Diversity & Inclusion: Networking the Future

Vision and Technology Requirements for a New-generation Network

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Introduction

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. Also in Japan, IT basic strategy was established in the year 2000 with the aim of becoming the world's leading IT nation by 2005. Moreover, the IT Strategic Headquarters (Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society) was established in the Cabinet in 2001, and the e-Japan strategy was determined. A well-known result of the e-Japan strategy is the steady achievement of the world's most advanced broadband environment with high speed and low cost. Moreover, as the strategy following on the e-Japan strategy, in 2004, the Ministry of Internal Affairs and Communications sets the goal of continuing to be the world's leading IT nation from 2005 onwards, and set out the u-Japan policy aiming at a ubiquitous society, with various measures now being implemented.

However, the current situation does not allow one to say that Japan leads the world in the ICT sector, nor that it is maintaining equal competitiveness with the world. The U.S. has gained great success by thoroughly implementing its competition principles and the resulting "selection and focus". On the other hand, Europe established a base to oppose the U.S. by forming a block focused on the EU, and is steadily obtaining a certain level of success. Moreover, the development of ICT related industries focused in BRIC countries is remarkable in recent years.

Meanwhile, one can unfortunately say that Japan's international competitiveness in ICT related R&D and industries is steadily declining. Of course, there are examples such as the globally incomparable development of Japan's mobile phone technologies. However, one can say that their lack of success in global markets clearly shows Japan's fundamental problems.

Some insist that Japan should push a survival strategy based on a closed market economy. But along with other industries, ICT industries have experienced waves of globalization, and even looking to the past, Japan is certainly not a second rate nation in the potential R&D abilities of its ICT sector. Essentially, Japan's people surely bear a responsibility to contribute to the further development of 21st century world civilization. In short, over the next several decades, it is important that R&D strategy related to the New-generation network which should become ICT infrastructure is established from the perspective of how to attain the ideal ICT society which Japan aims for, not only from the perspective of solving problems faced today by humanity. Japan should also abandon R&D techniques lacking strategy as has been done until now. Instead, we should first establish a comprehensive R&D strategy, then take prudent and bold measures to achieve it. This report describes the first steps of that recommendation.

Contents:

1. Background for Creating New-generation Network R&D Strategy

The Strategic Headquarters for New Generation Network R&D ("Strategic HQ") was established by the National Institute of Information and Communications Technology (NICT) on October 1, 2007, to strategically promote R&D on New-generation networks. The Strategic HQ aims to (1) Create a long term R&D strategy for New-generation networks, (2) Fulfill a main leadership role amidst international cooperation and competition, (3) Develop ICT related R&D human resources which have a long term international perspective, etc. This organization is headed by the NICT President. It does not replace an existing organization, and instead has an organization-wide character covering multiple R&D centers and the Collaborative Research Department of NICT. Accordingly, it ensures comprehensive consistency and efficiency of R&D activities in NICT, enabling provision of strategic policy for R&D advanced by NICT.

First of all, the New-generation network is based on new design concepts, looking further beyond the next-generation network (NGN). In short, it aims to fundamentally solve difficult issues and limits in an improved and extended Internet, by newly designing from a clean-slate unconstrained by existing technologies. A similar initiative is being actively pursued in the U.S. and Europe, and establishment of the Strategic HQ is a project for NICT to strategically pull forward Japan's R&D in this sector.

In the half year since its launch in the middle of FY2007, the Strategic HQ has been developing a system for advancement through industry/academia/government cooperation, and has been building a structure for future international cooperation. Also, following on establishment of the Strategic HQ, the Strategy Working Group ("Strategy WG") was established. The Strategy WG has gathered first class human resources from companies along with elite researchers from NICT, for a concentrated investigation of R&D strategy for the future ICT sector. The Strategy WG started its preparatory activities in January 2008, and has been doing its concentrated investigation since April 2008. It set five challenge issues on which it has been working.

(1) **Resolution of social issues to achieve our vision:** Create a strategy to solve problems in today's society, and achieve an information society based on a future vision.
(2) **Create strategy based on technological insight:** Go beyond comprehensive listing of R&D issues and technology issues to create a truly required strategy for development of a New-generation network, through insight as researchers and engineers.
(3) **Beyond existing schemes:** Create a strategy required for advancing a New-generation network, unconstrained by solidified existing research funding schemes and existing project schemes.
(4) **Pragmatic approach:** Clarify the problems for advancing R&D in Japan's industry/academia/government including NICT, by practicing industry/academia/government cooperation based on existing structures.

(5) **Human resource development:** Treat strategy creation work itself as human resource development, developing the next generation of leaders with a high level sense of R&D advancement through interaction with experts and practical strategy creation.

At the Strategy Working Group, since April 2008 we have conducted focused discussions on issues such as the future outlook, technology requirements, directions for solutions to social problems with a New-generation network, and the vision of a future society based on this network. This report brings together these arguments, and we plan to design strategies for technology, testbed development, R&D funding, standardization, internationalization and the fostering of human resources development, etc. as contributions to development of a New-generation network, then communicate them publicly.

Below, Chapter 2 presents a New-generation network vision, Chapter 3 clarifies emerging social issues and a solution approach, and Chapter 4 discusses an outlook towards future society and demands on a New-generation network. Chapter 5 recommends technology challenges to face for achieving the network goal, and Chapter 6 summarizes this report.

2. Our New-generation Network Vision

2.1. Vision

The 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 help achieve affluent lives of higher quality. Furthermore, by accepting their diversity, the New-generation network will aim to lay the cornerstones for information and communications which perpetually promote human society.

To achieve these, we need to construct a vision or concept, goals and values of a New-generation network, share consciousness of issues concerning future social problems, and moreover, raise an image of the yet unseen future society. Furthermore, we need to understand the roles and directions of each individual researcher or organization, and as a result contribute to achieving a sustainable and rich human society and world, bearing fruit as a meaningful activity.

Three values are presented below which are required in forming a New-generation network.

(1) 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. Have information and communications simply increased the quantities of things, with technology development relying only on that situation's transient values for only surface improvements? The New-generation network aims 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.

(2) Creation of New Value (Maximize the Potential)

If humankind is to have a bright future, it is essential to empower the latent potential of humans and society, and create new value which improves quality of life and productivity. Of course this is in an environment where the driving principle of economic society will undoubtedly be comprised with even more focus on information, demanding a radically new social information infrastructure.

So, are people's potential abilities being exhibited to their maximum in this society? Are society's potential abilities being utilized to their maximum? Are people living rich lives? Do we truly comprehend the importance of individual knowledge, the power of local communities, and the untapped knowledge of organizations and societies? Don't we have to form new values as residents living on planet earth?

The New-generation network aims to bloom the world's potential abilities in this broad sense.

(3) Contribute to Inclusion

As globalization progresses, its excessive advance has resulted in disparities 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 world culture to develop in new ways. In other words, there is a need to allow diverse situations in people’s lives and social economies, and on various scales from region to region.

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

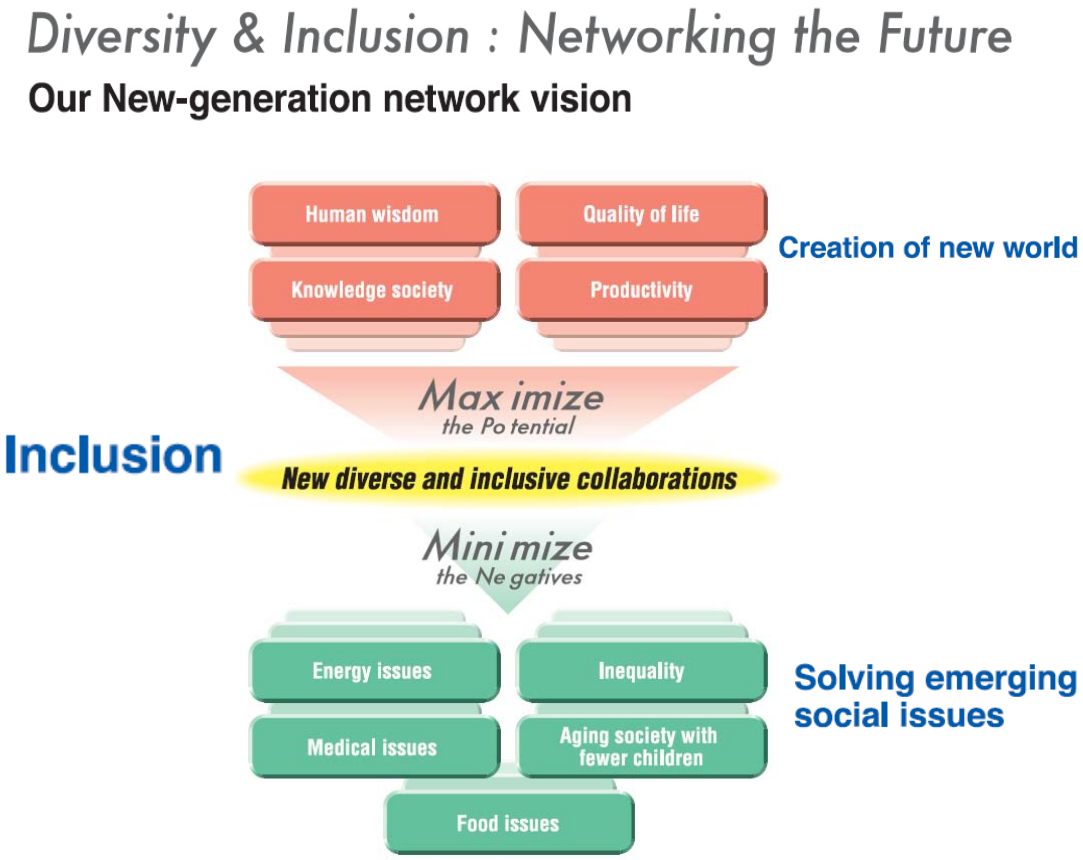

Figure 2.1 New-generation Network Vision

2.2. Forming a Vision

The above (1), (2), and (3) are all goals which look to the future, and the New-generation network especially emphasizes technology conceived unconstrained by current information and communication technologies. This is in a situation where network technologies until now have built

up improvements on existing technologies, resulting in the actual problem of current fears of failures, and as can be imagined from the description above, previously unseen new requirements are fundamentally demanded by people and society. Therefore we must value the active resolve to face the challenges of new technologies, based on comprehensively starting from the levels of principles of nature, devices, service layers, and even reaching to the social system, not only relying on traditional network technologies. In other words, innovation which sparks new technologies becomes especially important.

In addition, as the world's attention increasingly focuses on Asia, it is an undeniable fact that until now the U.S. and Europe have maintained hegemony over the technologies which lay the foundations of information and communication technologies. The New-generation network needs to support Asia region players themselves to become leaders in this field, bringing a focus as innovators. Japan must lead Asia and create unique technologies which bring innovation which can only be done in Japan, towards building a New-generation network.

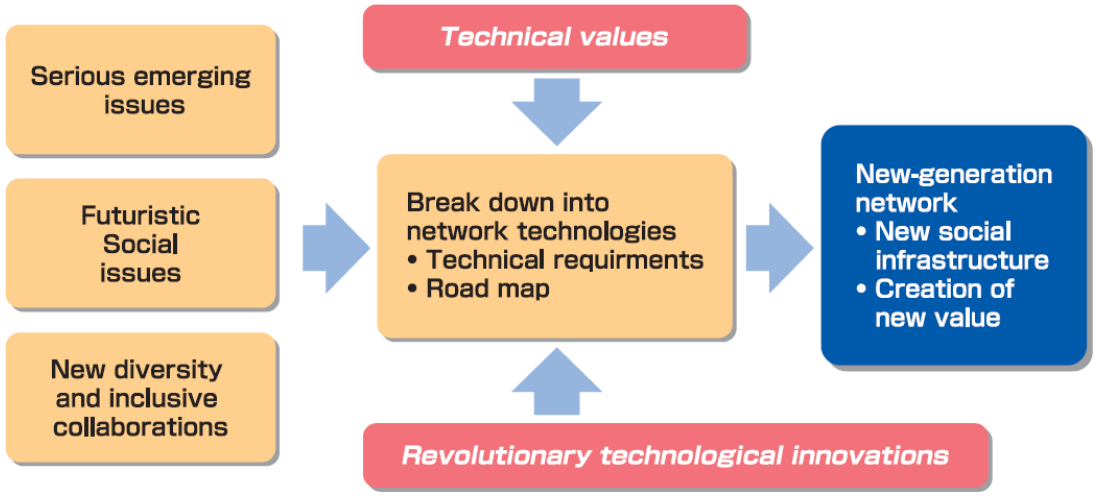

Figure 2.2 From Vision to Embodiment in the New-generation Network

As a process to embody the New-generation network, we first derive requirements for the New-generation network from Japan's emerging issues (social perspective), issues in achieving a future knowledge-society (future perspective), and respect for diversity and new cooperation (inclusion perspective). According to the requirements obtained, we break this down into network technologies. After breaking this down into network technologies, we form a New-generation network image by selecting technologies, looking at whether they are innovative technologies as described above, and sharing technology values.

3. Social Issues and Demands on the New-generation Network

3.1. Energy Issues and Demands on the New-generation Network

3.1.1. Emerging Energy Issues

There are great expectations for the New-generation network as ICT infrastructure which opens up the new information society. On the other hand, the environmental impact this network system places on the globe, in particular CO_2 gas emissions due to electricity use, is an important matter to investigate for its achievement. The power consumption of ICT equipment already accounted for about 5.8% of Japan's total annual consumption in FY2006, with about half used by networks [3-1-1]. On the other hand, estimating from the growth trend of network traffic volume in recent years indicates that traffic levels may be 1,000 to 100,000 times higher than they are presently by the time of the New-generation network. Of course, growth of network electricity use in the same ratio as this traffic growth surpasses allowable levels, regardless of our assumptions of how useful ICT is in society. In short, in achieving the New-generation network, we must achieve higher efficiency electricity use in the network system, technology which considers low electricity consumption in transmitting information and content, etc.

On the other hand, there is great focus on actively using the network as a means to reduce CO_2 gas emitted by society's activities. For example, telecommuting which minimizes the movement of people. To attain CO_2 gas reduction targets currently being debated on a global scale, it is thought that we must increase and promote such activities in the time of the New-generation network and also today. As the network's role becomes increasingly important, it must fulfill the requirement of sufficiently supporting those social activities.

Considering these conditions, it is thought appropriate to investigate the following four aspects of energy issues for the New-generation network.

Four Aspects of Energy Issues in the New-generation Network

1. Amount of energy consumed by the network
2. Energy savings by society's activities using the network
3. Environmental sensing technology using the network
4. CO_2 gas emission rights trading using network technologies, as a Clean Development Mechanism (CDM)

In the current New-generation network R&D strategy, the following examination focuses on aspect 1, for which technology elements are especially important.

3.1.2. Trends in Countermeasures for Energy Issues

Energy Consumed by the Network System

According to results of the survey committee, ICT currently consumes about 5.8% of all Japan's electricity (FY 2006). A breakdown by category is forecast for 2012 as shown in Figure 3.1.1. From this figure, we see that network equipment uses about 50% of ICT overall. Moreover, surveying electricity used by today's network equipment produces the following summary (analysis details are omitted in this document).

Outline of Electricity Used by the Network Currently

1. **About 50% of all ICT electricity is consumed during network use**
   CO_2 emitted per 1MB transfer = about 1g
   (Current emissions per broadband service user: about 290g/day)

2. **Appliances and network devices in the residence (telephone, broadband router, ONU, DSL modem, LAN-SW, etc.) use most electricity, about 50-80% of all network usage**
   An extremely large amount of electricity is used in standby, while not in use.

3. **About 20-30% of electricity used is related to manufacture and installation of access networks**
   In the case of optical access, there are large reductions by PON type fiber sharing. Adopting single star (SS) configuration results in large increases.

4. **In the mobile phone network, telephone manufacture and base station electricity dominate, with a tiny amount used by handsets**

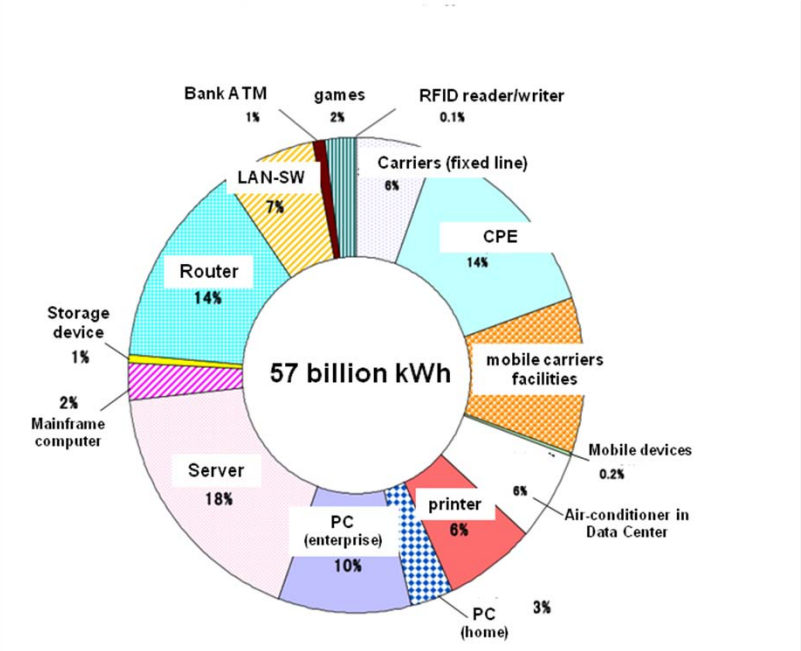

Figure 3.1.1 2012 ICT Electricity Consumption Forecast
(Report of Ministry of Internal Affairs and Communications in Japan [3-1-1])

Traffic Trends

From the research of broadband traffic in recent years [3-1-2], we see that in recent years Japan's traffic is growing exponentially by about 40% per year (This result is from both traffic usage growth per user, and increase in number of users. Excluding the increase in number of users, "traffic usage growth per user" is about 20% per year.). Assuming this traffic growth trend continues, one estimates that traffic volume will be about 10^3 to 10^5 times greater in the time of the New-generation network. Therefore, it is thought that the New-generation network must "increase electricity use efficiency per information unit transferred to 10^3 to 10^5 times current levels". However, traffic volume may change depending on the following factors, and the future trend must be watched carefully.

・Appearance or decline of killer applications
- In the past, traffic quickly grew due to P2P type file sharing applications, and quickly shrunk temporarily due to the resulting virus outbreaks.

• Subscriber number trends
- How will the number of broadband users change in the future? Will it hit a ceiling at the number of residences?

• Wireless access type broadband trend

If there is full scale use of 100Mbps level wireless broadband, it may suddenly boost traffic, which is currently dominated by home use traffic such as FTTH.

Situation of Initiatives to Reduce Energy Use in the Current Network

Summarizing simply, mobile phone handsets have seen repeated technical innovations in response to battery capacity restrictions, and have already achieved large energy savings based on advanced power management technology. In contrast, communications devices in the residence and other communications devices such as routers have been developed for lower cost and larger capacity, instead of for power savings. However, to face energy problems in recent years, R&D is also being done for power savings technology in these devices. Representative examples are shown below.

(1) ADSL2 Standard

Especially in Europe, there is progress in standardization of technology to reduce electricity consumption by sleep or underclocking when ADSL modems are not being used and during low speed communication [3-1-3].

(2) Lower Power Consumption in Broadband Routers and LAN-SW

Focused on the Communications and Information network Association of Japan (CIAJ), there is active progress in power savings for home use broadband routers and LAN-SW using a system of benchmarking against best-in-class [3-1-4].

(3) Lower Power Consumption in Carrier Use Core/Edge Routers

Development is being done on lower power consumption routers, for example by ALAXALA Networks Corporation [3-1-5].

All of these initiatives work on the premise of following the current network architecture unchanged, generally reducing power consumption by improvements at the level of each network equipment: internal composition, devices used, methods, etc. Except for mobile phone handsets mentioned above, power savings was not emphasized for communications equipment, so one can expect large power savings from these efforts. However in current forecasts, there are investigation results reporting a tendency of maximum savings at about 10 times higher efficiency per unit of information transferred (around the year 2015) [3-1-6], for efficiency falling far short of the above goals for the New-generation network. Therefore, it is thought necessary to take action beyond power use reductions for each communication equipment within the scope of current network architecture.

Energy Savings by Society's Activities Using the Network

There are expectations for gaining large energy savings by effective use of ICT in society's activities, and many initiatives have been implemented up to now. For example, according to a committee investigation [3-1-1], especially large energy savings can be expected by utilizing ICT in supply chain management (SCM), energy controls in buildings and homes (BEMS, HEMS), ITS, etc. Including these, total savings results forecast for 2012 are expected to exceed the amount of energy required in ICT. At the time of the New-generation network, it seems necessary to solidly achieve large savings results by taking action to more actively promote these initiatives. Also, the New-generation network must fulfill the requirements to solidly support reliance on ICT by such activities of society.

Environmental Sensing Technology Using the Network

In facing problems of global environmental impacts such as CO_2 emissions and electricity use, one important issue is environmental sensing technology to accurately measure these special amounts. There is also a great variety of measurement ranges and particle sizes, by global, country, region, building, home, and each power outlet, etc. Each of these requires a different network technology and sensor technology.

The New-generation network is ranked as one of the important technology elements for achieving this environmental sensing. For example, environmental sensing technology research is already being done on detection of CO_2 gas concentration and air pollutants, using remote sensing and lasers, etc. It is important to pioneer future environment sensing technologies by combining these technologies with the New-generation network.

CO2 gas Emission Rights Trading Using Network Technologies, as a Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM) is one of the flexible measures utilizing market mechanisms specified in the Kyoto Protocol adopted at the Third Conference of the Parties (COP-3) of the United Nations Framework Convention on Climate Change. In other countries which implemented projects for measures against global warming, when there are emissions reductions, credits (CERs) are issued for those emissions reductions, and those credits can be used towards attaining emission reduction targets of project implementing countries. At the time of the New-generation network, it seems we must actively promote suppression of CO_2 gas emissions on a global scale by international utilization of ICT technology. Furthermore, CO_2 gas emissions trading may be not only between countries, expanding to trading between companies, individuals, etc.

However, there is currently insufficient clarification and standardization of methods using ICT to

calculate CO_2 gas reductions. Therefore, international trading is difficult. Considering this situation, discussions have begun in the ITU-T, with central roles played by Japan's Ministry of Internal Affairs and Communications and TTC. As a result, a Focus Group (FG) was established in ITU-T to discuss this issue.

As described above, debate is required from four perspectives concerning the New-generation network and energy problems. The following mainly discusses the "network energy consumption" aspect, which has a strong technology element.

3.1.3. Proposed Approaches to Solving Energy Issues

R&D for energy consumption reduction technologies in the New-generation network is a future initiative, but several guidelines can be obtained from results of the current situation analysis described above. For example, an effective means for large reductions in electricity consumption in ICT overall seems to be adding a sleep function to communications devices in the home, which use the most electricity. However, if a sleep function is introduced in the L1 and L2 protocol layers of home devices such as ONU, broadband routers, LAN-SW, etc., problems arise such as the method to launch those devices from sleep, suspension time until launch, and communication speed changes due to power control. These may affect the behavior of higher protocols currently being used. In short, when aiming for large improvements in power consumption efficiency, there are limits to methods which work on individual devices and each layer, leaving current network architecture unchanged. It seems effective to investigate for the entire network (multiple layers). However, it is obviously necessary for such an investigation to fully consider ensuring independence between communication layers considering network development, and migration from the existing network.

Figure 3.1.3 shows multilayer technology fields focused on energy consumption. The lowest layer is the device layer, the lower protocol level layer. On this layer, power use reduction is mainly by each device function's composition and device technology innovation, and sleep while waiting and underclocking during low speed communication. There are also great expectations for power consumption savings in the core network by network architecture innovation, such as using photonic network technology to reduce power used in routers, which is an issue seen in the IP network. For network protocols, we hypothesize protocol layers equivalent to the current layers 3 and 4. These protocol layers require a communication system which considers that in lower layers there may be sleep, communication speed change by communication device power control, and temporary communication interruption. The content distribution platform is middleware which carries out information transmission with energy optimization as the primary objective. For example, the current contents delivery network (CDN) does not adopt a system which considers energy used, but one can easily imagine a contents delivery platform with a primary objective to minimize the total power use of network and server devices. Last is the application architecture. The application sends

and receives traffic, and according to its system, it is possible to reduce power used by reducing traffic volume. This field seems to include content compression and redesign the architecture of major network applications from today through the future such as search engines and the web, considering overall ICT energy.

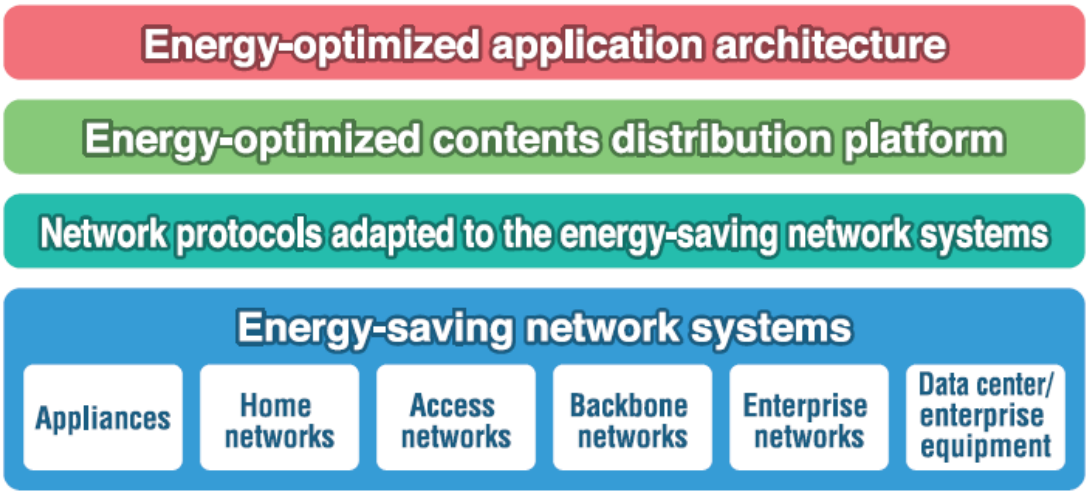

Figure 3.1.3 Fields to Investigate for New-generation Network Considering Energy Efficiency

3.1.4. Impacts on Society of Solving Energy Issues

(1) Reduction of CO2 Emissions

Of course, the greatest impact of energy savings in the New-generation network will be the reduction in CO_2 gas emitted by ICT. This holds great significance towards achieving a low carbon society by achieving high energy-efficiency against the growth in traffic.

(2) Achieving a Low Carbon Society System

As described above, large reductions in CO_2 emissions can be achieved by increasingly using networks for activities of society. Of course, one can expect such initiatives to further accelerate in the time of the New-generation network. Thus, many are pointing out the need for measures to promote such initiatives at the country level.

(3) Environmental Management Based on Environmental Sensing

Actively utilizing the New-generation network for environmental sensing will create the possibility to accurately ascertain the environmental impacts of ICT overall, enabling verification of network energy use reductions and utilizing the network to reduce energy use, thereby contributing to a safer and more secure society.

3.1.5. Advanced Technologies in Japan for Approaches to Solving Energy Issues

The following describes important advanced technologies in Japan for reducing energy used in the New-generation network.

• Photonic Network Technology

If a photonic network comprises a large capacity core network, large power efficiency improvements can be expected compared to a network comprised of conventional routers (there are calculations of about 5 to 50 times higher efficiency [3-1-7]). This is because compared to a process exchanging IP packets at the electricity level, exchanging signals at the optical level requires less power consumption.

In the photonic network technology sector, Japan leads the world from devices through to the system level, and this seems very important technology for achieving the New-generation network which demands lower power consumption.

• Power Management Technology for Terminals

As described above, in addition to communication devices in the home having the greatest potential reductions, this is a field where focused countermeasures have not been adopted much. In Japan, through mobile phone handset R&D, many vendors have handset power management technologies, and these technologies can be utilized in power conservation for communication devices and appliances in the home, thereby possibly enabling large reductions in power used in the overall network. Focused efforts must also be made in this field as part of the New-generation network initiative.

• System Design and Development Technology Under Power Restrictions

As represented by the current router development strategy in ALAXALA Networks Corporation [3-1-5], Japan's vendors have excellent design and development technologies achieving low power consumption in equipment with the same functions, and can be competitive. A desirable strategy is using those router power saving technologies as a competitive asset in the current network architecture, and further utilizing those technologies in communication devices in the New-generation network.

3.1.6. Technical Requirements of New-generation Networks for Solving Energy Issues

As described above, the New-generation network must achieve from 1000 to 100,000 times higher energy efficiency than currently, but power consumption savings in each equipment assuming the network architecture used in the current NGN is seen to have a limit of about 10 times savings. Therefore, in the New-generation network, further large efficiency improvements of about 2 to 4

orders of magnitude are required by technology innovation. Thus, R&D is needed on energy-optimized network architecture.

Also, to achieve energy savings in social activities by actively utilizing the network more than currently demands meeting the requirements for the network as infrastructure supporting social activities from their foundation, with the technologies of reliability, dependability, stability, low delay, etc. necessary to promote more efficient activities of society, and the transformation of activities of society into network-based activities.

Reference Documents:

[3-1-1] Ministry of Internal Affairs and Communications, Study Group on ICT Policy for Addressing Global Warming, (FY 2007)

[3-1-2] Ministry of Internal Affairs and Communications, "Understanding the Total Volume of Internet Traffic in Japan", 8/2008

[3-1-3] BT, "Opportunities and techniques for power saving in DSL," ITU SQ15 Low Power Tutorial Session, 2/2006

[3-1-4] Communications and Information network Association of Japan http://www.ciaj.or.jp/e.htm

[3-1-5] Energy conservation technologies of ALAXALA Networks Corporation http://www.alaxala.com/jp/solution/eco/index.html

[3-1-6] Yuitou, Nishi, "Calculation of Power Consumption in Broadband Networks", The Institute of Electronics, Information and Communication Engineers (IEICE), Submitted to the 2008 Society Conference

[3-1-7] Ministry of Internal Affairs and Communications, "21st Century Network Infrastructure Technology R&D Strategy" http://www.soumu.go.jp/s-news/2005/pdf/050728_8_1.pdf

3.2. Natural Disasters and Demands on the New-generation Network

Today, living safely and securely is becoming an important issue for people. Therefore, there are many initiatives for living safely and securely. For example, the “New IT Reform Strategy” [3-2-1] was determined on January 19, 2006 by the IT Strategic Headquarters (Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society). This strategy raises “Achieving a safe and secure society” as one focus point of IT measures, and sets out disaster countermeasures as part of this. Also, the “Third Phase of the Science and Technology Basic Plan” [3-2-2] determined by the Cabinet on March 28, 2006, raised “A country proud of its safety – Make Japan the World’s safest country” as one policy goal, aiming to ensure safety for the nation’s territory and society, including disasters. Moreover, “Innovation 25” [3-2-3] determined by the Cabinet on June 1, 2007 raises “Safe and secure society” as one aspect of Japan in the year 2025, opened up by innovation. This looks to use technology innovation to reduce damage by disasters. As described above, many measures are being developed aiming at achieving a safe and secure society, and disaster countermeasures are being advanced as part of this.

On the other hand, the Internet and other networks are steadily becoming essential infrastructure in daily life, and are becoming necessary for communication and acquisition of information. In this way, networks have the important function of sending and receiving information, and during disasters this function can be utilized to transmit information in a short time over a wide range. However, major issues remain regarding its use as a disaster countermeasure, and disaster issues are clarified below, along with clarifying information and communication network functions which will be even more needed.

3.2.1. Emerging Issues Concerning Disasters

Japan has encountered various disasters until today. For example, there are disasters due to earthquakes, typhoons, and volcanic eruptions. As reported in the 2008 White Paper on Disaster Prevention [3-2-4] (Figure 1-2-1 on page 32: Number of Dead and Missing Persons due to Natural Disasters; Table 1-2-1 on page 33: Situation of Japan’s Major Natural Disasters Since 1945), an overwhelming percentage of deaths and missing persons are due to earthquakes and typhoons.

For example, in disasters due to typhoons, there were 3,756 dead and missing in the 1945 Makurazaki Typhoon, 1,930 in the 1947 Typhoon Kathleen, and 5,098 in the 1959 Isewan Typhoon. In examples of disasters due to earthquakes, there were 2,306 in the 1945 Mikawa Earthquake, 3,769 in the 1948 Fukui Earthquake, and 6,437 in the 1995 Great Hanshin-Awaji Earthquake disaster. As seen above, there is enormous damage by earthquakes and typhoons, and disaster countermeasures focused on earthquakes and typhoons are mainly required.

On the other hand, according to the “Earthquake Occurrence Probability by Long-Term

Evaluation" [3-2-5] released by the Headquarters for Earthquake Research Promotion, there is about a 50% probability that an earthquake will occur at Nankai within the next 30 years, and about 60-70% at Tonankai (base calculation date: 1/1/2008). Also, according to Central Disaster Prevention Council documents [3-2-6], 18 variations of M7 class capital inland earthquake are hypothesized, and if there is an M7.3 earthquake in North Tokyo Bay at 18:00 in the winter with wind speed 15m/s, then it hypothesizes about 850,000 buildings will totally collapse or burn, with about 11,000 deaths. In economic damage, this calculates about 112 trillion yen (39 trillion yen of indirect damage due to lower productivity, etc.). If it occurs at 12:00 noon, then about 6.5 million people will be unable to return to their homes. In addition, this would cut about 1.1 million phone lines, with a target of 14 days to restore service.

As described above, there is serious damage in disasters due to earthquakes and typhoons, requiring disaster countermeasures focused on these. Countermeasures for earthquakes with growing probability of occurrence are especially important.

3.2.2. Trends in Countermeasures for Disaster Issues

For disaster countermeasure systems, especially for earthquakes and tsunamis, the Earthquake Phenomena Observation System (EPOS) and the Earthquake and Tsunami Observation System (ETOS) [3-2-7] are operating. EPOS operates at the Japan Meteorological Agency Headquarters, and ETOS operates at each District Meteorological Observatory in Sapporo, Sendai, Osaka, Fukuoka, and at the Okinawa Meteorological Observatory. EPOS and ETOS do real time analysis of observation data for earthquakes, tsunamis, etc., providing various disaster related information. Also, the Fire and Disaster Management Agency started operating J-ALERT (national early warning system) [3-2-8] on February 9, 2007.

Related to weather, there is the Computer System for Meteorological Services (COSMETS) [3-2-9], operated by the Office of Computer Systems Operations in the Japan Meteorological Agency of Ayase City, Tokyo. COSMETS is a system which forecasts weather conditions from precipitation and temperature information, weather observation data, etc., obtained from the Automatic Meteorological Data Acquisition System (AMeDAS). For weather observation, Himawari 6 [3-2-10] is currently operating. On the other hand, Himawari 7 is operating on standby status, planned for full operation for about 5 years starting around 2010.

Also, as shown in the 2008 White Paper on Disaster Prevention [3-2-4] (Figure 2-3-58 on page 151: Building a Disaster Prevention Information Sharing Platform), construction is proceeding on a platform for collective management of disaster information. This platform enables comprehensive sharing of weather information, traffic information, disaster damage information, river/lake/marsh/ ocean information and map information.

On the other hand, for volcano observations, the Japan Meteorological Agency is constantly

observing 108 active volcanoes throughout Japan from Volcanic Observations and Information Centers in Sapporo, Sendai, Tokyo and Fukuoka [3-2-11].

As described in the above overview, disaster countermeasure systems are being built for information and communication network related countermeasures, and many of them aim at rapidly providing information by real time processing and analysis of gathered data.

3.2.3. Proposed Approaches to Solving Disaster Issues

Until now, as information and communication network related disaster countermeasures, there have been R&D and investment for new system construction. However, large disasters do not occur frequently, and it is inefficient to make huge investments only for large disaster countermeasures. Thus there is a need for R&D and investment for efficient disaster countermeasures.

Thus, as an information and communications related disaster countermeasures approach in the New-generation network, we propose an approach to achieve a network enabling efficient use of information and communications resources. Specifically, for information and communications resources usually operating as independent services, construct a network system which in emergencies enables operation through coordination between remaining information and communication resources.

For example, for the observation network, disaster network, commercial network, etc. which usually operate independently, develop a mechanism which is able to combine and operate the remaining information and communications resources during a disaster, and urgently launches and operates during a disaster. Or, form a new disaster network which coordinates remaining resources for a network which utilizes various types of networks, for example wired, wireless, satellites, airships, etc.

Also propose an approach which allocates remaining network resources corresponding to the type and scale of disaster, and the urgent services which should be provided during a disaster, dynamically launching special functions for during disasters.

Moreover, aim to achieve a system which takes disaster countermeasures, utilizing large scale coordinated sensors to accurately understand the status of victims and emergency provisions and to control them, and protects people, equipment and data based on prompt disaster detections or predictions.

3.2.4. Impacts on Society of Solving Disaster Issues

Disaster measures until now focus on one-way countermeasures, providing information on predicted or detected disasters. But in the future, it is thought these will develop into interactive disaster countermeasures as explained above, by controlling information and communications resources corresponding to the type and scale of disaster, and dynamically launching special

functions for disaster countermeasures. For example, they will come to dynamically change functions operating before and after disasters, and transmit information and provide guidance for refuge corresponding to the status of people in the disaster. The main social impacts are shown below.

- Eliminating Communication Anxiety After a Disaster has Occurred

After a large scale disaster occurs, there is a sudden jump in communications to check on people's welfare. Therefore insufficient communication can occur due to exceeding the capacity of communication systems. Then according to the approach proposed above, temporarily combine and operate the remaining information and communications resources, from among usually independently operating information and communications resources. By doing this, dynamically secure information and communications resources required for disaster countermeasures, and selectively focus information and communications resources on important disaster countermeasures operations, thereby providing an environment enabling anybody to communicate as required, achieving relief for communication insecurities after a disaster occurs.

- Preservation of Information and Communications Assets by Protecting Equipment and Data in Disasters

During disasters, damage to important data and equipment leads to large losses. Under the proposed approach described above, in response to an emergency situation detected by a sensor network, automatically achieve preservation of information and communications assets by automatically shutting down operating equipment and automatically protecting transmission data.

- Ensuring Human Safety

Disaster countermeasures until now strove to provide information on the disaster and ensure human safety, by issuing warnings based on advance forecast of a disaster. However, this is mainly one-way provision of disaster related information, and there is insufficient use of two-way communication with victims. The approach proposed above achieves improved assurance of human safety, enabling two-way communication by securing resources for emergency and launching functions corresponding to the disaster's type, location and scale. Specifically, provide refuge guidance according to the disaster's location and scale, people's situations, etc. For example, deliver emergency provisions to the destination guided to for refuge, or guide to refuge where emergency provisions were delivered. By doing this, ensure guidance to a safe and secure refuge destination, and transport emergency provisions to the refuge, working to ensure human safety during the disaster.

- Countermeasures Before Disaster

Disaster forecasts are one factor greatly contributing to minimize damage by disaster. The more accurately one can forecast when, where, and on what scale a disaster will occur, the easier it is to improve the results of disaster prevention and reduction. Therefore, use the approaches proposed above to dynamically control resources utilized as necessary to detect signs of disasters, and improve disaster warning precision. For example, reallocate information and communication resources dynamically for disasters to areas where a disaster has become more probable, and boost the availability of these resources there to improve accuracy of detecting events. In this way, improve accuracy of disaster forecasts, and achieve stronger advance measures for disaster prevention and reduction.

- Disaster Countermeasure Cost Reduction

There is low probability of large disasters occurring, but once a large disaster occurs, its damage is enormous. Thus there must be investments in disaster countermeasures. However, it is inefficient to make large investments for large disasters which occur infrequently. Therefore, use approaches to share information and communication resources which have various uses. Achieve lower disaster countermeasure costs by a mechanism enabling use of suitable amounts of information and communication resources according to required conditions and uses.

3.2.5. Advanced Technologies in Japan for Approaches to Solving Disaster Issues

Table 3.2.1 shows Japan's advanced technologies in fields related to disaster countermeasures, and sample uses of each technology.

Table 3.2.1 Japan's Advanced Technologies in Fields Related to Disaster Countermeasures

	Field	Advanced Technology in Japan
1	Earthquake detection	The world's fastest earthquake recognition technology, which can output warnings 0.2 seconds after P-wave detection exists: This can be used to send advance warnings for near-source earthquakes.
2	Imaging radar	Observation technology by aircraft borne synthetic aperture radar exists: This can be used for real-time detailed damage status collection.
3	Sensing	Technology for detecting people and things by Terahertz waves exists: This can be used to find people and things when they are out of sight.
4	Network robots	Advanced service technology by visible, virtual and unconscious network robots exists: These can be used for evacuation guidance during disasters.
5	Home network	Remote controlling technology for managing equipment in homes from outside exists: This can be used to operate equipment in emergencies during disasters.
6	Data collection	Information collecting technology from various devices and sensors exists: This can be used to detect phenomena connected with disasters, and collect detailed status of disasters which occurred.

3.2.6. Requirements of the New-generation Network towards Solving Disaster Issues

This section describes New-generation network technologies required to implement approaches towards solving disaster issues.

- **Trustable Data Transmission**

Until today, for earthquakes which are not near the epicenter, it has become possible to broadcast warning of an earthquake occurrence before S-waves arrive. However, there are now great concerns of an earthquake epicenter near an urban center. Thus it is necessary to be able to broadcast advance warning and reliably protect equipment, even for an earthquake near the epicenter. Therefore, the New-generation network requires signal transmission functions for extremely low delay and reliable end-to-end transmission and equipment control before S-waves arrive. The evaluation of Earthquake Early Warning by the Japan Meteorological Agency [3-2-12] shows that an average 5.5 seconds are required to provide information using data from one observation point, and an average 6.6 seconds when using data from two observation points. On the other hand, in the Advanced Technology shown in Table 3.2.1, it is possible to output warnings in only 0.2 seconds after P-wave detection. Thus even in a large scale near-source earthquake, it is quite possible to output reliable warnings with extremely low delay from time detected until it reaches general residences and devices are controlled (about 0.5 seconds end-to-end), and achieving this is necessary.

- **Federation of Heterogeneous Network Resources**

It is very expensive to constantly keep prepared information and communication resources which are dedicated for disasters. Thus in disaster emergencies, the New-generation network will use integrated management of network resources remaining from multiple networks which normally operate separately and independently (network by wired, wireless, satellites, airships, etc.), to provide new network services for disasters, achieving lower cost. Dynamic resource control is also required, to dynamically reallocate resources according to the types and scale of damage and emergency services which should be provided, providing network services according to the situation.

- **Ensure Reliability of Detection Data**

In order to detect disaster related phenomena and disasters which occurred, and to correctly understand users of equipment being controlled, reliability of detected data must be ensured. Taking disaster countermeasures based on incorrect or improper data can worsen the damage. Thus the New-generation network requires functions which can ensure that the sensor data obtained from sensor networks is proper.

- **Dynamic Launch of Special Functions**

During disasters, there is a need for operations and service provision which differ from normal times. For example, along with changes in the amount of network resources which can be used, there must be control of priority and transmission volume for each user's data transmissions. Another example is that controls will be exercised so that processing ability and network resources for video meetings will be used for voice calls during disasters. In order to only launch such functions during disasters, the New-generation network will require functions to dynamically launch special functions according to the disaster situation.

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3.3. Medical Care and Requirements of the New-generation Network

Growing medical costs have been pointed out in recent years, but everyone wants to receive proper medical care for healthy lives.

There are currently many contributions to people's medical care from various aspects, but further improvements in medical care are possible. For example, even higher quality medical care for people seems possible through synergistic effects between medical technology and information and communication network technology. To achieve this, it is necessary to clarify the information and communication network functions needed to contribute to medical care, and develop technology.

Thus this section clarifies emerging medical care issues and the information and communication network functions which will be needed.

3.3.1. Emerging Medical Care Issues

- Issue of Increasing Medical Costs

Medical costs are an emerging medical care related issue in a situation which may worsen. "Medical Care System Reform" [3-3-1] by the Ministry of Health, Labour and Welfare reports future estimated total medical care costs. Total medical care costs on an Organisation for Economic Co-operation and Development (OECD) basis were 41 trillion yen in FY2004, but are forecast to grow further to 90 trillion yen in FY2025. Considering that Japan's FY2008 General Account Budget was about 83 trillion yen, we see that measures against medical costs are required.

In "Medical Care System Status and Issues" [3-3-2] by the Ministry of Health, Labour and Welfare, it is written that there is a strong correlation between inpatient medical care costs and number of hospital beds, as reference data. One option is that increasing the number of people in healthy situations may contribute to reducing medical care costs.

- Issue of Increase in Lifestyle Diseases

According to data in the Health, Labour and Welfare White Paper [3-3-3] (page 21, Figure 1-3-1: Trend in Death Rate by Main Cause of Death (Per 100,000 population)), malignant growths are the number 1 cause of death, heart disease is number 2, and cerebrovascular disease (stroke) is number 3. In recent years, these diseases are termed lifestyle diseases. Also according to this White Paper (page 30, Figure 2-1-3: Lifestyle Diseases – Medical Costs and Percentage of Deaths by Cause), the above Lifestyle Diseases (FY2004) had total medical costs of 10.4 trillion yen (about 1/3 of national medical costs), and were 60.9% of all deaths. The three largest diseases are lifestyle diseases, comprising a large percentage of medical costs and deaths, and measures must be taken against these lifestyle diseases.

- Issues concerning Number and Distribution of Physicians

"Composition of Health Data and Main Data on Japan" by the Permanent Delegation of Japan to the OECD [3-3-4] shows that Japan had fewer physicians (per 1000 population) than other countries in 2006. For example, compared to the 3.0 average of the OECD, Japan has 2.0.

On the other hand, according to the 2007 Health, Labour and Welfare White Paper [3-3-3] (page 45, Figure 2-2-9: Number of Physicians per 100,000 Population by Secondary Medical Care Zones), there tend to be more physicians in urban areas such as prefectural capitals.

As seen above, action must be taken on the issues of Japan's fewer physicians compared to other countries, and its uneven distribution of physicians.

- Issue of Growth in Ambulance Transport

According to the 2007 Fire and Disaster Management White Paper [3-3-5] (Topic IV: Rapidly Growing Emergency Demand! – Promoting Proper Use of Ambulances –), there were 5,240,000 transports in 2006, compared to 3,280,000 emergency transports in 1995, an increase of nearly 60%. Also, there were 1,081 annual average transports per ambulance in 2006, compared to 748 trips in 1995, showing an increase of over 40%. Moreover, ambulances took an average 6.0 minutes to arrive on site in 1995, growing steadily to 6.6 minutes in 2006.

On the other hand, according to Drinker's life saving curve [3-3-6], there is a 25% chance of revival 5 minutes after the heart stops. And according to the Cara's life saving curve (Golden Hour Principle) [3-3-7], 50% of people die about 3 minutes after their heart stops.

From the outline above, tiny delays in treatment during emergencies lead to death. Therefore prompt and proper medical care is very important in emergencies.

- Medical Care Accident Related Issues

According to the 26th Medical Incident Cases Report (3 month survey period: October 1 to December 31, 2007) of the 13th Report [3-3-8] for the Medical Care Accident Information Collection Project by Japan Council for Quality Health Care, there were 53,250 medical incident cases. The most common of these were the 11,733 medical incidents concerning prescriptions and drug provision, comprising 22% of all incidents. The second most common were the use and management of drain tubes, with 7,978 medical incidents (15% of total). On the other hand, the most common cause was insufficient checking, at 23.9% of all incidents. The second was insufficient observation, at 12.6% of all incidents.

From the above outline, many medical incidents occur which can lead to medical accidents. To reduce the probability of medical accidents occurring, there is a need to reduce the number of medical incidents which occur.

3.3.2. Trends in Countermeasures on Medical Issues

As shown in the “Study Group on Use of ICT in Medical Care Sector” report (April 18, 2006) [3-3-9] by the Ministry of Internal Affairs and Communications (MIC) and National Institute of Information and Communications Technology (NICT), various medical information system concepts are proposed to support sharing and use of medical data for (1) Inside medical care institutions, (2) Local medical care cooperation, (3) Daily life, and (4) The disaster and emergency medical care field.

Also, the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters) determined the “New IT Reform Strategy Policy Package” [3-3-10] on April 5, 2007, and one of the policy goals raised is achievement of a healthy and secure society. In particular, it raises three goals which the people can experience in the medical care field: 1) Achieve personal management of health information and medical care suited to the individual, 2) Achieve continual management of health information for the individual, 3) Provide evidence-based medical care.

On the other hand, the Medical Information System Development Center (MEDIS-DC) is currently contributing to various standardizations including disease names [3-3-11]. In industry, the Japanese Association of Healthcare Information Systems Industry (JAHIS) is comprised of 346 related companies as of June 27, 2008 [3-3-12], and is contributing to development of Healthcare Information Systems, etc.

Moreover, the Ministry of Health, Labour and Welfare “Council on Policy to Promote Remote Medical Care” [3-3-13] has been debating on distance medicine, such as remote image diagnosis and remote pathology diagnosis, since its first meeting on March 21, 2008.

3.3.3. Proposed Approaches to Solving Medical Care Issues

Various issues outlined above are emerging in the medical care field. On the other hand, in response to these issues, there is progress in policies for standardization, sharing and utilization of medical care information. In addition, technology research and experiments are being promoted, including on remote diagnosis.

As shown in Figure 3.3.1, we will contribute to solving medical care issues based on the following three pillars (1. Tailor-made medical and health care, 2. Global advanced medical care, 3. Safe and secure medical care), in the direction of further strengthening previous policies, from the perspective of information and communication networks.

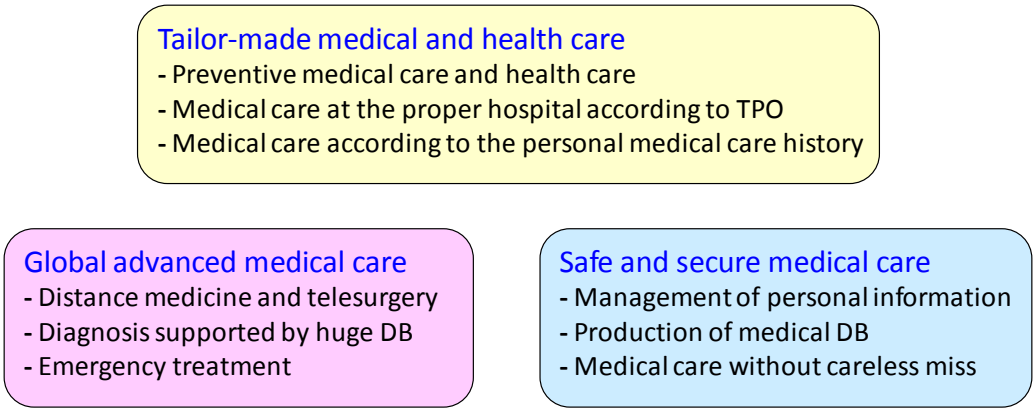

Figure 3.3.1 Medical Care Issues Solution Approach

- Tailor-made Medical and Health Care

Due to developments in science and technology, there are amazing improvements information processing abilities and further improvements are expected. Therefore, by using this processing ability via networks, instead of uniform provision of medical care, we can aim to provide medical and health care customized for the individual. Specifically, we can aim to record a "life log" with all phenomena such as genetic information, the individual's daily health status and food/drink/medicine ingested, thereby providing medical and health care based on that information. Also, by using real-time information of physicians and medical care institutions, it will also be possible to have the best medical care according to TPO. Moreover, based on the recorded individual characteristics and treatment history, we can aim to individually based achieve medical and health care.

- Global Advanced Medical Care

As global advanced medical care, basic remote diagnosis and remote surgery are starting to be achieved not only in Japan, but also via connections to international networks. As of today, this has not become popular due to complex restrictions including network capacity (bandwidth, delay and jitter, etc.). However, if network issues are solved by the future New-generation network, great progress may be made towards its popularity. This may result in greater scope of medical care which can be provided via the network, and contribute to solving the shortage of physicians specialized in such fields. Also, it is thought possible to prevent wider infection by real-time sharing of the international status of communicable diseases. Moreover, from the perspective of advanced treatment, by enhancing information processing abilities via the network, if highly reliable databases are built concerning the relation between symptoms and diseases, this may create stronger diagnostic support. Also, emergency patients have been transported to the hospital and given advanced treatment, but if advanced treatment is provided by the ambulance, emergency treatment may be enhanced.

- Safe and Secure Medical Care

It is thought important to achieve medical care according to the individual, but this requires handling a lot of personal information. Thus even more care and controls than previously must be required for handling information. For example, it may require controls on when and what kind of information to disclose to what people. Also, medical care information concerning individuals is unique, so information must be maintained and managed to avoid loss of valuable data even in a disaster, and to enable proper use anytime, anywhere when the individual needs it. Moreover, considering medical incident cases which can lead to medical accidents, considering possible improvements by sensor networks in cases of insufficient checks and observations, significant contributions to proper treatment for subject patients can be made via networks.

3.3.4. Impacts on Society from Solving Medical Care Issues

Until now, medical care has provided mostly uniform treatment for diseases without considering individuality. Currently, there are active efforts to achieve preventative medicine as a measure before disease appears, and medical care according to the individual's constitution. In the future, it is predicted that treatments will be provided which match the individual's health and disease status, anytime, anywhere, even more than before. This will result in a change from the era of uniform medical care focused on disease, to an era of medical care focused on the individual's situation. In this era of medical care matching the individual's characteristics, the following effects will be created.

- **Tailor-made Medical and Health Care:** Achieve an environment in which medical and health care according to the individual's medical history and characteristics can be obtained anytime, anywhere, based on the individual's unique information including genetic factors and medical history.

- **Global Advanced Medical Care:** Achieve an environment in which many people can obtain advanced health care anytime, anywhere, by providing remote medical care and surgery between countries.

- **Safe Medical Care:** Achieve an environment in which safe and secure medical care can be obtained anytime, anywhere, by automatically reducing medical faults with equipment such as sensors, and using strong security to protect data.

- **Hold Down Medical Costs**: The aforementioned improvements in the medical care environment will result in reduced mortality of lifestyle diseases, prolonged healthy life expectancy, and holding down total medical costs.

3.3.5. Advanced Technologies in Japan for Approaches to Solving Medical Care Issues

Table 3.3.1 shows Japan's advanced technologies in fields related to measures against medical care issues, and examples of their use.

Table 3.3.1 Japan's Advanced Technologies in Fields Related to Measures against Medical Care Issues

	Field	Advanced Technology in Japan
1	Medical equipment	Microscopes for brain surgery and endoscopes: These can be used in advanced medical imagery.
2	Realistic sensation video	Electronic holography: This can be used in 3D video with a sense of presence, such as treatment video.
3	High definition video	Ultra high definition video and transmission: This can be used to share extremely fine medical video.
4	Optical communication	Broadband transmission and optical switching: These can be used in sharing high definition treatment video, such as remote surgery
5	Access	Access networks: This can be used for remote treatment in home.
6	Quantum cryptography	Quantum key distribution: This can be used in safe transmission of important personal medical data.
7	Robots	Industrial robots and human interfaces: These can be used for medical assistance, etc.
8	Data collection	Information collection from diverse devices and sensors: This can be used to collect the health status of individuals, manage medical equipment, etc.

3.3.6. Technical Requirements of the New-generation Network for Solving Medical Care Issues

This section discusses technologies needed for the New-generation network, required to put into practice approaches towards solving medical care issues.

■ Requirements for Tailor-made Medical and Health Care

- **Random Connectivity**

In order to record living information, it is basically necessary to continually connect to the network. However, depending on the situation, there can be cases where it is difficult to connect to the network, or where there is no response in real-time. Thus the New-generation network must have

special connectivity functions which can record all of daily life, even if connections to the network are unstable.

- **Scalability**

There is a lack of means provided for consultation on which hospital should be visited in emergency cases, and when a hospital visit is not required but consultation is desired about treatment. As a way to handle this, opening an inquiry line which can provide remote medical consultation would provide an environment in which anyone can get consultation anytime, anywhere. To that end, the New-generation network must transmit the status information of ambulances/ hospital beds/ physicians (small data on numbers) in real-time, and have transmission functions such as concentration/ separation of small data sets which provides an environment manageable as a database.

■Required for Advanced Medical Care

- **Low Delay and Jitter Guarantee**

There are reports that highly interactive applications can be affected by delays of approximately 150 milliseconds [3-3-14]. Thus for the New-generation network used in remote surgery, which is extremely interactive, there must be guaranteed extremely low end-to-end delay and jitter.

- **Uninterruptible Connections**

It is unforgivable for data transmission to stop in the middle of remote surgery. Thus for the New-generation network which will also be used in remote surgery, there must be functions to achieve uninterruptible data transmissions on dynamically formed network paths.

- **Anonymization**

In order to build databases concerning symptoms, injuries and diseases, the New-generation network must have functions to enable building databases on disease cases and treatment methods by symptoms. For example, a means for using a huge electronic medical record system to process data without losing statistical information, while eliminating personal information.

- **Mobility Guarantee**

In order to provide advanced medical care while continually moving, the New-generation network must have functions which provide ultra-realistic video communications to enable sufficient understanding of the patient’s status, and can correctly transmit medical care signaling, even in a wireless communication environment.

■ **Required for Safe and Secure Medical Care**

- **Network Data Control**

In order to achieve tailor-made medical care, it is necessary to guarantee the safety of data. Thus the New-generation network must have functions which can handle strong security against improper use, and which enable providing data very conveniently for proper users. It must also have functions which enable control (deletion, etc.) of individual data in the network.

- **Data Permanence**

In order to protect unique medical care information concerning individuals, the New-generation network must have functions which operate to automatically maintain medical care data in multiple locations based on the data's backup status, and enable permanent provision of data access.

- **Treatment Consistency**

In order to provide proper medical care for the patients concerned, the New-generation network must have functions which can, for example, indirectly detect and judge whether treatment and drug provision are being done properly or not.

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3.4. Food Issues and Requirements of the New-generation Network

3.4.1. Emerging Food Issues

The food issues can be divided into two issues, global food issues and domestic food issues. The largest global food issue is food insecurity concerns due to the absolute growth in total population. This results from the total population exceeding the population to which the globe can provide food. Domestic food issues are food supply insecurity due to decreased food self-sufficiency ratio, and ensuring safe and secure food. In this report, the global food issues are only described.

[Global Food Shortage Concerns]

World population is forecast to grow 40% from today's 6.5 billion to 9.1 billion in 2050. Developed countries will remain almost the same, but the trend in developing countries is to grow an average 50%, with African countries forecast to grow 110%. Is today's world really able to supply food to handle this population? In table 3.2 of Reference document [3-4-1] shows the grain supply/demand outlook for 2050 which is forecasted by the Food and Agriculture Organization (FAO). This table shows that grain demand will grow 50% by 2050, but production will also grow by almost same percentage, and production will meet demand. From this result, averaging the entire world, these are just concerns of food shortages, even in 2050. However, this is the result of averaging, but food supply and demand are generally unevenly distributed regionally.

The table also shows regional imbalance in grain demand and production and demand. This table shows grain production/demand in 1999 alongside grain production/demand forecast in 2050. The 2050 forecast indicates that in developing countries where population grows, domestic production does not grow enough to meet grain demand growth, resulting in those regions suffering food shortages. This shows that these imbalances will be corrected by grain exports from industrial countries and other countries. However, it is difficult to foresee developing countries in Asia and Africa importing grains from industries countries, and one can easily imagine food shortages arising in these developing countries.

[Collapse of Safe Food Reputation]

Many events have occurred which reduce trust in food, such as the occurrence of mad cow disease (BSE: Bovine Spongiform Encephalopathy), poisoned pet foods, falsely labeled meat origins, etc. Securing food safety is becoming urgent. Also, in Japan which today relies on many food imports, it is important to track when, from where and in what form the raw materials of those foods were received, processed and reached the table, but that is currently extremely difficult. For beef, since BSE occurred, aiming to track the cause and prevent spreading infection, a beef traceability system was established and introduced in which all cattle are numbered, and this number is used to

manage the cattle's lifetime and history in many countries. This is producing certain results as a BSE countermeasures system, but is not necessarily effective in preventing falsification of origin and brand falsification. The problem is that when it is finally displayed in the shop, it can be easily falsified by human hand, and a new system is thought required including falsification countermeasures.

3.4.2. Trends in Food Issues Countermeasures

[Measures Using ICT to Boost Yield per Unit Area]

By using ICT, there is a sugarcane production management system [3-4-2] which combines GPS mobile phones with GIS, as a system making it easier to enter into agricultural production. This was built as an IT based management system for raising efficiency of sugarcane production. It was built with the following four points as objectives.

- Operation management for efficient operation of sugar factories
- Reduce documentation work
- More stable agricultural management
- Easier support for beginners

Of these, the focus is on easier, lower cost production management, by combining GPS functions with GIS functions which are in mobile phones for ordinary use. As a solution for the situation of agricultural/forestry/fishery workers and abandoned farming in recent years, one can consider using ICT to reduce barriers to entry into the food production industry.

Using low earth orbit observation satellites to support agriculture is also being put into practice. Here, we introduce remote sensing technology which contributes to enhanced wheat production in Hokkaido, Japan [3-4-3] and this system can be used in several countries. This system uses satellite imagery to estimate humus content of soil. Good soil preparation is possible by making a "humus soil classification diagram" from the sky, and preparing farmland soil and choosing suitable land for produce. Harvest forecasting can be realized using satellite imagery to estimate the water contained in wheat ears. Ears sprout if rain falls on ripe wheat, but if harvests wheat is done before it ripens, it becomes unsuitable as an ingredient for noodles, and drying high water content wheat also requires more fuel costs in the wheat drying factory, thus technology is being developed to use satellite imagery to judge optimal timing.

3.4.3. Proposed Approaches to Solving Food Issues

This chapter proposes the following four points as methods to help solving food issues.

- Develop an ICT technology platform that can be used by anyone
- Establish food production management techniques using sensor network technology, for

saving energy, higher quality, higher yield, and more stability)

- 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

In order to use ICT to solve food issues, it is first necessary to develop an ICT technology platform that can be used by anyone. That is, global spread of ICT infrastructure, terminals for anyone to easily access the new generation network, and a network which can be used without worrying about the network (highly reliable and usable). It is also important to establish food production management techniques using ICT, and make food production more labor efficient, higher yield, and more stable. Also, establishing food safety and security requires establishing advanced security infrastructure and traceability to make falsification impossible.

3.4.4. Impacts on Society of Solving Food Issues

Along with clothing and housing, food is essential in people's lives. It is obvious that if food shortages are eliminated, hunger will disappear, and the world will come closer to peace. If it is possible to use the New-generation network to enhance food productivity, this will lead to solving food shortages. Also, enhancing the profitability of agriculture, fishing and animal husbandry will boost incentives for producers, and at the same time promote employment.

Using ICT to achieve a rich food lifestyle will enrich people's spirits. Therefore, studying the importance and wealth of foods and gaining mutual understanding of cultures through foods are important for world peace.

Moreover, managing the production history all foods which reach the table enables elimination of wasteful food supply and dangerous foods, and also enables nutrition management in the home, establishing foods which foster health and with which people can feel safe.

3.4.5. Advanced Technologies in Japan for Approaches to Solving Food Issues

In Japan, the terrestrial digital subscriber networks and mobile phone networks are widely developed, which is a strength of Japan. There are also strengths in lower power consuming devices and embedded systems, as seen in advanced mobile terminals. By adding sensor technologies to these, application of ICT to food production management will be internationally competitive. RFID and wireless tag technologies have spread widely in Japan, and highly reliable systems are operating.

3.4.6. Technical Requirements of the New-generation Network for Solving Food Issues

[Network which Does Not Require Concerns about the Network]

People engaged in food production are not necessarily network experts. With the current network, users themselves must solve problems of systems which have become highly complex. Therefore, a network is required which automatically connects and autonomously solves problems, without concerns about the network.

[Sensor/Network Integration]

In order to exercise global food production management and resource management, a sensor network system is required which can observe the globe in (near) real-time. It is also necessary to establish remote control system with networked command such as controlled irrigation facilities. Further expanding this will enable remote agricultural guidance from agriculturally developed countries to agriculturally developing countries, which can be effective in correcting regional food supply/demand imbalances.

[Tag Technology and Network Enabling Tracking of All Foods

The dietary guidelines (Ministry of Health, Labour and Welfare Japan) revised in the year 2000 recommend consuming 30 items per day. It is necessary to be able to track the place produced and production history for all these foods, requiring tag technology and network technology to track the tags. Also, at the same time, security technology is required which makes it impossible to falsify their histories. If the expiration period of foods is one week on average, then about 1600 food items are consumed per person in one year, and tags are required to classify these. If the population is 8 billion, identification of over 10 trillion tags per year are required, and network technology which can trace these is required. Also, building an ICT distribution system which combines this traceability and resource management will enable balancing food supply/demand on a global scale.

[Food and Health]

If the traceable tags are edible, it will be possible to combine this with a Body Area Network (BAN), linking food management with health management.

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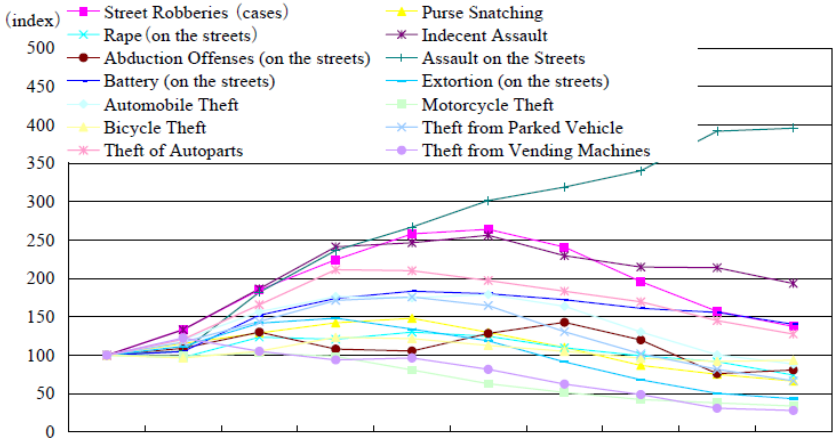
3.5. Crime Prevention Issues and Requirements of the New-Generation Network

3.5.1. Emerging Crime Prevention Issues

For achieving a safe and secure society, crime is one of the main issues. This section discusses crime prevention issues from the two perspectives of crime prevention measures and countermeasures when crimes occur, for crime in real space.

According to the White Paper on Police 2008 [3-5-2], major street crimes reported in 2007 decreased by 67,268 (7.1%) below 2006 to 876,346, and major break-in crimes reported decreased by 33,578 (14.2%) to 204,811, but street crimes and street break-in crimes remain at high levels. Specifically, as shown in Figure 3.5.1, over the past decade, street robberies increased by 40%, assaults on the streets by 300%, and indecent assaults by 90% respectively. Similarly, breaking and entering also increased by 110%.



Category \ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Street Robberies (cases)	1,119	1,495	2,070	2,509	2,888	2,955	2,695	2,192	1,759	1,537
Purse Snatching	35,763	41,173	46,064	50,838	52,919	46,354	39,399	31,017	26,828	23,687
Rape(on the streets)	668	648	825	806	869	832	732	663	612	495
Indecent Assault	2,399	3,196	4,475	5,786	5,915	6,145	5,510	5,154	5,131	4,640
Abduction Offenses (on the streets)	166	181	216	179	175	213	237	199	126	134
Assault on the Streets	4,801	5,051	8,734	11,352	12,814	14,477	15,319	16,332	18,816	18,993
Battery (on the streets)	11,157	11,687	16,965	19,400	20,465	20,098	19,218	17,961	17,373	15,665
Extortion (on the streets)	9,344	10,419	13,230	13,856	12,514	11,089	8,534	6,346	4,690	4,042
Automobile Theft	35,884	43,092	56,205	63,275	62,673	64,223	58,737	46,726	36,058	31,790
Motorcycle Theft	246,364	242,977	253,433	242,517	198,642	154,979	126,717	104,155	93,294	83,028
Bicycle Theft	423,183	408,306	445,301	521,801	514,120	476,589	444,268	406,104	388,463	395,344
Theft from Parked Vehicle	252,092	294,635	362,762	432,140	443,298	414,819	328,921	256,594	205,744	168,129
Theft of Autoparts	61,192	73,824	101,338	129,380	128,539	120,726	112,161	103,772	88,739	78,016
Theft from Vending Machines	181,444	222,328	190,490	170470	174,718	147,878	112,965	88,180	55,981	50,846

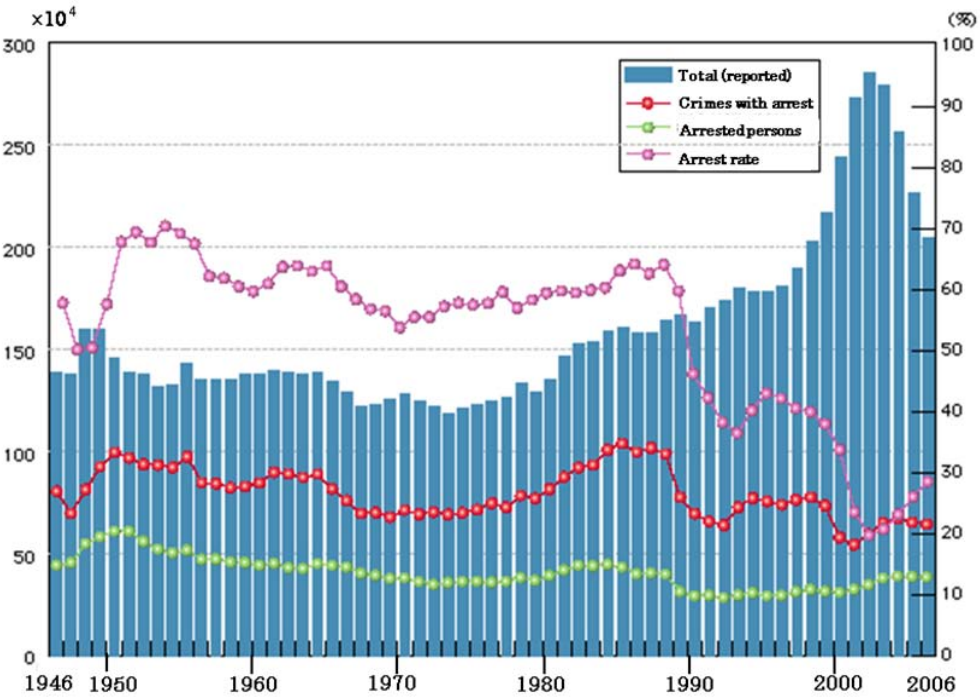
Note 1: A value of 100 was set for 1998 in the Index.
Note 2: "On the streets" includes roads, car and bicycle parking lots, city parks, vacant lots, public transportation (on the subway, bullet train, and other forms of trains, in stations and other railroad facilities, in aircrafts, airports, boats, ports and buses), other forms of transportation (inside taxis or other vehicles) and other open places (underground walkways and highways).

Figure 3.5.1 Trends in the Number of Confirmed Street Crimes [3-5-2]

(Source: National Police Agency, "White Paper on Police 2008")

Viewed longer term, as shown in Figure 3.5.2, the number of reported penal code crimes decreased by 218,442 (9.6%) to 2,050,850 in 2006, but the situation remained severe, still more than

50% higher than the approximately 1.2 million in 1965. Also, the arrest rate for penal code crimes was roughly 60% from 1926-1989, but this fell rapidly starting in the 1990s, with the lowest postwar record of 19.8% in 2001. It has steadily risen since 2002, to 31.2% in 2006 (2.6% higher than 2005). It has recovered to over 30%, but this remains about half the level of the 1926-1989 period.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total (reported)	1,899,564	2,033,548	2,165,828	2,443,470	2,735,812	2,853,739	2,790,136	2,562,787	2,269,293	2,050,850
Crimes with arrest	759,809	772,282	731,284	576,771	542,115	592,359	648,319	667,620	649,503	640,657
Arrested persons	313,573	324,263	315,355	309,649	325,292	347,558	379,602	389,027	386,955	384,250
Arrest rate	40.0	38.0	33.8	23.6	19.8	20.8	23.2	26.1	28.6	31.2

Figure 3.5.2 Trend in Penal Code Crime Reports and Arrest Situation [3-5-1]

(Source: National Police Agency, "White Paper on Police 2007")

This low arrest rate is the greatest concern for police, and must be considered a structural problem when looking at the crime situation of the past few years. Actually, in the White Paper on Police 2008 [3-5-2], a questionnaire survey of front line police officers indicated more difficulty in obtaining cooperation in investigation activities and more difficulty of investigating highly anonymous crimes, highlighting limits to efforts by the police themselves. If one comprehensively considers that in addition to structural problems, the trend of more difficult investigations will continue with more advanced and diverse crimes, and increases in highly anonymous crimes and foreigner crimes, then this may emerge as a more serious problem in the future.

On the other hand, aren't there crime issues from the perspective of people's lifestyles? Specifically, it is necessary to consider impacts of changes in social structures such as changes in

family composition and labor forms, weaker local communities due to urbanization, diversification of people's lifestyles, development of information networks via the internet, and change from fast growth to a mature society.

As typical changes in people's lifestyles, here we look at changes in family composition and labor forms. The following are some changes in family composition and labor forms: (1) Evolution of the nuclear family, (2) Increase in single person households (single people and elderly), (3) Increase in dual income families. According to the 2005 Census [3-5-3], there were 28,390,000 nuclear family households on October 1, 2005 (57.9% of private households), a 3.9% increase since the year 2000. About 9,640,000 (19.6%) of these were "only husband and wife", a 9.1% increase since the year 2000. Also, about 14,460,000 (29.5%) of private households were people living alone (single person households), a 12.0% increase since the year 2000. This indicates that even more elderly will live alone in the future.

Also, according to the White Paper on Gender Equality 2006 (Outline Version) [3-5-4], there were 9,880,000 husband/wife dual income households in 2005, more than the 8,630,000 households where the man employed and the wife not working. As a result, it is becoming more difficult for the family's adults to watch over children while at home.

Considering these trends of the move towards nuclear families, and the growth in single person households and dual income households, increasingly important issues are watching over the elderly and children and preventing residential breaking and entering. If there are close relations between neighbors, one can expect a certain level of crime prevention by neighbors watching, but this will become an even bigger issue in areas with weak local communities, especially in urban areas.

3.5.2. Trends in Measures Against Crime Prevention Issues

- Police Trends

Along with the worse crime situation, there are more incidents which should be investigated, and their details are more complex and advanced. In response, the police are thoroughly implementing improvements for efficient operations by its limited organization and staff, reinforcing the detectives of which there is a shortage, and working to strengthen the investigation organization. Police are also using scientific technologies (DNA profiling and record search, 3D facial image identification, automatic finger and palm print identification, profiling, etc.), sharing information with the Ministry of Justice (place of origin information, information on people whose location is unknown, etc.), and developing the police infrastructure system which receives reports from the 110 hotline and sends commands to police stations [3-5-1].

- Local Government Trends

In local governments throughout Japan, there is a growing trend to not only rely on control by police, and they are working to ensure the town's safety and security themselves. The police are aware of 31,931 crime prevention volunteer organizations in Japan (12,416 more than at the end of 2005). Many of the approximately 1,980,000 people who comprise these organizations (790,000 more than at the end of 2005) belong to neighborhood associations and other local resident organizations and parents organizations [3-5-1]. Specific initiatives are mainly local patrols and awareness campaigns, but some local governments and NPOs are cooperating with private companies to operate children and elderly monitoring systems which combine electronic tags with crime prevention cameras.

- Market Trends

According to the 2008 Security Related Markets Future Outlook [3-5-5], continued growth in the crime prevention market is forecast, but harsh price competition is expected due to the saturation of demand from large companies. Market forecasts for the main security markets which are expected to grow are as follows (2007 actual → 2011 forecasts).

- Home security: ¥225.9 billion → ¥458.7 billion (+103% above 2007)
- Car security: ¥68.4 billion → ¥71.4 billion (+35%)
- Office security: ¥17.5 billion → ¥24.3 billion (+39%)
- Personal security: ¥6.5 billion → ¥13.6 billion (+109%)

40% of the entire market is comprised of home security, mainly private security companies. This in particular is forecast to grow over 100% from 2007 to 2011, due to the spread of residential fire alarm equipment, home emergency earthquake alarm response terminals, trespass sensors and home security services.

Private security companies are providing crime prevention services such as entry/exit control using RFID, and location confirmation and emergency reporting using portable information terminals with GPS functions. One can also read business reports of individual companies [3-5-6] to see this trend towards emphasis on security services for houses, offices and factories.

3.5.3. Proposed Approaches to Solving Crime Prevention Issues

- Hold down the number of criminal incidents by improving the reliability and precision of crime prevention systems

First of all, one can consider the solution approach of holding down street crime and breaking and entering, by more advanced (more reliable and precise) crime prevention systems which aim to watch over vulnerable people such as children and the elderly. Here, as a crime prevention system,

we consider indoor and outdoor sensor networks and crime prevention camera systems, etc. This approach is in line with the R&D goals and technology trends shown in the Survey Research Group Final Report on “How to Have Information and Communications Technologies Towards Achieving a Safe and Secure Society” [3-5-7] and ICT R&D and Standardization Strategy to Strengthen Japan’s International Competitiveness [3-5-8]. Examples of more advanced and reliable crime prevention systems via the new generation network are: 1) Highly accurate information automatic collection mechanism in a high density (large scale) crime prevention camera system and sensor network without blind spots; 2) Highly reliable sensor information transfer from houses covered by crime prevention, using a single circuit to security management sensors.

- Increase detection rates by improving the precision of crime detection systems

Use the New-generation network to try and improve the crime arrest rate by a more precise police infrastructure system as described above. Specific possibilities are more precise elemental technologies for the police infrastructure system, such as DNA profiling and record search, and 3D facial image recognition. Also, more precision by close connections with related systems of external private and public institutions (fire prevention systems, Ministry of Justice databases, etc.). For example, in order to immediately perform more precise facial image identification on many people, there is a need for immediate and secure sharing of facial image data with remote databases, going beyond barriers between organizations.

- Ensure that both security and privacy are protected

When actually operating crime prevention systems which automatically collect personal information, high precision is desirable for stronger security, but there is the very common problem that higher precision makes it easier to invade the privacy of people watched. Therefore, one can consider an approach for coexistence of security with privacy protection in crime prevention systems, on a high dimension by the new generation network. For example, one possibility is to comprehensively evaluate by the status and context of people watched and the situation of their surroundings, then automatically increase monitoring precision only when required. Also, a precondition is the necessity to ensure security of the crime prevention system itself.

- Support crime prevention and detection through community activities

As mentioned above, due to structural problems of the police system, there are limits to improvements in arrest rates through efforts by the police themselves. But here we consider approaches to use the local and network community to enhance results in crime prevention and detection. For example one can consider a method which supports police investigations of suspects, by investigating their personal relationships in a general SNS service like mixi (network community),

coordinating the SNS service with a criminal profiling system.

Also, fostering and development of social capital (social organization including trust, norms, network) [3-5-9, 3-5-10] leads to stimulation of the local community and local industry growth. As a result, one can expect improved active crime prevention effects. Therefore, ICT technology is required which can support smooth communication and understanding between local residents.

3.5.4. Impacts on Society of Solving Crime Prevention Issues

The issue solution approaches mentioned above have the following social impacts.

- Watching over the elderly
  Create an environment where the elderly can live peacefully, even when the society becomes more elderly.
- Watching over children
  Prevent children from getting involved in crime or accidents, even if there are few people to watch over them.
- Stimulate the local community activity
  Use ICT technology to support integrated local crime prevention activities and foster and stimulate local communities.
- Protect privacy
  Achieve coexistence between privacy protection and automatically acquiring personal information using equipment such as sensors and crime prevention cameras.
- More advanced police infrastructure system
  More precise detection of criminals. Coordinate with various crime prevention systems.
- Expansion of the home security market
  Create and foster internationally competitive crime prevention industries.

3.5.5. Advanced Technologies in Japan for Approaches to Solving Crime Prevention Issues

Table 3.5.1 shows Japan's advanced technologies in fields related to countermeasures for crime prevention issues.

Table 3.5.1 Japan's Advanced Technologies in Fields Related to Countermeasures for Crime Prevention Issues

	Field	Advanced Technology in Japan
1	Network	Broadband wired/wireless network deployment and network management technology
2	Network	Technology for integrated management of wireless access (cognitive wireless technology, etc.)

3	RFID	Large-scale RFID system management technology
4	Terminal	Compact lightweight technology and advanced function technology for mobile terminals
5	Network	Technology for the operation and practical implementation of sensor and mesh networks

3.5.6. Technology Requirements of the New-generation Network for Solving Crime Prevention Issues

- Self-organization technology for wide-area or high-density large-scale sensor networks

There is progress in R&D on ad-hoc communications technology and mesh network technology which handles sensor networks, RFID readers and crime prevention cameras. However, there are difficulties in practical application of large scale sensor networks using wireless technology for communication between nodes, with wide deployment of large numbers of crime prevention nodes in the entire region, and high density deployment in specific areas. In such large scale crime prevention systems, network self-organizing technology is needed which can minimize deterioration of the entire system's communication performance, even if some nodes move or fail, without requiring action by the system administrator.

- Network virtualization technology to allow multiple networks with diverse requirements to be simultaneously accommodated in a single platform

Although "crime prevention system" is one phrase, there are various systems which apply science and technology for the police, monitoring systems for local government, home security systems, etc. These diverse systems also have a variety of reliability, cost, security strength and privacy levels. Currently, a different communication system is generally prepared and used for each system and each objective. However, in addition to their operating costs, when systems mutually connect, there are the large problems of mutual connection policy restrictions on network levels, and trouble of the network's physical mutual connection work. Therefore, multiple crime prevention systems with different requirements will need network virtual technology which enables simultaneous developments on a single network platform, while meeting each requirement.

- Dynamic network resource sharing technology to facilitate instant on-demand configuration of secure private networks at the user level

In order to guarantee quality of important communications between home security nodes and crime prevention nodes and the security management center (collection and analysis of danger information), crime prevention systems require highly reliable access networks. Methods of preparing multiple physical connections and multiple path routing are simple and practical, but

preparing multiple interfaces and multiple physical connections for home and crime prevention nodes is often difficult in terms of costs and equipment. Therefore, network resource sharing technology is required which uses multiple external connections and an adjoining home's access network as backup, and makes these multiple connections logically usable as one virtual network.

Also, crime prevention systems have the characteristic of handling information closely related to privacy. Thus ideally, it is necessary to build closed crime prevention dedicated secure networks at the user level. To instantaneously build secure virtual networks (private networks) equal to the number of users and number of services, dynamic network resource sharing technology is required.

In these situations, it is necessary to build virtual networks equal to the number of users, which also must be able to immediately conform to movements of users and crime prevention nodes. This requires resource sharing technology which, compared to VPN services for companies, would accommodate 100 times the quantity with 1/100 setup times.

- Adaptive privacy protection technology that can be modified according to user's presence or context

Use ICT technology to stimulate the local community, and achieve stronger crime prevention awareness of residents and mutual watching by neighbors, which indirectly leads to stronger crime prevention. In order to foster local community, technology for the new generation network to support social capital is needed. Specifically, technology is needed which coordinates resource sharing technology mentioned above with technology which automatically deduces trusting relationships with neighbors, and community (user) authentication technology.

Also, for high-level coexistence of security and privacy protection by new generation network in crime prevention systems, adaptive privacy protection technology is required which comprehensively judges using the status and context of the subject person, status of surroundings, and can adaptively and flexibly change monitoring precision settings.

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3.6. Accident Issues and Requirements of the New-generation Network

3.6.1. Emerging Accident Issues

In this section, “accident” signifies an event resulting in unforeseen injury or damage to people or property, excluding medical accidents and disaster accidents. There are generally various types of accidents, but the following table summarizes the numbers of major accidents.

Table 3.6.1 Number of Major Accidents in Japan

	Number of Accidents	Trend
Railway accident [3-6-1]	857 (2005)	Many are railway crossing obstacles (414)
Gas accident [3-6-2]	369 (2007)	Overall declining trend. Mainly leaks and catching fire.
Aviation accident [3-6-3]	23 (2007)	Many helicopter and small airplane accidents
Electricity accident [3-6-4]	11,251 (2007)	Almost all are aerial high voltage transmission lines: 9,706
Marine accident [3-6-5]	1,817 (2008)	Engine trouble (351), struck a rock (282), collision (278)
Water accident [3-6-6]	1,663 (2005)	86% are age 19 or older
Firefighting related [3-6-7]	Fires: 53,276 (2006)	Many arson incidents
Traffic accident [3-6-8]	830,000 (2007)	Number of deaths in declining trend

We see from the above table that fires and traffic accidents comprise an overwhelming percentage of accidents. Looking at their breakdown in the 2006 Fire and Disaster Management White Paper, in 53,276 fires there were 2,837 deaths and 114.2 billion yen damages. Looking at causes of fires in order, we see arson (6,649), stoves (5,990), cigarettes (5,135), suspected arson (4,619), and wood heating fire (2,630). On the other hand, in the White Paper on Traffic Safety in Japan 2007, there were 833,019 traffic accidents with 1,030,000 injured and 5,744 deaths. This was the first time since 1953 that there were less than 6,000 traffic deaths. An overview shows that traffic accidents comprise an overwhelming number of all accidents, averaging about 2,300 traffic accidents per day. Therefore, reducing traffic accidents can make Japan more safe and secure, and one can say that traffic accident reduction is a major issue.

In response to the question as to how many accidents would enable one to call Japan safe and secure, according to the French mathematician Emile Borel (1871-1956), approximately a one in a million (10^{-6}) probability on an individual basis can be ignored. Applying this to traffic accident deaths in FY2007, there were about 8100 deaths per million people. Considering the one in a million standard, one can see that this number is too high.

Below, we consider traffic accident details, using FY2007 statistical data.

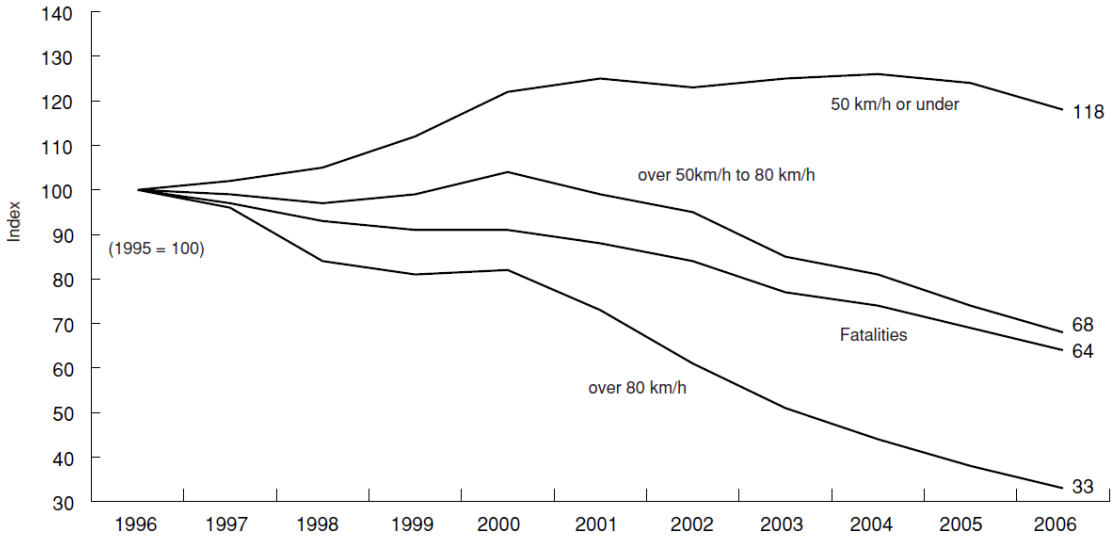


Figure 3.6.1 Number of General-road Traffic Accidents (by Speed at Moment Hazard Recognized) and Fatalities [3-6-8]

Figure 3.6.1 graphs the trend of fatal traffic accidents with 1995 as 100, by speed when occurred [3-6-8]. We see from this graph that there was a large drop in the number of deaths due to high speed automobile accidents, while fatal accidents at 50km/hr and below were almost the same. However, making it mandatory to wear seat belts is thought to be a major factor in this, while deaths from accidents at 50km/hr or less are almost unchanged.

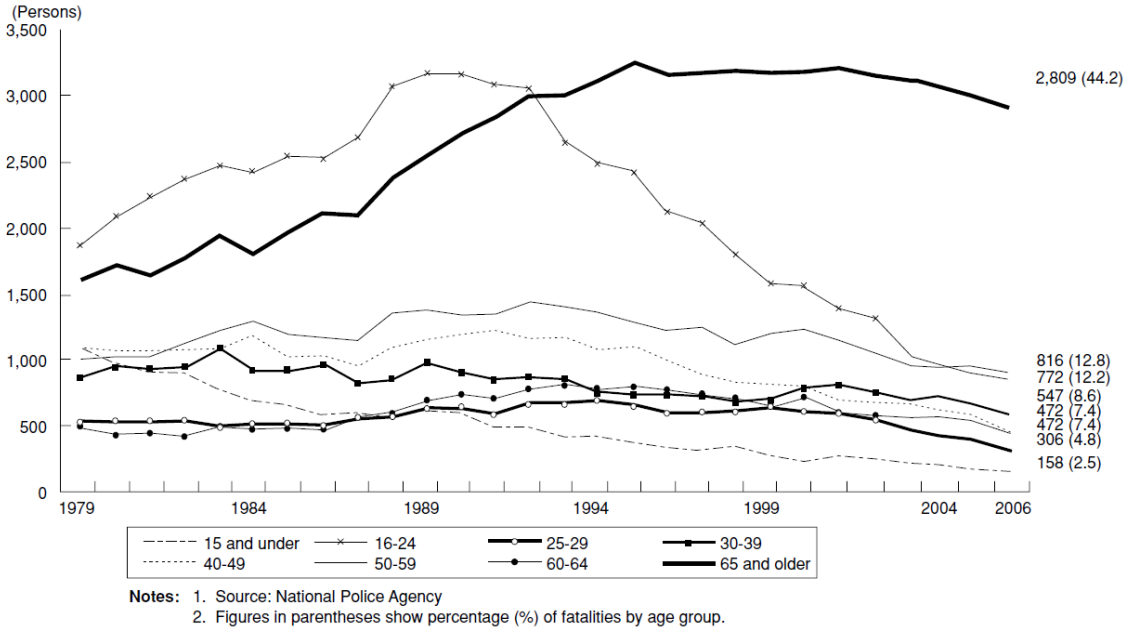
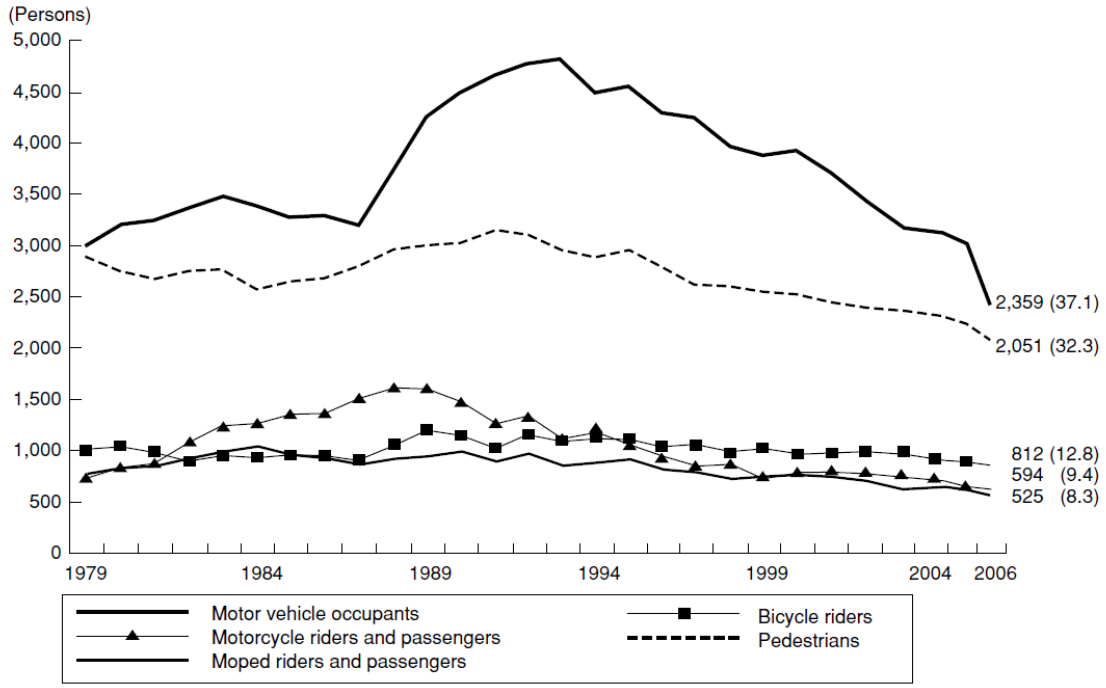


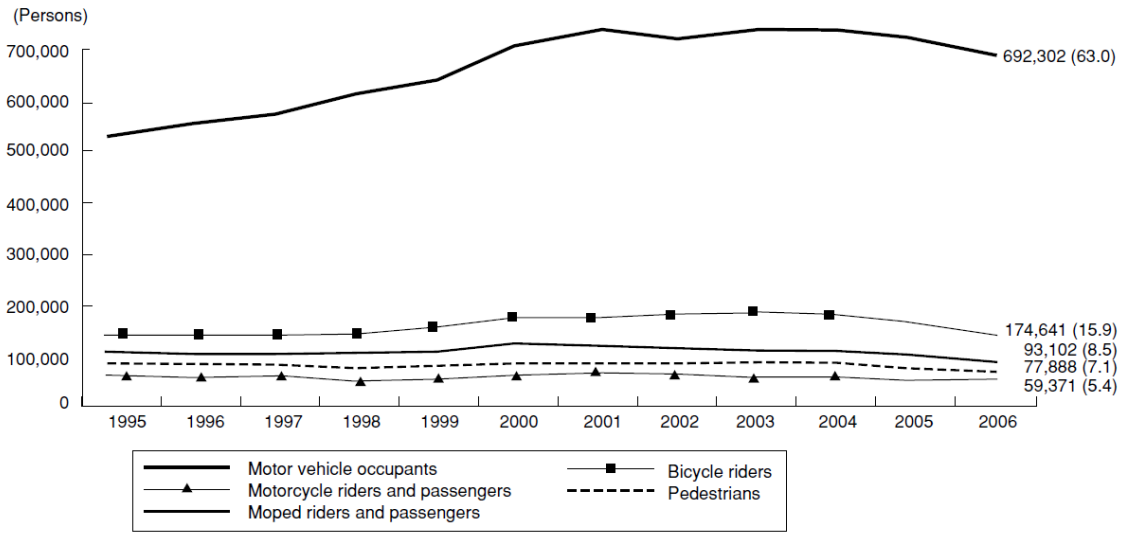
Figure 3.6.2 Trends in Traffic Accident Fatalities, by Age Group [3-6-8]

Figure 3.6.2 graphs trends in traffic accident deaths by age group [3-6-8]. We see from this graph that there was no decrease in the number of deaths age 65 and older.



Notes: 1. Source: National Police Agency (figures for "Other" omitted)
2. Figures in parentheses show percentage (%) of fatalities by mode of transportation.

Figure 3.6.3 Trends in Traffic Accident Fatalities, by Mode of Transportation [3-6-8]



Notes: 1. Source: National Police Agency (figures for "Other" omitted)
2. Figures in parentheses show percentage (%) of injuries by mode of transportation.

Figure 3.6.4 Trends in Traffic Accident Injuries, Mode of Transportation [3-6-8]

Figure 3.6.3 graphs the trends in number of traffic accident deaths by status, and Figure 3.6.4 graphs the number of injuries [3-6-8]. The number of deaths and injuries while riding in automobiles are in a declining trend, but the number of other deaths and injuries such as pedestrians are almost unchanged.

The above raises the following issues:

- Prevent medium and low speed accidents
- Prevent accidents with pedestrians, bicycles, etc.
- Prevent accidents of drivers age 65 and older

3.6.2. Accident Issue Solution Trends

Regarding traffic accident prevention, in the Intelligent Transport System (ITS), Advanced Cruise-Assist Highway Systems (AHS) are now being developed which use cooperation of the road with vehicles (road-vehicle cooperation). Among the various causes of accidents, AHS provides services for behavior immediately before accidents, such as driver noticing late, misjudgment and mistaken operation, which directly trigger accidents. AHS provides (1) information, (2) warnings, (3) operation support, and there are expectations that it will effectively prevent accidents [3-6-9].

3.6.3. Proposed Approaches to Solving Accident Issues

Split the existing data provision functions into three levels and link roads, vehicles, and the networks that connect them, not only for traffic accident prevention, but also aiming to create new value.

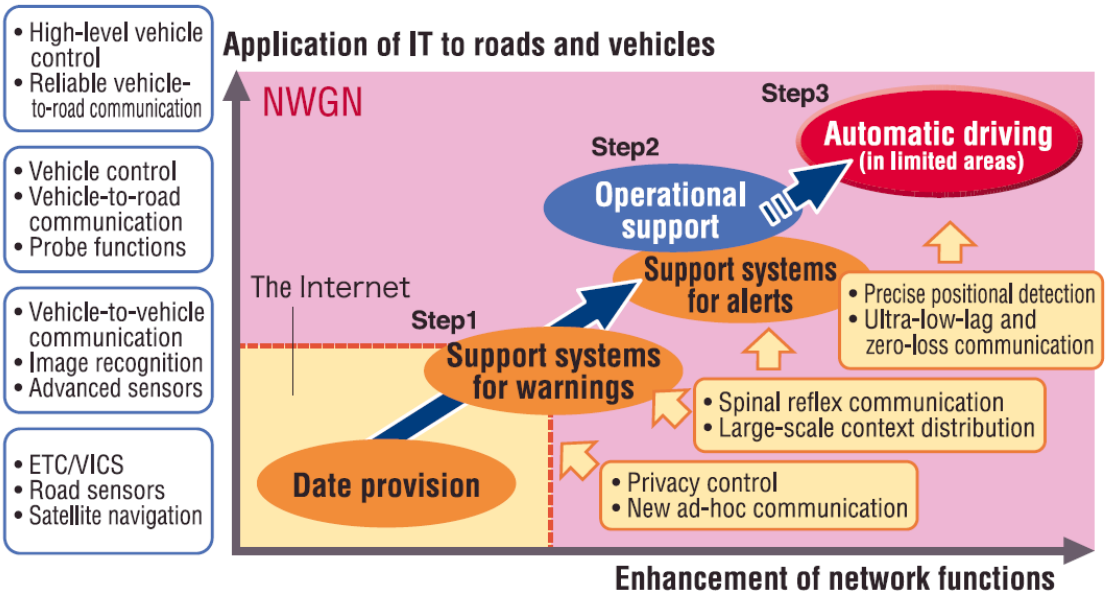


Figure 3.6.5 Three Steps to Achieve Next Generation ITS Services

Current ITS services provide information on the traffic situation, etc. Also, automobile manufacturers use the internet to share traffic information, and provide operator service in an accident or vehicle failure. The next generation ITS will have even more advanced functions, with its levels divided into three stages. Its outline is shown below.

Table 3.6.2 Three Stages of Support Levels in Advanced Cruise-Assist Highway Systems (AHS)

	Currently	Support level 1[Step1]	Support level 2[Step2]	Support level 3[Step3]
Data collection	Person	Person/system	Person/system	System
Driving operation	Person	Person	Person/system	System
Responsibility	Person	Person	Person	System

- Support Level 1

In support level 1, the system supports part of the driver's information collection, providing a service which provides data and support systems for warnings and alerts.

- Support Level 2

In support level 2, the system supports part of the driver's data collection, and also some driving operations.

- Support Level 3

Support level 3 goes further. This system handles collection of data, driving operations and bears all responsibility, with the goal of automatic driving in limited areas [3-6-9].

Support level 1 provides support to boost caution at intersections and merge locations where cars meet cars. R&D is being done for this in the ITS field with communications methods using usual internet protocols (IPs) as its basis. However, there are issues including the requirement for dedicated hardware to enable IP processing speed on the order of milliseconds. The New-generation network will require communications similar to human spinal reflexes, transmitting car positions and people's movements which change each moment, with data even transmitted by low speed sensors. Moreover, as probe functions of automobiles develop, infrastructure which transmits their contexts will be required for the large volume of automobile context data flowing into the network.

Support level 2 also has system support for automobile control, in addition to the functions of support level i. As this function becomes more advanced, it will help implement the current driving support program for drivers age 65 and older, and there are expectations for accident avoidance in emergencies.

Support level 3 has a goal of automobile driving in limited areas, for example on highways. It requires position detection at several decimeters level precision using multiple information sources

such as sensors and Global Positioning System (GPS), with very low delay and highly reliable communications methods for the road and automobile to cooperate and enable automobile driving. Especially in the future, it is foreseen that communications system infrastructure which also enables remote communications will be required.

- Current Situation and Problems

To a certain degree, one can say there are few infrastructure development problems in urban areas where infrastructure is developed. But the infrastructure itself is not developed in rural areas, and the situation makes it difficult to obtain next generation ITS services. In the New-generation network, even in places where the road's infrastructure is undeveloped, it is thought that communications methods for obtaining data will be required, for example ad-hoc communications. Current ad-hoc communications are being considered based on IP, but when handling automobiles which are relatively high speed and mobile, there are problems if routing calculations are not done well, etc. Also, in cases where the automobile is used as a sensor probe, controls are required for privacy of the entity which supplies data. A mechanism is required which only enables provision of data according to the settings of the information provider itself, not unilateral data collection by the network.

3.6.4. Impacts on Society of Solving Accident Issues

Building such an accident prevention and data distribution system using ICT will bring the following social impacts [3-6-9].

- Dealing with Japan's emerging issues (detailed calculation of negative legacy)

Detailed calculation of negative legacies such as reduction of traffic accidents, environmental impact, and road congestion can enable changes which people can really feel. Especially if road congestion can be held down to a certain degree, this can contribute to CO_2 reduction.

- Ensuring Mobility of the Elderly

It is possible to achieve a society where the elderly and handicapped can move around safely. In particular, automobiles will be increasingly used as a means of mobility in the progressively aging society, so it is desirable to ensure mobility and enhance safety for the elderly.

- Abundant Lifestyle and Local Community

Improve the vitality of society and prosperity people can really feel by effectively using highways and public transportation. Develop new means of communications, to enable reception in rural areas of ITS services which are the same as in cities. Also use cars to build ad-hoc communications networks during disasters, enabling provision of emergency communications.

- Better Business Environment

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

used seamlessly. If automatic driving can be achieved, for example automatic delivery using highways, then safe and low cost transportation can be achieved. Also, combining the distribution system with sensors embedded in roads can enable more accurate delivery management.

3.6.5. Advanced Technologies in Japan for Approaches to Solving Accident Issues

Dedicated Short Range Communication (DSRC)* used in electronic toll collection (ETC) has already been put into practical application, and its reliability is well regarded. Japan's environment also makes it easy to create new ITS services, with world leading automobile manufacturers and a road network, and also well developed car equipment such as car navigation systems. As Japan also has wireless technologies such as 3G and WiMAX, and developed sensor technologies and wired/wireless infrastructure, a similar country cannot be found anywhere else in the world.

* This can communicate over short distances of several meters to several hundred meters, and shortening the usable range achieves high speed communications (about 4Mbps) in specific spots. ETC systems using DSRC are not mutually compatible between Japan, Europe and the U.S.

3.6.6. Requirements of the New-generation Network for Solving Accident Issues

The following shows the technologies required for the New-generation network in order to achieve next generation ITS.

- Mobile transparency: Ensure communications in front of and behind movement. Technology is especially desired to ensure communications in rural areas where it is difficult to develop infrastructure.
- Spinal reflex communications: A mechanism is required which can preferentially transfer urgent information without subjecting it to excessive processing.
- Highly precise location detection: It is necessary to enable precise calculation of the positions of fast-moving objects by linking sensors and networks.
- Requires a mechanism which transmits location data of people and cars etc. as context, with privacy controls as necessary. Also requires infrastructure which distributes as context the data of various sensors installed in automobiles, and depending on the situation, mechanisms to control data which automobile manufacturers want to use in closed networks and data related to people's privacy.

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3.7. Domestic Regional Disparities and Requirements of the New-generation Network

3.7.1. Emerging Disparity Issues

Since Japan's Meiji era, the urban population grew explosively due to conversion of the industrial structure to heavy and chemical industries, and development of the railway network. In particular, there was no halt to overconcentration in Tokyo of almost all the nation's functions, and in the 2005 Census, metropolitan Tokyo's population reached 42.4 million, 33% of Japan's entire population [3-7-1]. The world's second most populace city is Mexico City with only 23 million, showing that Tokyo is unique in the world as one large metropolis. Many large companies are headquartered in Tokyo, and almost all information such as TV and newspapers are also transmitted from Tokyo. Also looking at university students, 43% are concentrated in metropolitan Tokyo, as young people leave other regions. This over-concentration of people, goods, money and information in Tokyo is forecast to continue.

On the other hand, walking through commercial districts of regional cities, we see economies where many shops have closed. This is partly caused by loss of customers to large suburban stores, but it seems tied to stagnant consumption itself because people flowed into Tokyo. There is especially a structural problem with the decline of young people and remaining elderly, so new things are not created, resulting in declining vitality of the region. This is resulting in a vicious circle, with fewer business chances, less accumulation of people and money, and declining public services, acting as another force reducing the young population. An important issue for regenerating Japan's economy is to somehow generate new employment and vitality in the regions.

The evils of Tokyo's overconcentration are not only problems in other regions. As a result of the concentrated population in Tokyo, land prices have soared in Tokyo and its surroundings, and there is long-distance commuting, heavy rush hour traffic, and chronic traffic congestion. Also, since the late 1990s, along with the increase in elderly households, there is a rapid increase in the number of households receiving public assistance. Weak relations with neighbors in cities can be easy to manage, but new social problems are arising such as elderly dying alone. In places built in the fast economic growth era such as Takashimadaira Danchi and Tama New Town, aging of residents is turning them into slums, with an increase in empty homes, etc.

In this way, Tokyo's overconcentration is leading to the emergence of various social problems, such as depopulation of other regions and growing regional disparities in public services. Solving these problems is becoming an important issue.

3.7.2. Trends in Disparity Issue Countermeasures

There are many restrictions on the uses of subsidies such as central government expenditures which support regional government budgets, thus it is easy to end up with uniform government

services and a focus on using up budgets, which are factors preventing regional revitalization. Various government reforms to promote regional decentralization are being tried. For example, the "Trinity Reform ("Elimination and reduction of subsidies from the central government", "Review of tax grants" and "Transfer of tax revenue sources")" implemented by the Koizumi cabinet contributed to regional independence and decentralization, and also to more sound government fiscal situations for the nation and regions. This reform is well regarded as a first step in regional tax and fiscal reform. However, during this period, the resulting reduction in tax grants provided has brought very harsh budget cuts in regional fiscal planning for regional public organizations, and it is pointed out that there was insufficient transfer of authority from the nation to the regions. Thus it is difficult to say that it produced sufficient results from the perspective of local revitalization. This period's economic recovery brought increased regional tax revenues which were mainly in urban areas. Thus a situation is arising where public services are forced to consider cutting essential costs, especially in fiscally weak organizations such as local medical care. With the economic depression, there are fears of sliding into a crisis situation.

3.7.3. Proposed Approaches to Solving Disparity Issues

The current goal is to bring broadband by the year 2010 to all areas which are not yet covered. Information and communications infrastructure development is proceeding [3-7-2]. If this is completed, people will be able to access the Internet while living anywhere in Japan, and regional information disparities will disappear. It is thought that active utilization of this information and communications infrastructure is a key to solving regional disparity issues.

Among local industries using local resources such as people, goods and money, there are industries such as manufacturing, agriculture, fishing and tourism which deliver industrial production and services to outside the region, as well as industries which contribute to enhance the quality of life of local residents, such as wholesale/retail, service industries, hospitals, local financial institutions, local transport institutions, educational institutions, gas and electricity. It is necessary that local residents, regional enterprises, and local government operate together various systems for local sustainable development, and that required information is provided to people and organizations as feedback [3-7-3]. There are expectations that local industries can be stimulated, employment generated and quality of life enhanced by using ICT to make information related to local resources such as people, goods, and finance accessible in a more visual, quantitative, and real-time form, and for using these resources effectively without waste. In considering local industries, people tend to focus on manufacturing, agriculture, fishing, tourism, etc., but with population decline and an aging society with fewer children, industries related to enhancing quality of life are also very important: services, hospitals, local financial institutions, local transport institutions, educational institutions, electricity, gas, etc. Looking at a questionnaire on degree of importance when considering returning

to one's home town, many items are related to quality of life, such as medical care, nursing, safety, security and comfort [3-7-4]. If network functions become even more advanced, remote medicine and education can also be considered. This can provide opportunities for all people to obtain advanced medical care and education regardless of where they live, and contribute to correcting disparities in public services. There is hope this will boost populations of local societies by people returning to their home towns, with more opportunities for local employment. There are hopes this will lead to local stimulation.

It is also important that new forms of work such as telecommuting using ICT be widely used in society. It is hoped this will lead to creating new ways of working and new lifestyles [3-7-5]. There are expectations first of all for local stimulation, and also for relieving urban commute rush hours, and reducing CO_2 by less travel.

If network security is strengthened further, there may be progress in electronic finance and government administration. In recent years, post office rationalization with postal privatization, and closures and mergers of agricultural and fishing cooperatives has led to a declining trend in the number of financial institution branches in towns and villages which have depopulated areas [3-7-6, 3-7-7]. As a result, securing access to financial services is steadily becoming a life or death situation for people living in those areas. As an approach to solving this problem, it is important to: (1) Ensure a means to access financial services in the home or current location, (2) Ensure mechanisms for money in the account to be used in the net, and also in real space like cash or bank cheques. Point (1) can be handled by Internet banking, and (2) by electronic payment methods such as electronic money [3-7-8]. These services are now rapidly developing, but the current trend is towards urban residents and skilled users of the Internet and information terminals [3-7-9]. Thus to solve problems, it is necessary to ensure flexibility in place and time of access to financial institutions, developing mechanisms enabling easy use of Internet banking and electronic payment services, regardless of age, sex and skills in handling information services, by developing network infrastructure and services even reaching towns and villages which have depopulated areas. This requires building mechanisms for electronic payment services which can be used like cash or bank cheques to pay small retail shops, self-employed workers, and even roadside stands.

3.7.4. Impacts on Society of Solving Disparity Issues

For regeneration of Japan's economy, it is essential to recover energy and vitality of all of Japan. ICT use is proposed as an approach to solve these issues, but one must always keep in mind that ICT is just a tool. Independence and autonomy are the most essential things for local stimulation. If each resident uses ICT to share information and become actively involved in local government and local development, there will be great progress towards local stimulation. Then effective utilization of original local resources such as industries and tourism and creating local originality leads to vitality

of both the regions and Japan as a whole. In the time of the new generation network, remote medicine and education will be introduced, and there will be progress in electronic finance and government, which should eliminate disparity in public services. The new generation network is likely to play an important role as essential infrastructure to make it “possible for anyone to live well anywhere in Japan”.

3.7.5. Advanced Technologies in Japan for Approaches to Solving Disparity Issues

- High rate of broadband penetration

  Developing the broadband network as social infrastructure throughout Japan is a precondition for utilizing ICT in solving regional disparity issues. The number of broadband circuit subscribers in Japan (note: not equal to number of subscribing households) reached 28.3 million at the end of 2007 [3-7-10]. Simply dividing this by the number of households obtains a figure of about 57%, but actively promoting further penetration should enable it to fulfill a role as social infrastructure.

- Advanced sensing technology

  An important technology issue for promoting ICT use is a human interface which anyone can easily operate and even elderly living in depopulated areas can use. There is excellent sensing technology in Japan, and we want to utilize this to achieve advanced human interfaces. Sensing technology is also a key to achieving remote medicine and education, and this is a field in which there are expectations for the use of advanced technology in Japan.

- 3D video and high-resolution video technology

  Highly realistic display technology is needed in order to spread remote medicine and education. There are excellent high resolution video technologies in Japan such as 3D video technology and super high vision, which can contribute to building a remote communication system with a rich sense of presence.

- Optical switch technology and low power consumption device technology

  Broadband networks are also an important requirement in solving disparity issues, i.e. remote medicine and education, and for popularity of telecommuting. If we disregard power consumption, it is possible to make broadband networks by increasing the amount of hardware. But from the perspective of local environmental protection, there is a need to achieve further expansion of broadband networks with better power conservation. Japan has world leading technology in optical switches and lower power consumption devices, and there are expectations that actively supporting development of these technologies will achieve a network which combines broadband with power conservation.

- Electronic Encrypted Communications Technology

  Stronger network security is an important issue for promoting electronic finance and government. A current cryptographic system (RSA) will have its foundation destroyed by the achievement of quantum computers, so the world is focusing on quantum cryptography communications whose absolute security is physically guaranteed. In this technology field, Japan has achieved the world's longest distance communication [3-7-11], and is expected to continue leading the world in this field.

- 3G, WiMAX and other wireless communications technologies

  For new forms of work such as telecommuting to spread widely in society, ubiquity is needed which also enables access to the network at high speeds from places outside the home. Japan has excellent wireless communications technologies such as 3G and WiMAX. These can be utilized to develop an environment which enables access to the network from anywhere at high speeds.

3.7.6. Technical Requirements of the New-generation Network for Solving Disparity Issues

- Robust and low cost, to function as a lifeline

  Japan's broadband penetration rate at the end of 2007 was 57%, if one simply divides the number of subscribers by the number of households as mentioned above. Thus one cannot say yet that it has the penetration rate of social infrastructure. Especially in Japan's 307 isolated islands, the broadband penetration rate was a low 35.2% as of March 2006 (Not the household coverage ratio. The number of islands served by broadband divided by 307.). To promote the move to broadband, survey research is being done on cost/benefit according to distance from the mainland, island surface area, etc. On isolated islands and other areas at the edge of the network, if the trunk line linking the region is damaged due to some problem, there is the danger of the entire region being cut off from the network. Robust functioning as a lifeline in all regions is an important requirement sought for the new generation network, but on the other hand one cannot ignore the perspectives of costs and enhancing the penetration rate. It seems an important issue will be low cost construction of robust systems which ensure backup circuits such as satellite communications and fixed wireless access (FWA), and will automatically switch over in an emergency.

- Dependability and advanced sensing and display technologies, to support remote services

  To utilize ICT for correcting disparities in public services, there is a need to develop network infrastructure everywhere, and at the same time make network functions more

advanced. It should exchange large volumes of information dependably without congestion (broadband, low lag, uninterrupted). This also requires development of new technologies which collect and transmit sensory information of the subject being contacted in remote areas for a realistic sensation without loss, i.e. high quality complex information such as the subject's hardness, surface roughness, sense of weight, heat and odor. Achieving these requires building sensory information sensing technology, and its network interface, coding, and advanced display technology. These are important requirements for the spread of remote medicine and a wide range of other remote services, i.e. remote education with a sense of presence.

- Safe and convenient authentication technology, real-time monitoring of transactions, and human interfaces that can be individually customized

  Ensuring safety is essential for promoting electronic finance and government. Internet banking is already steadily becoming more popular, but some question its safety, and many people are choosing to wait and see [3-7-12]. The new generation network will require safe and convenient authentication technology, anonymous communication technology, and technology for real-time monitoring of all transactions. It will also become important to have human interfaces customized to the individual's information processing ability, which even elderly people living in depopulated areas can easily operate. Building a system in the financial network which anybody can use safely and conveniently is an important issue.

- Technology for advanced computerization of local resources

  It is necessary to build a network for local residents to have more advanced utilization of information on local resources such as people, goods and money. Network technology is required which can widely share information on local resources, efficiently judge in what situation that information is sought, and detect the latest information. It is hoped this will help stimulate local industry, create employment and enhance quality of life.

- Broadband and ubiquitous technology which encourages telecommuting

  From the perspective of personal information protection, more companies are prohibiting people from taking internal hard disks outside. This is becoming a factor which hinders the popularity of telecommuting. Therefore thin client systems are recommended in which users carry only a terminal outside, and access a server via the network. If this becomes popular and there is frequent access to servers, then access delays will increase, leading to user stress and lower work efficiency. It seems that even more expansion of the broadband network will be sought. Ubiquity which enables high speed access to the network from places outside the home is also essential for the popularity of telecommuting. Also, telecommuting has been progressively introduced up to now for indirect work (non-manufacturing) employees, but if

technology is achieved for sensing of sensory information and for transmission of that information via the network with low delay, then it will also become possible to introduce telecommuting for direct work (manufacturing) employees, which is expected to further increase its popularity.

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3.8. Aging Society with Fewer Children and Requirements of the New-generation Network

3.8.1. Emerging Issues of Aging Society with Fewer Children

[Aging society with fewer children]

Japan's aging society with fewer children is rapidly progressing. Already one in five people is elderly (65 or older), and one in ten is very old (75 or older). According to "Population Projections for Japan" released by the National Institute of Population and Social Security Research, Japan's total population is projected to continue declining and reach 89,930,000 in 2055. In the year 2055, 40.5% (one per 2.5 people) are projected to be 65 or older, and the ratio of very old people (75 or older) that year will be 26.5% (one in four people). Births will also continue to decline, projected at 460,000 in 2055, with a projected young population (age 0 to 14) of 7,520,000 in 2055, less than half of today. In 2055, the productive population ages 15 to 64 will be 1.3 times the population age 65 or older. Even if we consider the productive population to be ages 15 to 69, it will only be 1.7 times the population age 70 or older. This ratio was 3.3 in 2005, so the active generation will bear an extremely heavy burden in the future. Average lifespans are also forecast to continue rising, with men expected to live 83.67 years in 2055, and women 90.34 years.

[Issues]

Here, we discuss issues arising due to the aging society with fewer children described above, considering their relationships with technologies to be developed later, by dividing them into the following three categories: (1) Individual, (2) Environment, and (3) Society. These three categories are actually closely linked, and it is important to understand the overall situation, but these are used to more easily discuss the outlook.

[Individual]

We start by discussing issues of the aging society from the perspective of individuals.

First, we raise health problems as an issue arising from the individual. Due to aging, the elderly themselves cannot avoid deterioration in their physical abilities, and there will also be a larger population with damaged sensory and recognition abilities due to brain related diseases. For example, while there will be longer average lifespans, severe problems are also forecast, such as over 100 million Alzheimer's disease patients by the year 2050 (one in 85 people) [3-8-1]. Also, health issues of such elderly individuals leads to a need for nursing, especially for the very old. Thus the growing nursing related burden on families is becoming even more prominent. The importance of preventing individual's health problems and nursing problems is pointed out, with the issue of creating health from a young age, and also promoting prevention of the need for nursing.

Also, reduced physical ability and environmental recognition ability that comes with aging makes it easier to create various traffic accidents, they can become especially serious burdens in disasters, and they are easily mistreated as socially vulnerable. Actually, the number of elderly traffic accidents

are continuing to grow as their driving opportunities increase. Elderly traffic accidents as a percentage of all traffic accidents are also growing. Half of deaths by fire are also people age 65 or older. The majority of victims of bank transfer fraud and blackmail are also elderly. Their consumer problems are also growing each year.

[Environment]

Next, as the environment surrounding the elderly, there is a serious nursing problem as described above. Difficulties of independent lives of the elderly themselves pressures families of the elderly with physically and also psychologically heavy burdens. Also, there is a trend towards elderly living alone, and there is an extremely large number of elderly who are “a worry”. It is important to achieve housing and living environments which are easy for their deteriorating physical abilities, a living environment without worry and loneliness, and moreover an environment in which their family can feel secure in having them live.

[Society]

On the other hand, it is important to maintain active lives with the health of elderly described above, along with elderly employment, and also social participation. With the decline in the young population, there is socially important significance for labor participation by the elderly to supply the labor force, and a need for diverse ways of living including lifetime employment. Lifetime learning and participation in the local community will help achieve full lives, while preventing elderly isolation and lonely deaths and elderly nursing ending in suicide, also leading to creating social capital in the local community.

[Fewer Children]

Next, we discuss fewer children. Along with the aging society, the labor population will decline, so it will be even more important to promote employment participation by the youth, women and elderly. On the other hand, the difficulty of combining employment with raising children and nursing is currently pointed out. Considering this situation, the “Japan which Supports Children and Families” priority strategy investigation council was established in February 2007 under the Birthrate-Declining Society Countermeasures Council. Thereafter, the “Work/Life Balance Charter” and “Action Guidelines for Promoting Work/Life Balance” were determined in the “Council for Government/Private Top Level Promotion of Work/Life Balance”. Also, the gap between people’s desires and reality for marriage and childbirth and child raising is being analyzed in the “Special Subcommittee on Population Structure Changes” in the Social Security Council of the Ministry of Health, Labour and Welfare. That raised the following issues: Regarding marriage, the economic foundations, and outlook and stability for employment and career; For childbirth, the degree of allocating time to both raising children and continued employment, and degree of gaining harmony between work and results; For the second and later children, the degree of sharing housework and child raising between spouses, and degree of insecurities concerning raising children.

3.8.2. Trend of Countermeasures for Issues of the Aging Society with Fewer Children

[Law]

The government has passed laws and budgets for both the aging society and fewer children. Details are in documents [3-8-2] and [3-8-3]. As an example of aging society countermeasures, The Basic Law on Measures for the Aging Society was enforced in 1995, and the Aging Society Measures Council was established in the Cabinet Office. This section does not focus on effective results of such measures, and instead focuses on an overview of trends in the roles of information and communications technology.

[Individual]

Firstly, as a trend in countermeasures for people around elderly individuals, there are “watchover services”. Also, some mobile phone service companies are providing location services which can detect and prevent wanderings of elderly. There is also steady development of healthcare technology to monitor the health status of elderly, and welfare engineering for partially supporting independent living. Robot technology is also steadily developing to support physical functions. Furthermore, there is increasingly active basic research globally on various brain-machine interfaces, i.e. directly using information from the brain to control actuators and give effective visual function to blind people. However, there are many issues which must be solved, such as safety problems of biological compatibility.

At the same time, a problem pointed out is elderly feelings about use of various devices, equipment, facilities, services, etc., and various initiatives are being taken concerning issues of so-called universal design. Also, large numbers of devices with interfaces of extremely simplified design are being sold, especially wired telephones and mobile phones which are network devices. This indicates strong effects and demand for universal design.

[Environment]

From the perspective of support by family and the environment, in addition to the watchover services mentioned above, several services are being provided by security companies. However, these have not yet developed advanced functions such as automatic detection and reporting for various kinds of elderly emergencies. In the general traffic system and social infrastructure, there is steady development of environments to reduce elderly physical burdens (buses without steps, escalators, etc.), but functions to detect and report unexpected and uncertain phenomena are totally insufficient.

[Society]

Also, regarding ICT utilization from the perspective of elderly participation in society and the labor force, one can say that prominent technology does not yet exist from this perspective. The importance of telecommuting is pointed out as a countermeasure for the aging society, and also as a

low birthrate countermeasure. The spread of the broadband environment is making good progress, but even first steps toward large reforms in society are unseen in the current situation, such as fundamental reform in ways of working, active elderly participation in employment, and elimination of overconcentration in Tokyo.

[Europe and U.S. Trends]

As a trend in information and communications R&D related to aging society with fewer children in the world, one example is “Independent Living” which is raised as “ICT Challenge 7” in Europe’s Seventh Framework Programme. The aging society is also recognized as an extremely important problem in Europe, with a focus on independent living and social inclusion of the elderly. This is also clearly recognized as a business opportunity for Europe’s information and communications industry. An example in the U.S. is the “Quality-of-Life Technology Center” launched by the National Science Foundation (NSF), with R&D being done from various aspects to maintain quality of life for the elderly and people with disabilities [3-8-4].

3.8.3. Proposed Approaches to Solving Issues of the Aging Society with Fewer Children

Considering the issues and categories discussed up to the previous section, one can arrange them into the following three approaches. These are:

(1) Issue solution approach focused on the *individual*

(2) Issue solution approach focused on the *environment*

(3) Issue solution approach focused on the *society*

(1) is an approach which supports individual abilities, for assisting in nursing, labor and social participation, compensating for declining abilities of the individual’s sensory-motor system. (2) is an approach which adds advanced functions to the individual’s surrounding environment, thereby ensuring safety and security, augmenting the individual’s abilities, and gaining safety and security for the family and region. (3) is an approach based on participation in society, which eliminates labor population shortages resulting from the aging society with fewer children, builds full lives by lifetime learning for people with longer lifespans, has coexistence of work and family to achieve work/life balance, participation in the local community, etc.

3.8.4. Impacts on Society of Solving Issues of the Aging Society with Fewer Children

[Individual]

Firstly, safe and pleasant lives for the elderly will be achieved by technology development from the perspective of the “individual”. For individuals, deterioration of various body functions due to aging is unavoidable. There is deterioration in sensory systems such as vision and hearing, motor systems including ingestion and excretion, indoor/outdoor mobility, memory and information

processing abilities, environment recognition abilities, etc. Compensating for deterioration of these sensory-motor systems and supporting independent living leads to individuals achieving full lives, and the important social contribution of elderly participation in employment to compensate for serious labor population shortages resulting from the aging society with fewer children.

[Environment]

These technologies which support the “individual” function in a network closely connected with the individual’s surrounding environment. Build an advanced network for the indoor environment in which the environment recognizes the situation including the elderly, providing certain levels of support as needed, substantially augmenting the elderly’s physical abilities and recognition abilities, or detect and report abnormalities occurring in the elderly himself or herself, and thereby secure peace of mind for the family around the elderly. This is also expected to reduce the burdens of nursing for the family, leading to the benefit of efficient acquisition of labor. Also, elderly living alone are increasing. Provide them with lives without insecurities, removing worries, with close communication to eliminate lonely feelings and prevent dementia, and a lifelong learning environment for a full daily life, even for elderly without family. It is also important to protect elderly from various crimes, and there are expectations that advanced network technology can contribute to this.

Also in the outdoor environment, link with information on the elderly’s surrounding environment, thereby providing safety and security by guidance and danger warnings when moving. There are expectations that an environment will be achieved which provides support for operations in various social systems according to the situation. There are expectations that substantial universal design will be built widely, in which the individual’s surrounding network coordinates with the network embedded in the environment in any situation, building to overcome barriers according to the place.

[Society]

Such a network between individuals and the environment spreads into social benefits in the form of elderly participation in society and labor. Active elderly participation in raising youth and in the local community works to stimulate communication between the elderly, and also stimulates communication between elderly and youth. It is also possible for the scope of participation of individuals to broaden from a network at the level of neighboring residents, to local government, city/town/village, prefecture, and further to a global scale. This will provide an environment to broadly and deeply experience diverse aspects of life such as health, hobbies and various studies. These are also expected to lead to achieving new forms of social capital which the community contains in its people, from youth through the elderly. One can also hope this will lead to achieving a sustainable society crossing cultural barriers onto a global scale.

3.8.5. Advanced Technologies in Japan for Approaches to Solving Issues of the Aging Society

with Fewer Children

Firstly, on the level of individual people, we will point out Japan's characteristics in various terminal technologies, led by mobile terminal technology, information appliances, game machines, etc. Embedded systems technologies and integration technologies to realize these products are some of Japan's advantages. It is necessary that this variety of terminal technology itself placed in the individual's surroundings gain functions to compensate for deterioration of sensory-motor systems of the elderly. These diverse terminals should be networked, and support individual's safety and living functions. Japan has also built up advanced technologies in more elemental devices and fundamental materials which support various systems and terminal devices. In diverse terminals, which will be widely distributed in individuals and the environment, there should be more opportunities for Japan from the aspect of material technologies.

Regarding robot technologies, in addition to so-called humanoid-form robots, diverse technologies are recently being created such as healing robots and robots which assist human muscles. There are hopes for creation of new forms of robot technologies in response to demanding pressures of the aging society with fewer children.

Moreover, from the perspective of terminals embedded in environmental systems, various sensor technologies and embedded system technologies are important where Japan can expect advantages. New software technologies should be developed, led by network functions, environment recognition and context analysis.

Development of broadband infrastructure is also fundamentally important; for example, the subscribers of fiber-to-the-home (FTTH) in Japan has been increasing, which is considered to be an advantage for Japan.

3.8.6. Technical Requirements of the New-generation Network for Solving Issues of the Aging Society with Fewer Children

[Individual and Environment]

Even more advanced terminal technologies embedded in the environment are required, including in the individual's surroundings and home, which support sensory-motor systems of the elderly, thereby contributing to independent living and labor participation by the elderly themselves, and moreover for safety and security of their family and the community around them. In response, first of all on the physical level, a situation is hypothesized in which people's physical information is obtained invasively or non-invasively, and controlled depending on the situation. Such a situation requires engineering in the microscopic world represented by biological principles and technology, and there are also expectations for network technology based on totally new principles.

Also, in order to assist the sensory-motor systems and recognition abilities of the elderly themselves, it is necessary to prepare the environment including terminal technology with even more

advanced environmental recognition abilities and context recognition abilities. This requires information achieving processing ability and information storage capacity in tiny volume with a tiny amount of power. It becomes even more important to perform overall system design and packaging considering various limits in elemental devices, that is, system design under network concepts. Especially for the elderly, it becomes important to have networks around individuals, technology for networks with the surrounding environment, and also network technology which adaptively controls the individual or environment. There are also expectations for development as environmental network technology which supports safety and security in the family and community, reporting abnormalities to the elderly themselves and to their family around them, connecting with other services, etc.

[Advanced Recognition]

It is thought that various new challenges will also arise for functions built on the network embedded in individuals and in the environment. It is necessary to achieve a system which abstractly recognizes difficult to forecast situations which change in various ways, and which safely provides functions matching those situations. In addition, there may be a different scope of support expected from technology corresponding to each information and desire of each individual elderly person, individual home and individual community. In this way, there will be a need to achieve network technology which can meet even more advanced and diverse demands.

Also, in effective utilization of networking with the environment, safe and secure movement is also achievable in the outdoor environment by preventing falls and danger warnings. There are expectations that this will prevent accidents. One can also expect functions in which the environment infers the sensory-motor abilities of the elderly, and provides universal design corresponding to that person’s individual abilities. A shared important factor is that these technologies secure people’s safety, thus fundamental network characteristics such as high reliability, high usability, low delay and security must be ensured.

[Society]

As described above, in addition to the network centered on the individual and the environment, it also becomes important to achieve functions as a social system. That is, employment of the elderly themselves is expected to bring benefits such as easing the active generation’s heavier labor burden due to the low birthrate, and achieving work/life balance for the active generation such as a balance between work and raising children. To that end, a network function is required which just eliminates insecurities in the home and work environment, and network technology is also sought which contributes to achieve rich lifestyles and lives through lifelong learning and participation in the local community.

Reference Documents:

[3-8-1] Ron Brookmeyer, Elizabeth Johnson, Kathryn Ziegler-Graham, and H. Michael Arrighi, "Forecasting the Global Burden of Alzheimer's Disease," Alzheimer's and Dementia 3.3 (2007): 186-191.

[3-8-2] Cabinet Office, White Paper on Aging Society
http://www8.cao.go.jp/kourei/whitepaper/index-w.html

[3-8-3] Cabinet Office, White Paper on Birthrate-Declining Society
http://www8.cao.go.jp/shoushi/whitepaper/index-w.html

[3-8-4] Quality of Life Technology Center
http://www.qolt.org/

3.9. International Economic Disparity and Requirements of the New-generation Network

3.9.1. Emerging Issues of International Economic Disparity

With the development of transportation and communication technologies, there is global movement of people, and all kinds of economic activities, distribution of information etc. In particulate, the spread of the internet in recent years has enabled real-time information exchange and information transmission anywhere in the world. This has led to a progressive transition in information and communications methods, from the model of one-way transmission of information held by the means of communication such as mass communications, towards a bidirectional model in which anyone can transmit information, and feedback is easily provided in response to that transmitted information.

Internet and various communications networks first developed rapidly in economically rich developed countries, due to restrictions such as ability to develop technology and bear costs. Countries and institutions which want to start connecting must connect their network to “trunks” and work to expand the network. Developed countries which own the trunks become the hubs, and the situation arises wherein information which can become a source of wealth concentrates in these countries. Thus developing countries fall behind in expanding their networks, leading to information disparity.

3.9.2. Trends in Countermeasures for International Economic Disparity Issues

The phone network and Internet are currently still at the expansion stage in developing countries. Raising examples often reported in African countries, costs of cable installation required for the spread of fixed telephony becomes a barrier, and there is very slow progress in expansion. In contrast, recent years have seen a rapid expansion of mobile telephony which can provide coverage for an area at lower infrastructure cost than for fixed telephony. Mobile phones have become the main telephony in many countries. Also, terminal prices are expensive for the local economic situation, resulting in situations where several neighbors share and use one terminal.

In this way, the importance of networks is also recognized in developing countries. One can say they are at the stage of starting installation and use matching each region’s situation, but there are still large gaps in connectivity to information compared to developed countries.

3.9.3. Proposed Approaches to Solving International Economic Disparity Issues

In order to eliminate such information disparities caused by differences in the economic situation, the new generation network must achieve networks and services that are affordable and easy to use for all. For an architecture which enables building an environment usable throughout the globe, the following three requirements must be met.

First, it must accommodate diverse networks and devices, to be able to meet the different demands of each region. It seems that network equipment which can provide a high throughput communications environment are being developed one after another, but such advanced equipment is expensive, and it seems unlikely that architecture required for introducing such equipment will spread everywhere. The same applies to architecture which assumes good characteristics of fiber and cable installations. Architecture is required which enables use of various equipment and cables corresponding to the economic and infrastructure situations of each region, not only new equipment.

Second, it must be easy to manage. Network maintenance work is important when there are more users and communications traffic, during failures, etc. However, specialized knowledge is currently required for network expansion and settings, to investigate and sort out causes during failures. etc. There is a need to achieve networks which can be easily maintained, with automated functions for management and settings and remote management functions, reducing their personnel costs and monetary costs of maintenance and management.

Third, there is a need to achieve simple devices that are easy to use, such as existing telephones and televisions. Today's user terminals such as PCs and multifunction mobile phones demand a certain level of information literacy to use freely, which is one cause of information disparity. It is necessary to achieve easily handled user terminals so they will be used widely everywhere. Especially in order to make the new generation network become the infrastructure for delivering any information, the appearance of such devices may become key, along with achieving a network to which the various devices for each use around us can connect to as is.

3.9.4. Impacts on Society of Solving International Economic Disparity Issues

Achieving a new generation network which takes an approach like in the previous paragraphs will make it possible to reduce information disparities between developed countries and developing countries caused by international economic disparities. The following social and economic effects can be expected.

[Global-scale networks]

Enable building networks using suitable equipment and physical media (fiber optics, metal cables, etc.) corresponding to the region's situation and demands. Also, maintenance and management will be easier, making a network which spreads throughout the world achievable. This will achieve an environment which anyone can connect to, and also enable reuse of legacy networks which stretch around each country of the world like the public phone network.

[Networks that are affordable and easy to use for all]

Achieve networks that anyone can use, by developing simple devices and services that are easy to use. Provide user devices which are easy to understand and easy to use, and by connecting those to the new generation network, one should be able to intuitively receive desired information from the network, and easily obtain desired services provided in the network, without requiring complex knowledge and know-how. Creating a situation where anyone can actively use the network may bring changes in the means of providing education and nursing, and methods of community and social participation.

[Relieving the information disparity]

Anyone will be able to become a transmitter of information, enabling transmission of information from developing countries at a level unseen in the network until today, thereby reducing the concentration of information in developed countries. Until now, the main flow of information was transmitted from economically rich and powerfully advantageous countries. But information transmission from different perspectives will become possible, which is expected to increase the diversity of information and enable investigation of matters based on multiple information sources, with progress in mutual understanding.

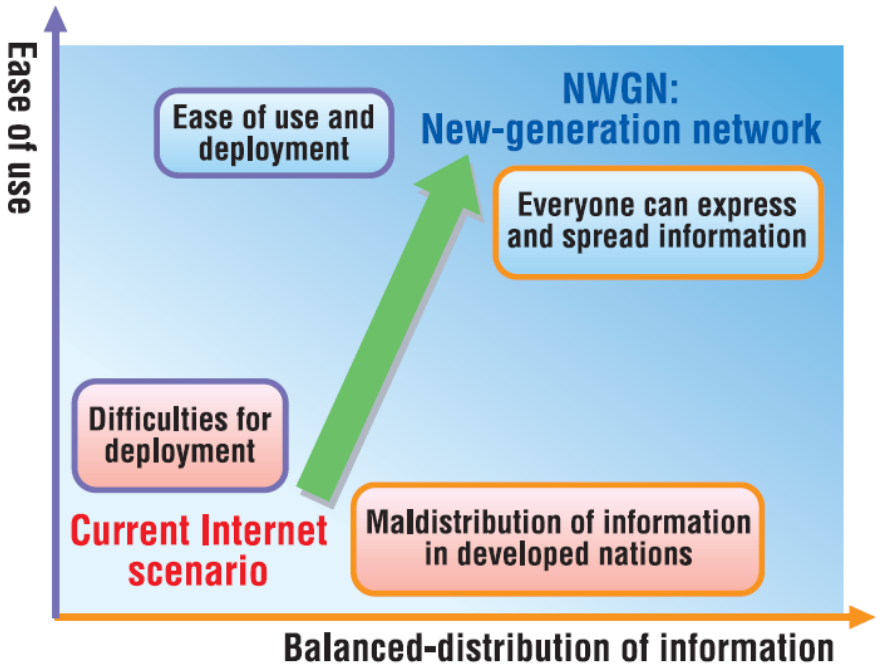

Figure 3.9.1 Direction of Evolution for the New Generation Network

3.9.5. Advanced Technologies in Japan for Approaches to Solving International Economic Disparity Issues

There are multiple advanced technologies in Japan for achieving this kind of new generation network which can contribute to correcting disparities.

[Network management/control technology]

In network management automation and remote management technology, Japan has commercialized technologies on various levels, from industry through home appliances. Japan has globally competitive manufacturing and sale of Internet routers, and of network nodes in the mobile phone network.

[Mobile terminal technology]

There are several excellent companies in Japan for miniaturization and advanced functions for phones. Japan especially leads the world in its abilities to achieve new functions in a form coordinated with the network. In Japan, there is a strong tendency to create unique specifications without standardizing technology, and develop advanced services only in Japan. Thus while Japan is facing a harsh situation in recent years in terms of market share and price competitiveness in global markets, it has advanced technology for advanced functions of services and terminals.

[Energy-saving technology]

Japan began working on environmental technologies early on, and it also has leading technologies in energy conservation. This network is expected to be used throughout the world, thus energy conservation in each device is essential. At the same time, considering that mobile terminals and sensor terminals using wireless technology will also connect to the new generation network, it is necessary to use energy conservation to give these terminals long usage times.

[Manufacturing and quality control technology]

Japan’s products generally maintain quality which is even called excessive, and have gained an international reputation for reliability. By using this quality control ability to provide high reliability, high quality products, and aiming at reducing exchanges and repairs, Japan can contribute to achieving a new generation network with reduced maintenance and management costs.

3.9.6. Technical Requirements of the New-generation Network for Solving International Economic Disparity Issues

In order to reduce information disparities resulting from international disparities, the following technology is needed in the new generation network.

First, there is a need for scalable architecture design that is compatible with a wide range of network sizes. A network must be achieved which accepts network equipment with various characteristics, making it possible to build and flexibly connect networks which match each country's situation. Also, equipment like Zeroconf with automatic settings and technology for autonomously configuring networks in a distributed manner is required in order to reduce network maintenance and management costs.

Also, it will not necessarily be used in places with stable electricity, thus network equipment and configurations that are available even in unstable and uncertain environments are required. For example, it is necessary to achieve network equipment which operates normally even if voltage is unstable or power supply fluctuations occur, and a network which can transfer information even when some equipment temporarily fails to operate, ensuring recoverable resending, rerouting, and redundancy.

3.10. Education and Requirements of the New-generation Network

3.10.1. Emerging Education Issues

Education issues have been discussed and investigated in a very wide range of fields. In the final report of the Education Rebuilding Council [3-10-1], education content reform, higher quality education, education system reform, and citizen participation by the whole society are recommended as educational rebuilding issues, and it shows the importance of rebuilding Japan's education in the 21st century. Also, in the Survey on Problems in Student Guidance such as Problematic Behavior of Child Students [3-10-2], major characteristics were (1) There were about 53,000 cases of violent conduct, the most in history at elementary, junior high and secondary school levels; (2) There were about 101,000 recognized cases of bullying, about 24,000 less than the previous fiscal year (about 125,000), but still a large number; (3) About 53,000 people do not attend secondary school (about 58,000 the previous fiscal year), with about 73,000 dropouts (77,000 the previous fiscal year), decreasing in recent years but still a large number; (4) As the situations of child students who committed suicide, there were 5 cases of "bullying problems" recorded (6 the previous fiscal year). This shows that violent conduct and bullying are still large problems. Moreover, in the Survey on Unofficial School Web Sites Used by Youth [3-10-3], there are about 38,000 unofficial school web sites (so-called "school underground sites") in Japan. Almost all (87.6%) are thread type unofficial school sites. Half of sites selected for the survey write abuse and slander, showing the need in schools for promoting information morals education and promoting awareness activities for children concerning harmful information.

This unofficial school site problem is thought strongly related to the wider popularity of children's mobile phones and popularity of PCs and broadband lines in general families. On the other hand, in the FY2007 Results of Survey on the State of IT Use for Education in Schools [3-10-4]: One educational use computer is available for each 7.0 students (the target is 1 PC per 3.6 people by March 2011); 62.5% of schools have LANs (target is about 100% by March 2011), which is growing at the same rate at the previous fiscal year; and 51.8% have very high speed internet (30Mbps or higher) (target is about 100% by march 2011), a large 16.8% jump from the previous fiscal year (35%). Viewed by prefecture, for example LAN availability in common classrooms ranges from 91.4% to 35.4%, with a slightly smaller gap than in the previous fiscal year (89.9% to 28.3%), but this shows that disparities are still seen. Moreover, in a questionnaire survey on ability of teachers to provide guidance on ICT utilization, an average 55.2% replied they have ability to utilize ICT during class and provide guidance. An average 57.8% replied they have ability to guide ICT utilization by child students. These are slightly lower ratios than for abilities to provide guidance on other topics. Viewed by school type (elementary, junior high and secondary schools), secondary schools had the highest results among the three school types in 10 out of 18 topics, while

junior high schools had the lowest results in 13 topics. Also, looking again by prefecture, for example the prefecture with the highest average had 80.6% replies that they have ability to utilize ICT during class and provide guidance, with the lowest prefecture at 45.9%, showing a large disparity between regions.

According to data from the Ministry of Internal Affairs and Communications, Statistics Bureau [3-10-5], there were 17,250,000 children as of April 1, 2008 (population under age 15), which was 130,000 less than the previous year. This was 13.5% of the total population, reaching its lowest point ever after a continual decrease over the 27 years since 1982. This progressively smaller young population and declining student age population creates a declining trend in the market size of the education business. On the other hand, the population of elderly (age 65 and up, estimate as of September 15, 2008) was 28,190,000, which was 22.1% of the total population. Compared to the previous year (27,430,000 at 21.5%), this grew by 760,000 (0.6%), as the elderly population and ratio are both the highest in history and continue growing. Post retirement learning activities of the elderly are in a growth trend, with interest in recurrent education for adults, and it seems large changes are occurring in the entire education business.

According to a National Media Educational Development Center report [3-10-6], utilizing ICT in higher educational institutions faces these issues: Lack staff for creating and maintaining system and contents (58.7%), teachers lack skills in education utilizing ICT (51.9%), lack know-how about system development for e-learning lectures (including classes) (43.9%), etc. Also, in another report [3-10-7], in higher education institutions of foreign countries, the following were given as factors inhibiting the spread of online education (issues): labor and hours of teaching team, lack of support staff, lack of incentives, support matching the university's characteristics, preparation of an organization which jointly develops and shares excellent contents, etc. Thus issues are lack of staff, enhanced content quality, and promotion of sharing/reuse.

3.10.2. Trends in Education Issue Countermeasures

The first report of the reorganized Education Rebuilding Council [3-10-8] raises the following specific issues which should be worked on: 1. Protect children from harmful information, 2. Support young parents and guardians in their raising children, 3. Implement "The 300000 International Students Action Plan" as a national strategy, 4. Radically review English language education, 5. Develop environment in a practical environment, 6. Make quick progress in school earthquake reinforcement.

Also, the IT Safety Council of the Cabinet Secretariat [3-10-9] has raised several specific items for promoting introduction of more filtering for mobile phones, and Focused Countermeasures Against Illegal and Harmful Information on the Internet. There were two items as investigations towards revising laws and ordinances: review of regulations on social networking sites (National

Police Agency), and review of laws and ordinances on junk emails (Ministry of Internal Affairs and Communications with the Ministry of Economy, Trade and Industry). These raised four policies for strengthening which form the “Countermeasures Against Illegal and Harmful Information on the Internet”: Support self-regulation by service provider etc., Solid education on information morals, Enhance places for providing consultation, and Promote introduction of filtering.

Moreover, as an initiative for fostering users, the Study Group on Responses to Illegal and Harmful Information on the Internet by the Ministry of Internal Affairs and Communications [3-10-10] raised the following items which should be promoted: Information morals education in homes, community and schools; Promotion of parental control; User awareness activities promotion by content businesses etc.; Build framework for cooperative promotion of initiatives to foster users; Perform survey which will become a basis for illegal and harmful information countermeasures, etc.

3.10.3. Proposed Approaches to Solving Education Issues

As outlined above, various issues are emerging in the education sector, but these are arranged here into three solution approaches below to which the New-generation network can contribute.

Approaches to solving issues:

(1) Network supports people

(2) Network mutual interaction with people

(3) Network takes the lead

(1) is an approach which tries to support learning activities of the individual (English language and lifelong) and education activities at school and home by more active ICT utilization: Provide learning materials matching the student’s characteristics, sharing of students’ collective intelligence and tacit knowledge, etc. (2) is an approach which tries to provide the original sense of “study”, by using ICT technology to build stronger ties between learning activities and real society. (3) is an approach in which the network itself provides adaptive controls for the distribution of content, and tries to take the lead in solving problems.

Combining these approaches will enable a full time learning environment in which anyone can learn anytime, anywhere, and enables the ICT field to act as a force for achieving a bright future society.

3.10.4. Impacts on Society of Solving Education Issues

First, focusing on the aspect of “Study and Compulsory Education for Minors”, study achieves support for understanding mutual links with real society, which is the original sense of “study”, not simply pushing knowledge into the heads of individuals. Use ICT to provide various forms of information linking all “happenings in the world” related to learning activities, and use the framework of Computer Supported Collaborative Learning (CSCL) to combine learning with some

kind of practice, providing a learning environment connected to “happenings in the world”. For example, it is thought very effective to provide a network edition extracurricular class by a famous person in a specialized field, or a service in which students can experience various jobs virtually in the network.

Also, aim to enhance the quality of education by using ICT to customize and provide diverse learning materials matching various individual characteristics of the student. Currently, the same learning materials are being used for all students. However, there are initiatives to advance learning by using multimedia textbooks and entertainment equipment to build interest, which provide content matching the student’s progress level and degree of understanding which can be called the learning profile. It is possible to provide content matching the individual’s situation, which is expected to enhance the student’s understanding, and also contribute to enhancing the quality of education.

Next, focusing on the aspect of “lifelong learning and recurrent education”, achieve advanced e-learning which fully utilizes ICT technology. In recent years, e-learning has begun to be used in various situations such as education in companies, English language study and lifelong learning. However, ICT is not being utilized sufficiently. Multimedia and customizability are benefits of digital learning materials. Create content which incorporates these benefits, and develop a full time learning environment using mobile terminals, not only in front of a PC. This will make it possible to provide “study” with more effective learning.

Moreover, a common perspective of both aspects is the use of ICT technology at the learning site to share the experience and know-how which each teacher has individually, as collective intelligence and tacit knowledge. Currently, teachers only accumulate knowledge implicitly and explicitly individually. But by using ICT technology to digitize, concentrate and share knowledge, it will be used as more beneficial information in many educational activities, and more problems at each site will be solved.

Also achieve a network environment in which the network itself adaptively controls the transmission of content. If the network itself can understand content while guaranteeing security and privacy, then more effective network controls and information filtering are possible, with adaptive control of distribution according to its content, showing warnings in transmissions of harmful content in networks for adults, shutting out harmful content in networks for children, etc.

Finally, the New-generation network will become a network which all people can ordinarily use, and there are expectations for results in study which fully utilizes ICT, certainly in children’s compulsory education and secondary school education, and also at sites of English language study and lifelong learning for adults. By achieving an environment in which anyone can receive education anytime, anywhere, all people can study in effective ways that suit them better, enabling them to obtain “study” in the true sense where they understand connections with real society.

3.10.5. Advanced Technologies in Japan for Approaches to Solving Education Issues

The high broadband penetration rate in Japan is a very advantageous point for achieving an environment in which anyone can receive education anytime, anywhere.

Also, for providing content matching each situation, Japan has advanced information media processing technology and advanced sensing technology.

Moreover, user interface related technology for network terminal development, and very high definition/ extremely realistic sensation technology and CG/ virtual reality technology in the entertainment field are also technologies with plenty of possibilities in educational applications.

3.10.6. Technical Requirements of the New-generation Network for Solving Education Issues

This section discusses technology requirements for the New-generation network required for implementing approaches towards solving education issues.

First, in achieving communication learning linked to “happenings in the world”, actual communication with real society is vital, and in services like receiving direct lessons from famous people of the “world”, real-time communication technology is required. In achieving services which enable virtual work experience, real CG composition technology is required.

Next, to achieve multimedia textbooks and digital learning materials, in order to link with various related information, there is a need for technology to digitize content which becomes learning materials, technology which obtains the student’s learning profile, technology which customizes and effectively provides learning material content which matches the profile, etc.

Moreover, to achieve a network which itself controls transmission of content, there is a need for technology which changes the network’s composition according to its use, and technology which understands the content transmitted by the network, while ensuring security and privacy.

Then, to achieve a full time learning environment enabling anyone to study anytime, anywhere, and for the ICT field to act as a force for achieving a bright future society, it is necessary that the New-generation network becomes a platform for a social system which all people can obviously use, and to prepare a mechanism which guarantees reliability of content, safely shares individual’s learning profiles, and provides education full time.

Considering the above, technology required for New-generation network is shown below:

- Real-time communication technology to truly feel connections with real society
- Network technology which guarantees reliability of content, and can obtain, use and share individual’s learning profiles
- Network virtualization technology which changes network quality to match the user, and controls information transmission
- Technology which digitizes know-how information which teachers have, and gains and shares the information as collective intelligence and tacit knowledge

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3.11. Cyber Security and Demands on the New Generation Network

3.11.1. Cyber Security Issues

"Cyber crime" refers to three types of crimes: Violations of the Unauthorized Computer Access Law, crimes against computers and electronic records, and network use crimes. According to the White Paper on Police 2008 (National Police Agency) [3-11-1], the number of cyber crime arrests is steadily increasing. 2007 saw 1048 more arrests (+23.7%) than the previous year, rising to 5473, the most ever. In particular, violations of the Unauthorized Computer Access Law resulted in 703 arrests in 2006, which more than doubled to 1442 in 2007, according to the White Paper on Police 2008 (National Police Agency) [3-11-1] and the 2008 WHITE PAPER Information and Communications in Japan (Ministry of Internal Affairs and Communications) [3-11-2].

Ten big threats to security are shown in the Information Security White Paper 2008 (Information-Technology Promotion Agency) [3-11-3]. For example, the paper shows No.1: Increasing threat of "induced type" attacks; No.2: Spread of attacks aimed at web sites; No.3: Constant information leaks; No.4: Skillfully targeted attacks; No.5: Legitimate sites which can no longer be trusted; etc. It reports progress in more advanced attacks, and progress in "invisibility".

Also, according to a 2007 report on information leak incidents (Japan Network Security Association) [3-11-4], 2007 saw a large increase in people whose information was leaked compared to 2006, at about 30,530,000 people (about 8 million more than the previous year). Resulting assumed total loss compensation also saw a large increase, surging past 2 trillion yen (note: this huge number largely resulted from two personal information leak incidents which leaked personal information of about 23,070,000 people). 15.4% of all leaks were via file sharing software "Web and Network", a decrease from the previous year's 22%, but this remains a large route for leaks, just below paper media.

On the other hand, another growing problem is cyber attacks which target vulnerabilities of the network infrastructure itself such as routing systems and servers. Famous examples of cyber attacks in recent years are: "BGP route hijack" which improperly induces traffic of addressees with specific prefixes by intentionally announcing improper Boarder Gateway Protocol (BGP) routing information; "DNS cache poisoning" which misuses the DNS server's cache function naming resolution requests by having it hold false information in order to reply with a false IP address; and "SQL Injection" which injects a malicious small script into the web server which the application did not anticipate, thereby improperly operating the database, etc. Although these cyber attacks are critical in leading to all personal information leaks, in the Situation of Reporting on Vulnerability Related Information (IPA and Japan Computer Emergency Response Team Coordination Center (JPCERT/CC)) in 2008 4th quarter (October to December) [3-11-5], it revealed that the cumulative total number of DNS cache poisoning vulnerabilities reported grew rapidly from 283 (September) to

792 (December). Also, in the Web Site Security Assessment: Trends Analysis Report 2008 (NRI Secure) [3-11-6], it was statistically shown that unauthorized access is possible in 41% of web sites, and of those, 22% are vulnerable to SQL injection attack. Also in the X-Force 2008 Trend & Risk Report (IBM Internet Security Services) [3-11-7], SQL injection and malicious URL poisoning were raised as large trends in 2008 cyber attacks.

Looking at awareness of individuals, the 2008 WHITE PAPER Information and Communications in Japan [3-11-2] showed that 60.2% of Internet users at the end of 2007 feel “It’s unclear how far I should take security countermeasures”. Also, for information and communications network use in the company, 61.6% voiced the opinion “It is difficult to establish security countermeasures” at the end of 2007, although this decreased by 8.1% since the end of 2006. As this shows, many users are taking security countermeasures by using security services and introducing security related software, but still doubt the sufficiency of their security countermeasures. Also, many companies think it is difficult to implement sufficient security countermeasures, and it is thought that security countermeasures currently being implemented are insufficient.

Comprehensively considering the security trends described above, this section establishes the following four items as emerging cyber security issues.

Issue 1: Interruptions in network infrastructure due to cyber attacks cause enormous economic and social losses

Issue 2: User losses are also growing - Virus infections, personal information leaks, etc.

Issue 3: Rapid increase in complexity of security settings and difficulty of proper settings

Issue 4: Difficult to immediately identify and defend against new types of cyber attacks

3.11.2. Trends in Cyber Security Issue Countermeasures

As countermeasures against cyber attacks, there is software installation by business and home users and server administrators: virus checkers, firewalls, spyware countermeasures, fishing countermeasures, etc. Countermeasures using security related services provided by ISPs are also being utilized.

Meanwhile, Telecom-ISAC Japan was launched as a non-profit group in July 2002, and the Japan Data Communications Association of Telecom-ISAC Japan [3-11-8] was established in February 2005. These are putting effort into the sharing and analysis of security information in the communications industry, and the spread of countermeasures technologies. More specifically, activities are proceeding in six working groups (WG): 1. Route Information Sharing-WG, 2. Traceback-WG, 3. ACCESS-WG, 4. CCC (Cyber Clean Center) Operations Promotion-WG, 5. SoNAR-WG, 6. T-CEPTOAR3-WG (Capability for Engineering of Protection, Technical Operation, Analysis and Response).

Also, as security related technologies, in addition to virus checking, firewall and spyware

countermeasures technologies, various security technologies are being actively researched by many institutions: Encryption technology, user authentication technology, device authentication technology, Intrusion Detection Systems (IDS) technology, Distributed Denial of Service (DDoS) attack countermeasures technology, traceback technology, trusted computing technology [3-11-9], network forensics technology, etc. [3-11-2].

3.11.3. Proposed Approaches to Solving Cyber Security Issues

When assuming the new generation network, it is generally difficult to specify measures to solve cyber security issues. That is because based on the fact that “There is no certainty is IT security”, cyber security countermeasures have a very strong tendency to be after the fact countermeasures, somehow repairing clear vulnerabilities in the network, or somehow protecting against attacks targeting those vulnerabilities. However, such an approach generally runs the risk of falling into the vicious circle of new vulnerabilities occurring due to the mechanism preventing vulnerabilities. In fact, measures against new types of malware created daily are huge physical and psychological burdens on security service providers and users.

Also, at the current stage where R&D on the new generation network has just begun, it is impossible to predict specific cyber attack methods 10 years in the future when the network is expected to be implemented. Thus as a solution approach, it is important to clarify security countermeasure functions which should be primitive.

Thus three approaches will be investigated in this section, as shown in Figure 3.11.1: (1) Cooperation between entities; (2) Dependable network design, assuming it contains vulnerabilities; (3) Automated security settings.

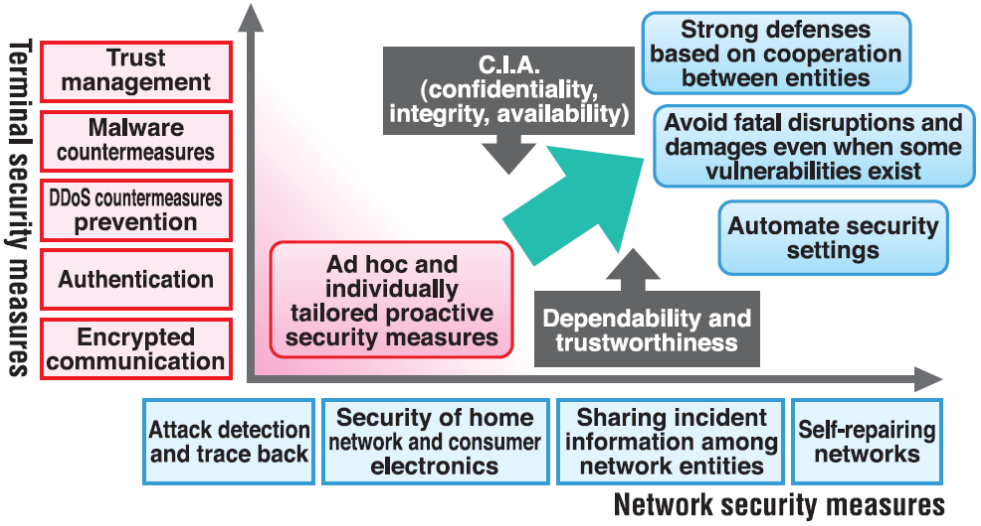

Figure 3.11.1 Approaches to Solving Cyber Security Issues in the New Generation Network

- Build strong defense by using coordination and cooperation between entities (network equipment, terminal, server). Prevent the spread of damage by quickly isolating attack sources

In order to minimize losses when cyber attacks occur, strong defense of the attack's target is required, along with rapid isolation of the attack source. Until now, specific incident response organizations such as Telecom-ISAC Japan and JP-CERT/CC have been coordinating incident information collection and security countermeasure activities, unconstrained by barriers between networks (ISPs). Countermeasures have also been implemented within specific networks, such as identification of attack sources, and tracking leaked data. But in the Internet, tracebacks on DoS attacks and tracing data must be done over wide areas, which is across networks. There are limits to countermeasures by a central authority organization, and limits to tracing within one network.

Thus the new generation network will take an approach of executing cooperative cyber attack countermeasures in real-time over the entire network including network equipment, end terminals and servers. This will minimize damage, and enable investigation of the attack's details in order to clarify afterwards the place with responsibility.

- Dependable network design which can avoid fatal failure and damage, even if it contains vulnerabilities

In IT systems which do advanced software processing, it is nearly impossible to maintain a 100% secure status and completely eliminate vulnerabilities. For example, the X-Force 2008 Trend & Risk Report (IBM Internet Security Services)[3-11-7] reported that at the end of 2008, 46% of vulnerabilities made clear in 2006 were still unpatched, along with 44% of vulnerabilities made clear in 2007. It was also reported that 7,406 new vulnerabilities were created in 2008, a record number. Moreover, new types of malware and cyber attack methods are being developed daily. Thus it is thought there is a limit to previous security countermeasures with ad-hoc individual responses. Therefore, the new generation network will take an approach in which assumes there are vulnerabilities in the IT system including network infrastructure. Its network design and network repair will be able to avoid fatal failure and loss such as the entire system going down, putting many users in danger, even if it suffers a cyber attack against its vulnerabilities. This will enable building a dependable and trustable network platform which can provide minimum functionality and reliability, even when failure occurs.

- Learn suitable security settings from the behavior history and damage situations of attacker and victims, and automate security settings of entities

To make the network into social infrastructure like electricity, gas and water, an environment must be built which can be used safely and securely without troubling the user. To do this, it must

provide a feeling of security that there are sufficient security countermeasures for online systems, servers and terminals, while reducing the management burden of individual users and system administrators. In security countermeasures for network equipment and information systems, considering the current situation with new attack methods and malware constantly appearing, it is impossible to constantly maintain the system in a secure state with static settings. It is possible to understand the latest security information, manually change settings, apply security patches, and download security definition files from the server. But it is quite possible that such countermeasures will face limits anyway, considering the larger scale and complexity of systems, growing diversity of terminal hardware and software, growing diversity of network environments, growing traffic volume, etc.

Thus the new generation network will take an approach introducing a mechanism which can automatically evaluate service requirements, and automatically change security settings and security countermeasure policies without inconsistencies. It will build a database including past damage situations and behavior histories of attackers and victims, and deduce effective rules from that as security countermeasures. By automating security settings for entities based on the deduced rules, management burdens on individual users and system administrators can be reduced.

3.11.4. Impacts on Society of Solving Cyber Security Issues

In the approach to solving issues described above is a process of dependable network construction assuming weaknesses. This will have the following social impacts.

- **Safe network**
  Highly reliable and trusted ICT infrastructure, by achieving quick defenses against cyber attacks
- **Safe network services**
  Minimize damage by immediately detecting and intercepting cyber attacks, malfunctions and operating mistakes
- **Protect privacy**
  While minimizing risks of personal information leaks, even if a leak occurs, quickly identify the location of the leaked information and delete it, thereby maximizing privacy protection
- **Coexistence of convenience and security**
  Ensure security as required, without loss of convenience

3.11.5. Advanced Technologies in Japan for Approaches to Solving Cyber Security Issues

Table 3.11.1 shows advanced technologies in fields related to countermeasures against cyber security issues.

Table 3.11.1 Japan's Advanced Technologies in Fields Related to Countermeasures for Cyber Security Issues

	Field	Advanced Technology in Japan
1	Encryption	Encryption of network data, etc.
2	Authentication	Biometric authentication: fingerprint authentication, vein authentication, etc.
3	Home electronics	Advanced functions in information appliances
4	Node	Node technology with advanced functions by hardware
5	Network	Broadband network deployment
6	Network	Large scale IP network operation management

3.11.6. Technologies Required in the New Generation Network for Solving Cyber Security Issues

- Cooperative defense technology to immediately detect and intercept cyber attacks

With security countermeasures within one ISP or by centralized authority coordination that have been pursued until now, there are limits to defenses against active cyber attacks across barriers between ISPs. Therefore, to achieve strong security countermeasures, there is a need for development of cooperative defense technology between entities (network equipment, terminals, servers, etc). Specifically, when an incident occurs, coordinate between ISPs and immediately share incident information, which will enable development of the following technologies. Namely, technology for multiple ISPs to cooperatively detect and intercept attacks, technology for terminals and servers which detected the latest malware to share malware information with other terminals and servers (via virus definition file provision servers, etc.), mutual authentication technology for secure path information exchange between network equipment and for secure message exchange between end terminals and servers, etc.

- Against attack sources, technology for attack interception which immediately detects attacks, issues warnings, and isolates attacks

When cyber attacks are executed via multiple networks, or many attack sources are broadly distributed like in a DDoS, it is not easy to identify the attack sources. Also, even if the attack sources can be identified, currently the only countermeasure is to have transmitted data of the attack sources forcibly filtered in access routers, and there is no method for interaction with the attack sources. Therefore, a series of primitive attack interception technologies is required, such as immediately identify distributed attack sources by traceback, then first give warnings requesting

halts to intentional and unintentional attacks, and if the attacks still do not stop, then isolate attack sources from the network. It is thought that cooperation and coordination between entities described above will also enable accurate identification of attack sources in other networks.

- Network self-repairing technology which can maintain minimum functionality and trustability, even when a cyber attack occurs

Cyber attacks targeting the core network and core server, such as BGP route hijack, DNS cache poisoning and SQL injection, create fatal failures and losses such as service halts and huge leaks of personal information. Therefore, one cannot say that the current network is able to maintain minimum functions and trustability. Thus there is first of all a need for improper entity access interception technology which uses coordination and cooperation between entities to immediately detect losses due to cyber attacks, and cooperatively intercept access to servers which contain false path information announcements and malicious programs. For entities which suffered damage, there is also a need to develop technology for self-detection of damages and technology for self-repair of damage.

- Network mechanism type information processing technology which can immediately search for, locate and delete leaked information

It is important to have system design and software design which do not leak personal information nor secret information, but if information does leak, later countermeasures which can minimize damage are also important. Thus there is a need for development of technology to immediately detect information leaks, search if there are copies of leaked information somewhere in the net, information tracking technology which can identify location, remote data processing technology which (immediately) deletes from the network all copies of leaked information located, data control technology with timeout functions which can also delete the leaked information from offline network equipment, etc. To trace the transmission route of leaked information across borders between networks, the cooperation and coordination between entities described above is required.

- Technology to automatically learn security settings, utilizing database technology

It has been difficult until now to grasp what kinds of incidents are occurring in the network, unless the user receives explicit alerts from virus countermeasure software or the firewall. In short, there are invisible threats, so it is difficult to have users learn security countermeasure methods for self-defense, and to maintain and enhance security awareness. Thus there is a need to develop security setting automatic learning technology and automatic settings technology, in which network side entities (gateway, access router, firewall, etc.) deduce security countermeasure rules from an integrated control database which collected behavior histories of attackers and victims and damage

situations, and learn suitable security settings, thereby automating security settings.

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4. Future Social Outlook and Demands on the New-generation Network

4.1. Cultural/Lifestyle Diversity and Demands on the New-generation Network

4.1.1. Expected Future Developments in Cultural/Lifestyle Diversity

Since people around the world are connected through networks, it has become possible for people of varied backgrounds to send information, exchange opinions and interact. Though this trend is already in process with the appearance of Internet, the Internet does not necessarily work in a positive direction due to differences in the languages used and basic standpoints (concepts and ideas).

Consequently, there is need for building a framework equipped with a mechanism that will exclude or reduce the events that hinder this interaction and which will provide support for exchanging views and establishing mutual understanding across cultural, social, racial, ethnic, and religious divides and offer various services based on this framework. There is also a need for providing a support for social participation and contributions by accommodating diverse skills arising from different physical abilities and handicaps, using the same framework.

4.1.2. Proposed Approaches for Cultural/Lifestyle Diversity

Language differences may be the largest barrier when people with different cultural backgrounds interact. Although the development of software for automatic translation between various languages is progressing, there is a need for further improvements in accuracy for practical use, such as mistranslation of informal writing such as colloquial language, lack of translated nuances from the original colloquial language even if the meaning is correct, etc. There are also advancements in development of voice recognition and voice synthesis technologies. These functions will be combined to achieve functions for real-time translation during video play or during two-way communications, and functions for automatically generating translation subtitles whereby one will be able to understand the text of an incomprehensible language, etc.

Digital data is mainly transmitted and received through the network. But hand operations (keyboard, mouse, buttons, touch panel) are mostly used for light (display) and sound (speakers). And these operations may be difficult for the elderly, persons with disabilities, etc. Therefore, there is a need to diversify these input-outputs in the New-generation network, for instance, give the network functions that can recognize and generate movements based on certain rules of sign language and gestures and eye movements, etc. and incorporate them in the above-mentioned frameworks to provide functions for assisting the lifestyles of people with disabilities.

With the progress of globalization in the present age, it has become very common for people speaking different languages to come in contact. Therefore, it is necessary to offer functions that can support cross-cultural exchanges wherever one goes. Also, it is also desirable to achieve a ubiquitous

network access on a global scale, in which the above-mentioned services in the network can be used from anywhere through small wireless equipment that can communicate at high speed, such as today's mobile phones. If we try to expand the processing or memory capacity of such portable equipment, it greatly affects the power consumption or size of the equipment. As such it is necessary to devise a framework, so-called cloud computing, that has a mechanism which relies on the network for processing capacity and memory.

4.1.3. Impacts on Society of Achieving Cultural/Lifestyle Diversity

The proposed approach can contribute towards achieving a world where people can live together with respect for diversity and whereby we can expect the following social and economic effects.

[Overcoming cultural barriers]

Previous burdens caused by different languages that hinder interaction between people of different cultural backgrounds will be eliminated by achieving a real-time automatic interpreting service through the combination of language translation technology and speech recognition/speech synthesis technology. This will enable smooth interaction through language translation even when one goes to a foreign country for travel, business, etc.

[Support for people with visual/auditory impairment]

Speech recognition and sign language recognition/synthesis technologies can help people with visual/auditory impairment to participate in society, using functions to convert information into the most easily assimilated form. These technologies remove physical obstructions for people with disabilities to participate in society. Since this support is provided by networks (machines) instead of by people, psychological resistance such as hesitance or restraint of people with disabilities to using support is removed. This provides a sense of security of always getting support, which can promote easier social participation.

[Support for geographical/cultural knowledge]

It will be possible to achieve a service that will collect knowledge characteristic to a region or culture, which is natural for people in that society, and provide varied information (maps, collective intelligence, tacit knowledge) to a person who is visiting that area for the first time. For example, it will be possible to provide information about social customs and tips, dangerous locations in terms of law and order, means for going to the next destination using public transport, etc. to people during travel. To give another example, when talking with people of different religious beliefs, this knowledge can be used to foster mutual respect and avoid unnecessary collision between people with different religious beliefs, as a person can have information required for a conversation or will know

about topics that need to be avoided in advance, such as common knowledge or taboos of a region.

[Global-scale ubiquitous networks]

To achieve this, it will be possible to connect to networks from any place and provide the necessary services and information at any time and place with the necessary quality and security. As a result, it will be possible to refer to and use network services such as automatic translation, speech recognition, collective intelligence databases, etc. whenever necessary. However, a current problem is the difficulty of achieving a network that is 100% accessible from any location, but this possibility is being pursued by taking advantage of cognitive radio technology and ubiquitous network technology.

Such services will establish communication by adapting a series of multistage services, for instance, “Speak in language A”→ (voice information in language A) → “Speech recognition technology of language A” → (Character information of language A) → “Translation from language A to language B” → (Character information of language B) → “Conversion into Braille information of language B”→ (Braille character information of language B) → “Reading language B Braille”. This linked series pattern varies according to the pairing of persons who are communicating and also varies by the communication direction (for example, B→ A direction in the previous example). To that end, it is necessary to provide a framework for finding if the necessary services are provided in the network, and use them in combination.

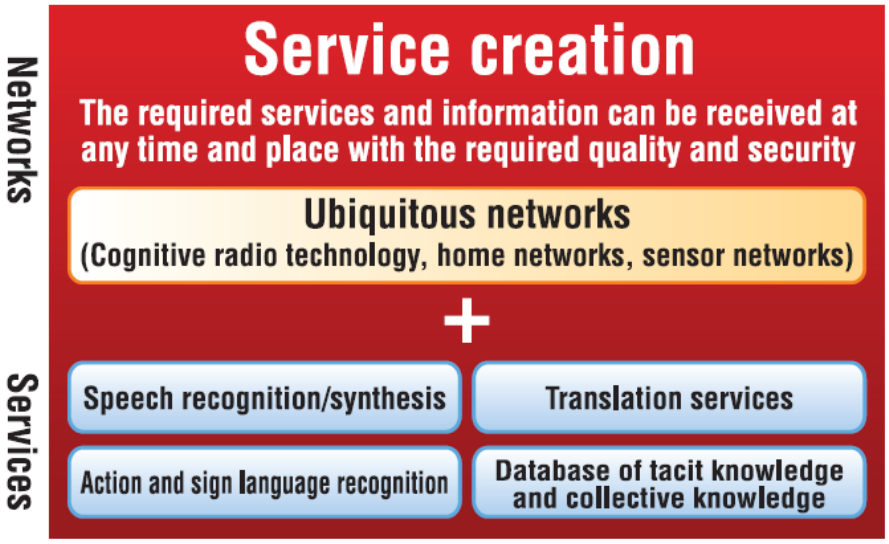

Fig. 4.1.1 Service Generating Technology Supporting Interaction that Across Cultural Barriers

4.1.4. Advanced Technologies in Japan for Approaches to Achieve Cultural/Lifestyle Diversity

There are several advanced technologies in Japan for achieving a New-generation network that can contribute to redressing such disparities.

[Natural language processing technology]

Much research is being carried out in the field of language translation technology. Similarly, research related to building language corpuses and language grids are also being pursued. And there has been a certain measure of practical application in computer software. There has also been progress in the research related to speech recognition technology, but difficulties remain in recognizing individual variations, dialects, etc. However, there are already commercial applications in computer software, car navigation operation, auto-answering systems of telephones, etc.

[Electronic media processing technology]

Research is proceeding in technologies for recognizing movements such as sign language, converting these movement patterns into characters, recognizing handwritten text from images and stroke order, etc. Especially the latter character recognition is being put to practical use even though there are limitations in character types and fonts, for instance in the input means of devices such as PDAs which use stroke order, in mail sorting devices that use images, as OCR software for PCs, etc.

[Energy-saving, highly reliable, and small device development technology]

For mobile terminals that use wireless technology, enabling long time use of the terminal by means of power saving is essential technology. Many Japanese companies are manufacturing and selling small devices such as small mobile phones and electronic dictionaries that require small electrical power and Japan is leading the world in this technology.

[Technology for the application and utilization of ubiquitous networks (sensors, RFID, etc.)]

Research on ubiquitous computing and ubiquitous network technology began early on in Japan. This technology has also been promoted as part of the national u-Japan strategy, and a lot of knowledge has been built up about this technology.

4.1.5. Technical Requirements of the New-generation Network for Achieving Cultural/Lifestyle Diversity

The following technologies are needed in the New-generation network to enable acceptance of cultural and lifestyle diversity.

First of all, distributed media processing technology and autonomous service creation technology

are necessary. A framework must be provided in which individual functions can be operated easily and at high speeds and the functions can be combined freely. In addition, the New-generation network must also have distribution technology for the information databases themselves necessary for recognition and translation, and data placement optimization and power saving access technology.

Moreover, technology that combines cognitive radio technology, sensor network technology and mesh/ad-hoc network technology and which automatically searches usable frequencies and establishes links with frequencies in the vicinity, is needed in the access network on the edge in order to achieve a ubiquitous network access environment. It is also essential to make power saving devices even if they conflict with the achievement of high connectivity.

4.2. Media Convergence and Requirements of the New-generation Network

4.2.1. Expected Future Developments in Media Convergence

From the very beginning, media has been used for transmitting information such as images, voice and text. Media that transmits information to an many unspecified receivers is also called mass media. Along with newspapers, television and radio that play powerful roles in reporting, magazines and the web also fall within the category of media. Following the spread of high-speed communication environments in general households, digitalization of broadcast content, and availability of cheap receivers in recent years, there has long been a clamor for communication and broadcasting convergence services typified by media convergence. Well-known examples are data broadcasting in 1seg already being used for broadcasting to portable terminals, image distribution using the Internet, etc. Consequently, media convergence is first of all being looked at from the aspect of services.

Looking at convergence services from the aspect of communication technology, in wired broadcasting using optical cables, there are services that transmit by multiplexing broadcasting and communication using Wavelength Division Multiplexing (WDM). Multimedia services using Internet, for instance, acTVila [4-2-1] and YouTube [4-2-2] are also well-known. Furthermore, services have already been started that enable transmission of a great number of the same content simultaneously using IP multicast technology and enable retransmission of IP of terrestrial digital broadcasting [4-2-3].

On the other hand, from the aspect of convergence services from the aspect of broadcasting technology, there are services that enable solving quizzes and answering questionnaires using the digitalization of broadcasting and two-way (interactive) functions. Besides these, there are services in which even if the transmitted content is the same, the display changes are personalized to suit the user demands for weather forecast or stock price information, etc., depending on the selection at the user presentation side.

However, there is currently no “convergence” service in the strictest sense of the word, i.e. there is no coordinated service that is a combination or simply replacement of various transmission media and has both merits of individual adaptability and instantaneous broadcasting. One of the reasons is that both communication and broadcasting technologies do not completely complement each other's advantages. It is thought that a “convergence” service in the true sense of the word will appear only after a universally wide instantaneous information transmission, which is the advantage of broadcasting, is ensured in communication, and adapting to individual demands, which is the advantage of communication, is achieved in broadcasting. That is, it is expected that a new service that cannot be sensed by each media alone will be created using the synergic effect of making the best use of and combining the features of each media to the fullest extent.

Next, if we turn our attention to the contents that are transmitted by the media, an environment in which not only the broadcasting station or communication common carrier, but any individual can easily create using higher performance PCs and the spread of digital equipment, is now in being put in place. Additionally, with the introduction of broadband in communication environments and the popularization of mobile phones, an individual can easily send information on his own as typified by blogs and SNS, etc. In web services, contents provided from multiple originators can be provided as completely new contents through various combinations by mash-up technology. There will be more and more increases in various information sent by individuals and communities connected with so-called highly public broadcasting contents, and it is hoped that new communication services will be created. Consequently, it is important to develop technology that will ensure the quality of the great volume of content, for instance, judge how much we can trust it, whether the information violates copyrights or privacy, is the information significant, etc. and create a platform to support easy information transmission by individuals and communities.

There is also a strong trend towards transmitting through communication media the articles and photo contents of the so-called paper media of newspapers and magazines, and there is increasing progress in new experimental media convergence such as transmission of more urgent news articles, and digitalization to transmit information matching individuals, transmission of information of advertisement media that includes several magazines, etc. That is, there will be even more emphasis on the quality of contents when true media convergence is actually achieved. It is expected that existing business models will change, new business models will appear, and there will be demand for creation of flexible media convergence services.

Furthermore, if we consider the legal definition, telecommunication means “sending, conveying or receiving codes, sound or images through wired, wireless or other electromagnetic methods (Telecommunications Business Act, Article 2, paragraph 1) [4-2-4]” and broadcasting means “Transmission of wireless communication that is intended to be received directly by the public (Broadcast Act, Article 2, paragraph 1) [4-2-5]”. In this sense, broadcasting can be said be a part of communication. But until now both have been handled under different legal systems [4-2-6] [4-2-7]. Convergence and coordination of communication and broadcasting are currently being addressed, and what should be the overall system of law for communication and broadcasting is being discussed by the Information and Communications Council since February 2008. The current “Vertically divided type” system of law of each service is being reviewed and the transmission facility rules, transmission service rules, contents rules, etc. are under examination to revise into an overall rational system of law [4-2-8]. This Council intends to put together a report by around December 2009 and submit a draft law in 2010. Moreover, the licensing of the rights of both differ even in the Copyright Act [4-2-9] and it is necessary to eliminate these differences in order to press forward with the convergence of communication and broadcasting. There have been efforts to eliminate the

differences between the two in the revisions of December 2006, wherein communication is handled in equal terms with broadcasting as along as it is resent simultaneously with broadcasting. Thus it is expected that the legal aspect of media convergence will be steadily addressed in the future as stated above.

4.2.2. Proposed Approaches to Realizing Media Convergence

If we consider the communication field, it is first of all necessary to achieve extensive and stable transmission, which is a feature of broadcasting. For that purpose, the network should be robust enough to never stop, and technology is needed that can always ensure bandwidth for providing stable video, enable communication irrespective of the location, and that can simultaneously transmit a large amount of the same content. It should also be possible to transmit large volume content or additional information, etc. that cannot be transmitted through broadcasting.

Next, if we consider the broadcasting field, it should be possible to select or change the content to adapt to the demands of the user, which is a feature of communication. For that purpose, not only must more diverse content be provided in broadcasts to expand the range of selection for the receiving side, but technology will also be needed that can combine contents transmitted by other transmission media and convert and present them as per the demands of the user. Of course, technology is also needed for high-definition and highly realistic video not possible in current broadcasting.

And, if we consider services, it will be important to provide new added value that cannot be obtained by individual media services. For that purpose, it is essential to develop services that will have currently unimaginable impacts, for instance transmitting information freely or be able to view desired content any place any time, see video that people could not seen previously, get feelings that could not be experienced, etc. Another important point to remember is the requirement for a system that is easy to understand and does not put any burdens on the user.

4.2.3. Impacts on Society of Media Convergence

With enhanced content, it will be possible to achieve services that present revolutionary sensations. User-adaptive-services that are enjoyable for all will be enabled wherein contents will be suitably converted and presented depending on the age or receiving abilities of the user, for instance, voice will be automatically played slowly in case of senior citizens or news will be automatically read out for visually impaired people, etc. Moreover, services that can impart high-definition and highly-realistic sensations that are completely different from the audio visual dimensions viewed until now will also be achieved. With the provision of such services, all people will be able to acquire more information with even more real sensations while sitting in the comfort of one’s home, and there will be even more possibility of transmitting contents using all five senses to the fullest,

not just sight and hearing.

On the other hand, by achieving networks in which the users do not have to be aware of the means of transmitting the contents (wireless communication, wired communication, broadcasting, etc.), the user will be able to enjoy services that provide new communication in a seamless environment in which the user can transmit and view content anytime anywhere in any conditions. New communication services will come into existence for sending information that people could not be troubled to send previously, enabling viewing various unimaginable information from among that, effectively using detailed information that cannot be used sufficiently today. To realize such new communication services, it is also important to develop systems which can be used for the community like in school education and local society, and which will enable the secondary use of content immediately.

Finally, by integrating both technologies, it will be possible to provide a public transmission and receiving environment that will recreate the atmosphere of a place and confer a sense of participation. By completing such an environment, a theater/stadium type public viewing service having realistic sensations and feeling of participation and which can be visualized by the user can be achieved. This kind of media convergence can be used for reviving family life by positioning it newly as a media which forms the center of a family, and it can be applied in school education for interactive classes between schools and experience classes, etc. Various services that will further enhance the feeling of participation will also be possible, for instance communication between like-minded users due to sharing of videos of athletic meets or soccer matches in the local community, etc.

The New-generation network offers a network platform for supporting media convergence as described above.

4.2.4. Advanced Technologies In Japan for Approaches to Achieve Media Convergence

Extensive popularization of broadband environments is the reason why the communications field has become very predominant as the platform for transmitting contents universally.

In the broadcasting field, technological R&D for ultra high definition and ultra realistic broadcasting is now at the forefront of the world [4-2-10] and can be said to have reached very close to realization.

Moreover, terrestrial digital TV and 1seg broadcasting are already in practical use, their operational results are being repeatedly proven, and they have technical advantages in terms of operation management. In addition, Japan can be said to have a sizeable edge in portable terminal technology that has helped in the rapid spread of compatible portable terminals.

4.2.5. Technical Requirements of the New-generation Network for Achieving Media Convergence

Technical requirements of the New-generation network necessary for embodying approaches for achieving media convergence are discussed in this section, especially from the standpoint of broadcasting and the user.

First of all, from the standpoint of broadcasting, “achieving a universally broad, high quality, highly reliable and stable low priced transmission from material transmission to primary and secondary distribution” and “enabling transmission of large volume contents (high-definition/ highly realistic video) not possible to transmit in current broadcasting” are essential requirements as a means of transmitting the broadcasting content. Moreover, it is necessary to achieve new media convergence services that will not just be a transmission means, but will be used as means for transmitting additional content. For example, it should be possible to “Provide rich services (beneficial related information, related video, etc.) that cannot be provided via broadcasting only”, and “Acquire social trends and viewer needs from sensing information from various sensors and reflect them in services”.

Next, from the user standpoint, the following services that have great impact may be enjoyed: “Services that allow viewing desired content any time, any place (TPO shift viewing)”, “Services that present suitable content depending on the condition of the user”, “Services that offer sensations that user has not experienced till now”, “Services that enable easy distribution and sharing of content within the scope of individuals and communities”, etc.

Considering the above, technical requirements for New-generation network are given below.

- Network technology where users do not have to be aware of the means of content transmission (wireless transmission, wired transmission, broadcasting, etc.)
- Communication 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

Reference documents:

[4-2-1] acTVila
http://actvila.jp

[4-2-2] YouTube
http://jp.youtube.com

[4-2-3] Hikari TV
http://www.hikaritv.net/

[4-2-4] Telecommunications Business Act
http://law.e-gov.go.jp/htmldata/S59/S59HO086.html

[4-2-5] Broadcast Act
http://law.e-gov.go.jp/htmldata/S25/S25HO132.html

[4-2-6] Ministry of Internal Affairs and Communications, “Guidelines for Classifying Communication and Broadcasting with regards to New Services in the Field Between Communications and Broadcasting Using Communication Satellites” (created December 1997, revised December 2001)
http://www.soumu.go.jp/s-news/2001/011226_1.html

[4-2-7] Law Concerning Broadcasts via Telecommunication Services
http://law.e-gov.go.jp/htmldata/H13/H13HO085.html

[4-2-8] Information and Communication Council, Agenda for investigation of the overall system of law for communication and broadcasting (December 2008)
http://www.soumu.go.jp/joho_tsusin/policyreports/joho_tsusin/houtai/pdf/081226_1.pdf

[4-2-9] Copyright Act
http://law.e-gov.go.jp/htmldata/S45/S45HO048.html

[4-2-10] NHK Science & Technology Research Laboratories
http://www.nhk.or.jp/strl/

4.3. Knowledge-Society and Requirements of the New-generation Network

4.3.1. Future Outlook for the Knowledge-society

[Shift in industries]

The rapid postwar economic growth was based on a core of efficient and uniform mass production, but with the rapid developments in information and communication technology in the latter half of the 20th century, the core of industry shifted from manufacturing to tertiary industries such as services. This is called a conversion from a society led by industry to an information society led by knowledge. Of course, this does not at all mean that the importance of manufacturing will disappear, but the central concept changed from uniform mass production to small but varied production.

Such a trend signifies that in various economic activities, the importance has shifted towards a knowledge-based sector, for instance in the mode of “from production to concept and design”, “new creation instead of following others”, “knowledge creation instead of simple work”, etc., and the move towards a so-called knowledge-society is growing stronger. Also, new phenomenon in which network technologies play essential roles are seen one after another as ways of, for instance, acquiring creativity and wisdom, as seen in crowd sourcing [4-3-1] and collective intelligence [4-3-2], etc.

Various direct and indirect issues are emerging in Japan in relation to this knowledge-society.

[Labor productivity]

One example is the problem of labor productivity. Labor productivity is very low in Japan, and the issue of making business processes more efficient is an urgent necessity, even prior to responding to the knowledge-society. Of course, to improve the business efficiency, procuring information technology resources on demand and without the need for huge investments is a very important requirement of information and communication technology for making a knowledge-society, as will pointed out later.

[Labor force]

Moreover, following the aging society with fewer children, it is essential to expand the working population and it is important for people to be involved in creative activities without prejudices of gender, age, region, etc.

[New modes of value creation]

There is a drastic and fundamental change in traditional values and ways of making profits following the progress in the knowledge-society, as observed in, for instance, the conflict between packaged software sales typified by Microsoft Corporation and free of charge information accumulation, analysis and provision services typified by Google, Inc. There is a strong trend towards opening of knowledge with open source software, etc. These current trends can also be

termed one of the middle phases on the road towards a knowledge-society, and the necessity of radical activities with an eye toward future expansion has risen even more.

4.3.2. Proposed Approaches to Achieving a Knowledge-society

Technology trends related to the knowledge-society can be observed in many ways in various aspects of information and communication technology.

[Tools]

The opportunity cost of collecting or sending information has gone down a great extent for individuals, as seen in the spread of broadband environments and trends of Internet technology like Web2.0, etc. Search services provided for instance by Google are not just simple keyword searches, but are continuously changing to highly-developed service provision functions based on interests and history of individuals. These services have been radically changing the ways of carrying out intellectual activities, and the scope of the intellectual activities of individuals into completely different modalities.

[Environment, Office]

Services that provide higher efficiency for management or business processes for enterprises or organizations, such as groupware and Enterprise Resource Planning (ERP), have been widely used. Furthermore, the resources that support such services, namely, hardware, software or services, have substantially moved outside of enterprises and organizations. In other words, as a consequence of the shift towards a knowledge-society, individuals and organizations are concentrating on expanding their core competencies, core business, or creative activities while placing peripheral or incidental processes outside, or obtaining them on-demand. This can also be paraphrased that the wave of virtualization has been progressing.

Meanwhile, the importance of information management has risen ever further in the knowledge-society. Security and privacy issues are more critical. Some enterprises, for instance, have started to use memory-less terminals so that critical information may not be stored in the peripheral machines. Also, since information is the lifeline for individuals, enterprises, and organizations, preservation of information and instant backup of information are becoming more important issues.

[Infrastructure]

In order to provide the advanced and complex services mentioned above, trustworthy computing and networking environments and infrastructures are essentially required. Data centers and databases are becoming increasingly large, and they are truly becoming the lifelines of many businesses and social activities. There is a strong software trend towards a direction in which very complex and functional or social scale problems can be handled computational manner.

In observing the above mentioned technological and social trends, the proposed approaches to achieving a knowledge-society have been divided into four sections: (1) Individual, (2) Organization or environment, (3) Society, and (4) Infrastructure. It should be also noted that it is difficult to consider these sections independently; the above four sections are classified for ease of discussion on the knowledge society and the New-generation network.

[Individual]

We first look at the aspect of creativity of individuals as a section of knowledge-society as seen from an individual. As an ultimate approach to enhancing the creativity of individuals, direct control of physical and cognitive abilities of individuals, such as brain or body, by network and information technology could be imagined. Besides such ultimate cases, various technological possibilities exist for improving creative activities of individuals, for instance by providing information based on his or her preferences. Specifically, various approaches can be examined for supporting creativity in diverse terminal environments around individuals, or for supporting individual creativity in an information explosion environment that includes a large amount of information in networks.

[Organization / Environment]

At an organization or environment level, it is also critical to stimulate creative activities of the organization. This can also be paraphrased that focusing on the core competency of organizations is of critical importance. To that end, in addition to supporting enhanced creativity of individuals in an organization, it is also important for an organization to obtain emergent creativity as an organization; this would be possible by networking between individuals and networking between individuals and organization, etc. Here, it is of course important to utilize and exploit the knowledge stored explicitly in digital form in an organization. Moreover, implicit knowledge that is latent in organizations is another important asset for improving the creativity of organizations. Also, with the globalization of scope of activities of an organization and changes in work force due to the aging society with fewer children, it has become important to develop creative environments where the barriers related to languages and generations are eliminated.

[Society]

Likewise, activities related to acquiring knowledge across organizations, as already seen from terms such as crowd-sourcing, collective intelligence, open innovation, etc., are being carried out to support creativity at the level of society. Various technological issues related to creativity on such societal and global scales will be considered in the future. For example, technological solutions to eliminate or minimize the barriers associated with languages and cultures should be considered. Also, we could think of conditions that are fundamentally different from the present which can be visualized for methods of intellectual property, economic principles, and money and finance.

[Infrastructure]

Information and communication infrastructure is of fundamental importance in the knowledge-society described above. It would become even more important to build further larger scale systems, achieve robustness, provide instant responses to users, for advanced management and operations, etc. Moreover, enhancement of such infrastructure is extremely important so that individuals and organizations may concentrate on their creative activities. In fact, the trend of virtualization, procuring hardware and software and even services on-demand, is spreading very rapidly. Technological developments in such a context are becoming important.

Meanwhile, a large amount of data is also present on the periphery of individuals and homes, such as end terminals of individuals and homes. Therefore, further insight should be considered on how such vast digital data located in the periphery provides emergent value from the view of the knowledge-society.

4.3.3. Impacts on Society of Achieving a Knowledge-society

[Individual]

Cultivating the creativity of individuals means to contribute to business processes in the knowledge-society, and to provide value creation. Also, from the viewpoints of changes in working population and the balance of work and life, supporting and enhancing creativity of individuals will also contribute to improve labor productivity as well as contribute towards fulfilling lives.

[Organization]

For organizations, it would be important to exploit synergy effects by networking between individuals, between individuals and organization, between individuals and environment, and between organizations in order to obtain competitive advantages in the knowledge-society.

Improving the efficiency of various business processes, such as in production, logistics, finance, or administration, is a fundamental issue even before the knowledge-society. In addition to such business process improvement, emergent values are expected by incorporating awareness or emotions of individuals in society and actions of each individual, by advanced networking of persons and organizations in a ubiquitous and ambient-assisted environment and networked society.

[Society]

From the perspective of society, new value could be created thanks to the interactions across different regions, generations, languages, and cultures. Crowd-sourcing is already spreading, but has not at all reached a level where it can completely cover the diverse societies and individuals. To get to that level, the information and communication environment will have to spread to practically all areas where it has not reached yet, both in terms of people and physical area.

4.3.4. Advanced Technologies in Japan for Approaches to Achieve a Knowledge-society

[Terminal technologies]

First, if we look around individuals, we can see that terminals such as mobile phones, consumer electronics, and game consoles have spread widely, and Japan's competitive edge in domains related to such information equipment can be seen clearly. Many domains have already merged into people's lives, and it is hoped that these domains will lead to enhanced creativity and productivity.

[Integration]

While low productivity has been indicated as an industrial problem for Japan, it has a competitive edge in so-called integral-type industries, in which fine-tuned or precise coordination between organizations and within organizations is required. There is a possibility that the ability for mutual coordination, such as so-called "suriawase", and tacit knowledge inherent in organizations are one of the unique and competitive strengths for Japan. At the same time, for information and communications technology, it is of course important to develop highly integrated technologies, but it is also very important to make standardized open interfaces. Therefore, it may be important to find the boundaries between integrated domains and open domains in the New-generation network.

[Broadband environments]

Wide spread of broadband environments can also be interpreted as provision of a part of the infrastructure for a knowledge-society, and one of Japan's advantages is that it has already implemented this.

4.3.5. Technological Requirements of the New-Generation Network for Achieving a Knowledge-society

[Individual]

We first discuss technologies with a focus on the individual. If we take an extreme interpretation that creativity is a resultant behavior of an individual's brain, the ultimate approach for creativity is to develop network technologies directly supporting the brain. As can be argued in the report from a study of the aging society with fewer children, deterioration of sensory-motor systems and cognitive systems with aging is inevitable, and technological assistance will be effective in the first place for participation in creative activities by senior citizens. Network technology that can provide us necessary or compensating functions depending on the ability inherent in individuals is under examination.

In the above discussion, each individual has been considered separately from the environment. However, an individual is actually inseparable from the culture in which he or she lives, various aspects of cultural heritage and restrictions, and also from his or her own physical characteristics, etc. It also means that various unique ideas, imagination, and versatile creativity are generated by the interactions between individuals and their surrounding environment in a broad sense. Different ideas

and imagination could emerge from individuals even when they are located in the same environment, thanks to their individual histories and individual sensibilities. It is hoped that functions for supporting creativity of individuals will be acquired from the advantageous effects of such an environment, from the accumulation of a person's experience, or from his or her learning, for example in the form of synchronization of databases of life logs. Of course, it is essential to ensure adequate security and privacy.

[Individual and environment]

As network technologies that support individuals' creativity, terminal technologies around individuals should be further improved. Networking between these terminals including interactions with environments in offices and public spaces would be required.

Furthermore, coordination functions would be expected where, for instance, even hidden knowledge will be exploited for communications. We could think of understanding and exploiting the implicit communications between individuals and organizations and between organizations, and non-verbal communications.

[Society]

It is hoped that an environment that crosses the boundaries of culture, language and generations will be built in preparation of a joint creation environment on a societal and global scale. It is believed that such a new way of creativity will bring about principles that are fundamentally different from the past, even for intellectual property and finance, etc. Power of imagination on a global scale will become very important. Consequently, it is important to conceptualize corresponding new technologies.

[Infrastructure]

For the knowledge-society described above, infrastructure is required that not only enables responding to information processing demands that continuously expand quantitatively, but also qualitatively supports new and more advanced functions which are demanded. Safety, security and robustness are of fundamental importance and form the basis of a knowledge-society. Meanwhile, in addition to the fact that massive data would be centralized at data centers, a great deal of data resources are also unevenly distributed in various terminals in the periphery of individuals and homes. It is hoped that the New-generation network that will handle such circumstances and environments will form the basis of the knowledge-society.

Reference documents:

[4-3-1] Jeff Howe, "Crowdsourcing: The Coming Big Bang of Business and How It Will Change Your World," Crown Pub, 2008.

[4-3-2] Pierre Levy, Robert Bononno, "Collective Intelligence: Mankind's Emerging World in Cyberspace," Basic Books, 1999.

4.4. Productivity Improvement and Requirements of the New-generation Network

4.4.1. Expected Future Developments in Productivity

- Background

[Current situation of productivity in Japan]

If we assume the productivity of United States to be 100, then the current productivity of Europe is 87 and that of Japan is 71 (as of 2005), and it has been pointed out that there has been very little growth in the rate of increase in productivity of service industries (1.52%) (1995-2005) as compared to manufacturing industries (4.10%) [4-4-1]. Here, service industries include electricity, gas, water supply, heat supply, commerce, finance, insurance, transportation, communication and other service industries. Until now Japan specialized in manufacturing and the manufacturing industry played the role of an engine pulling the industries in Japan forward. However, with the availability of cheap labor in developing countries and commoditization of products, it is forecast that manufacturing industry will rush into an even more severe environment. The aim is to achieve a post-manufacturing era, and improving the productivity of service industries is necessary for making this possible.

Japan has achieved economic development on the basis of its manufacturing industries, and it can be said that there have been no efforts in the service field until now. Even after the oil crisis and trade frictions and following the collapse of the speculation bubble, the manufacturing industry has maintained high competitive power and has supported Japan's industries. Though Japanese service industries are reputed for their high quality, they have fallen far behind internationally. This can be seen because of traditionally low awareness regarding services in Japan, a feeling that services should be free of charge, and a relatively low ranking of the service industries amongst students as compared to manufacturing industries.

Japan is a country with a high penetration of optical fiber that is rarely seen in the world, and at the same time it has an excellent reputation in the world for communication speed and types of services for cellular phones. However, some barriers can be seen for the use of ICT by Japanese companies [4-4-1]. One example is given below.

- Over 70% of all enterprises use software that is customized or order-made for each section.
- Software development related to work that is at the core of the company tends to be commissioned, and all other are procured package software.
- The percentage of order-made software in service industries, especially transport and wholesale and retail, is higher than in manufacturing industries.
- There is lack in maturity of developing common infrastructure for systems to send/receive orders in transactions between enterprises.
- In small and medium-sized enterprises, there is a shortage of human and material resources, transactions are done through telephone and fax, or barriers like refraining from

coordinating with customer's business systems, refraining from investment itself, etc.

Although the example given above is just one example, there is a lot of room for improvements in enterprise systems. There is a need for building an ICT system to support service industries that makes 100% use of the excellent ICT infrastructure of Japan, and there is a need for a system that can be used (shared) from one's system or and a need for software that can be shared. Specifically, further progress is hoped for in common infrastructure and horizontal distribution (including outsourcing) of business systems (services).

[Aging society with fewer children]

The population of the world is growing continuously and the population was estimated to be around 6.75 billion as of January 2009 [4-4-2] which was an increase of around 0.25 billion since 2006. However, as described in Section 3.8, the aging society with fewer children is rapidly advancing in Japan and it is forecast that 40.5%, i.e. 1 in every 2.5 persons will be age 65 or older in the year 2055. Moreover, in the same year the percentage of the very elderly will be 26.5%, i.e. in every 4 persons will be 75 years old or more. This trend of aging population with fewer children is also remarkable in Europe. The average life expectancy in Europe is currently 80 years, and there are reports that 25% of the EU population will be age 65 years older by the year 2020 [4-4-3].

Various problems occur in an aging society with fewer children, especially decrease in productivity following the reduction in working population due to the problem of declining population of children. Since the 1960s, there has been a steady decline in the productive age population in Japan, as a result of which the growth rate has also slowed down (Refer to [4-4-1]).

Table 4.4.1 Relation Between Total Population, Productive Age Population and Growth Rate in Japan

(unit: %)

	Changes in total population	Changes in productive age population	GDP growth rate
1960s	1.1	1.8	10.5
1970s	1.2	1.0	5.2
1980s	0.6	0.9	3.8
1990s	0.3	0.0	1.7
2000s	0.0	-0.5	1.9
2010s	-0.3	-1.0	-
2020s	-0.6	-0.8	-

It is now even more imperative to improve productivity in order to maintain the growth rate in the aging society with fewer children.

[Situation in the United States]

In the United States, service industries grew considerably in the 1990's and they became industries employing large numbers of people. As per a survey conducted by the Cabinet Office, the number of people employed in the tertiary industry in Japan increased by 4.81 million during the 1990s ~ 2000s, compared to an increase of 16.09 million in the United States. There is a pressing need to follow the United States and shift to tertiary industry centered on the service industry in order to deal with the fall in employment due to stagnation in manufacturing industries.

There have been various studies by various organizations to find out the reasons behind increase in productivity of service industries in United States. An overview is given below.

- Industries that use ICT saw greater improvements than ICT producing industries.
- There was a trend of high productivity in "ICT using countries" with more investment in ICT.
- Companies in the service sector that use ICT succeeded in drawing out the potential power of ICT by using ICT effectively.

Also, this enhanced U.S. service productivity, contributing to globalization. U.S. companies themselves initiated the flow of globalization by proceeding with aggressive overseas operations, and at the same time improved their earning power and productivity by positively promoting out-sourcing. It should be noted here that overseas dependence of US enterprises makes up a very small percentage of the total outsourcing, and the majority of the outsourcing is done to other companies in the United States. Overseas outsourcing is no more than about 1/20th of domestic outsourcing [4-4-4] [4-4-5].

- Prospective image of the future

A new industrial field based on the 2 axes of manufacturing industry and service industry will be created to sustain the future Japan, by building an ICT foundation to support service industries that make 100% use of the excellent ICT infrastructure of Japan, and initiating innovations in the services field and economic growth that will exceed the growth rate prior to the decline in population will be achieved.

- New service industries that will bring forth high productivity will be created, and a network system to support them will be constructed.
- Network functions, middleware and applications will become components, customization matching the service will be possible, and it will be possible to combine them on demand.
- Services will be provided to suit user needs, from elderly to children, large enterprises to

small and medium-sized enterprises, government and municipal offices to village government offices, etc., and a platform to support these services will be built.

- Especially in business systems, there are expectations for cost reduction through functional components and outsourcing of systems and services, employment through services stimulation.
- In the future, platforms that can be used as services will be built with convergence of information collected from sensors and knowledge information such as tacit knowing, etc.

4.4.2. Proposed Approaches to Achieving Productivity Improvements

- Definition and characteristics of services

Service is defined as “Providing only intangible functions and performance to the user”. Generally, “simultaneous” and “immediacy” are characteristics of services. Simultaneous implies that demand and supply must occur at the same time spatially as well as in time. Therefore, there is no concept of “stock” as in manufacturing industries. In other words, response to changes in demands must be handled on the supplier side. Moreover, “quality” which is an important index in manufacturing industry is invisible in “intangible” services. There are many elements that determine quality, and the change in needs depending on the person and time is also a characteristic [4-4-6].

The industry has been classified into 4 levels, large, medium, small and very small, by the Ministry of Internal Affairs and Communications. There are 19 categories in large, 97 in medium, 420 in small and 1269 in very small, and revisions are currently ongoing [4-4-7].

- Characteristics of service businesses

Service businesses have the following characteristics: “separation of ownership and use” providing only functions and performance without transferring proprietary rights of the media as seen in video rental services, “handling diversification” to satisfy various needs of users, and “service standardization” with the aim of reducing cost which is absolutely essential to providing diversified services [4-4-6].

- Service provision in manufacturing industries

It has been pointed out that American manufacturing industries that were defeated by Japanese manufacturing have revived with their success in service provision. A simple example of service provision in manufacturing industry is the aftercare service of sold products. GE is offering services wherein it is applying remote medical diagnostic systems to its own manufactured aircraft engines. Making the best use of skills and strong points of manufacturing to move into the service field is very typical.

America is proceeding with making components of each function of an enterprise. These

enterprises are concentrating on fields in which they excel, and are also providing these skills as services outside their own company. For non-core functions, the general style is for subcontracting by outsourcing or through BTO.

- Smile curve

If the upstream to downstream manufacturing processes (device components, product assembly, sales, after service) of personal computer production are put on the horizontal axis and profitability is put on the vertical axis, the graph is as shown in the figure below.

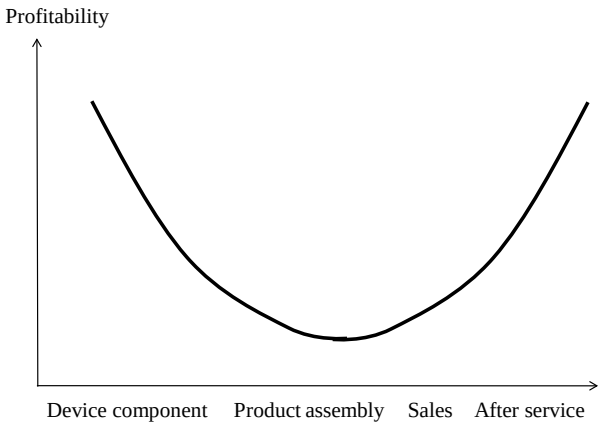

Fig 4.4.1 Relation Between Process and Profitability in PC Production

The graph is shaped like a smile and is therefore called a smile curve. This indicates profitability is high in device components such as CPUs and in after services, but low in product assembly.

Such a componentized service provision is seen in common manufacturing businesses, but smile curve will not be seen in the case of automotive and steel industries. The automotive industry especially requires know-how and skill to join together different parts so that all parts demonstrate performance as a whole, and thus it is very difficult to break down the manufacturing process into components. The assembly of parts that requires such advanced know-how and skill is called “Suriawase” which means interdependent.

- Necessity of service innovations

Service productivity is improved by promoting service innovations with due considerations to characteristics of the service business. In Japan, “innovation” was changed to “technical innovation” for the first time in the Economic White Paper in 1956, but it differed from the meaning proposed by the original economists. It was unavoidable at the time, but the overemphasis on manufacturing can be seen even here.

Although “innovation” is generally defined in each organization, it is defined as below for the

sake of simplicity.

- Innovations are ground-breaking products or services themselves or ground-breaking methods to produce those products and services that were not available in the past, and which enhance market value.

In accordance with the above definition, service innovation is defined as follows [4-4-8].

(1) Development of new service products that were not available in the market (Product innovation)
(2) Development of new methods not available till now to generate service products, or development of concrete practical methods for the site of service execution or delivery (Process innovation)
(3) Not just creating the concepts for above innovations, but actually converting them into market value

- Approach for achieving service innovations

[Basic approach]

As mentioned previously, there are 2 approaches to fulfill the conditions for a service business: (1) Rearrangement by adding/deleting in the value chain, and (2) Combining diversification and service standardization. The former involves adding new value to an established value chain, for example, development of a lease rental business in manufacturing. This is a simple downstream expansion approach.

The latter involves combining diversification based on user needs with using a standard component for improving the efficiency of the business. For example, chain operations typified by multiple convenience stores or family restaurants. Service standardization is achieved by having multiple stores, and providing products or services matching user needs while expanding the scale.

[Service innovation platform]

Limits are already visible in the simple downstream expansion or chain store operations of the basic approach described above. As such, mechanisms for creating new service value have become essential. These mechanisms are referred to here simply as the service innovation platform. In service innovation platform, functions are componentized to the utmost limit, and are rearranged and used according to the service in order to break through the limits of the basic approach. An image is shown below.

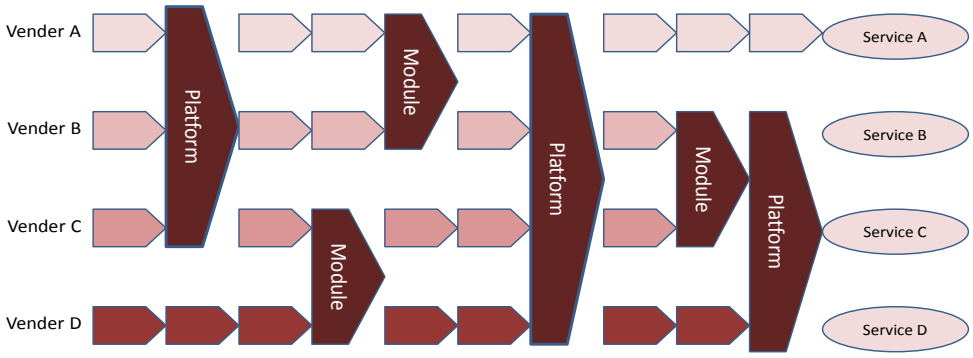

Fig 4.4.2 Image of Service Innovation Platform [4-4-6]

In service innovation platform, modularized services are promoted to combine diversification and service standardization. Service modularization is the policy of componentizing services or service processes that are used repeatedly, and standardizing services without sacrificing their diversity.

[Service innovation platform that takes into account a person's knowledge and situation]

The aim is to further develop the service innovation platform described above, and provide optimal services to users by making reference databases of human knowledge such as people's knowledge information (skills, know-how and tacit knowledge) as well as business information and psychology and engineering knowledge, and using these databases for visualization of the service.

Generally, the following steps are involved until a service is provided to the user.

- Measuring the status of the user "visualizing the current status"
- Finding the problem "Visualizing the problem"
- Service design "Visualizing the service concept"
- Proposal / delivery "Visualizing the user value and risks"

In visualization the service in each of the above steps, refining the service using people's knowledge will lead to differentiation in service.

4.4.3. Impacts on Society of Productivity Improvement

Improving the productivity of services is the first step for Japan to move away from the traditional industrialized society, and it should aim for a large platform to support the future knowledge-society. By bringing about innovations in the services field, Japan is creating new industrial fields to sustain the future Japan through the 2 axes of manufacturing industries which have been its traditional strength and service industries.

Examples of services using a service innovation platform are given below.

- Provide a network only for you

  Diversify / open the network functions and provide network services matched to an

individual's lifestyle on demand. For instance, enable the provision of personal mail address, storage and computer resources without depending on the ISPs.

- Achieve service innovation by building service visualization functions into the network

  Converting the network functions from "packet forwarding" to "service forwarding" and build into the network service visualizing functions for service status, finding problems in service provision, service design and service provision verification, etc., and reference databases for supporting these functions. Build a network platform that will provide sensor information flowing through the network, and also open/offer this information to service providers to bring about innovations.

4.4.4. Advanced Technologies in Japan for Approaches to Achieve Productivity Improvement

- Broadband network environment
- Electronic tag technologies like RFID
- Detailed service provision systems such as home delivery, convenience stores and video rentals
- User-driven network services such as i-mode (wireless Internet service in Japan) and ringtones (song/melody)

4.4.5. Technical Requirements of the New-generation Network for Productivity Improvement

- Service visualization technology that will enable visualization of service status and problems in the service provision process
- Reference database construction technology that can store business knowledge, human knowledge, engineering knowledge, etc.
- Service functions modularization technology for achieving service diversification
- Provision of tools for designing services

Reference Documents:

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4.5. Creation of New Value Circulation Infrastructure and Demands on the New-generation Network

There is no question about the importance of ICT technology in circulation and financial systems that support the economic society. POS systems are used widely in the retail trade such as supermarkets and convenience stores [4-5-1]. There is also a long history of development of online systems in the finance industry, and bank ATMs have become indispensable in our daily lives [4-5-2]. Recent advancements in ICT technology have resulted in a new flow of products and value such as net shopping, electronic money, etc. Trust in the central bank is at a peak since the collapse of the gold standard system, and though the flow of things and values has been established with paper printed matter such as cash, cheques, stamps, tickets, etc. as the root value, conventional beliefs are crumbling with the spread of electronic money and developments in computerization of value stamps such as stock certificates and airline tickets, etc., and it can be said that there are questions about new methods of value circulation. If we consider the flow of value that accompanies the actual movement of goods, flow of valuable information such as digitalized literary works and intellectual property on the network, flow of monetary value such as electronic money (money circulation), etc. as value circulation, then this chapter discusses the possibility of creating a future value circulation infrastructure using the New-generation network and the network requirements for achieving new functions.

4.5.1. Expected Future Developments in Value Circulation Infrastructure

Here, things that have monetary value or commercial value or information of value such as literary works are termed “value” and their entire flow is termed “circulation”. Monetary value and digitalized literary works can be circulated on the network. Although equivalent electronic transfer of commercial value goods by means of quantum teleportation or through advanced sensory communication etc. may be possible in the future, at present it is necessary to move goods using physical distribution systems. Moreover, although there are values that can be transmitted electronically via the network, owing to the issues of confidence in the network such as network security and the methods of payment or due to current commercial practices, there is considerable use of methods which transfer items printed on paper. It is hoped that economy will be stimulated by achieving a value circulation infrastructure that will increase the stability as well as user-friendliness of conventional circulation and financial systems. As a result of this, it is believed that not only will there be a reduction in problems of conventional circulation and financial systems, but due to new connections, such as between businesses (B to B), between businesses and individuals (B to C) and between individuals (C to C), it will lead to the creation of new ways of business. Examples of expected future developments in new value circulation infrastructure include stimulation of the

economy through a stable circulation and financial infrastructure, achievement of seamless global and local connections, safe and efficient circulation of literary works and intellectual property by means of the ICT technology, creation of value by means of construction of a flexible value chain, etc. The current state and the future developments of important items that support the value circulation infrastructure are given below.

[Financial information systems]

The use of networks and computers in the financial system has been progressing for many years (refer to Figure 4.5.1). At present, 3rd phase online systems are in operation in banks, and accounting systems have been integrated with the information systems [4-5-2, 4-5-3]. Moreover, the Bank of Japan Financial Network System (BOJ-NET) is the backbone of the settlement system, and it has been converted to the Real Time Gross Settlement (RTGS) system. Although the system is characterized by low risks and high stability owing to complete settlements instantly, it is necessary to keep a lot of liquid assets ready and there are issues regarding the effective use of assets. On the other hand, in the case of interbank transfer settlements, the Japanese Bankers Data Communication System is used, which is a Determined Time Net Settlement (DTNS) system in which netting (balancing) and settlement of differences is done at a determined time. Although large amounts of liquid assets are not needed in this system, there is a problem of big risks in case of default on the part of the netting parties. In Europe, the U.S., Singapore and Hong Kong, effective use of value and minimization of risks is being pursued by making hybrid systems of RTGS and DTNS and also implementing advanced queue processes [4-5-4]. This is a good example of the development of a financial information system in which there has been improvement in not only the processing capacity, but also effective use of value. Furthermore it shows that it can lead to the reformation of an economic structure. However, the core of the current settlement system is either central bank deposits or cash (this is indicates finality) and therefore it can be said that it is founded on the confidence in the central bank. In short, the network technologies only have a role of calculating the balance of accounts of each other, and transmitting the status of the transaction, and in most of the cases the means of settlement do not have the essential finality. Contrary to this, there can be a finality in settlement without going through central bank in case of cash. Therefore, it is hoped that a settlement infrastructure that has finality similar to that of the electronic money technology mentioned above and cash and has the combination of high flexibility and high reliability will be achieved in the New-generation network

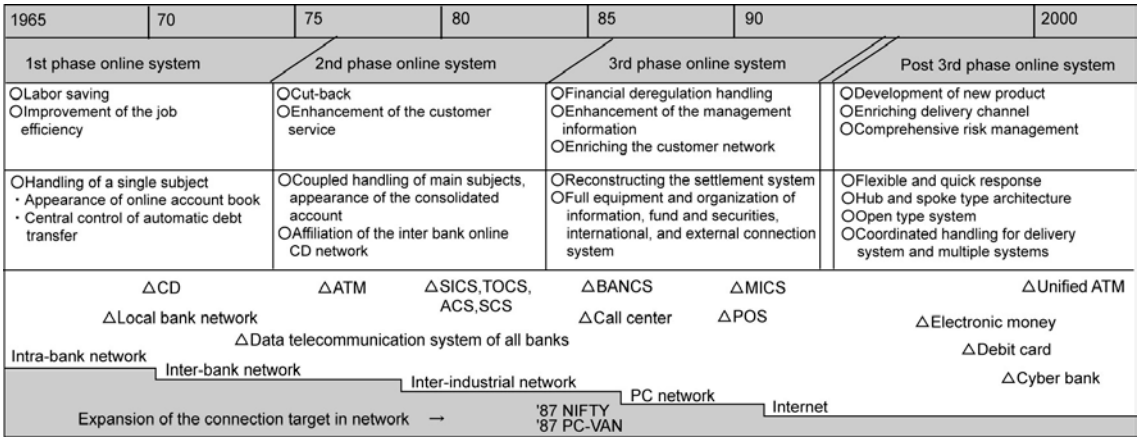

Figure 4.5.1 Development of Online Banking Systems Exhibit: [4-5-2]

[Electronic money]

We are using money as the medium for circulation and accumulation of value. Money has the mandatory circulating power, and its circulation is guaranteed based on the credit strength of the Central bank. The exchange of money is a means of settlement with finality. On the other hand, electronic money has started emerging in recent years as a means that can replace some functions of currency. The reasons are: it can have special privileges attached to it such as gaining points at the time of usage, its use enables smooth settlement, and there is no need to provide small change. In the current situation, effects of electronic money can be provided only by contract between the issuer and user. Though it cannot be denied that in the current situation its credit strengthen is weaker than currency and its scope of use is also limited, it is thought that in the future it will replace more and more areas of money by combining the developments of various functions and business models that make use of electronic media [4-5-5].

[Circulation and payment]

In the past generally products and services were offered in shops in exchange of money or credit cards. However now due to the popularization of net-shopping, payment is commonly done by bank transfer, credit cards, cash on delivery (COD) or convenience store receiving agent (convenience store reception). The Working Group on Settlements of the Financial Services Agency actively discussed electronic money, point systems, cash on delivery, and how to do convenience store reception. In order to stabilize the settlement system, institutions other than banks (deposit handling financial institutions) are in principle prohibited from carrying out currency exchange transactions. However, COD and convenience store reception are widely executed by transporting agents and retailers. The idea is that convenience store reception is especially suitable for currency exchange business, and discussions are proceeding from the perspectives of deregulation and safety of the settlement system. [4-5-6].

In B to B transactions, various systems have been developed to solve timing issues related to the flow of value. A typical example is the letter of credit (LC). It is a widely used method when transporting goods by sea to remote places. With an LC, even while the products are being transported by sea, their value can be used for new business activities. Transactions are carried out based on the bill of lading (B/L), and the bank converts the freight value into cash or other convertible item. In LC transactions, instead of checking the cargo itself, the importer and exporter must obtain credit from their respective banks. This is because the exchange of product value with highly convertible value is carried out via credit relationships between banks and traders. LC transactions have the problems of the necessity to obtain credit, high barriers to entry, and the risk that the transaction is not carried out. However, if and monetary value and information on value such as freight are properly and safely exchanged by network technology, then construction of new business models and new entry of small and medium sized companies can be promoted. Further, development of an all inclusive value circulation infrastructure is expected in which there are no distinctions between B to B, B to C and C to C transactions.

4.5.2. Proposed Approaches to Achieving New Value Circulation Infrastructure

As described above, we have not yet achieved the true meaning of electronic money, but there is a possibility of developing a system that can guarantee sufficient credit strength for electronic money and as a result, many money functions can be substituted if this system has circulation. Needless to say, it is important for everyone to trust electronic money, and for it have an excellent interface, terminals, communication means and operation system that guarantee easy use. Moreover, a highly computerized distribution and payment infrastructure is indispensable for safely and smoothly circulating value. To achieve this, the following approaches are contemplated.

1) **Certain transfer/exchange of value by network technology:** In the payment system in which current network is used, data flowing through the network does not have finality by only sending messages instructing to send or transfer money. Regarding this, cash sending/receiving or similar exchanges can be electronically achieved by using network technology to ensure that there is no data duplication during the transfer, and to confirm that the other party received the money. With the achievement of having technology to reliably transfer/exchange the value of monetary value applied to high volume data transmissions, it may become possible to safely use the network to deal in high value intellectual property right protected literary works, software, etc.
2) **Achieve physical, combined credit-worthiness that competes with paper currency:** This aims at not only improving security by existing encryption technology, but also at the multifaceted credit-worthiness as is held by paper money. To enhance combined credit-

worthiness, a possible method is to record information such as credit-worthiness of passed nodes by stamping standard electric wave signals at the time of node passage by combining multiple transfer media.

3) **Computerization of distribution and settlements, and establishment of close links:** Smooth exchange of monetary value and commercial value will be achieved by further progress in the computerization of physical distribution systems and settlement systems, along with linking them closely. To be specific, achieve a system which will go beyond the difference in the time required for the exchange and the difference in the value characteristics, and enable effective use of value and minimize the risks, in value exchange that links distribution of goods and money flow such as LC transactions mentioned above.

4) **Setting priority according to the weight of the value of data, and measurement of values that exist in the network:** Aim to optimize cost-effectiveness by setting priority according to the weight of value of electronic money data or valuable information. In addition, aim to stabilize the value circulation system by measuring the value that exists in the network. This is an important factor for commercial transactions which compete to minimize delays in data transmission. Recently, an optical submarine cable was laid between Russia and Japan with the aim of low delay transmissions between Europe and Japan. Transmission delay of 200 milliseconds has been achieved, which is 30 percent less that the existing Indian Ocean route (300 milliseconds) and North American routes (260 milliseconds) [4-5-7].

5) **Advanced coexistence of sharing and protection of information:** In efficient value chain construction, besides a smooth flow of things and money, the information sharing between the value chain participants is also important. On the other hand, the protection of each participant’s strategic information is indispensable to achieve an open value chain in a market crowded with many competitors. This will satisfy conflicting demands.

At present, the finality of settlement depends on confidence in the central bank in each country. However, not only has importance of international trade obviously risen in the modern economic era of expanding globalization, but there have been progressive innovations in international settlement systems like CLS (Continuous Linked Settlement) banking [4-5-4]. Achievement of an international value circulation infrastructure that enables trading with foreign countries at the same cost as domestic transactions is essential for achieving seamless global and local connections. Provision of information in English is one of the important factors in transactions with foreign countries. While it is believed within Japan that ability to speak English is important for internationalization, foreign countries are seeking for the provision of document information within Japan in English [4-5-8]. It is thought that systems that automatically translate information necessary for transactions will contribute to reinforcing international competitive strengths of Japan.

4.5.3. Impacts on Society of New Value Circulation Infrastructure

Value circulation systems are infrastructures since ancient times that characterize the ways of a society. Its efficiency, stability and reliability are important points for maintaining its safety and security. Moreover, a new value circulation system refers to new ways of doing business and of creating connections between individuals, and between individuals and society. Below, new value circulation infrastructure is broadly divided into 2 components: “Maximization of convenience and minimization of risk” which is a basic function required in value infrastructure, and “Participation of all, grass-roots circulation” which leads to new business models. The impacts of the new value circulation infrastructure on the society are discussed here.

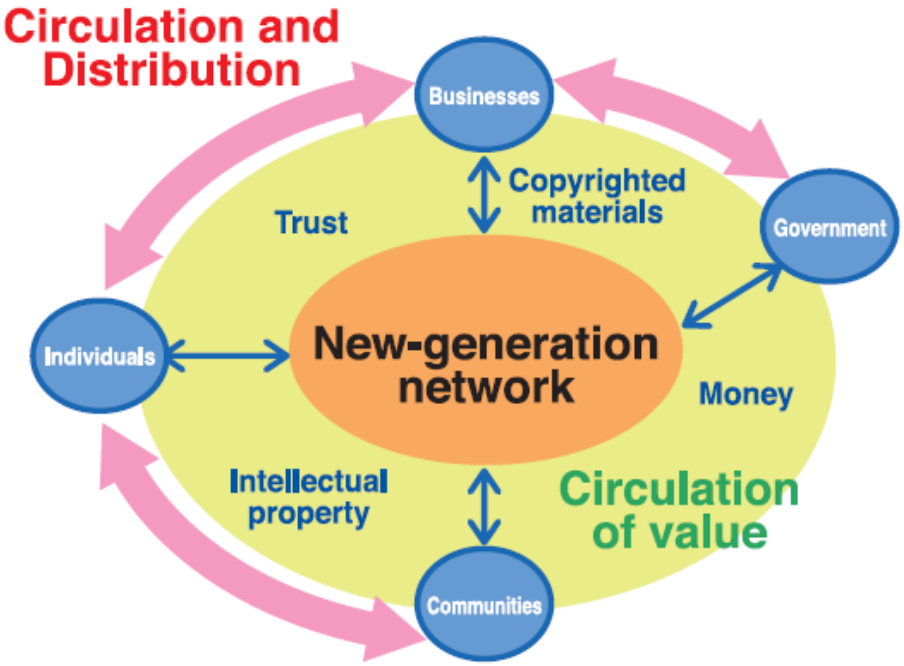

Diagram 4.5.2 Value Circulation Infrastructure by New-generation Network

[Maximization of convenience and minimization of risk]

Though some risks are unavoidable in transactions between individuals and enterprises, various systems have been constructed until now to minimize these risks. Similarly, achieving smooth transactions by improving user-friendliness is also extremely important. It is commonly believed that there is a trade-off relation between maximization of convenience and minimization of risks, and if a balance is struck between those by means of the New-generation network technology, it will have a great impact on the society. For instance, if electronic money is seen as informationalized money, the risk of it being used by a stranger if lost can be minimized by maintaining private information within the electronic money, and money can be kept more safely. In addition, cost-effective strong safety can be maintained by the network itself handling the data according to the data value transmitted,

and assurance of certain transactions, quality and value can be expected by combining the flow of monetary value with the flow of value that arises from distribution. On the other hand, electronic monetary value can be said to have higher convenience as compared to conventional money, as it can be transferred through the network. This has been partially achieved in internet shopping, etc., but if it becomes possible to make payments daily and globally through electronic money at all levels, it is believed that there will be increased variation in the parties that exchange values, and circulation will become more active. More improvements can also be expected in convenience due to new functions that were not available in conventional money. It will be possible to provide services custom-made to suit individual circumstances by referring to an individual's product purchase history or medical treatment, education, government and other services utilization history. In addition, money can easily be given filtering functions that depend on the attributes of the user, i.e. age, address, sex, etc. There are hopes that services will be provided smoothly according to product attributes, such as restrictions on cigarettes or liquor purchases, receiving refunds and taxes, etc. If only that information which is necessary for improving convenience is provided without reducing the benefits to the user, and if the information that is to be protected is easily protected, it will lead to building an open and effective value chain. There is a possibility of providing interest-bearing currency that is strong against inflation by adding points to the electronic money, which is an element that could influence currency policy. Moreover, it is hoped that further computerization of distribution will lead to innovations in the distribution system as well as achievement of new functions and reduction in distribution costs. It is also expected that the currently hesitant exchange of various content in the network from the viewpoint of protection of intellectual property will expand rapidly when it is possible to reliably forward and exchange data that has value other than money, for instance literary works.

Though unrelated to value distribution, if the values of data distributed on the network can be recognized, suitable charges can be applied based on that information, and it will be possible to build very fair beneficiary charge schemes which it is hoped will lead to continuous development of the network.

[Grass roots distribution where everyone can participate]

Present distribution and financial systems are subdivided according to their scale and purpose. They are almost always accompanied by some kind of credit provision and receipt, and credit must be obtained from trading counterparties in order to participate. Even in case of net auctions where everyone can participate freely, the situation is the same as in conventional systems when it comes to the necessity of trust, and the past transaction history is checked. As against this, it will be possible to monitor and evaluate the value held by the participant more accurately by closely linking the physical distribution system with the payment system, and achieve a value circulation system in

which new participants can enter easily without any distinction between B to B, B to C, and C to C, by using evaluated value effectively irrespective of past results. This can enable a shift from a tiered/ subdivided conventional system to an autonomous any-size circulation/financial system, in which small and medium-sized enterprises and individuals can participate easily, and has enabled each enterprise and individual to efficiently create added value and send them wherever necessary. This will lead to an improvement in the productivity and creativity of the society. Moreover, the exchange of intellectual value between enterprises and various people in various forms will expand with the establishment of a new value circulation mechanism, and it is expected to become important infrastructure for supporting the knowledge-society.

On the other hand, achievement of value circulation that matches local and individual circumstances is also important. Issuance of local currency will become easy by means of the new value circulation mechanism, and there is a possibility that it will play a part in the improvement of liquidity of currency and in construction of local money flow which is buffered to some degree from changes in the global economic situation, and thereby contribute to stimulation and stabilization of the local economy. Electronic money can also play the role of lowering physical hurdles. It can minimize troublesome time required such as PIN number input during payment and calculating change, people will be saved from the trouble of managing things and money, and people will be freed from having to carry or keep ready small change or paper money. These features indicate the possibility of providing a means of settlement that will not be strongly aware of individual circumstances, age differences, regional differences, handicaps, etc.

4.5.4. Advanced Technologies in Japan for Approaches to Achieving New Value Circulation Infrastructure

For advanced technologies in Japan related to electronic money, there are RFID technology and near-field technology. RFID technology and near-field technology are in widespread use in Japan in electronic money, boarding cards, employee ID cards and security lock authentication. Japanese technologies have also been adopted overseas such as in Hong Kong, and highly reliable systems are operating. There are many powerful vendors of financial information systems in Japan, and they have proven results in building systems from the dawn of mainframe computer systems until today. Distribution and stock control in manufacturing, typified by just-in-time systems and factory automation technology including advanced conveyor systems are important elements of technology that controls the flow of things. Moreover, sensing technologies and access network technologies are believed to be useful in monitoring and evaluating commercial value, and Japan has a highly competitive edge in these fields as well. Of course, advanced terminal technologies in Japan include POS and bank ATMs.

International standardization of technologies related to circulation is also extremely important.

Electronic money standardization activity has intensified overseas [4-5-5, 4-5-9] and it is necessary to move positively towards international competition and cooperation with Japanese technologies as a basis. Moreover, ISO (International Standards Organization) is carrying out various international standardizations for financial information systems. For instance, the TC68 Technical Committee is in charge of managing the message format standards (ISO 20022) related to conversion of SWIFT into XML (SWIFT is responsible for message communication between financial institutions) [4-5-10].

4.5.5. Technical Requirements of the New-generation Network for Achieving New Value Circulation Infrastructure

[Electronic money that is more trusted than paper money, settlement technologies]

Since the value circulation system must be more reliable than current settlement and circulation systems, the security and dependability of electronic money and its operative systems must of very high levels. Technology for preventing the duplication or seizure of computerized data value in the network, and technology for confirming reception by the counterparty are important to achieve certain value exchange. When the ownership rights of data being transmitted are unclear, or when the timing of transaction is important, reduction in transmission delay becomes very important. If it is difficult to reduce delay, a mechanism should be available which can find out where the data is in the network or which can return the value to the original owner in case of trouble.

[Electronic money whose route and origins are known]

The characteristic of computerized currency can be used to maintain the usage history and origin of the electronic money, and this history can be used in various services according to the circumstances of the individual, and also to prevent illegal flow of money. RFID technology, which is an excellent basic technology to maintain history information and individual information, is essential to achieve this. It is also important to have processing technology which distinguishes the information that can be shown and information that should be hidden, and network technology that traces innumerable tags that are distributed widely. It is also necessary to have techniques that verify transmission paths using combinations of wired and wireless transmission media, and techniques that record information such as credit rating of passed nodes using standard wireless signals, etc.

[Electronic money which is exchangeable with value that moves at low speed]

It is necessary to accurately monitor and evaluate the value of things during their movement in order to link slow moving things with electronic money. Low cost, highly accurate sensing technologies and network technologies that can be used anywhere in the world are required to achieve this.

[Network that recognizes the value of data]

Technologies are required which can distinguish data circulating in a network by its value and not by its quantity, and do various processes. This would enable value transfer with high cost -effectiveness and suitable charges.

[Technology that protects intellectual property at low cost]

In order for valuable data circulation in the network such as literary works to become common, it is necessary to achieve low cost technology that can transmit data by exchanging it with other value, while preventing its duplication, same as would be done for electronic money value. Moreover, technology that can manage intellectual property at a distant location is also important.

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4.6. e-Government / e-Democracy and Requirements of the New-generation Network

4.6.1. Expected Future Developments in e-Government / e-Democracy

This section establishes a slightly wider scope for the information network pertaining to government and public administration, in addition to electronic public administrative services such as various procedures related to administrative institutions, including part of the scope of "e-democracy" [4-6-1]. Actually, a very wide range of fields are potentially involved in this type of e-government or e-democracy, and advanced expertise is necessary, thus this section arranges the hoped for future vision into the following four items, keeping in mind matters connected to technological discussions in following sections.

(1) Enriched electronic government services that any citizen can enjoy

(2) Achieve new forms of participation in local government, politics and public administration via the network

(3) Achieve emerging values by the networking of individuals, local government, non-profit organizations, local communities, administrative bodies, etc.

(4) Preserving data pertaining to citizens and the nation

Hereafter, each of these items is mentioned simply. Firstly, in (1) there are a huge number of clerical procedures and citizen's request procedures that are related to official organizations such as local governments and central government offices, and discussions are continuing on considerable efficiency improvement by means of electronic technologies [4-6-1]. The transactions in governmental organizations have not yet been completely moved on-line, and partial adoption is in progress nationwide. However, from the point of view of users (individuals, enterprises, organizations, etc.), electronic administrative services have not yet been very user-friendly. These services are now being discussed in "Next-generation Administrative Services" etc. in [4-6-2, 4-6-3] and are expected to be further upgraded.

Besides such electronic administrative services, for the future, we should develop (2) a platform for new forms of participation and involvement through the network in local government, politics and public administration wherein citizens can be more closely involved with the local community, local government, government offices, etc.; and (3) a platform for bringing new, emerging values to individuals, the community and society wherein individuals and various organizations and corporations such as non-profit organizations and enterprises, and various public administration institutions can interact mutually through the network. These seem to be the points of discussion related to new democracy that involves network technology, in other words "e-democracy" [4-6-1]. Moreover, with the increasing dependency of individuals and society on the network and information, the reliability and security of information in a broad sense is surely gaining importance for both electronic administration and democracy, and this has been expressed in (4) above.

4.6.2. Proposed Approaches to Achieving e-Government / e-Democracy

Corresponding to the four future visions mentioned in the previous section, the following three approaches or viewpoints can be considered in e-Government and e-Democracy.

(1) First of all, the development of platform technology wherein administrative services can be offered more efficiently and conveniently via the network could be given as one approach. Here, the point is whether individual requests regarding local government and various public administrative procedures, etc. are obtained very flexibly and efficiently and whether user-friendliness is achieved.

(2) Secondly, due to the link-up of individuals, non-profit organizations, enterprises, and public institutions via the network, a complex situation arises due to the diversity of systems and terminals participating in the network, along with the huge number of terminals including sensors and mobile terminals. In other words, how to make such a diverse and complex network stable is an issue.

(3) Thirdly, the reliability and security of information are gaining increasing importance in the face of various situations: political participation such as public administrative procedures and electronic voting, participation in local governments, value creation via the network, etc. Moreover, as regards the varied information held by public administrative institutions etc., it is important to achieve broad transparency typified by information disclosure even in the network, and tie it to local value creation. However, it is also important to ensure preservation of information that should be strictly managed. It is believed that the achievement of reliability and fairness of such information becomes a very important issue.

4.6.3. Impacts on Society of e-Government / e-Democracy

The points mentioned below may be impacts on society, in view of the 4 future visions mentioned in section 4.6.1.

(1) Enriched electronic government services that any citizen can enjoy:

This is an impact of the continued progress of computerization of administrative services. If an electronic public administrative service is achieved which is fair, pleasant and secure, then basic issues such as administrative cost reduction and convenience in people’s lives are achieved, and there are also expectations of contribution to a knowledge society as is discussed below in (3).

(2) Achieve new forms of participation in local government, politics and public administration via the network:

The wide spread of information and communications technology provides a new platform for a way of consensus-building process. For example, it provides new forms of participation and involvement in local government bodies such as schools, cities, towns, villages and prefectures. Moreover, although there is growing interest in social contributions through various non-profit

organizations, there can also be diverse ways to participate through the information and communications network.

This is also a response to the inevitable socio-economic situation of the aging society with fewer children, and severe structural changes in the global economy and the domestic economy. However, if they are linked to peaceful democracy on a global level, then it is hoped this will contribute to sustainability of humanity.

(3) Achieve emerging values by the networking of individuals, local government, non-profit organizations, local communities, administrative bodies, etc.:

As discussed in the section concerning the knowledge society, improving the creativity of individuals and the society is becoming more important. Moreover, as discussed in the section on regional disparity issues, it is also extremely important to create new value by organizing the related players based on the unique characteristics of each region. As also discussed in the section on cultural/lifestyle diversity, individuals with different physical or cultural backgrounds are also expected to interact closely without any barriers.

When such new values are being created while the individuals and society are networked, then public institutions also naturally become one of the players. In this regard, as mentioned above in (1), there are expectations that public administration will go beyond merely providing administrative procedural services, but will also be expanded to provide a platform that creates new value.

(4) Preservation of information of citizens and the nation:

Reliability and security of information are fundamentally important in all of (1), (2) and (3) mentioned above. Moreover, electronic voting is one example of an administrative process in which the nation must provide completely strict and secure information management. The preservation of important information that affects people’s lives is a fundamental demand of the government and public administration. In order to properly handle these, it is essential to achieve the impacts described above in (1), (2) and (3).

4.6.4. Advanced Technologies in Japan for Approaches to Achieving e-Government / e-Democracy

There are advanced technologies in Japan for environments connected to the information network. In other words, there is widespread broadband communications infrastructure and portable information terminals, etc. It is also believed that authentication technology and ubiquitous technology including sensing technology are related technologies.

4.6.5. Technical Requirements of the New-generation Network for Achieving e-Government /

e-Democracy

Firstly, the technological need for the New-generation network is briefly discussed based on the three points discussed in section 4.6.2.

First of all, from the point of view of providing efficient and highly user-friendly public services as mentioned in the first point, so-called virtualization technology is required. Already, as discussed for next-generation electronic public administrative services, it is planned that not only the hardware of the information systems but also the software is to be externalized and shared, and there are expectations for technology that dramatically reduces the introduction and maintenance cost for each organization. In a broad sense, this can be rephrased as the advancement of virtualization technologies including virtualization of networks. It also becomes important to develop technologies for network services that appropriately and efficiently reflect the circumstances of local government and public administration, while at the same time improving convenience from a user standpoint. From the perspective of user-friendliness, it is also important to have interface technologies and so-called ambient and ubiquitous related technologies.

Next, as discussed in point 2 above, from the aspect of handling the diversification and growing complexity of terminals and networks involved in e-government and e-democracy, there is a need for technology that achieves a stable network between the different kinds of networks, and technology that achieves stable public administrative services in a mobile environment, etc. Moreover, it is very important to have “real-time” information for the community and environment, in other words a very real-time information environment becomes especially important in case of distribution etc. in the community, and more advanced sensor network technology is also needed.

Finally, from the point of view of obtaining reliability of information as discussed in point 3 above, various requisites are necessary for security/reliability (trust), authentication, etc. Moreover, very advanced technology for resistance to failure and damage is required from the point of view of security of important information.

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4.7. New-generation Entertainment and Demands on the New-generation Network

4.7.1. Expected Future Developments in New-generation Entertainment

The New-generation network can be expected as an infrastructure that delivers content of the entertainment field, and also a platform which manages charges and copyrights. When the Internet is used as an infrastructure for delivering any digitized data, the New-generation network can also be expected to play the role of infrastructure for delivering new-generation entertainment.

The word “entertainment” has a wide range of meanings. Along with enjoying movies, music and games, entertainment also includes communication and transmission of information such as bulletin boards and blogs. There are many ways of enjoying this. Apart from enjoying live performances in theatres and concert halls, recorded media such as books, CDs and DVDs in which those performances are recorded can be enjoyed. Moreover, programs broadcast on television and radio can also be enjoyed. Since data can be downloaded at high speeds and at low prices due to the wide spread of internet, it is possible to enjoy the digitized content by downloading it or receiving it in form of streaming transmission through the network. Also, entertainment formed by communications can be called a truly new entertainment brought about by the Internet.

New generation entertainment (future entertainment) will be created based on the two pillars of new technologies (breakthroughs), and new concepts which seek refreshing surprises. Some examples are given below.

Firstly, positional information and movement information can be obtained following advancements in sensors and GPS devices, and due to the development of an environment in which the information obtained from such devices can be used for general purposes. By combining this information with highly precise map information and linking it with real-space information, a service could be provided in which the user’s location itself forms the stage for entertainment. That is, a new entertainment system may appear that uses experiential devices that recognize the movements of humans and offer realistic sensations of stimulating the five senses.

Moreover, it is likely that a platform will be prepared the transmission of information that can be easily and safely used by individuals, which can be called a way that video submission and sharing sites will develop. It is expected that functions will enable easy settings per the needs of users, so that self-created content such as videos and music can be easily transmitted and access controlled, with copy control and charges as necessary.

More and more forms of communication such as social networking sites, virtual spaces, blogs and bulletin boards, etc. are being developed in communication based entertainment, and its development technology has become a platform of society and information transmission. This entertainment will have impacts.

4.7.2. Proposed Approaches to Achieving New-generation Entertainment

Both new concepts and new technologies are important for achieving next generation entertainment. With the expectation that a young generation filled with new concepts should constantly be fostered, the direction of technology needed is discussed below.

Sweeping away boundaries between the real world and digital data and the network carrying such data can pioneer a fused field, which is a strong candidate for the flowering of new-generation entertainment. For instance, research on technology called augmented reality is becoming very popular recently. It involves research on technology that supports human activities by displaying the information on transparent displays, as seen in science fiction movies and animation. If a car windshield has a transparent display, it will be possible to achieve navigation whereby attention will be drawn to pedestrians and motorcycles, which are easily overlooked, by display of warning information or arrows on the road while the car is driving. By using spectacle-type transparent displays, one can get production location information of a product that is right in front of ones eyes, and the person can be directed to shops in the background which handle the types of products one is searching for. Even experiential games and fighting games set in streets can be achieved by using the same technology, and structures of communications like word of mouth information networks which only specified users can refer to can also be achieved. In short, new-generation entertainment has a broad scope and refers not only to “happiness” but also to “convenience”. It can be used in various ways depending on how the information is handled and how it is presented, based on the same technology. We now show several key technologies from this point of view.

First of all, evolution of devices that control input/output is very important. Efforts are continuously focused on providing higher accuracy solutions for detecting persons and things and their (digitalized) location information and movements using RFID, GPS and acceleration sensors. It is necessary to for each application to be able to obtain accurate location information required, when the New-generation network is in practical use (Certainly, it is necessary to clearly specify the degree of accuracy required for each application). It is necessary to develop not only keyboard, mouse and controllers that explicitly handle input, but also sensing technologies and user interfaces that enable obtaining and processing operations detected by these location detection devices as “input”. For output, in addition to the above described spectacle type and window integrated transparency devices, it is also necessary to take into consideration the use of devices adapted to the environment (that can be adopted in ambient networks) such as fluorescent lamps and speakers, etc. It is also necessary to provide development of a general-purpose interface for input and output of information so that these input and output devices can be used freely.

Secondly, making real-space exhaustive databases is also important. To link real-space information with network information, geographic information that forms the basis of information mapping must be accurate and up to date. All digital maps seen in GIS, car-navigation, map sites etc.

having a certain degree of accuracy can be used easily, but 3D geographical information is necessary in case of buildings or subways, etc. When this information is to be used for controlling the automatic operations of the car, practical use is not possible without securing a definite level of accuracy. If detailed information is constructed, it is easily possible to simulate damage situations during disasters, or create movies or games against the background of real world. In contrast, the virtual world used in games or community type services etc. can be provided by creating complete virtual spatial data having similar data format.

Thirdly, since there is huge amount of location information, and generation of interactive information reception is assumed, the New-generation network itself should be able to handle any demanded bandwidth and various traffic characteristics, and must be able to provide dependable network reliability. In addition, the New-generation network should also be equipped with an information transmission platform that will enable easy and safe information transmission. Input/ output device - spatial information - transmission platform, all are closely linked and the threshold is kept low so that everyone can freely use this platform. As such, it will help any individual with an idea to transmit that information to create new entertainment.

4.7.3. Impacts on Society of New-generation Entertainment

As already described in the previous point, new-generation entertainment results from the area of convergence of real world with data, and its scope is wider than today's entertainment. An application platform for new-generation entertainment, in which input/output devices - space information - transmission are integrated, is constructed on the New-generation network, and entertainment (in the present sense) such as movies and music, games that have been freed from displays or controllers, and virtual space that enables interaction with the real-space or gives a sensation of a real-space are built on this platform. Moreover, the New-generation entertainment consists of blogs, social networking sites, media that has a convergence of or is developed from video sharing sites, information societies, etc.

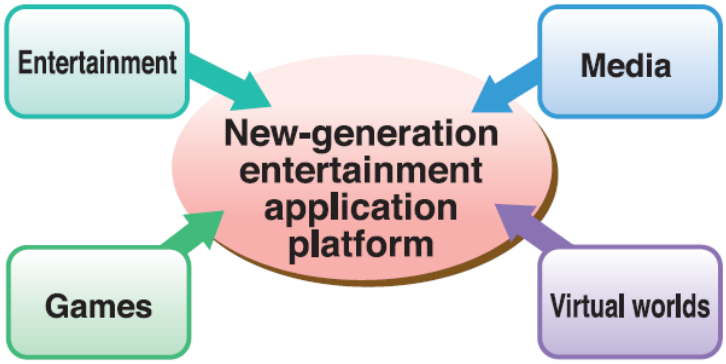

Figure 4.7.1 Positioning of New Generation Entertainment

If such a new-generation entertainment and application platform for that entertainment are constructed, the following 4 impacts on society are expected.

First of all, diversification of communication by achieving virtual spaces. When users are gathered in virtual space, the virtual space itself starts having a new value. In short, constructed virtual space itself has value as a “business zone”, and if it operates as a “playground” for communication, it can also be a place for advertisements because of the people who gathered in that space. In addition to the possibility of such new places, diversification and innovation of communication modes can be expected by visualizing information in 3D virtual space in an easily understood form.

Secondly, achieving a world in which augmented realities are put to practical use. This will enable supporting actions of a user, for instance, navigation of human or car with services that will project supplementary information like displaying text or arrow information above real-space information that is visible. This may also enable the use of information services that will overlay context information of products and shops on the space depending on the preferences and attributes of the user, or display advertisements or word of mouth information of that product or shop, etc.

Thirdly, it may be possible to achieve games that are not constrained by existing limitations. In home video games, the main market is shifting from stationary types in which home-video games are connected to the PC or TV, to battery-operated portable types or types that operate as applications on mobile phones, etc. Moreover, there is a progressive evolution toward devices which enable operation which appeals to direct sensation, with operations changing from keyboards to controllers, and from controllers to touch panels or sensor types. Similarly, competitive or community functions whereby one can enjoy games by matching up against or with friends or compete against users of the same level through the network are also becoming popular. In the new-generation entertainment platform, the degree of freedom has increased due to wider use of various devices. At the same time, possibility of diverting common functions such as user authentication and community functions has also increased, and this may enable a focus of development cost on necessary parts.

Fourthly, with the progress in the entertainment field, it has become easy to make rich contents and even the quality of content in the education field is expected to evolve. In the case of school education, it seems that it will become easy to create highly interactive content that can give a virtual experience, for content that is easily understood that students learn with interest. Moreover, one would be able to freely enjoy studying anything at one’s own pace as many times as desired, and get support from teachers and friends through the network, and all this has brought down the threshold for taking part in lifelong learning.

4.7.4. Advanced Technologies in Japan for Approaches to Achieve New-generation

Entertainment

Japan has been relatively strong in hardware technology for the entertainment field. It has launched several major platforms especially in the field of game consoles, and has consolidated its strength in this field by creating qualitative changes itself. In addition, Japan has also succeeded in creating a market ecosystem (sell hardware - sell software - expand the choices for users) which is the source of its hardware share. Japan also excels in technologies for development and practical application of user interfaces which use new devices as typified by experiential arcade games, and these technologies and know-how are strong points of Japan.

It can be said that Japan has played a key role in the development of consumer products for media fields such as music and movies, driving its evolution internationally. It has also played a major role in creating the standards of CDs, DVDs and blue-ray discs, and it has a competitive edge in technologies for miniaturization and for portable product commercialization.

It leads or is on par with the world in application development technologies and their operational results that form the foundation of new communication styles. Moreover, Japan is also strong in advanced location and geographical information processing technologies seen in car navigation systems and in technologies that handle spatial information.

4.7.5. Technical Requirements of the New-generation Network for Achieving New-generation Entertainment

Technical requirements of the new generation network are given below.

- Achieve dependability that can be a foundation of the information-driven society
- Develop a platform in which can use information of multiple devices through PAN and BAN
- Foundation providing freely accessible real-space information, and related context information
- Build an information transmission platform on which individuals can transmit information easily and safely
- Dynamic processing of intellectual property, whereby both rights holder and user can benefit
- Develop an easy-to-use user interface

The first 2 points can be said to be required for the network itself. Achievement of a network that can be reliably used anywhere is a must. The following three points are necessary for the new-generation entertainment application platform. It should assure the transmission of necessary information freely and safely, and have a mechanism in which advantages and disadvantages generated in the transmission process can be handled rationally. The final point is a requirement that is necessary so that any person irrespective of age or gender can use New-generation entertainment.

4.8. Frontier Fields and Requirements of the New-generation Network

Space, ocean exploration, and bio genome science fields are considered frontier areas here.

4.8.1. Expected Future Developments in Frontier Fields

Space exploration to search for the origin of life and the human race, and understanding the earth's environment and ocean environment have steadily been pushed forward through the history of mankind. From the point view of frontier contents delivery, the common nature of these two fields is that it is not possible to achieve these fields through wired communication infrastructures including optical fiber, and very long-distance wireless sections are necessary.

In solar system exploration, many probe vehicles have reached the Moon, Mars and Venus. These probe vehicles are equipped with observation systems that are operated by remote control and transmit the atmospheric condition and surface condition etc. of these planets in the form of still images to the earth. These communications are direct communications between earth stations having extremely large antennas and probe vehicles, or communications using relay satellites, and transmission rate remain at several kbps. The target of these space explorations is to land a probe vehicle on all the planets in the solar system and acquire ultra-high definition images in order to observe the atmosphere and surface etc. This detailed data can help us to elucidate the origin of life and approach the mysteries of space.

As for the understanding the ocean environment, the investigation of sea beds using various submersible vessels is making progress, and detailed clarification of the entire earth's marine environment is expected using the state of the art observation technologies. Especially, since Japan has a vast exclusive economic zone, the investigation of marine resources is extremely important for its energy policy and rare metals strategy, which will be important factors in governing its national capabilities in the future. Global environmental surveys for understanding the global situation of carbon dioxide emissions and hydrosphere investigations etc. are essential to achieve a sustainable society. If real-time global environmental understanding becomes possible, then understanding of natural environment data as well as flows of things all over the world will also become possible, and distribution of goods, sources of global environmental pollution, and movements of schools of fish, etc. can be understood, thereby making it possible to decrease distribution costs including energy, towards achieving a low carbon society.

Genome science in which the structure of living organisms is elucidated at the DNA level is one of the frontier fields for the human race. Decoding of the human genome was started through international cooperation in 1991, and came to an end in the form of completion of total decoding in April 2003, launching a new age called post sequence [4-8-3]. The United States has already started a project for developing new DNA sequence technology which can determine the genome sequence at the cost of 1000 dollars per person. [4-8-4, 4-8-5]. After 15-20 years, the age might come where

all the people will have their genome information. Providing optimal medical treatment based on heredity factors of an individual may become possible in the age of 1000 dollar genomes. Moreover, with the accumulation and analysis of a huge amount of individual genome information, it will not only help in administering the appropriate anti-cancer drugs to cancer patients, but is also expected to increase accuracy in prevention and prognosis of multifactorial diseases such as diabetes, high blood pressure and cardiac infarction, for which it is currently difficult to determine heredity factors.

Meta genome analysis is an important trend of the future genome science wherein useful genes for the human race and the earth will be found by collecting, processing and creating a database of the genome information of any living organisms. It is known that there are bacteria in the natural world which produce chemical energy from light energy, and bacteria which produce hydrogen from water. It seems there will be a focus on the field of synthetic biology wherein useful genes are extracted from these natural bacteria, to create new bacteria and microorganisms having even more efficiency than the natural world. Such efforts are making progress all over the world, and it is expected that sharing of information will contribute to the development of new medicines and solutions to global environmental problems.

In addition, a platform technology that enables wide use of this cutting-edge observation data and analytical results must be developed and it should be easily accessible to all, and referring system to the results of these cutting edge sciences, then even more achievements can be expected. Moreover, with the establishment of such a platform technology, it will be possible to nurture the next generation of scientists.

4.8.2. Proposed Approaches for Achievements in Frontier Fields

It is difficult to achieve the high definition and high resolution data transmissions required for getting close to explaining the origins of life and mysteries of space with several kbps rate. It will be necessary to attain communication links with minimum speeds of at least thousand times of recent rate, around several Mbps. This requires development of millimeter-wave or optical communication devices installed on observation satellites and development of efficient transmission methods and onboard communication devices. These are also important for ocean exploration, and in this case it is also necessary to development transmission links that include antennas and communication methods for efficiently using the limited mobile satellite spectrum.

In the present earth environment observation, obtained data cannot be transmitted in real time because of the constraints of communication systems. Many systems use remote sensing from low earth orbit (altitude of several hundred kilometers), because of the resolution. Since this system has ground speeds of tens of kilometers per hour, there are only a few minutes of time for communicating with an earth station (also called visible time) when downloading observation data to earth, but they lack real-time characteristics, and there are limits to the amount of data which can be

downloaded each time. The rate of down-links from low earth orbit satellites currently in use are less than 1Gbps, and it is not enough from the point of data resolution and the coverage. The problem of visible time has been significantly resolved using the relay system with data relay satellites placed on geostationary orbits and it can also improve the real-time characteristic, but it is necessary to send the transmission data to geostationary orbit, and this requires a huge amount of electric power. Consequently, many earth stations have been combined with data relay satellites, and network-centric observation systems with improved large data transmission and real-time characteristics have been constructed, thereby making instantaneous observation of earth's environment possible. Real-time global pollution monitoring has also enabled to detect pollution emission sources. The aim is to completely observe the ocean environment and ocean resources of exclusive economic zones, by attaining high data rates by low earth orbit satellite systems, not from geostationary satellite systems.

As for the bioscience field, it is hoped that ultimate tailor-made medical treatments will be achieved by decoding the genome sequence of individuals at a low cost. But in a sense, genome information is the "ultimate personal information". There are problems in developing a social system to handle genome information safely and there are ethical issues. For instance, there is information that will have few drawbacks even if it is known, such as risks of contracting lifestyle related diseases (information that should probably be known). On the other hand there is information which may be better not known, like knowing about a hereditary disease with low probability of being contracted but which will cause a great hindrance to one's social life if contracted. Greater ethics will be demanded from doctors, including the issue of how much disease information predicted from genome information should be disclosed to patients. Moreover, concerns have been raised over misuse of an individual's genome information by insurance companies, employers, judicial personnel, neighbors and salesmen, etc. In the United States, an "Individual genome plan" was launched in which people can voluntarily disclose their genome information and traits data to the public on the web, for the purpose of assessing the benefits and risks arising from the availability of such individual genome information [4-8-6]. There are technical problems of how to actually manage the genome information safely also. If managed at an individual level, there is possibility that a person may find out disease information which need not be known or there is danger of theft and misuse of this information by a third party. Therefore, some public institution will probably have to manage this information collectively as a database, and physicians would obtain a patient's genome information through the network. Moreover, by managing the information collectively like this, researchers will be able to obtain and analyze a large amount of genome information easily (Of course, it will not be possible to obtain personal information) which is expected to greatly advance the research of disease genes. Though there is plenty of scope for discussion, such as specific operations etc, ICT is sure to become an important fundamental technology for supporting medical

treatments and bio genome research in the $1000 genome age. It will be important to know how to handle the massive volume of genome information that will be generated, in order to use meta genome analysis for finding information about genes that are useful for the human race and the earth. There is increasing importance of bioinformatics, by which essential, useful data is discovered from a huge amount of data [4-8-7]. With the keen competition for development in such research fields, it is also important to share various biological information collected in all parts of the world as common property for the human race, and ICT is considered to be an important fundamental technology which will support bioinformatics.

4.8.3. Impacts on Society of Frontier Fields

With the new-generation network, it will be possible to achieve a platform which enables the permeation into every corner of society of the information explosion from extreme environments such as space, sea beds, living cells etc. This is expected to greatly advance the frontiers of the human race. This will enable investigations of planets and satellites in space, and global instantaneous understanding of disasters may enable minimize damages. Moreover, if the resources which exist at the bottom of sea are understood completely and can be used, then Japan with its vast exclusive economic zone may actually become a resource exporting country. If we set our sights on the bio field, and share anonymized DNA information through networks, it will greatly advance synthetic biology research and may enable us to find countermeasures for mutant viruses within short periods of time. There are also expectations for achievement of ultimate tailor-made medical treatments based on hereditary factors, searching for genes that are useful for the human race and earth by genome analysis of any living things and creating new bacteria and microorganisms etc. based on that information, etc. There are growing public concerns about science and technology with wide sharing of information of such new sciences and technological fields through the network. This sharing is also expected to impact the development of human resources, such as nurturing scientists who will lead us into the next era.

4.8.4. Advanced Technologies in Japan for Approaches to Achievements in Frontier Fields

The spread of a high-speed networks, for example FTTH, is a relevant advanced technology in Japan. Smart antenna technology, large antenna satellite technology, unmanned submersible vessels, and unmanned aircraft technologies, etc. can be cited as other elemental technologies.

4.8.5. Technical Requirements of the New-generation Network for Achievements in Frontier Fields

New-generation network technological requirements necessary for advancement of frontier fields are given below.

- **Technology for handover between wireless networks with different conditions**

  Though data is sent to the earth through multiple relay nodes by space probe vehicles and planetary explorers, the handover conditions of these data are different, and end-to-end connection may not be possible. It is necessary to establish technology that adaptively changes and relays the physical layers and data link layers, etc. depending on the conditions.

- **Data with time limit (delete or nullify data in the network)**

  DNA information is the ultimate private information, and its permanent existence on the network is dangerous unless there is total security. Therefore it is necessary to establish a technology that can delete or nullify data in the network if it leaks due to negligent handling, to prevent its spread.

- **Virtualization technology which accommodates researchers and readers in the same network**

  It is necessary to establish virtualization technology for efficient circulation of the latest scientific data.

- **Advanced individual authentication technology**

  It is necessary to establish an advanced individual technology in which biological authentication and network authentication are integrated.

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5. Technical Challenges of Implementing the New-generation Network

Besides helping to solve social problems and achieve a future knowledge-society, New-generation network technology is absolutely essential as a platform for all modes of communication. We plan to promote strong R&D in Japan in order to build a sustainable future society which can keep up with Europe and America and deploy original technologies to make great contributions to the international community. For this, the scheduled next steps are [1] Create a technology roadmap showing how to solve social problems, common and fundamental technologies deduced from examination of a vision of future society, and milestones for entering the market, and [2] Plan the research framework, funding strategy, standardization strategy, human resource development strategy, and testbed construction and utilization strategy, after analyzing strengths and weaknesses of our R&D capability in Japan, and analyzing the envisioned international technology and business competitive environment.

Before creating the technology roadmap, the five technical challenges below were derived at the time of issuing this report (February, 2009) by taking into account the technology road map created to achieve the New-generation network vision described in Chapter 2, and by taking into consideration the functions demanded from the New-generation network as clarified in Chapter 3 and Chapter 4 (Figure 5.1).

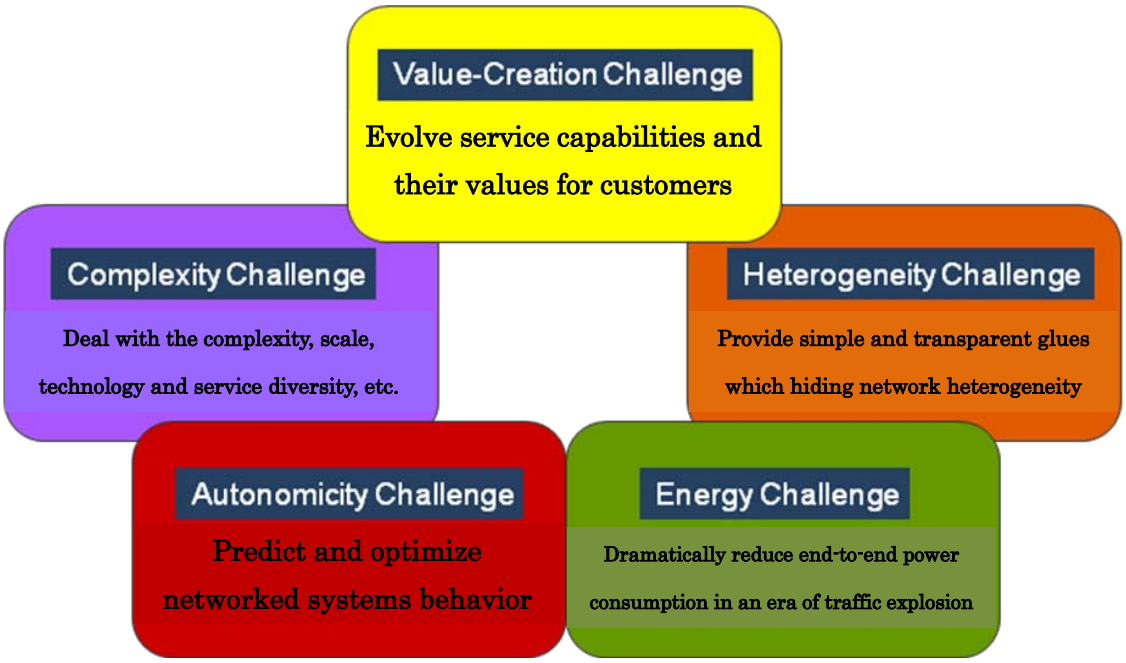

Figure 5.1 Technology Challenges for Implementing the New-generation Network

The common requirements derived from the function groups demanded in Chapter 3 and Chapter 4 include continuous improvements in performance, scale and reliability and achievements of interoperability and sustainability in converged network and application services. Moreover, for transforming from an industrial society to a knowledge-society, the existing network infrastructures that link humans and services/ information need to migrate into New-generation network infrastructure that “connect” societies in a broader sense, and it is important to create a control mechanism that can be operated within the scale and complexity of the global international community. Furthermore, it should be noted that these new technologies should be achieved simultaneously with the achievement of power consumption reduction/ cost reduction/ advanced ease of use, etc. which generally have a trade-off relation with new technology creation, but are indispensable and most important from the aspect of social problem solving.

The above requirements are described as technological challenges in Figure 5.1. It is thought that the focus should be on establishing new innovative technological groups for achieving the following: In the *Value-Creation Challenge*, support the total life cycle of application and service functions to help create new business models; In *Heterogeneity Challenge*, maximize the network resource usage efficiency even while hiding the different system characteristics of the diversified media services; In *Energy Challenge*, optimize the energy for the entire network system end-to-end including all services; In *Autonomicity Challenge*, minimize the operation cost by autonomous coordinated operation of elements comprising the system, etc.; In *Complexity Challenge*, achieve system integration and visualization which can allow various uncertainties in complex and extremely large scale systems.

By tackling the five technical challenges in R&D that make up the New-generation network and by creating innovations with a clean-slate approach, we hope to improve Japanese presence in the global community, and at the same time greatly contribute to the creating and building of the future knowledge-society desired by all humans.

6. Summary and Future Issues

In this report, the following 3 points have been put down as the first steps in the R&D strategy for achieving the New-generation network which will become the ICT platform over the next several decades: (1) Vision of a new generation network which will support the future society, (2) Functional requirements of the New-generation network for solving emerging social problems and achieving the future society, and (3) Technology challenges in the New-generation network for achieving the above.

In particular, the vision of the New-generation network that will support society for the next several decades includes (i) *Minimize the Negatives*: Solve emerging social issues with the power of the ICT technology, (ii) *Maximize the Potential*: Create new value perspectives for the future society, and (iii) *Achieve Inclusion*: A new symbiotic knowledge-society that allows diversity in individuals, organizations and society.

The aim of this report is to specify the five technical challenges in creating innovation towards achieving the New-generation network vision, without being constrained by existing technologies. It specified them urgently as the R&D roadmap and strategies for testbed development/ standardization/ practical application, and is delivering recommendations that will contribute to the stimulation of the information and communications industry of Japan and rapid development of the international community.