

# 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, Technology 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

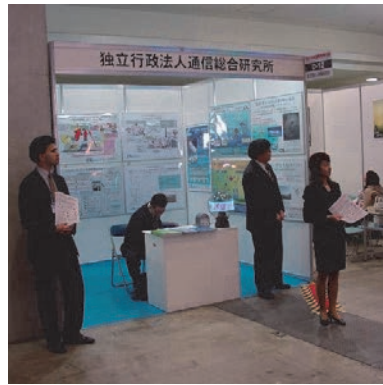
was aware of the usefulness of ICT (information communication technology) as an established technology in the event of a disaster, and he repeatedly emphasized the fact in his lectures. Nevertheless, he could not help feeling a sense of helplessness in the face of a disaster of this magnitude, reflecting 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 since 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.

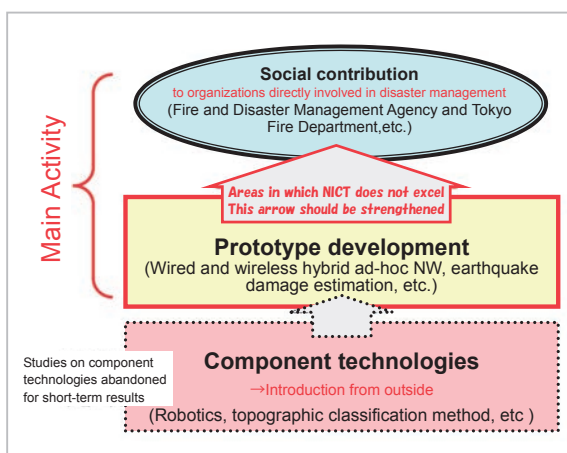
The Disaster Management and Mitigation Group aimed directly at the technology for disaster management, not component technologies. Research and development into disaster management ICT, which is directly connected to everyday life, is a severe field. The results are not used and criticized with the lives 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-

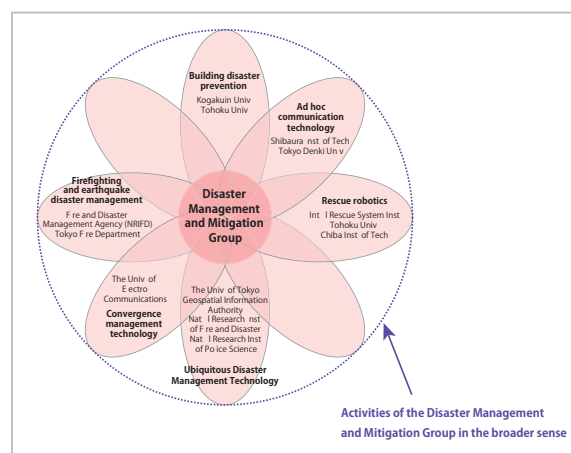
oped based on the component technologies that are established through R&D, and technologies that are useful in making a social contribution are developed based on the prototype. In contrast, in the case of the disaster management ICT, the author considered that such an approach would not yield technologies 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



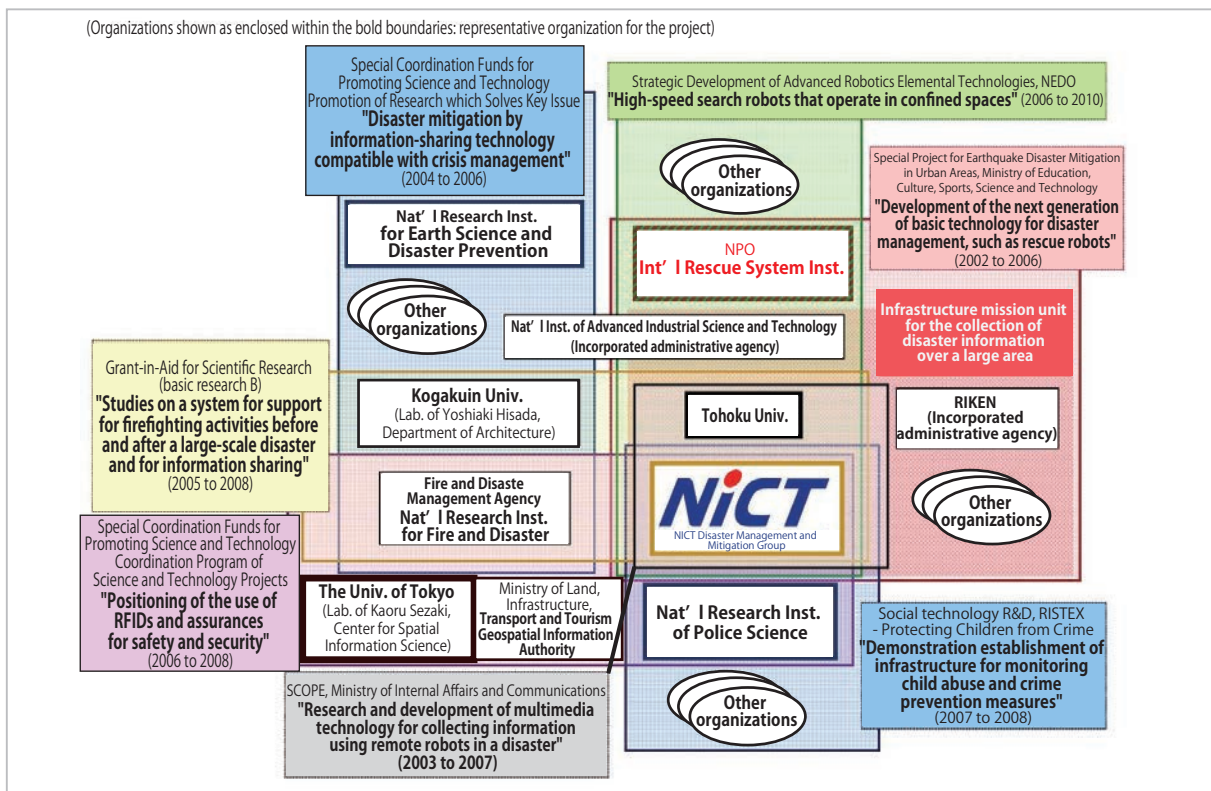
**Fig.3** Disaster Management and Mitigation Group shown as flower

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-



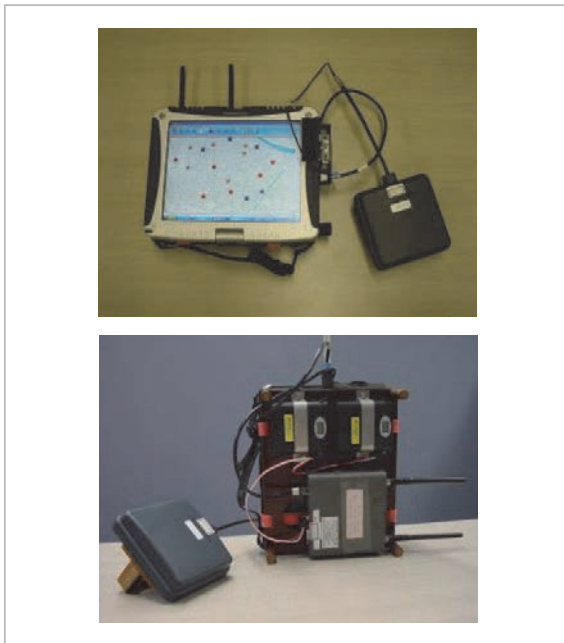
**Fig.5** Hybrid tag attached to a damaged building (left), and triage tag attached to victim transported (right)

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).

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



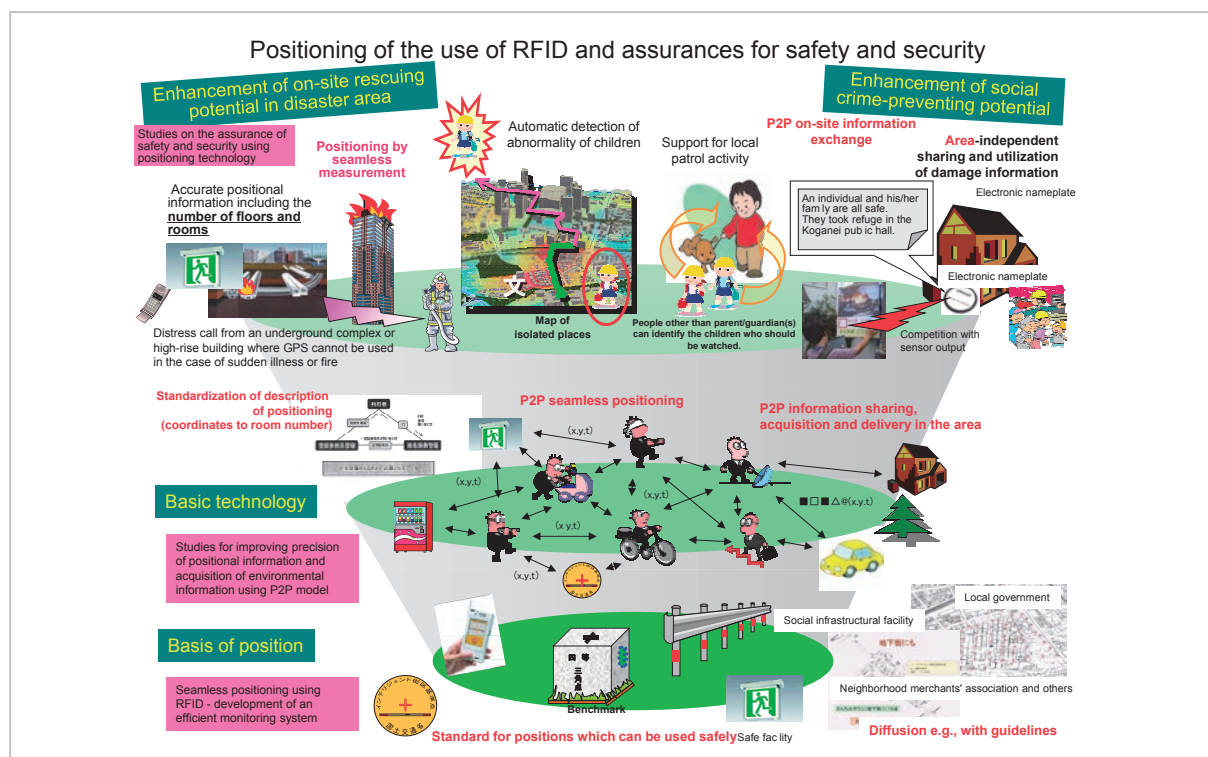
**Fig.7** Simulation drill using rescue robot (Tachikawa Training Ground, 8th Fire District HQ, Tokyo Fire Department)

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).

### 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



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



**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

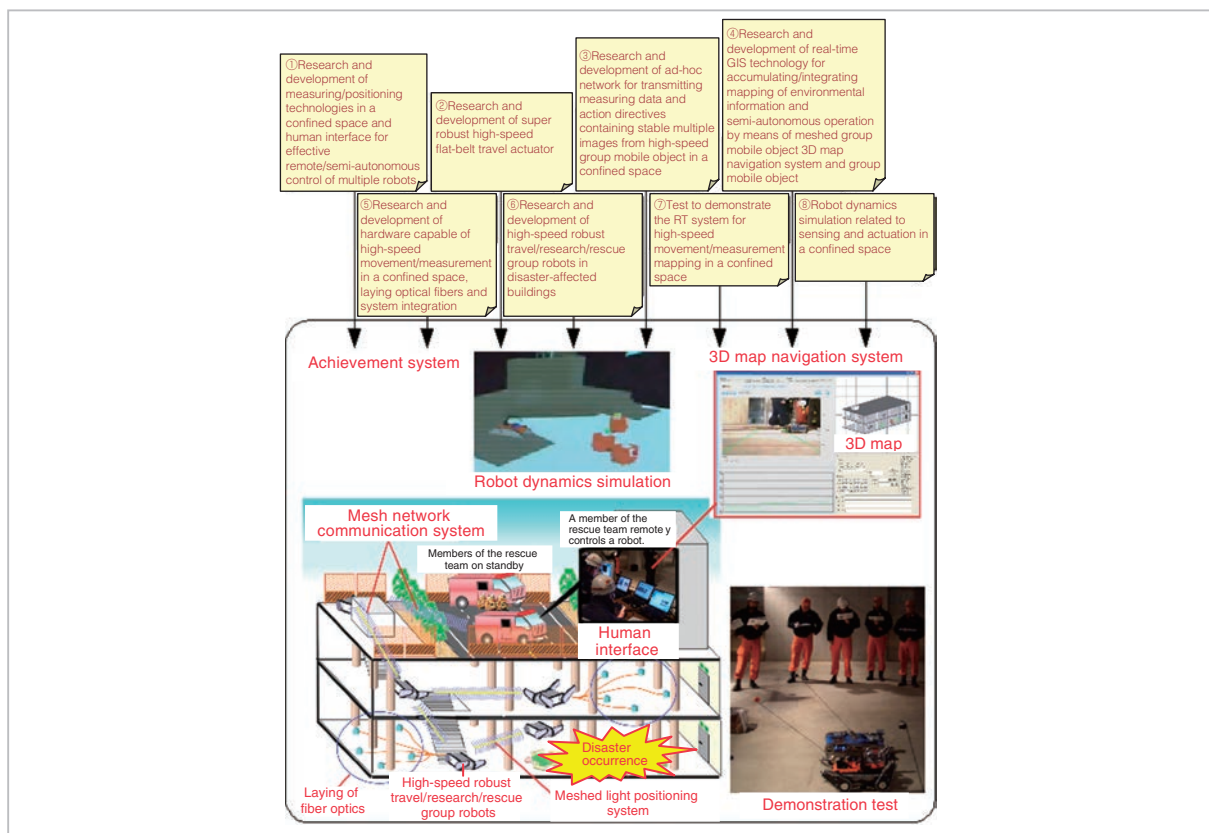


Fig. 11 Summary of the high-speed search robot in confined space

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-

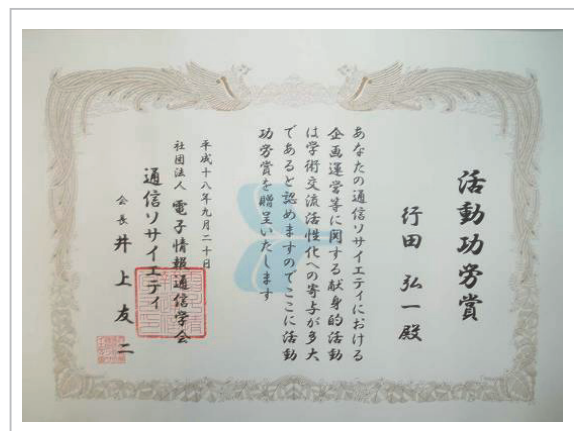


Fig. 12 Senior Researcher Koichi Gyoda receiving award for distinguished service in society activities

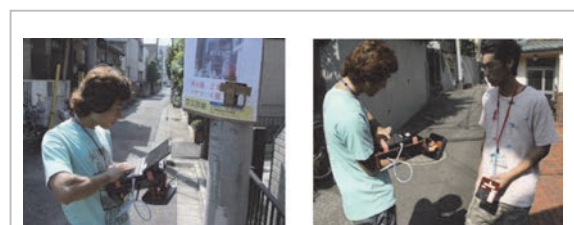


Fig. 13 Demonstration test in disaster management drill in 5-chome, Kamijujo, Kita-ku, Tokyo

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 demon-

stration test in the former Yamakoshi-mura under the Special Project for Earthquake Disaster Mitigation in Urban Areas was demonstrated.

**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.

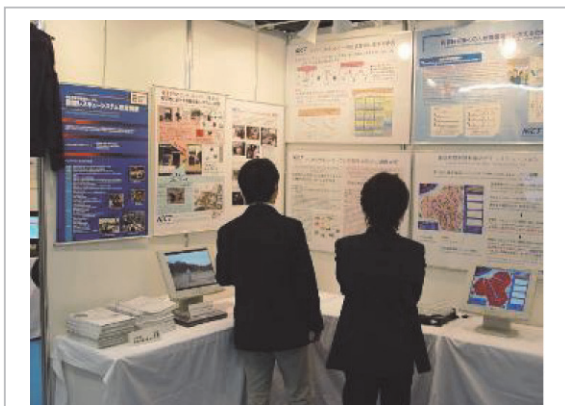
**3.8 Nov. 2006**

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

Research results obtained in the Special



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



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



**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).



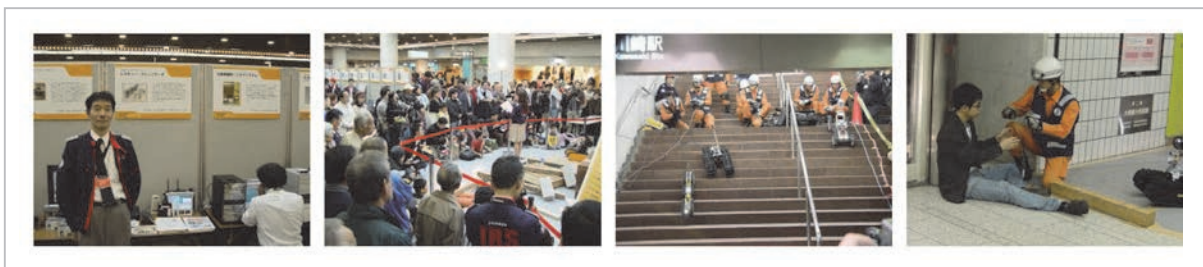
**Fig.19** CSS 2006 (Palulu Plaza Kyoto)

### 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).



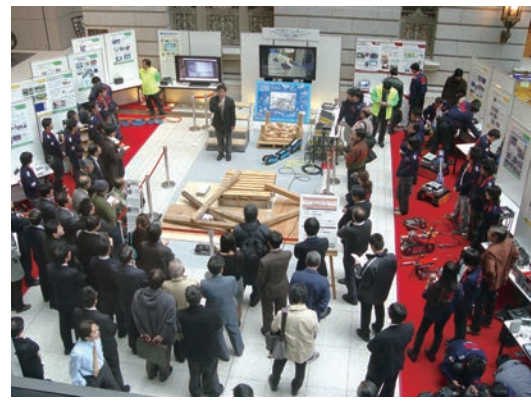
**Fig.20** Demonstration and simulation drill in the underground complex of JR Kawasaki Station (far right: a triage tag (green: not severe) is attach around the neck of a victim by a firefighter)



**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. How-

ever, 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.

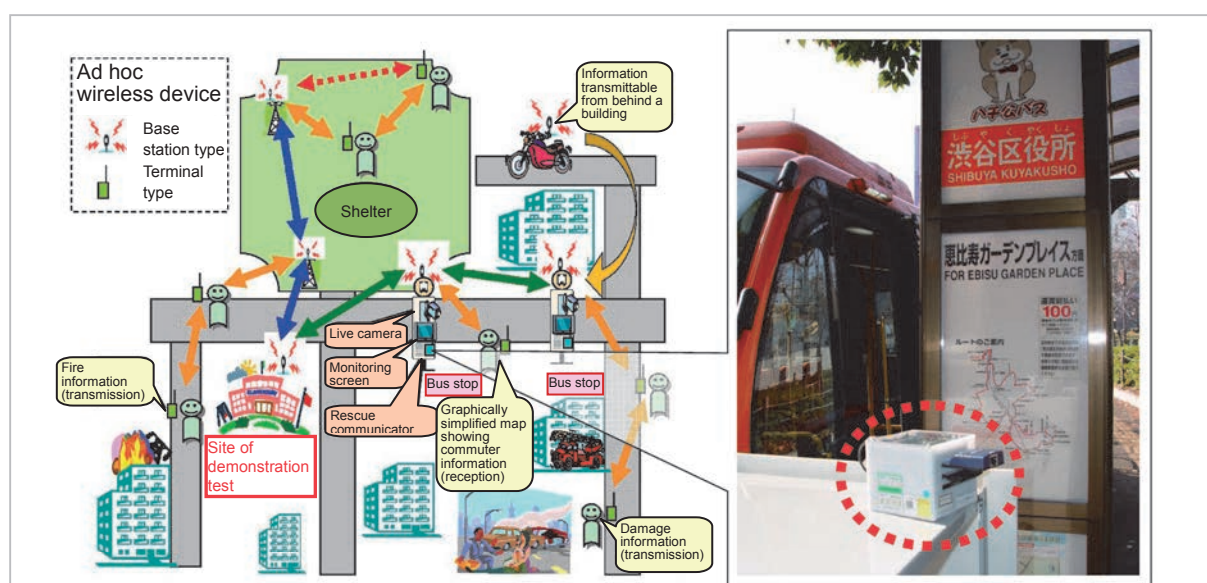
#### 3.10.2 Presentations at academic meetings

(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)



nication model using an ad hoc network — when there is restriction on the route of terminal movement”

(3) The following four presentations were given at the Symposium on Cryptography and Information Security (SCIS 2007) of the Inst. of Electronics, Information and Communication Engineers held in Nagasaki Huis Ten Bosch on Jan. 23 to 26.

- Kenichiro Akai (Mitsubishi Res. Inst.), Ichiro Murase (Mitsubishi Res. Inst.), Kyoko Makino (Mitsubishi Res. Inst.), Daisuke Inoue (Network Security Incident Response Group), Katsunari Yoshioka (Network Security Incident Response Group), Kotaro Sonoda, Junji Nakazato (Network Security Incident Response Group), Hiroshi Nakagawa (The Univ. of Tokyo), Tsutomu Matsumoto (Yokohama Nat'l Univ.), Tsuyoshi Toyama (Yokohama Nat'l Univ.) and Takizawa: “Discussion on the security of Web 2.0”
- Sonoda, Noriaki Asemi (Nat'l Inst. of Advanced Industrial Science and Technology (AIST)), Junji Nakazato (Security Fundamentals Group), Katsunari Yoshioka (Network Security Incident Response Group), Daisuke Inoue (Network Security Incident Response Group) and Takizawa: “Studies on a validation system based on the individual difference in the sense of hearing”
- Masashi Eto (Network Security Incident Response Group), Sonoda, Katsunari Yoshioka (Network Security Incident Response Group), Daisuke Inoue (Network Security Incident Response Group), Junichi Takeuchi (Kyushu Univ.) and Koji Nakao (Network Security Incident Response Group): “Proposal for a method of examining the similarity of malware by spectral analysis”
- Takizawa: “Positioning using RFID and information security in assuring safety and security”

### 3.11 Feb. 2007

#### 3.11.1 Disaster/Crisis Management ICT Symposium

Group Leader Takizawa participated in the symposium held in Pacifico Yokohama on Feb. 1 as a panelist in the panel discussion on the viewpoints of disaster management organizations (Fig. 26).

#### 3.11.2 Exhibitions and demonstrations

(1) Technical Show Yokohama

An RFID-based oral reading system was exhibited at the booth of the NICT Incubations in the exhibition held in Pacifico Yokohama on Jan. 31 to Feb. 2.

(2) Earthquake Management Technology Exposition

A summary of the studies of the Disaster Management and Mitigation Group was presented at the exposition held in Pacifico Yokohama on Feb. 1 and 2.

(3) Second Nat'l Conference on Firefighting, Rescue and Emergency

In the research meeting for firefighters, emergency medical technicians and others held in the Tachikawa Training Ground of Tokyo Fire Department, 8th Fire District HQ on Feb. 4, Group Leader Takizawa exhibited the RFID system developed under the Special Project for Earthquake Disaster Mitigation in Urban Areas (Fig. 27).

#### 3.11.3 Presentations at academic meetings

(1) Mobile Response 2007

Group Leader Takizawa and Senior



**Fig.26** Disaster/Crisis Management ICT Symposium

Researcher Gyoda attended the Int'l Workshop on Mobile Information Technology for Emergency Response held in Fraunhofer Inst., St. Augustin, Germany on Feb, 22 and 23, where Group Leader Takizawa gave a presentation entitled "Hybrid Radio Frequency Identification System for Use in Disaster Relief" (Fig. 28). The adoption rate was 43% and Group Leader Takizawa was the only presenter from Asia. The workshop was the first conference specialized to mobile systems, wearable computers, data treatment technologies and the like for emergency, rescue, firefighting and disaster management organizations, where various achievements obtained in related projects in EU countries were presented. The proceedings of the workshop were published later from Springer as one of the lecture

notes in computer science (LNCS).

### 3.12 March 2007

#### 3.12.1 Results of ad hoc network simulation during a disaster

For the application of the ad hoc network technology during a disaster, a computer simulation directed to a practical target was examined, as described below:

(1) The behavior of an ad hoc network formed by terminals moving on a road, when the road is obstructed due to a large-scale disaster, was studied in an area 500 meters square at the center of downtown Sendai City, which may possibly be damaged if an earthquake off the coast of Miyagi occurs. The following findings were obtained (Fig. 29).

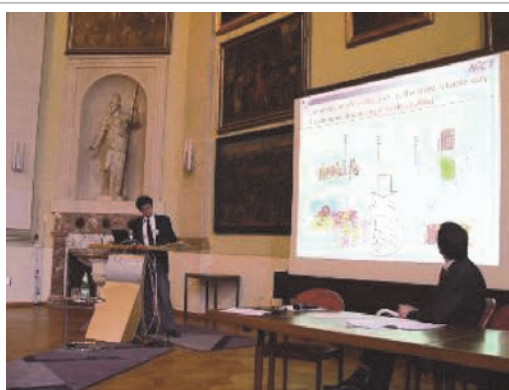
1. The data delivery rate declines as the speed at which the terminals travel increases, because the route change due to the termination of communication increases.
2. The change in the selection rate in the direction in which the terminals are traveling at intersections caused by road obstruction does not have a large influence on the data delivery rate.
3. When some areas are blocked, prohibiting the terminals from traveling into the areas, the data delivery rate declines under the influence of the blockage if the terminal is traveling at a speed of 4 m/s or less, but the influence is small if the speed is higher than that.

Parts of the studies were conducted as contracted research under the Ministry of Internal Affairs and Communications (SCOPE), "Research and development of multimedia technology for collecting information using remote robots in a disaster".

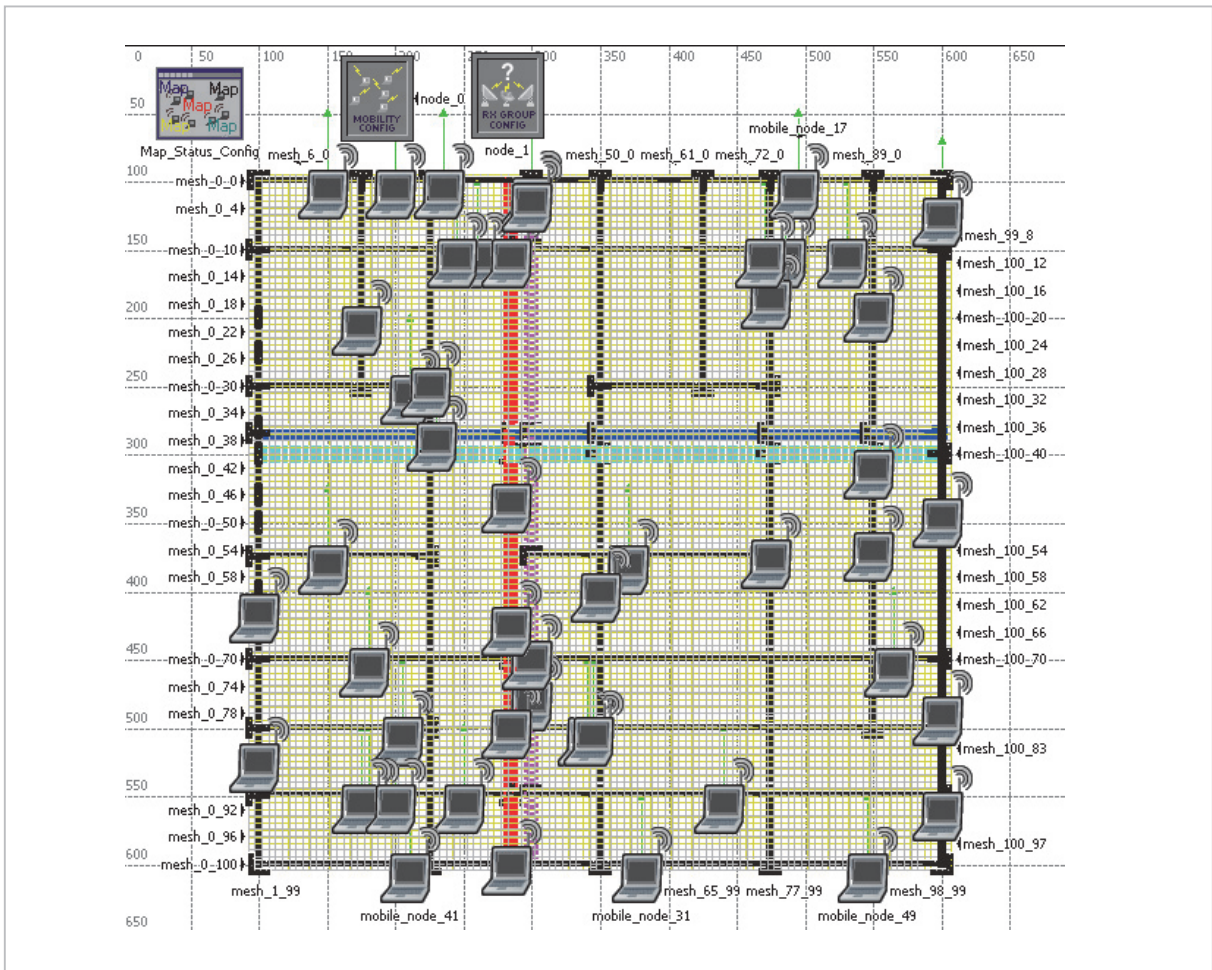
(2) For data collection and transmission from high-speed search robots, a trunk cable with wireless LAN access points formed at intervals of 50 meters was installed in an underground complex with a total length of 700 meters, and a system in which a robot searched the area surrounding the respective



**Fig.27** Group Leader Takizawa introducing the RFID system in the second Nat'l Conference on Firefighting, Rescue and Emergency



**Fig.28** Group Leader Takizawa lecturing in Mobile Response 2007



**Fig.29** Terminal traveling model in the area, simulating the central area of Sendai City

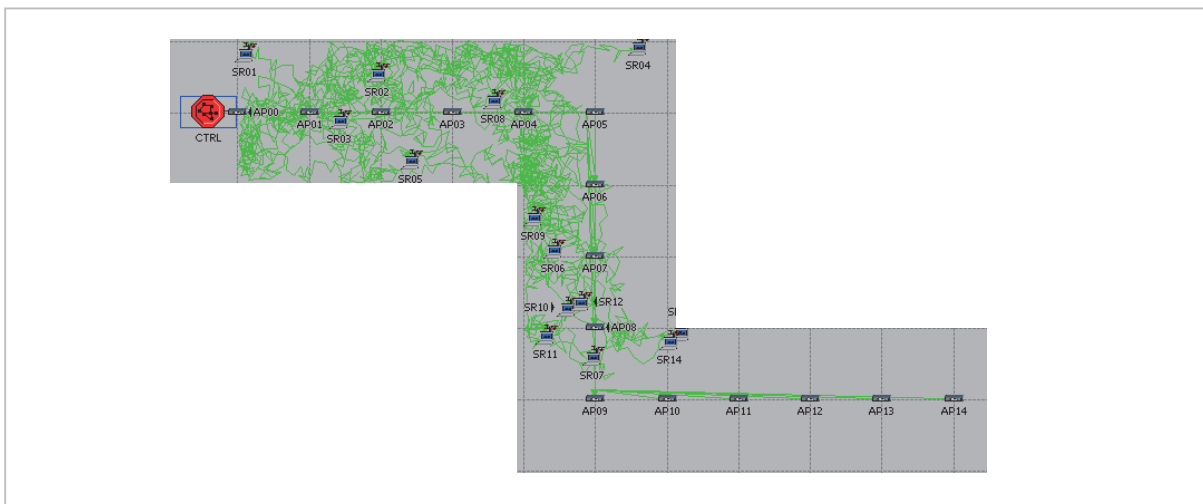
access points was simulated. As a result, the following findings were obtained (Fig. 30).

1. The difference in data delivery rate caused by the difference in the shape of search area is small.
2. In the case of a system in which access points are installed and the search robots start searching simultaneously (simultaneous system), the data delivery rate declines significantly, for example, due to data collision, but in the case of a system in which each robot starts searching at a time difference (sequential system), the data delivery rate, especially of the image signal, is possibly improved significantly.

Part of this research was carried out under NEDO contracted research: “RT system movable in damaged buildings (in the field of robots for special environments)”.

### 3.12.2 Presentations at academic meetings

- (1) The following two presentations were given in the general meeting of the Inst. of Electronics, Information and Communication Engineers.
  - Ling Zhong Wei (The Univ. of Electro-Communications), Gyoda and Nobuo Nakajima (The Univ. of Electro-Communications): “Test for demonstration and evaluation of an information exchange system using a wireless ad hoc network, Fleama.net”
  - Gyoda, Nam, Okada, and Takizawa: “Analysis of the performance of an ad hoc network in the model of communication during a disaster”
- (2) The following presentation was given at the 2007 spring research meeting of the



**Fig.30** Examples of the search area (crank-shaped) and the locus of robots used in computer simulation

Acoustical Society of Japan.

- Expert Researcher Kotaro Sonoda, Ryouichi Nishimura (Tohoku Univ.), Suzuki, and Takizawa: “DWPT-QIM electronic watermarks”

### 3.13 April 2007

#### 3.13.1 Arrival of two Expert Researchers

Akihiro Shibayama (formerly, Research Assistant, Disaster Control Research Center, Tohoku Univ.) and Yasushi Hada (formerly, Co-operative Research Fellow, RIKEN) arrived as Expert Researchers on April 1. Akihiro Shibayama specializes in building/urban disaster management and Yasushi Hada specializes in disaster information collection robots.

#### 3.13.2 Collaborative graduate schools

Senior Researcher Okada is a visiting professor for the graduate school of Information Systems of The Univ. of Electro-Communications, and Senior Researcher Gyoda is a visiting associate professor of the graduate school of Electro-Communications. Last year, Senior Researcher Okada started providing continuous research guidance to a second-year master’s student, a first-year student in the same course and Cui Lu Ming, a third-year exchange master’s student from Beijing Univ. of Posts and Telecommunications. Senior Researcher Gyoda started providing research

guidance to Wadhah Al-Mandhari, a first-year doctoral student.

#### 3.13.3 Award for excellent presentation from the Society of Instrument and Control Engineers

The presentation entitled “Development of a Damage Information-Sharing System Using Hybrid Wireless Tags,” given by Group Leader Takizawa together with Expert Researcher Akihiro Shibayama (then in Tohoku Univ.) and researchers at the Nat’l Research Inst. of Fire and Disaster and Kogakuin Univ. at the seminar of the System Integration Division (SI2006) of the Society of Instrument and Control Engineers (SICE) in Dec. 2006 received an award for excellent presentation (disclosed on Apr. 23) (Fig. 31). The presentation covered the results obtained under the Special Project for Earthquake Disaster Mitigation in Urban Areas and the Grant-in-Aid for Scientific Research (basic research B).

### 3.14 May 2007

#### 3.14.1 Exhibition in u-Japan Festa in Hiroshima 2007

In the event held in Hiroshima on May 17 and 18, studies on RFID, Web GIS, ad hoc communication, regulation of cell phone communication period, damage information collection system and acoustic signal electronic watermark were disclosed by a panel presentation and by demonstration (Fig. 32).

### 3.14.2 Newspaper coverage

The activities of the Disaster Management and Mitigation Group were reported in an article related to safety and security that appears every Wednesday in *The Nikkan Kogyo Shim-bun* (May 23).

### 3.14.3 Multimedia Information Hiding Research Working Group

The first meeting of the “Multimedia

Information Hiding Research Working Group,” a temporary research group of the Inst. of Electronics, Information and Communication Engineers established in April this year was held at the NICT headquarters (Fig. 33). Professor Hideki Noda, Kyushu Inst. of Tech., who was formerly at CRL, was the chairman, and Expert Researcher Kotaro Sonoda assumed the role of secretary. Keynote addresses were given by Professor Hiroshi Yasuda and a director of the Japanese Society for Rights of Authors, Composers and Publishers (JASRAC), and there were invited lectures, panel discussions and exhibitions by ten companies. With approximately 100 participants, the meeting was better attended than expected. The Disaster Management and Mitigation Group presented two studies, “Acoustic Electronic Watermarks” and “Hiding Information in Documents” (May 29).



**Fig.31** Award for excellent presentation provided by the Society of Instrument and Control Engineers

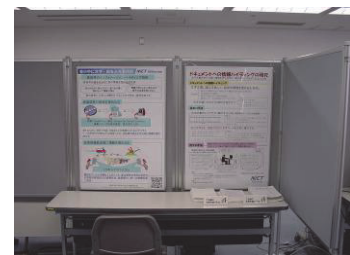
### 3.15 June 2007

#### 3.15.1 Arrival of an Expert Researcher

On June 1, Expert Researcher Jeong Byeong-pyo (formerly, Guest Researcher in the Nat'l Research Inst. of Fire and Disaster,



**Fig.32** u-Japan Festa in Hiroshima 2007



**Fig.33** Multimedia Information Hiding research meeting

Fire and Disaster Management Agency) arrived as an Expert Researcher. His specialty is urban disaster management and firefighting and disaster management.

### **3.15.2 Next-Generation Safety/Security ICT Forum**

The Next-Generation Safety/Security ICT Forum was established, based on a report of the research group examining studies that should be conducted in information communication technology to provide a safe and secure society, which was conducted in 2006 by the Ministry of Internal Affairs and Communications. Its inaugural meeting and the inaugural symposium were held in Otemachi Sankei Plaza on June 26. The Disaster Management and Mitigation Group participated in the exhibition held concurrently, and Expert Researchers Shibayama and Hada and Group Leader Takizawa attended the exhibition (Fig. 34).

### **3.15.3 Presentations at academic meetings**

Expert Researcher Hoang Nam attended the 3rd Int'l Conference on Networking and Services (ICNS2007) held in Athens, Greece, on June 19 to 25 and gave a presentation entitled "On the Performance of Hybrid Wireless Network of Emergency Communications in Disaster Areas". He received the Best Paper Award.

### **3.15.4 Committee and lecture**

(1) Group Leader Takizawa attended the meeting to support the evacuation of victims needing to be rescued and information trans-

mission during a disaster. The meeting was held by those in charge of disaster management at the Cabinet Office on June 19. Takizawa explained the progress of the research and development into disaster management and mitigation ICT as an activity concerning the transmission of information during a disaster that is taken by the Ministry of Internal Affairs and Communications. The committee was established after the heavy rain disaster in July 2004 and the meetings are held during the rainy season every year with the managers from relevant ministries participating.

(2) Group Leader Takizawa attended as a member the first meeting of the committee for utilization of the communication support system for local disaster management for use in major earthquakes, held by the Kanto Bureau of Telecommunications on June 27. The committee examines the measures to make the most of ICT in local disaster management with representatives from the automatic dispenser industry and convenience store industry. Discussions started for preparation of the final report in December.

(3) A new science/technology seminar, "Efficient utilization of RFIDs in the firefighting and disaster management fields" by Fire and Disaster Management Agency and the Science/Technology-Promoting Association for Firefighting and Disaster Management (secretariat: The Inst. for Fire Safety & Disaster Preparedness) was held in Tokyo on June 28. Group Leader Takizawa gave a presentation entitled "Front Line in the Studies on the Use of RFIDs during Disaster—Support for Firefighting and Disaster Management Activities and Measures in Large-Scale Disaster—". The aim was to introduce the technical field of a sensor network in combination with fire detection and RFIDs for people engaged in firefighting.



**Fig.34** Exhibition in Next-generation Safety/Security ICT Forum

## **3.16 July 2007**

### **3.16.1 Award presented in Rescue Robot League, RoboCup 2007**

In a world championship on robots, Robo-

Cup 2007, held in Atlanta, the United States, “Pelican United” (a joint team of five organizations; Int’l Rescue System Inst., Tohoku Univ., Chiba Inst. of Tech., Nat’l Inst. of Advanced Industrial Science and Technology (AIST) and NICT) had the following results: 2nd place overall in the Rescue Robot League and 1st place in the Mobility division (Fig. 35).

### 3.16.2 Presentations at academic meetings

- (1) The following presentation was given at the communication quality research meeting of the Inst. of Electronics, Information and Communication Engineers, held on July 12.
  - Gyoda, Okada, Nam, and Takizawa: “Evaluation of the performance of an emergency communication model using an ad hoc network”
- (2) The following presentation was given at the IEEE Int’l Geoscience and Remote Sensing Symposium held in Barcelona on July 27.
  - Masafumi Hosokawa (NRIFD), Jeong Byeong-pyo, and Takizawa: “Earthquake Damage Detection Using Remote Sensing Data”

### 3.16.3 Committees and lectures

- (1) The first meeting on studies into the transmission of government radio announcements into each home to prevent disasters by the Ministry of Internal Affairs and Communications, Kinki Bureau of Telecommunications, was held in July 3, and Group Leader Takizawa attended the meeting as a member.

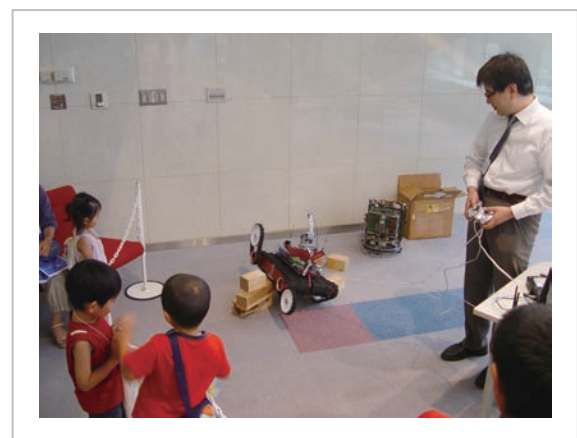


**Fig.35** Certificate of first place in Mobility division

- (2) A new science/technology seminar, “Efficient utilization of RFIDs in the firefighting and disaster management fields” by the Nat’l Research Inst. of Fire and Disaster of Ministry of Internal Affairs and Communications and the Science/Technology Association for Firefighting and Disaster Management (secretariat: Inst. for Fire Safety & Disaster Preparedness) was held in Osaka in July 6. Group Leader Takizawa gave a lecture entitled “The Front Line of Studies on the Use of RFIDs During a Disaster —Support for Firefighting and Disaster Management Activities and Measures in Large-Scale Disasters—”.

### 3.16.4 Events

- (1) Technology Transfer in Kawasaki
  - In the exhibition held on July 11 to 13, a voice-reading terminal using RFID was displayed in the NICT Incubations’ booth.
- (2) NICT’s Facilities’ Open House
  - When the facility was opened to the public on July 27 to 28, the Disaster Management and Mitigation Group showed a 3D disaster management map (Google Earth map) of the area close to NICT. It was displayed on a large screen and attracted a lot of interest. In addition, a rescue robot, Kenaf, developed jointly under NEDO contracted research was revealed for the first time (Fig. 36). Kenaf had received an award in the world championships for rescue robots, RoboCup.



**Fig.36** Disclosure of rescue robot, Kenaf, when the facility was opened to the public

### 3.16.5 Qualification acquired

Group Leader Takizawa was registered as a “Bousaishi(disaster manager)” by the Japan Bousaisi Organization on July 23 (Registration number: 018010).

### 3.17 Aug. 2007

#### 3.17.1 Paper published in EI-registered journal

The trainee, Cui, summarized his half-year studies and gave a presentation entitled “Performance Estimation on IEEE 802.11e (EDCA) Considering Emergency Calls during Network Congestion” in IC-BNMT2007 held in Beijing on Sep. 18 to 20. He won the award for the best paper (adoption rate: 10%). It was published in the Journal of China Universities of Post and Telecommunications (EI-registered Journal).

#### 3.17.2 Tests

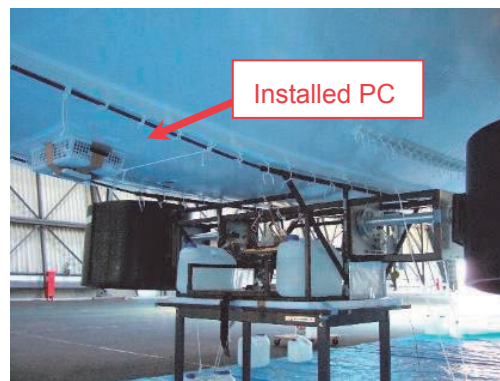
Expert Researcher Hada joined a basic test on automatic control of a 14 meter-class unmanned LTA (lighter-than-air) airplane, conducted by the Japan Aerospace Exploration Agency (JAXA) in Taiki-cho, Hokkaido on Aug. 23 to 25. He conducted a test on the collection of damage information using a rescue communicator from above (Fig. 37). Although it was not possible to obtain the desired results in the test because of interference in the control transmission from the PC collecting the information, it was the first outdoor test of a robot moving in three-dimensions for the Disaster Management and Mitigation Group. The test yielded valuable results, such as operation and maintenance method and created a favorable cooperative relationship with JAXA.

#### 3.17.3 Acceptance of summer trainees

Expert Researcher Shibayama accepted two summer trainees, juniors in Takushoku Univ., for training on RFID during the period from Aug. 1 to Sep. 7.

#### 3.17.4 Summer science camp

High school students were accepted for summer training during the period of Aug. 8 to 10. Expert Researcher Akihiro Shibayama conducted most of the training, in which a 3D disaster management map was prepared by



**Fig.37** Test for collection of damage information using JAXA unmanned airship

using Google Earth (Fig. 38).

### 3.18 Sep. 2007

#### 3.18.1 Lectures and presentations

- (1) In the NICT-PTIT Joint Seminar for ICT R&D held in Hanoi, Vietnam, on Sep. 7, Expert Researcher Nam gave a presentation entitled “Research Activities into Emergency Communications and Services”.
- (2) In the Society meeting 2007 of the Inst. of Electronics, Information and Communication Engineers held in Tottori Univ. on Sep. 10 to 14, the following two presentations were given:
  - Semba, Okada, Gyoda, Nam, and Takizawa: “Evaluation of the Performance of Microcell Networks when There Are Many Non-Operating Base Stations”
  - Cui, Okada, and Chen Xingyi (Beijin Unig. Posts and Telecommunications): “A Performance Study on Wireless LAN Considering Emergency Calls in Congested Situations” (presentation given



also at the 2007 Int'l Conference on Broadband Network & Multimedia Technology)

(3) In the 25th seminar of the Robotics Society of Japan, held at the Chiba Inst. of Tech. on Sep. 13 to 15, the following presentation was given.

- Ryuji Sugizaki (Tokyo Denki Univ.), Tsuyoshi Suzuki (Tokyo Denki Univ.), Kuniaki Kawabata (RIKEN), Hada, and Yoshito Tobe (Tokyo Denki Univ.): “Construction and Control of a Wireless Sensor Network Using Mobile Robots For Collecting Information on Areas Affected by a Disaster”

(4) In the SICE Annual Conference 2007, held in Kagawa Univ. on Sep. 17 to 20, the following presentation was given.

- Gyoda, Hada, and Takizawa: “Performance Analysis of the Network and Scenarios for the Search Robot Rescue System”

(5) In the IEEE Int'l Workshop on Safety, Security, and Rescue Robotics (SSRR 2007) held in Rome, Italy, on Sep. 27 to 29, the following presentation was given.

- Gyoda, Hada, and Takizawa: “Performance Analysis of the Network Models for the Search Robot Rescue System in the Closed Spaces”

### 3.18.2 Demonstration and exhibition

(1) A joint disaster management drill by Tokyo Metropolitan Government, Akishima City, Fussa City, Musashi-murayama City, Hamura City, and Mizuho-cho was held in Akishi-



**Fig.38** Summer science camp

ma City, Tokyo, on Sep. 1, where the rescue robot, Kenaf, was demonstrated (Fig. 39).

(2) In the Int'l Frontier Industry Messe held in Kobe Int'l Exhibition Center on Sep. 13 and 14, Kenaf and an RFID voice-reading terminal were exhibited in the NICT Incubations' booth (Fig. 40).

### 3.18.3 Competitive research funds acquired

The following research and development project and project planning investigation applied by the Disaster Management and Mitigation Group as a research member in the research and development area of “Protecting children from crime” in the Research Inst. of Science and Technology for Society (RISTEX) of the Japan Science and Technology Agency (JST) were both accepted.

- Research and development project: “Establishment of practical grounds for determining the damage to children and crime prevention activities”

Research representative: Yutaka Harada, Department of Criminology and Behavioral Sciences, Nat'l Police Agency Nat'l Research Inst. for Police Science

- Project-planning investigation: “Feasibility study on ensuring the safety of children using IT”

Research representative: Tsutomu Matsumoto, Graduate School of Environment and Information Science, Yokohama Nat'l Univ.



**Fig.39** Joint disaster management drill held by Tokyo Metropolitan Government, Akishima City, Fussa City, Musashi-murayama City, Hamura City and Mizuho-cho



**Fig.40** Int'l Frontier Industry Messe

### 3.19 Oct. 2007

#### 3.19.1 Test

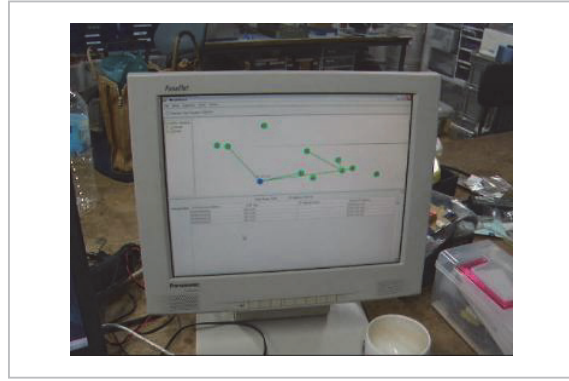
Expert Researcher Yasushi Hada conducted a demonstration and verification test on operation of a search robot using 13 ad hoc wireless nodes in Tohoku Univ. on Oct. 13. The test was conducted in collaboration with Professors Kazuya Yoshida and Keiji Nagatani, Tohoku Univ., as part of the “Research and development of multimedia technology for collecting information using remote robots in a disaster” which is conducted under the SCOPE contracted research of the Ministry of Internal Affairs and Communications (Figs. 41, 42 and 43). The test demonstrated that it was possible, by viewing a video image, to actuate the robot via ten hops of the ad hoc wireless nodes by remote wireless operation.

#### 3.19.2 Guidance of diagram training

Expert Researcher Jeong Byeong-pyo who was appointed as an instructor in the model project to promote training in local disaster management using diagrams, of the Nat'l Research Inst. of Fire and Disaster of the Ministry of Internal Affairs and Communications, provided guidance in diagram training to the municipal officers in Saiki City, Oita, on Oct. 26 to 28.

#### 3.19.3 Presentations at academic meetings

(1) The following presentation was given at the 16th research meeting of the GIS Association of Japan, held in Sapporo on Oct. 19 to 21.



**Fig.41** Screen of ad hoc network topology



**Fig.42** Ad hoc wireless nodes



**Fig.43** Remote operation of robot

- Expert Researchers Jeong Byeong-pyo and Masafumi Hosokawa (Nat'l Research Inst. of Fire and Disaster) and Takizawa: “Studies on spatial information communication system to support the activities of international firefighting and rescue teams – summary of the studies and preparation of the on-site activity support map”
- (2) The following presentation was given at the 9th Int'l Cooperate Seminar between

KAGIS (Korean Association of Geographic Information Studies) and GISA (Geographic Information Systems Association, Japan), held in Daegu, Korea, on Oct. 22 and 23.

- Expert Researchers Jeong Byeong-pyo and Masafumi Hosokawa (Nat'l Research Inst. of Fire and Disaster), Shinsaku Zama (NRIFD) and Takizawa: “Development of a System for Estimating the Damage Caused by an Earthquake in Seoul, Korea”

(3) The following presentation was given at the research meeting on multi-dimensional mobile communication networks of the Japan Society for Simulation Technology held in YRP on Oct. 25.

- Semba, Okada, Gyoda, and Nam: “Evaluation of the Characteristics of Emergency Multisystem Access when There Are Many Non-Operating Base Stations”

#### 3.19.4 Exhibition

Studies by this group were exhibited at the CEATEC Japan 2007, held in Makuhari Messe on Oct. 2 to 6 (Fig. 44), in the Local ICT Future Festa in Aomori, held in Shin-Aomori General Sport Park on Oct. 12 to 14 (Fig. 45), and at the Crisis Management Industry Exposition 2007, held in Tokyo Big Sight on Oct. 17 to 19 (Figs. 46 and 47).

### 3.20 Nov. 2007

#### 3.20.1 Exhibition of the results obtained in the SCOPE project of the Ministry of Internal Affairs and Communications

A meeting to report the results obtained in the “Research and development of multimedia technology for collecting information using remote robots in a disaster” (research representative: Professor Kazuya Yoshida, Tohoku Univ.) conducted under SCOPE of the Ministry of Internal Affairs and Communications, and to conduct a demonstration, was convened in the science communication event held in Tokyo Academic Park on Nov. 24, “Science Agora” (held by JST) (Fig. 48). The Disaster Management and Mitigation Group reported



Fig.44 CEATEC JAPAN 2007



Fig.45 Local ICT Future Festa in Aomori



Fig.46 Security & Safety Trade Expo 2007



Fig.47 Security & Safety Trade Expo 2007

results concerning characterization of an ad hoc network for communication between robots (urban model) and also presented an exhibition of actual ad hoc network nodes used for the remote control of search robots. The demonstration of remote control of a robot for use in a disaster area was the first example of a test using the ETS-VIII satellite, and a joint press release was issued by Tohoku Univ., Osaka Univ., and NICT on Nov. 14.

### **3.20.2 Cooperative research agreement with JAXA (Unmanned and Innovative Aircraft Team)**

For the damage information collection experiment from above using a rescue communicator, a joint research agreement to research mission compatibility through a flight test on an LTA unmanned airplane was reached with JAXA on Dec. 3.

### **3.20.3 Survey of the Emergency Fire Response Team sent after the Noto Peninsula Earthquake**

On Nov. 29 and 30, Expert Researcher Jeong Byeong-pyo and members of the Laboratory of Disaster (Earthquake) Study of the Nat'l Research Inst. of Fire and Disaster went to the fire-defense headquarters of Fukui City as well as Toyama City (which provided support) and Kanazawa City (which received support). They conducted a survey, by way of interview, on the support activities conducted by Emergency Fire Response Teams after the Noto Peninsula Earthquake that occurred on March 25, 2007. There is concern about deterioration in the efficiency of activities due to the problem of communication congestion

after a large disaster, such as an earthquake. The survey, conducted by interviews, focused on the activities of the fire-defense headquarters sent as support from the neighboring prefectures, the means of communication used, the efficiency of communication (ease of connection), preservation and use of important communication (disaster-related communication), as well as the demands made of NICT.

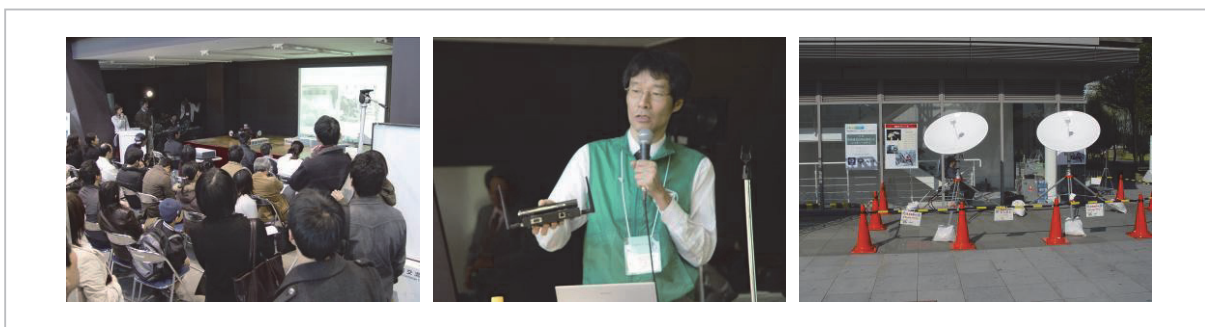
### **3.20.4 Presentations at academic meetings**

(1) In the 3rd Int'l Conference on Intelligent Information Encoding and Multimedia Signal Processing (IIHMSP 2007) held in Taiwan on Nov. 26 to 28, Expert Researcher Kotaro Sonoda gave the following presentation:

- Sonoda, Katsunari Yoshioka, and Takizawa: "Information Encoding for Public Address Audio Signal Using FH/FSK a Wide Spectrum"

(2) Expert Researcher Akihiro Shibayama made the following presentation:

- Akihiro Shibayama, Masaki Nagata (Oyo Corp.), Shinzaburo Hori (Disaster Prevention Technologies.), Tetsuro Okuno (Disaster Prevention Technologies.), Satoshi Masuda (Tohoku Univ.), Ken Sato (Tohoku Univ.), and Masato Motokasa (Tohoku Univ.): "Development of a disaster management information-sharing platform in the case of the earthquake off Miyagi", Abstract of the meeting of the Inst. of Social Safety Science No. 21, pp. 113–114, Nov., 2007.
- Shibayama, Yoshiaki Hisada (Kogakuin



**Fig.48** Meeting and demonstration for reporting final-year results obtained under the SCOPE project (Tokyo Academic Park)

Univ.), Masahiro Murakami (Kogakuin Univ.), Kanji Sugii (NRIFD), Shinsaku Zama (NRIFD), and Takizawa: “Development and performance test of a mid- and long-distance damage information collection system for use in a disaster”, Abstract of the Annual Meeting of Japan Association for Earthquake Engineering pp. 350–351, Nov., 2007, and three other presentations

(3) Expert Researcher Jeong Byeong-pyo made the following presentation:

- Jeong Byeong-pyo, Shinsaku Zama (NRIFD), Makoto Endo (NRIFD), and Takizawa: “Development of a prototype of the information collection system using cell phones for use during a disaster”. Abstract of the Meeting of the Inst. of Social Safety Science, No. 21, pp. 15–16, Nov., 2007, and five other presentations

(4) The trainee, Shinya Semba, gave the following presentation:

- Semba, Okada, Gyoda, and Nam: “Evaluation of the characteristics of emergency multi-system access in a microcell network when there are many non-operating base stations,” IEICE Technical Report, RCS 2007-109, pp. 71–76, Nov., 2007.

### 3.20.5 Various exhibitions

(1) Int’l Robot Exhibition 2007

In the exhibition held at Tokyo Big Sight on Nov. 28 to Dec. 1, results obtained in the research project of the Research Inst. for Science and Technology, Tokyo Denki Univ., SCOPE of the Ministry of Internal Affairs and Communications and the NEDO contracted research project were exhibited in the booth jointly operated by Tokyo Denki Univ., RIKEN, and NICT (Fig. 49).

(2) Patent Solution Fair

In the exhibition held at Tokyo Big Sight on Nov. 28 to 30, an RFID-based voice-reading terminal was exhibited at the booth of NICT Incubations (Fig. 50).

## 3.21 Dec. 2007

### 3.21.1 Test in the earthquake management drill conducted in the Shinjuku high-rise campus of Kogakuin Univ.

In a large-scale earthquake management drill conducted in a 25-story building in the center of Tokyo on Dec. 6, Expert Researcher Akihiro Shibayama conducted the following two tests (Fig. 51).

- (1) Test on real-time assessment using an active RFID tag to determine whether victims remain in the houses or have been evacuated
- (2) Test on the collection of local damage information by student and staff volunteers

Participation in this drill is based on the research contract agreement between NICT and Kogakuin Univ. concerning studies on disaster mitigation through the cooperation of commuters unable to get home with local residents and governments in a large-scale urban disaster.

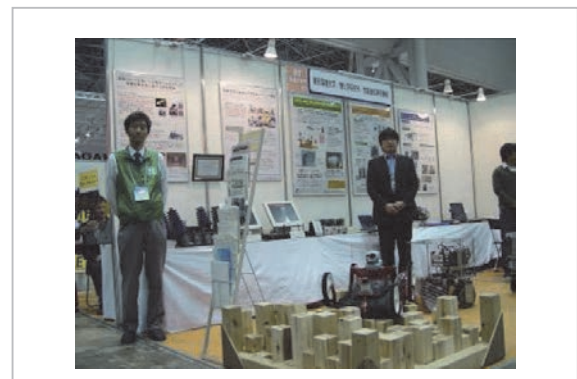


Fig.49 Int'l Robot Exhibition 2007



Fig.50 Patent Solution Fair

### 3.21.2 Robot demonstration test in the east/west free passage of Sendai City and Sendai Subway Station

A joint demonstration test of a search robot for use in a large-scale disaster was held on Dec. 16 with organizations participating in the NEDO contracted research, with cooperation of the Sendai City Transportation Bureau. A robot was controlled remotely, for example, on the concourse, platform and stairs of the station after operation of the subway. NICT was responsible for development and the demonstration test of the main communication part of the system to control the robot and transmission of the monitoring image. The demonstration revealed that it was possible to control the system remotely and to transmit the monitoring image over a distance of about 300 meters in an environment where there were both wired LAN and an ad hoc wireless LAN (Fig. 52).

### 3.21.3 Test on damage information collection by LTA aircraft

Expert Researcher Yasushi Hada participated in a flight test of an n 14 meter-class

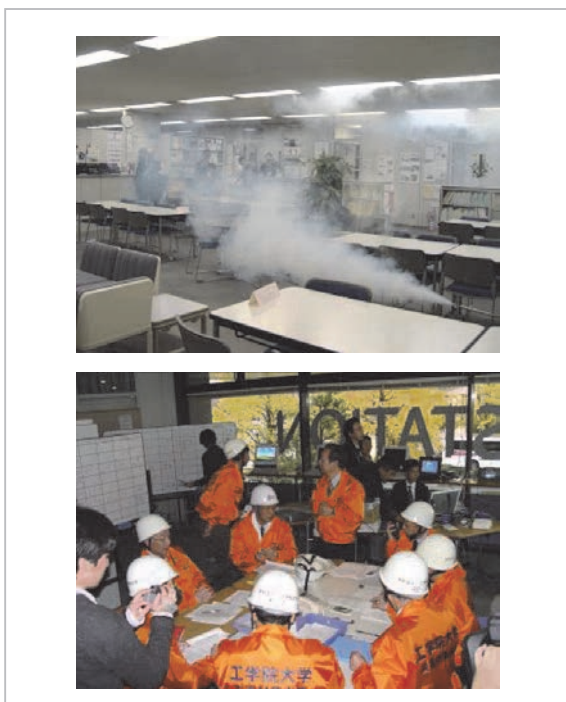
LTA conducted by JAXA in Kagoshima on Dec. 17 to 19 and held a damage information collection test between the ground and sky using a rescue communicator. The NICT Workshop helped to prepare the shield box (Fig. 53 right) to prevent interference with the control system for the LTA.

### 3.21.4 Workshop on Communication and Navigation for the Development of Vietnam's Marine Economy

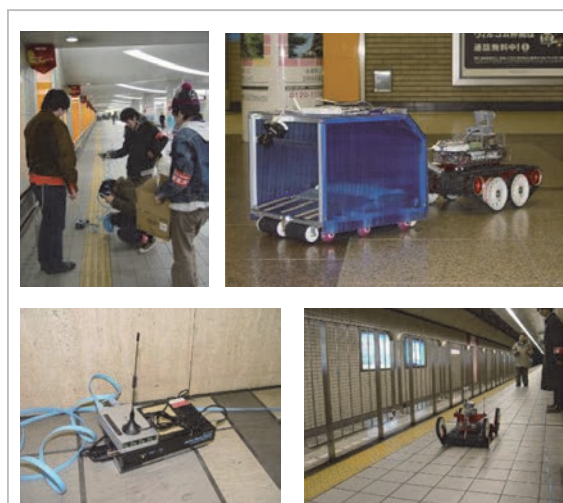
Due to Vietnam's long coastline, there is a significant problem in the responses to disasters involving small ships. There is therefore an urgent need for the development of an inexpensive means of communication along the coastline and a means of receiving distress signals. Against this background, a workshop was held by Hanoi Univ. of Science and Tech. in Hanoi, Vietnam, on Dec. 15 to 16. Expert Researcher Nguyen Hoang Nam presented the results of his studies on the OFDMA ad hoc cellular network and joined in the panel discussion with government officials, in which he explained the latest situation of marine communication technology in Japan.

### 3.21.5 Lecture in Ochanomizu Univ.

Expert Researcher Akihiro Shibayama



**Fig.51** Test in the earthquake disaster management drill conducted in the Shinjuku high-rise campus of Kogakuin Univ.



**Fig.52** Robot demonstration test conducted in the east/west free passage of Sendai City and the Sendai Subway Station (top right) cable-installing robot (under development by Chiba Inst. Tech., not used this time), (bottom left) wireless ad hoc nodes

who was a part-time lecturer of a special lecture on natural environment “disaster risk and geographic information” in the Geography course, Faculty of Letters and Education of Ochanomizu Univ. in the latter half of 2007, gave a lecture entitled “Information Sharing and Improved Efficiency of Activities after an Earthquake through the Cooperation of Local Residents and Governments and through the Optimum Use of ICT” on Dec. 20.

**3.21.6 Exhibit in the Special Science of Safety Exhibition (Centennial Memorial Hall of Nihon Univ., College of Humanities and Sciences, Dec. 8 to 24)**

NICT’s studies, conducted out under three contracted research projects (positioning of the use of RFIDs and assurances for safety and security, establishment of the practical grounds for monitoring the damage to children and crime-preventing activities, and research and development for assurance of children safety using IT) were presented in an exhibit entitled “Studies in the Prevention of Crime — Examples of Studies Abroad and in Japan” (Fig. 54).



**Fig.53** Test on collection of damage information by LTA aircraft

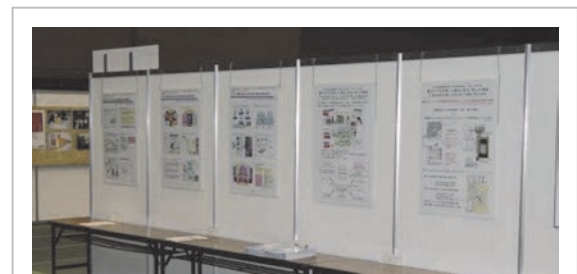
**3.21.7 Newspaper coverage**

The comment of Group Leader Takizawa that the preservation of public telephones is important in ensuring a means of communication during a disaster was cited in a special article in the Osaka Edition of *The Yomiuri Simbun* (Dec. 5), under the headline, “Public telephones removed also from schools in disaster-prone areas, despite their effectiveness in an earthquake”.

**3.22 Jan. 2008**

**3.22.1 Symposium on Cryptography and Information Security (SCIS 2008) by the Inst. of Electronics, Information and Communication Engineers**

In the meeting held in Miyazaki Seagaia on Jan. 22 to 25, Expert Researcher Kotaro Sonoda gave a presentation entitled “Studies on Individual Authentication System Based on the Sound of One’s Voice” (Fig. 55) and Group Leader Takizawa gave a presentation entitled “Concept for Ensuring Child Safety Using IT”. The presentation entitled “Proposal for a Means of Examining the Similarity of



**Fig.54** Special exhibition, “The Science of Safety”



**Fig.55** Presentation by Expert Researcher Kotaro Sonoda in SCIS 2008

Malware Using Spectral Analysis,” which was given jointly by Expert Researcher Kotaro Sonoda and the Researcher Mr. Eto of the Network Security Incident Response Group at SCIS last year, received the Excellent Paper Award and the commendation ceremony was held during the meeting.

### **3.22.2 Tohoku area meeting of the Japan Society for Natural Disaster Science**

In the meeting held at the Hachinohe Area Local Industry Promotion Center on Jan. 13, Expert Researcher Akihiro Shibayama gave several presentations. The first, entitled “Establishing a Platform for Sharing Disaster Management Information for Preparing for the Earthquake off Miyagi and the Method of Operation” was given individually, and two other presentations, entitled “Research on the Method of Evaluating the Local Disaster-Managing Potential Against the Earthquake off Miyagi” and “Studies on the Potential of the Disaster Management Organization in Sendai City for Earthquakes” were given with other researchers.

### **3.22.3 Coverage in Nikkan Kogyo**

Group Leader Takizawa, Senior Researchers Kazunori Okada, and Koichi Gyoda wrote four consecutive articles on advanced ICT and disaster management and mitigation in the section, “Risk Control” in the Thursday Edition of *The Nikkan Kogyo Shimbun*.

- Jan. 10: Site-oriented research and development (Takizawa)
- Jan. 17: Cell phones during a disaster (Okada)
- Jan. 24: Rescue robots (Gyoda)
- Jan. 31: Ubiquity is essential (Takizawa)

## **3.23 Feb. 2008**

### **3.23.1 Investigative research for international cooperation with support activities, based on spatial information systems**

Expert Researcher Jeong Byeong-pyo made a trip to the Philippine Inst. of Volcanology and Seismology on Feb. 4 to 11 to improve the map of earthquake risks in the

Philippines and to conduct investigative research on the construction of a research network (Fig. 56). The investigative research is a first step toward developing a system to support international contributions both in manpower and technology that facilitates rapid and efficient rescue activities. The research achieves this by promoting the exchange and sharing of spatial information that is beneficial to the rescue activities of the international emergency rescue team, such as basic maps and information on the damage situation. The research also strives to enable the operations headquarters to remain informed of the safety and activities of the team members by connecting the disaster area abroad where the international emergency rescue team performs its operation with the headquarters in Japan by satellite communication.

### **3.23.2 Demonstration of a disaster robot**

A demonstration exhibition of a robot jointly developed under a NEDO contracted research project in 2007 was held for members of the police force, fire brigade and self-defense forces on Feb. 26. The exhibition was part of a project to support the technological development of equipment against a chemical disaster under the Ministry of Economy, Trade and Industry. In response to a request from the project administrators, Expert Researcher Yasushi Hada participated in a demonstration of the NICT’s robot, Kenaf.



**Fig.56** Cooperative investigation in the Philippines



### 3.23.3 Research on the database containing the results of survey on the buildings damaged in The Niigataken Chuetsu-oki Earthquake in 2007 and The Noto Hanto Earthquake in 2007

Expert Researcher Shibayama traveled to Niigata and Ishikawa Prefectures on Feb. 25 to 28 to investigate the site in Kashiwazaki City that was seriously affected by The Niigataken Chuetsu-oki Earthquake in 2007. He exchanged views with Associate Professor Masami Gotou of the Kanazawa Inst. of Tech., who is a coordinator at the Architectural Inst. of Japan engaged in summarizing the damage after The Noto Hanto Earthquake in 2007. The focus of this research is to identify a method for summarizing and providing a vast amount of disaster information collected after an earthquake. The data will be used in researching a method of investigation in disaster areas and for elucidating the factors leading to building damage.

### 3.23.4 Demonstration test of disaster information collection system

The effective implementation of emergency measures after an earthquake requires quickly understanding the damage situation. The Disaster Management and Mitigation Group conducted a study on a method for effectively collecting damage information by using ICT and has been developing an information collection system using cell phones that could be used during a disaster. For this purpose, a demonstration test concerning information collection that involved simulating circumstances during a disaster, was held in Takamatsu City on Feb. 29 and 30 in front of the public who may use the system in the future (Fig. 57).

### 3.23.5 Exhibition

- (1) In the Technical Show Yokohama 2008 held in Pacifico Yokohama on Feb. 13 to 15, a voice-reading system using wireless tag was exhibited at the booth of NICT Incubations (Fig. 58).
- (2) An open test by the technical committee studying government radio transmissions

into each home to prevent disaster, under the Kinki Bureau of Telecommunications, of which Group Leader Takizawa is a member, was held in Awaji City, Hyogo on Feb. 27. The test included exhibiting the rescue communicator (Fig. 59).

### 3.23.6 Job experience for junior high school students

Six students in the 2nd year of Tokyo Denki University Junior High School were accepted for job experience on Feb. 4 (Fig. 60).

## 3.24 March 2008

### 3.24.1 Patent granted

The following patent for a method of



Fig.57 Demonstration test of disaster information collection system

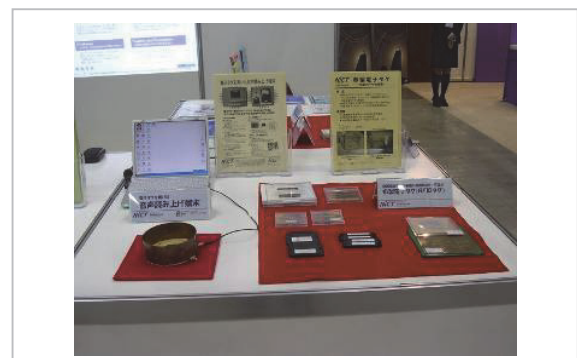
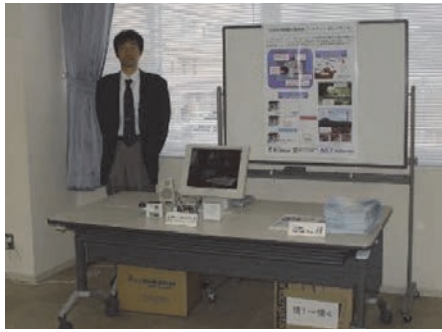


Fig.58 Technical Show Yokohama 2008



**Fig.59** Committee studying government radio transmissions into each home to prevent disasters

restricting the duration only of general calls, created by Senior Researcher Kazunori Okada and others, was granted on March 5. The invention makes both important communication calls and general calls, for example, when members of the public want to confirm the safety of their loved ones, easier to connect during times of congestion in a disaster (application date: Dec. 21).

- Okada and Masahiro Kuroda (Medical ICT Group): “Method of restricting and controlling the duration of telephone calls made via a communication network,” Patent No. 4056013

### 3.24.2 Research presentation

(1) 1st Int’l Workshop on Disaster and Emergency Information Network Systems (IWDENS 2008)

A satellite workshop of the Int’l Conf. on Advanced Information Networking and Applications (AINA2008) held by the IEEE Computer Society, IWDENS 2008, was held in Okinawa on March 26. Group Leader Takizawa and Senior Researcher Koichi Gyoda each made the following presentations.



**Fig.60** Job experience for junior high school students

- Takizawa, Masafumi Hosokawa (NRIFD), Ken’ichi Takanashi (NRIFD), Hada, Akihiro Shibayama, and Jeong Byeong-pyo: Pinpointing the place an emergency cell phone call originates using an active RFID tag.
  - Gyoda, Nam, Okada, and Takizawa: Analysis of Ad Hoc Network Performance in Emergency Communication Models.
- (2) General journals
- Hada: Disaster mitigation research platform — rescue communicator, *Telecom Frontiers*, No. 58, pp. 23–32, Mar. 2008.
- (3) Symposium in the general meeting of Inst. of Electronics, Information and Communication Engineers (March 18 to 21) “Ad hoc network that supports recovery from a disaster”
- Gyoda, Nam, Okada, and Takizawa: “Analysis of the performance of ad hoc network in the communication model during an urban disaster”
- General session
- Semba, Okada, Gyoda, and Nam: “Evaluation of the characteristics of emergency multisystem access in microcell network when there are many non-operating base stations”
- (4) Joint presentation (by researchers in external organizations)
- General meeting of the Inst. of Electronics, Information and Communication Engineers

- Masafumi Hosokawa, (NRIFD), Ken'ichi Takanashi (NRIFD), Takizawa, and Hada: "Positioning system using RFIDs for sending distress messages by cell phone"
- Hideo Sato (Tokyo Denki Univ.), Kuniaki Kawabata (RIKEN), Hayato Kaetsu (Tokyo Denki Univ.), Tsuyoshi Suzuki (Tokyo Denki Univ.), Yasunori Yakiyama (Tokyo Denki Univ.), Yasushi Hada, and Yoshito Tobe (Tokyo Denki Univ.): "Environmental information collection by sensor nodes with a passive pendulum mechanism" (poster session by students)
- Research presentation by students of the Tokyo branch of the Inst. of Electronics, Information and Communication Engineers (March 1)
  - Hitoshi Kono (Tokyo Denki Univ.), Kei Sawai (Tokyo Denki Univ.), Kuniaki Kawabata (RIKEN), Hada, and Tsuyoshi Suzuki (Tokyo Denki Univ.): "Development of shock-resistant sensor nodes for collection of information in disaster areas"
- 13th Robotics Symposia (March 16 to 17)
  - Ryuji Sugizaki (Tokyo Denki Univ.), Tsuyoshi Suzuki (Tokyo Denki Univ.), Kuniaki Kawabata (RIKEN), Yasushi Hada, and Yoshito Tobe (Tokyo Denki Univ.): "Gathering of environmental information with mobile robots and wireless sensor networks"

### **3.24.3 Demonstration test of disaster information collection system**

After the demonstration test on disaster information collection with cell phone terminals performed in Takamatsu City at the end of Feb., a second test was carried out using the same subjects (20 to 60 years of age) over two days, March 28 and 29. In this test, ease of operation of the information collection system (confirmation of the fact that the operation once experienced can be repeated even after a prolonged period) and reliability of the information were verified.

This test was reported in *The Shikoku Shimbun*, Setonaikai Broadcasting Co., Ltd., NHK local news, and others on March 29.

### **3.24.4 Koichi Gyoda, transferred to Shibaura Inst. of Tech.**

Senior Researcher Koichi Gyoda who was responsible for the research and development of the ad hoc network, was transferred to Dept. Electrical Communication, College of Engineering, Shibaura Inst. of Tech. as an associate professor on April 1.

## **3.25 April 2008**

### **3.25.1 Facilities' Open House of Nat'l Research Inst. of Fire and Disaster**

When the facilities of the Nat'l Research Inst. of Fire and Disaster, were opened to the public on April 18, Expert Researcher Jeong Byeong-pyo made a demonstration of the damage information collection system using cell phones (Fig. 61).

## **3.26 May 2008**

### **3.26.1 Contribution to "The research meeting concerning how to make important communication more sophisticated"**

The final meeting of the research committee for making important communication more sophisticated, under the Telecommunications Business Department of Ministry of Internal Affairs and Communications, was held on May 26. Studies on restricting the duration of



**Fig.61** Opening of the facilities of Nat'l Research Inst. of Fire and Disaster to the public

communications during a disaster, which was proposed as an important technology for ensuring communication, were described in an independent chapter of the report. The section of the report describing future directions also stated that it is desirable that technologies effective for communication time-restriction should be studied in collaboration between NICT and telecommunication carriers.

### **3.26.2 Expert Researcher Jeong Byeong-pyo estimated the soil amplification factor of the Sichuan Earthquake (China) from satellite data**

In 2008, Expert Researcher Jeong Byeong-pyo started research on a method for estimating the soil amplification factors observed in large-scale earthquakes that occurred mainly in developing countries. He used a digital elevation model previously obtained, for example, from artificial satellites. He also roughly estimated the seismic intensity distribution from them, in collaboration with the Nat'l Research Inst. of Fire and Disaster. This research is focused more on speed than accuracy and strives to support determining a strategy on the place to which the international emergency rescue team is to be dispatched. As part of the research, Expert Researcher Jeong Byeong-pyo estimated the soil amplification factor of the Sichuan Earthquake that occurred on May 12. The results were reported urgently in the Remote Sensing Society of Japan on May 23. He was interviewed about the results by *The Asahi Shimbun* on May 26 and 27.

### **3.26.3 Invited lectures and presentations in academic meetings**

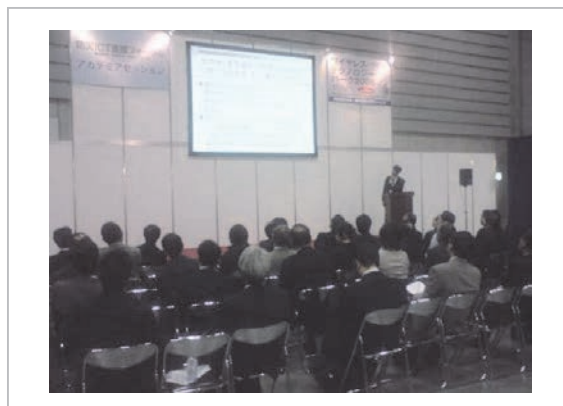
(1) The second local disaster management information symposium, “Toward establishing a means of communicating information that is effective in disaster mitigation”, was held on May 8 at Iwate Prefectural Univ. by the Inst. of Local Disaster Management Information, Iwate Prefectural Univ. Group Leader Takizawa gave a lecture entitled “Studies on ICT for Disaster Management in NICT”. The lecture was presented, as Iwate Pref. Univ., Univ. of Shizuoka, and Kochi

Univ. of Tech. were connected to each other by JGN2plus (Fig. 62).

- (2) In the forum for supporting disaster management ICT at the Wireless Technology Park 2008, held in Pacifico Yokohama on May 13, Group Leader Takizawa gave a lecture entitled “Studies Conducted in NICT to Establish a Useful ICT for Disaster Management and Mitigation (Fig. 63).
- (3) On May 16, Group Leader Takizawa gave a lecture entitled “Collecting Information on Disaster Areas with IC Tags”. He gave the lecture to 34 students as part of telecommunication training in the professional course of the College of Land, Infrastructure, Transport and Tourism.
- (4) In the Int'l Symposium on Mobile Information Technology for Emergency Response (Mobile Response 2008) held in Germany on May 30, Expert Researcher Yasushi Hada



**Fig.62** Second Local Disaster Management Information Symposium



**Fig.63** Forum for supporting disaster management ICT in Wireless Technology Park 2008

gave a presentation entitled “Three-Way Pinpointing of Emergency Calls from a Cell Phone Equipped with an RFID Reader.” Yasushi Hada replaced the first author and Group Leader Takizawa in this event. This presentation gave the results of the development under contracted research of the Special Coordination Funds for Promoting Science and Technology. The Proceedings were published as LNCS from Springer.

(5) In the meeting of the Remote Sensing Society of Japan held in Tokyo Inst. of Tech. on May 23, Expert Researcher Jeong Byeong-pyo gave a presentation entitled “Topographic Classification Using ASTER-DEM for Estimation of Soil Amplification”. The results of the on-site investigation in the Philippines obtained by analysis using satellite data and also those obtained in emergency analysis of Sichuan Earthquake were included in the presentation.

(6) In the spring meeting of the Inst. of Social Safety Science held in Toyako Lake on May 30 to June 1, Expert Researcher Jeong Byeong-pyo gave a presentation entitled “Information Collection System Using Cell Phones for Use During a Disaster”. The presentation was related to the results obtained in the field test performed in Takamatsu City in February and March of the same year.

### 3.27 June 2008

#### 3.27.1 Tokyo Int’l Fire and Safety Exhibition (Fig. 64)

In an exhibition held by the Tokyo Fire Department approximately every 5 years, the Disaster Management and Mitigation Group presented an exhibition on June 5 to 8 and presented various research results of the group and collaborated organizations. The following two workshops were held on the first day of the exhibition.

(1) Workshop, “ICT, firefighting and disaster management” (morning of June 5)

Members of the research team engaged in “studies on a system to support firefighting activities before and after a large-scale disaster and to share information” performed



**Fig.64** Tokyo Int’l Fire and Safety Exhibition 2008

under the Grant-in-Aid for Scientific Research (basic research B), in which Group Leader Takizawa is the representative, presented their results. The Expert Researcher Masafumi Hosokawa of the Nat’l Research Inst. of Fire and Disaster urgently reported the results of the topographic classification and soil amplification factor estimation of Sichuan Earthquake obtained in collaboration with Expert Researcher Jeong Byeong-pyo. The presentation attracted considerable attention. A summary of what Expert Researcher Jeong Byeong-pyo stated in interviews on May 26 and 27 (see **3.26.2**) was reported in an article on “Accurately estimating the damage from earthquakes using data from space” in the morning edition of the *The Asahi Shimbun* on June 4. The program is shown below:

“Studies on a system for support for firefighting activities before and after large-scale disaster and for information sharing,” Osamu Takizawa (NICT)

“Research and development of sensing to support activities to manage disasters and ubiquitous space-time basic technology,”

Masafumi Hosokawa (Science and Technology Policy Office, FDMA)

“Studies on disaster mitigation through cooperation between commuters unable to get home and local residents and governments in large-scale urban disasters,” Yoshiaki Hisada and Masahiro Murakami/Akihiro Shibayama (Kogakuin Univ./NICT)  
(2) Workshop, “Positioning of the use of RFID and assurances for safety and security” (afternoon of June 5)

A meeting to present the results obtained through contracted research under the Special Coordination Funds for Promoting Science and Technology, in which NICT is also involved, on “positioning of the use of RFID and assurances for safety and security” was held and the meeting was very successful. Many people engaged in firefighting participated. The program is shown below:

“Summary of entire project and improvement in precision of positional information and acquisition of environmental information using the P2P model,” Kaoru Sezaki (Center for Spatial Information Science, The Univ. of Tokyo)

“Seamless positioning using RFID and development of an efficient surveying system,” Izumi Kamiya (Geospatial Information Authority)

“Assurance of safety and security using positioning technology,” Osamu Takizawa (NICT)

“Positioning technology needed when responding to a distress call,” Masafumi Hosokawa (Science and Technology Policy office, FDMA)

“Technology for search and rescue,” Ken’ichi Takanashi (NRIFD)

“Ensuring the safety and security of children,” Tomonori Saito (NRIPS)

### **3.27.2 On-site investigation on The Iwate-Miyagi Nairiku Earthquake in 2008**

The Iwate-Miyagi Nairiku Earthquake in 2008 occurred at 8:43 on June 14, 2008.

Expert Researcher Akihiro Shibayama traveled to the site on the same day and made

an immediate investigation on the damage with Professor Masato Motosaka, Disaster Control Research Center, Tohoku Univ. (Fig. 65). The investigation results were reported through the disaster committee of the Architectural Inst. of Japan.

### **3.27.3 On-site test under the NEDO project for the development of component technologies for construction of a strategic advanced robot**

A test for a NEDO contracted research project, “high-speed search robots for confined spaces” was conducted in the underground complex of Sannomiya, Kobe, during the period from midnight on June 17 to the early morning of June 18. Expert Researcher Yasushi Hada and Group Leader Takizawa participated in the test (Fig. 66). A drill to simulate the operation of a robot was performed by the firefighters from the fire-defense headquarters of Odawara, Kawasaki, and Kobe, in front of the people from the Ministry of Economy, Trade and Industry and NEDO. Other professionals also attended the test for evaluation. A problem was observed concerning the communication, for which NICT and others were responsible. It was not possible to display a particular function due to radio interference, for example, from the surveillance cameras of shops in the underground complex. Further improvement was therefore needed.

### **3.27.4 Presentations at academic meetings**

(1) The following presentation was given at



**Fig.65** On-site investigation of the Iwate-Miyagi Nairiku Earthquake in 2008

the 27th meeting of the Japan Society for Simulation Technology held on June 20.

- Senior Researcher Okada, Suzuki, the trainee Semba, and Expert Researcher Nam: “Call quantity characteristics of emergency multisystem access in a microcell network when there are many non-operating base stations”
- (2) In the Robotics and Mechatronics Conference (ROBOMECH 2008) of the Robotics Society of Japan held on June 5 to 7, the following presentations were given.
- Hada et al. : “Outdoor demonstration test of an information collection network using intelligent sensor nodes and an autonomous airship,” “Test of long-distance remote control of a mobile robot using wireless LAN communication,” and three other collaborative presentations.

### 3.27.5 Patent granted

Okada and Masahiro Kuroda (Medical ICT Group): “Method and system of restricting and controlling the duration of telephone calls communicating via a network”(Patent No. 4130973, registered: June 6, 2008)

## 3.28 July 2008

### 3.28.1 Techno Transfer in Kawasaki

In the exhibition held in the Kanagawa Science Park on July 9 to 11, the RFID-based voice-reading terminal was exhibited at the booth of NICT Incubations (Fig. 67).



**Fig.66** On-site demonstration of NEDO project for Strategic Development of Advanced Robotics Elemental Technologies

### 3.28.2 General Government Fair 2008

In the exhibition held at Tokyo Big Sight on July 16 to 18, progress of the research and development project: “Protecting children from crime” was exhibited jointly with the Nat’l Research Inst. for Police Science of Nat’l Police Agency, Surugadai Univ. and the Center for Spatial Information Science, The Univ. of Tokyo (Fig. 68).

### 3.28.3 Spatial Information Symposium 2008

At the Symposium held in Tokyo Conference Center on July 17, Expert Researcher Akihiro Shibayama gave a presentation entitled “Sharing of Disaster Management Information between Local Residents and Government Using ICT”.

### 3.28.4 NICT’s Facilities’ Open House

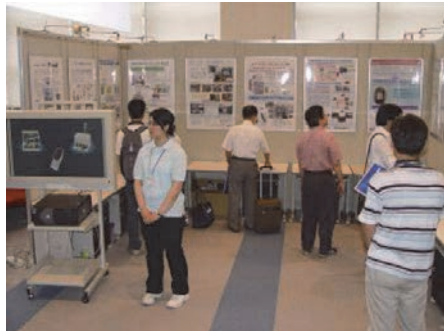
The facilities of NICT were made open to public on July 25 and 26, when a rescue robot and other items were demonstrated. At the event, studies conducted in the Disaster Management and Mitigation Group were presented (Fig. 69).



**Fig.67** Technology Transfer in Kawasaki



**Fig.68** General Government Fair 2008



**Fig.69** Facilities' Open House

### 3.29 Aug. 2008

#### 3.29.1 Test for collection of damage information from above by an unmanned airship

On Aug. 12 to 15, Expert Researcher Yasushi Hada participated in a test flight of a 14 meter-class LTA held by JAXA in Taiki-cho, Hokkaido and conducted a damage information collection test between ground and sky using rescue communicator (Fig. 70). This is the third in a series of tests, continuing from those in Aug. and Dec. last year. In the earlier tests, the transmission of audio information collected every minute by the rescue communicator to an unmanned airship high above via an ad hoc network was tested. It was confirmed then that communication of the rescue communicator with the airship, with which it is not possible to communicate directly, can be achieved by multi-hop transfer, and that communication with the rescue communicator is also possible even when it is covered with a wooden plate 10 cm thick, which simulates a damaged building. The results obtained in these collaborative tests were disclosed in the



**Fig.70** Test on collecting damage information from above by an unmanned airship

international conference held in The Univ. of Electro-Communications on Aug. 20 to 22, SICE Annual Conference 2008.

#### 3.29.2 Participation in academic activities and drills

- (1) Expert Researcher Kotaro Sonoda attended the IEEE IJHMSP 2009 (Int'l Conf. on Intelligent Information Encoding and Multimedia Signal Processing) held in Harbin, China, on Aug. 15 to 17. He played the role of chairman for the session of Advanced Data Encoding and Coding Techniques for Audio signals. The current meeting, which was related to information encoding and mining of multimedia signals, was the fourth.
- (2) Expert Researcher Yasushi Hada gave a lecture entitled "research and development of robot sensor network for use in disaster management or mitigation" in the 51st mobile unit communication research meeting of Megurokai on Aug. 28.
- (3) In the joint disaster management drill of Tokyo Metropolitan Government and other cities held on Aug. 31 (In Harumi-futou Park, Chuo-ku), a corner of the exhibition space, to provide operational experience of the cell phone terminal with a damage information collection function. The function was developed in collaboration with Nat'l Research Inst. of Fire and Disaster, Fire Defense Agency, Ministry of Internal Affairs and Communications, was formed (Fig. 71). The cell phone terminal was reported to the media on Aug. 25 before the drill.



### 3.29.3 Status of NEDO contract research

The robot developed under the NEDO contracted research project participated again in the RoboCup 2008 World Championship held in Suzhou, China on July 14 to 20 under the team name, Pelican United, after participating in the previous year and won 3rd prize in the section, Autonomy (autonomous performance) of the Rescue Robot League (Fig. 72).

### 3.30 Sep. 2008

#### 3.30.1 Presentations at academic meetings and magazine coverage

(1) In the meeting of the Architectural Inst. of Japan 2008 held in Hiroshima Univ, on Sep. 18 to 20 the following presentations were given.

- Jeong Byeong-pyo, Shinsaku Zama



**Fig.71** Joint disaster management drill of Tokyo Metropolitan Government and other governments

(NRIFD), Shibayama, and Takizawa: “Demonstration test of disaster information collection system using cell phones”

- Nishigaya Norifumi (Kanto Gakuin Univ.), Norio Abeki (Kanto Gakuin Univ.), and Jeong Byeong-pyo: “Micro-tremor-based vibration characteristics of the ground in San Pedro, the Philippines”
- Shibayama, Masami Gotou (Kanazawa Inst. of Tech.), and Shinya Muranishi (Kanazawa Inst. of Tech.): “Studies on the period needed to investigate building damage”
- Takeshi Okubo (Kanazawa Inst. of Tech.), Shinya Muranishi (Kanazawa Inst. of Tech.), Shibayama, and Masami Gotou (Kanazawa Inst. of Tech.): “Investigation of buildings half a year after the Noto Hanto Earthquake in 2007”

(2) J. of Radio Engineering & Electronics Association, “FORN”, Sep. issue

Group Leader Takizawa wrote an article entitled “Information communication technology useful for disaster management and mitigation”.

#### 3.30.2 Committee

(1) Committee for investigation and management of the joint resident/government ubiquitous disaster mitigation information system



**Fig.72** left: Logo of Pelican United (Chiba Inst. Tech., Tohoku Univ., Tsukuba Univ., Okayama Univ., AIST and NICT)  
right: Certificate of commendation from the RoboCup 2008 World Championship

The first meeting of the committee for the investigation and management of the project for science and technology of safety and security of the Ministry of Education, Culture, Sports, Science and Technology, which started the same year, was held at Univ. of Yamanashi on Sep. 22. The project started with the purpose of constructing a system to improve disaster information sharing in collaboration between local residents and governments and for achieving disaster mitigation and also of constructing an information system to support the system. Univ. of Yamanashi was the representative organization. The Univ. of Tokyo (Graduate School of Information Science and Technology, Institute of Industrial Science) and the Nat'l Inst. of Advanced Industrial Science and Technology (AIST) were joint research organizations, and the Nat'l Research Inst. of Fire and Disaster and NICT were cooperative research organizations.

### 3.30.3 Tests

- (1) High-speed search robots for use in confined spaces (NEDO contracted research)

After the test in August, Expert Researcher Hada conducted a field test of the integrated wired/wireless ad hoc network in the underground complex in front of the Sannomiya Station, Kobe, after the railway service had stopped operating, twice on Sep. 7 to 8 and 12 to 14.

- (2) Workshop on "Protecting children from crime" (contracted research of JST/RISTEX)

A workshop for the contracted research, "Establishing a practical ground for monitoring damage to children and crime-prevention activities" (representative organization: Nat'l Research Inst. for Police Science) was held at the Tsukuba Int'l Congress Center on Sep. 22. Group Leader Takizawa attended the workshop. Four pairs, each consisting of a parent and a child, participated in the workshop, collecting data by performing regional risk analysis and walking in the town to conduct inspections. NICT was responsible for development of the application for the cell phones used during the

walking inspections (Fig. 73).

### 3.31 Oct. 2008

#### 3.31.1 Test on evacuation monitoring with a real-time evacuation-monitoring system using active RFID

In the disaster management drill held in the Shinjuku campus of Kogakuin Univ. on Oct. 22, Expert Researcher Shibayama conducted a test on monitoring the evacuation in a high-rise building with Kogakuin Univ. (Fig. 74). In the test, the evacuation status in the high-rise building was monitored in real time, with active RFIDs being carried by teachers and students. The test results are useful for predicting congestion in the evacuation routes and for decision-making when determining the evacuation routes. The test was performed under the cooperative research with Kogakuin Univ., "studies on disaster mitigation through the cooperation of commuters unable to get home with local residents and government agencies in a large-scale urban disaster".

#### 3.31.2 On-site investigation of Sichuan Earthquake

Expert Researcher Jeong Byeong-pyo conducted investigative research on topography of the area damaged in the Sichuan Earthquake, which occurred on May 12, and the surrounding areas in cooperation with Kyoto Univ. and Kanazawa Univ. in the period from Oct. 18 to



**Fig.73** Workshop for "Protecting children from crime"

27 (Fig. 75). The investigation was conducted as part of the research on international contribution concerning the estimation of damage and transmission during a disaster through the combination of remote sensing and technical test satellites. The validity of our method for estimating earthquake damage based on numerical altitude data (DEM) obtained from artificial satellites was verified. The results of the investigation showed that the method has accuracy sufficient for use in urgent reports issued immediately after a disaster.

### 3.31.3 Presentations at academic meetings and acceptance of trainees

(1) At the 14th World Conference on Earthquake Engineering held in Beijing on Oct. 13 to 17, the following presentations were given.

- Jeong Byeong-pyo, Shinsaku Zama, Masafumi Hosokawa, Osamu Takizawa, and Bartlome C. Bautista: “A study on the classification of landform based on SRTM-3 for estimating site amplification factors in metropolitan Manila,” the Philippines, 14th World Conf. Earthq. Eng., DVD 2008
- Akihiro Shibayama, Yoshiaki Hisada,

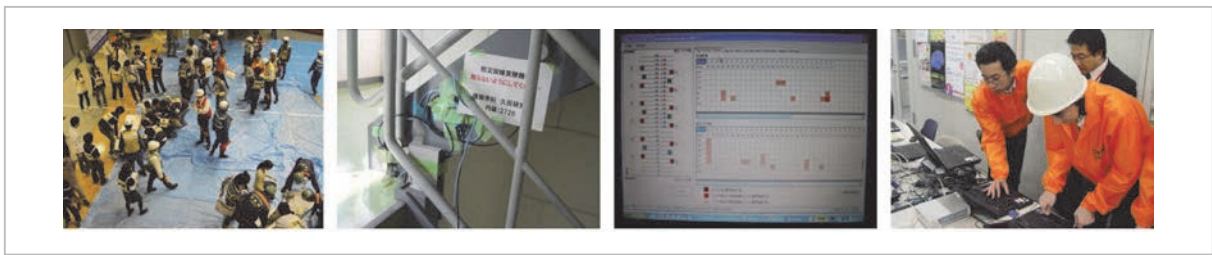
Masahiro Murakami, Makoto Endo, Shinsaku Zama, Osamu Takizawa, Masafumi Hosokawa, and Tsuguyuki Ichii: “A study on the support system for disaster information collection using information and communication technology,” 14th World Conf. Earth. Eng., DVD 2008

(2) At the international conference held Seoul, Korea on Oct. 14 to 17, the following presentation was given.

- Hideo Sato, Kuniaki Kawabata, Tsuyoshi Suzuki, Hayato Kaetsu, Yasushi Hada, and Yoshito Tobe: “Information gathering by wireless camera node with passive pendulum mechanism,” Int’l Conference on Control, Automation and Systems 2008 (ICCAS 2008), pp. 137–140, Seoul, Korea, Oct. 14–17, 2008.

(3) At the research meeting on multi-dimensional mobile communication network of the Japan Society for Simulation Technology held in Niigata Univ. on Oct. 31, the following presentation was given.

- Tomotaka Suzuki (a trainee), Kazunori Okada, and Nguyen Hoang Nam: “Evaluation of characteristics of W-CDMA micro cell network when there are non-



**Fig.74** Disaster management drill held in Shinjuku campus of Kogakuin Univ.



**Fig.75** On-site investigation of Sichuan Earthquake

operating base stations”

(4) At the meeting of the Japan Society for Disaster Information Studies held in the Center for Integrated Disaster Information Research, The Univ. of Tokyo on Oct. 25, the following presentation was given.

- Takizawa, Jeong Byeong-pyo, Masafumi Hosokawa,(NRIFD), and Masashi Matsuoka (AIST): “Research and development project on damage estimation during a disaster to support by International Rescue Team of Japan Fire-Service”

(5) Sixteen members of the Firefighters’ Union and Firefighting Advisory Committee for East Iruma area were accepted for inspection and training on Oct. 31.

### 3.31.4 Exhibitions

(1) CEATEC JAPAN 2008

The system for estimating earthquake damage was exhibited in the NICT Super Event, held in Makuhari Messe on Sep. 30 to Oct. 4 (Fig. 76).

(2) Security & Safety Trade Expo 2008

The author participated in the exhibition held at Tokyo Big Sight on Oct. 8 to 10 (Fig. 77).

(3) The International Industrial Fair 2008

An RFID-based voice-reading system was exhibited at the booth of NICT Incubations at the exhibition held at the Kobe Int’l Exhibition Kobe International Exhibition Hall on Oct. 8 and 9 (Fig. 78).

## 3.32 Nov. 2008

### 3.32.1 Demonstration evaluation of the high-speed search robot for use in confined spaces, developed under NEDO contracted research

Technical demonstration to evaluate the NEDO contracted research project, which was underway since 2006, was conducted in the underground complex of Sannomiya, Kobe on Nov. 6. To test the communication portion, for which NICT is mainly responsible, five robots were actuated simultaneously using the system developed. Two of the robots could be controlled remotely even from a long distance of



Fig.76 CEATEC JAPAN 2008

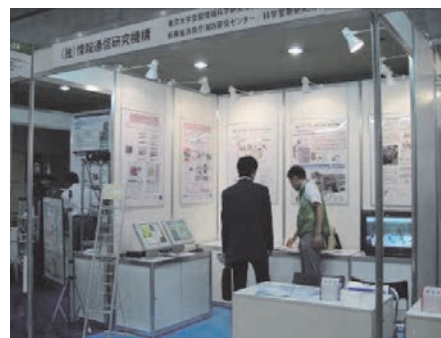


Fig.77 Security & Safety Trade Expo 2008



Fig.78 Int'l Frontier Industry Messe

683 meters, demonstrating to the reviewers that the system satisfied the initial target of actuating multiple search robots simultaneously in a confine space 700 meters in length (Fig. 79).

### 3.32.2 Local ICT Future Festa 2008 in Tokushima

Future information communication technology for use during a disaster was exhibited jointly with the Nat’l Research Inst. of Fire

and Disaster. Group Leader Takizawa gave a lecture entitled “Advanced ICT for disaster management and mitigation” in the Tonankai and Nankai Earthquakes Seminar held on Nov. 8 (Fig. 80).

### 3.32.3 u-Japan Festa in Fukuyama

In the forum for investigation the use of RFID in Chugoku, held at the event in Fukuyama, Hiroshima on Nov. 14, Group Leader Takizawa gave a lecture on mobile terminals and RFID used in a ubiquitous networked society (Fig. 81).

### 3.32.4 Open demonstration test of positioning using RFID and assurances for safety and security

On Nov. 26, a demonstration test of the research and development project under the Special Coordination Funds for Promoting Science and Technology, which was carried out in collaboration with The Univ. of Tokyo, Geospatial Information Authority, NRIFD and Nat’l Research Inst. for Police Science, was held in Nagareyama City, Chiba (Fig. 82). The test was reported to the media on Nov. 18.

### 3.32.5 Presentations at academic meetings

In the meeting of the Seismological Society of Japan held in Tsukuba Int’l Congress



**Fig.80** Exhibition and lecture in Local ICT Future Festa 2008 in Tokushima



**Fig.79** Demonstration for evaluation of NEDO project



**Fig.81** Lecture in u-Japan Festa in Fukuyama



**Fig.82** Open demonstration test of "Positioning using an RFID and assurances for safety and security"

Center on Nov. 24, the following presentation was given.

- Jeong Byeong-pyo, Shinsaku Zama (NRIFD), Makoto Endo (NRIFD), Masafumi Hosokawa, (NRIFD), and Takizawa: "Estimation of seismic intensity distribution in Sichuan Earthquake"

### **3.32.6 Expert Researcher, Akihiro Shibayama, transferred to Tohoku Univ.**

Expert Researcher Akihiro Shibayama was transferred as assistant professor to the laboratory of Professor Masato Motosaka in the Disaster Control Research Center, Tohoku Univ. on Dec. 1.

## **3.33 Dec. 2008**

### **3.33.1 Discussion group for the utilization of ICT in the field of fire-fighting and disaster management**

Under the current status and future prospects concerning advances in ICT, including ubiquitous network and broadband, for the purpose of establishing an environment of cooperative research and development by matching the seeds in research organizations with the needs in firefighting, the Nat'l Research Inst. of Fire and Disaster initiated a discussion group for the use of ICT in the field of firefighting and disaster management. The

objective was to allow ICT to be used more actively in the field of firefighting and disaster management, for example to support firefighting activities and to collect disaster information. The first meeting was held in the NICT Kojimachi meeting room on Dec. 19, where Group Leader Takizawa was selected as the chief examiner.

### **3.33.2 Participation of the engineer, Kim Taewoon**

To accelerate the research and development project into the international contribution concerning the estimation of damage and data transmission during a disaster through the combination of remote sensing and technical test satellites, Kim Taewoon of, Urban Safety and Security Research Institute, Univ. of Seoul, Korea, joined the team as a fixed-term engineer on Dec. 1. He is responsible for developing the topographic classification algorithm for estimating soil amplification factors.

## **3.34 Jan. 2009**

### **3.34.1 Continuation of the NEDO rescue robot project approved**

Among the three projects initially approved after the "stage gate evaluation" to determine whether the projects should be continued or terminated, under the NEDO contracted research in progress since 2006, entitled "RT System Moving in Damaged Buildings, Strategic Development of Advanced Robotics Elemental Technologies (in the field of robot for special environment)," the project in which NICT is participating, namely, "high-speed search robots for use in confined spaces" (representative organization: Int'l Rescue System Inst.) was approved for continuation. Two additional years were approved for it to achieve practical application. One of the reasons for the decision was that the selection of the wireless/wired hybrid communication system is practical and that the system is also practical, indicating that the method proposed by NICT, as its practical application is taken into consideration, is highly regarded.

### 3.34.2 Participation to the test of providing information to commuters unable to get home, held by the Kanto Bureau of Telecommunications of the Ministry of Internal Affairs and Communications

An on-site test aimed at providing information to commuters unable to get home was held through an investigation and discussion group concerning the establishment of a communication support system for local disaster management, initiated by the Kanto Bureau of Telecommunications of the Ministry of Internal Affairs and Communications. The test was held in the area in front of the east gate of Ikebukuro Station on Jan. 23 (Fig. 83). In the test, a wireless mesh network was constructed using a high-output wireless LAN with a 4.9GHz band and IEEE802.11s. Local disaster information was transmitted to and from portable terminals. Electronic papers and information display devices such as LEDs were deployed in “Machikado” disaster management information stations and various areas. In this way, the effectiveness of the system in evacuating and providing guidance to the commuters unable to get home was verified. Former Expert Researcher Akihiro Shibayama currently assistant professor in Tohoku Univ. (also a short-term researcher of NICT since Jan.), participated in the test as an application-related professional advisor. He provided technological advice concerning the mobile ad hoc network using portable terminals.



**Fig.83** Test for providing information to commuters unable to get home

### 3.34.3 Lectures and public relations

- (1) In the symposium, “Summary and future prospects of the five-year research into disaster management systems to prepare against a large-scale disaster,” held by the Disaster Management System Research Center of Ritsumeikan Univ. in Hotel Granvia Kyoto on Jan. 23, Group Leader Takizawa gave a keynote lecture entitled “Advanced ICT and disaster management and mitigation”. He also participated in the panel discussion (Fig. 84).
- (2) In the “Disaster Management Tokushima Podcast,” an Internet radio program provided by the Crisis Management Bureau of Tokushima Prefecture, interviews with Group Leader Takizawa entitled “Disaster management and mitigation with cell phones — communication technology in the near future” were broadcast from Jan. 12.
- (3) Comments on the means of communication during a disaster by Group Leader Takizawa appeared in an article dealing with the problems of hospitals at the heart of a disaster, which ran in *The Asahi Shimbun*, Osaka morning edition on Jan. 19, which was the anniversary of the Great Hanshin Earthquake.

### 3.35 Feb. 2009

#### 3.35.1 Cooperative research carried out with Dr. Vu, Hanoi Inst. of Tech.

Dr. Vu Van Yem, Director of Department



**Fig.84** Symposium, “Summary and future prospect of the disaster management system research for preparation against large-scale disaster conducted over five years”

of Telecommunication Systems, School of Electronics and Telecommunications Hanoi Inst. of Tech. was invited to the Disaster Management and Mitigation Group for the period of Feb. 23 to 26 to engage in cooperative research on the emergency wireless network. He gave a lecture entitled “Research into Advanced Emergency Communications System for Fishing Boats in Vietnam,” in the video conference room of the main building on Feb. 23 (Fig. 85).

### 3.35.2 Demonstration test of disaster information collection system using cell phone terminals

A simulation demonstration test on the collection of information during a disaster by the information collection system during disaster using cell phones was carried out in Takamatsu City on Feb. 27 and 28, with citizens aged 20 to 60 years participating, as was the case the previous year. The purpose of the test was to examine whether the same subject remembered the operation method after one year.

### 3.35.3 Exhibitions

- (1) The 13th Technology Against Earthquake Expo

The damage estimation technology during a disaster and the disaster information collection system using cell phones were presented in the exhibition held in Pacifico Yokohama on Feb. 5 and 6 (Fig. 86).

- (2) Technical Show Yokohama 2009

The RFID-based voice-reading system was exhibited by NICT Incubations in the exhibition held in Pacifico Yokohama on

Feb. 4 to 6 (Fig. 87).

- (3) Tama Industrial Exchange Exhibition

In the exhibition held in the Showa Memorial park in Tachikawa City on Feb. 20–21, the RFID-based voice-reading system was exhibited by NICT Incubations (Fig. 88).

### 3.35.4 Guidance for trainees completed

- (1) The trainee, Tomotaka Suzuki (The Univ. of Electro-Communications, M2), prepared



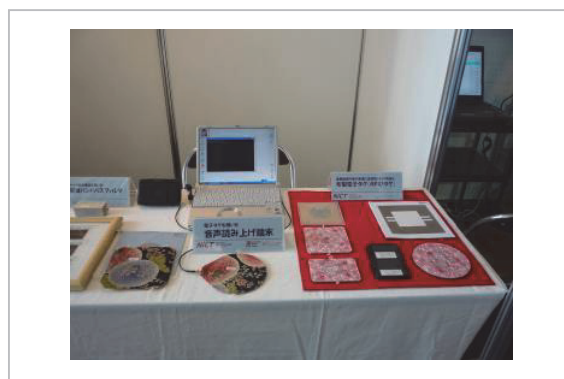
**Fig.86** Earthquake Management Technology Exhibition



**Fig.87** Technical Show Yokohama 2009



**Fig.85** Lecture by Dr. Vu Van Yem



**Fig.88** Tama Industrial Exchange Exhibition



a master's thesis entitled "Discussion on the performance of W-CDMA microcell networks when there are non-operating base stations and the responses to problems," under the guidance of Senior Researcher Kazunori Okada (Professor of Collaborative Graduate School). He presented his thesis at a meeting convened for this purpose at the university on Feb. 5.

- (2) The trainee, Yasuhiro Tanaka (Tokyo Denki Univ. B4), prepared and submitted a graduate thesis entitled "Development and evaluation of a VoP system suitable for rescue activities in underground spaces," under the guidance of Expert Researcher Yasushi Hada.

### 3.36 March 2009

#### 3.36.1 *Demonstration test (additional test) of disaster information collection system using cell phones*

A demonstration test on the collection of information through the use of terminals was carried out in Takamatsu City, Kagawa, on March 27 and 28, as in February, with citizens aged 20 to 70 years participating (Fig. 89). There were additional participants mainly in their 50s and 60s. An examination was conducted on whether the participants in the test last year remembered the operational method after one year.

#### 3.36.2 *Invited lectures*

- (1) Seminar on the communication of information during a disaster

In a joint seminar held by the Kinki Bureau of Telecommunications, Kinki Emergency Communication Conference and Kinki Information Communication Conference in Osaka Museum of History on March 6, Group Leader Takizawa presented research and development into advanced ICT for disaster management and mitigation (Fig. 90). "The technology for convoluting information on the siren of an emergency vehicle" (research theme of Expert Researcher Kotaro Sonoda) disclosed therein was broadcast in detail for three minutes



**Fig.89** *Demonstration test of disaster information collection system using cell phones*



**Fig.90** *Seminar on information communication during a disaster*

during the NHK television program, "News Terrace Kansai," at 18:00 the same day.

- (2) Special session of Information Processing Society of Japan, "Current status of and future prospects for disaster management or mitigation using advanced IT technology"

In the special session of the Society held at Ritsumeikan Univ. on March 10, Group Leader Takizawa gave a lecture entitled "Information collection during a disaster using ubiquitous technology — damage estimation technology".

#### 3.36.3 *Presentation in China-Japan Science Forum and repeated investigation of Sichuan Earthquake disaster areas*

Expert Researcher Jeong Byeong-pyo attended to the session of the 2008 Wenchuan Earthquake and Natural Disaster Mitigation in the 2nd China-Japan Science Forum held by the Japan Society for the Promotion of Science in Beijing on March 9 and 10. He gave a

poster presentation entitled “Estimation of Seismic Intensity Due to the 2008 Wenchuan Earthquake”. He also investigated the disaster areas of the Sichuan Earthquake as in October last year, and identified, from the interviews with the researchers there, the problems in the seismic intensity distribution presented by Chinese counterparts and in internal and external transmission of information. In this way, he confirmed the importance of our technology for estimating the extent of the damage.

### 3.36.4 Publications

(1) Special coverage in J. of Inst. of Electronics, Information and Communication Engineers, March, 2009: “Information communication technology for disaster management or mitigation”

Expert Researcher Akihiro Shibayama was responsible for this special article as a guest editor. The following topics were provided by NICT researchers:

- Kazunori Okada: “Problems of cell phones during a disaster and the countermeasures”
- Yoshiaki Hisada (Kogakuin Univ.), Masahiro Murakami (Kogakuin Univ.), Akihiro Shibayama, and Takizawa: “Disaster mitigation measures in cooperation with local governments and residents for ultrahigh-rise buildings during a large-scale disaster”

(2) An introductory article “Positioning of the use of RFID and assurances for safety and security” prepared by Group Leader Takizawa appeared in J. of Radio Engineering & Electronics Association FORN, March Ed.

### 3.36.5 Presentation of research results

(1) Suzuki, Okada, and Nam: “Evaluation of the performance of W-CDMA microcell network when there are multiple non-operating base stations,” general meeting of the Inst. of Electronics, Information and Communication Engineers in 2009, B-5-1, March 2009.

(2) Kei Sawai (Tokyo Denki Univ.), Hitoshi Kono (Tokyo Denki Univ.), Tsuyoshi Suzuki (Tokyo Denki Univ.), Hada, and Kuniaki Kawabata (RIKEN): “Development of a wire-

less sensor node with impact-resisting mechanism to protect against being dropped in the case of projected configuration,” 14th Robotics Symposia, 5C2, pp. 459–464, Mar. 16–17, 2009.

(3) Hada,, Takayuki Kaiso (Thinktube Inc.), Kentaro Matsuyama (Thinktube Inc.), Gyoda, and Takizawa: “Long-distance remote control of mobile robots using an ad hoc mesh network,” 14th Robotics Symposia, 5C3, pp. 465–470, Mar. 16–17, 2009.

(4) Jeong, Sinsaku Zama (NRIFD), Takizawa, Makoto Endo (NRIFD), and Shibayama: “Development of information collection system using cell phones for use during a disaster,” J. of Japan Association for Earthquake Engineering, 9, 2, pp. 102–112, 2009.

(5) Shibayama,, Yoshiaki Hisada (Kogakuin Univ.), Masahiro Murakami (Kogakuin Univ.), Shinsaku Zama (NRIFD), Makoto Endo (NRIFD), Takizawa, Itsuki Noda (AIST), Ai Sekizawa (The Univ. of Tokyo), Koji Suematsu (Vector Research Inst.) and Akira Ohgai (Toyohashi Univ. of Tech.): “Research on disaster information sharing using a damage information collection system,” J. of Japan Association for Earthquake Engineering, 9, 2, pp. 113–129, 2009.

(6) Shinsaku Zama (NRIFD), Makoto Endo (NRIFD), Kenichi Takanashi (NRIFD), Kiminori Araiba (NRIFD), Ai Sekikawa (The Univ. of Tokyo), Masafumi Hosokawa (FDMA), Jeong Byeong-pyo, Yoshiaki Hisada (Kogakuin Univ.) and Masahiro Murakami (Kogakuin Univ.): “Proposal and verification of efficient collection and usage of damage information,” J. of Japan Association for Earthquake Engineering, 9, 2, pp. 185–199, 2009.

## 3.37 May 2009

### 3.37.1 Open demonstration of NEDO contracted research, “High-speed search robots for use in confined spaces”

A demonstration test of NEDO contracted research into high-speed search robots moving in confined spaces was held for researchers

and the media at Hyogo Prefectural Emergency Management and Training Center on May 11. A communication system needed for remote control and the collection of information by multiple robots was constructed in the environment inside a 10-story building and operation of the robots was exhibited (Fig. 91).

### **3.37.2 New research group formed at the Inst. of Electronics, Information and Communication Engineers**

A “third-class” research group investigating an information communication network for a safe and secure life, which aims at studying various technologies concerning information communication networks that provide safety and security from various viewpoints, including those from interdisciplinary areas with social sciences, was formed in the Engineering Sciences Society of the Inst. of Electronics, Information and Communication Engineers. The chairperson is Senior Researcher Kazunori Okada and there are 47 committee members. The duration is two years.

### **3.37.3 Research presentation**

At the Robotics and Mechatronics Seminar 2009 of the Japan Society of Mechanical Engineers (ROBOMECH2009) held in Fukuoka on May 24 to 26, the following two presentations were given.

- Hada, Yasuhiro Tanaka (Tokyo Denki Univ.), Takayuki Kaiso (Thinktube Inc.), Kentaro Matsuyama (Thinktube Inc.), Tsuyoshi Suzuki (Tokyo Denki Univ.), and Takizawa: “Development and evaluation of a VoP system suitable for rescue activities in underground spaces,” 1A2-G19.
- Shoji Kawamoto (Chiba Inst. of Tech.),

Nobuto Hara (Chiba Inst. of Tech.), Tomoaki Yoshida (Chiba Inst. of Tech.), Eiji Koyanagi (Chiba Inst. of Tech.), and Hada: “Development of a LAN cable-installing robot,” 1A2-G20.

## **3.38 June 2009**

### **3.38.1 Introduction of researches**

Expert Researcher Jeong Byeong-pyo attended the 5th GIS Community Forum held in midtown Tokyo on June 4 and 5, where he gave a presentation on the entire concept of the research and development project into estimating damage during a disaster to support international firefighting/rescue teams. He explained some analytical examples in the case of the Sichuan Earthquake.

### **3.38.2 Senior member of Inst. of Electronics, Information and Communication Engineers**

Senior Researcher Okada was awarded a senior member certificate, indicating that he has become a senior member (a new title) of the Inst. of Electronics, Information and Communication Engineers.

### **3.38.3 Results of RoboCup 2009**

The team, Pelican United (joint team of five organizations: Int’l Rescue System Inst., Tohoku Univ., Chiba Inst. of Tech, AIST, and NICT), achieved the following results in the robotics world championship, RoboCup 2009, Rescue Robot League, held in Graz, Austria on June 29 to July 5 (Fig. 92).

Mobility:	1st prize
Manipulator:	1st prize
Autonomy:	2nd prize
Championship:	2nd prize



**Fig.91** Open demonstration of NEDO contracted research project

### 3.39 July 2009

#### 3.39.1 Research presentation

Expert Researcher Jeong Byeong-pyo attended the IEEE Int'l Geoscience and Remote Sensing Symposium 2009, held in Cape Town, South Africa on July 13 to 17. He gave a research presentation entitled "Estimation of Seismic Intensity Due to the 2008 Wenchuan Earthquake".

#### 3.39.2 NICT's Facilities' Open House

The facilities of NICT were opened to the public on July 24 and 25, when a rescue robot and other items were demonstrated. At the event, the studies conducted in the Disaster Management and Mitigation Group were presented (Fig. 93).

### 3.40 Aug. 2009

#### 3.40.1 Joint disaster management drill held by Tokyo Metropolitan Government, Setagaya-ku and Chofu City

In the disaster management drill carried out in Setagaya Park on Aug. 30, a demonstration test of a cell phone terminal with a function for collecting damage information was conducted (Fig. 94). The main task was to verify the function of autonomous GPS positioning without assistance from base stations, which was developed earlier at the end of last year. Group Leader Takizawa, Expert Researcher Jeong and Guest Researcher Hosokawa (NRIFD) were there for the drill.

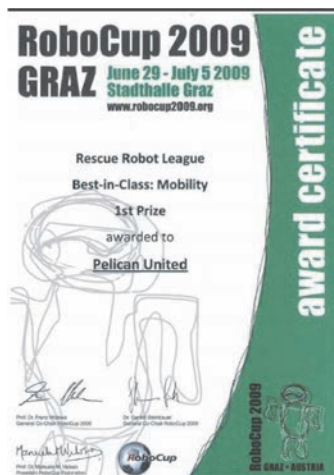
### 3.41 Sep. 2009.

#### 3.41.1 Disaster Management Drill in Tokushima Pref.

Problems identified from the experience of The Iwate-Miyagi Nairiku Earthquake in 2008 and the Chuetsu Earthquake in 2004 include the problem of towns in mountainous areas becoming isolated, the collection of disaster information before the first action, and deteri-

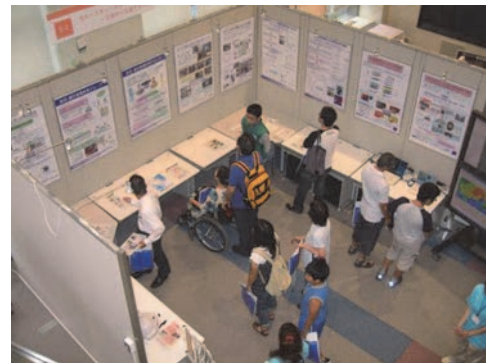


Trophies of four sections



Certificate of Mobility section

**Fig.92** Trophies and certificate obtained in RoboCup 2009



**Fig.93** Facilities' Open House

oration in the potential for local disaster management due to depopulation and aging. In the disaster management drill in Tokushima Pref. carried out on Sep. 1, the following demonstration test was performed. The test involved the collection, transmission and sharing of disaster information in mountainous areas where cell phones cannot be used. The test was performed in cooperation with the Nat'l Research Inst. of Fire and Disaster, Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications (Fig. 95). Guest Researcher Masafumi Hosokawa (NRIFD), and Expert Researcher Jeong Byeong-pyo participated in the drill.

(1) Test on image information collection (NICT)

A test was conducted to verify a system for collecting information on damage in isolated villages (with coordinated image data obtained by autonomous positioning) and well-being information using cell phone ter-



**Fig.94** Joint disaster management drill held by Tokyo Metropolitan Government, Setagaya-ku, and Chofu City

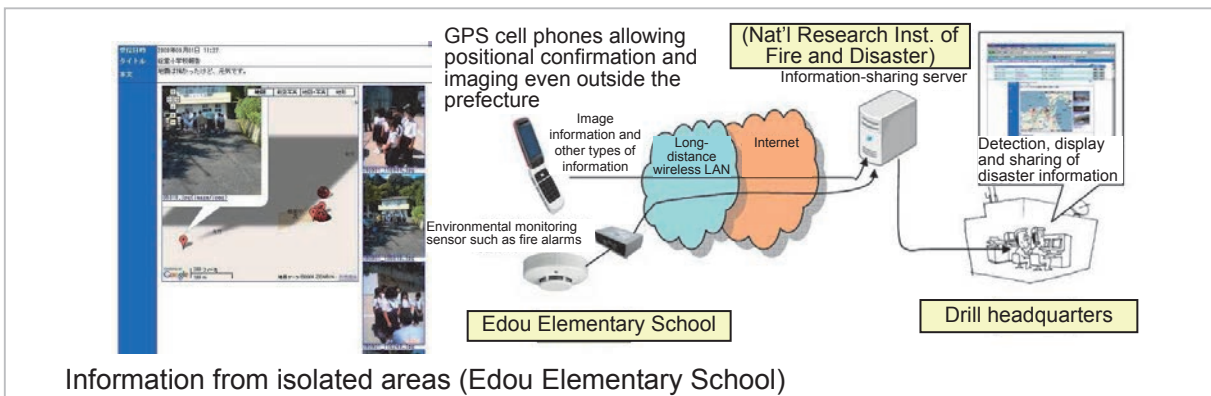
minals that have a function for collecting damage information. The information stored in external memory was transmitted from the local disaster management centers to the information-sharing server of NRIFD via a long-distance wireless LAN. The information was displayed and shared with positional information at the drill headquarters.

(2) Test on collection of environmental monitoring data (NRIFD)

In the event that victims that need to be rescued in mountainous areas need to be protected during a disaster, a test was conducted that involved collecting data from fire alarms and environmental monitoring sensors, such as temperature sensors, via a long-distance wireless LAN, and transferring the data to the information-sharing server of NRIFD.

**3.41.2 Society meeting of the Inst. of Electronics, Information and Communication Engineers (Niigata Univ.)**

(1) A research meeting on an information communication network to ensure safety and security (“third class”) and its steering committee were held on Sep. 18. As the chairperson, Senior Researcher Okada gave a presentation on the action policy of the research meeting. In addition, Guest Researcher Hosokawa (NRIFD) and the trainee Mark (The Univ. of Electro-Communications) who is under the guidance of Senior Researcher Kazunori Okada, each gave research presentations. Approximately



**Fig.95** Disaster Management Drill in Tokushima Pref.

40 people attended.

- (2) In the panel session entitled “The social installation of an ad hoc network —possibility of application to safety and security—,” held on Sep. 16, which was planned by Technical Committee on Ad Hoc Networks of the Communications Society, Group Leader Takizawa guided the session as the session organizer (Fig. 96). Developmental examples aimed at application of an ad hoc network for disaster management and crime prevention created through research close to disaster-stricken areas, such as those in the Tokyo Fire Department and The Chugoku Electric Power Co.,Inc., were presented and discussed, and the possibility of their social application was examined.

### **3.41.3 Expert Researcher, Sonoda, transferred to Nagasaki Univ.**

Expert Researcher Kotaro Sonoda who was responsible for studies on the application of acoustic signal processing for security and disaster management, was transferred on Oct. 1 to the Laboratory of Electronic Information Engineering, Dept. of Computer and Information Sciences and the Laboratory of Theoretical and Applied Software Science, School of Engineering, Nagasaki Univ., as an assistant professor.

## **3.42 Oct. 2009**

### **3.42.1 Presentations at academic meetings**

The following presentations were given in



**Fig.96** Panel session in Society meeting of Inst. of Electronics, Information, and Communication Engineers

October 2009:

- Ayako Fukushima, Jeong Byeong-pyo, Astuyuki Ida, Shin'ichi Tsuchiya, and Yuji Hasemi: Proposal of an Evacuation Navigation System in the Event of a Natural Disaster, USMCA 2009 (Seoul, Korea)
- Jeong Byeong-pyo, Masafumi Hosokawa, Osamu Takizawa, Nguyen Hoang Nam, and Taewoon Kim: “Distribution of earthquake damage estimation using broadband satellite communications to support international rescue operations,” IEEE ATC 2009 (Vietnam)
- Jeong, Takizawa, Ayako Fukushima (Waseda Univ.), Makoto Endo (NRIFD), and Shinsaku Zama (NRIFD): “Development of an information collection system using cell phones,” J. of GIS Association of Japan lecture, GIS Association of Japan (Niigata)
- Kim, Jeong, Takizawa, and Masafumi Hosokawa (NRIFD): “Research into the automatic extraction of topographic classification information using DEM,” J. of GIS Association of Japan, GIS Association of Japan (Niigata)
- Jeong, Takizawa, Shinsaku Zama (NRIFD), and Masafumi Hosokawa (NRIFD): “Estimation of seismic intensity distribution of the earthquake off Sumatra Island (Sept. 30, 2009) using SRTM,” fall meeting of the Seismological Society of Japan (emergency session on earthquakes off Samoa Islands and off Sumatra Island), Seismological Society of Japan

### **3.42.2 Exhibition**

- (1) CEATEC JAPAN 2009

At the NICT Super Event held in Makuhari Messe on Oct. 6 to 10, an exhibition entitled “Survival cell phones,” was presented in the area, “ICT for safety and security”. The results of damage estimation after Sichuan earthquake, China were displayed on the tiled display (Fig. 97).

- (2) Security & Safety Trade Expo 2009

An earthquake damage estimation system and a cell phone terminal with a function for collecting damage information were shown

in the exhibition held at Tokyo Big Sight on Oct. 21–23 jointly with the Nat'l Research Inst. of Fire and Disaster of Fire and Disaster Management Agency (Fig. 98).

### 3.43 Nov. 2009

#### 3.43.1 Presentations at academic meetings

At the meeting of the Inst. of Social Safety Science held in Shizuoka, the following presentations were given.

- Makoto Endo (NRIFD), Shinsaku Zama (NRIFD), and Jeong: “Expansion of information-sharing tools for use in disaster management drills and the use of a simple means of information input”
- Jeong, Kim, Takizawa, Masafumi Hosokawa (NRIFD), and Shinsaku Zama (NRIFD): “Research into an algorithm for extracting topographic classification information of an alluvial fan using DEM”
- Jeong, Shinsaku Zama (NRIFD), Makoto Endo (NRIFD), Takizawa, and Ayako Fukushima (Waseda Univ.): “Development of information collection system

using cell phones — tests on convenience in practical operation of the system and system improvement”

- Ayako Fukushima (Waseda Univ.), Jeong Byeong-pyo, Yuji Hasemi (Waseda Univ.), and Atsuyuki Ida (Waseda Univ.): “Development of information collection system using cell phones — discussion on the period needed for information collection”

#### 3.43.2 Exhibition

A system for collecting data in the disaster-stricken area, which was made by applying mobile robot technology and sensor network technology in cooperation with Tokyo Denki Univ. and RIKEN, for ad hoc use in a disaster-stricken area was exhibited at the Int'l Robot Exhibition 2009 held at Tokyo Big Sight on Nov. 25 to 28 (Fig. 99). In addition, a rescue robot that is being jointly developed was exhibited in the NEDO booth.

### 3.44 Dec. 2009

#### 3.44.1 Lecture in AFICT 2009 and visit to NECTEC

Group Leader Takizawa, and Expert Researchers Jeong Byeong-pyo and Nguyen Hoang Nam, attended the Asian Forum on Information and Communications Technology 2009 held in Bangkok, Thailand, on Dec. 16. At the forum, Expert Researcher Nguyen Hoang Nam gave a lecture on research into estimating earthquake damage based on numerical altitude data obtained from artificial satellites and on the concept of international cooperation. They visited the Nat'l Electronics

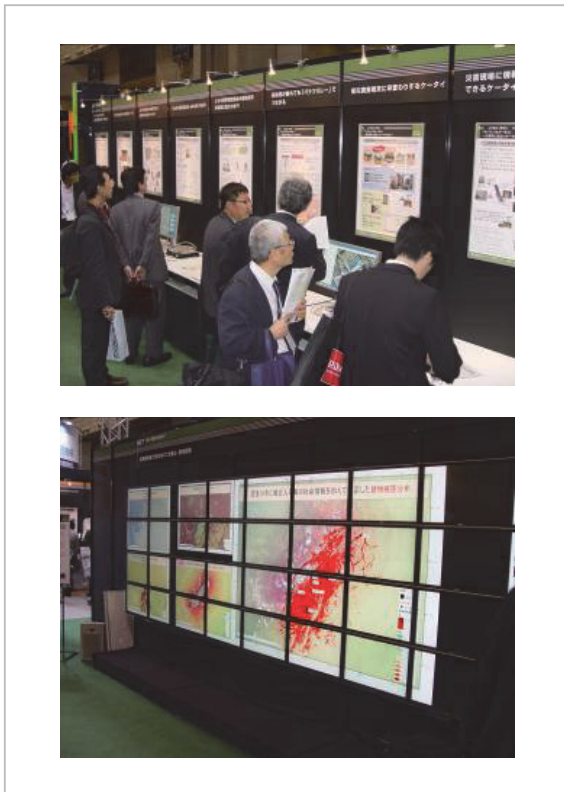


Fig.97 CEATEC JAPAN 2009



Fig.98 Security & Safety Trade Expo 2009



**Fig.99** Int'l Robot Exhibition 2009

and Computer Technology Center earlier on Dec. 15 and solicited cooperation for the international cooperative test on transmitting the results of estimating earthquake damage obtained by using Wideband InterNetworking engineering test and Demonstration Satellite “KIZUNA”(WINDS) (Fig. 100).

### 3.45 Jan. 2010

#### 3.45.1 Estimation of seismic intensity distribution of the Haiti earthquake on Jan. 12, 2010

Expert Researcher Jeong calculated the seismic intensity distribution over a period of 16 hours after reports of the Haiti earthquake that occurred on Jan. 12 (Fig. 101). He provided the information via the Nat'l Research Inst. of Fire and Disaster and other means to the Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications and to the Caribbean Division, Latin American and Caribbean Affairs Bureau, Ministry of Foreign Affairs. The information was also urgently released to the media on Jan. 15.

[Media coverage]

“Haiti earthquake: estimated seismic intensity was 7 or more in the capital,” *The Mainichi Newspapers*, morning edition, p. 6, Jan. 16, 2010

“Haiti earthquake: seismic intensity of 6+ to 7 in the capital,” *The Nikkei*, morning edition, p. 13, Jan. 18, 2010

“Haiti earthquake, seismic intensity is 6+ to 7, as estimated by Japan professional,” *The Yomiuri Shimbun*, morning edition P. 33, Jan.



**Fig.100** Lecture in AFICT 2009 and visit to NECTEC

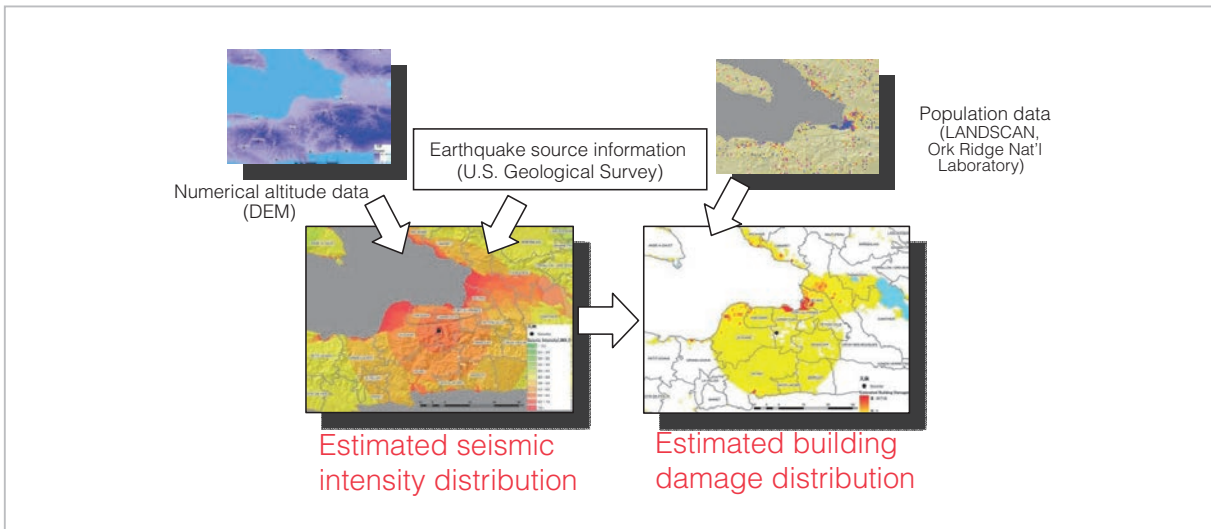
24, 2010

#### 3.45.2 Presentations at academic meetings and papers published

The following presentations were given and the following papers were published in January 2010.

- Takizawa, Kotaro Sonoda (Nagasaki Univ.), Katsunari Yoshioka (Yokohama Nat'l Univ.), and Suzuki: “Acoustic electronic watermark for emergency vehicle sirens,” Symposium on Cryptography and Information Security, Inst. of Electronics, Information and Communication Engineers (SCIS 2010)
- Takizawa, Masafumi Hosokawa, (NRIFD),





**Fig.101** Estimated seismic intensity distribution of Haiti earthquake on Jan. 12, 2010

Yoshifumi Shimazaki (KDDI) and Hiroyuki Fukuoka (KDDI R&D Laboratories): “Development of label/message board function with added positional information in cell phone terminals in combination with Bluetooth and RFID,” *J. of Information Processing Society of Japan* Vol. 51, No. 1, pp. 174–179.

### 3.46 Feb. 2010

#### 3.46.1 Open demonstration of project for estimating earthquake damage

As part of the research and development into systems for earthquake damage estimation that are in progress under the Disaster Management and Mitigation Group, an open demonstration of the developed system was given at the “Int’l Symposium on Wideband InterNetworking engineering test and Demonstration Satellite ‘KIZUNA’(WINDS)” (Fig. 102) held at the Science Museum (Kudan, Tokyo) on Feb. 4 and at the “Disaster/Crisis Management ICT Symposium 2010” (Fig. 103) held at Pacifico Yokohama on Feb. 5.

In the demonstration, the Nat’l Research Inst. for Fire and Disaster (Chofu City) provided disaster management headquarters connected to the demonstration site, and simulated a disaster area via the NICT headquarters. The NRIFD and the NICT headquarters,

which were 7.8 kilometers apart, were connected via a 5 GHz-band wireless access system. NRIFD was connected to the NICT headquarters and the site via WINDS. The demonstration was carried out according to a scenario whereby the rescue team on site has bidirectional image transmission and oral communication via IP phone with the Nat’l Research Inst. of Fire and Disaster, and rescues the victims with the instructions from the headquarters. A damage estimation server was installed at the NICT headquarters, and delivered the results of the estimation both to NRIFD and the demonstration site. Senior Vice-Minister of Internal Affairs and Communications, Naito, Senior Vice-Minister of the Ministry of Education, Culture, Science, Sports, and Technology, Nakagawa and Mr. Okumura, a member of the Council for Science and Technology Policy visited the site to inspect the proceedings.

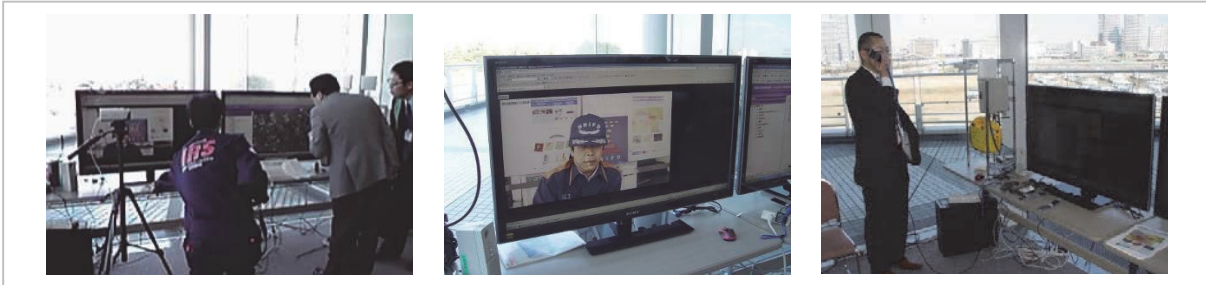
#### 3.46.2 Lecture and exhibition

(1) NICT Information Communication Security Symposium on security in the age of cloud computing

At the symposium held in Kokuyo Hall (Shinagawa, Tokyo) on Feb. 12, the trainee, Fumiko Takeuchi (Tokyo Univ. of Science), gave a presentation entitled “Cloud Service—from Disaster Management to Business Stimulation—”.



**Fig.102** Open test in Science Museum



**Fig.103** Open test in Pacifico Yokohama

- (2) 6th RFID Meeting of Japan Automatic Identification Systems Association (JAISA), 2009

At the meeting of RFID-related industries held in Kikai Shinko Building on Feb. 17, Group Leader Takizawa was invited to give a lecture entitled “RFID-based positioning and assurances for safety and security”.

- (3) The 14th Technology Against Earthquake Expo

At the exhibition held in Pacifico Yokohama on Feb. 4 and 5, cell phones that are useful for investigating damage and patrolling to prevent crime were presented, together with an estimation of the seismic intensity distribution of the Haiti earthquake.

### 3.46.3 Papers published

The following papers were published in Feb. 2010.

- Takizawa and Kyoko Makino (Mitsubishi Res. Inst.): “Insertion of encoding information text IH into plain text by controlling the line-feed position,” *J. of Inst. of Electronics, Information and Communication Engineers*, J93-A, No. 2, pp. 100–103.

### 3.47 March 2010

#### 3.47.1 General meeting of the Inst. of Electronics, Information and Communication Engineers

- (1) A symposium on “Information communication networks for ensuring safety and security” was held on March 17–18. The symposium was planned by the research committee for information communication networks for ensuring safety and security (“third class” research meeting) of the Inst. of Electronics, Information and Communication Engineers. The chairperson was Senior Researcher Okada and the trainee Attoungble Kouakou Jean Marc (The Univ. of Electro-Communications), gave a presentation. In addition, a tutorial on the topic of “safety and security: challenges of information communication network-circuit-system technology,” which was planned jointly by the research meeting and the Technical Committee on Circuits and Systems, was held on March 18. During the tutorial, Guest Researcher Masafumi Hosokawa (NRIFD) gave a presentation.

- (2) The trainee, Takeuchi, gave a presentation entitled “Studies on Low-Power FM Broadcasting Using the Wireless Specifications for

Voice Assist for Use During a Disaster,” in the general session of the radio communication system A (mobile communication) on March 17.

### **3.47.2 Papers published**

The following paper was published in March 2010.

- Gyoda, Nam, Okada, and Takizawa: “Evaluation of the performance of a wireless ad hoc network in the model of communication during a disaster,” J. of Inst. of Social Safety Science, No. 12, pp. 1–9.

## **3.48 April 2010**

### **3.48.1 Diffusion through society of Cellular Phone Application for Safety/Disaster Information Collection and Transmission; “Easy-Reporter”**

By 2009, the Disaster Management and Mitigation Group had mostly finished development of Cellular Phone Application for Safety/Disaster Information Collection and Transmission; “Easy-Reporter”. The application facilitates the acquisition of positional information by GPS, the acquisition of situational photography using the camera and the registration of the situation by item selection simultaneously. The application had been under development in collaboration with the Nat’l Research Inst. of Fire and Disaster, Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications. The application has functions that are not found in similar applications, such as autonomous positioning without referring to a base station and the storage of collected information in external memory, even when transmission goes down or the network is congested, for example, if the cell phone base station is damaged. This application is intended to be used to ensure safety and security, to acquire damage information during a large-scale disaster, for example, by victims acquiring damage information during evacuation and providing the damage information to neighboring disaster management bases (such as shelters) or by delivering it to the disaster management head-

quarters. The application can also be used to identify places where it is necessary to exercise caution when patrolling to prevent crime.

In 2010, steps were underway to register the application in the download server of a communications carrier (au) and the application was ready for commercialization. One possibility of commercialization is to use the application for emergency notification during the transportation of radioactive materials, which was requested by the Japan Atomic Energy Agency (JAEA). Joint development of this kind of system started in 2009. JAEA examined the usefulness of the application in a demonstration test using terminals borrowed from NICT with the transportation workers (Fig. 104). The application was proposed to the Cabinet Office Nuclear Safety Commission and to those engaged in administration and industries related to safety regulation. The application was presented in a transportation accident-related investigation report issued by the Nuclear Safety Commission. The application was revised in 2009 due to a request for functional addition from JAEA, and JAEA examined the revised application in April.

### **3.48.2 Facilities’ Open House in the Nat’l Research Inst. of Fire and Disaster**

Under a request made to the Disaster Management and Mitigation Group to hold an Open House when the facilities of the Nat’l Research Inst. for Fire and Disaster were



**Fig. 104** Demonstration of the measures against a transport accident in Tokai-mura (photo from: JAEA)

opened to the public on April 16, we were able to exhibit four items. They were: an application for collecting information by cell phones (Easy-Reporter), a system for estimating earthquake damage, a long-distance wireless access system that connects NICT and NRIFD, and the convolution of information in the siren of an emergency vehicle. We demonstrated the actual machines, and strongly promoted the collaborative relationship between the two organizations (Fig. 105). The items exhibited remained on site under the management of the Center for Continuous Display after the facilities were open to the public.

### 3.48.3 Lecture

Group Leader Takizawa was invited to give a lecture entitled “Managing and mitigating disaster using the familiar ICT,” at a seminar held by the Communications and Information network Association of Japan (CIAJ) on April 22 (Fig. 106).

### 3.48.4 Papers published

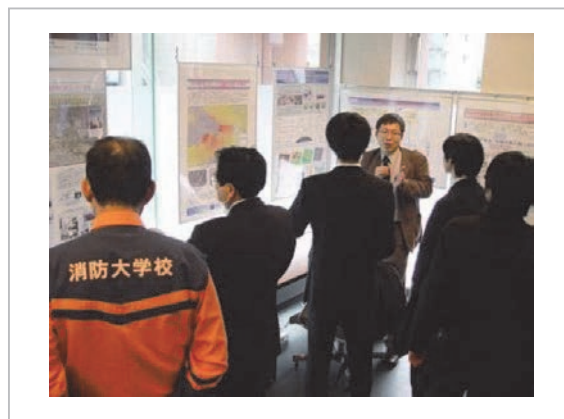
The following papers were published in April 2010.

- Yasushi Hada, Takayuki Kaise (Thinktube Inc.), Kentaro Matsuyama (Thinktube Inc.), Koichi Gyoda, and Takizawa: “Wired and Wireless Hybrid Ad-hoc Network for Long Distance Navigation of Rescue Search Robots,” *J. of Information Processing Society of Japan*, Vol. 51, No. 4, pp. 1204–1214.

## 3.49 June 2010

### 3.49.1 Participation in RoboCup World Championship, Rescue Robot League —victory in manipulation section—

Expert Researcher Yasushi Hada traveled to the world championship of robotics technology, RoboCup 2010, Rescue Robot League, held in Singapore on June 19 to 25. The team, Pelican United, was made up five organizations: Int’l Rescue System Inst., Tohoku Univ., Chiba Inst. of Tech., AIST and NICT. The team achieved 4th rank overall among the 18 participating teams and was the highest of the three Japanese teams. It



**Fig. 105** Opening of National Research Inst. of Fire and Disaster to the public



**Fig. 106** Lecture given in CIAJ

achieved 1st rank in the Manipulation Class (Fig. 107). The teams ranked 1st to 3rd all came from Thailand, showing the rapid progress the country is making, where the research and development of robots is promoted under a national policy with strong support from the government and industry.

The aim of RoboCup is to evaluate the performance of various robots from different countries as they compete in the same field. The favorable results in this world championship show the disaster robot developed under NEDO contracted research “Strategic Development of Advanced Robotics Elemental Technologies” since 2006 has strong potential, even when seen from the global perspective. NICT was responsible for developing a communication system for use in long-distance search, for example, in an underground complex using robots. Expert Researcher Yasushi

Hada gave a scientific presentation on the newly developed directional variable antenna and a communication reconnection system at the Robotics and Mechatronics Seminar (ROBOMECH 2010) of the Japan Society of Mechanical Engineers held on June 13 to 16.

### 3.49.2 Papers published

The following two papers were published in J. of GIS Association of Japan in June 2010.

- Masafumi Hosokawa (NRIFD) Kenichi Takanashi (NRIFD), and Takizawa: “Cellular phone messaging system using indoor positioning by RFID,” GIS — Theory and Application, Vol. 18, No. 1, pp. 79–85.
- Takizawa, Masafumi Hosokawa (NRIFD), and Shibayama: “Development of a mobile terminal for monitoring damage that is compatible with many kinds of positioning RFIDs,” GIS — Theory and Application, Vol. 18, No. 1, pp. 87–93.

### 3.50 July 2010

#### 3.50.1 NICT's Facilities' Open House

When the facilities of NICT were opened to the public on July 23 to 24, the Disaster Management and Mitigation Group demonstrated a rescue robot and other items in the booth on the 1st floor of the No.5 building (Figs. 108 and 109). special low power FM transmitter for voice assistance, which was developed for installation in shelters during large-scale disaster, was exhibited this year. FM radios were placed at two positions in the lobby of the main building and in the corridor

between the 4th and 5th buildings (Figs. 110 and 111) and an announcement broadcast from a steel tower was received. In addition, Group Leader Takizawa gave a lecture on “Disaster! Is communication assured?” in the seminar held on July 24.

### 3.51 Aug. 2010

#### 3.51.1 Joint disaster management drill of Tokyo Metropolitan Government and Bunkyo-ku

The Easy-Reporter and the special low power FM transmitter for voice assistance were demonstrated in the joint disaster management drill of Tokyo Metropolitan Government and Bunkyo-ku held in Hakusan Campus, Toyo Univ. on Aug. 29. To demonstrate the special low power FM transmitter for voice assistance, a tent was erected on the ground (Fig. 112) and an FM antenna installed on the roof of the site (Fig. 113) were connected via a wireless LAN. The voice transmitted by VoIP was broadcast at 75.8 MHz. Although there was failure in the system because of the exceptionally hot weather, the demonstration was continued with a reserve machine available. A survey of the participants in the form of a questionnaire was also presented in the research meeting of the Japan Society for Disaster Information Studies in October. Before the drill, an article introducing the transmitter appeared in *The Eizo Shimbun* (Visual Communications Journal) Aug. 9, p. 11.



Trophy of the Manipulation Class

Pelican United's robot, Quince

**Fig.107** RoboCup World Championship, Rescue Robot League

### 3.52 Sep. 2010

#### 3.52.1 Society Meeting of the Inst. of Electronics, Information and Communication Engineers

(1) In the session entitled, “Network technology to protect against a devastating disaster — if a major earthquake occurs,” which was planned by the Society Meeting of the Inst. of Electronics, Information and Communi-

cation Engineers, held in Osaka Pref. Univ. on Sep. 15, Group Leader Takizawa gave a keynote address entitled “The requirements of ICT to protect against a devastating disaster”. He also joined the panel discussion.

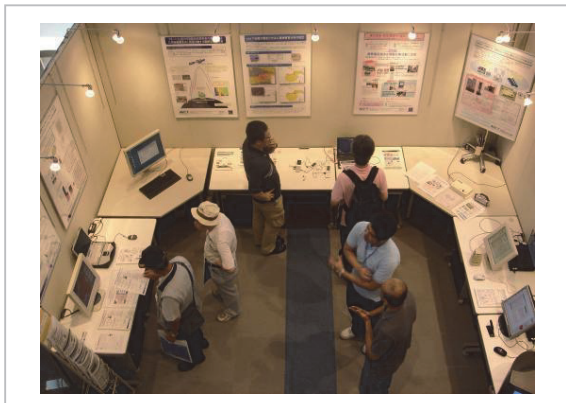
(2) The “third class” research committee on “Information communication network for ensuring safety and security” of the Inst. of Electronics, Information and Communica-



**Fig. 108** Demonstration of rescue robot



**Fig. 111** Satellite booth 2



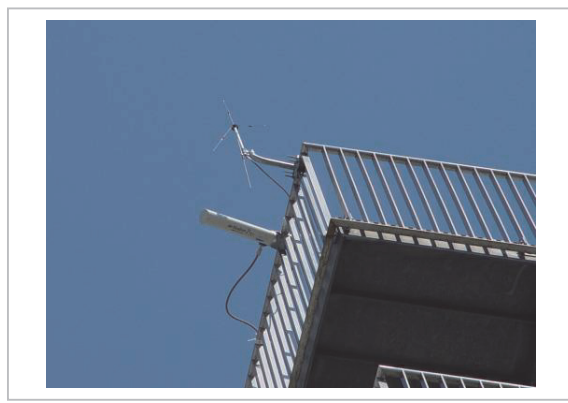
**Fig. 109** Main booth



**Fig. 112** Tent in disaster management drill



**Fig. 110** Satellite booth 1



**Fig. 113** FM antenna (right) and wireless LAN antenna (left)

tion Engineers, in which Senior Researcher Kazunori Okada was the chief examiner, held a symposium during the Society meeting on Sep. 16. The trainee, Han Jin Chun (The Univ. of Electro-Communications), gave a presentation entitled “Discussion on Prioritized Connection Control by Emergency Multi-System Access”.

### 3.52.2 Geospatial Expo 2010

- (1) This group presented an exhibition jointly with the Nat'l Research Inst. of Fire and Disaster in the Geospatial EXPO 2010 held in Pacifico Yokohama on Sep. 19 to 21 (Fig. 114).
- (2) Expert Researcher Nguyen Hoang Nam gave a lecture entitled “GIS-Based Earthquake Damage Estimation for Supporting Int'l Rescue Operations” on Sep. 20, during the business meeting on “Int'l symposium on safety and security through the integrated use of geographical special information: Geo-Intelligence” sponsored by the Cabinet Office (Council for Science and Technology Policy), which is also an activity of the Geospatial Expo 2010.

## 3.53 Oct. 2010

### 3.53.1 Security & Safety Trade Expo 2010

The team presented an exhibition jointly with the Nat'l Research Inst. for Fire and Disaster and Space Robotics Lab., Tohoku Univ. (Lab. of Professor Kazuya Yoshida and Associate Professor Keiji Nagatani) in the exhibition held at Tokyo Big Sight on Oct. 6 to 8 (Fig. 115). In this exhibition, research conducted by the Disaster Management and Mitigation Group and NRIFD were exhibited. A demonstration operations test of a volcanic search robot for monitoring active volcanoes was also conducted under the sponsorship of Technical Committee (on/of) Tele-operation Technology for Robotic Explorations in Active Volcano Area, the System Integration Division, Society of Instrument and Control Engineers. In the test, a robot able to traverse irregular surfaces, developed by Tohoku Univ. placed on Mount Asama was controlled

remotely from the Big Site via an ultrahigh-speed internet satellite WINDS (Fig. 116). Professor Kazuya Yoshida and the students participated in the test at Big Site, while Associate Professor Keiji Nagatani, the students and Expert Researcher Yasushi Hada participated at Mount Asama. This exhibition was reported, for example, in *The Dempa Times* (Oct. 6, p. 9, on 18, p. 4) and J. of Radio Engineering & Electronics Association, “FORN”. The WINDS was used in cooperation with the Space Communication Group, NICT and the Association of Radio Industries and Businesses.

### 3.53.2 Rescue robot test

Expert Researcher Yasushi Hada participated in a test on integrating maps obtained by multiple robots. The test was held as part of the NEDO contract research project in Tohoku Univ. on Oct. 12 and 13.

### 3.53.3 Presentations at academic meetings

- (1) In the meeting of the Japan Society for



Fig. 114 Geospatial EXPO



Fig. 115 Security & Safety Trade Expo 2010

Disaster Information Studies held at the Faculty of Safety Science, Kansai Univ. on Oct. 23, Group Leader Takizawa as chairperson of the session, gave a presentation entitled “Development of a Particular Low-Powered FM Broadcasting Device Capable of Broadcasting in an Area with a Radius of 500 Meters and Verification of the System in Disaster Management Drill”.

- (2) In the research meeting of the Geographic Information Systems Association (GISA)/GIS Association of Japan held at Ritsumeikan Univ. on Oct. 23 and 24, Expert Researcher Jeong Byeong-pyo gave a presentation entitled “Research into Spatial Information Communication System to Support the Activities of Int’l Firefighting and Rescue Teams—Estimation of Seismic Intensity Distribution and Building Damage Distribution in the Haiti Earthquake,” while Researcher Kim Taewoon gave a presentation entitled “Building Landform Classification Maps from DEM: Alluvial Fan Extraction Method”.

### 3.53.4 Exhibition held with the meeting of information communication/economy-related APEC ministers

At the exhibition (TELMIN 8) held together with the meeting of the information communication/economy-related ministers of APEC in Bankoku Shinryokan, Nago, Okinawa on Oct. 28 to 31, an earthquake damage estimation system was demonstrated. With participation of former members of the inter-

national emergency rescue team of the Tokyo Fire Department, the demonstration was held according to a scenario whereby a large-scale earthquake occurs in Chiang Mai, Thailand. This location was chosen as NECTEC in Thailand and the site at which the demonstration was conducted were connected via WINDS (Fig. 117). After a press interview on the first day, it was broadcast on the local NHK news. Although the demonstration was terminated immediately after press interview because of an approaching typhoon on the first day, the test was continued without problem on the second day, although there were some small system troubles. Minister Katayama for Internal Affairs and Communications made an inspection on Oct. 30th (Fig. 118).

## 3.54 Nov. 2010

### 3.54.1 Exhibition during the APEC Leaders’ Week [Japan Experience]

In the exhibition, Japan Experience, held

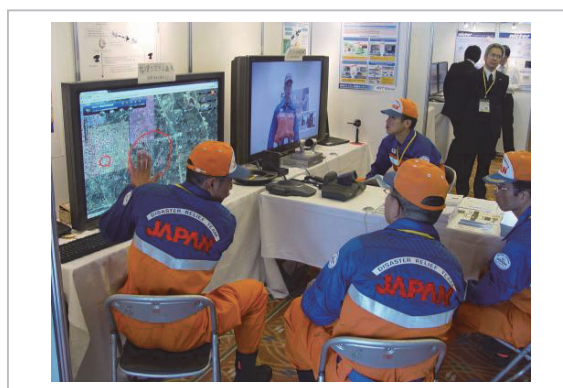


Fig. 117 Demonstration in APEC-TELMIN 8



Fig. 116 Remote control of a robot on Mount Asama



Fig. 118 Director Enami providing an explanation to Minister Katayama



in Pacifico Yokohama on Nov. 7 to 14, an earthquake damage estimation system was exhibited visually with the cooperation of the Nat'l Research Inst. of Fire and Disaster to coincide with the APEC Leaders' Week (summit meeting). The movie was uploaded on YouTube, which was linked to the official website of the government exhibition.

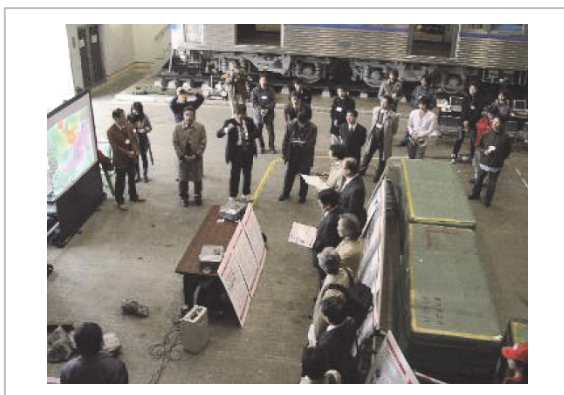
<http://www.apec2010je.go.jp/>

### 3.54.2 Evaluation test of NEDO contract research project

Evaluation test of NEDO contract research project was conducted in the Tachikawa Training Ground of the Tokyo Fire Department, 8th Fire District HQ on Nov. 22. Expert Researcher Hada and Group Leader Takizawa participated in the test (Fig. 119).

### 3.54.3 Presentations at academic meetings and lectures

- (1) A research meeting of the Inst. of Social Safety Science was held at the Shizuoka Earthquake Disaster Management Center on Nov. 5, where Expert Researcher Jeong Byeong-pyo gave two research presentations: "Estimation of Seismic Intensity Distribution and Building Damage Estimation in the Haiti Earthquake and its Verification" and "Development of Cellular Phone Application for Safety/Disaster Information Collection and Transmission; 'Easy-Reporter'"
- (2) The trainee, Mark (Univ. Electro-Communications, D1), under the guidance of Senior Researcher Okada, gave a presentation entitled "LRD: A Distributed and Accurate



**Fig. 119** Expert researcher, Yasushi Hada, answering questions from examiners in the NEDO evaluation test

Localization Technique for Wireless Sensors Networks" in IEEE TENCON 2010 on Nov. 22 (adoption rate: 43%).

- (3) The disaster management information communication seminar, jointly sponsored by the Kinki Bureau of Telecommunications of Ministry of Internal Affairs and Communications, Human Network for Researches toward Advanced Telecommunications, Kinki emergency Communication Conference and Kinki Information Communication Conference, was held at the Hotel New Hankyu Osaka on Nov. 29. Group Leader Takizawa gave a lecture on "The possibility of disaster management and mitigation with familiar ICT" (Fig. 120).

### 3.55 Dec. 2010

#### 3.55.1 Lectures

- (1) A workshop concerning Wideband Inter-Networking engineering test and Demonstration Satellite "KIZUNA"(WINDS) entitled "WINDS and future satellite communication," was held at the NICT headquarters on Dec. 2. Group Leader Takizawa gave a lecture entitled "Examples of the application of WINDS by the NICT Disaster Management and Mitigation Group," and reported a test on the collection of damage information by a robot able to traverse irregular ground, which was conducted at the Crisis Management Industry Exposition in Oct. Takizawa also reported on a test for estimating and transmitting earthquake damage conducted in APEC-TELMIN 8, and gave a presentation in the lobby (Fig. 121).
- (2) Group Leader Takizawa gave a special lecture entitled "Information communication during a disaster —Information transmission for emergency medicine and rescue—" in the professional (basic) class of Basics of Disaster Medicine in the Unit for Livable Cities, Graduate School of Medicine and Graduate School of Engineering, Kyoto Univ. on Dec. 8.

#### 3.55.2 Media coverage

- (1) The siren that had been convoluted with information, which was revealed by Group

Leader Takizawa in the disaster management information communication seminar held in Osaka on Nov. 29, was reported on the front page of *The Sankei Shimbun* (Osaka evening edition) on Dec. 4.

- (2) An article presenting the earthquake damage estimation system jointly developed with the Nat'l Research Inst. of Fire and Disaster appeared in *The Shobo Daigakko Dayori* (Letter from Fire and Disaster Management College) of the monthly magazine, *Shobo no Ugoki*, Dec. ed. of the Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications. It can be viewed via the website of the Nat'l Research Inst. of Fire and Disaster of Ministry of Internal Affairs and Communications.

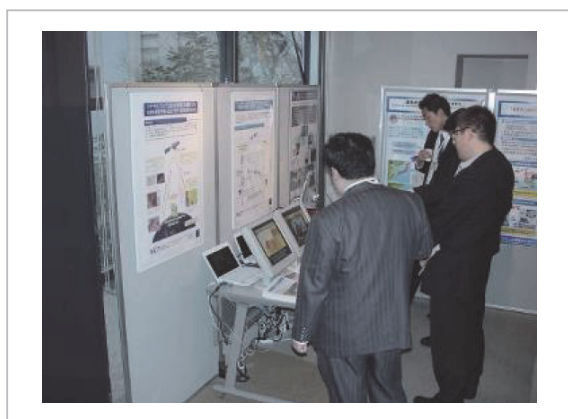
<http://www.fdma.go.jp/>

### **3.55.3 Evaluation test of joint resident/government ubiquitous disaster mitigation information system**

A demonstration test of the contract



**Fig. 120** Disaster management information communication seminar



**Fig. 121** Exhibition in WINDS workshop

research and development project of the Ministry of Education, Culture, Sports, Science and Technology: “Joint resident/government ubiquitous disaster mitigation information system,” in which NICT participated as a cooperative organization, was held in Chuo City, Yamanashi on Dec. 19. Group Leader Takizawa made an inspection.

## **3.56 Jan. 2011**

### **3.56.1 Media coverage**

On the first anniversary of the Haiti earthquake on Jan. 13, an article introducing the earthquake damage estimation system jointly developed with the Nat'l Research Inst. of Fire and Disaster appeared in *The Asahi Shimbun*, morning edition, p. 39.

### **3.56.2 Lectures**

Group Leader Takizawa gave a lecture on the “Activities of the Nat'l Inst. of Information and Communications Technology for establishing a disaster management and mitigation ICT—from safety at home to support for the activities of the international emergency rescue team—” in the 3rd seminar of the research meeting of the Fire & Disaster Response Robotics Network on Jan. 27 (Fig. 122).

## **3.57 Feb. 2011**

### **3.57.1 Media coverage**

An article presenting the technology for convoluting information on a siren as an “acoustic electronic watermark technology” appeared in the column of DIME Scope in “DIME” Feb. 1 edition, a magazine published by Shogakukan Inc.

### **3.57.2 Exhibition**

The damage estimation system was exhibited at The 15th Technology Against Earthquake Expo held in Pacifico Yokohama on Feb. 3 and 4. Group Leader Takizawa and Expert Researcher Jeong Byeong-pyo participated to provide explanations of the system (Fig. 123).

### **3.57.3 Lectures**

At the NICT Information Communication Security Symposium held on Feb. 17, Group

Leader Takizawa gave a lecture entitled “Research results obtained by the Disaster Management and Mitigation Group during the period of the second mid-term plan”. In addition, an exhibition showing the research activities of the group was also provided (Fig. 124).

#### **3.57.4 Acceptance of junior high school students for job experience**

Three students in the 2nd- year of Tokyo Denki University Junior High School , who were accepted for job experience on Feb. 10, conducted a field study on the transmittable range of radio waves from a special low power FM transmitter for voice assistance. Group Leader Takizawa participated in the test (Fig. 125).

#### **3.57.5 Estimated seismic intensity distribution and building damage distribution of the Christchurch Earthquake in New Zealand provided to Japan Disaster Relief Team (JDR) for the first time**

An earthquake having a magnitude of 6.3 occurred in the area close to Christchurch on the South Island of New Zealand at around 8:51 (Japan time) on Feb. 22. The damage was estimated by the earthquake damage estimation system and the results, obtained about 11 hours after the earthquake, were disclosed via the internet and provided to the relevant organizations simultaneously. As a result, the results of the estimations were delivered to the Japan Disaster Relief Team (JDR) in the disaster-stricken area through the JDR secretary-general of JICA. It was the first time that the results of estimation obtained by the system



**Fig. 122** Research meeting of Fire & Disaster Response Robotics Network



**Fig. 124** Exhibition held during NICT Information Communication Security Symposium



**Fig. 123** Earthquake Management Technology Exhibition



**Fig. 125** Acceptance of junior high school students for job experience

were provided to JDR. This is because it was possible to provide the information in the early phase when the disaster relief team was formed, which in turn was due to the accelerated estimation processing and the information route already being in place for just this kind of emergency.

The seismic intensity distribution estimated by the system is shown in Fig. 126 and the building damage distribution in Fig. 127.

The seismic intensity calculated in the estimated seismic intensity distribution, was 6+ maximum, in the seismic intensity used by the Japanese Meteorological Agency, and the data shown in Table 1 was reported. It was estimated that the vibration of the area close to Christchurch, which is more remote from the earthquake source, was more vigorous, because of the difference in the terrestrial properties. These estimation results agreed well with the damage information from the disaster area.

### **3.58 March 2011**

#### **3.58.1 Final demonstration of NEDO contract research project**

An open demonstration of the NEDO rescue robot project for the media was held in the Kobe Laboratory of the Int'l Rescue System Inst. in Kobe on March 4. It was a demonstration summarizing the results obtained in the NEDO project over five years. Expert Researcher Yasushi Hada and Group Leader Takizawa participated.

#### **3.58.2 Actions taken after the 2011 off the Pacific coast of Tohoku Earthquake**

An earthquake at a magnitude of 9.0 occurred with its epicenter in the Pacific Ocean off the Sanriku coast at around 14:46 on March 11. There was significant damage over a wide area, from Tohoku to Kanto. The Disaster Management and Mitigation Group took the following actions after the disaster:

(1) Estimation of seismic intensity distribution and building damage distribution using the earthquake damage estimation system

Estimation results were obtained at 0:45

on March 12 and dispatched from the emergency report site: <http://disaster.nict.go.jp/> starting at 14:00 the same day. It was the first estimation made by the automatic processing server, with the system in its complete form. There were restrictions that this was a domestic earthquake for which the system is not directed, and that it was rough estimation based on point earthquake source. Damage from the tsunami was not taken into consideration (Fig. 128).

(2) Support of emergency observation by the Polarimetric and Interferometric Airborne Synthetic Aperture Radar System (Pi-SAR2) installed in airplane

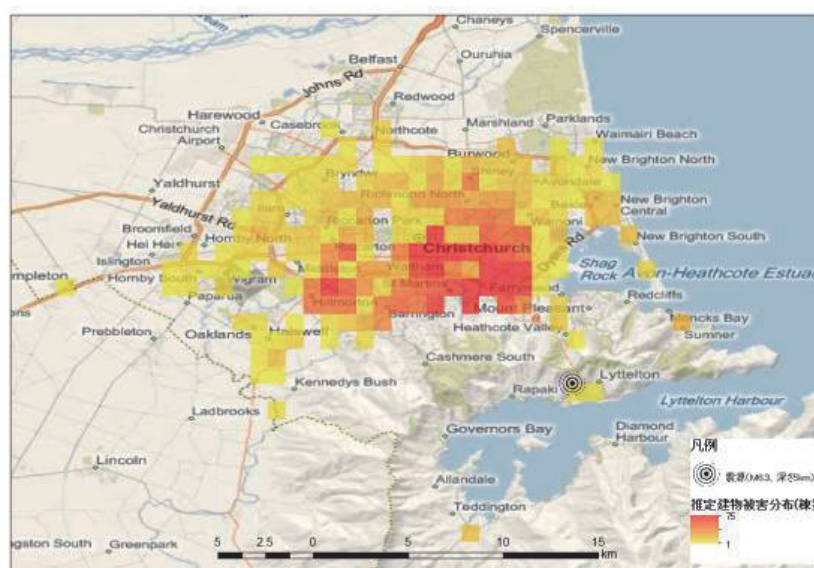
For the emergency observation of disaster-stricken areas with the Polarimetric and Interferometric Airborne Synthetic Aperture Radar System installed in airplane developed by NICT, the flight route was discussed, based on the data on seismic intensity distribution and building damage distribution described above, by the Strategic Planning Department of NICT with Expert Researcher Jeong Byeong-pyo. The route along the coastline was shown to be suitable, based on various media reports and real-time damage information. Investigations were made based on the conclusion on March 12.

(3) Support to the Emergency Fire Response Teams, Tokyo Fire Department by operation of the ultrahigh-speed internet satellite, WINDS

NICT officers traveled to the Disaster Countermeasures Office for Kesenuma City with the Emergency Fire Response Teams, Tokyo Fire Department, and operated the WINDS circuit connected to the operational headquarters (in Otemachi). Expert Researcher Jeong Byeong-pyo who joined in activities at the operational headquarters as a coordinator with Tokyo Fire Department on March 14, was engaged in supporting the WINDS satellite continuously until March 18. Because of the contribution, Expert Researcher Jeong Byeong-pyo and the WINDS team received a special award from the director of NICT.



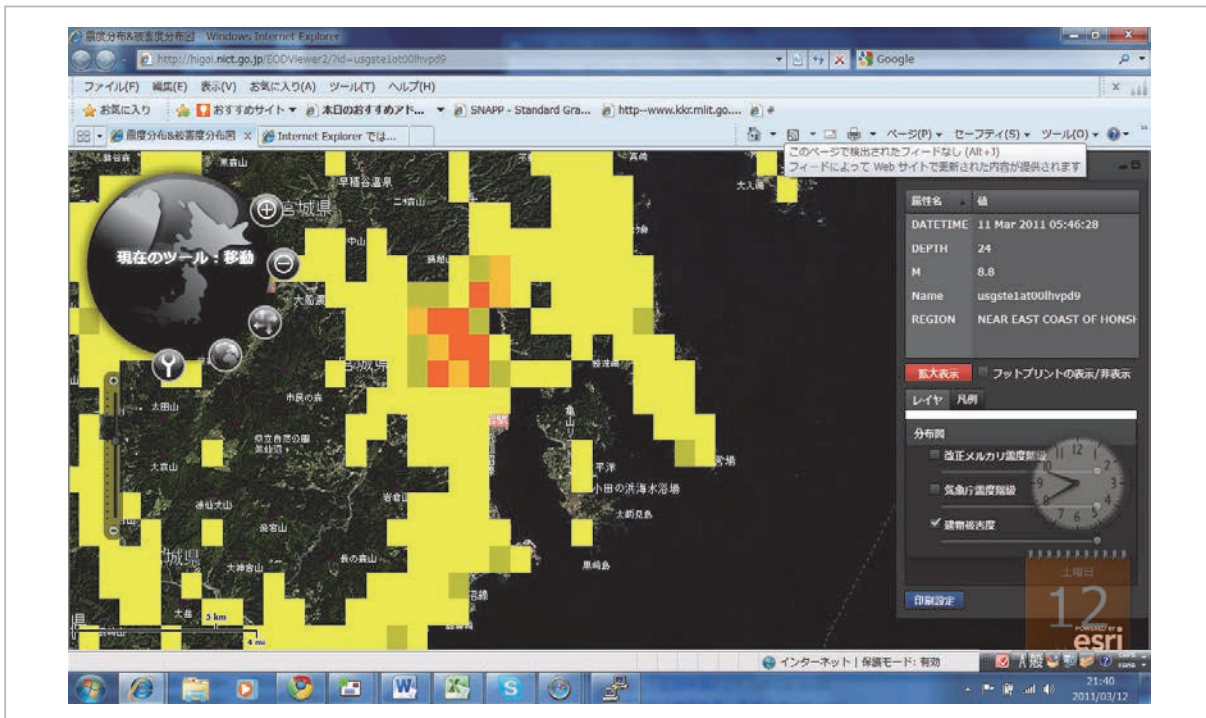
**Fig.126** Estimated seismic intensity distribution (displayed by the seismic intensity of Meteorological Agency)



**Fig.127** Estimated building damage distribution

**Table 1** Media coverage (only major articles)

11 Japanese missing in Christchurch Earthquake whose seismic intensity registered 6+	( <i>The Yomiuri Shimbun</i> , Feb. 23 2011, morning edition, p. 1)
Earthquake whose seismic intensity registered 6+ or 940 Gal, which is equivalent to the Great Hanshin Earthquake	( <i>The Mainichi Newspapers</i> Feb. 23 2011, evening edition, p. 1)
News 23 cross	(TBS TV, 23:00 Feb. 23, 2011)
Soft ground possibly intensifying vibration? Seismic wave destroying low buildings observed	( <i>The Asahi Shimbun</i> , Feb. 24 2011, morning edition, p. 3)
Soft ground intensifying vibration, Seismic intensity equivalent to 6+	( <i>The Nikkei</i> , Feb. 24 2011, morning edition, p. 38)
Acceleration of 2160 Gal, larger than that of the Great Hanshin Earthquake	( <i>The Tokyo Shimbun</i> , Feb. 24 2011, evening edition, p. 9)



**Fig. 128** Estimated distribution of building damage after the 2011 off the Pacific coast of Tohoku Earthquake (estimation of the damage caused only by the earthquake)

- (4) Preparation for emergency operation of the high-speed search robots moving in a confined space, developed under NEDO contracted research

To cope with the accident at Fukushima Daiichi Nuclear Power Station caused by the earthquake, it was decided that the damage information was to be collected by applying the results developed under the NEDO contracted research project, “High-speed search robots moving in a confined space”. Expert Researcher Yasushi Hada visited Chiba Inst. of Tech. for two days from March 19 and was engaged in improving the developed robot in cooperation with Eiji Koyanagi, vice director of the Future Robotics Technology Center of the institute and Keiji Nagatani, Associate Professor of Tohoku Univ. Expert Researcher Hada was responsible for increasing the communication distance that is needed for remote control of the disaster robot, Quince. The robot was developed under the NEDO contracted research project (Fig. 107). Quince is a robot for collecting information and is controlled remote-

ly via a wireless LAN. The robot experienced the problem that remote control is difficult in an environment where long-distance communication is needed or there are objects obstructing the transmission. In anticipation of an environment where wireless LAN is not usable because of objects obstructing the transmission, a system permitting long-distance travel and search in combination with a robot that installs a fiber optic cable and a wireless LAN was constructed. This system integrated wired/wireless ad hoc network developed mainly by Expert Researcher Yasushi Hada was simplified, resulting in a system that was able to be sent to the site.

The system was reported in *The Nikkan Kogyo Shimbun*, March 29, p. 1 under the headline, “Monitoring robot in Fukushima Nuclear Power Plant”.

### **3.58.3 Non-gratuitous use of “Koganei RFID Workbench” started under facility utilization system**

The Disaster Management and Mitigation Group has been engaged in studies on the

application of RFID's disaster management from the time of the former Emergency Communications Group. During this time, it has accumulated various RFID-related hardware and development applications. In addition, the team received a research and development tested environment, known as the Koganei RFID test room. The room was constructed in 2004 and used for research and development. To promote more active use of the facility from 2011, the team constructed the Koganei RFID workbench, a facility for non-gratuitous use by external organizations for research and development purposes, under the facility utilization system that started in NICT at the end of 2010 (Fig. 129). The facility was already rented out to a company for two days in March. The facility has a ubiquitous terminal containing a UHF-band passive/active RFID reader/writer and an application with the function of a messageboard. These items were the joint development results obtained by Hitachi and KDDI (Fig. 130). It can be used widely, not only in the field of disaster management, but also in research and development into ubiquitous technology in the future.

#### **3.58.4 Lecture in Shunan City, Yamaguchi**

In the seminar for council members held in Tokuyama Health Center in Shunan City, Yamaguchi, on March 22, Group Leader Takizawa gave a lecture entitled "Communication technology for collecting and communicating information during a disaster".

#### **3.58.5 End of the project**

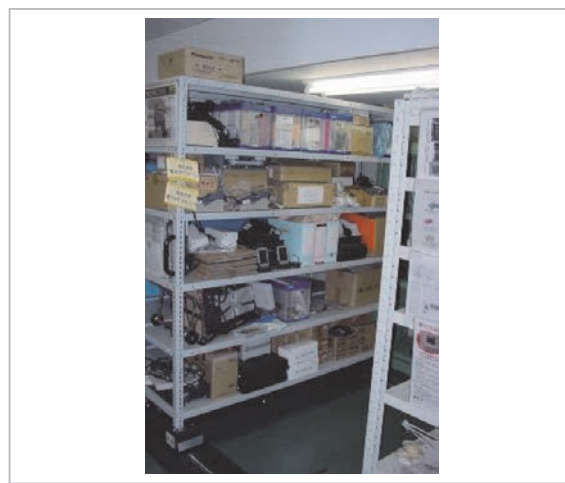
After the project continued for five years, the Disaster Management and Mitigation Group was dissolved on March 31. Expert Researcher Yasushi Hada was transferred to Dept. Mechanical Systems Engineering, Faculty of Engineering, Kogakuin Univ.; Expert Researcher Jeong Byeong-pyo was transferred to Nat'l Research Inst. of Fire and Disaster and Engineer Kim Taewoon transferred to a Japanese company in the Integrated Ocean Drilling Program (IODP-MI).

## **4 Achievements obtained by the Disaster Management and Mitigation Group**

### **4.1 Introduction**

This chapter briefly describes the research and development results obtained by the project over five years of activities, as mentioned in Chapter 3. As shown in Fig. 131, the results of each area of research and development are interconnected like a chain through the component technology, such as the ad hoc network or by the application, such as rescue support.

Herein, summary of the results is given in the direction from the left to right and from top to bottom in Fig. 131.



**Fig. 129** Koganei RFID workbench



**Fig. 130** Ubiquitous terminal containing UHF-band passive/active RFID reader/writer and the screen of message board application

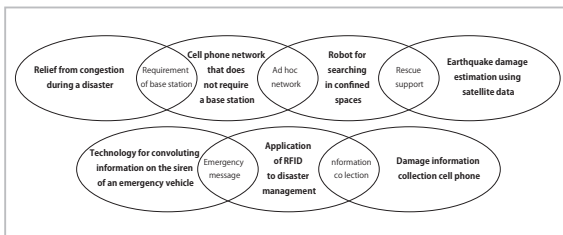
## 4.2 Technology for controlling congestion during a disaster

New technology for controlling congestion was proposed from the viewpoint of permitting more communication by restricting the duration of communication rather than by restricting communication outright (Fig. 132). The simulation of a cell phone network and an ad hoc network when the base stations are destroyed was evaluated using a detailed model similar to a real network, showing the various characteristics (Fig. 133). The work yielded four registered patents, one patent application, two unpublished papers and 12 published papers. Two of the published papers were selected as best papers in international conferences, and the method proposed (communication time-restriction) was referred to in a report on “the research meeting on the method making important communication more

sophisticated” of the Ministry of Internal Affairs and Communications (summarized in May 2008) as technology for controlling congestion for use in a disaster.

After the 2011 off the Pacific coast of Tohoku Earthquake, many commuters in the metropolitan area were unable to get home because the railways were no longer operating. There was thus increased demand for communication, resulting in restrictions on communication continuing for an extended period. The difficulty in telephone communication in the metropolitan area where the earthquake damage was no so severe attracted considerable attention. The relief of congestion by imposing time restrictions on communication, which does not require much modification of the existing equipment, is promising as a system for alleviating congestion.

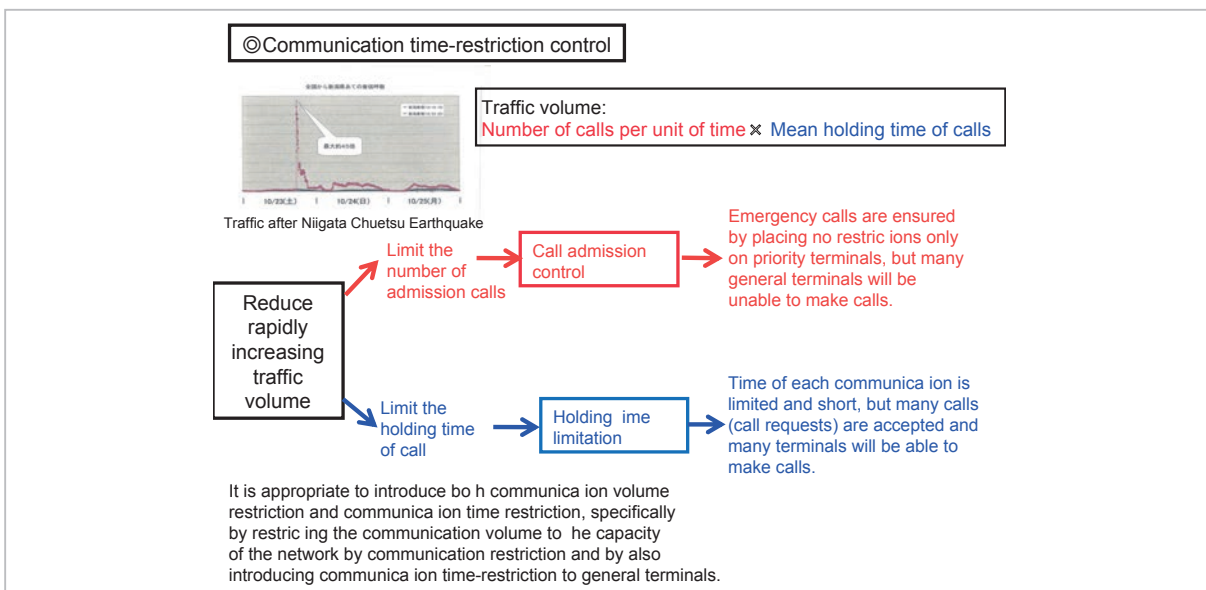
The results will be described in Chapter 2-1 in this Special issue.



**Fig. 131** Major R&D results obtained by the Disaster Management and Mitigation Group and their contact points

## 4.3 Cell phone network that requires no base station

The effectiveness of a new system, in which multiple terminals communicate with each other by repeated (multihop) transfer while temporarily (ad hoc) forming a network without the use of base stations, such as those for cell phones, was verified under the condi-



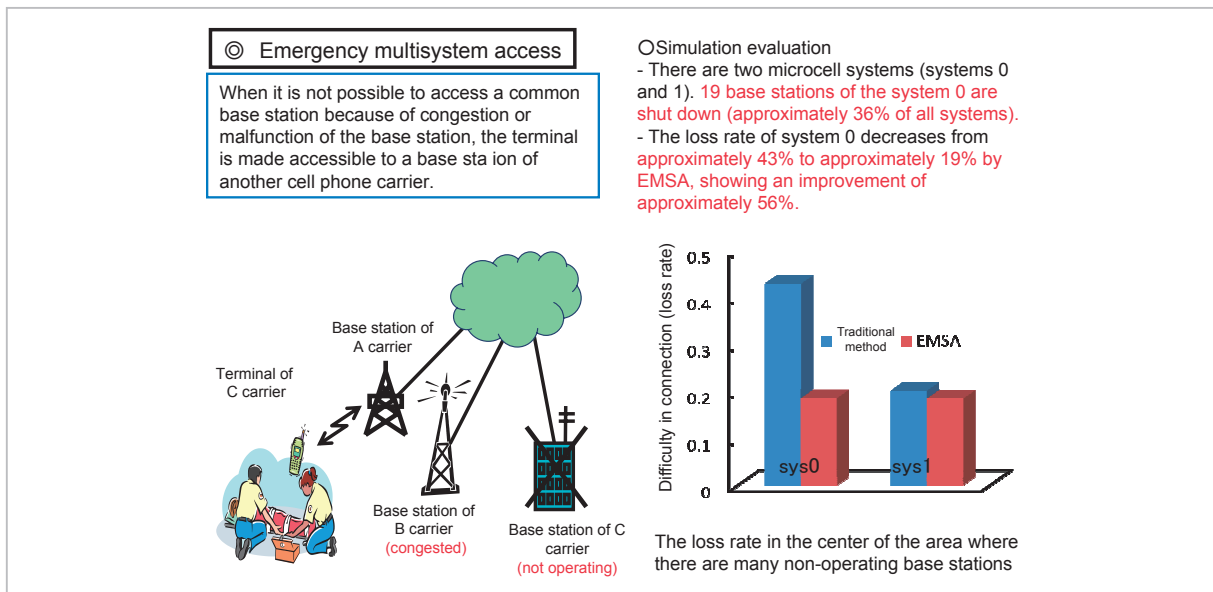
**Fig. 132** Congestion relaxation technology for use during disaster – communication time-restriction control



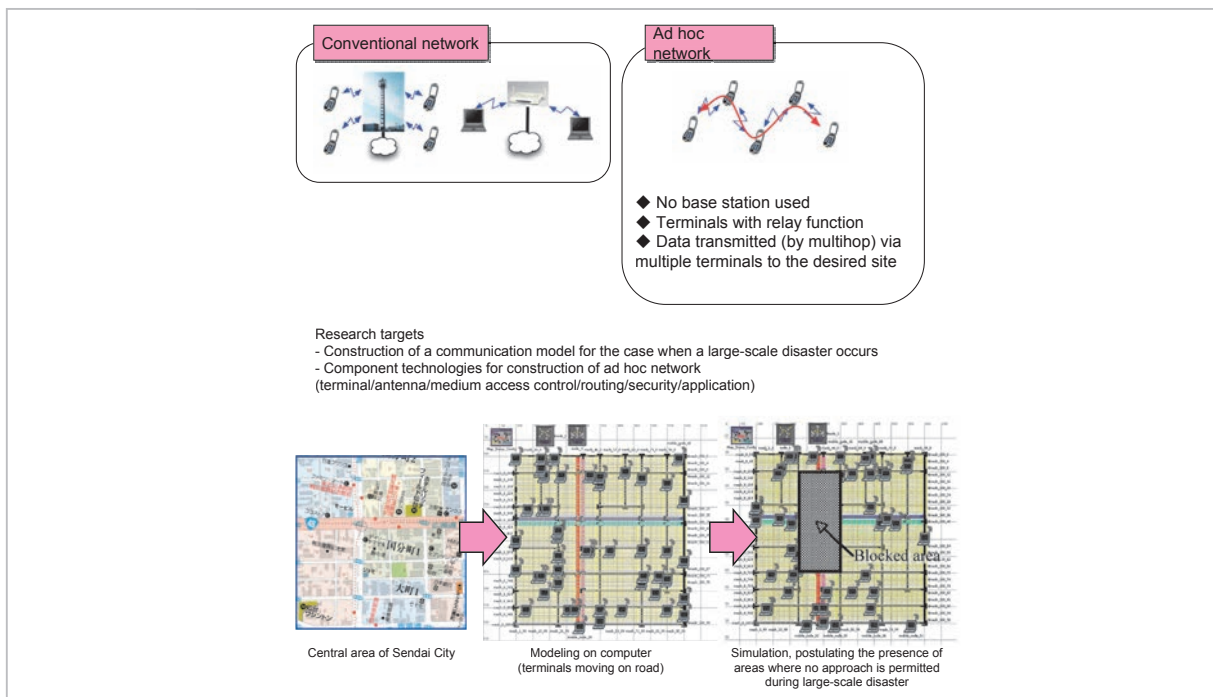
tion of a large-scale urban disaster (Fig. 134). An ad hoc multihop network was formed in an area of 500 meters square, simulating the central area of Sendai City, Miyagi. The conditions for successful communication were determined by simulating the data delivery rate according to terminal number and rate of movement.

In addition, as part of the research and

development of multimedia technology for collecting information using remote robots in a disaster, the communication control technology during a crisis based on the organic combination of various radio communication systems and networks available was developed. The system was technically verified using the Engineering Test Satellite VIII “KIKU No. 8” (ETS-VIII), and it was confirmed that the sys-



**Fig.133** Congestion dissipation technology for use during disaster - emergency multisystem access



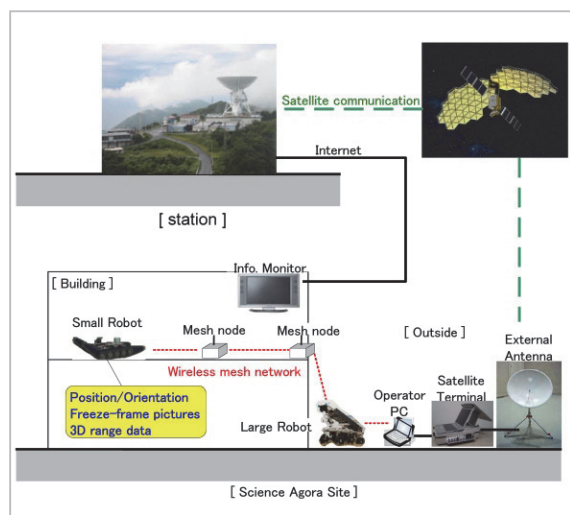
**Fig.134** Verification of the effectiveness of the ad hoc - multihop communication system during a large-scale urban disaster

tem was suitable for collecting information during a large-area disaster (Fig. 135). The finding was used effectively in the research and development of the search robot for operating in confined spaces, described below (Contracted research of the Ministry of Internal Affairs and Communications SCOPE, 2003 to 2007).

The results are described in detail in Chapters 2-2 and 2-3 of this Special issue.

#### 4.4 Search robot for use in confined spaces

An integrated wired/wireless ad hoc network technology was designed and developed as communication technology permitting the navigation of robots in an area of 700 meters. Research and development was conducted to improve the performance and application of the technology and to resolve various problems to facilitate practical application (Fig. 136). As an application of the ad hoc-multihop network technology described above, a computer simulation was conducted to examine the effectiveness of a search conducted when a trunk cable having wireless LAN access points at intervals of 50 meters are installed by a trailer robot and the periphery of each access point is searched by multiple robots for data acquisition and transmission from the robots



**Fig. 135** Research and development of multi-media technology for collecting information using remote robots in a disaster

in an underground complex with a length of 700 meters (NEDO contracted research in 2006 to 2010).

The results are described in detail in Chapter 2-4 in this special issue.

#### 4.5 Estimation of earthquake damage using satellite data

A simplified system for estimating the damage from earthquakes (international version) was developed for estimating the soil amplification factor based on numerical altitude data (Digital Elevation Model: DEM). This data was previously determined, for example, by an artificial satellite (Fig. 137). The system also estimates the seismic intensity distribution and damage distribution, approximately and quickly based on the data, when a large-scale earthquake occurs in a foreign country. The system was developed in cooperation with the Nat'l Research Inst. of Fire and Disaster, Fire and Disaster Manage-

1. Purpose of the research  
An integrated wired/wireless ad hoc network technology was designed and developed as communication technology permitting navigation of robots in an area of 700 meters. Research and development was undertaken to improve performance and application of the technology and to take measures against various problems leading to practical application.

Blue line: wired communication  
Yellow line: wireless communication

Search robots  
Ad hoc terminal bearing reel (length up to 1.4 terminal, 700m)  
Production sites set by connection between the nodes on cable both via wireless and wireless networks  
Cable installing robot  
Wireless LAN communication length: 50m

Integrated wired/wireless ad hoc network

Communication helmet containing a camera and communication function

Variable direction antenna (compatible with 5 GHz, waterproof and dustproof)

2. Technical characteristics and results

- Reduction of the influence by external noise by using the network at 5 GHz
- Improvement in performance when the communication route switched
- Communication with helmet equipped with a camera for firefighters
- Development of a variable direction antenna that retains its performance when tilted or placed upside down
- Development of a waterproof, dustproof communication-stabilizing antenna base
- Return to the earlier place by autonomous action when moved out of communication range
- Reduction in size of relay nodes and development of mobile relay nodes
- Redundancy of communication system by combined use of wireless LAN and cell phone network
- Ultralong-distance communication using artificial satellite (remote control over the distance of 140 km between Tokyo and Mount Asama)
- Studies by simulation on the search efficiency when multiple terminals are used

Examples of the results of computer simulation showing the search area (cranked) and the locus of the robot

Kenaf Model 5 for research into communication and waterproof/dustproof antenna base

3. Results  
Search conducted by five robots over a long distance of 683 meters in a 10-story building  
Integrated wired/wireless ad hoc technology already commercialized

3D map of 10 story building

**Fig. 136** Development of communication technology for confined-space high-speed search robots

ment Agency, Ministry of Internal Affairs and Communications(Fig. 138). The system focuses on estimating the damage rapidly at the phase when there is no damage information available from the disaster area and helping Japan Disaster Relief Team(JDR) to establish strategies in selecting the areas to send them by providing them with the required information.

The results are described in detail in Chapter 3-4 in this Special issue.

#### 4.6 Technology for convoluting information on the siren of an emergency vehicle

As an application of the electronic water-

mark technology for convoluting information that cannot be detected by human ears on sound through digital technology, a technology for convoluting the positional information of an ambulance on the siren was developed so that the position of the ambulance could be displayed on the navigation systems of nearby cars (Fig. 139). A method of modulating a higher harmonic component with digital information was developed, which generates a chord and thus causes a relatively small sense of incompatibility in hearing. The method is intended to be useful in determining whether evacuation is needed, as an ambulance broadcasts its positional information in its siren.

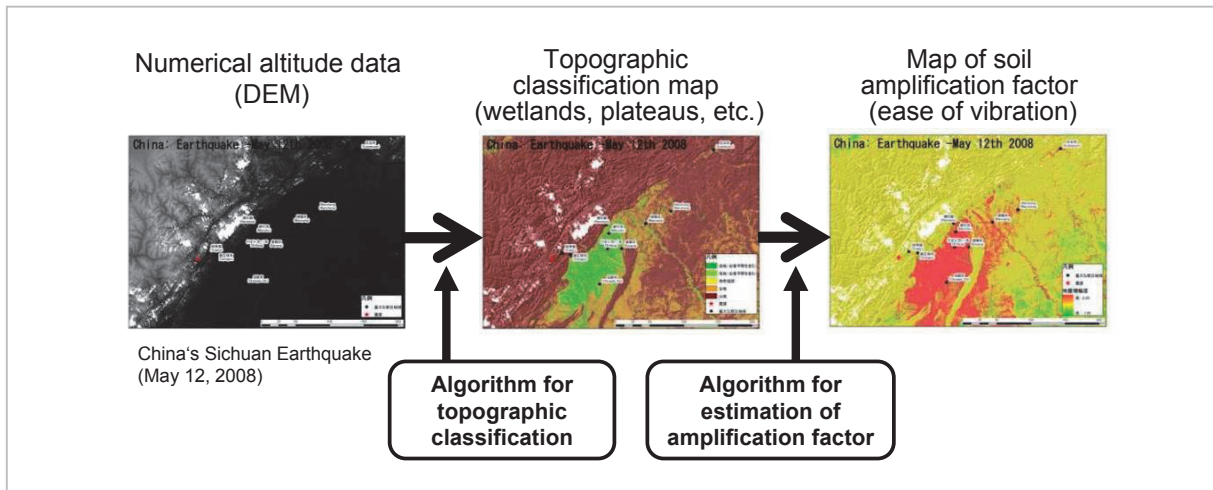


Fig.137 Algorithm for estimation of soil amplification factor from numerical altitude data

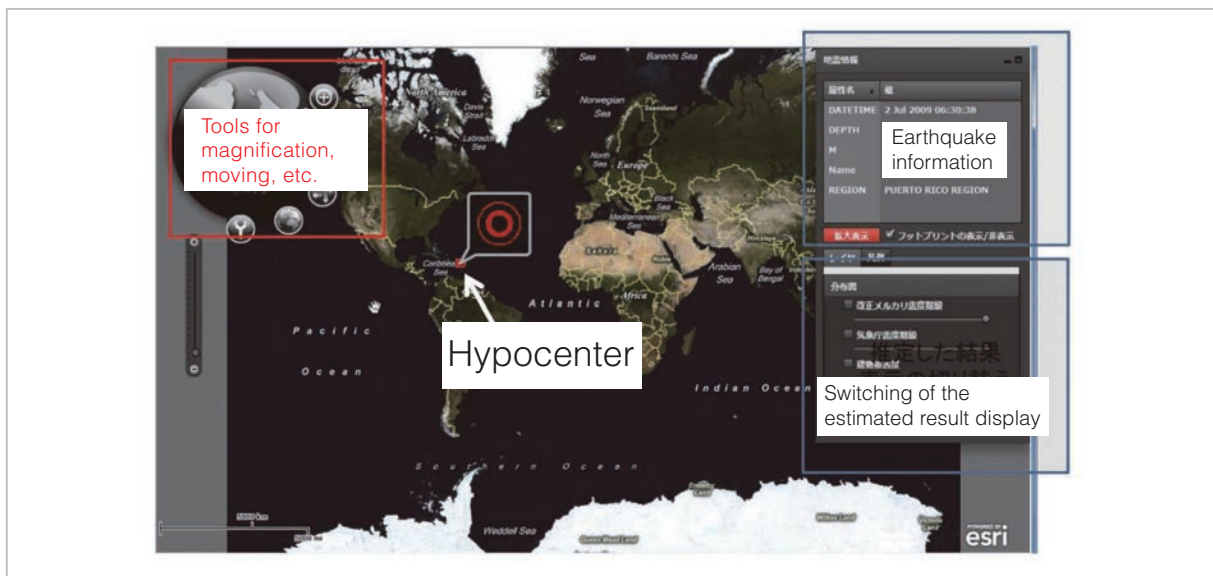
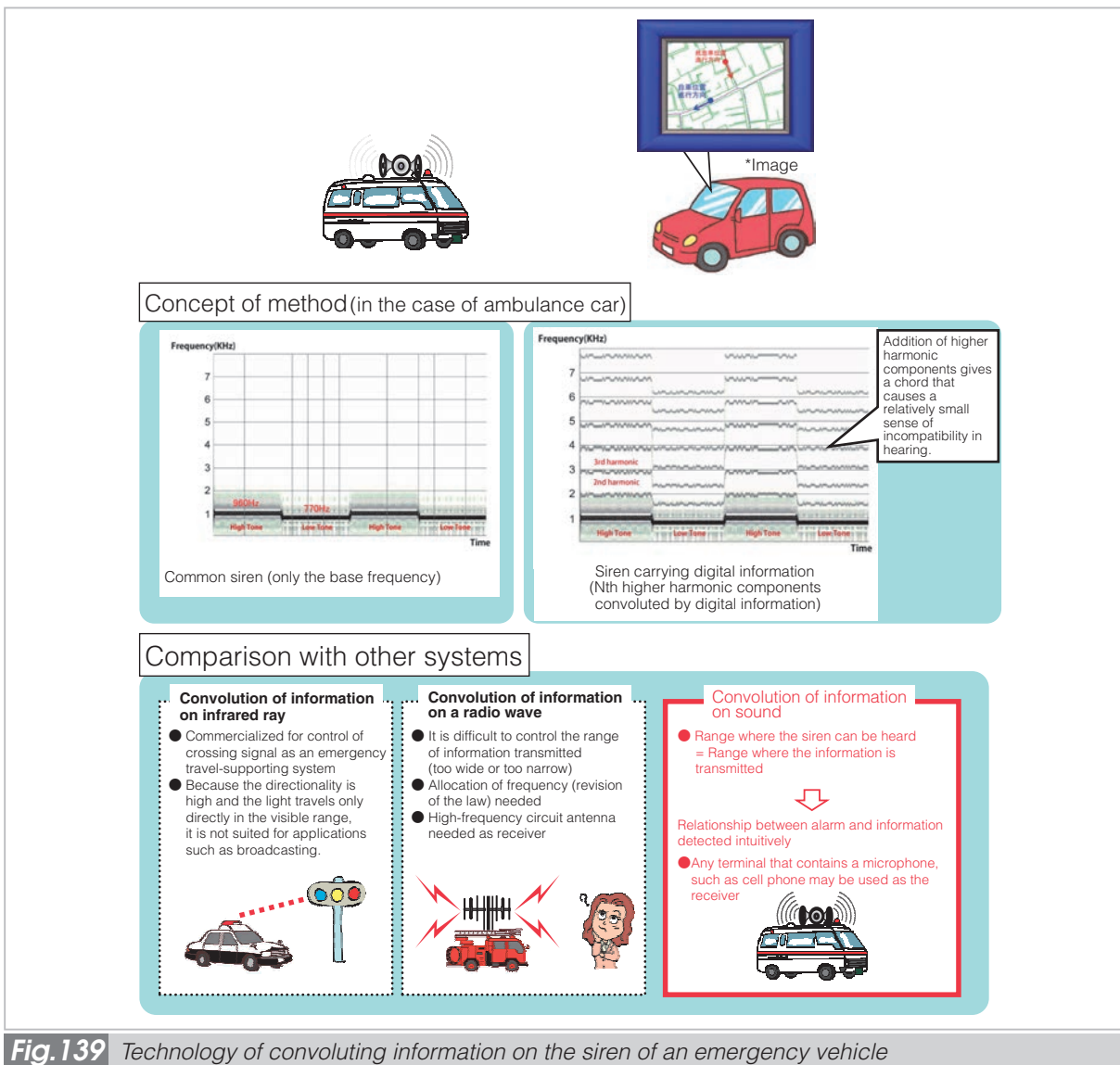


Fig.138 Screen of the simplified system for estimating earthquake damage (international version) developed



**Fig.139** Technology of convoluting information on the siren of an emergency vehicle

The information is obtained by GPS and the car navigation systems of surrounding cars display the position and direction in which the ambulance is moving by receiving and analyzing the information. Its characteristic is that centralized control and communication of the information is not needed and thus the hurdle for the system to come into widespread use is lower.

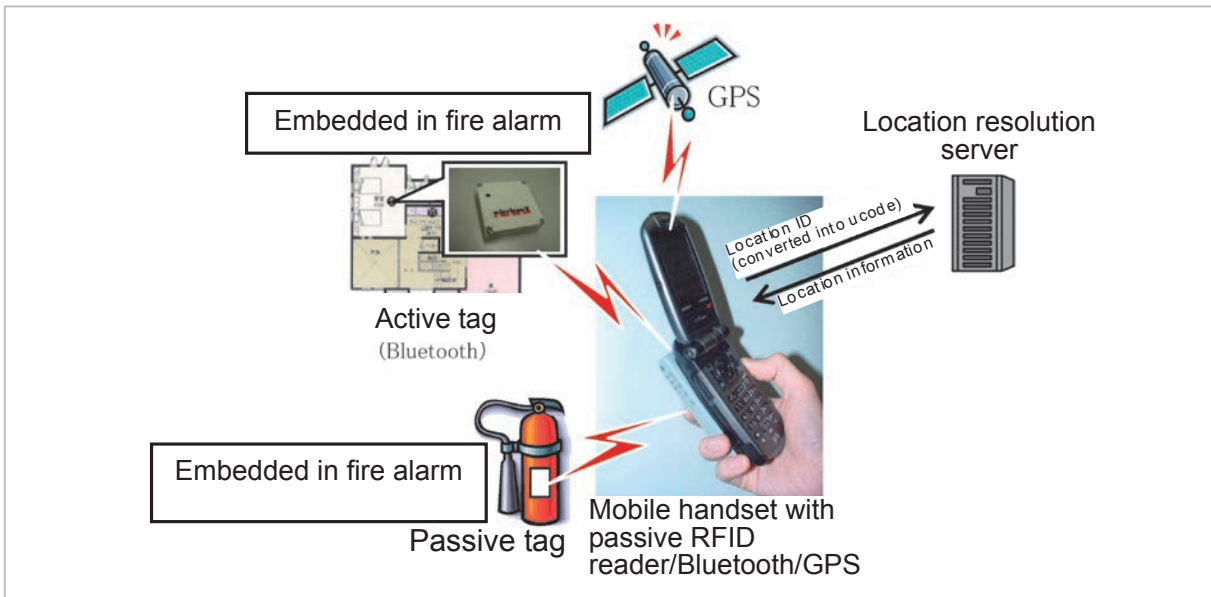
The results are described in detail in Chapter 3-3 in this Special issue.

#### 4.7 Application of RFID to disaster management

A cell phone application was developed using a passive RFID tag that does not require

a battery or an active RFID tag that contains a battery (Bluetooth) as a position marker. The application permits three-way positioning using its GPS-receiving function. In addition, a system was developed in which the IDs of position markers installed indoors are received by cell phone terminals and an emergency message with highly accurate positional information can be sent even from a confined space out of the range of a GPS signal (Fig. 140).

A cell phone terminal application was also developed for the exchange of off-line messages by using multiple passive RFIDs, which are placed for data storage in disaster-stricken areas as local message boards. The application is for use in large-scale disasters when the



**Fig. 140** Cell phone application enabling three-way positioning by passive RFID, Bluetooth tag and GPS

communication infrastructure is unavailable (Fig. 141). Even if communication is terminated after a large-scale disaster, it is possible to exchange electronic messages in the disaster area by using the passive RFID and cell phone terminal as the paper and pencil, respectively.

To use the position marker function and the local message board function on various RFIDs, a portable terminal was developed that is compatible with six kinds of passive/active RFIDs at the 13.56 MHz, 300 MHz, and 2.4 GHz bands simultaneously in a single container (Fig. 142). A Windows-based application that can seamlessly display its position obtained by GPS, irrespective of whether the application is used indoors or outdoors, was developed for the terminal (Fig. 143). The terminal is approved by the Council for Science and Technology Policy as one of the technological components for creating a ubiquitous network.

The results were obtained under the Special Project for Earthquake Disaster Mitigation in Urban Areas of Ministry of Education, Culture, Sports, Science and Technology (2002 to 2006), the Grant-in-Aid for Scientific Research — basic research B (2005 to 2008) and the Special Coordination Funds for Promoting Science and Technology (2006 to 2008) and others. The results are described in



**Fig. 141** Screen of a cell phone application that permits writing of message on passive RFID

detail in Section 3-1 in this Special issue.

#### 4.8 Damage information collection cell phone

A simple and inexpensive tool, the Easy-Reporter, was developed as a cell phone application to facilitate the cooperation of local residents and governments. The tool is useful for monitoring damage and patrolling to prevent crime.

Local governments and other agencies

should be able to rapidly assess the damage in the area during a disaster. However, there is the problem of the limited number of officers who can be allocated to the investigation in an emergency. A tool for recording the areas of caution is needed when conducting patrols to prevent crime, but it is not practical to use an unfamiliar special terminal. It is thus conceivable to use a cell phone terminal to perform this task. Everybody carries a cell phone under normal conditions or during a disaster, and even elderly volunteers can use it easily in patrols to prevent crime.

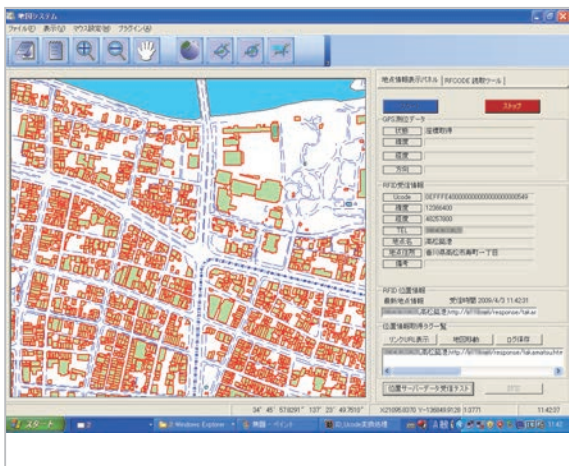
Most similar existing information collection systems collect information and transmit it according to the instruction of the informa-

tion collection server. These systems assume that the communication infrastructure, such as the cell phone network is operating. But in the event of a large-scale disaster, it is highly probable that these systems fail because the base stations are destroyed or because of congestion. In contrast, Easy-Reporter has a function to accumulate disaster information in its memory, and to yield the information to an information collection server when it is brought directly to a neighboring disaster management point. In this way, it is possible to provide information when no communication is possible. Concerning the acquisition of positional information by GPS, most cell phones calculate their position based on the positional information sent from GPS satellites via base stations. Therefore, the cell phones may not be able to obtain their positions if the base stations are damaged or if the network is congested. In contrast, Easy-Reporter converts the terminal to an autonomous positioning system (standalone GPS) automatically, thus enabling its position to be determined without assistance from the base stations, in the event that communication is not possible. Most application-based information collection systems contain menu settings and collection items incorporated in the system according to the purpose. It is therefore necessary to modify the system when there is a change in some of the items. In contrast, Easy-Reporter, in which the user defines the menu settings and collection items with a simple editable setting file, can be used in various applications, including disaster management and crime prevention and is thus highly flexible (Fig. 144).

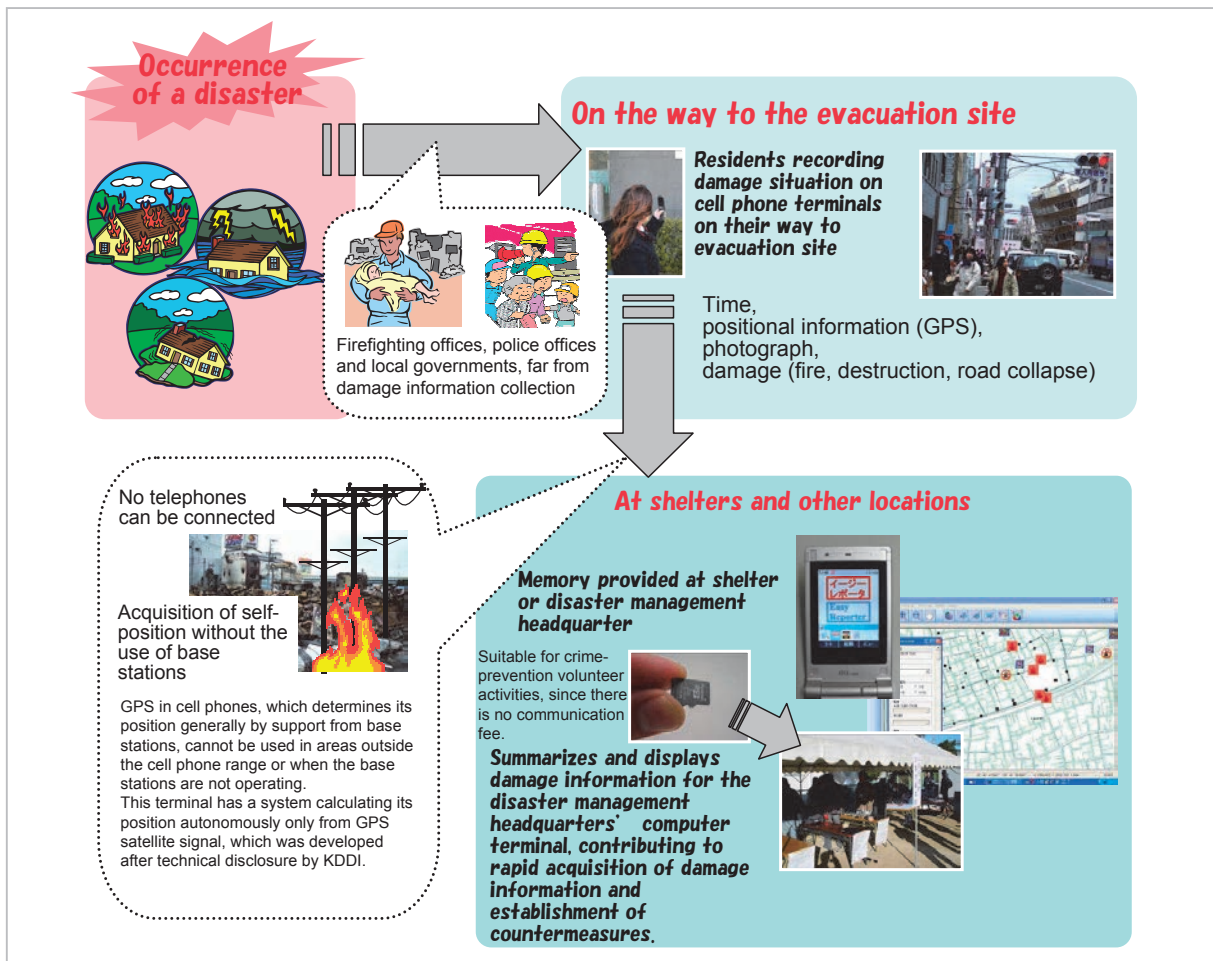
The results were obtained under the contracted research, establishment of practical grounds for monitoring damage to children and preventing crime under the research and development program, “Protecting children from crime” of the Research Inst. of Science and Technology for Society (RISTEX), Japan Science and Technology Agency (JST) (2007 to 2008), the science and technology project for safety and security, “joint resident/govern-



**Fig. 142** Integrated multi-RFID reader/writer



**Fig. 143** Screen of the positioning application for integrated multi-RFID reader/writer

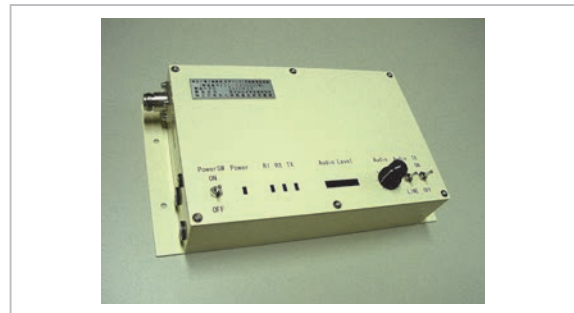


**Fig. 144** Applications and characteristics of Easy-Reporter

ment ubiquitous disaster mitigation information system” of the Ministry of Education, Culture, Sports, Science and Technology (2008 to 2010) and others. The results are described in detail in Chapter 3-2 in this Special issue.

#### 4.9 Development of a license-free FM broadcasting device for use during a disaster

An FM transmitter for use during a disaster satisfying the requirement of a special low power radiotelephone specification for voice assistance (ARIB STD-T68) was developed (Fig. 145). The specification, which was established in 2001 for broadcasting voice guidance for visually handicapped people, was not used, and it was reported that the number of devices approved as satisfying the requirement of this technical standard after 10 years



**Fig. 145** Prototype radio telephone equipment for voice assistance

was less than 10. The specification is directed to special low power radio stations that require no license or qualification for operation. Because it has been allocated a frequency of 75.8 MHz, which is immediately below the FM band, it is not received by digital-display FM tuners containing PLL synthesizers, such as portable music players. However, it can be received without any problems by simpler

scale-tuner FM radios, such as handheld generator radios for use in disasters. This is because such devices have some margin in the frequency band that they receive. Such a device may be used as a means of transmitting information that is more localized than community FM broadcasting information or more voluntary than government crime-preventing radio. Such a device may broadcast individual information specific to each shelter, such as an elementary school, to an area on site or close to it during a large-scale disaster, supplementing the slave unit of the government crime-preventing radio. There will be a need to send information on the goods delivered to a shelter, to the victims who do not go to shelter but remain in their own houses, to places where the lifeline is disconnected, and to those living in cars.

Assuming this type of broadcast application, three transmitters with an external non-directional antenna were prepared (Fig. 145), and a transmission test was performed from a 60-meter steel tower. The tower stands in the NICT headquarters and was approved as satisfying the technical standards. The test confirmed that the radio signal can be received with a portable FM radio within a radius of approximately 500 meters. It is not possible to use the mini-FM transmitter using a weak transmission under the Radio Act to transmit such a wide range of information, as is the case with regular broadcasting.

The device, which is constructed only using traditionally available technologies, may be considered as technology that should be used immediately in society, considering optimum use of existing specifications and functionality in supporting the operation of a shelter during a large-scale disaster.

#### 4.10 Finally

In addition to the research and development results above, the author wants to comment finally that there were unique, more personal research and development, such as research on auditory memory-based authentication by Expert Researcher Kotaro Sonoda

(Grant-in-Aid for Scientific Research – young researcher work B, 2007 to 2010) and research on disaster management of high-rise buildings and earthquake sensor network by former Expert Researcher Akihiro Shibayama.

## 5 Conclusion

The research and development by the Disaster Management and Mitigation Group concluded at the end of March 2011, when the period for the second medium-term plan expired. The research on disaster management ICT in NICT may be divided into component technologies, such as wireless and electromagnetic monitoring for individual application. The environment surrounding the disaster management ICT research has changed drastically since March 11, 2011. The author knows that there is concern about the possibility of NICT sending an inappropriate message by retracting the studies on its disaster management ICT by removing the only research group carrying the flag of disaster management from NICT at this time, even though the decisions were taken earlier. There is the possibility that all research and development in NICT should be connected to disaster management in response to social demand in the future. And if so, it is important to consider the disaster management ICT not as a theme to be studied only in one group, but as a very big theme to be studied by the entire NICT. As described in the Tokyo International Fire and Safety Exhibition 2003 back at the opening of this report, the author considers that disaster management ICT is the entirety of component technologies that are each suitable for various disaster management applications. An in this case, it is a very big theme. The author considers that, if the concept of the Disaster Management and Mitigation Group, namely, “research and development on disaster management ICT that can be used on site,” spreads to the entire NICT, the Disaster Management and Mitigation Group has justified its existence. However in systemization by the integration of component technologies, it is necessary to pay



attention sufficiently to whether the system genuinely satisfies the needs of the sites of disaster management, not just the combination of component technologies.

If the disaster management ICT is considered as research that makes a social contribution, operation of the group of taking emergency measures may be necessary after each disaster. Such an operation may throw the problems in our results into sharp relief and the problems may be fed back to the research by the group. But, according to the author's experience in research and development on safety information-registering/retrieving system (IAA system) for the support of victims, which was conducted in the former Emergency Communications Section, the operation often becomes its own goal, and it puts a great load on the operator, occasionally resulting in operation on a patchwork basis. Such inconsistent operation only leads to reduced trust in the system. In conducting research and development aimed at a social contribution with the disaster management ICT, it is an inevitable question for NICT, a research organization not responsible for disaster management, how much it is responsible for operations during a disaster.

With the unprecedented damage caused by The 2011 off the Pacific coast of Tohoku Earthquake, many disaster management engineers have a feeling of helplessness greater than that felt in The Southern Hyogo prefecture earthquake in 1995. Is it really possible to manage or mitigate disaster using technology? However, it may not be possible to prevent damage completely, but it must be possible to mitigate the damage. It may be considered that many residents were able to evacuate because

the large tsunami alarms were broadcast on this occasion to the residents immediately on the government disaster prevention radio. In that sense, disaster mitigation technology is surely advanced from that in the Meiji Era, when there was no ICT. There is a great role left for ICT for further disaster mitigation in the future. For example in this earthquake, videos taken from helicopters and hills show that people were making their way in the evacuation did not know that the tsunami was approaching immediately behind them. Also in the Great Hanshin Earthquake, there was a resonant photograph taken from a helicopter above, showing victims who had been evacuated to the grounds of an elementary school, oblivious of the approaching fire. It is considered that there should be both a macroscopic "bird's eye" view and a microscopic "bug's eye" view in disaster management, and lack of the "bird's-eye view" may directly endanger human life. Nothing except ICT can provide both the "bird's-eye" and the "bug's-eye" view.

The flower shown in Fig. 3 blossomed into a large flower over the period of five years. The petals will grow independently into new flowers in respective new worlds after the five years. The author considers and claims with confidence that the root of the flowers is in the Disaster Management and Mitigation Group of NICT.

The author wishes to thank everybody who supported the Disaster Management and Mitigation Group for five years and prays for early recovery of the area stricken by The 2011 off the Pacific coast of Tohoku Earthquake.

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