1 Introduction –The Aim and Strategy of the Disaster Management and Mitigation Group–

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Disaster Management and Mitigation Group has been a research group which deals with not fundamental research but social application of disaster management technology. Therefore, the group has aimed to achieve selection of research theme, perform research and development, systematization for practical use, academic activity, and technology transfer within 5 years of the 2nd medium-term plan of National Institute of Information and Communications Technology (NICT). This paper describes the strategy and aim for such short-period activity. And, the activity for five years is surveyed by the series at the time of every month. Moreover, typical achievement of the 5 years project is mentioned.

Keywords
Disaster management, Disaster mitigation, Techology transfer

1 Preface

The Disaster Management and Mitigation Group, which was to be disbanded by the end of March when the period of the second mid-term plan ended, held its final group meeting on Friday, March 11, 2011. Researchers who were assigned to new work places in April were busy dealing with residual tasks. Some researchers planned to take a paid vacation the following week. The Friday was therefore the last day when all members were present. The main item on the agenda for the meeting was to confirm the progress in preparations for the special issue on disaster management and mitigation technologies in Review of NICT, Vol. 57 Nos. 1/2 March/June, 2011(combined issue). This was the last major task of the group. It is a special comprehensive issue that highlights the positive features of the group, which is made up of researchers from various disaster management fields. The issue of periodical also summarizes the results of the research projects over the five-years period, including the procedure for alleviating congestion with cell phone communication in the event of a disaster, wireless ad hoc communication, rescue robots, the RFID-based emergency offline information exchange application, the system for assessing the extent of damage due to an earthquake, disaster information collection terminal and others. Despite the eagerness of the researchers to leave their results in the form of documents for future researchers to continue after the group is disbanded, nobody was confident of preparing the manuscript for the special issue, although there was only two weeks left. After the group members submitted their reports, the author confessed that he had finished only the introduction, because he had at hand another introduction and two papers to prepare. At that very instant, the ground began to shake. The researchers were all familiar with earthquakes, and they noticed that this particular earthquake had the unusual characteristic of a very

long duration. For the author, who had experienced the Great Hanshin Earthquake in the area west of Kobe, such a long tremor was a new experience. The author rushed out of the meeting room and ran thorough corridors into his office, unconsciously shouting, "Earthquake Early Warning!" The earthquake early warning in the building sounded their sirens. The siren was unpleasant, and the author had heard it several years earlier when he was an investigative researcher attending Real-time Earthquake Information Consortium. The siren was one of the candidate sounds being considered by the working group looking at the optimum sound for warning members of the public of earthquakes. The shaking became more intense, and he took shelter under his desk. The long, violent shaking meant that very large earthquake had occurred a significant distance away. After the vibration subsided, he turned on the television. But the cable television at NICT had stopped its terrestrial broadcast, and was broadcasting only BS news. The first report was that an earthquake of magnitude 7.9 had occurred, with its epicenter in the Pacific Ocean off the coast of Tohoku. Was this earthquake much larger than the Great Hanshin Earthquake? Was it possible that the anticipated earthquake off the coast of Miyagi, which was predicted to occur within 30 years with a probability of 99%, had finally occurred? He calmly contemplated this question, based on his professional knowledge. Soon, the magnitude of the earthquake was upgraded to 9.0, and the extent of the damage turned out to be far greater than expected.

The author and the other researchers, who sat, donning their helmets, and gleaning as much information as possible from television reports, tried hard to consider the optimum course of action under the circumstances. The author had on hand many amateur portable wireless transceivers used by the former Measurement Technology Group in its research into wireless identification[1]. He recharged the transceivers so that they would be available for use in the disaster area. The author was aware of the usefulness of ICT (information communication technology) as an established technology in the event of a disaster, and he repeatedly emphasized the fact in his lectures. Nevertheless, he could not help feeling a sense of helplessness in the face of a disaster of this magnitude, reflecting of the achievements of the group over five years. This report reviews the achievements of the Disaster Management and Mitigation Group over its five years of work, with deep introspection concerning the emergency operations implemented for the 2011 off the Pacific coast of Tohoku Earthquake.

2 Concept of the Disaster Management and Mitigation Group

The Great Hanshin Earthquake, which occurred on Jan. 17, 1995, was the first large natural disaster that exerted an influence on highly developed ICT. The social impact of the earthquake was significant, and the Communications Research Laboratory (CRL) under the Ministry of Posts and Telecommunications initiated research and development into emergency communication using the network simulation facility established in 1995. It established the Emergency Communications Section in 1996, which was the forerunner to the Disaster Management and Mitigation Group.

The author, who had been a member of the Emergency Communications Section since 2000, summarized the research and development into component technologies applicable to disaster management conducted in the laboratories of CRL and exhibited them extensively at Tokyo International Fire and Safety Exhibition held at the Tokyo Big Sight in 2003 (Fig. 1). It was to be the first initiative that involved all of CRL that explicitly targeted disaster management.

The emphasis of the research and development into ICT for safety and security conducted by the Emergency Communications Section since then gradually moved from disaster management ICT to information security due

- System for distributing educational, local and disaster management information using pocket bell network
(Research Collaboration Office, Planning Department)
- Development of a safety confirmation system (IAA system) using the internet
(Emergency Communications Group, Information Communication Department)
- Application of RFID to disaster management: emergency information transmission with an RFID
(contracted research of the Ministry of Education, Culture, Sports, Science and Technology - Emergency Communications Group, Information Communication Department)
- Application of the RFID to disaster management: acceleration of damage estimation with an electronic nameplate (Emergency Communications Group, Information Communication Department)
- Next generation of firefighting radio communication system using IP
(Emergency Communications Group, Information Communication Department)
- Emergency medical support system in which different communication systems are integrated seamlessly
(Yokosuka Radio Communication Research Center, Wireless Communication Department)
- Disaster monitoring by unmanned airship: development of a stratospheric platform
(Yokosuka Radio Communication Research Center, Wireless Communication Department)
- Satellite digital transmission of disaster/disaster management information
(Kashima Space Communication Research Center, Wireless Communication Department)
- Real-time wide-range damage information collection system using aircraft or satellite communication
(Kashima Space Communication Research Center, Wireless Communication Department)
- Definite examination of the ground from above by using radio waves - imaging radar installed in aircraft (Pi-SAR) - (Climatic data system group, Electromagnetic Wave Measurement Department)
- Rapid detection of approaching tsunami using radar, research on tsunami/oceanic climate monitoring using oceanic radar (Okinawa Subtropical Environment Remote Sensing Center, Electromagnetic Wave Measurement Department)

* Division name, as of 2003

Fig.1 *Exhibition and items exhibited in 2003 Tokyo Int'l Fire and Safety Exhibition*

to the demands of time and with time elapsing sine the Great Hanshin Earthquake. As a result, the Laboratory was expanded to become the Information Security Center immediately before Jan. 2004, when NICT was established. Subsequently, it became the Information Security Research Center in April 2006. In the second medium-term plan, the Disaster Management and Mitigation Group in the Information Security Research Center took over themes on information security, which included research into disaster management ICT and content security. One of the reasons for the Disaster Management and Mitigation Group being engaged in research into encoding information in multimedia, as shown in this special issue, is the history.

The Disaster Management and Mitigation Group aimed directly at the technology for disaster management, not component technologies. Research and development into disaster management ICT, which is directly connected to everyday life, is a severe field. The results are not used and criticized with the lives saved justified against the budget used, unless the results satisfy the needs of the people[2]. Disaster management technology is not evaluated by the values of the component technologies used in the field but by the apparent convenience and robustness in use. There are many problems in disaster management that cannot be solved simply by technology. The author therefore considers that research into disaster management ICT should not be directed toward cutting-edge technology and that it should be carried out in the short term, as it is directed to practical application. For these reasons, the author tried to select a research theme that could be completed within the five years of the second medium-term plan. That is, research and development had to progress within the five years, the results had to be systematized for practical use, and the research had to yield academic activity and make a social contribution. Research and development was conducted, and a range of questions were considered, such as which technology is effective for making a social contribution, what can NICT, which is not a manufacturer or communication carrier, do regarding disaster management in the short term. With most R&D, a prototype is devel-

oped based on the component technologies that are established through R&D, and technologies that are useful in making a social contribution are developed based on the prototype. In contrast, in the case of the disaster management ICT, the author considered that such an approach would not yield technologies that are effective in making a social contribution in the short term. The reasons for this view were twofold: many of the advanced component technologies of NICT were yet to reach the stage of practical application, and there is a demand for older technologies in the field of disaster management. Thus, we took the opposite approach, as shown in Fig. 2, of first examining what things are in demand in the field of disaster management, identifying which prototype is needed for that purpose and obtaining the component technologies needed for the prototype in the short term. If the technologies could not easily be obtained by the Disaster Management and Mitigation Group itself in the short term and if the component technologies available in NICT were not applicable, we introduced the technologies from external organizations and modified them in NICT's way. Accordingly, the upper half of Fig. 2 shows the activities of the Disaster Management and Mitigation Group, i.e., a repetition of the cycle of introduction and modification of suitable component technologies, prototype development using them and verification of the prototype. There may be some argument on whether such a strategy is acceptable for a technology research organization, in which research and development of component technologies are essential. However, the author considers it inevitable for the Disaster Management and Mitigation Group to have such a strategy, which has an explicit goal of disaster management, not component technology, so that it can exhibit its unique position. Since the former Emergency Communications Section was unable to establish a distinct presence in the field of disaster management even after ten years, when the Disaster Management and Mitigation Group was established, the author contemplated the optimum means by which the Group could make its presence felt in the field of disaster management with limited resources. Figure 3 shows the approach we took, where a flower viewed from a distance represents the activities of the Disaster Management and Mitigation Group. Each researcher in the Disaster Management and Mitigation Group (center of the flower) collaborates in his or her field with external organizations (petals of the flower).

To promote collaboration between the Disaster Management and Mitigation Group and external organizations (petals), the Group hired disaster management researchers familiar with ICT, rather than ICT researchers familiar with disaster management. As a result, the Group brought together researchers for example specializing building disaster

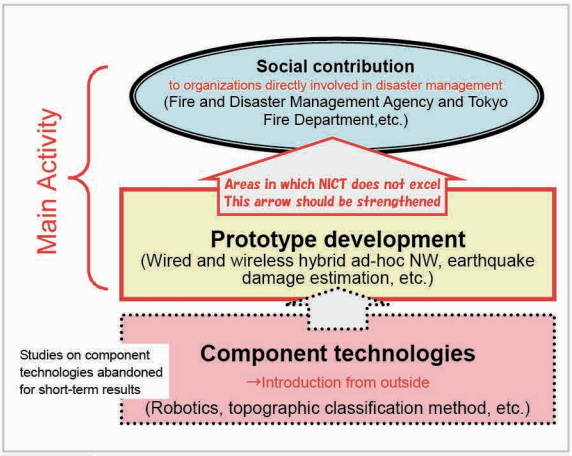

Fig.2 *Strategy adopted by the Disaster Management and Mitigation Group*

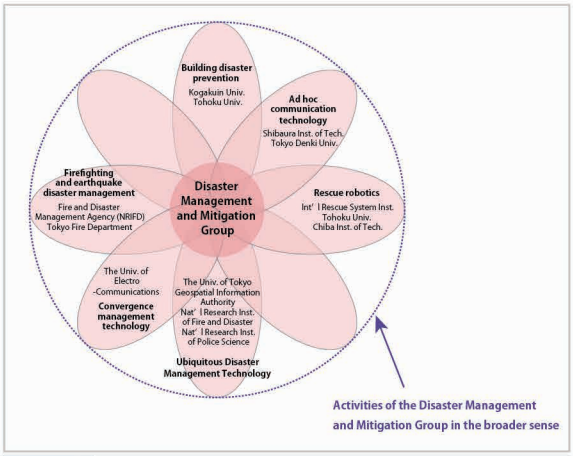

Fig.3 *Disaster Management and Mitigation Group shown as flower*

management, rescue robotics and firefighting, and those engaged in the fields that had nothing to do with NICT. The link between individual researchers of the group in the professional field is inevitably weaker, and their only point of commonality is their passion for disaster management. The author intended to establish, within five years, an impression that the NICT Disaster Management and Mitigation Group is involved in any field related to disaster management by enlarging the flower, even if the group is small. The strategy proved to be successful because at least the presence of NICT is recognized by many disaster management organizations within these past five years, although NICT was quite anonymous earlier.

To strengthen the petals of the flower, the Group has acquired many competitive research funds with respective organizations, as shown in Fig. 4. We believed that the acquisition of competitive research funds through joint application with external organizations is important for enhancing collaboration and it provides objective proof that the research plan is adequate and the research potential is strong.

The disaster management ICT can be divided generally into the disaster management of ICT and ICT for disaster management. Research into the disaster management of ICT is aimed at creating fully dependable communication, i.e., improving the robustness of the network itself, which suits NICT. However, to create an unbreakable network, it is more effective to have daily routine operations performed by communication carriers, such as ensuring the reliability of the power source and improving the earthquake resistance of the equipment, than to improve ICT. Therefore, there is no possibility that NICT is involved in these operations. Studies into fully resilient networks based on a newly developed architecture are no longer included in the scope of studies into disaster management ICT, and the results would not be readily accepted in the field of disaster management. Under these circumstances, it is very likely that there would

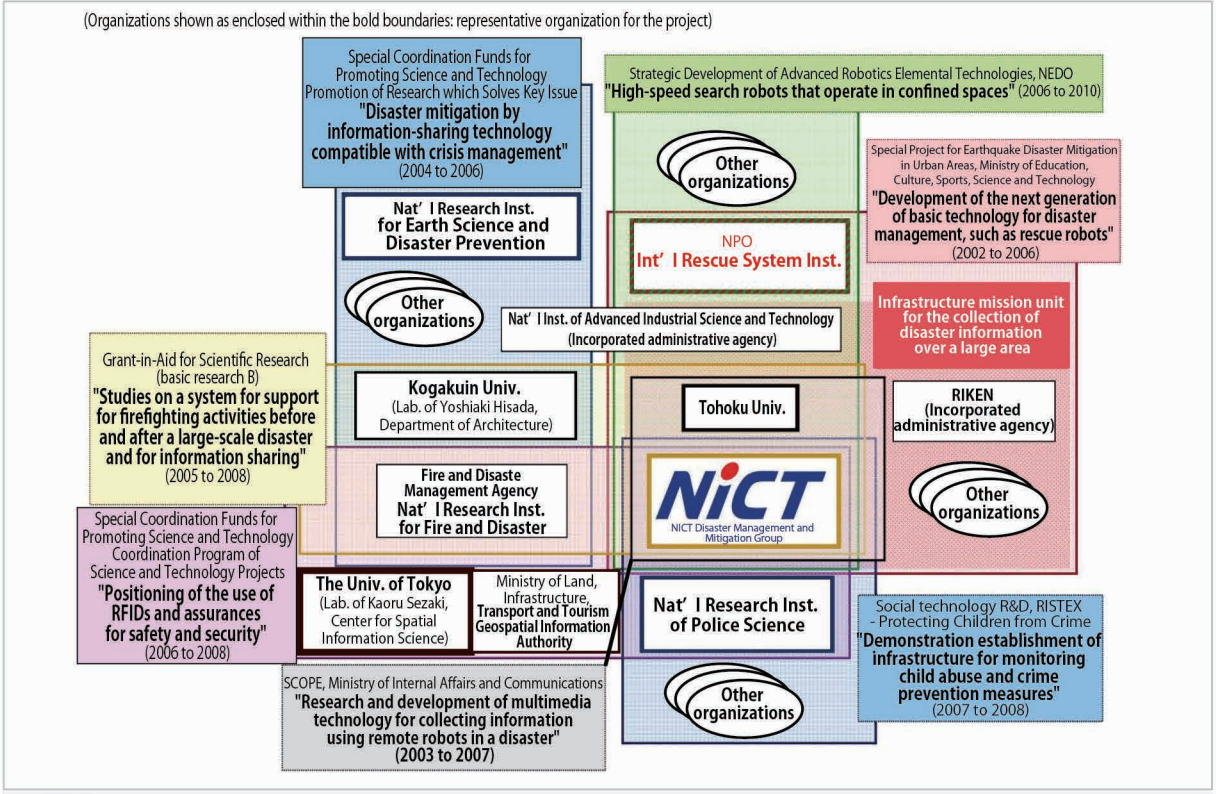

Fig.4 *Map of collaborating studies on competitive research funds conducted by the Disaster Management and Mitigation Group*

be no social contribution when only the output of disaster management is considered.

On the other hand, if we take the approach of ICT for disaster management, the pursuit of ICT that is directly effective in disaster management results in an increase in the number of components of non-advanced ICT. This is the domain of private companies and users, and thus it is quite questionable whether NICT would select it as an area of research. Of course, there is no ICT that can be used exclusively for disaster management.

Pursuit of the disaster management of ICT, i.e., of a fully resilient network, results in studies being conducted outside the research scope of disaster management. Therefore, such a study cannot be the subject of a research group that promotes disaster management as its output. On the other hand, pursuit of ICT for disaster management results in studies outside the scope of the studies conducted in NICT. The five years during which the Disaster Management and Mitigation Group operated was a period during which the group tackled this dilemma and searched for definite disaster management ICT studies that should be conducted within NICT.

The process for achieving the objectives that were set is reviewed in Chapter **3** in chronological order, recognizing the importance of such everyday collaborative studies with other organizations over the last five years.

3 Activities of the Disaster Management and Mitigation Group over the last five years

3.1 April 2006

3.1.1 Establishment of the group

The Disaster Management and Mitigation Group was established on April 1. Two research projects were launched, namely, the creation of an emergency communication network (communication that is resilient to disaster) and ubiquitous disaster management and mitigation (ICT that is useful in the event of a disaster). The Group pursued needs-based research and development for the first project, taking into consideration the needs for ICT in disaster management or mitigation and searching for technologies for that purpose.

3.1.2 Development of a system for gathering information on the extent of damage using hybrid RFID, and participation in a simulation drill

Group Leader Takizawa had been developing a system for collecting/sharing information on damage using RFID as an electronic label for use in large-scale disasters since 2001. It is ubiquitous technology to which disaster management and mitigation ICT is applied, and it has various possible applications, such as the emergency risk assessments of buildings, confirming people's safety, and searching for victims.

Collaboration in prototype development with the Result Development and Promotion Group led to the creation of a hybrid RFID tag that combined a passive tag (without a battery) and an active tag (with a battery) (Fig. 5) and a reader/writer unit (Fig. 6). These devices made it possible for investigators in the disaster-stricken area to use them practically by receiving the transmission from an active tag and exchanging detailed information with the passive tag at a location closer to the tag.

Members of the group used these devices when they participated in the simulation drill using a rescue robot. The drill was held under the Special Project for Earthquake Disaster Mitigation in Urban Areas by the Ministry of Education, Culture, Sports, Science and Tech-

Fig.5 *Hybrid tag attached to a damaged building (left), and triage tag attached to victim transported (right)*

nology in the Tachikawa Training Ground of the Tokyo Fire Department, 8th Fire District HQ on April 22 and 23. The aim of the experiment was to demonstrate that the developed devices could operate without any problems in a practical simulation, where a victim buried under rubble (a mannequin) was rescued using the rescue robot. A triage tag (prioritized tag for treatment and transportation) to be attached to rescued victims and a hybrid tag to be attached to damaged buildings, developed by NICT, were used in the experiment, demonstrating that the RFID system can be used without any problems in an actual disaster setting by professional firefighters in their rescue operations (Fig. 7).

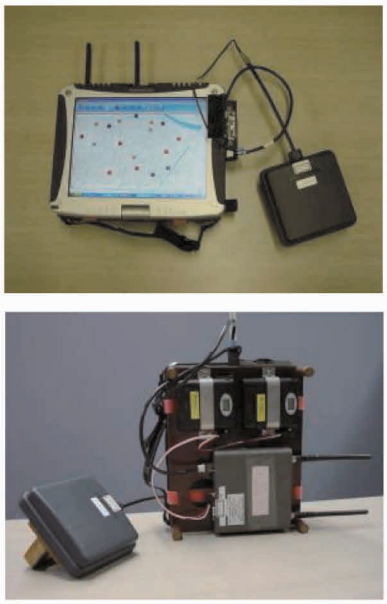

Fig.6 *Hybrid RFID reader/writer unit (front face: GIS and passive tag reader/writer, rear face: active tag receiver)*

3.2 May 2006

3.2.1 Acquisition of competitive research funds (relevant to RFID)

The Disaster Management and Mitigation Group initiated the following ongoing research projects with competitive research funds: "Special Project for Earthquake Disaster Mitigation in Urban Areas, development of the next generation of basic technology for disaster management, such as rescue robots" (studies on emergency information transmission system using wireless tags) (2002 to 2006), research under contract sponsored by the Ministry of Education, Culture, Sports, Science and Technology, which was acquired when the Group was the Emergency Communications Group; "Research and development of multimedia technology for collecting information using remote robots in a disaster" (2003 to 2007), a project that is part of the Strategic Information and Communications R&D Promotion Programme (SCOPE) under the Ministry of Internal Affairs and Communications; and "Studies on a system for supporting firefighting activities before and after large-scale disasters and for information sharing" (2006 to 2008) directed by Group Leader Takizawa basic research B under the Grant-in-Aid for Scientific Research. In addition, a project was newly adopted for the "positioning and the use of RFIDs and assurances for safety and security," which was applied to the project entitled "Effective and Efficient Promotion of Special Coordination Funds for Promoting Science and Technology: Ubiquitous Network – Application of RFID Technology" under the Special Coordination Funds for Pro-

Fig.7 *Simulation drill using rescue robot (Tachikawa Training Ground, 8th Fire District HQ, Tokyo Fire Department)*

moting Science and Technology, together with Assistant Professor Kaoru Sezaki, Center for Spatial Information Science, The Univ. of Tokyo, as well as The Geospatial Information Authority of Japan (GSI), the Nat'l Research Inst. of Fire and Disaster and the Nat'l Research Inst. for Police Science. In this way, a three-year project that continued until 2008 started. NICT was a second-in-command organization overseeing studies into assurances of safety and security using positioning technology, while directing two organizations, the Nat'l Research Inst. of Fire and Disaster and Nat'l Research Inst. for Police Science (Fig. 8).

3.2.2 Presentation of the results on theory of congested traffic during disaster

In the event of a disaster, such as an earthquake, communication networks become congested and it becomes difficult to make a call, such as when people call their friends and loved ones to check if they are okay. To solve this problem, Senior Researcher Kazunori Okada proposed a system of imposing time restrictions on calls so that communication resources could be shared and communication could be made consistently. Traffic theory analysis of this control was carried out in collaboration with Professor Takahashi, Waseda Univ., who was at that time an authority in communication traffic theory in the NTT laboratory, Professor Shikata of Shobi Univ., and Professor Komatsu of Waseda Univ., who was a member of the Committee on Information Security Support. Professor Takahashi presented some of the results on May 19 at the Technical Committee on Information Networks (IN) of the Inst. of Electronics, Information and Communication Engineers. The presentation revealed that restricting the communication time leads to a reduction in the average and the variation coefficient, streamlining the traffic and dissipating the congestion, as predicted by the traffic theory, and provides an approximate expression that takes into consideration repeated calls caused by the restriction in communication duration. Traffic behavior and the theory of congestion during a disaster when communication is time-restricted have been studied since that time in collaboration with these universities.

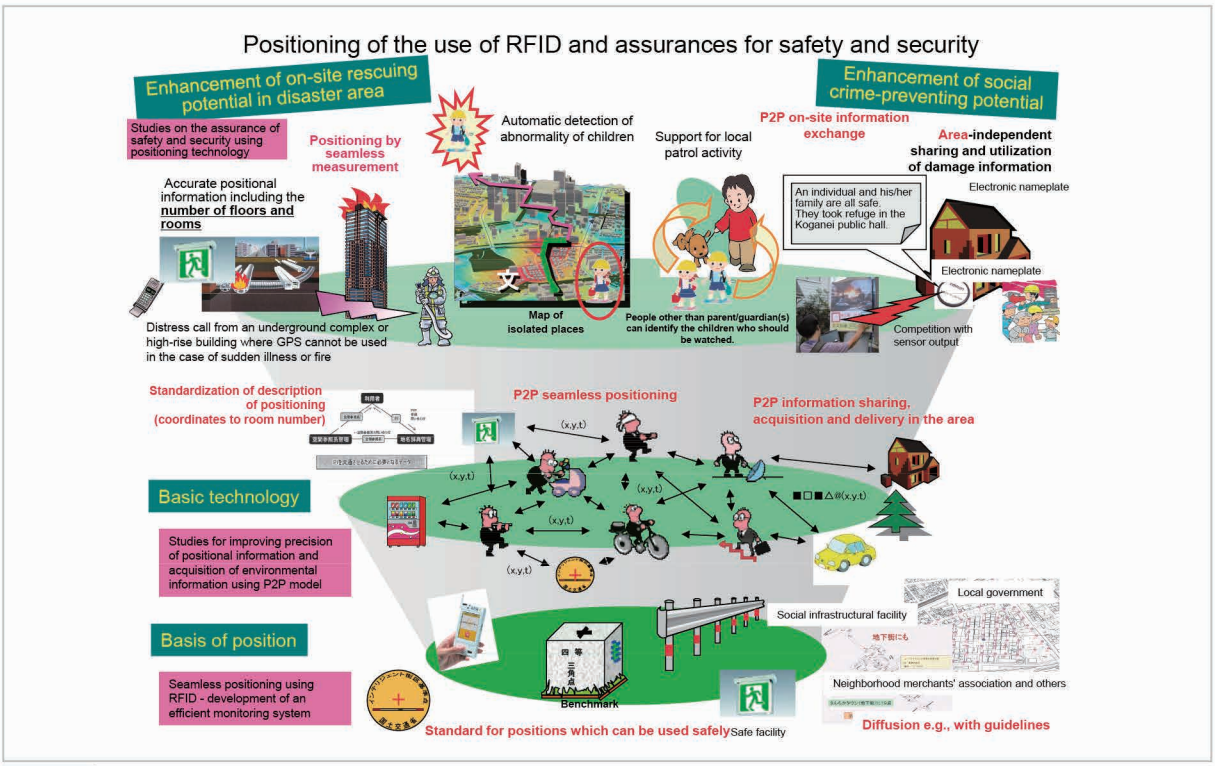

Fig.8 *Summary of positioning of the use of RFIDs and assurances for safety and security*

3.3 June 2006

3.3.1 Presentations at academic meetings

In WESPAC IX 2006 (the 9th Western Pacific Acoustics Conference) held in Seoul, Korea on June 26, Expert Researcher Kotaro Sonoda gave a presentation entitled "Digital Audio Watermarking Based on Quantization Index Modulation of Wavelet Domain". Katsunari Yoshioka, a researcher from the Network Security Incident Response Group gave a presentation entitled, "Encoding Information in Emergency Public Address Alarms," together with Expert Researcher Kotaro Sonoda and Group Leader Takizawa (Fig. 9).

3.3.2 Simulation drill using RFID damage information collection system (2nd)

The group participated in the second simulation drill on June 24. The drill was held in the Tachikawa Training Ground of the Tokyo Fire Department, 8th Fire District HQ, and was similar to the drill in April (Fig. 10). The drill made use of the damage information collection system using RFID, which was developed mainly under the Special Project for Earthquake Disaster Mitigation in Urban Areas of the Ministry of Education, Culture, Sports, Science and Technology. This drill assumed there was an NBC (nuclear/biological/chemical) terrorist attack in an underground complex. A tag was attached to the entrances to hot zones (dangerous zones) as a marker during the search for victims and the operations to remove hazardous substances using a rescue robot. In this drill, the results of the search operations (e.g., the examination results of exposed victims) were written on the tag at the site and the details of the site were electronically transmitted via the tag accurately to the following rescue team.

Because this drill focused on measures to terrorism, it created considerable media interest. Nat'l and local newspapers, including *The Asahi Shimbun* and *The Nikkei*, reported the drill and an interview appeared on the NHK program, "Methods of Professionals" (the program after Project X).

Fig.9 *Expert Researcher Kotaro Sonoda making a presentation at WESPAC 2006*

3.4 July 2006

3.4.1 Patent granted (relevant to measures to the congestion during disaster)

On June 30, Senior Researcher Okada obtained the following patent concerning the means of controlling repeated calls, which is a

Introduction of search robot into the hot zone → Removal of hazardous substances (spray cans) → Attachment of a tag to the entrance of the hot zone (→ The following rescue team obtains information about the site)

Fig.10 *Simulation drill using RFID-based damage information collection system (held in Tachikawa Training Ground of Tokyo Fire Department, 8th Fire District HQ)*

significant cause of congestion during disaster.

Title of invention: Method and apparatus of controlling repeated calls in communication systems (Patent No. 3820447)

Repeated calls, i.e., demand for repeated connection after a communication failure, have a significant influence on congestion, such as during a disaster. There should be some restriction on repeated calls while ensuring fairness. The patent proposes a control method for restricting the number of repeated calls accepted and the waiting time of the repeated call, based on information concerning past communication time, the situation at the end of previous communication and the acceptance number for repeated calls stored in the terminal, such as the cell phone.

3.4.2 Competitive research funds acquired (related to ad hoc communication during disaster)

Research into high-speed search robots in confined spaces, which the Int'l Rescue System Inst. proposed as a representative, and which was adopted as the contracted study, "Strategic Development of Advanced Robotics Elemental Technologies – RT (robot technology) Systems where a Robot Moves in Damaged Buildings" (in the field of robots for special environments). This research was publicly offered as a research project in the "21st-Century Robot Challenge Program," sponsored by the New Energy and Industrial Technology Development Organization (NEDO) of the Ministry of Economy, Trade and Industry (Fig. 11). In the project, NICT mainly took charge of one of the subordinate studies, "Research and development of an ad hoc network for stabilized transmission of the measurement data including multiple images from high-speed mobile units in confined space and the operational directive data thereto". The duration of the project was three years in principle, until 2008 or at most, five years.

This project is closely related to the contracted research, "Research and development of multimedia technology for collecting information using remote robots in a disaster," which is in progress under the Special Project

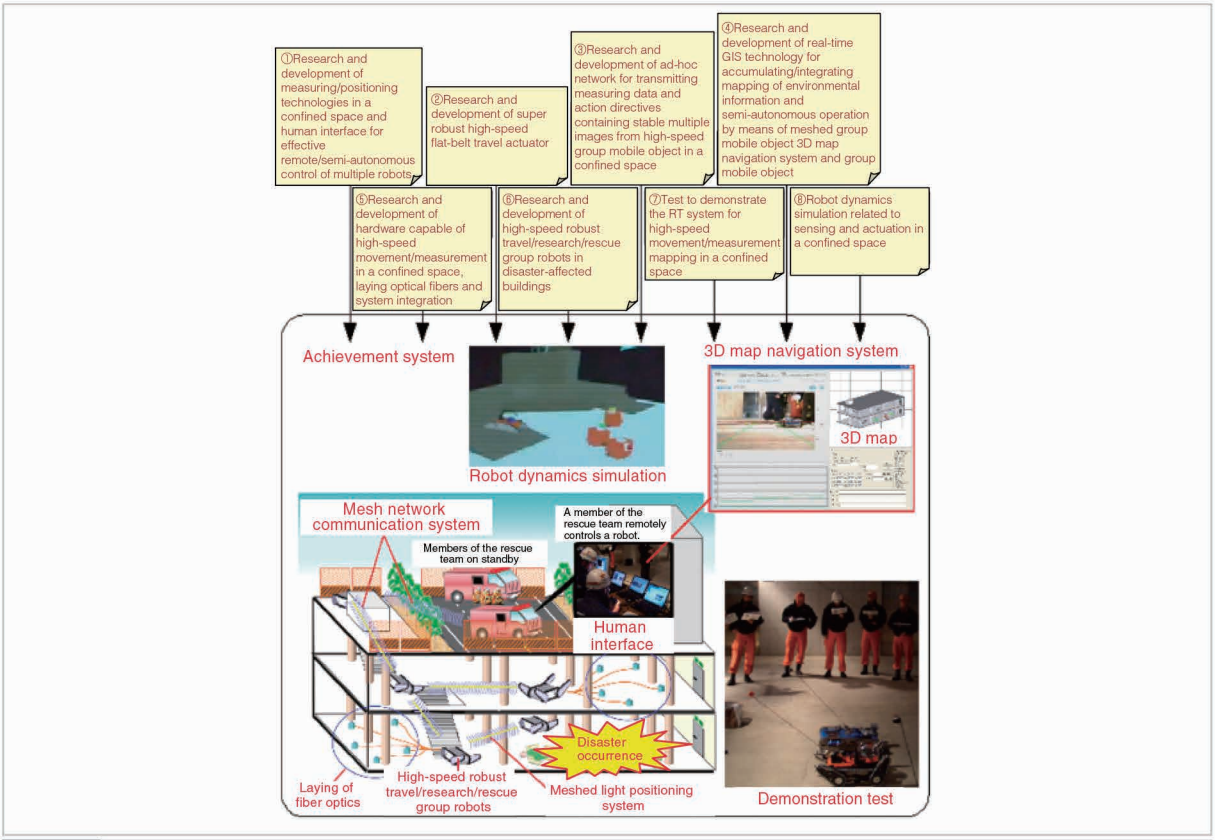

Fig.11 *Summary of the high-speed search robot in confined space*

for Earthquake Disaster Mitigation in Urban Areas of Ministry of Education, Culture, Sports, Science and Technology, and SCOPE of the Ministry of Internal Affairs and Communications.

3.5 Aug. 2006

3.5.1 Publication and magazines

(1) ROBOCON Magazine (Ohmsha) (August Ed.)

The RFID system of Group Leader Takizawa was introduced as a system developed under the Special Project for Earthquake Disaster Mitigation in Urban Areas in an article on rescue robots published in a bimonthly magazine.

(2) Electromagnetic wave and communication (Gijutsu-Hyohron Co. Ltd.)

Guest Researcher, Jouji Suzuki, this month published an introductory book based on his research experience in the former Radio Research Laboratory/Communications Research Laboratory.

He became a Guest Researcher of the Disaster Management and Mitigation Group in April and since then has been a research/development member working on the technology for convoluting information on sound. He has been active as a member of the Earthquake Early Warning Discussion Committee in the Meteorological Agency.

3.6 Sep. 2006

3.6.1 Senior Researcher Koichi Gyoda received an award for distinguished service in his activities for the Inst. of Electronics, Information and Communication Engineers.

In the general meeting of the Communications Society of the Inst. of Electronics, Information and Communication Engineers held on Sep. 20, Senior Researcher Gyoda received an award for distinguished service in social activities in 2006 for the following reasons (Fig. 12): He managed ten research meetings as secretary of the Technical Committee on Communication Quality, he planned and organized two QoS workshops, a national meeting and a society meeting in the period spanning two years, and thus contributed significantly to the activities and development of the research meeting. In addition, he participated as a member of the ad hoc committee for self-financing of the Communications Society and helped to prepare the codes of the society.

3.6.2 Demonstration test in disaster management drill at 5-chome, Kamijujo, Kita-ku, Tokyo

On Sep. 3, a field test of the RFID-based damage information collection system was conducted in a disaster management drill held by local communities (Fig. 13). In this experiment, a test was conducted in which two hybrid wireless tags (one active, containing a battery, and one passive, not containing a battery) were attached to postulated damaged sites. Victims and an investigator, who was not familiar with the area, searched for the tags using the transmission from the active tags, collecting information on the damage (col-

Fig.12 *Senior Researcher Koichi Gyoda receiving award for distinguished service in society activities*

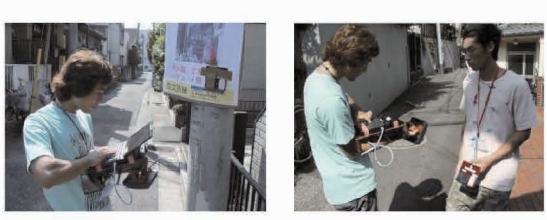

Fig.13 *Demonstration test in disaster management drill in 5-chome, Kamijujo, Kita-ku, Tokyo*

lapsed buildings, number of victims and such-like) and entering the information on the tag. The aim of the test was to examine the distance the transmission could travel and the operability of the device in the field.

3.6.3 Automatic Recognition Exposition/Auto-ID Security Expo

Six organizations participating in the project of the Special Coordination Funds for Promoting Science and Technology, which were described in ***3.2.1***. NICT, Special Project for Earthquake Disaster Mitigation in Urban Areas, jointly operated a booth in the professional expo concerning automatic recognition technology and devices such as bar codes, RFID and IC cards, which was held in Tokyo Big Sight on Sep. 13 to 15 (Fig. 14). The following projects in NICT were presented: the damage information collection system using RFID; the fabric-based RFID and the UHF-band RFID reader using software wireless technology of the New Generation Wireless Communications Research Center; and the research and development into applied ITS technology using RFIDs of the Yokosuka ITS Research Center.

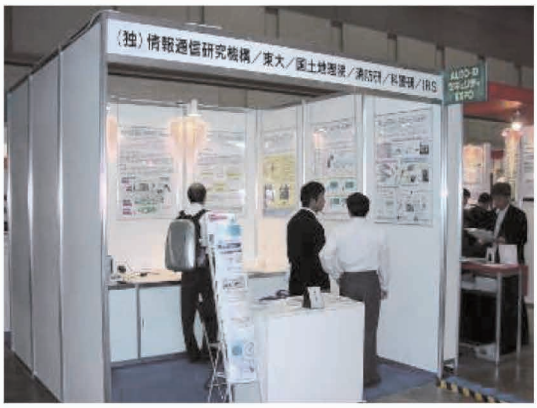

Fig.14 *Automatic Recognition Exposition*

3.6.4 Presentation at WPMC 2006 (Sep. 18 to 20)

Expert Researcher Hoang Nam Nguyen gave a presentation, together with Senior Researcher Koichi Gyoda, entitled "Secure Communication Provision in Mobile Communication Systems for Emergency and Disaster Management" in the 9th Int'l Symposium on Wireless Personal Multimedia Communication held in San Diego, the United States.

3.7 Oct. 2006

3.7.1 Demonstration test in the drill By Japan Disaster Relief Team (JDR) of Int'l Cooperation Agency (JICA)

On Oct. 4, a drill of Japan Disaster Relief Team of JICA was held in Hyogo prefectural Disaster Management Park, Miki City, Hyogo. Group Leader Takizawa participated in the drill, conducting a demonstration test of the damage information collection system using RFID (Fig. 15). In this test, a victim (a mannequin) buried under rubble was searched for and rescued with a rescue robot by using a hybrid RFID with an active RFID (containing a battery) and a passive RFID (not containing a battery). Application of the system was examined for triage (prioritized treatment and transportation) of victims and for indication of the completion of the rescue, as it is attached to damaged buildings.

3.7.2 Exhibition

(1) Int'l Frontier Industry Messe 2006

An applied RFID-based disaster management system was exhibited at the booth of NICT Incubations in an exposition held in Kobe Int'l Exhibition Center (Fig. 16) on Oct. 4 and 5.

Fig.15 *Demonstration test in the drill of JICA int'l emergency rescue team (Hyogo Prefectural Disaster Management Park)*

(2) Security & Safety Trade Expo

Congestion-controlling technology, ad hoc network, application of RFID-based disaster management and acoustic electronic watermark were exhibited in the exposition held in Tokyo Big Sight on Oct. 24 to 26 (Fig. 17). The technology presented was reported in Robot Watch and described in Radio Life magazine (Nov. 25 edition).

(3) Local ICT Future Festa in Niigata

The author participated in the event held in Toki Messe in Niigata City on Oct. 27 to 29, and explained the ad hoc network and application of the RFID-based disaster management at the exhibition booth of NICT. The author helped in the demonstration and exhibition of the rescue robot by Nagaoka Univ. of Tech.(Fig. 18). In the seminar on ICT-based disaster management information sharing held by NICT (contracted research), transmission of the data used in the demonstration test in the former Yamakoshi-mura under the Special Project for Earthquake Disaster Mitigation in Urban Areas was demonstrated.

Fig.16 *Int'l Frontier Industry Messe 2006 (Kobe Int'l Exhibition Center)*

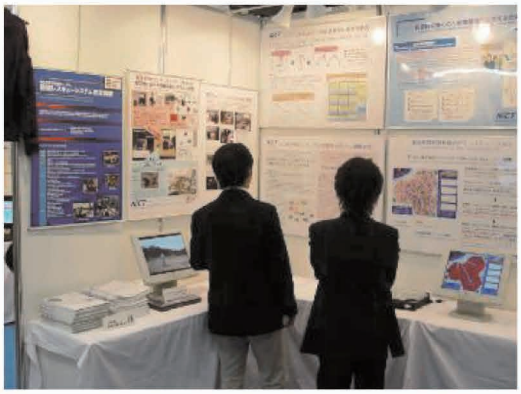

Fig.17 *Security & Safety Trade Expo (Tokyo Big Sight)*

3.7.3 Presentation at CSS 2006

In the Computer Security Symposium (CSS 2006) held in Palulu Plaza Kyoto by the Information Processing Society of Japan on Oct. 26, Group Leader Takizawa gave a presentation entitled "Demonstration of a Means of Prohibiting an RFID Link, Based on ID Rewriting by the Tag Owner" (Fig. 19). The presentation covered a proposal concerning a means for solving the problems associated with the invasion of privacy essentially by the detection of RFID signals, which was the result obtained earlier in the former Security Improvement Group.

3.8 Nov. 2006

3.8.1 Exhibition and simulation drill in underground complex (Nov. 5)

Research results obtained in the Special

Fig.18 *Local ICT Future Festa in Niigata (Toki Messe)*

Project for Earthquake Disaster Mitigation in Urban Areas were demonstrated in the underground complex of JR Kawasaki Station and the damage information collection system using RFID was exhibited there. At midnight, after the business hours of the underground complex, there was a simulation drill, together with the Kawasaki City Fire Department. There was then a demonstration of information sharing, based on a triage tag that was attached to a victim according to the severity of the symptoms (red: severe, yellow: moderate, green: not severe) after search and rescue of the victim by a rescue robot (Fig. 20).

Fig.19 *CSS 2006 (Palulu Plaza Kyoto)*

3.8.2 Demonstration exhibition of rescue robot and simulation drill (Nov. 23 to 24)

A demonstration was held concerning the research results obtained in the Special Project for Earthquake Disaster Mitigation in Urban Areas in Kobe Int'l Exhibition Center and damage information collection system using RFID was exhibited. In addition, a simulation drill was conducted in the collapsed-house test facility of the Int'l Rescue System Inst., demonstrating information sharing by using a building tag showing the completion of rescue and a triage tag showing the severity of the victim's symptoms, after search and rescue of a mannequin by a rescue robot (Fig. 21).

3.8.3 Symposium: "IT Society - Safety and Security During Disasters" (Nov. 27)

In the symposium held by the Cyber Assist Consortium (Information Technology Research Inst., AIST) in the Akihabara Convention Center, Group Leader Takizawa gave a lecture entitled "The Positioning of the Use of RFIDs and Assurances for Safety and Security" (Fig. 22).

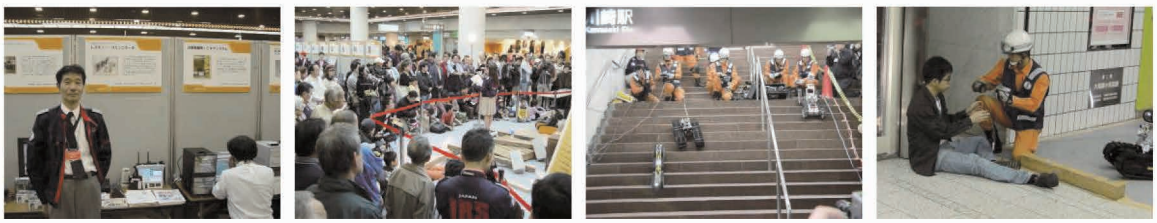

Fig.20 *Demonstration and simulation drill in the underground complex of JR Kawasaki Station (far right: a triage tag (green: not severe) is attach around the neck of a victim by a firefighter)*

Fig.21 *Demonstration exhibition of rescue robot and simulation drill (2nd from right: rescue completion tag attached to the building, far right: triage tag (red) indicating severe damage)*

Fig.22 Symposium "IT society - safety and security during a disaster"

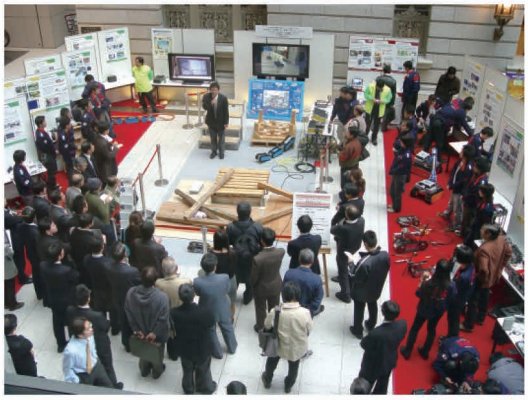

Fig.23 Concluding symposium on Special Project for Earthquake Disaster Mitigation in Urban Areas

3.9 Dec. 2006

3.9.1 Presentation at an international conference (IIHMSP'06)

Expert Researcher Kotaro Sonoda attended the 2006 IEEE Int'l Conference on Intelligent Information Encoding and Multimedia Signal Processing held in Pasadena, the United States on Dec. 18 to 20 and gave a presentation entitled "Information Encoding in Lossless Data Compression" with Researcher Katsunari Yoshioka of the Network Security Incident Response Group as the lead author.

3.9.2 Activities in the Special Project for Earthquake Disaster Mitigation in Urban Areas

(1) Concluding symposium

A joint symposium summarizing the results obtained during the five-year project was held in the Tokyo Int'l Forum and in Meiji Yasuda Life Insurance Company Building at Marunouchi on Dec. 21 and 22. The group of field Ⅲ.4, "Development of Next-Generation Basic Technology for Disaster Management such as Rescue Robot" gave a presentation on the results and a demonstration on the first day, while NICT presented an exhibition on the RFID system for the collection of damage information (Fig. 23).

The Special Project for Earthquake Disaster Mitigation in Urban Areas was a large contracted research project spanning four large fields, including rescue robots. However, this symposium brought to a close the research activities spanning five years.

(2) Seminar by the System Integration Division of Society of Instrument and Control Engineers (SICE SI2006)

In the session of the Special Project for Earthquake Disaster Mitigation in Urban Areas held by the Society in Sapporo Convention Center on Dec. 15, Group Leader Takizawa gave a presentation on progress in the research, "Development of a Damage Information-Sharing System Using Hybrid Wireless Tags".

(3) Participation in the demonstration test of Kanto Bureau of Telecommunications

The committee for examining the possibility of constructing an ad hoc wireless network for evacuating and providing guidance to commuters unable to get home in the event of an earthquake in the Tokyo metropolitan area, in the Kanto Bureau of Telecommunications, gave an open demonstration test mainly in the Shibuya Ward Office on Dec. 16 (Fig. 24). In the test, the Disaster Management and Mitigation Group placed the rescue communicator for the collection of damage information developed jointly in the Special Project for Earthquake Disaster Mitigation in Urban Areas at a bus stop and demonstrated that it functions as a relay node for wireless LAN ad hoc network (Fig. 25).

Fig.24 Group Leader Takizawa explaining the rescue communicator

3.10 Jan. 2007

3.10.1 Acquisition of patent Concerning a Method of Controlling Congestion of Portable IP Telephone Systems during a Disaster

Senior Researcher Okada and others obtained the following patent, together with Mitsubishi Electric Corp.:

Takashi Sakakura (Mitsubishi Electric Corp.), Senior Researcher Kazunori Okada, and Masahiro Kuroda (NICT): "Voice communication system and peripheral router," Patent No. 3899463

This patent concerns a control method for preserving favorable voice communication independently of the influence of load, by inhibiting communication in each session or by switching to semi- or full-duplex communication according to the congestion, for example, during a disaster, in a portable IP telephone system connected to an IP network.

3.10.2 Presentations at academic meetings

(1) The following presentation was given at the workshop for the method of automatically designing multi-dimension mobile information communication network of the Japan Society for Simulation Technology held in Niigata Toki Messe on Jan. 18.

- Shinya Semba (Trainee/The Univ. of Electro-Communications), Okada, Gyoda, Nam, and Takizawa: "Discussion on various characteristics of cell phone network in the presence of non-operating base stations during a large-scale disaster"

(2) The following presentation was given in the meeting on communication quality research held by the Inst. of Electronics, Information and Communication Engineers in Kitakyushu-Asia-Pacific Import Mart on Jan. 25.

- Gyoda, Nam, Okada, and Takizawa: "Basic studies on an emergency commu-

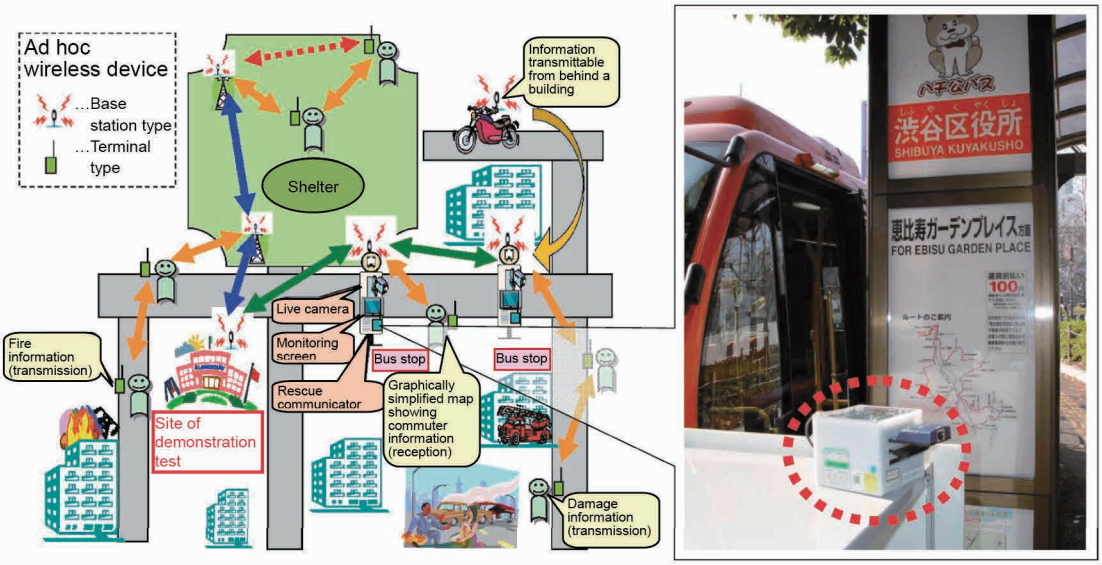

Fig.25 Demonstration test by Kanto Bureau of Telecommunications (red circle: rescue communicator)