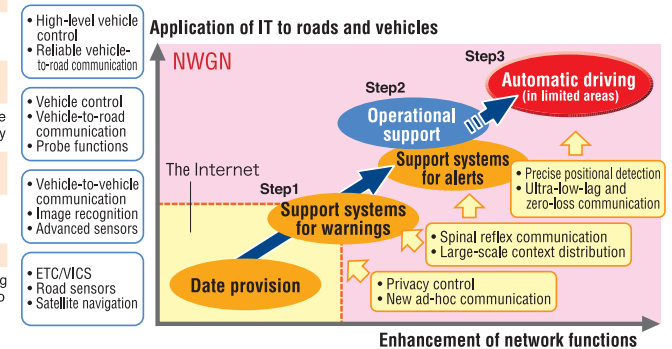
Abundant lifestyle and regional society

Improve the vitality of societies by effectively using freeways and public transportation

Better business environments

Improve business environments by distributing products more efficiently and allowing data to be used seamlessly

(Reference: ITS Japan)



Advanced technologies in Japan

- ITS technology used in ETC, such as DSRC (Dedicated Short Range Communication)
- On-board data terminal technology, such as satellite navigation
- Wireless communication technology, such as 3G/WiMAX and millimeter-wave radar

Technical requirements of new-generation networks

- Technology for ensuring connectivity of communications before, during, and after movement
- Technology for preferentially transferring urgent information without subjecting it to excessive processing
- Technology for the precise calculation of the position of fast-moving objects by linking sensors and networks
- Technology for circulating information on the position of people and vehicles as context information while protecting privacy

7 Domestic regional disparities and New-generation network

Overview of emerging problems

- Over-concentration of people, goods, money, and information in Tokyo
- Decline of regional economies, reduced employment, depopulation (exodus of young people), and reduction in public services
- Long-distance commuting into Tokyo, heavy rush hour traffic, and chronic traffic congestion

Approaches to solving these problems

- Use ICT to rectify disparities in public services such as healthcare, education, and finance
- Use ICT to make information related to local resources such as people, goods, and finance accessible in a more visual, quantitative, and real-time form
- Stimulate local industry to create new jobs and improve the local standard of living
- Create new lifestyles

Impacts on society

Make it possible for anyone to live well anywhere in Japan

Eliminate disparity in public services

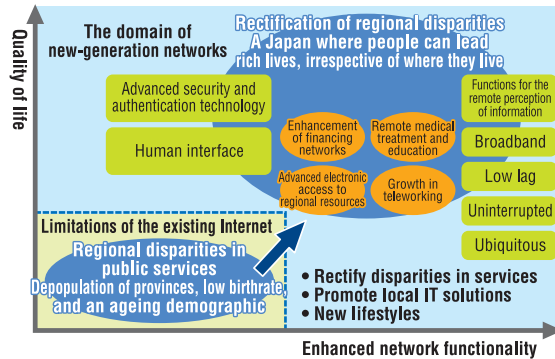
Provide everyone with the opportunity to receive high-quality healthcare, nursing, and education, irrespective of where they live. Reduce bureaucracy and secure lifelines by performing the functions of financing and administration electronically.

Stimulation of local business and promotion of regional independence and autonomy

Effective utilization of local resources for a revitalized Japan.

Creation of new ways of working and new lifestyles

Use of ICT to provide environments where people can work from home whenever they like. Contribute to alleviating the rush hour traffic in urban areas and improving the quality of life.



Advanced technologies in Japan

- Broadband environments
- Sensing technology
- 3D video and high-resolution video technology
- Optical communication technology and low power consumption device technology
- Security technology

Technical requirements of new-generation networks

- Technology for gathering and transmitting a wide range of sensory information at remote locations without losing the sense of presence
- Safe and convenient authentication technology and real-time monitoring of transactions and human interfaces that can be individually customized
- Networks for the advanced utilization of local resources (people, goods, finance)
- Broadband and ubiquitous technology compatible with thin clients

8 Aging society with fewer children and New-generation network

Overview of emerging problems

- Rapidly falling birthrates and an aging population
- Changes in the labor force participation population
- Importance of health, welfare, and nursing
- Achieving a balance between work and home

Approaches to solving these problems

- Networks to support individual safety and a fulfilling life
- Ambient assisted living
- Networks to assist people's participation in work and society

Impacts on society

Networks in the era of falling birthrates and an aging population

Safe and comfortable living

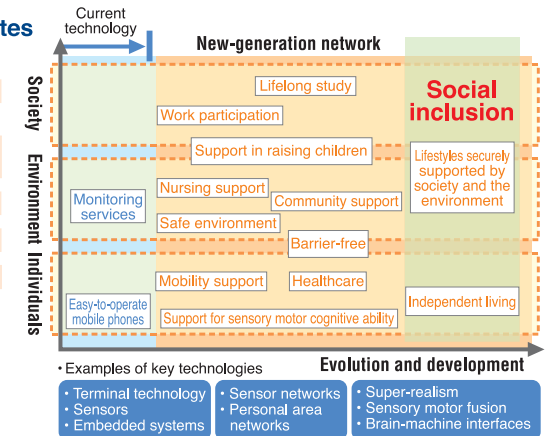
Support for individual mobility, sensory motor systems, etc.

Realization of safe and secure communities and fulfilling lifestyles

Nursing support, work/life balance support

Participation of the elderly in work and society

Support in raising children



Advanced technologies in Japan

- A diverse range of terminal technologies such as mobile phones, sensors, consumer electronics, and game consoles, and embedded system technology
- Sensing technology
- Robotics technology
- Broadband environments

Technical requirements of new-generation networks

- Personal network technology such as support for mobility and other forms of sensory motor ability including cognitive processes
- Environmental network technology to support safety and security in households and communities
- Social network technology to achieve balanced, highly productive, and fulfilling lifestyles

9 International economic disparity and New-generation network

Overview of emerging problems

- Maldistribution of information due to the deployment process of communication networks oriented from rich and developed nations
- Broadening international information disparity due to the delayed deployment of networks in developing countries

Approaches to solving these problems

- Networks and services that are affordable and easy to use for all
- Networks that are easy to manage, thereby promoting their widespread deployment
- Diverse networks and devices that fulfill regional requirements
- Simple devices that are easy to use, such as existing telephones and televisions

Impact on society

Networks that are affordable and easy to use for all

Global-scale networks

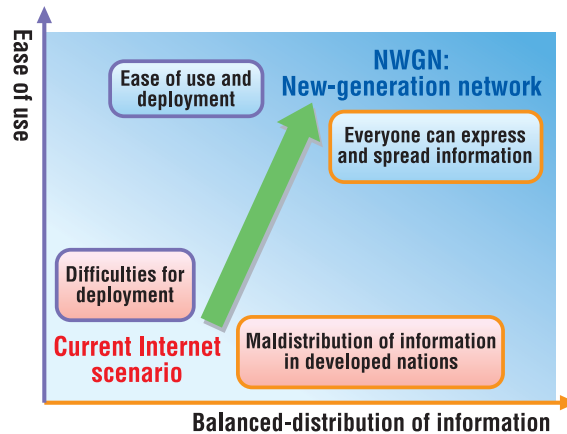
Networks that are easy to manage and can fulfill regional requirements

Networks can be used by all

Networks that anyone can connect using simple devices and services that are easy to use

Relieving the data disparity

Promoting efforts to express and spread information, e.g., regional culture and opinions, by technologies that allow anyone in the world to exchange information easily



Technologies that Japan has to offer

- Network management/control technology
- Mobile terminal technology
- Energy-saving technology
- Manufacturing and quality control technology

Technical requirements of new-generation networks

- Technology for autonomously configuring networks in a distributed manner, which are easy to set up and recover if problems occur
- Enhancement of Zeroconf (automatic set-up) technology to simplify network management
- Scalable architecture that is compatible with a wide range of network sizes
- Networking technologies that are available even in unstable and uncertain environments

10 Cultural/lifestyle diversity and New-generation network

Expected future developments

- Support for exchanging views and establishing mutual understanding across cultural, social, racial, ethnic, and religious divides
- Support for social participation and contributions by accommodating diverse skills

Approaches to realizing these developments

- Multilingual communication support
- Systems that can accommodate diverse skills
- Ubiquitous services on a global scale so that data can be accessed from anywhere

Impact on society

A world where people can live together with respect for diversity

Overcoming cultural barriers

Real-time automatic interpreting service through the combination of language translation technology and speech recognition/speech synthesis technology

Support for people with visual/auditory impairment

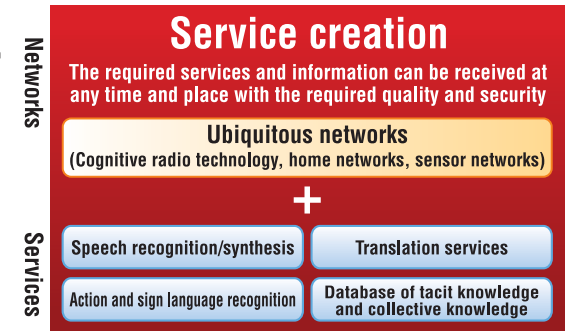
Helping people with visual/auditory impairment to participate in society by means of speech recognition and sign language recognition/synthesis

Support for geographical/cultural knowledge

Realizing a safe society and supporting cross-cultural understanding by collecting and providing cultural knowledge and common understanding in the region

Global-scale ubiquitous networks

Providing the necessary services and information at any time and place with the necessary quality and security



Technologies that Japan has to offer

- Natural language processing technology
- Electronic media processing technology
- Energy-saving, reliable, and small-scale device development technology
- Technology for the application and utilization of ubiquitous networks (sensors, RFID, etc.)

Technical requirements of new-generation networks

- Distributed electronic media processing technology
- Autonomous service creation technology
- Cognitive radio technology and mesh/ad-hoc network technology
- Sensor network technology
- Energy-saving device development technology
- Data distribution optimization and energy-saving access technology

11 Media convergence and New-generation network

Expected future developments

- Adapting to media convergence within the scope of communication and broadcasting legislation and copyright law
- Provision of services that are converged in a true sense
- Increase in diverse information transmission from individuals and communities
- Creation of new business models

Approaches to realizing these developments

- Extensive and stable broadband networks
- Adapting to individual needs while supporting multiple simultaneous delivery
- Creation of new value additions to the available information using diverse transmission media
- Creation of platforms where individuals and communities can easily deliver information
- Creation of flexible media convergence services

Impacts on society

Networks to support the media convergence

Information sharing environments that are not tied to any transmission means

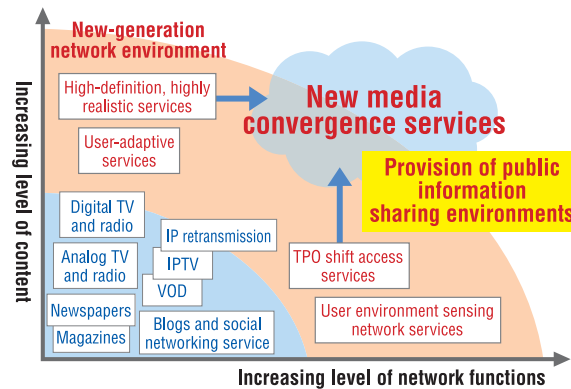
Possible to transmit and access content at any time and place Effective utilization of limited spare time

Services that provide new experiences

Implementation of high definition and highly realistic and user-adaptive services that are simple to use for everyone

Public information-sharing environments that recreate the atmosphere of a place and confer a sense of participation

Provision of public view services
Use of video sharing in school education and local communities



Advanced technologies in Japan

- Broadband environments
- Ultra high definition, ultra realistic video technology
- Operational experience in terrestrial digital TV and 1seg broadcasting and corresponding receiver terminal technology

Technical requirements of new-generation networks

- Network technology where users do not have to be aware of the means of content transmission (wireless transmission, cable transmission, broadcasting, etc.)
- Sensor network technology that uses various sensing techniques to provide a viewing environment suited to the user's intentions and emotions
- Synchronization control technology for merging and presenting content obtained from multiple sources over multiple transmission paths without any sense of incongruity
- Media convergence platforms where information can be delivered easily

12 Knowledge society and New-generation network

Expected future developments

- Transition from a society led by industry to a society led by knowledge
- Importance of creativity in individuals, organizations, and society
- A new style for the acquisition of creativity that is coordinated on a global scale
- Information systems as a critical infrastructure that can cope with information explosion

Approaches to realizing these developments

- Support individual creativity
- Expansion of the creativity of organizations and society
- More effective development of the power of environment such as tacit knowledge
- Creation of new knowledge through regional, linguistic, and cultural exchanges

Impacts on society

Toward networks that support knowledge society

Expansion of individual creativity

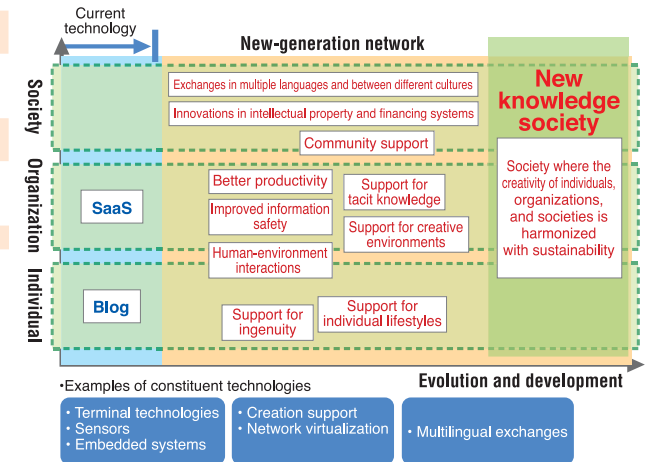
Creation of new value
Contribution to work participation and fulfilling lifestyles

Creative and efficient knowledge society

Effective utilization of tacit knowledge and nonverbal communications. Environment and society that support creativity and efficiency

Creation of new value

Creating new wisdom for humans through regional, linguistic, and cultural exchanges, while maintaining diversity



Advanced technologies in Japan

- Broadband environments
- Process know-how and technical ability aimed at improving quality and reducing costs
- Diverse terminal technologies such as mobile phones, consumer electronics, and game consoles

Technical requirements of new-generation networks

- Network technology that can stimulate creative activity in individuals while ensuring security
- Productivity-enhancing technology that allows individuals and organizations to engage in creative activities
- Creativity support technology that works with individuals, organizations, and the society
- Network technology that supports exchanges between different languages and cultures on a global scale
- Creativity support technology that utilizes nonverbal communication and tacit knowledge

The technical challenges of implementing new-generation network

Towards a delightful future society, new-generation network should strongly contribute to minimizing social negatives and maximizing human and social potential. Furthermore, this network should be reliable, dependable, trustable, cost-efficient, low-energy consuming, etc. as a lifeline infrastructure. In order for creating this new infrastructure in a sustainable manner, we will promote a strategic R&D plan to solicit hot research activities in Japan to collaborate and contribute in the international community and to reactivate considerable growth in the related industries.

In order to achieve our new-generation network vision, we suggest that we should tackle the following R&D challenges and create and validate many ideas.

