The Transformation and Future Direction of Communications

Norio Wada, President and CEO, NTT

Abstract

The NTT Group is undertaking research and development of the Next Generation Network (NGN) and a wide variety of other subjects with a view to solving the problems facing the information and communications technology (ICT) society and enhancing Japan's international competitiveness. This article is based on the speech given by Norio Wada, President and CEO of NTT, during NTT R&D Forum 2007, which was held on February 8–9, 2007.

1. Background

The numbers of broadband and mobile phone subscribers in Japan have been changing over the years, as shown in **Fig. 1**. The total number of broadband subscribers has continued to grow, and the 25-million mark was passed in September 2006. As indicated by the breakdown by access method, the number of DSL (digital subscriber line) users began to decline in June 2006, while the number of FTTH (fiber to the home) subscribers has been growing rapidly, signaling the advent of the age of optical broadband access.

Subscribers to mobile phones are shifting rapidly from traditional 2G (second-generation) to the much faster 3G (third-generation) services, with about two-thirds of mobile users already converted to 3G. Last August, NTT DoCoMo introduced a 3.5G service, called HSDPA (high-speed downlink packet access),

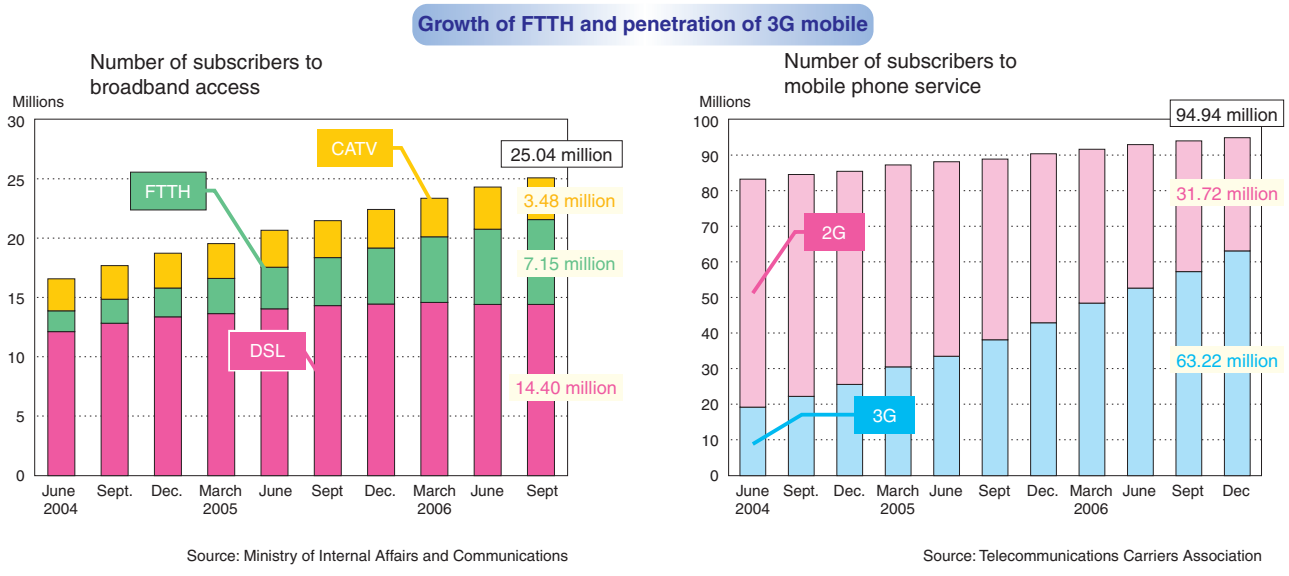

Fig. 1. Changes in the numbers of subscribers to broadband access and mobile phone services.

which provides a maximum transfer rate of 3.6 Mbit/s for the downlink and 384 kbit/s for the uplink. Another recent milestone is that the number of subscribers to mobile phone services, including both cellular phone and PHS (personal handyphone system) services, exceeded 100 million, which is approaching Japan's population of 128 million.

2. Major impacts of ICT on society

The figures above indicate the solid establishment of infrastructures for broadband access and for 3G and 3.5G mobile phones. With this promoting the use of information and communications technology (ICT), we are witnessing great changes taking place in society.

2.1 Ability to overcome the barriers of time, distance, and the uneven distribution of knowledge

We can identify three directions in which the changes are heading (**Fig. 2**). One is service convergence. This covers the convergence of broadcasting and telecommunications, the convergence of fixed-line and mobile phone services, known as fixed-mobile convergence, and the convergence of PCs, TVs, and mobile phones and other terminals. As the walls separating services and businesses collapse, convergence will accelerate in many fields. The second trend is new waves of Internet business, represented by "Web2.0". This includes the growth of services featuring user participation, such as blogs (web logs) and social networking services (SNSs), the growth of services (e.g., by Amazon) catering for small and diverse needs, known as the "long tail", and the growth of "open" services (by Google, Amazon etc.) making information (databases) owned by the provider available to others. The third trend is the globalization of business activities and its consequent problems. This globalization includes outsourcing to overseas partners and offshore development. It has, however, led to problems, such as cyber-terrorism and viruses, on a global scale. Thomas Freedman, an American journalist, describes the social change driven by ICT and globalization as the "flattening of the world". I truly believe that today is a time of great transformation in which the world is continuing to change as we overcome the barriers of time, distance, and uneven distribution of knowledge.

2.1.1 Barriers of time and distance

Some examples of overcoming the barriers of time and distance are shown in **Fig. 3**. The case of a global call center is shown in Fig. 3(a). In his book, "The World Is Flat," Friedman considers a call center located in India. More and more US companies are making good use of global networks to outsource not only their call centers but also office functions, such as accounting, tax declaration, and data processing to India or the Philippines. Besides being able to employ competent people, fluent in English, at lower labor costs, they get the added advantage of the time difference, which enables them to provide services 24 hours a day.

Remote medical diagnosis is another example of overcoming the barriers of time and distance. A trial of fetal diagnosis being carried out jointly by the National Center for Child Health and Development and NTT Laboratories is shown in Fig. 3(b). Japan has a shortage of specialists in the diagnosis of problems that fetuses may have in their internal organs, which can pose a high risk to their lives. As a result, the number of mothers-to-be who can receive this medical service is limited. The trial connects a medical center in Japan with a university hospital in California via a high-quality link so that high-definition images for use in diagnosis can be sent to a specialist in the US hospital. This enables patients in Japan to receive a specialist's diagnosis service without making a trip abroad.

We expect that, as these examples show, the spread of ICT via broadband access will boost productivity and create added value by transcending the barriers of

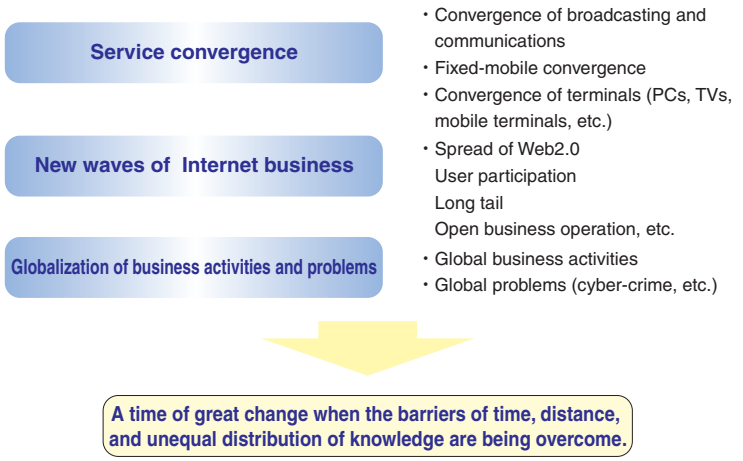

Fig. 2. Changes affecting society.

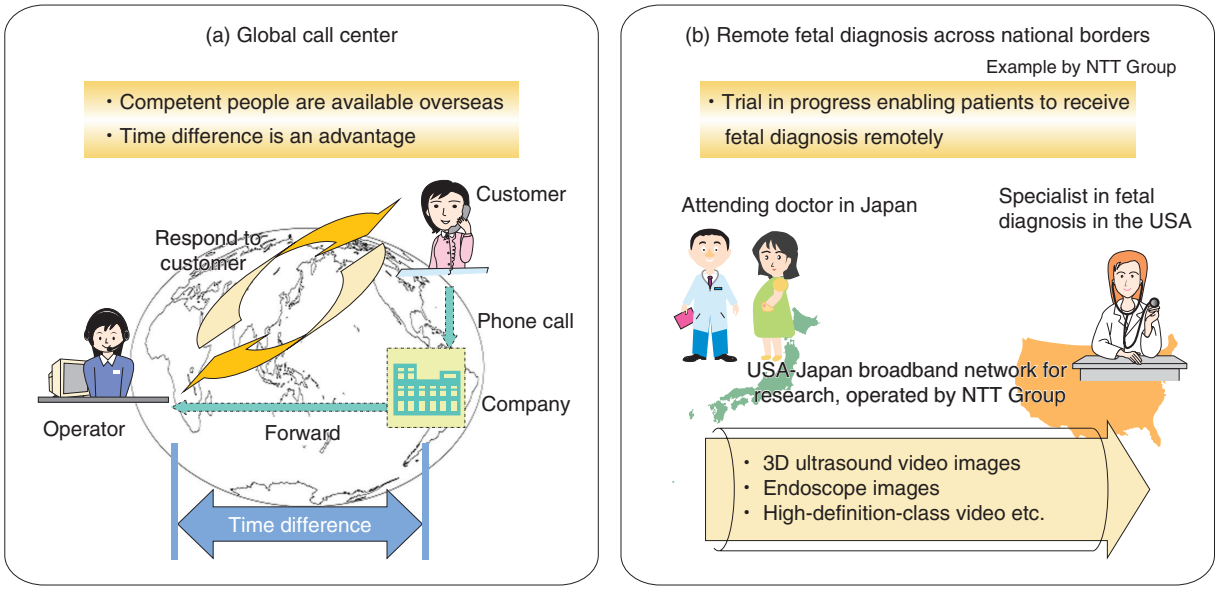

Fig. 3. Examples of overcoming the barriers of time and distance.

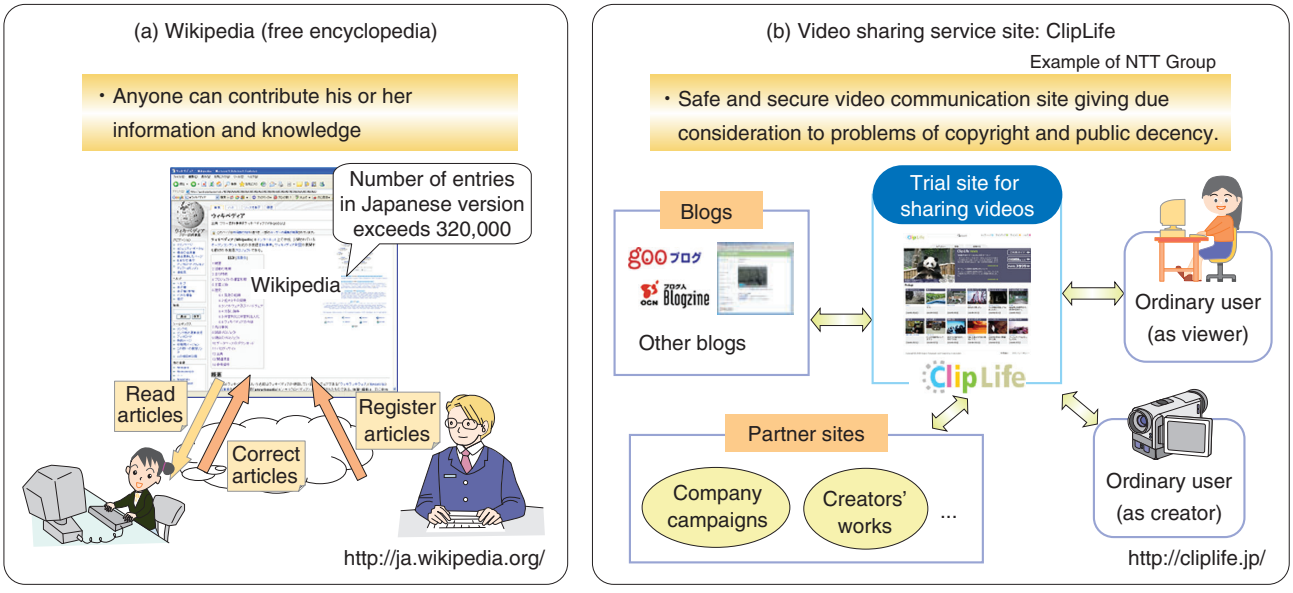

Fig. 4. Examples of overcoming the unequal distribution of knowledge.

time and distance.

2.1.2 Barrier of unequal distribution of knowledge

An example of overcoming the barrier of unequal distribution of knowledge is shown in **Fig. 4**. Wikipedia is a free encyclopedia that allows anyone, not just selected experts, to contribute to its content over the Internet (Fig. 4(a)). This project was started in 2001 in the USA. The Japanese language version was also started the same year and today has more than 320,000 entries, which means that it is more comprehensive than any ordinary paper-based encyclopedia. We expect that the Internet encyclopedia will continue to improve and grow through the sharing of knowledge by many people.

An example of a video sharing site, called ClipLife, which is the subject of experiments by the NTT Group, is shown in Fig. 4(b). We aim to make it a safe

and secure video communication site by developing technologies that encourage usage and enable operation that is fair and of good quality by giving due consideration to the problems of public decency and copyright, which have recently been spotlighted at YouTube and other similar sites. NTT is also experimenting with an initiative to support creative activities by collaborating with communities of music and video creators and with university and enterprise partners.

In this way, the spread of ICT is sure to give rise to a series of mechanisms, one after another, that will enable new value to be created by collecting unevenly distributed wisdom and knowledge and making it available over the Internet.

2.2 The dark side of ICT

In addition to its bright side, ICT also has a dark side specific to the Internet society. The problems include unauthorized access, bogus single-click billing, viruses, spam, copyright infringement, leakage of personal information, addiction to the Internet, and the digital divide. Some examples of this dark side are illustrated in **Fig. 5**.

An example of bogus single-click billing is shown in Fig. 5(a). When a person simply accesses a web page or clicks an image, he or she may see a message such as the one shown in the bottom left of this figure. This is a rapidly increasing type of fraud in which unsuspecting users are induced to make a bank transfer to pay for a bogus claim. It was responsible for the greatest number of requests for advice about losses that the Information Technology Promotion Agency in Japan received in 2006.

An example of Internet addiction is shown in Fig. 5(b). Some people are engaged in online chatting or playing games online to such an extent that they can no longer distinguish between virtual and real lives, which disrupts their real lives. An addict who became rich in a virtual online game decided to buy a luxury car, so he borrowed a large amount of real money. The number of such Internet addicts is increasing.

While ICT brings various benefits, it also results in problems external to individual users, such as the problem of malicious users mentioned above, and problems internal to individuals, which adversely affect their lives by degrading their ability to communicate face to face. We believe that finding a way to deal with this dark side of ICT is an important emerging challenge that demands practical action.

3. NTT Group's NGN activities

3.1 Roles of the NGN

Our NGN has three broad roles to play, as shown in **Fig. 6**.

- Advancing innovation in society through the use of ICT and contributing to the creation of new added value and improved productivity
- Contributing to resolving the issues of the dark side of ICT, such as unauthorized access and Internet fraud
- Contributing to resolving Japan's social problems, such as the declining birthrate and aging of society, insufficient nursing and medical care, environmental problems, the need to save energy, and the need to reduce damage by and respond quickly and effectively to earthquakes and other large-scale disasters.

Neither the existing telephone network nor the best-effort-based Internet is suitable to play these roles. Therefore, it is essential to build a new network that possesses the positive aspects of both, namely the reliability and stability of the telephone network and the flexibility and economy of the Internet. These are the characteristics that NTT aims to achieve in

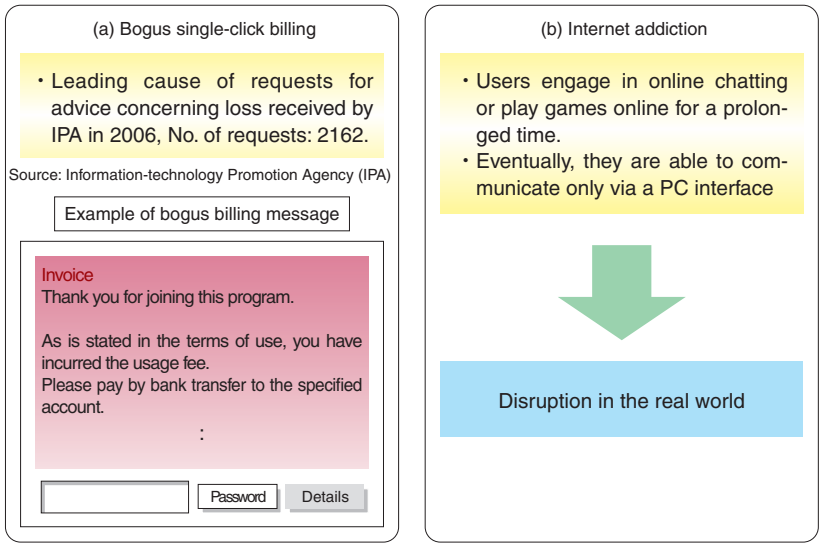

Fig. 5. Specific examples of the dark side of ICT society.

designing its NGN.

3.2 Features of NTT's NGN

- Quality of service (QoS) guarantee: The NGN will offer four QoS classes, including the best-effort class, which can be selected according to the needs of each application.
- Security: It will check the caller's identity (ID) at each access attempt, to prevent spoofing, and block unauthorized access or excessive traffic where it enters the network.
- Reliability: It will have a highly reliable structure and will be able to provide traffic control and guaranteed delivery of important communications to ensure its availability in the event of a disaster or traffic congestion.
- Open interfaces: Its interface specifications will be disclosed to other network carriers and appropriate parties in other industries.

3.3 "Open" and "collaboration"

The concepts of our NGN trial can be summarized in the key words "open" and "collaboration" (**Fig. 7**). Networks will be used widely by everyone. The NTT Group by itself cannot make the most effective use of the NGN. Our NGN will connect openly with the networks of other providers, and we will collaborate with partners in other business fields to create new services and added value.

3.4 Schedule of the NGN field trial

The NGN field trial started in December 2006 with NGN Open Trial Exhibitions in Tokyo and Osaka as demonstration centers where anyone can visit and try out demonstration services. We have seen a significant amount of interest in the field trial, and the demonstration center in Otemachi, Tokyo, has been flooded with requests for visit reservations. We expect that eventually about 30 companies, some of whom are now discussing details with NTT, will participate in the field trial. These will include information appliance vendors, application providers, Internet service providers (ISPs) and major telecommunication carriers. Preparations are also in progress for about 700 ordinary consumers to begin using the NGN as test users from April 2007 (**Fig. 8**). When the field trial ends, sometime before the end of this year, we will

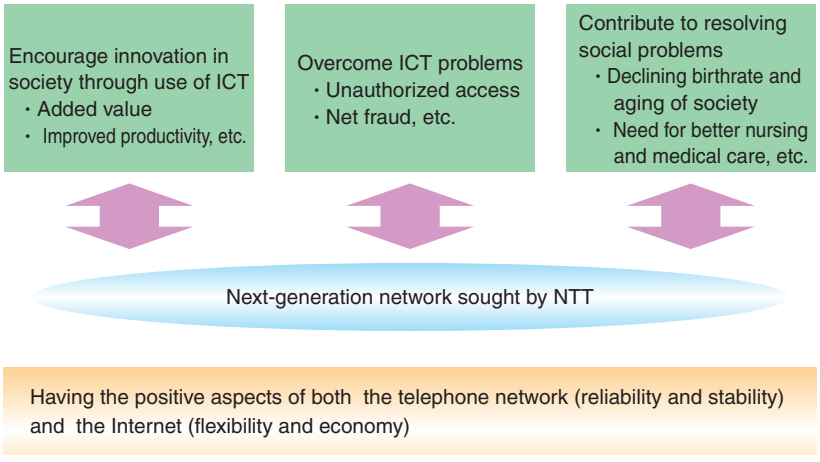

Fig. 6. NTT Group's NGN activities.

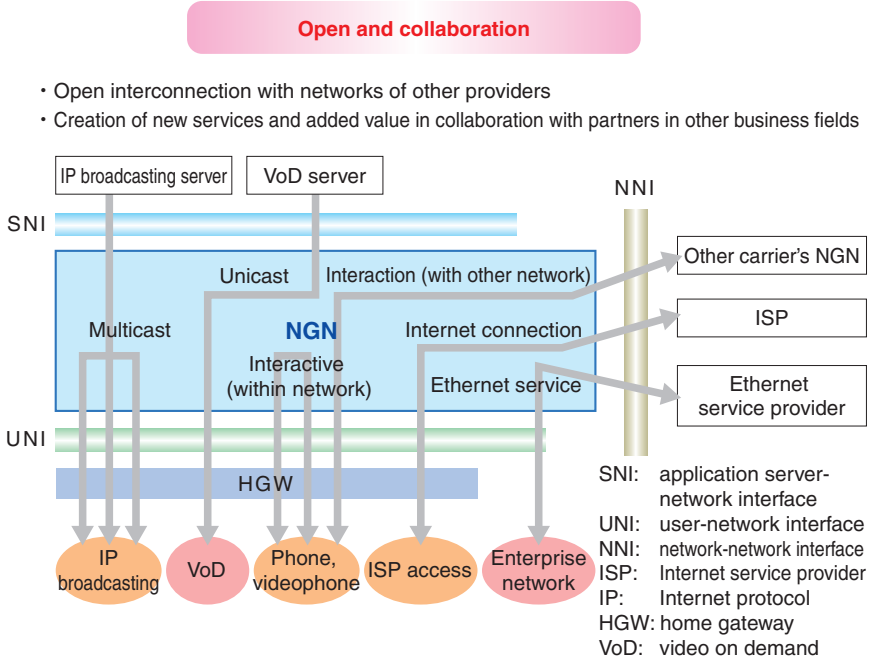

Fig. 7. Key concepts in building the NGN.

move on promptly to a commercial offering.

3.5 Examples of services using the NGN

A nursing and healthcare service being demonstrated at an NGN Open Trial Exhibition in conjunction with Hitachi is shown in **Fig. 9**. The NGN links the office of a nursing care helper and the home of person receiving nursing care. Every day the helper can check the recipient's health condition, such as blood pressure, in the morning and again at night while the person is asleep. The NGN's QoS control ensures the reliable delivery of blood pressure data to the nursing care server. In addition, a family member at a remote site can also check the health data. The NGN's mechanism of verifying a caller's identity using caller ID prevents access by third parties, so the person's privacy is protected. Thus, the NGN's high transmission quality and caller ID-based security will support secure nursing and health care while rigorously protecting privacy.

The retransmission of digital terrestrial television over IP is shown in **Fig. 10**. This is being exhibited by

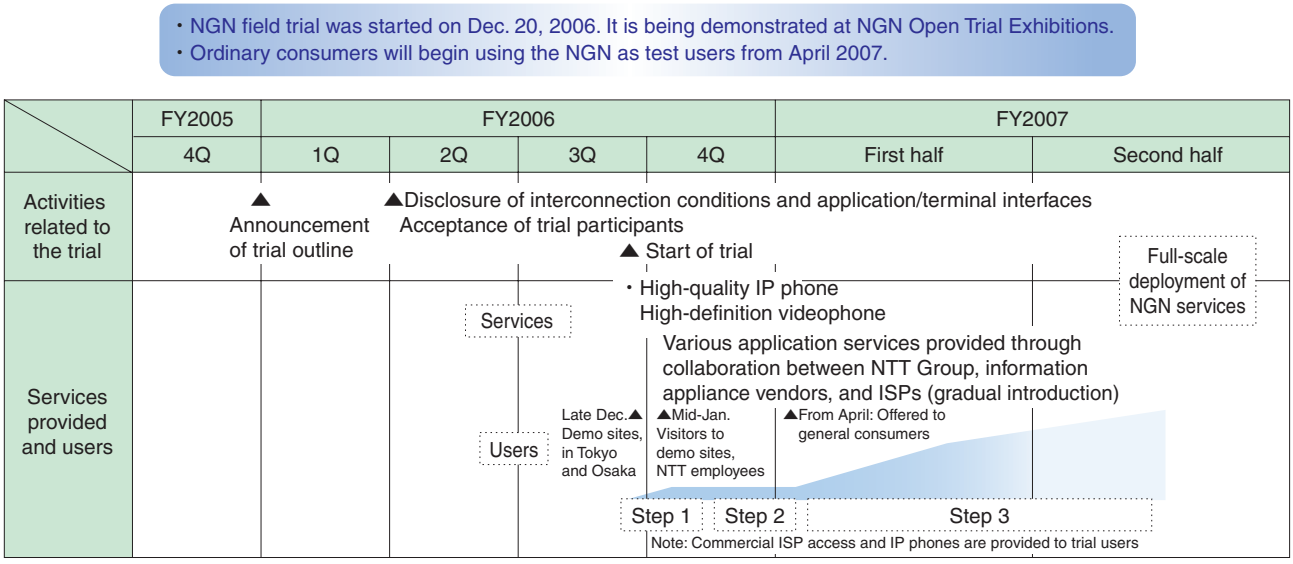

Fig. 8. NGN field trial.

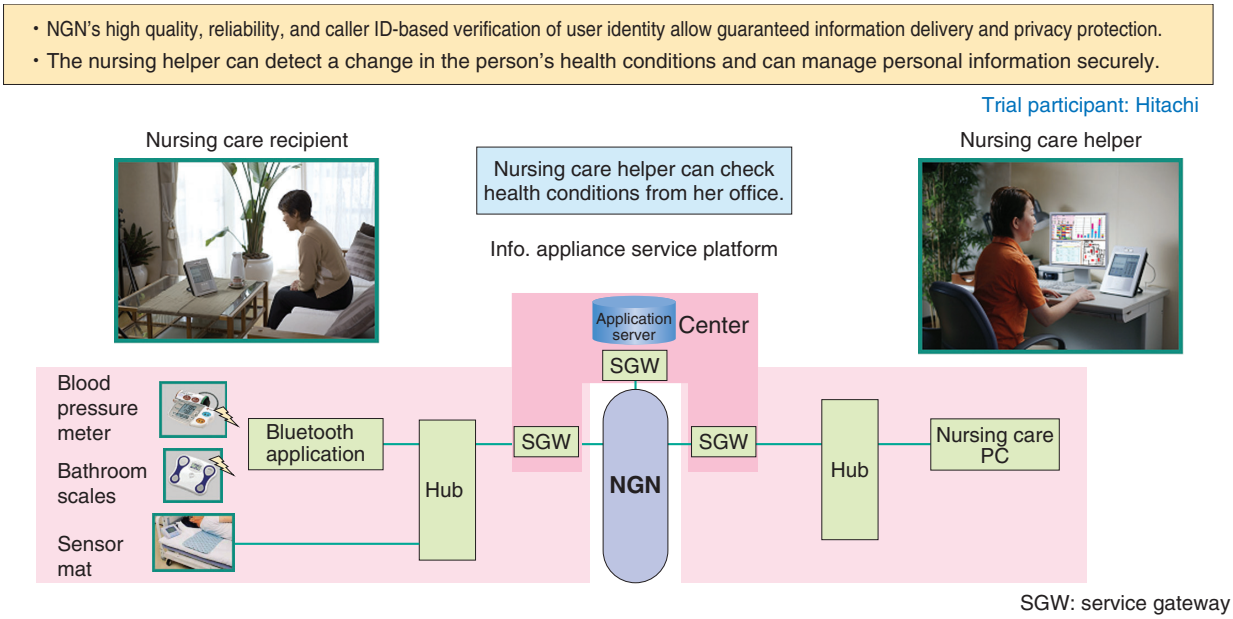

Fig. 9. Health care.

NTT Communications. This trial is based on the "Report on the study of the public use of digital terrestrial television" by the Ministry of Internal Affairs and Communications. In Japan, the issue of copyright protection related to the retransmission of TV program was settled on January 11, 2007 when a revision to the Copyright Law came into effect. An IP (Internet protocol) delivery center receives digital terrestrial television programs and delivers them as IP packets over the NGN to users' TVs. Users can watch high-definition TV programs received through their optical fiber access links. After July 2011, the date for the scheduled termination of analog terrestrial broadcasting, all terrestrial broadcasting will be digital. IP retransmission will be used to deliver digital television to areas that cannot receive the radio waves used for broadcasting digital terrestrial signals. It will thus eliminate a potential digital divide.

4. NTT's R&D activities

NTT's R&D activities provide the driving force for its business. Their objectives can be summarized as follows:

- Develop the NGN and use it to contribute to resolving environmental and social problems and help to bring about a safe and secure society
- Undertake a wide range of R&D while seeking to strike a balance between research into basic or elemental technologies and ones for use in commercial services
- Contribute to enhancing Japan's international competitiveness

I'd like to mention just a few of the many R&D subjects that our researchers are working on.

(1) Optical ring system

An optical ring system can be built simply by interconnecting nodes in a ring (**Fig. 11**). Therefore, a large-capacity optical network can be built economically. Since the remote control of nodes is easier in a ring network than in conventional networks, operations and maintenance are also easier. NTT is developing not only node systems for the ring network but also the key devices, such as switches, used in the node systems.

(2) Robust authentication platform and timestamping

An integrated authentication and timestamping mechanism achieves secure transactions by checking each access attempt against the caller ID, which is associated with the line that the user is using, and by attaching timestamps to transaction details (**Fig. 12**). When the user at home attempts to access an online banking service, her caller ID is automatically verified so that she can conduct transactions, such as bank transfers, easily and securely. If someone tries to access the bank account from a place other than the authentic user's home, the caller ID does not pass the check and the network sends back a request for additional authentication information. This prevents fraudulent use of stolen passwords. Moreover, since bank transaction details have timestamps, any falsifi-

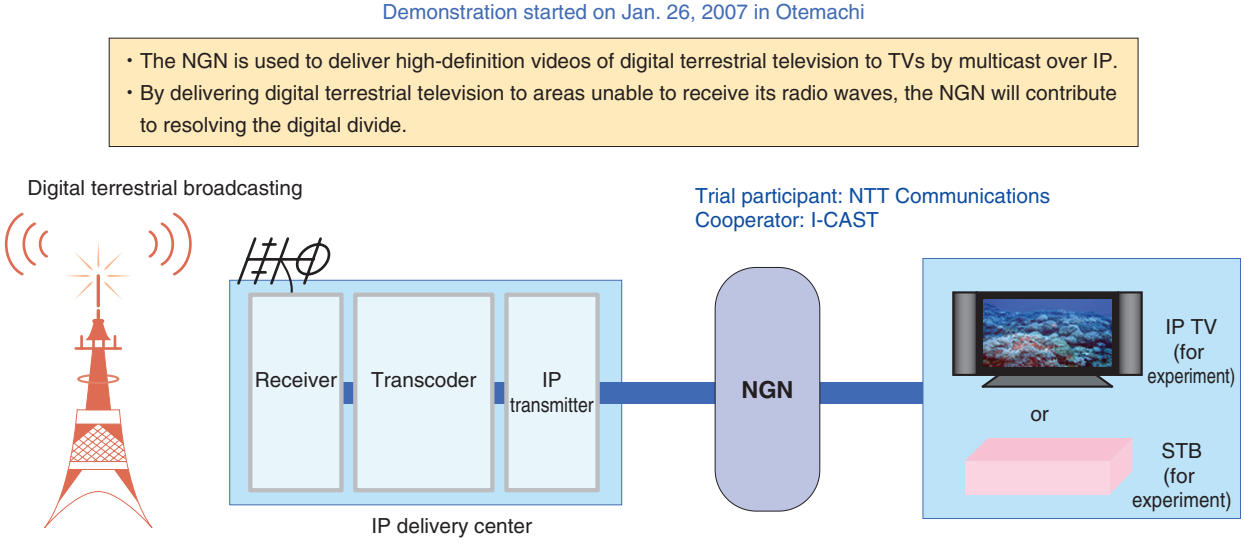

Fig. 10. Retransmission of digital terrestrial television over IP.

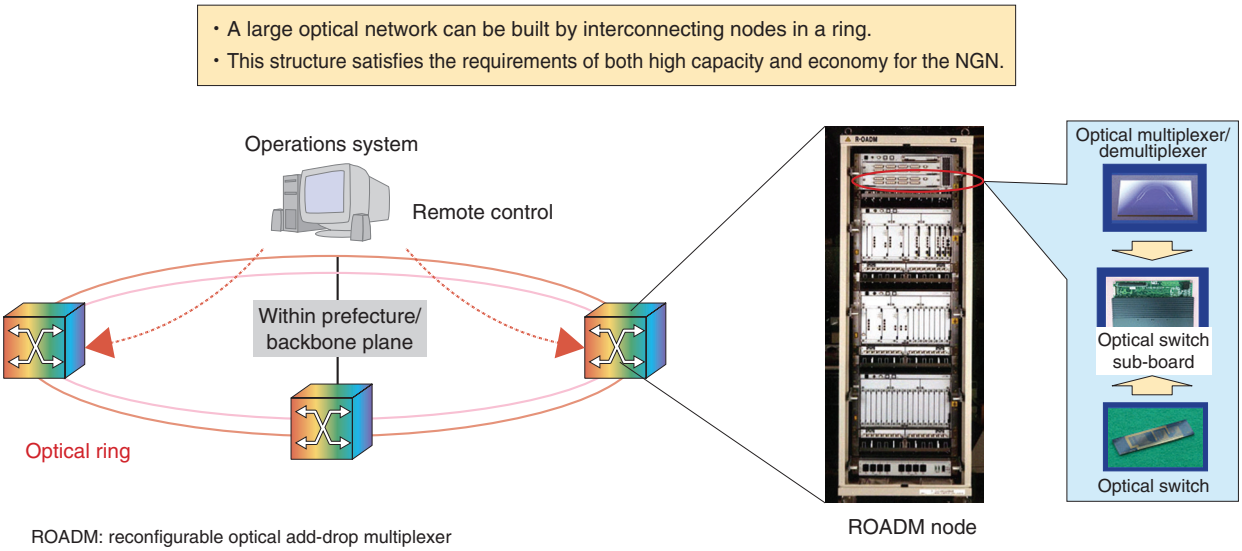

Fig. 11. Optical ring system supporting the NGN.

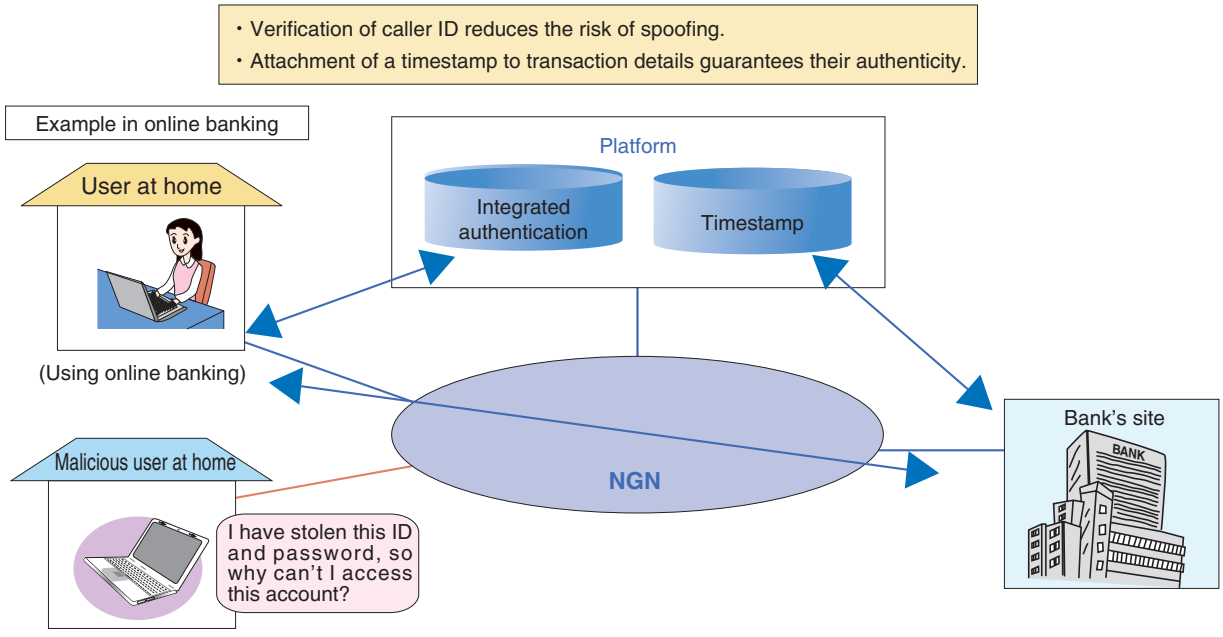

Fig. 12. Safe and secure robust authentication and timestamping.

cation of transactions can be identified, so only authentic transactions are processed and recorded.

(3) KTN crystal

NTT succeeded in fabricating potassium tantalate niobate (KTN: KTa1-x NbxO3) crystals of a practical small size for the first time in the world in 2003 (**Fig. 13**). Last year, an NTT researcher discovered that when a voltage is applied to it, a KTN crystal can deflect an optical beam through a large angle. Although he discovered this by accident, he did not overlook the potential value of this phenomenon and further studied its operating principle both theoretically and experimentally. The crystal is smaller than the ones used conventionally for such functions, requires only a low voltage to deflect an optical beam, and should enable us to build an optical beam scanner with the world's highest efficiency. We are currently exploring a wide range of potential applications of

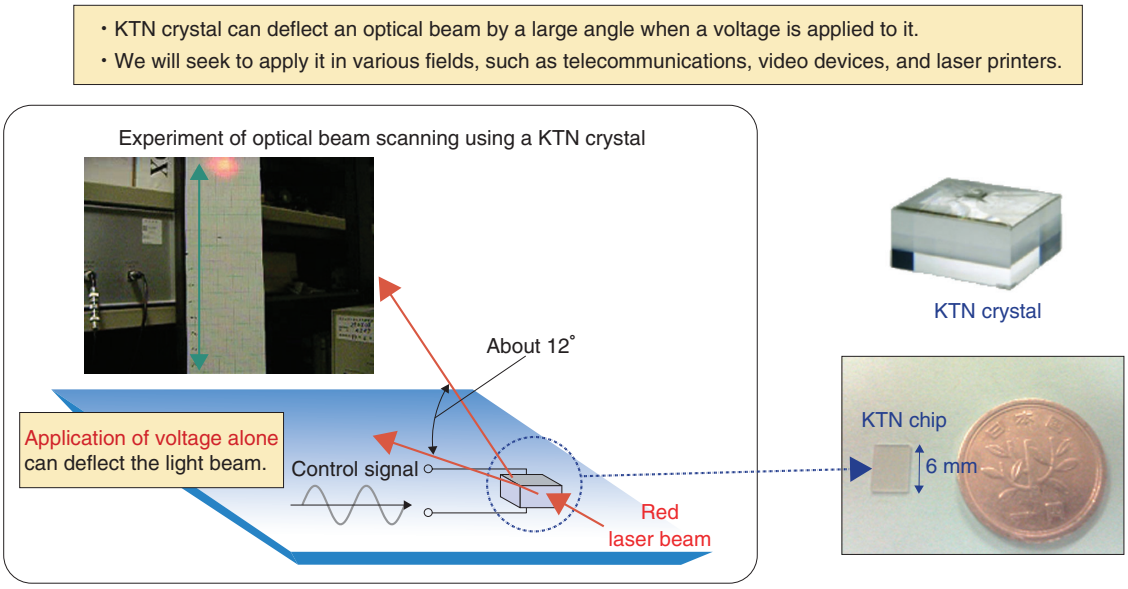

Fig. 13. KTN crystal.

this crystal, including telecommunications, video devices, and laser printers. We expect KTN to have an impact on the world in about ten years.

5. Conclusions

Through the use of the NGN and by means of its R&D, the NTT Group is seeking to resolve problems facing the ICT society and to enhance Japan's international competitiveness. These cannot be achieved by NTT alone. It will be necessary to pursue these objectives in close collaboration with other network carriers, service providers, vendors, and entities in other industries. We will undertake our business activities with the key words "open" and "collaboration" guiding us.