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

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

(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 InterNetworking 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 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.

Fig.120 Disaster management information communication seminar

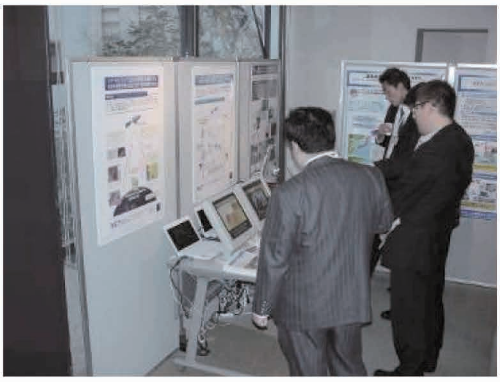

Fig.121 Exhibition in WINDS workshop

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 Kesennuma 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.

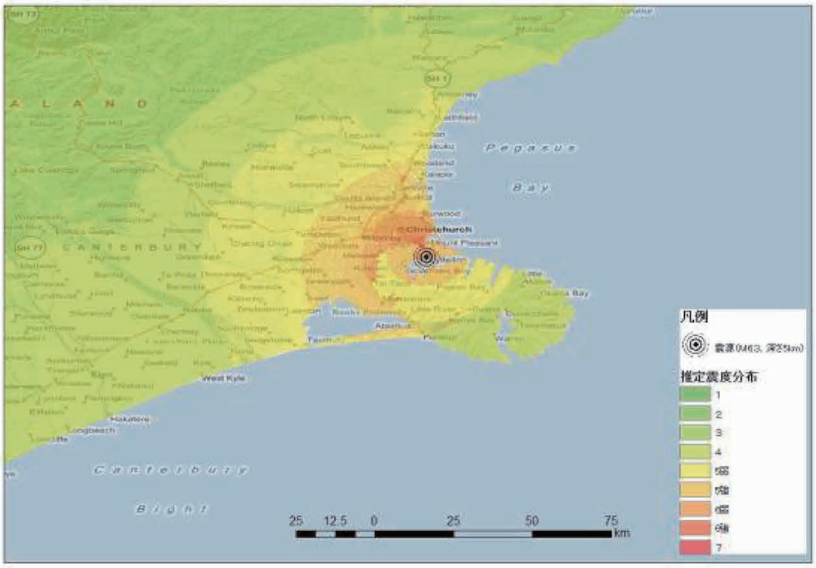

Fig.126 Estimated seismic intensity distribution (displayed by the seismic intensity of Meteorological Agency)

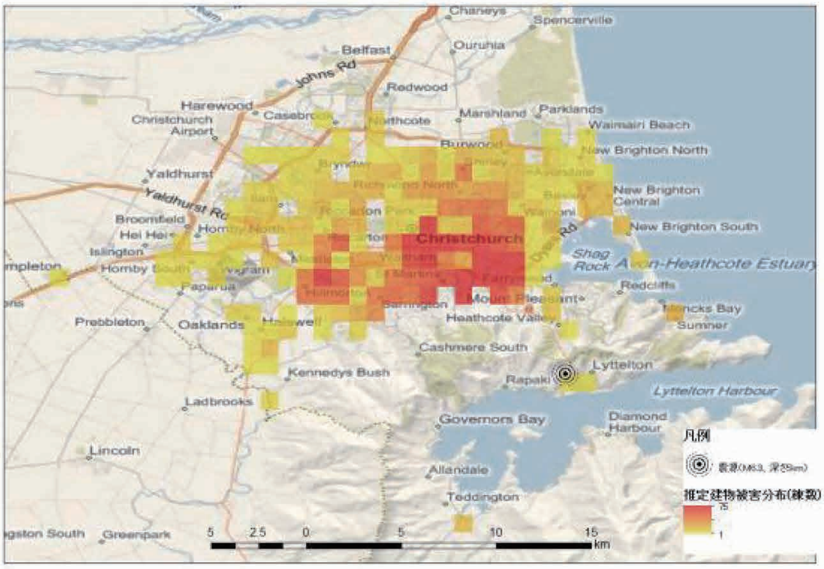

Fig.127 Estimated building damage distribution

Table 1 Media coverage (only major articles)

11 Japanese missing in Christchurch Earthquake whose seismic intensity registered 6+	(*The Yomiuri Shimbun*, Feb. 23 2011, morning edition, p. 1)
Earthquake whose seismic intensity registered 6+ or 940 Gal, which is equivalent to the Great Hanshin Earthquake	(*The Mainichi Newspapers* 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	(*The Asahi Shimbun*, Feb. 24 2011, morning edition, p. 3)
Soft ground intensifying vibration, Seismic intensity equivalent to 6+	(*The Nikkei*, Feb. 24 2011, morning edition, p. 38)
Acceleration of 2160 Gal, larger than that of the Great Hanshin Earthquake	(*The Tokyo Shimbun*, Feb. 24 2011, evening edition, p. 9)

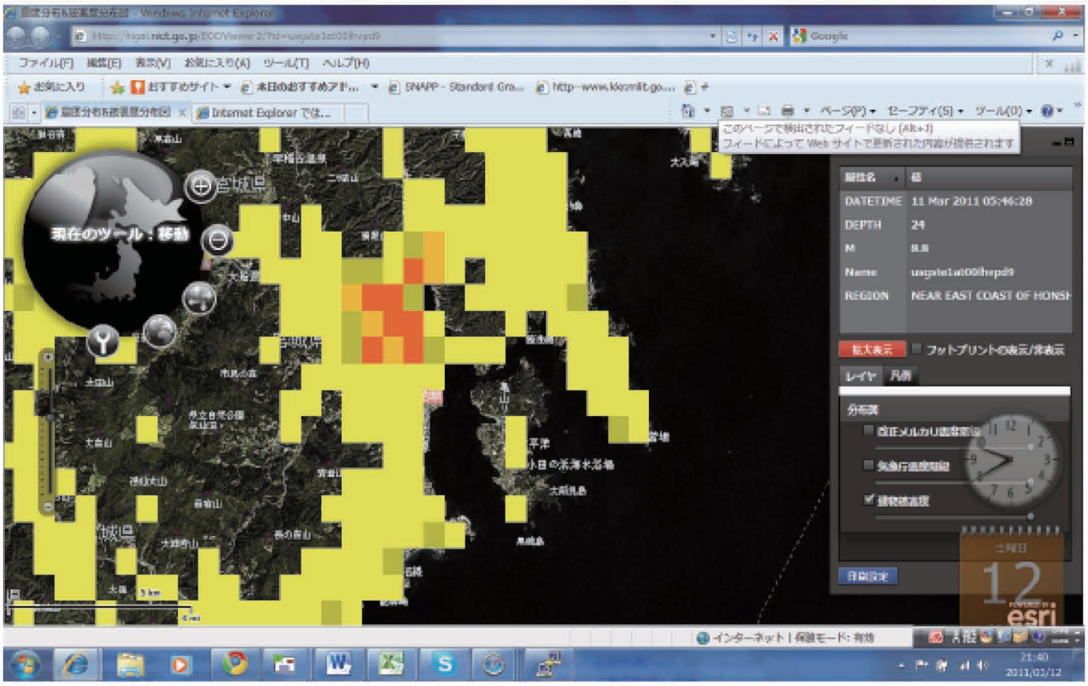

Fig.128 Estimated distribution of building damage after the 2011 off the Pacific coast of Tohoku Earthquake (estimation of the damage caused only by the earthquake)

(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 remotely 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 testbed 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 form 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.

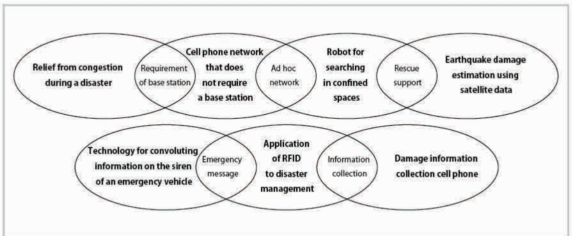

Fig.131 *Major R&D results obtained by the Disaster Management and Mitigation Group and their contact points*

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-

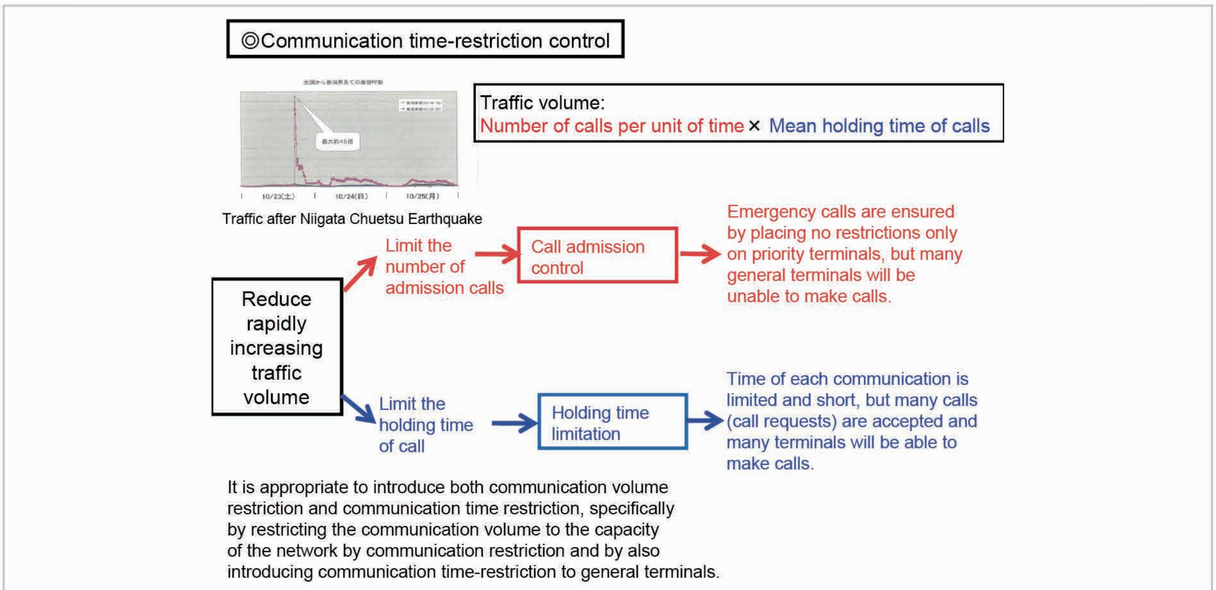

Fig.132 *Congestion relaxation technology for use during disaster – communication time-restriction control*

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-

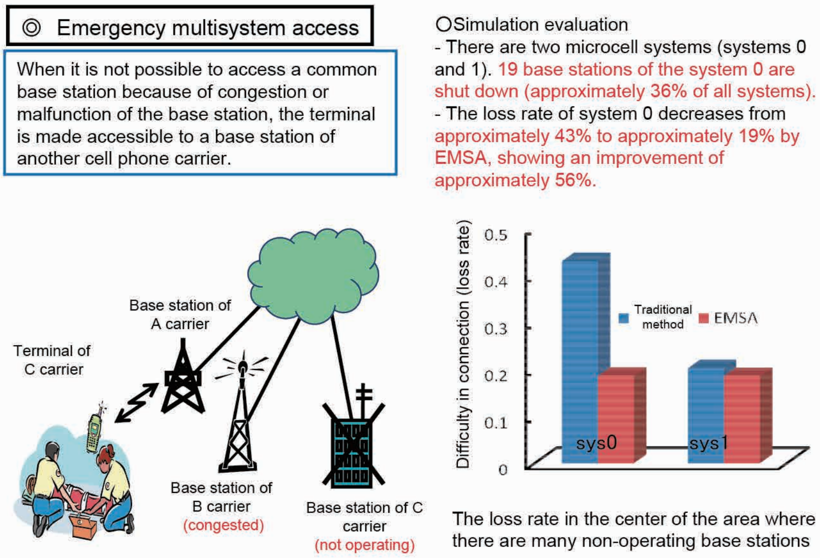

Fig.133 *Congestion dissipation technology for use during disaster - emergency multisystem access*

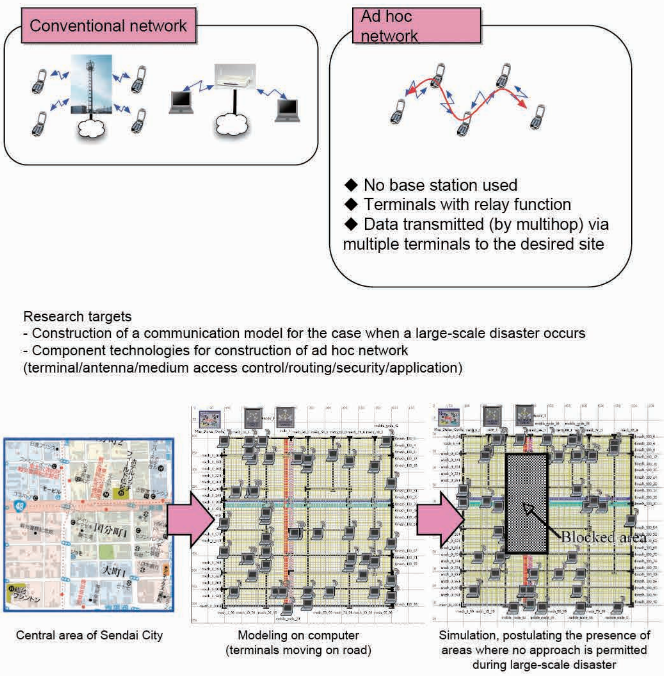

Fig.134 *Verification of the effectiveness of the ad hoc - multihop communication system during a large-scale urban disaster*

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 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-

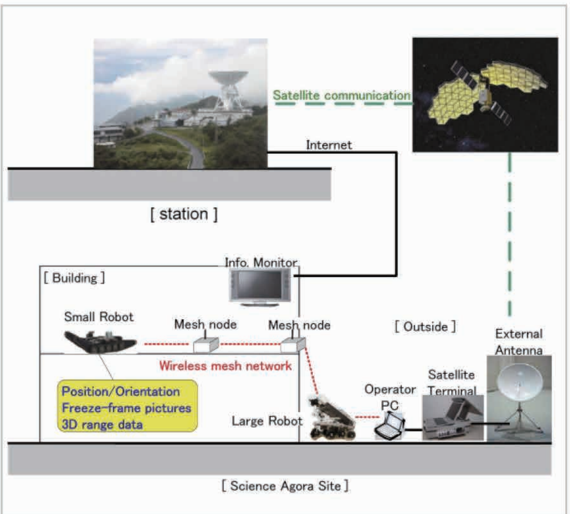

Fig.135 Research and development of multimedia technology for collecting information using remote robots in a disaster

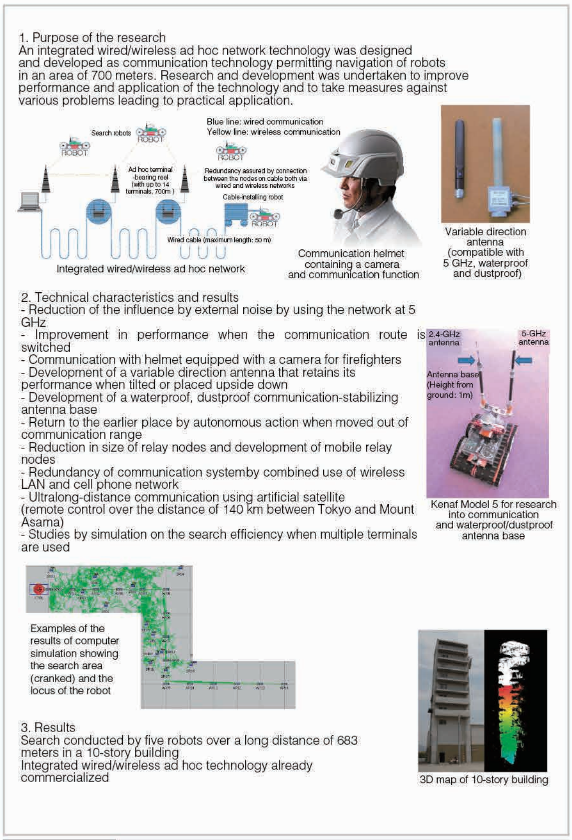

Fig.136 Development of communication technology for confined-space high-speed search robots

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 watermark 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.

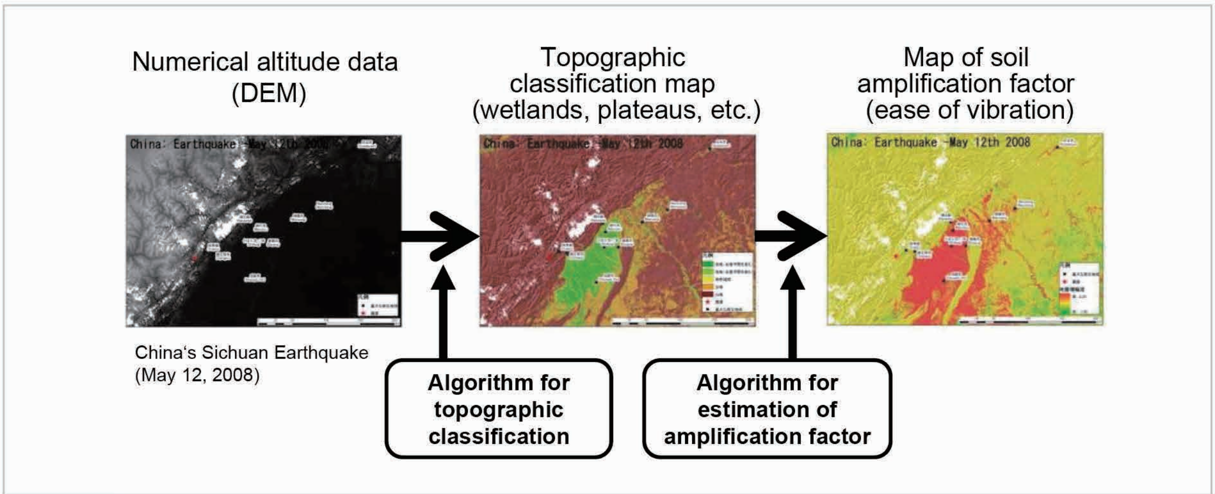

Fig.137 *Algorithm for estimation of soil amplification factor from numerical altitude data*

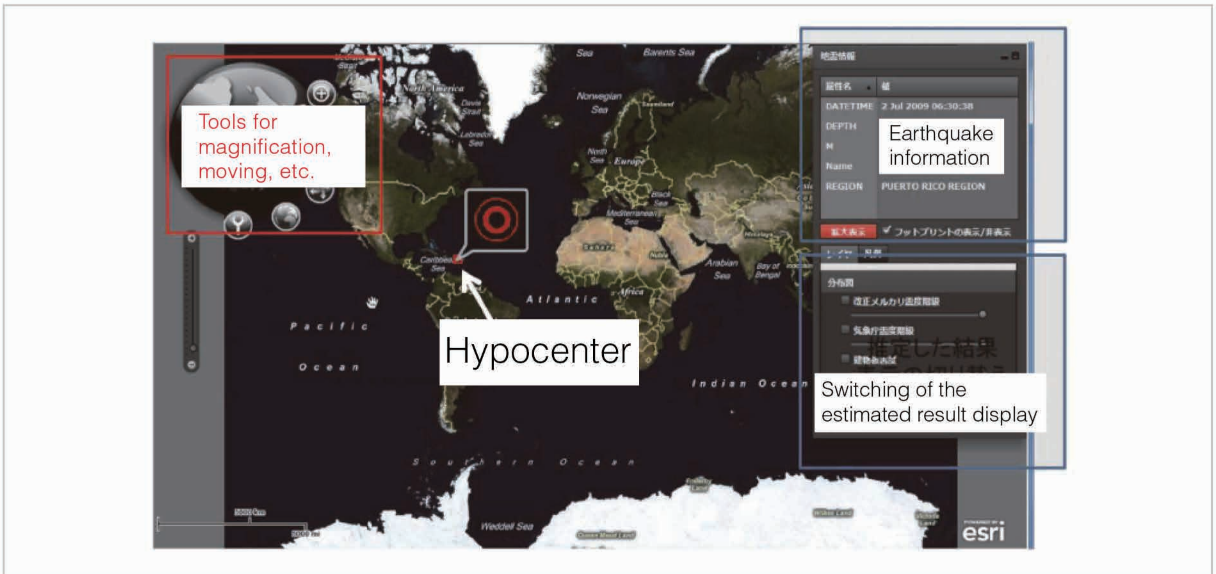

Fig.138 *Screen of the simplified system for estimating earthquake damage (international version) developed*

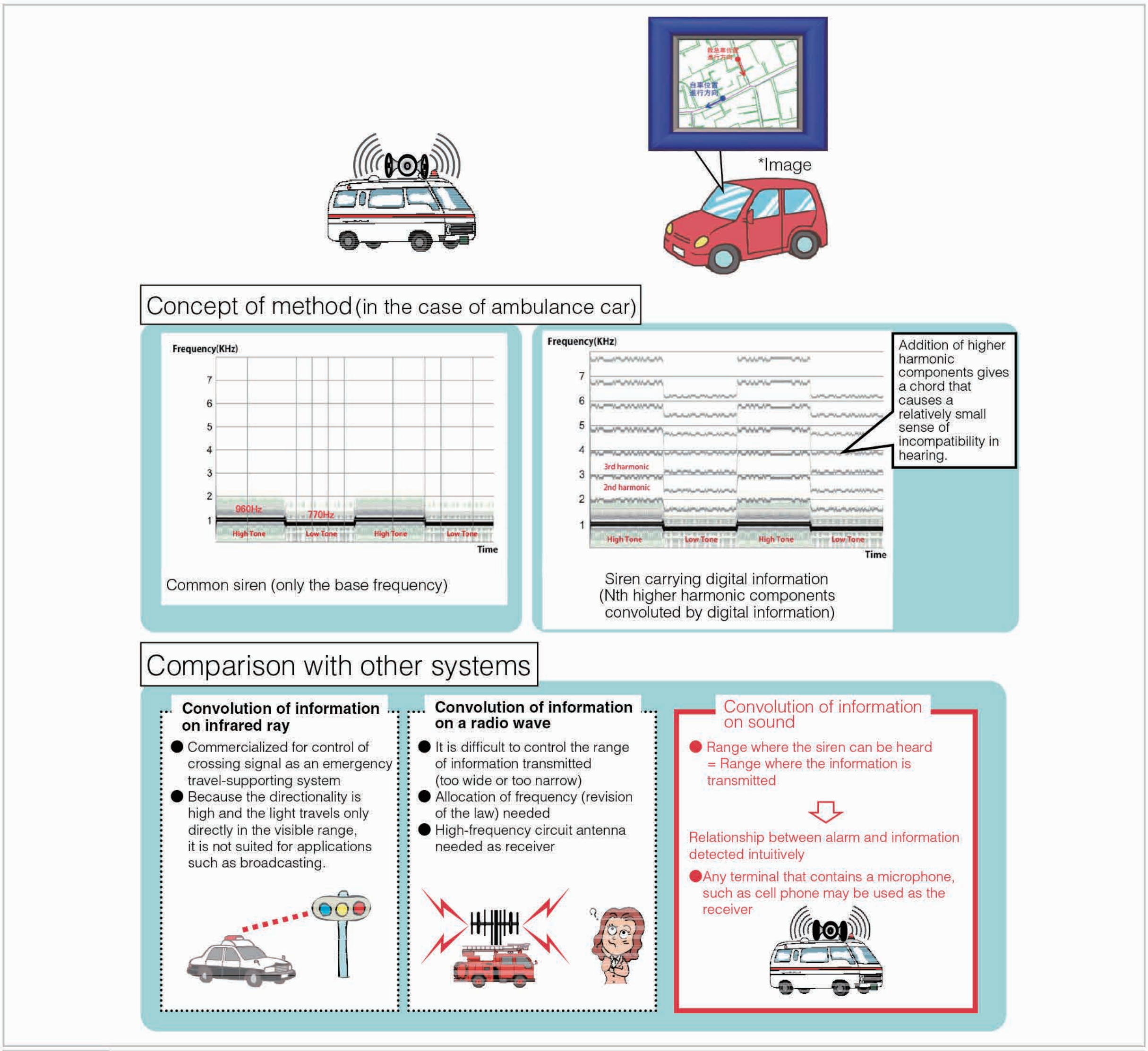

Fig.139 *Technology of convoluting information on the siren of an emergency vehicle*

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

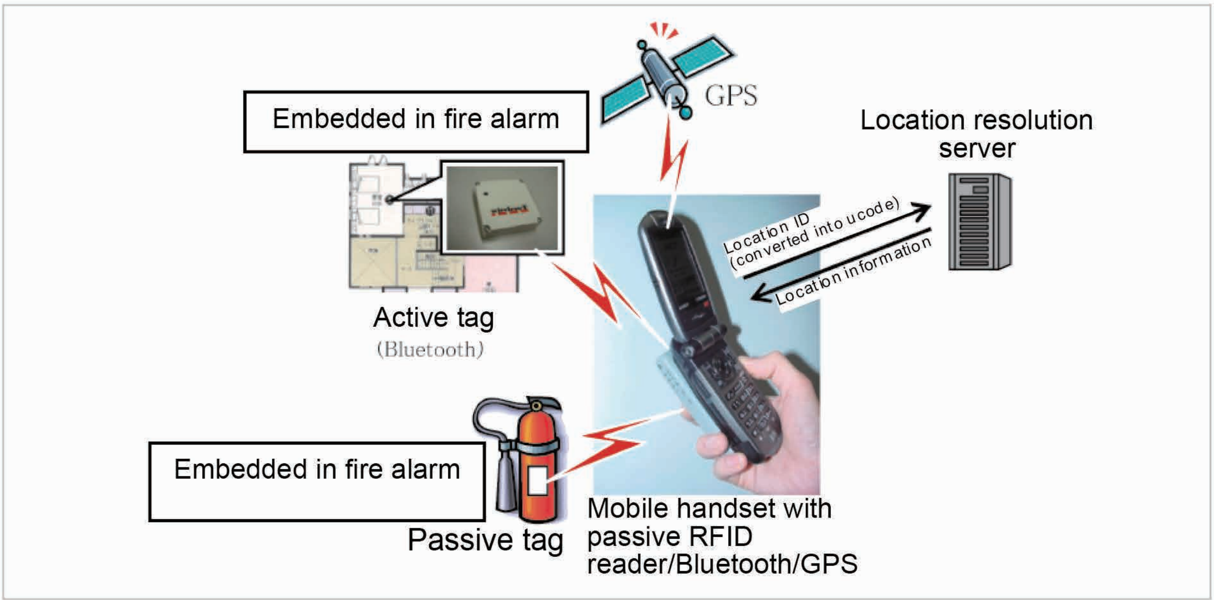

Fig. 140 *Cell phone application enabling three-way positioning by passive RFID, Bluetooth tag and GPS*

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 information 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).

Fig. 142 Integrated multi-RFID reader/writer

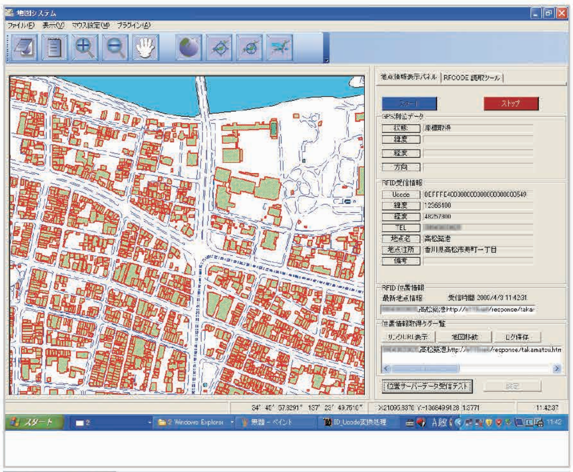

Fig. 143 Screen of the positioning application for integrated multi-RFID reader/writer

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-

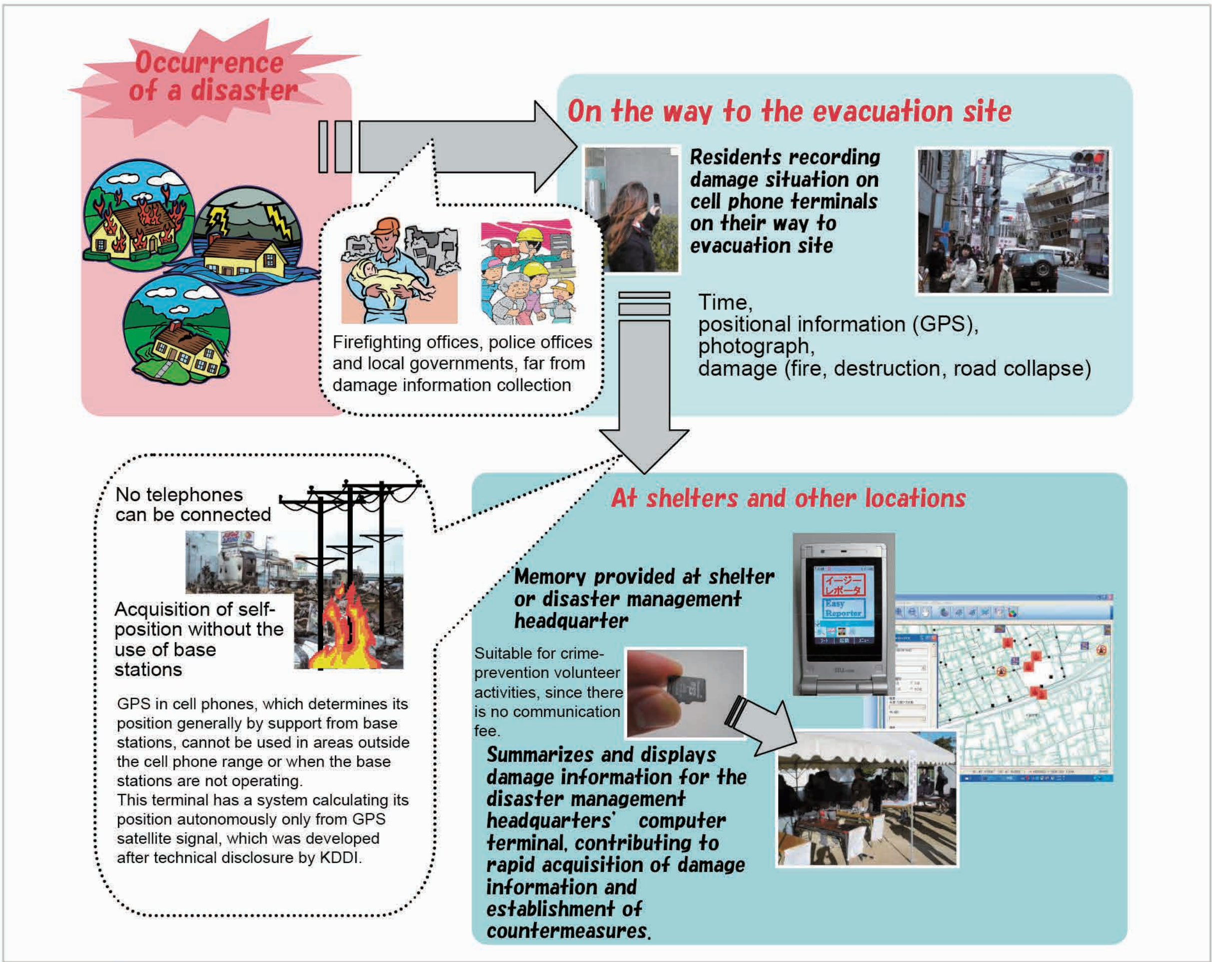

Fig. 144 Applications and characteristics of Easy-Reporter

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.

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