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**NiCT** National Institute of  
Information and  
Communications  
Technology

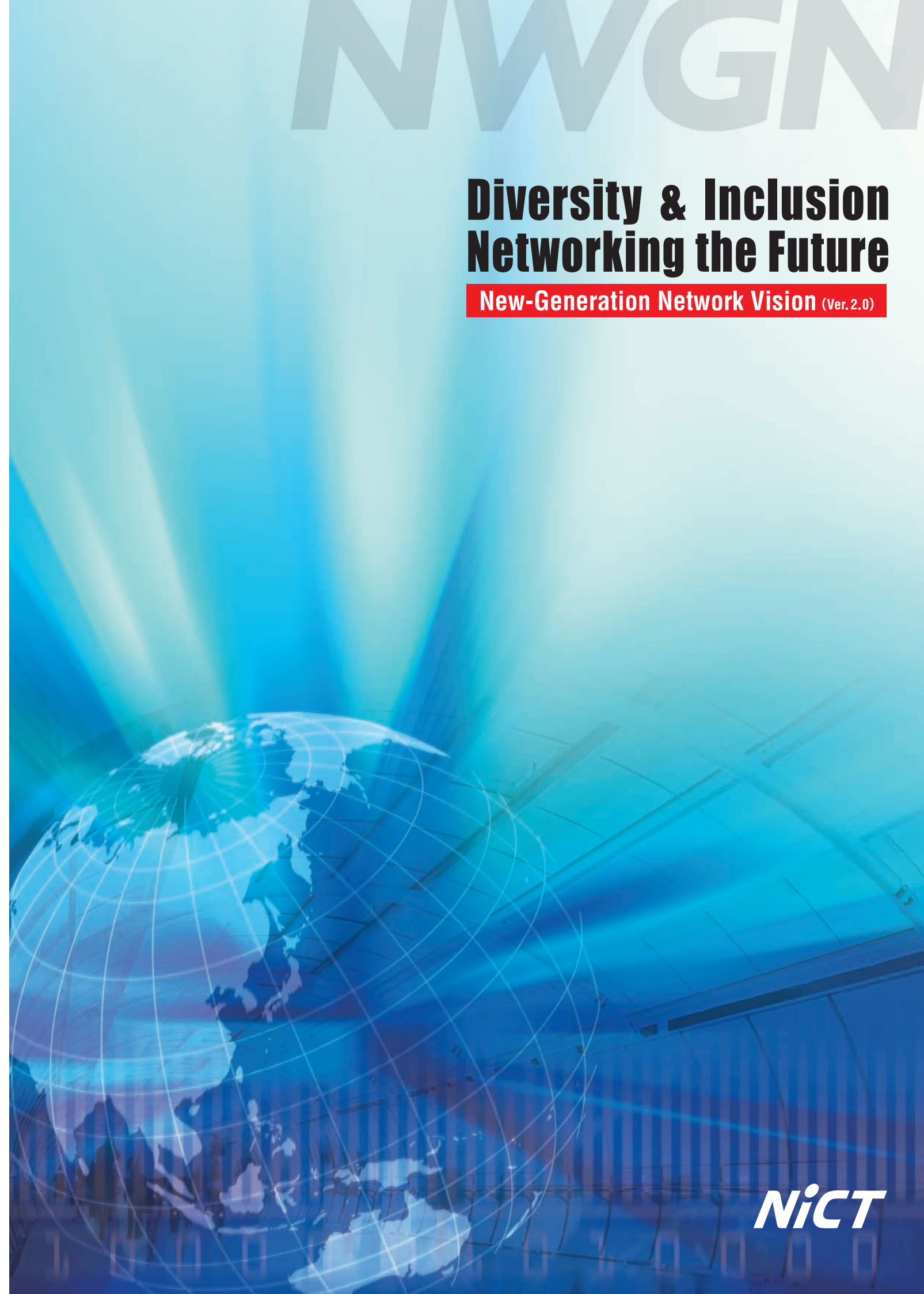
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# NWGN

## Diversity & Inclusion Networking the Future

New-Generation Network Vision (Ver. 2.0)



**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 network (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 network 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 network should play in this society. This vision will navigate the further step towards realizing an R&D strategy for New-generation network.

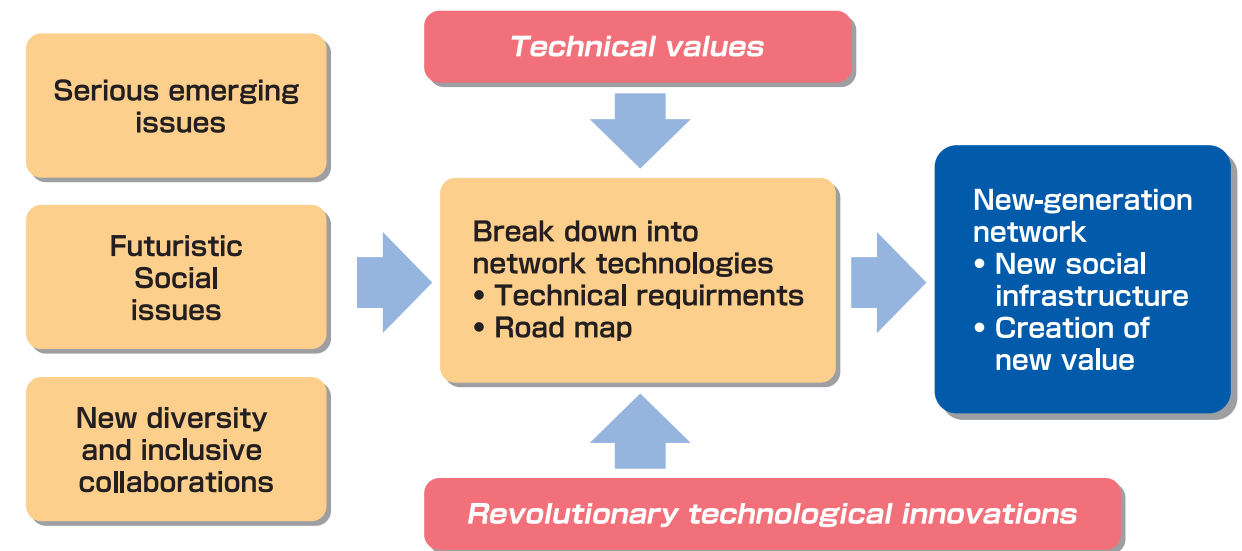


**Hideo Miyahara**  
President of NICT

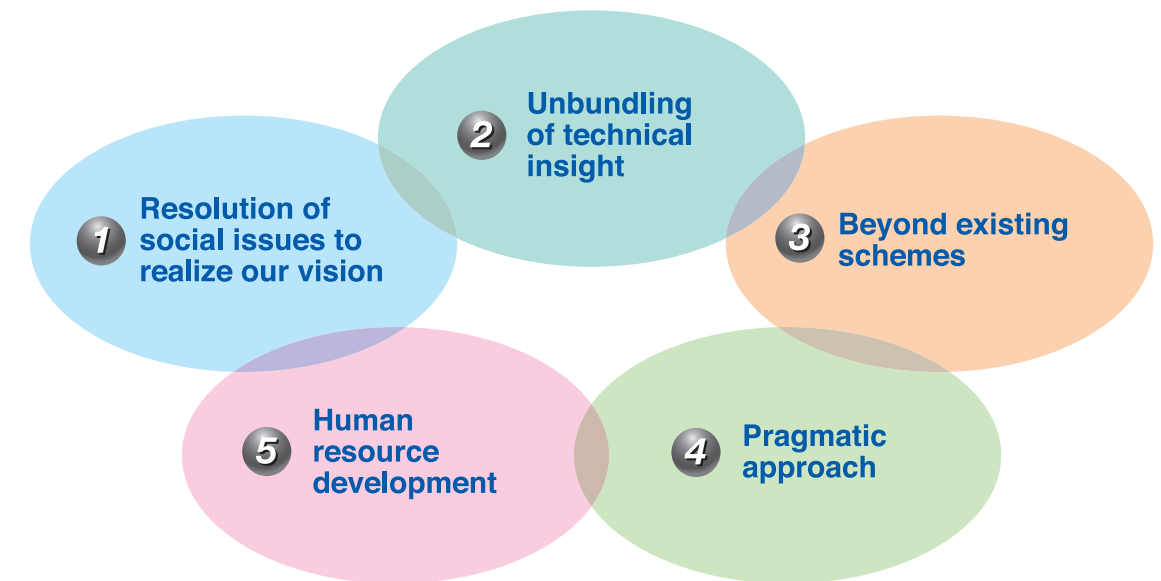
## Selection of a New-generation network R&D strategy

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 network. Its mission is to draw up a medium-term strategy for Japan to seize the initiative in the R&D of New-generation network 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 network 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 network, 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

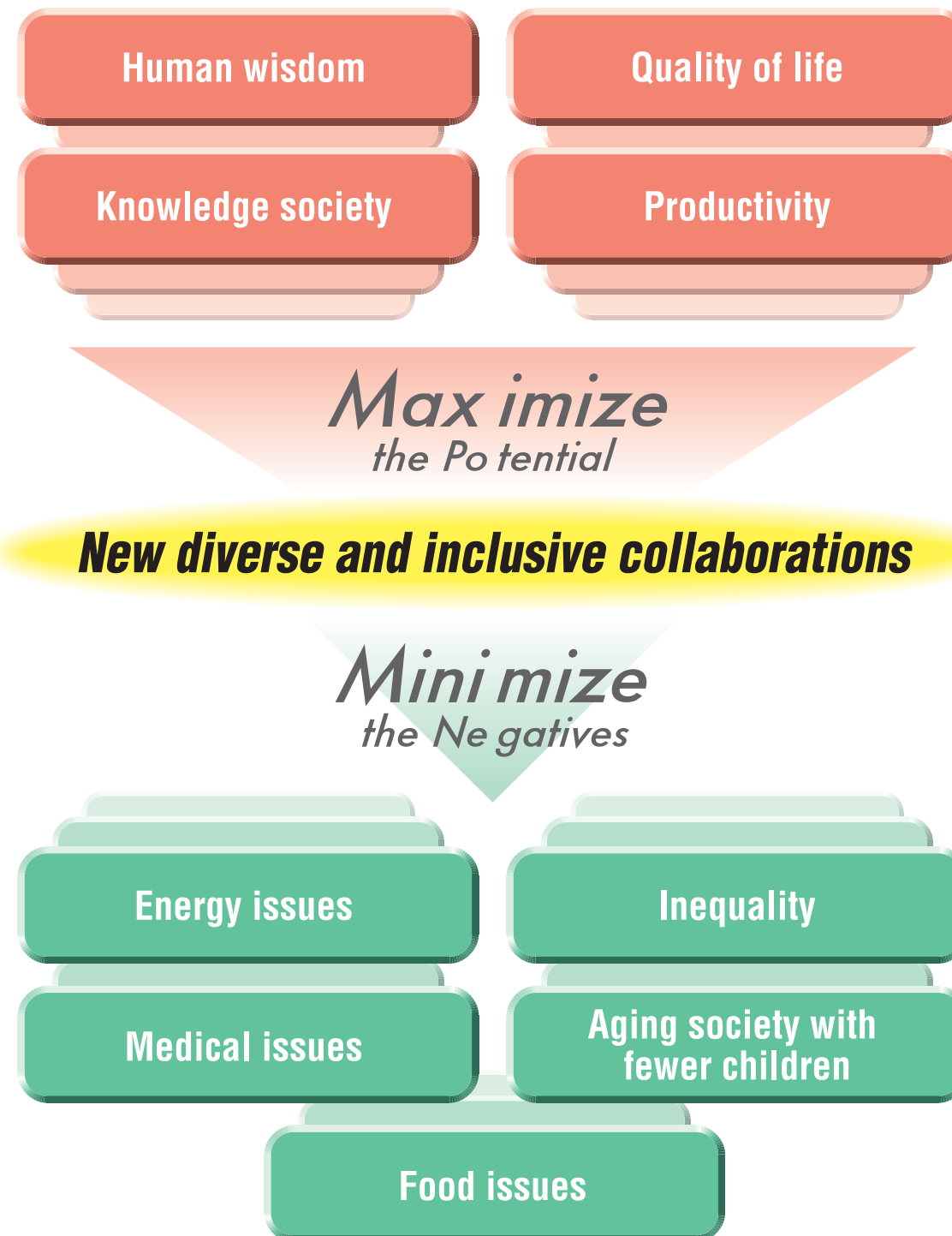
New-generation network will maintain the sustainability of our prosperous civilization by looking beyond the next generation network and solving various social issues and problems through using information and communications technologies.

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.



## 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 network 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 CO<sub>2</sub> 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 network
- Environmental management using sensing technologies
- Contribute to reduction of CO<sub>2</sub> emissions through network technology at the global level

## Impacts on society

### For a sustainable low-carbon society

#### Reduction of CO<sub>2</sub> emissions

New-generation network will reduce CO<sub>2</sub> emissions from ICT systems themselves and achieve high energy-efficiency against the growth in traffic.

#### Reducing the carbon footprint of social activities

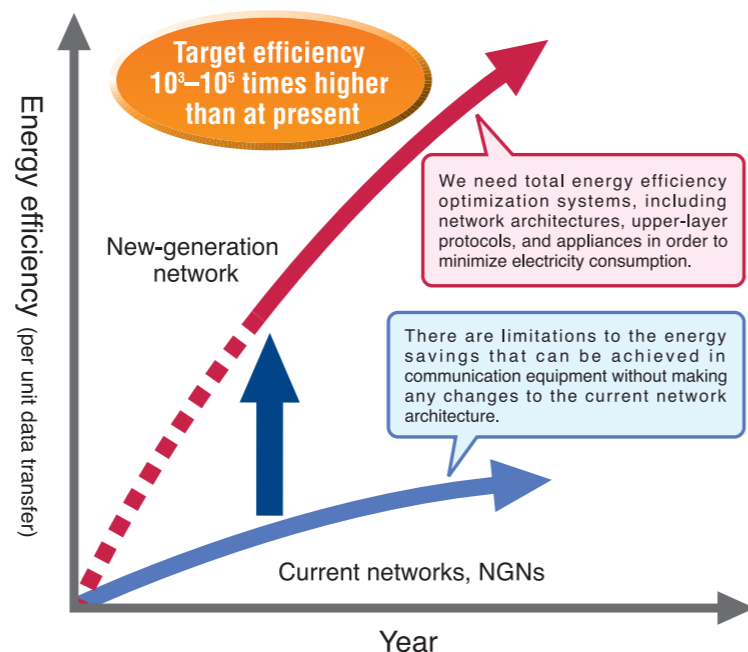
Large reductions in CO<sub>2</sub> emissions can be achieved by increasingly using networks for social activities.

#### 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 CO<sub>2</sub> emissions on a global scale will be promoted by using frameworks such as CDM(Clean Development Mechanism) to enable ICT technology to be used internationally.

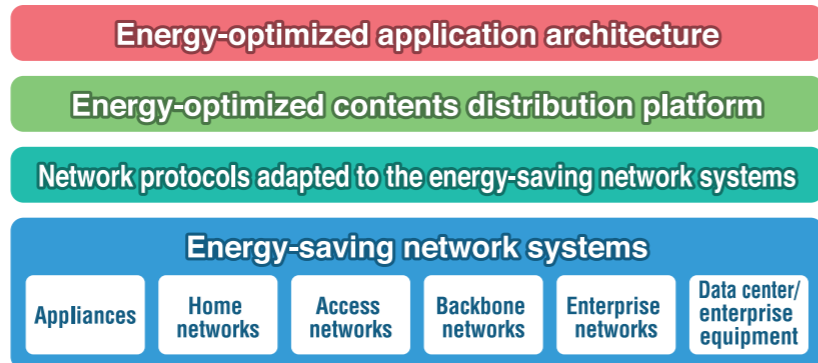


## Advanced Technologies in Japan

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

## Technical requirements of New-generation network

- 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

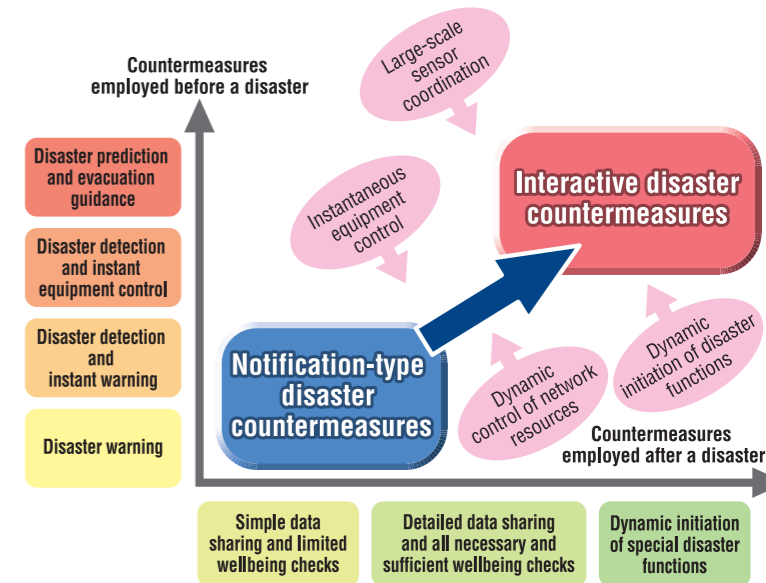
Issuance of warnings immediately before a disaster, automatic disaster detection and evacuation guidance when a disaster has occurred, and transportation and supply of disaster relief depending on the state of evacuation are realized

#### 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 network

- 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

- Increasing 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 global, advanced, safe, and secure medical care

#### Impacts on society

##### From standardized to personalized medical care

###### Tailor-made medical care and health care

Optimal medical care is implemented at any time and place, suited to the individual patient's medical history and characteristics.

###### Global and advanced medical care

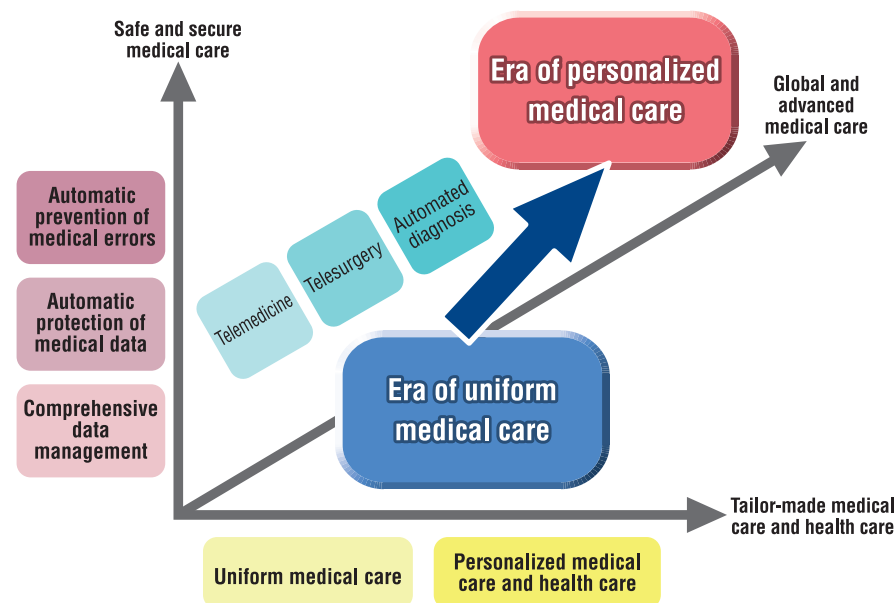
Remote medical care and surgery will be implemented to produce an environment where a large number of people can receive high quality medical care at any time and place.

###### Safe and secure 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 network

- 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

###### A world free from hunger

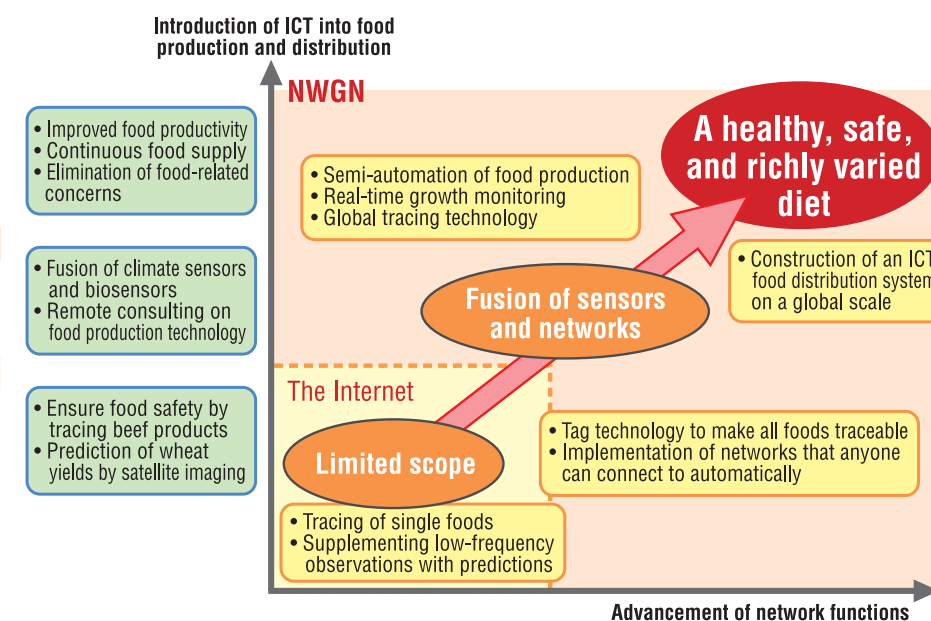
Improve productivity through advances in sensor networks and remote sensing  
Incentivize producers to increase recruitment in farming, fisheries, and stock rising and to improve yields

###### Safe food

Ensure that all the food reaching tables is healthful and trustworthy and can be accurately tracked back to its source

###### Abundant food

Manage food resources on a global scale to provide a stable supply of high-quality wholesome food



#### Advanced technologies in Japan

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

#### Technical requirements of New-generation network

- 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

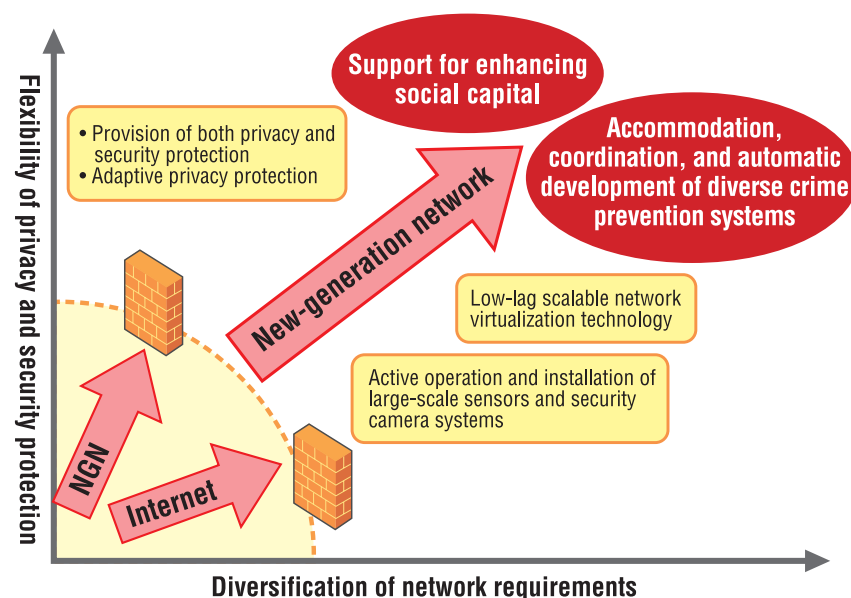
Provide users with a sense of security by automatically acquiring personal information using equipment such as cameras and sensors without violating privacy

##### 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 network

- 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

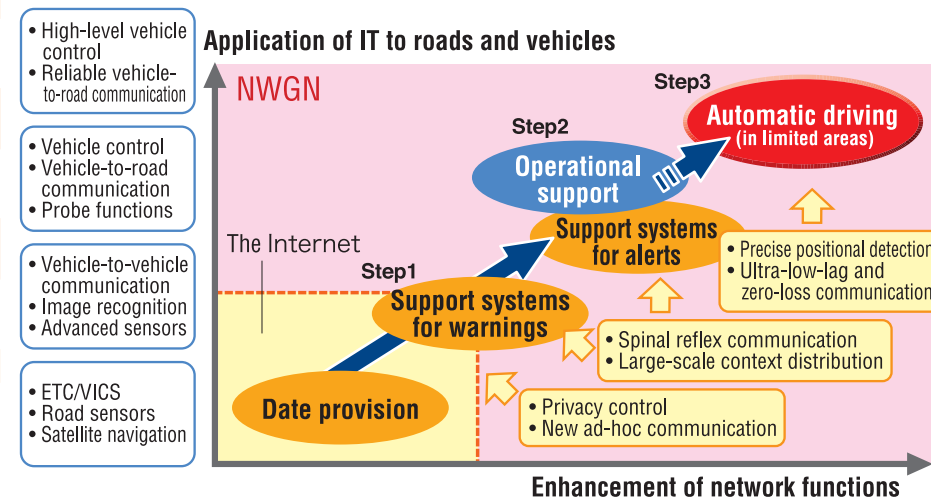
##### Abundant lifestyle and regional society

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 (Electric Toll Collection system), 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 network

- 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

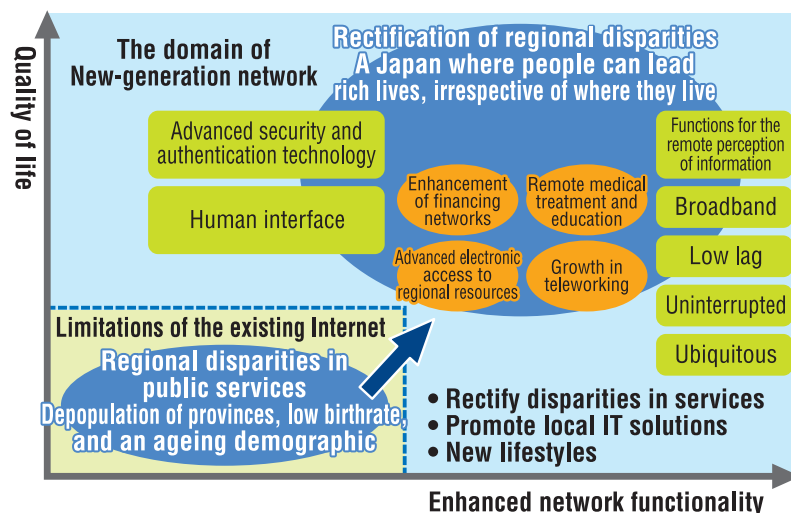
Provide everyone with the opportunity to receive high-quality healthcare, nursing, and education, irrespective of where they live. Reduce bureaucracy and secure lifelines by performing the functions of financing and administration electronically.

##### 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 network 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 network

- 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

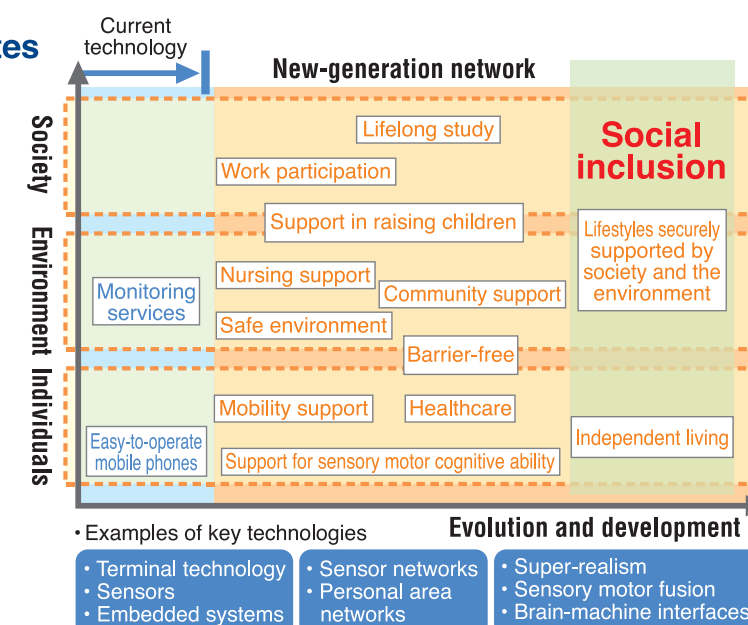
Support for individual mobility, sensory motor systems, etc.

##### 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 network environments

### Technical requirements of New-generation network

- 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

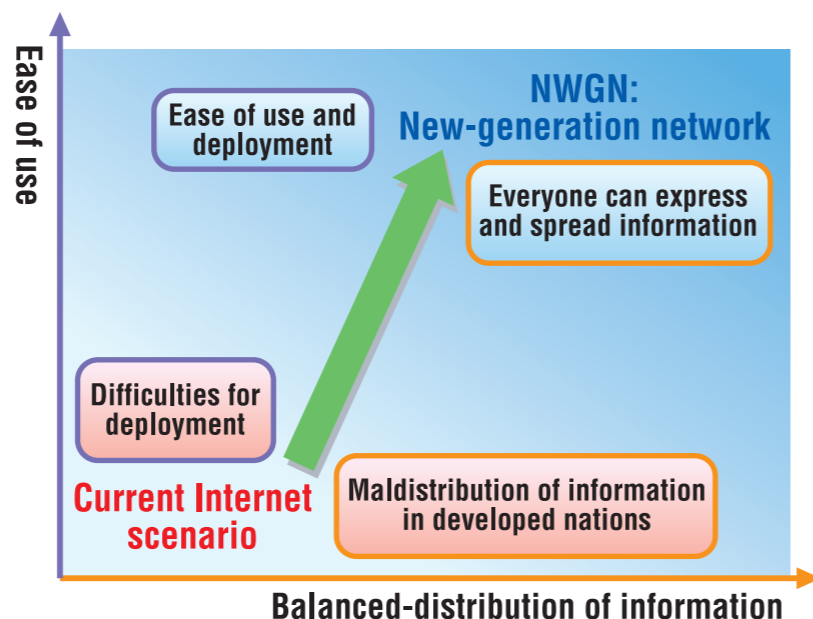
Networks that are easy to manage and can fulfill regional requirements

##### 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



### Advanced technologies in Japan

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

### Technical requirements of New-generation network

- 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 Educational issues and New-generation network

### Overview of emerging problems

- Quality of educational content and reliability of educational interfaces
- Current quantity and quality of English teaching
- Threat of accidental access to harmful information
- Poor ICT literacy
- Changes in the education business

### Approaches to solving these problems

- Proper “learning” support in mutual cooperation with real society
- Making learning more effective by using diverse teaching materials tailored to meet individual needs
- Network environments where the distribution of content is adaptively controlled
- Promotion of ICT in studies and education support activities
- Environments where anyone can study anywhere and at any time

### Impact on society

#### Networks to support a richer studying experience and trouble-free education

##### Communication study

Using networks to impart extracurricular lessons and lessons based on experience to help learners gain a holistic understanding of the world

##### Multimedia textbooks; studying made entertaining

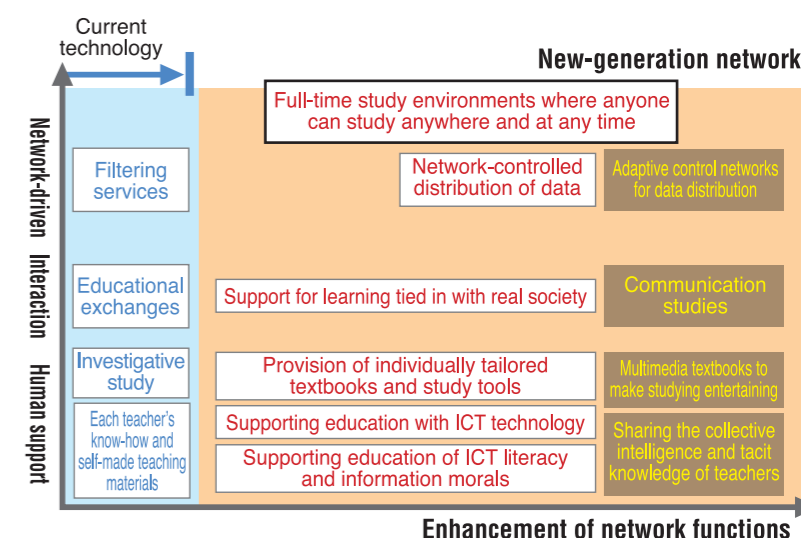
Provide teaching materials, media and study tools that are suited to the student’s level of comprehension

##### Sharing the collective intelligence and tacit knowledge of teachers

Support for sharing of information such as educational know-how  
Support for ICT literacy and information morals education

##### Adaptive control network for data distribution

Network actively controls the distribution of content by making its own decisions



### Advanced technologies in Japan

- Broadband network environments
- Information media processing technology
- Sensing technology
- Network terminal technology (technology related to user interfaces)
- Ultra-high definition and ultra-realistic technology
- Computer graphics/virtual reality technology

### Technical requirements of New-generation network

- Real-time communication technology to ensure true social connectivity
- Network technology that assures the reliability of content and facilitates the acquisition, use and sharing of individual study profiles
- Network virtualization technology to control the distribution of data and change the network quality depending on who is using it
- Technology for digitizing and sharing teachers’ know-how—their collective intelligence and tacit knowledge



# 11 Recurrent education and New-generation network

## Overview of emerging problems

- Changes in the education business (owing to an ageing society with fewer children)
- Growing importance of recurrent education (lifelong learning)
- Inadequate utilization of ICT
- Basic academic ability, English proficiency
- Quality of content

## Approaches to solving these problems

- Making learning more effective by using diverse teaching materials, tailored to meet the needs of the learner
- Environments where anyone can study anywhere and at any time
- Network environments where the distribution of content is adaptively controlled
- Promotion of ICT in activities such as learning and education support

## Impacts on society

### Toward an era of enriched study and dependable education

#### Advanced e-learning (digital teaching materials; full-time study environments)

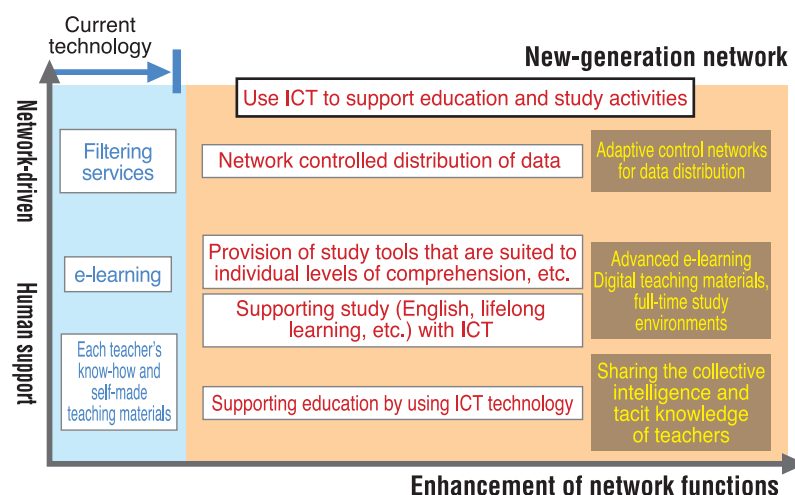
Provide an experience that facilitates more effective learning  
Provide teaching materials and study tools that are well-suited to the students' levels of comprehension  
Provide study environments where concurrent studies are conducted in a full-time, cooperative manner

#### Sharing the collective intelligence and tacit knowledge of teachers

Support for sharing information such as educational know-how

#### Adaptive control network for data distributing

Network environments where the distribution of content is adaptively controlled by the network itself



## Advanced technologies in Japan

- Broadband network environments
- Information and media processing technology
- Sensing technology
- Network terminal technology (technology related to user interfaces)

## Technical requirements of New-generation network

- Network technology that assures the reliability of content and facilitates the acquisition, use and sharing of individual study profiles
- Technology for digitizing and sharing teachers' know-how—their collective intelligence and tacit knowledge
- Network virtualization technology to control the distribution of data and change the network quality depending on who is using it

# 12 Cyber security and New-generation network

## Overview of emerging problems

- The interruption of basic network functions by cyber attacks causes significant social and economic damage
- Problems such as computer viral infections and leakages of personal information are also serious issues for users
- As security settings become more complex, the difficult task of configuring suitable settings is rapidly becoming more complex
- It is difficult to immediately identify and respond to new types of cyber attack

## Approaches to solving these problems

- Prevent damage escalation by promptly isolating the source of an attack and setting up a strong defense network based on cooperation between entities (networks, terminals, servers)
- Design dependable networks that can avoid fatal disruption and avert significant damage even if they are vulnerable in other areas
- Automate the security settings of each entity by learning the appropriate defense policies from the behavioral history of the attackers and the victims, and the status of the damage inflicted

## Impacts on society

### Toward a robust networked society that can withstand security threats

#### Secure networks

Implement a highly reliable ICT platform that can defend itself against cyber attacks

#### Dependable network services

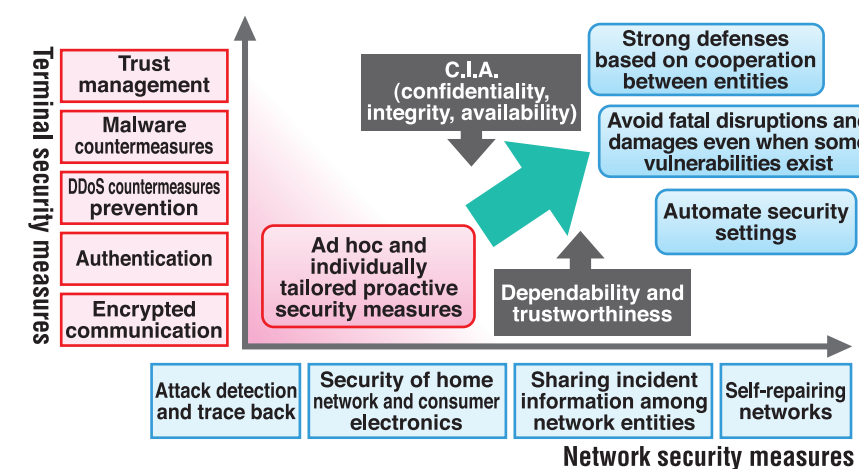
Minimize damage by instantly detecting and blocking cyber attacks, malfunctions, and human error

#### Protection of privacy

Prevention of information leakage

#### Automatic balance between usability and security

Security protection without loss of usability



## Advanced technologies in Japan

- Cryptography
- Biometric authentication technology
- Consumer electronics with advanced functionality
- Advanced node technology implemented in hardware
- Broadband network construction technology
- Operation, administration and maintenance technology for large-scale IP networks

## Technical requirements of New-generation network

- Cooperative defense technology for instantaneously detecting and blocking cyber attacks
- Incident handling technology which instantaneously detects attacks, issues alerts and isolates the attackers
- Self-repairing network technology that can maintain a minimum level of functionality and usability while under attacks
- Network-embedded data processing technology that can instantaneously search, detect and delete leaked information
- Technology that can be used to automatically detect security configurations, by exploiting sophisticated database technology

## 13 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

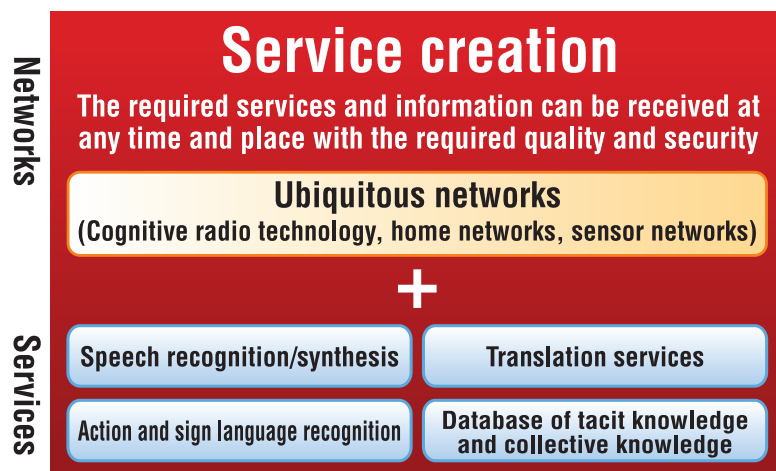
Helping people with visual/auditory impairment to participate in society by means of speech recognition and sign language recognition/synthesis

##### 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



### Advanced technologies in Japan

- 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 network

- 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

## 14 Media convergence and New-generation network

### Expected future developments

- A new media experience that has not been obtained under the present situation
- Increase in the diverse forms of information transmission among individuals and communities
- Creation of new business models
- Adaptation to media convergence within the scope of the communication and broadcasting legislations and the copyright laws

### Approaches to realizing these developments

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

### Impacts on society

#### Networks to support an era of media convergence

##### Services that provide new experiences

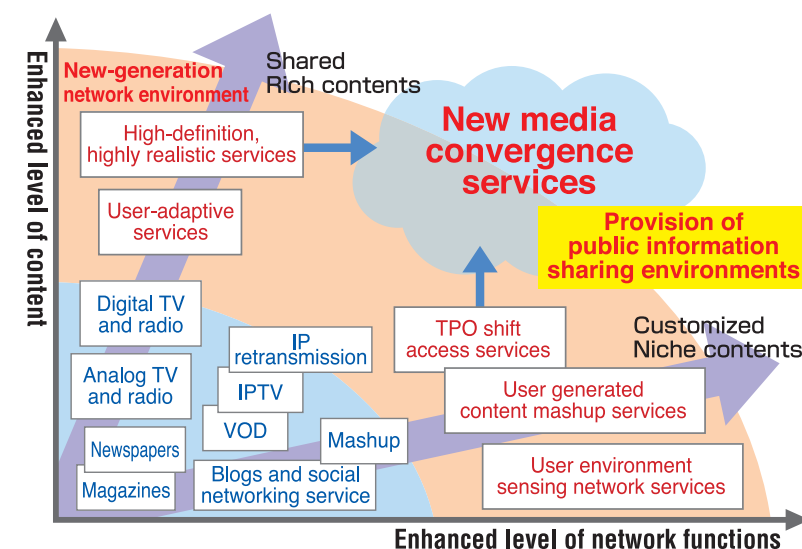
High-definition and highly realistic services  
User-adaptive services that are simple to use for everyone

##### Services that provide new communications

Platforms where the facilities of transmitting and accessing content are enabled anytime and anywhere  
For community use—in school education; in regional societies  
Systems that allow, promptly, further use of content

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

Provision of public view services with high presence  
Effect of uplift of a sense of participation according to user's communications



### Advanced technologies in Japan

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

### Technical requirements of New-generation network

- Network technology where users do not have to be aware of the means of content transmission (wireless transmission, cable transmission, broadcasting, etc.)
- Media convergence platforms where information can be delivered easily
- 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

## 15 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

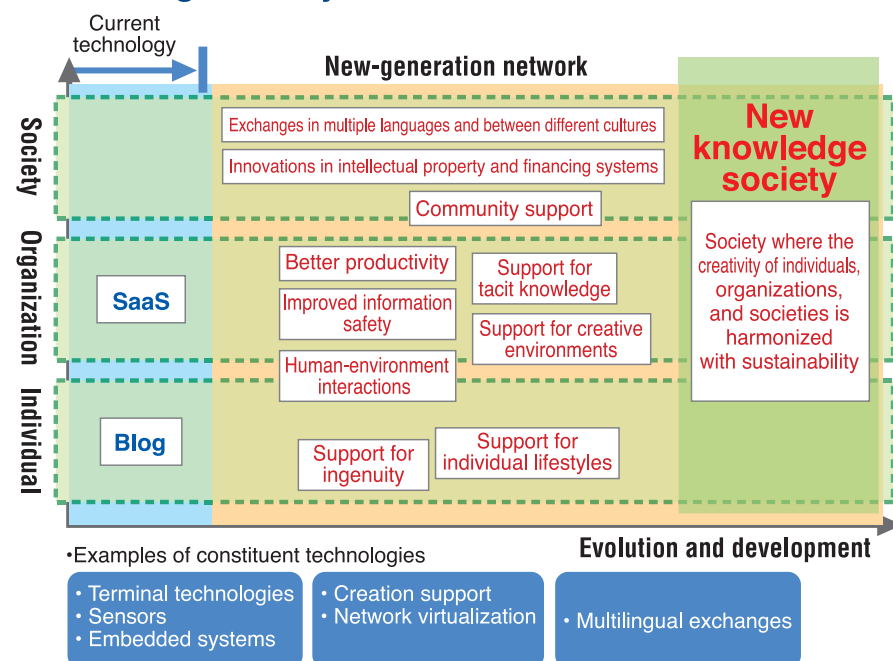
Creation of new value  
Contribution to work participation and fulfilling lifestyles

##### 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 network 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 network

- 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

## 16 Service productivity and New-generation network

### Expected future developments

- Use ICT technology to achieve better economic growth rates than those before the decline in population
- Productivity growth comparable to that of the US (US: Japan = 100: 71)
- Stimulate innovation in the service sector to spur the creation of new business fields in order to support Japan's future in manufacturing and services

### Approaches to realizing these developments

- Create services that provide new value by ensuring that Japan's broadband network infrastructure achieves 100% usage, and that the networks themselves offer a platform for service innovation.
- Promote further modularization and openness of network functions
- Construct a platform that provides service value by fusing information on such themes as the collective wisdom of users and lifestyle information; further, the platform should have built-in features that allow the visualization of the service status and other provider services

### Impacts on society

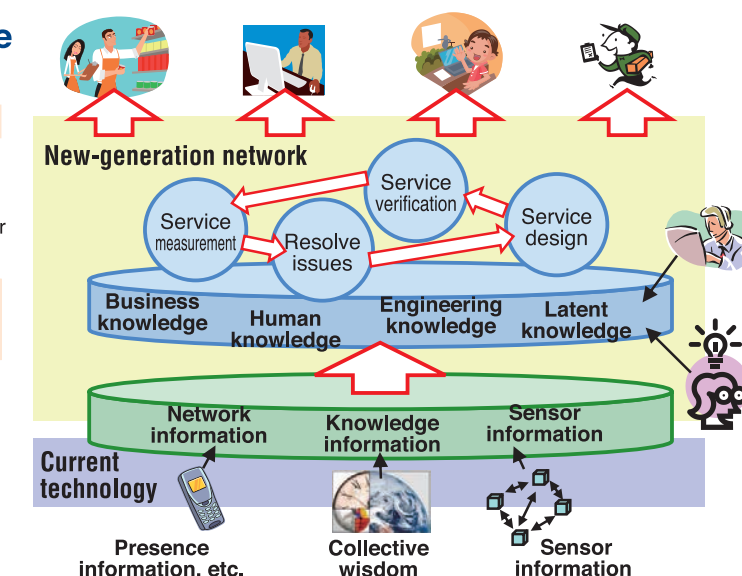
#### Toward networks that support service innovation

##### Offering personalized network services

Increased diversity and openness of network functions, and on-demand provision of network services matched to individual lifestyles  
Provision of personalized email addresses, storage and computer resources, independent of the ISPs

##### Toward the implementation of services by incorporating service visualization functions into the networks

Transformation of network functions from "packet transfer" to "service transfer"; discovery of issues with service status and service provision; service visualization functions that can verify service designs and service provision; and a reference database to support these functions built into the network  
In combination with sensor data and other information flowing through the network, these information are published and passed onto service providers to construct a network platform that facilitates innovation



### Advanced technologies in Japan

- Broadband network environments
- Electronic tag technologies (RFIDs, etc.)
- Systems providing detailed services such as home deliveries, convenience stores and video rentals
- User-driven network services such as i-mode (wireless internet service in Japan) and ringtones (song/melody) for mobile phones

### Technical requirements of New-generation network

- Service visualization technology for visualizing problems within the service status and service provision processes
- Technology for the construction of reference databases that can be stocked with business knowledge, human knowledge, engineering knowledge etc.
- Modularization technology for service functions that implement a wide range of services
- Provision of service design tools

## 17 Circulation and distribution of value and New-generation network

### Expected future developments

- Stimulate economic activity by means of stable circulation/financing
- Seamless circulation and distribution on global and local scales
- Creation of value based on a flexible value chain structure
- Safe and efficient circulation of authored works and intellectual property

### Approaches to realizing these developments

- Reliable transfer and exchange of value by network technology
- Attainment of physical and composite reliability levels comparable to currency
- Electronic distribution and payments, systematic links
- Setting of priorities according to data value weightings, and measurement of certain values on networks
- Advanced compatibility of data sharing and data protection

### Impacts on society

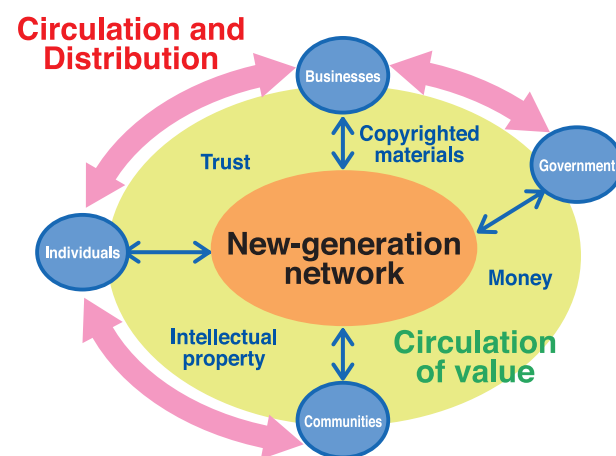
#### Towards the creation of further value by new-generation value circulation and distribution

##### Maximize convenience and minimize risk

Guarantee the reliability, quality and value of transactions  
Implement new functions and reduce distribution costs  
Create new business models out of the distribution of new value for the continuous development of networks

##### Implement grassroots circulation and distribution and full participation evolved from net auctions

Implement circulation and distribution suited to the individual circumstances of regions targeting the stimulation of regional economies and small to medium enterprises  
Construct a new value circulation system to support the future knowledge-based society



### Advanced technologies in Japan

- RFID technology, near-field technology
- Factory automation technology (production management, stock management, etc.)
- Mainframe technology
- Sensing technology
- Access networks, terminal technology

### Technical requirements of New-generation network

- Electronic money and settlement that are more trustworthy than paper money
- Traceable electronic money (to foil money laundering)
- Circulation and exchange of electronic money on network and physically moving value at low speed
- Networks that recognize the value of data
- Low-cost technology to protect copyright and intellectual property

## 18 e-government, e-democracy and New-generation network

### Expected future developments

- Enriched e-government services available to all citizens with smart Ubiquitous network technologies
- New modes of participation and involvement in autonomous and governmental administration
- Creating value by networking governments, NPOs and other organizations
- Preserving data pertaining to citizens and nations

### Approaches to realizing these developments

- Platform for highly efficient and suitable governmental network services
- Platform for the provision of governmental services that can adapt to diverse and complex requests
- Protect security and privacy, enhance reliability (trust)

### Impacts on society

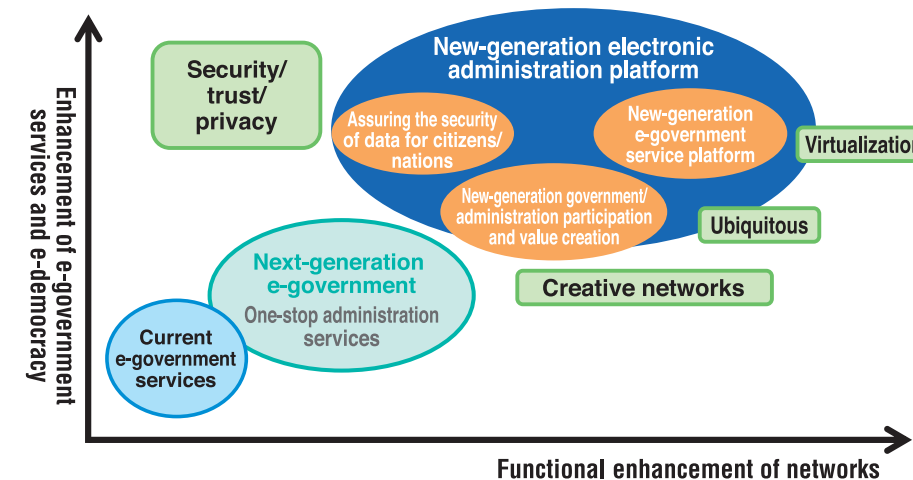
#### Toward the implementation of safe e-government services and e-democracy to herald an era of New-generation network

##### New-generation e-government service platforms

Safe, convenient and efficient government services  
Enhancement of data reliability and preservation of important administrative data

##### Participation and value creation in new-generation government/administration

Network-based autonomy, new modes of consensus building, fair and barrier-free e-democracy  
Value-creation through networking of regional entities, NPOs, regional resources etc.



### Advanced technologies in Japan

- Broadband network environments
- Sensing technology
- Security, authentication technology
- Diverse terminal technology

### Technical requirements of New-generation network

- Provision of efficient public service networks
- Environments for the provision of stable network services between disparate networks and different types of terminals
- Technology for smooth, real-time, cooperative use of regional data, etc.
- Technology for security, privacy protection and dependability (trust)

## 19 Entertainment and New-generation network

### Expected future developments

- Services coupled with real-space information will appear, and new entertainment systems will develop based on the recognition of human actions and the use of sensor devices (compatible with all five senses) that provide a sense of realism
- Individuals are able to deliver and/or broadcast contents, e.g. video and music, safely and easily
- Diverse types of communication — social networking sites, virtual spaces, blogs, bulletin boards etc.— will continue to grow and develop into platforms for societies and for the delivery of data

### Approaches to realizing these developments

- Reproduce real spaces over a network as virtual spaces to implement advanced navigation services or estimate the damage that might occur in a disaster situation, and to simplify the creation of movies and games that use real-world backgrounds
- Provide virtual worlds that can be used in games, community type services
- Development of input/output devices and user interfaces that can provide a sense of immersion in virtual worlds, and of control interfaces for the utilization of devices
- Construction of data delivery platforms where people can deliver data easily and safely, and implementation of dependable networks
- Construction of networks that can handle diverse traffic characteristics such as different bandwidths and traffic patterns

### Impacts on society

#### Construct dependable application platforms that provide services ranging from spatial data collection to content delivery and distribution

##### Make communication more diverse by constructing virtual spaces

Diversify and reform communication styles by using 3D virtual spaces to visualize information in an easily understood form, and explore the possibilities of having commercial areas and recreation areas in the virtual spaces themselves

##### Implement projection services for assistive information

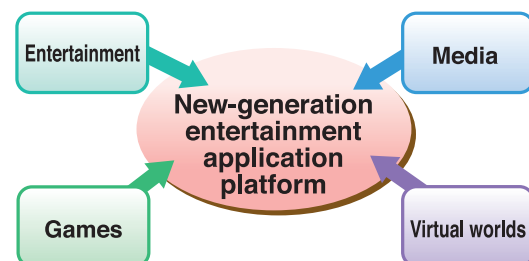
Support actions of users by superimposing information such as text and arrows on real-world information for purposes such as personal/car navigation and displaying context information about objects, such as artificial reality (AR)

##### Implement new types of games

Implement new game environments using diverse interfaces and devices that break away from the combination of usual display and controller

##### Implement user-friendly entertainment

Provide virtual experiences to achieve heightened interactivity, allowing the use of materials that stimulate intelligent curiosity and interests, thereby improving the quality of school education and lifelong studies



### Advanced technologies in Japan

- Global traction of consumer product development in media fields such as video and music, and their technological strength
- Innovation and foresight in the field of video games (non-PC), and complementary revenue models of hardware and software vendors
- Technology for the development of applications as platforms for new styles of communication, and the commercial benefits of this technology
- Technology for the development and practical implementation of new interfaces such as sensory arcade games
- Advanced positioning and geographical information processing technology such as car navigation systems

### Technical requirements of New-generation network

- Construct of a data delivery platform where individuals can deliver data easily and safely
- Implement sufficient dependability for information society platforms
- Make real-world information freely accessible and implement a platform for the provision of accompanying context information
- Develop user interfaces that are easy to use
- Develop platforms where data from multiple devices can be utilized via personal area networks (PANs) and body area networks (BANs)
- Implement dynamic processing of copyrights to achieve benefits for both rights holders and users

## 20 Frontier fields and New-generation network

### Expected future developments

- Appearance of real-time earth monitoring systems
- Precise observations of planets in the solar system
- Precise searching for marine resources and their effective utilization
- Develop the ultimate tailor-made medical treatment based on individual genetically related factors
- Creation of new bacteria and microorganisms that are useful to people and the planet based on meta-genome analysis
- Make scientific measurement data, even from the most extreme regions, accessible to researchers working from home

### Approaches to realizing these developments

- Construct broad-band network by connecting networks of multiple earth stations and networks between multiple satellites to receive signals from observation satellites and space exploration satellites
- Construct marine observation networks that combine remote sensing with a satellite sensor network that efficiently collects data from sensors distributed widely across the oceans
- Establish broadband communication network across the oceans by using innovative mobile satellite communication technology
- A DNA cloud that combines the collection of DNA information on a global scale with network-based sharing, advanced security and high-speed access and matching processes

### Impacts on society

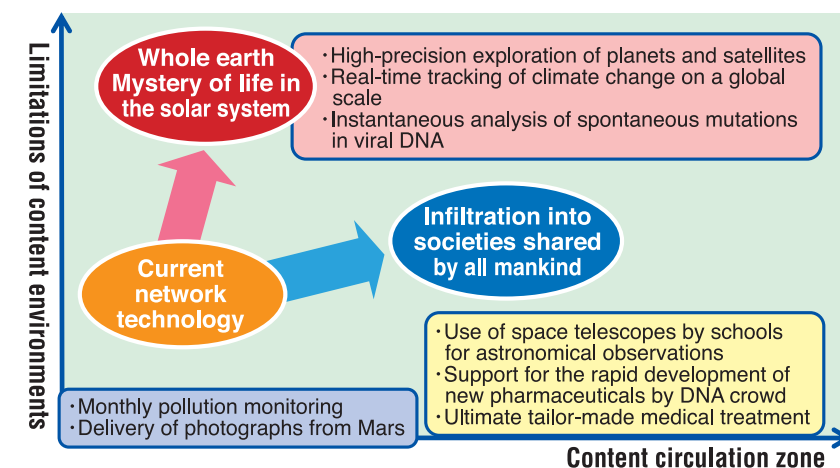
#### Implement a platform that allows vast quantities of information from extreme environments to penetrate every corner of society

##### NWGNs for driving forward the frontiers of human endeavor

Explore the solar system—the planets and satellites in space. Minimize the damage incurred in natural disasters by instantly ascertaining the disaster status. Make Japan an exporter of resources by conducting an exhaustive study of the marine resources in Japan's exclusive economic zone.

##### NWGNs helping to spread the results of cutting-edge science research

Take prompt countermeasures against threats to humans posed by mutated viruses by sharing DNA data across networks and conducting research into bio-informatics and synthetic biology, and enable the creation of new bacteria and microorganisms to resolve global environmental issues by sharing cutting-edge scientific data across networks, thereby raising awareness of science and technology and encouraging the next generation of scientists.



### Advanced technologies in Japan

- Broadband network environments
- Smart antennas
- Satellite-mounted large antenna technology
- Unmanned submersible technology and unmanned probes

### Technical requirements of New-generation network

- Technology for hand-overs between wireless networks with different criteria
- Time-limited data (deletion or invalidation of data from a network)
- Virtualization technology that can accommodate researchers and casual visitors in the same network
- Advanced personal authentication technology that integrates biometrics with network authentication, and communication with absolute privacy

# 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.

